

**From marine sediments to explosive eruption record:
A case study from New Zealand and a revised methodical approach**

Dissertation

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Preface

The extensive marine tephrochronostratigraphic study of New Zealand's volcanism based on eleven deep ocean drill sites was the main goal of my PhD project complemented by field work in New Zealand. Therefore, my supervisor Steffen Kutterolf and me planned our field campaign in spring 2020 and intended to meet with our New Zealand colleague Jenni L. Hopkins and her students for a three-week long trip at different locations on North Island in order to complement the marine tephra record and fill-in gaps in the volcanic onshore record. Preceding the field campaign we planned to attend the postcruise meeting of IODP (International Ocean Discovery Program) Exp. 375, which was scheduled in Napier, North Island (New Zealand). These postcruise meetings are a regular feature of each IODP expedition and are meant to strengthen the scientific community consisting of shipboard and shore-based scientists, to present first results and to discuss and plan future scientific output. Unfortunately, this meeting as well as the planned field work coincided with the world's first pandemic and although already in New Zealand we were forced to cancel our plans and return immediately without participating in the postcruise meeting and without doing any field work.

These circumstances also had a major effect on my PhD project. Beside the missing sample material from the onshore deposits, I was not able to integrate in the IODP Exp. 375 scientific community and therefore missed out on opportunities to establish an international scientific network, and more importantly I greatly missed out on the opportunity to discuss preliminary results and interpretations with other expedition scientists in person. Nonetheless, these circumstances brought new opportunities that allowed me to participate in other projects than originally planned - the establishments of the marine tephra records of the Aegean Sea and the Indian Ocean. Both studies gave me a broader overview about the research field of marine tephrochronostratigraphy and its applications and allowed me to collaborate with different scientists, and therefore start to establish my scientific career.

This dissertation is a cumulative work composed of four scientific articles. These articles are either published, in preparation for resubmission, or in preparation for submission to an international peer-reviewed journal. Three scientific articles present the marine tephrochronostratigraphy of New Zealand's volcanism since the Neogene (Studies I, II, III). One contribution presents a methodical approach for efficient marine tephra sampling, sample preparation and data acquisition (Study IV) with additional focus on the benefits and limitations of different coring techniques for marine tephrostratigraphy. All manuscripts are stand-alone

contributions and I am the first author of all studies. The dissertation is complemented by an introduction and scientific objectives, a conclusion and scientific outlook.

The 1st manuscript (Study I) reports on the analysed major and trace element compositions of all investigated marine volcanic samples from New Zealand recovered during different deep ocean drilling campaigns. In addition, relevant information about the drill sites, for example water and drilling depths, recovered lithostratigraphic units, and first age models, are reported here. This study provides the foundation for the 2nd (Study II) and 3rd (Study III) manuscript.

In the 2nd (Study II) and 3rd (Study III) manuscript I focus on New Zealand's marine tephrostratigraphy of the Quaternary (c. 2.6 Ma to recent) and Neogene (c. 17 Ma to 2.6 Ma). The marine tephrochronostratigraphy was established based on the marine tephra inventory and include first calculations of repose times and eruption frequencies. Study II additionally provides first holistic estimates of erupted tephra volumes and associated eruption magnitudes, whereas Study III provides first investigations of geochemical trends since the Neogene.

The 4th manuscript (Study IV) presents a methodical approach for marine tephrostratigraphy. This contribution provides a detailed description of different work steps from core to correlation and is particularly interesting for studies focussing on large sample quantities. In addition, this manuscript highlights different coring and drilling techniques in terms of their individual benefits and limitations for marine tephrostratigraphy.

During my PhD project I contributed to two other manuscripts (Woodhouse et al., 2022; Luo et al., 2023) related to my tephra studies in New Zealand by providing geochemical data, and editorial reading and writing of the manuscripts. In addition, I contributed to five other manuscripts (Kutterolf et al., 2021b; Kutterolf et al., 2021a; Kutterolf et al., 2023b; Kutterolf et al., 2023c; Kutterolf et al., 2023a) and was responsible for sample preparation and analyses, conceptualisation of the manuscripts including initial and editorial reading and writing, graphics, discussion and interpretation. Contemporaneously, I published the results of my master thesis (Pank et al., 2022) and was responsible for the sample preparation and analyses, conceptualisation of the manuscript, including initial and editorial writing, graphics, discussion and interpretation.

Abstract

The investigation of marine tephra records allows the establishment of most complete long-term eruptive sequences of volcanoes, volcanic centres, and arc systems. These eruptive sequences enable further research of systematic changes, including potential links to external forcing, over entire life cycles of volcanic systems which is a major goal of this thesis.

Five deep ocean drilling campaigns targeted the marine sediments offshore New Zealand and drilled 21 holes at eleven drill sites, covering the marine environment towards the East and Southeast of New Zealand in the direction of the prevailing winds. The recovered sediments comprised several intercalated volcanic deposits (i.e. tephra) and therefore enabled the investigation of the marine tephra record from New Zealand's volcanic arc systems. The result of this investigation is a most complete marine tephrochronostratigraphy of New Zealand's volcanism reaching back to the Neogene. The marine tephra record is continuous until c. 12 Ma and therefore complements and extends the volcanic onshore record of New Zealand's volcanoes, which is considered to be well-established until ≤ 61 ka. The older onshore eruptive record, however, lacks continuity most likely due to erosion or inaccessibility of volcanic deposits as discussed in several preceding onshore tephra studies. Therefore, the established marine tephrochronostratigraphy is of high value and a major step towards understanding and investigating New Zealand's volcanic arc systems.

Marine tephrostratigraphic studies, especially when linked to deep ocean drilling campaigns, usually imply large sample numbers, often exceeding preparation and analytical capabilities. Therefore, the tephra study of New Zealand in combination with two other very recent tephra studies, served as a case study for the establishment of a revised methodical approach.

This cumulative thesis is based on four independent manuscripts. The first three contributions present the marine tephrochronostratigraphy of New Zealand's volcanism reaching back to the Neogene. The fourth contribution presents a methodical approach designed for marine tephra studies and optimised for large sample quantities and can be used as a "core to correlation" - recipe. For illustration, this methodical approach particularly focusses on three marine tephra studies (New Zealand, Aegean Sea, and Sumatra/Indian Ocean) and discusses the benefits and limitations of different coring and drilling techniques for marine tephrostratigraphic studies.

The major findings of this thesis are: 1) a continuous marine tephrochronostratigraphy for New Zealand's volcanic arcs for the last 12 Myr that covers the lifetime of the Quaternary Taupō Volcanic Zone and parts of the Coromandel Volcanic Zone, the Neogene predecessor volcanic arc with earliest volcanism dated at c. 18 Ma, 2) temporal geochemical variations and trends

within and between the two arc systems, 3) insights into the dispersal, depositional processes and overall preservation of tephra in the marine environment, 4) first estimates of tephra volumes, equivalent magma masses and eruption magnitudes, and 5) eruption frequencies and repose times for the Quaternary and Neogene volcanic arcs.

Although the established continuous marine tephrochronostratigraphy is the most complete eruptive time series for New Zealand's volcanism up to now, only eruptions with magnitudes $M \leq 5$ were preserved as discrete layers in the marine sediments. Therefore, future tephrostratigraphic research in that area may benefit from combining the marine tephrochronostratigraphic record with preceding onshore tephra studies and ultimately result in the most complete eruptive record of New Zealand.

Kurzfassung

Die Untersuchung mariner Tephren ermöglicht die Erstellung möglichst vollständiger Langzeit-Eruptionsequenzen von Vulkanen, Vulkanzentren und vulkanischen Bogensystemen. Dies ermöglicht detaillierte Untersuchungen von systematischen Veränderungen einschließlich möglicher Verbindungen zu externen Einflüssen über den gesamten Lebenszyklus vulkanischer Systeme, was ein Hauptziel dieser Arbeit ist.

Während fünf Bohrkampagnen wurden die Tiefseesedimente vor der Küste Neuseelands untersucht und insgesamt 21 Löcher an elf Bohrlokalationen gebohrt. Sie erstreckten sich östlich und südöstlich in Richtung der vorherrschenden Winde von Neuseeland. Die gewonnenen marinen Sedimente umfassten viele zwischengelagerte vulkanische Ablagerungen (auch Tephren genannt) und ermöglichten daher die Untersuchung der marinen Tephrasequenzen der Vulkanbogensysteme Neuseelands. Das Ergebnis dieser Untersuchung ist eine äußerst vollständige marine Tephrochronostratigraphie des neuseeländischen Vulkanismus die bis ins Neogen zurückreicht. Die marine Tephra-Aufzeichnung der marinen Sedimente ist kontinuierlich bis etwa 12 Millionen Jahre und ergänzt somit die auf dem Festland vorhandene Eruptionshistorie Neuseelands. Diese ist für die letzten 61.000 Jahre sehr detailliert beschrieben und etabliert, doch wie bereits in vorherigen Tephra-Studien diskutiert, mangelt es den älteren Eruptionsaufzeichnungen an Land an Vollständigkeit, vermutlich bedingt durch Erosion oder Überlagerung der vulkanischen Ablagerungen. Daher ist die in dieser Dissertation etablierte kontinuierliche marine Tephrochronostratigraphie von großem Wert und ein wichtiger Schritt in Richtung weiterführender Erforschung der Vulkanbogensysteme Neuseelands.

Marine tephrostratigraphische Studien, insbesondere wenn sie mit marinen Bohrkampagnen in Verbindung stehen, umfassen in der Regel sehr große Probenmengen die häufig die Aufbereitungs- und Analysemöglichkeiten übersteigen. Daher diene die Erforschung der marinen Tephrostratigraphie Neuseelands in Kombination mit zwei weiteren, sehr aktuellen Tephra-Studien als Referenz für die Erstellung eines überarbeiteten methodischen Ansatzes.

Diese kumulative Dissertation basiert auf vier unabhängigen Manuskripten. Die ersten drei Beiträge präsentieren die marine Tephrochronostratigraphie des neuseeländischen Vulkanismus bis ins Neogen. Der vierte Beitrag stellt einen methodischen Ansatz vor, der für marine Tephra-Studien entwickelt und für große Probenmengen optimiert wurde. Dieser Ansatz kann als eine Art Rezept „von Kern zu Korrelation“ angewandt werden und konzentriert sich zur besseren Veranschaulichung auf drei marine Tephra-Studien (Neuseeland, Ägäisches Meer

und Sumatra/Indischer Ozean). Des Weiteren werden die Vor- und Nachteile verschiedener Kern- und Bohrtechniken für die marine Tephrostratigraphie erörtert.

Die wichtigsten Ergebnisse dieser Dissertation sind: 1) eine kontinuierliche marine Tephrochronostratigraphie für Neuseelands Vulkanismus der letzten 12 Millionen Jahre, welche die Lebensdauer der quartären Taupō-Vulkanzone und der jüngeren Entwicklung der neogenen Coromandel-Vulkanzone abdeckt, 2) zeitliche geochemische Variationen und Trends innerhalb und zwischen den beiden Vulkanbogensystemen, 3) Einblicke in die Verbreitung, der Ablagerungsprozesse und die allgemeine Erhaltung von Tephren im Ozean, 4) erste Abschätzungen von Tephravolumina, äquivalenten Magmamassen und Eruptionsmagnituden, und 5) Eruptionshäufigkeit und -frequenzen des quartären und neogenen Vulkanbogens.

Obwohl die in dieser Dissertation erstellte marine Tephrochronostratigraphie die bisher vollständigste Eruptionszeitreihe für den neuseeländischen Vulkanismus ist, ist sie teilweise unvollständig da nur die vulkanischen Ablagerungen von Eruptionen mit Magnituden $M \leq 5$ als klar identifizierbare Schichten in den Meeressedimenten erhalten sind. Zukünftige tephrostratigraphische Forschung könnte daher stark von der Kombination der hier erstellten marinen Tephrochronostratigraphie mit vorherigen Festland-Tephra-Studien Neuseelands profitieren und letztendlich zu einer vollständigeren Eruptionshistorie Neuseelands führen.

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1 General introduction

Earth's volcanism occurs at different geological settings and is mainly concentrated along plate boundaries. About 75% of the Earth's magmatic activity occurs along divergent plate boundaries, like mid-ocean ridges (Schmincke, 2004). The other 25% of magmatism occur along convergent plate boundaries (i.e. subduction zones) forming volcanic arcs, or to a minor extent within plates (intraplate volcanism) often triggered by mantle plumes (Schmincke, 2004). In general, 65% of all subaerial volcanoes with at least one Holocene eruption and 85% of all volcanoes with historic eruptions are located along subduction zones (Schmincke, 2004). Whereas magmatism along mid-ocean ridges is comparably stable, calm and effusive, subduction zone related volcanoes show a combination of effusive and explosive volcanic activity. Since subductions zones are usually located close to the oceans, deposits of such explosive eruptions (pyroclastics) are deposited onshore and offshore, depending on the overall geological setting of the volcanically active region, transport mechanisms, and eruption magnitude. The temporal investigation of such pyroclastic deposits is crucial for the understanding and reconstruction of the volcanic history of individual volcanoes or entire arcs and is mainly summarised in the research field of tephro(-chrono-)stratigraphy. Here, the field of offshore tephrostratigraphy has grown over the last decades as sea-going expeditions and evolving coring and drilling techniques enable successful recoveries of marine sediments which complement and often extend the onshore sedimentary record.

Within this dissertation the most complete marine tephrochronostratigraphy of New Zealand is established. This data set is used in combination with the results of two other marine tephra studies (Aegean Sea and Indian Ocean) and other preceding tephra studies to establish a revised methodical approach for (marine) tephrostratigraphic studies. The investigated marine tephra records were established based on marine sediments from several drilling (deep sea ocean drilling) and coring (shallow marine gravity coring) campaigns and therefore enable a comparison of the benefits and limitations of different coring and drilling techniques for (marine) tephrostratigraphic studies.

1.1 Geological background of the study area

The so-called “Ring of Fire” (ROF) is a horseshoe-shaped belt characterised by active plate tectonics and highly explosive volcanism that surrounds the Pacific Ocean. It geologically connects South and North America with the Aleutian Islands, Kamchatka, Japan, Indonesia and

New Zealand (Figure 1-1 A) and therefore is the Earth's longest continuous expression of subaerial and partly submarine volcanism.

The main study area of the thesis chapters is New Zealand, which is located in the Southwest Pacific (Figure 1-1 A), where the Pacific Plate subducts beneath the Indo-Australian Plate in northwesterly direction (Figure 1-1 B). At present, the thickened Hikurangi Plateau is subducted along the Hikurangi trench under the North Island whereas northeastward normal oceanic crust is subducted along the Kermadec and Tonga trench (Figure 1-1 B; Wallace and Beavan, 2004). The Kermadec-Tonga trench is the northeastward continuation of the Hikurangi subduction zone and separated into two segments at $\sim 25^{\circ}\text{S}$ (southern Kermadec and northern Tonga trench) by the prominent Louisville seamount chain (Figure 1-1 B; Smith and Price, 2006). At present, both subduction zones are associated with volcanic arcs, the Taupō Volcanic Zone (TVZ) in New Zealand and the Tonga-Kermadec volcanic arc (e.g. Wilson et al., 1995; Ewart et al., 1998).

At New Zealand continuous plate re-arrangements since the Neogene (e.g. Strogon et al., 2022) led to the formation of two proceeding Neogene volcanic arcs, the Northland arc and Coromandel Volcanic Zone (e.g. Adams et al., 1994; Herzer, 1995; Hayward et al., 2001; Briggs et al., 2005; Booden et al., 2012). The Northland arc was oriented NW-SE along the present-day Northland Peninsula (northwestern tip of the North Island; Figure 1-1 B) and earliest volcanism is dated at c. 23.5 Ma. The main activity of the Northland arc, however, has been dated at c. 22 Ma and at c. 16 Ma the arc was extinct (Herzer, 1995). As the plate boundaries shifted, volcanism commenced along the Coromandel Volcanic Zone (CVZ) and earliest records were found on Coromandel Peninsula (northwest North Island; Figure 1-1 B) and indicate that this arc was active since c. 18 Ma (Adams et al., 1994). Several caldera structures were identified that are decreasing in age towards the central North Island from N to S (Booden et al., 2012). Since c. 4 Myr the plate boundaries are relatively stable (Strogon et al., 2022) and at present volcanism is mainly concentrated along the TVZ, an arc that is oriented NE-SW (Figure 1-1 B; e.g. Houghton et al., 1995). It is still not yet resolved when the volcanic activity shifted from the CVZ to TVZ, but there is evidence (e.g. volcanic edifices and calderas, volcanic deposits) of temporal overlapping volcanic activity (e.g. Pittari et al., 2021; Prentice et al., 2022).

The present volcanic arc, the TVZ, is one of the world's most productive Quaternary volcanic regions characterised by predominantly silicic volcanism (e.g. Wilson and Rowland, 2016). Several relatively short-lived, nested and overlapping volcanic centres evolved over the last <1.6 Myr and are responsible for at least 34 caldera-forming eruptions identified so far (e.g.

Houghton et al., 1995). At present, Whakaari Island, an offshore island volcano, counts as the most active volcano of the TVZ (Kilgour et al., 2021), although several other volcanic edifices located on central North Island also count as volcanically active (e.g. Gamble et al., 1999; Walker et al., 2007).

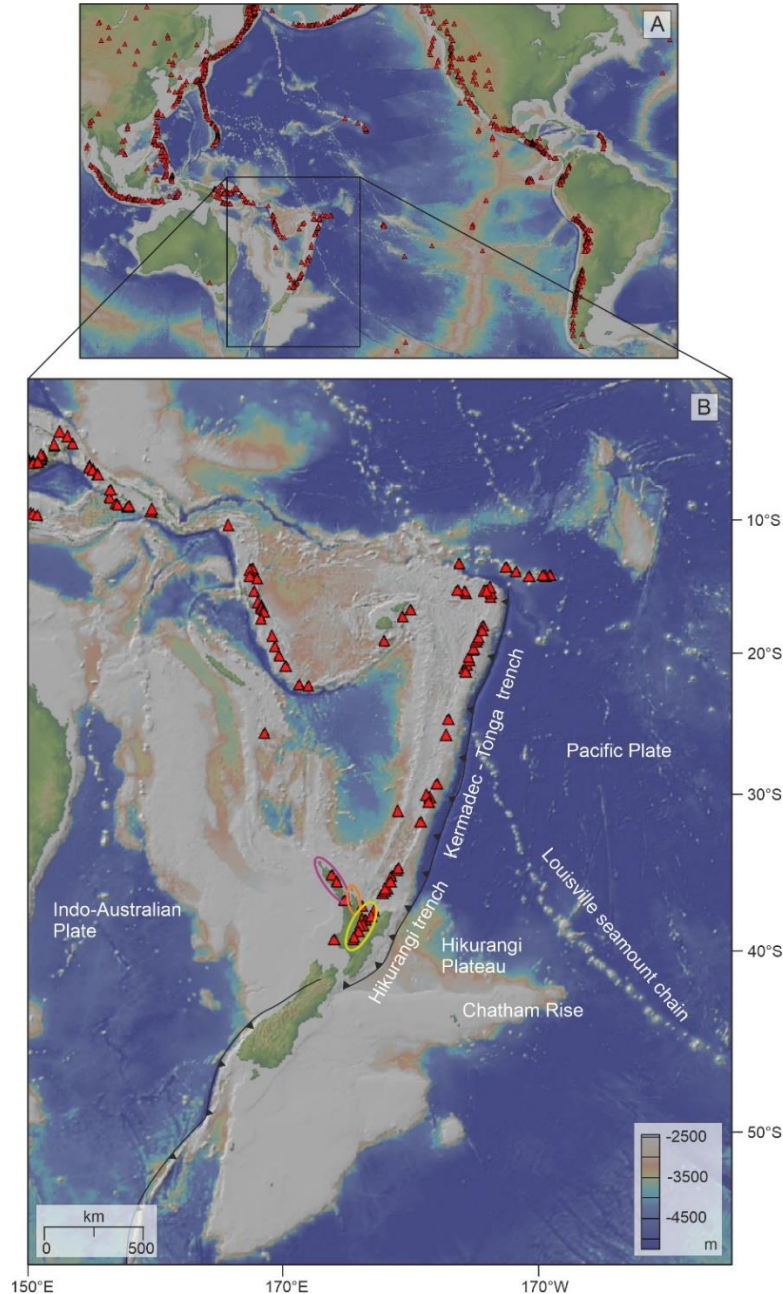


Figure 1-1 Overview maps of the Pacific Ring of Fire and the study area New Zealand in the southwest Pacific.

A) The Pacific Ring of Fire is characterised by active tectonics and volcanism and surrounds the Pacific Ocean. The box in A) indicates the inset B) that gives a closer overview about the tectonic and volcanic setting of New Zealand. The different volcanic arcs of New Zealand are indicated by the colored ellipsoids (yellow: Taupō Volcanic Zone, orange: Coromandel Volcanic Zone, purple: Northland arc). Both maps were created with GeoMapApp (<http://geomapapp.org>) using the GMRT-Global Multi-Resolution Topography from Ryan et al. (2009) and volcano positions (red triangles) are from the Smithsonian Global Volcanism Program after Simkin and Siebert (2002).

1.2 Introduction to tephrostratigraphy

Volcanic arc volcanoes can generate large explosive eruptions (Plinian eruptions), which produce high eruption columns (>20 km height). The eruptive plumes inject large volumes of solid pyroclastic material so called tephra (mostly ash: $\phi < 2$ mm, and lapilli: ϕ 2 to 64 mm) and climatically active aerosols (water vapor, carbon dioxide, sulfur) into the stratosphere. The term tephra (Greek: ash) is a description for solid volcanic material (i.e. volcanic glass, crystals and lithics) consisting of unconsolidated pyroclastic material that is generated during the fragmentation of magma in explosive eruptions (e.g. Thorarinsson, 1944; Fisher and Schmincke, 1984; Lowe, 2011). Stable eruption columns spread laterally once they reached their level of neutral buoyancy where they are further distributed by the prevailing wind direction. These stable phases of explosive eruptions are usually short episodes, which only last for hours to days, (Lowe, 2011). The dispersal and deposition through the air is mainly controlled by the erupted volume and dominating winds, and ultimately lead to fallout deposits usually forming discrete tephra layers with decreasing particle size with distance from source (Bonadonna et al., 1998). Unstable eruption columns are likely to collapse and therefore produce pyroclastic density currents, which form flow deposits. These occur syn- or post-eruptive and distribute tephra by travelling in morphological lows over hundreds of kilometres (Cisneros de León et al., 2021).

Both transport mechanisms widely distribute tephra and lead to the formation of tephra layers onland (onshore tephrostratigraphy) and offshore (marine tephrostratigraphy). Kutterolf et al. (2008) and subsequent studies have shown that tephtras are best preserved in marine and lacustrine environments because erosional effects are limited compared to terrestrial environments. This especially accounts for volcanic regions where landmass is small and the prevailing winds disperse the volcanic material towards the ocean (e.g. Japan, Central America, New Zealand, Aegean Sea).

In order to enable assessments about potential future developments of volcanically active regions and related potential volcanic hazards it is crucial to study the long-term eruptive history (Connor et al., 2001). Here, the field of tephrostratigraphy has proven to be a reliable tool for reconstructing and complementing the eruption records of volcanic arcs or individual volcanic edifices (e.g. Lowe, 2011). Tephrostratigraphic studies investigate and describe the occurrence of volcanic deposits (i.e. tephra layers) intercalated within background sediments (Fisher and Schmincke, 1984) and therefore enable correlations between volcanic events in independent sedimentary successions (Lowe, 2011).

Fallout tephra, deposited simultaneous to the eruption, and syn-eruptive density currents usually produce primary volcanic deposits. Post-eruptive density currents and their deposits, however, are considered as secondary or reworked and usually lead to repeatedly occurring tephra layers from the same volcanic event in the sedimentary stratigraphy. The identification of primary versus reworked tephra layers is therefore crucial because 1) only primary deposits are relevant when establishing the eruption record of a volcanic arc or edifice, 2) primary and secondary deposits provide insights into pre-, syn-, and post-eruption processes, whose recognition is 3) important for potential hazard assessments.

1.2.1 Marine tephrostratigraphy

The research field of marine tephrostratigraphy has grown over decades as seagoing expeditions and evolving coring or drilling techniques allow to recover coherent successions of submarine sediments usually within an intact stratigraphic context covering up to millions of years of sedimentation. When operating close to volcanic arcs, or in general volcanically active regions, the recovered marine sediment successions often comprise valuable insights into the volcanic activity since the onset of volcanism. For instance, the submarine tephra records are often the only possibility to reconstruct the early volcanic history of volcanic arcs as onshore records are often incomplete due to burial or erosion.

In the marine environment, however, the identification of primary versus reworked deposits is even more important because syn-depositional turbidity currents might distort the true eruption record. Two important tools for a successful identification (onshore and marine tephrostratigraphy) are 1) ‘geochemical fingerprinting’ (geochemical tephra characterisation by using glass shard chemistry) in combination with 2) chronological criteria (tephrochronology; Lowe, 2011, 2014). Once deposited (proximal or distal to source), a primary tephra layer with a unique geochemical fingerprint can be used as a time marker because its deposition occurs simultaneously, on geological time scales, with the volcanic event (e.g. Carey, 1997; Zielinski et al., 1997a; Zielinski et al., 1997b; Manville and Wilson, 2004; Wiesner et al., 2004; Rose and Durant, 2009). However, misidentification or miscorrelation of tephra layers can lead to significant problems in the age modelling and ultimately in the stratigraphy (Kutterolf et al., 2008; Lowe, 2011).

1.3 Objectives of this study

1.3.1 Marine tephrostratigraphy of New Zealand (Studies I, II, and III)

The first part of this thesis focuses on the marine tephra inventory from proximal and distal marine drill sites offshore of New Zealand.

The main goals were and are:

- 1) to create a comprehensive and open access data base for marine tephras offshore of New Zealand drilled during IODP Expedition 375, comprising major and trace element analyses.
- 2) to revisit and re-analyse marine tephra layers from older drilling campaigns (ODP Leg 181, DSDP Leg 90 or IODP Leg 329) in order to a) establish a homogeneous data set, b) to cover the long distances between volcanic source and older drill sites, and c) complemente the data base established for Expedition 375.
- 3) to establish a most complete tephra record preserved in the marine sediments offshore of New Zealand using correlations between cores, sites and to onshore deposits and therefore create an eruptive time series for New Zealand back to the Early Miocene.

Using the tephrostratigraphic framework the following scientific questions were addressed:

- 1) How many primary and reworked tephra layers are preserved in the sediments, and how many of these can be correlated?
- 2) What is the volcanic source (eruptions or volcanoes) of the volcanic events identified in the marine sediments?
- 3) Does the marine tephra record allow to unravel the volcanic potential of New Zealand's Neogene and Quaternary volcanism?
- 4) Does the marine tephra inventory indicate seasonal or long-term variations of wind directions?
- 5) Does the marine tephra record reveal geochemical insights to better define the boundary between volcanism located at the CVZ and TVZ?
- 6) What are the eruption frequencies based on the marine tephrostratigraphic framework and do they indicate times of increased volcanic activity or volcanic quiescence?
- 7) What are the implications in terms of eruption sizes and magnitudes for known and unknown volcanic events?

1.3.2 Revised methodical approach for marine tephrostratigraphy (Study IV)

The second part of this dissertation presents a methodical approach from core to correlation for marine (and lacustrine) tephrostratigraphy.

The main goals of this study are:

- 1) to present the most common and successful shallow marine coring and deep ocean drilling techniques.
- 2) to create a comprehensive summary of our methodical approach from sample to correlation suitable for large sample quantities.
- 3) to evaluate the benefits and limitations of different coring and drilling techniques for marine tephra studies.

In particular the following scientific questions were addressed:

- 1) What are the main advantages of each coring and drilling technique and what are potential limitations for marine tephrostratigraphy?
- 2) Is the revised approach applicable for tephra studies focussing on smaller sample quantities, or even for other research disciplines?

2 Study I

The subsequent chapter provides the foundation of New Zealand's marine tephrostratigraphy and was published in the Proceedings of the International Ocean Discovery Program Volume 372B/375. The supplementary material is available in the original version of this article.

Data report: marine tephra compositions in proximal and distal drill cores, IODP Expeditions 375, 372, and 329, ODP Leg 181, and DSDP Leg 90, offshore New Zealand, Southwest Pacific.

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2.1 Abstract

We report on a total of 1005 samples analyzed for major and trace element compositions from marine sediments drilled along the Hikurangi subduction zone and within the incoming Pacific plate. The samples are from International Ocean Discovery Program Expeditions 375 and 372; Integrated Ocean Drilling Program Expedition 329; Ocean Drilling Program Leg 181; and Deep Sea Drilling Project Leg 90.

All 1005 samples, resulting in a total number of ~20,200 individual measurements, were analyzed for major element compositions with the electron microprobe. A subset of 419 samples, resulting in a total number of ~1820 individual glass shard analyses, were analyzed for trace element compositions using the laser ablation-inductively coupled plasma-mass spectrometer. In total, ~640 samples were identified as primary ash layers based on their homogeneous geochemistry, visual appearance in the core pictures, and high amount of volcanic glass. Based on the biostratigraphy presented in the cruise reports and subsequent work, we can distinguish between Quaternary and Neogene-derived tephras. The tephra layers of Quaternary age are mostly of rhyolitic composition with occasional andesitic, dacitic, and trachytic glass shards. The Neogene tephras are mostly of basaltic andesite, andesitic, and rhyolitic composition, with a few basaltic and trachytic tephras. Tephras of both age groups follow the calc-alkaline series trend with a tendency to shift into the high-K calc-alkaline series for tephras with >70 wt% SiO₂.

2.2 Introduction

International Ocean Discovery Program (IODP) Expedition 375, together with Expedition 372, was initiated to investigate regularly recurring slow slip events (SSEs) along the northern Hikurangi subduction margin. These SSEs recur every 1–2 y over a period of 2–3 weeks at <2–15 km below the seafloor (see Saffer et al., 2019, and references therein) and are linked to several factors that were investigated during Expeditions 375 and 372. The main objectives of Expedition 375 were the deformation rate and associated chemical and physical properties throughout entire slow slip cycles, the lithologic and structural character of active faults, and the material that is transported to the SSE source region. Expedition 372 also focused on landslides potentially involving gas hydrates along the Hikurangi margin. Together, both expeditions aimed to investigate the character and properties of SSEs and their relationship with earthquakes along the subduction interface. Pecher et al. (2018) found that earthquakes along

the Hikurangi margin influence sedimentation on both the slope and the incoming plate either by remobilizing large stratigraphically intact blocks of sediments or frequent triggering of turbidity currents. Here, the amount and character of the sediments involved play a fundamental role. In the case of New Zealand, the sediments are strongly influenced by the high volcanological input from the Taupō Volcanic Zone (Quaternary) and Coromandel Volcanic Zone (Neogene) in the form of discrete tephra layers or dispersed ash. These tephra layers may be used to help characterize the timing and distribution of submarine slides along the Hikurangi margin. For this, a tephrochronostratigraphic framework based on correlations to well-dated onshore deposits (e.g., through geochemical fingerprinting) or direct age dating (e.g., radiometric techniques) is required and will help to date sediment sequences and potential submarine slides. The investigation and understanding of earthquakes, submarine slides, and volcanism and their potential links is crucial not only to New Zealand but globally.

We here present individual glass shard analyses of major and trace elements of (discrete) tephra layers building the foundation of the tephrostratigraphic framework back to the Miocene. The major and trace element compositions of tephras generally provide information about the depositional character (e.g., primary versus reworked origin) of the layers (e.g., Freundt et al., 2022) and allow for correlation between sites and onshore reference data. The compositional data provided in this report will be the foundation for upcoming publications focusing on the compositional and temporal tephrostratigraphic framework during the Quaternary and Neogene. Upcoming publications will also include correlations between individual holes, sites, and terrestrial reference deposits and new age models based on sedimentation rates verified by prominent marker horizons, finally contributing to a tephrochronostratigraphic framework for New Zealand.

2.2.1 Expedition 372/375 sites

The majority of investigated tephras were retrieved from four Expedition 375 sites (U1518–U1520 and U1526) and one Expedition 372 site (U1517). Tephras from Holes U1519C–U1519E were recovered during Expedition 375, but the site was initiated with logging while drilling operations during Expedition 372. Expedition 375 sites are aligned on a northwest–southeast transect offshore of Gisborne, New Zealand, covering distinct areas of the subduction margin (Figure 2-1).

2.2.1.1 Site U1519

Site U1519 (Figure 2-1A) is the northernmost drill site and is located on the shelf in the Tuaheni Basin (Figure 2-1B) about 38 km from shore at a water depth of ~1000 m (Saffer et al., 2019). Calcareous nannofossils and planktonic foraminifer species indicate an age between the Holocene (base at 4.4–14.0 meters below seafloor [mbsf]) and Pleistocene (~635 mbsf) (Crundwell and Woodhouse, 2022b). Two lithostratigraphic units were identified at Site U1519 (Barnes et al., 2019b). Unit I (shallower than 282.66 mbsf) consists of mud, mudstone, minor silt, and volcanic ash in a hemipelagic setting with rare dilute turbidity currents. Unit II consists of (silty) mudstone, fine to coarse sand, rare volcanic ash, and mass transport deposits in a hemipelagic setting with turbidity currents and debris flows.

2.2.1.2 Site U1518

Site U1518 (Figure 2-1) is located in the frontal accretionary wedge about 73 km from shore at a water depth of ~2630 m. Planktonic foraminifers and calcareous nannofossils indicate an age of Holocene–Pleistocene (Crundwell and Woodhouse, 2022b). Three lithostratigraphic units were identified (Saffer et al., 2019). Unit I (divided into Subunits IA and IB) consists of silty clay/sand and sandy silt interbedded with volcanic ash in the upper 40 m and fine-grained turbidites and hemipelagic sediments deposited in a trench-floor environment (Subunit IA, lower part). Subunit IB (197.7–304.5 mbsf) consists of mudstone with siltstone, hemipelagic sediments, and fine grained turbidites deposited in a trench-floor environment. Unit II (304.5–370.4 mbsf) consists of alternating layers of silty mudstone and sparse siltstone, with hemipelagic sediments in the lower parts. Unit III is also divided into two parts (Subunits IIIA and IIIB). The upper part of Subunit

IIIA (370.4–475.7 mbsf) contains bioturbated mudstone interbedded with thin layers of (sandy) siltstone, and the lower part contains turbidites and soft-sediment deformation (mass transport deposits). Subunit IIIB (deeper than 475.7 mbsf) consists of mudstone/siltstone interbeds.

2.2.1.3 Site U1520

Site U1520 (Figure 2-1A) is located on the incoming subducting Pacific plate in the Hikurangi Trough (Figure 2-1B), about 16 km east of the deformation front and ~95 km from shore at a water depth of ~3520 m. The biostratigraphy indicates a discontinuous recovery of Holocene

to Late Cretaceous successions comprising several hiatus-bounded packages. Six lithostratigraphic units were identified (Barnes et al., 2019c). Unit I (shallower than 110.5 mbsf) consists of hemipelagic trench-wedge facies with sand, silt, and silty sand(stones). Unit II (110.5–222.0 mbsf) is characterized as the Ruatoria slide, hemipelagic mud(stone) with silt. Unit III (222.0–509.82 mbsf) consists of hemipelagic trench-wedge facies with volcanic ash/tuff, silty sand(stone), debris flow deposits, and black mudstones. Unit IV (509.82–848.54 mbsf) consists of pelagic facies (predominantly marl), debris flow deposits, volcanic ash/tuff, and (muddy) chalk at the base. Unit V (848.45– 1016.26 mbsf) is a volcanoclastic facies, and Unit VI (deeper than 1016.24 mbsf) consists of mixed lithologies such as volcanoclastic conglomerates, black mudstone, and basalts.

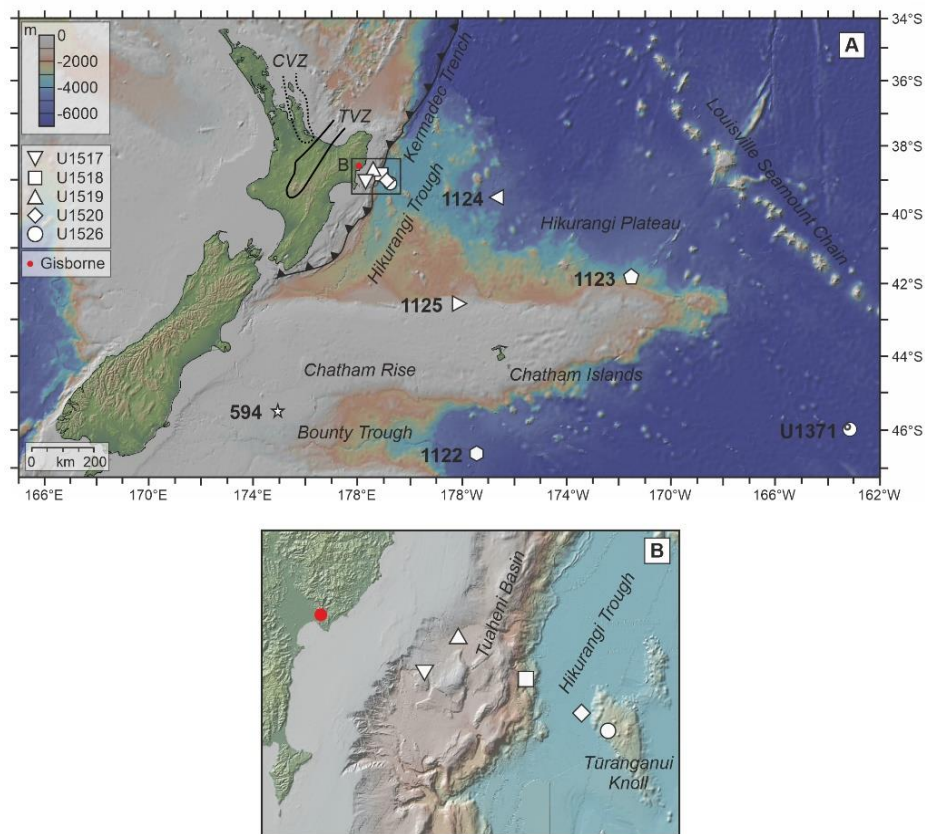


Figure 2-1 IODP, ODP, and DSDP sites and larger scale tectonic features east of New Zealand.

A. TVZ = Taupō Volcanic Zone (solid line), CVZ = Coromandel Volcanic Zone (dotted line). B. Expedition 372 and 375 sites across the Hikurangi subduction margin with smaller scale tectonic features. Maps created with GeoMapApp, Global Multiresolution Topography Data Synthesis (GMRT) after Ryan et al. (2009).

2.2.1.4 Site U1526

Site U1526, the southeasternmost drill site (Figure 2-1A), is located on the Tūrangānui Knoll at a water depth of 2908 m (Figure 2-1B). The biostratigraphy indicates a varying age of the

sedimentary succession from the Holocene to Late Cretaceous (Crundwell and Woodhouse, 2022b). Two lithostratigraphic units were identified (Wallace et al., 2019). Unit I (shallower than 30.23 mbsf) consists of hemipelagic to biocalcareous facies of (calcareous) mud and nannofossil ooze. Unit II (deeper than 30.23 mbsf) is a volcanoclastic facies with coarse volcanoclastic sandstone, including shell hash, volcanoclastic conglomerate/breccia, and vesicular basalt, probably deposited in a shallow marine environment.

2.2.1.5 Site U1517

Site U1517 (Figure 2-1) is located southwest of Site U1519 in the extensional, creeping part of the Tuaheni Landslide Complex at a water depth of about 720 m. Calcareous nannofossils and planktonic foraminifers indicate that the sedimentary sequence is of Holocene to Middle Pleistocene age (Crundwell and Woodhouse, 2022b). Five lithostratigraphic units were described (Barnes et al., 2019a). Unit I (shallower than 3 mbsf) consists of silty clay, volcanoclastic fine sand, and a sandy base. Unit II (3.0–40.74 mbsf; alternating mud and sand) and Unit III (40.74–66.38 mbsf; massive clayey silt to silty clay with alternating silt and clay, including blebs of sand and ash) comprise the Tuaheni slide mass, apparently an intact block that was mobilized from the upper slope sedimentary sequences. Unit IV (66.38–103.16 mbsf) is characterized as massive clayey silt with variable amounts of clay and volcanoclastic material with a sand bed at the base. Unit V (103.16–187.53 mbsf) is composed of alternating sand and mud intervals of massive clayey silt or silty clay, very fine grained silt, and volcanoclastic material in the form of ash/tuff layers.

2.2.2 Leg 181 sites

The drill sites of Expeditions 375 and 372 cover the proximal submarine area of the Hikurangi margin and trough and may contain volcanoclastic material from relatively minor eruptions with a potentially smaller geographic distribution as well as material from large eruptions with a potentially wide geographic distribution. The volcanological record in these cores, however, might be incomplete because of erosive processes and submarine slides along the shelf and margin. Additionally, it is difficult to estimate eruption sizes based on tephra layers in proximal cores only, and especially eruptions of unknown origin, which cannot be correlated to a specific source. To address these issues in future studies, we revisited distal cores from previous expeditions: Ocean Drilling Program (ODP) Leg 181 (Carter et al., 1999), Deep Sea Drilling

Program (DSDP) Leg 90 (Kennett, von der Borch et al., 1986), and Integrated Ocean Drilling Program Expedition 329 (Expedition 329 Scientists, 2011), enlarging our study area offshore of New Zealand (Figure 2-1).

Leg 181 Sites 1122–1125 are situated on the Pacific plate between ~480 and ~960 km east and southeast of Gisborne (Figure 2-1). The information given below is referenced in the Volume 181 Initial Report (Carter et al., 1999). Sites 1123 and 1124 were previously the focus of marine tephra inventory studies (e.g., Alloway et al., 2005; Allan et al., 2008; Stevens, 2010). However, for better compatibility and to allow trace element measurements to be made accurately, we decided to resample the cores and analyzed the tephra layers. This process also gives a good control on variabilities in the data sets based on different measuring protocols, allowing the data to be directly compared.

2.2.2.1 Site 1122

Site 1122 is located ~950 km south-southeast of Gisborne at a water depth of 4432 m on the northern bank levee of the abyssal Bounty Fan (Figure 2-1). The recovered stratigraphic sequence is mostly of Miocene to Pleistocene age, including a few meters of Holocene. Three lithostratigraphic units were identified. Unit I consists of a thick sequence of turbidites and is divided into four subunits. Unit II (386.9–550.4 mbsf) consists of bioturbated pelagic/hemipelagic sediments interspersed with current-laminated deposits, and Unit III (550.4–617.85 mbsf) contains bioturbated pelagic/hemipelagic sediments interspersed with laminated current deposits common to drift deposits.

2.2.2.2 Site 1123

Site 1123 (Figure 2-1) is located on the northeastern slopes of Chatham Rise about 960 km southeast of Gisborne at a water depth of 3290 m. Recovered cores range from Pleistocene to Miocene age and contain successions of clay-rich nannofossil ooze, chalk, and limestone. Four lithostratigraphic units were identified. Unit I (0–256.59 mbsf) is characterized by an interglacial–glacial cyclic sedimentation pattern of clayey nannofossil ooze and abundant to occasional tephra intercalations. Unit II (256.59–450.8 mbsf) consists of a fairly uniform lithology of chalk with tephra beds. Unit III (450.8–489 and 484–542.9 mbsf) is again characterized by an interglacial–glacial cyclic sedimentation pattern of mudstone and chalk and

contains a ~7 m thick debris flow. Unit I V (587.2–632.8 mbsf) is of Eocene/Oligocene age and consists of micritic limestone with bioturbation.

2.2.2.3 Site 1124

Site 1124 is located about 480 km east-southeast from Gisborne (Figure 2-1) at a water depth of 3978 m. The biostratigraphy indicates an age of Late Cretaceous to Pleistocene. Six lithostratigraphic units were described. Unit I (shallower than 300 mbsf) is divided into three subunits and consists of a succession of interbedded ooze, chalk, and silty clay with frequent tephra layers of varying thickness. Unit II (~302–411 mbsf) consists of nannofossil chalk with interbeds of claybearing nannofossil chalk containing a biosiliceous component. Unit III (~411–419 mbsf) is composed of a uniform clayey nannofossil chalk. Unit IV (~419–429 mbsf) marks an abrupt change to mudstones. Unit V (~429–467 mbsf) consists of nannofossil-bearing mudstone and isolated beds of nannofossil chalk. Unit VI (~467–473 mbsf) consists of nannofossil-bearing mudstones with chert lenses.

2.2.2.4 Site 1125

Site 1125 is located about 550 km southeast of Gisborne (Figure 2-1) on the north slope of Chatham Rise at a water depth of 1360 m. Two lithostratigraphic units of Miocene to Pleistocene age were recovered. Unit I (shallower than 245.2 mbsf) represents an interglacial–glacial cyclic sedimentation pattern of alternating nannofossil ooze and silty clay and is divided into two subunits. Unit II (245.2–331.5 mbsf) consists of mainly clayey nannofossil chalk.

2.2.3 Leg 90 site

2.2.3.1 Site 594

Leg 90 Site 594 is located 790 km south of Gisborne at the southern margin of the Chatham Rise, east of South Island, New Zealand (Figure 2-1). Two lithostratigraphic units were recognized. Unit I consists of alternating pelagic and hemipelagic lithofacies with nannofossil ooze. Unit II consists of pelagic facies with nannofossil ooze and nannofossil chalk (Kennett, von der Borch et al., 1986).

2.2.4 Expedition 329 site

2.2.4.1 Site U1371

Expedition 329 Site U1371 is the southeasternmost drill site and is located about ~1750 km southeast of Gisborne and about 840 km southeast of Site 1123 (Figure 2-1) at a water depth of about 5301 m. The recovered sediments consist of diatom ooze and pelagic clay and are divided into two units. Unit I consists of ooze with varying diatom and clay content and numerous ash layers. Unit II consists of clay and zeolite (Expedition 329 Scientists, 2011).

By combining the selected drill sites, including both the proximal subduction margin and distal Pacific plate, our research and especially the data report presented here offer a unique opportunity to investigate an unprecedented and holistic view of the volcanic activity of New Zealand and the surrounding volcanic areas (e.g., the Kermadec arc) since the Miocene.

Additionally, the elaboration and interpretation of the data will allow us to fill or verify gaps in the well-constrained Quaternary Taupō Volcanic Zone volcanic activity by including tephra of smaller eruptions, which are more likely to be eroded or obscured in the geologic record on land, and thus not described so far.

2.3 Method

2.3.1 Sampling

The cores retrieved during Expeditions 375 and 372 were sampled for visible tephra deposits during the expedition. Visual core descriptions, including lithologic and sedimentary features, and smear slide analyses were used to identify intervals of interest indicating (primary) tephra layers. The visual description of the cores was done on archive-half sections, whereas samples were taken from the working-half sections. The cores from Leg 181, Expedition 329, and Leg 90 were resampled at the IODP Gulf Coast Repository (USA).

2.3.2 Laboratory preparation

The marine ash samples were wet-sieved into different grain size fractions (63–125, 125–250, >250, and if necessary, 32–63 μm). Lithified samples from deeper sections of Site U1520 were disaggregated in an ultrasonic bath prior to sieving. The fraction 63–125 μm was further used for compositional analysis of glass shards with the electron microprobe (EMP) by embedding

twelve samples with the two-component epoxy resin, Araldite, into one 1 inch predrilled acrylic mount that has twelve 2 mm- $\varnothing$ holes. After approximately 48 h at about 50°C in the drying cabinet, the sample surfaces were polished with polishing paste of 9, 3, and 1 μm grain size and then carbon coated to provide discharge of the electrons during EMP analysis. For laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) analyses, both fractions 63–125 and 125–250 μm were embedded and further processed as described above.

2.3.3 Electron microprobe analyses

A total of 1005 samples, resulting in ~20,200 individual measurements (15–20 glass shards per sample), were analyzed for major and minor elements (Na_2O , K_2O , FeO , SiO_2 , TiO_2 , MgO , MnO , Al_2O_3 , and P_2O_5) using a JEOL JXA 8200 wavelength dispersive EMP at GEOMAR Helmholtz Centre for Ocean Research Kiel utilizing the methods of Kutterolf et al. (2011). An internal, calibrated measuring program was used based on international standard material and a 6 nA strong and 10 μm wide electron minimized sodium loss. Oxide concentrations were determined using the ZAF correction method. The accuracy was monitored with repeated measurements every 80 individual glass shard measurements using the standards Lipari (Obsidian rhyolite; Hunt and Hill, 2001) and VGA99 (basalt from Makaopuhi Lava Lake; Jarosewich et al., 1980). The resulting standard deviations are generally better than 0.5% for major elements and <0.3% for minor elements. Analyses with <90 wt% total oxides were excluded from the data set to avoid possible alteration effects on the results. However, exceptions were made for analyses of the presumably oldest samples (e.g., Site U1520), where data acquisition was difficult, most likely because of advanced dehydration related to the older age. Accidentally measured microcrystals (e.g., highly increased Al_2O_3 content) were excluded from the data set as well. The data was normalized to 100% to eliminate possible effects of minor postdepositional hydration and/or deviations of the electron beam (e.g., defocused beam). All resulting major and minor element data are listed in ELEMENT in Supplementary material.

2.3.4 Laser ablation-inductively coupled plasma-mass spectrometry

A total of 419 tephra layers, selected (1) for the presumably major eruptive events (e.g., largest thicknesses), (2) equally throughout the stratigraphies to cover compositional changes with time, and (3) where correlation attempts will need clarification or proof using trace elements, were analyzed for trace element concentrations, resulting in a total number of ~1820 glass shard

measurements (3–6 glass shards per sample). The samples were analyzed at the Institute of Earth Sciences (Taiwan) following the methods described in Kutterolf et al. (2021) using a Photon Machines Analyte G2 (193 nm) excimer laser ablation system linked to a high-resolution inductively coupled plasma–mass spectrometer (ICP-MS) (Agilent 7900). The spot size was set to 24–30 μm using 5–10 J/cm^2 energy density at 4–10 Hz repetition rate. Blank acquisition was 45 s, followed by typical ablation times of ~ 75 s. Data reduction was performed using GLITTER software (version 4.0) (van Achterberg et al., 2001) immediately following each ablation analysis. Individual calcium and silica concentrations for each analyzed glass shard of the samples, previously measured with EMP, were used as internal standard to calibrate the trace element analyses. Accuracy was monitored with repeated measurements of the international glass standard BCR-2G after every tenth sample measurement. The repeated measurement of the standard material assured the correction of matrix effects and signal drift of the LA-ICP-MS just as it monitors the differences in the ablation efficiency between sample and reference material (Günther et al., 1999). The reference material NIST SRM612 was needed for external calibration (Norman et al., 1996; Jochum et al., 2011). The detection limit is <100 ppb for most trace elements and around 10 ppb for rare earth elements. The analytical precision compared to the international glass standard BCR-2G is generally better than 10% for most trace elements (see all resulting trace element data in Supplementary material).

2.4 Results

Of 1005 investigated ash-bearing samples, ~ 640 samples are characterized as primary ash layers because of (1) their characteristic and usually homogeneous composition in major and trace elements, (2) their visual appearance in the core pictures, and (3) volcanic glass being the dominant component. Because of the large number of investigated samples, we distinguish between tephras of the Quaternary and tephras of the Neogene. We refer to the individual cruise reports and therein included biostratigraphy with resulting age models for basic details and to more recent studies (e.g., Carter et al., 2004; Alloway et al., 2005; Crundwell and Woodhouse, 2022b, 2022a) for revised age models of Expedition 372/375 and Leg 181. Based on the established and partly revised age models for the marine sediments, we identified ~ 330 primary tephra layers of Quaternary age and ~ 310 of Neogene age (Figures 2-2, 2-3). The most continuous tephra records, covering the entire age range from recent to Neogene, were recovered from Sites U1520 and 1124 (Figure 2-1).

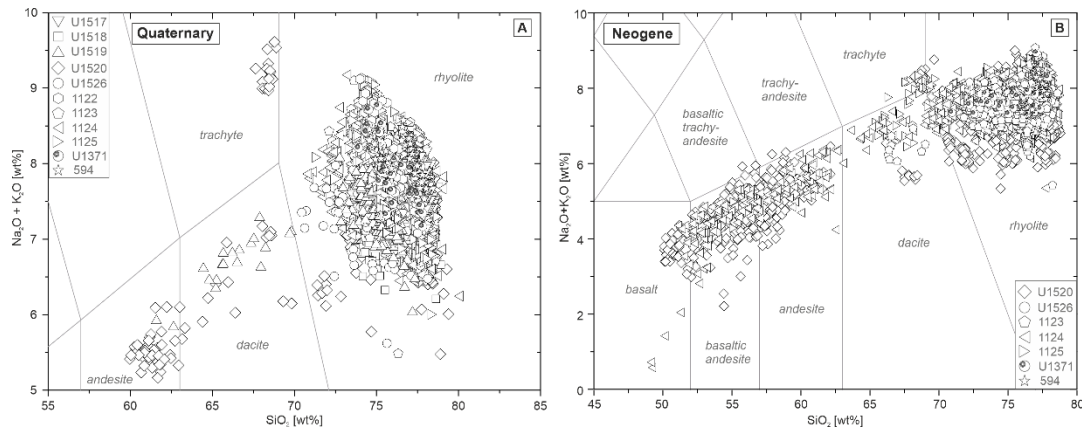


Figure 2-2 Total alkali vs. silica diagrams for the (A) Quaternary and (B) Neogene.

The majority of tephra, independent of their age, are rhyolitic after Le Maitre et al. (2002). Basaltic, dacitic, and trachytic glass shards are rare in the Quaternary but common in the Neogene (especially present in Sites U1520, 1123, and 1124). Shown are individual measurements of glass shards.

Following the total alkali versus silica diagram after Le Maitre et al. (2002), New Zealand's volcanism produced basaltic to trachytic and rhyolitic compositions (Figure 2-2) since the Neogene. The tephra layers corresponding to Quaternary age (Figure 2-2A) are predominantly rhyolitic, and the majority show SiO_2 between ~ 72.5 and 78 wt% and $\text{Na}_2\text{O} + \text{K}_2\text{O}$ of ~ 6.5 – 9 wt%. Dacitic and andesitic glass shards ranging ~ 60 – 63 wt% SiO_2 and 5 – 6 wt% $\text{Na}_2\text{O} + \text{K}_2\text{O}$ and trachytic glass shards with high alkali concentrations (≥ 8.8 wt%) occur rarely (Figure 2-2A). Neogene glass shards have a broader compositional range from basaltic to rhyolitic (Figure 2-2B), and the majority of tephra are basaltic andesites to andesites and rhyolites with rare low alkali (~ 8 wt%) trachytic glass shards. The Neogene rhyolitic compositional field is slightly broader than shown by Quaternary-derived tephra, with ~ 70 – 78 wt% SiO_2 and 6 – 9 wt% $\text{Na}_2\text{O} + \text{K}_2\text{O}$.

The K_2O classification diagram after Peccerillo and Taylor (1976) shows that the majority of investigated glass shards follow the calc-alkaline series, with an increase in K_2O for glass shards > 70 wt% SiO_2 and minor trachytic glass shards (Figure 2-3) corresponding to the high-K calc-alkaline series. Few glass shards with < 0.5 wt% K_2O and < 62.5 wt% SiO_2 fall within the tholeiitic series (Figure 2-3). Although Quaternary and Neogene tephra show a similar composition, the majority of Neogene-derived glass shards fall into the calc-alkaline series, with a tail-like trend into the high-K calc-alkaline field for glass shards with > 75 wt% SiO_2 (Figure 2-3B).

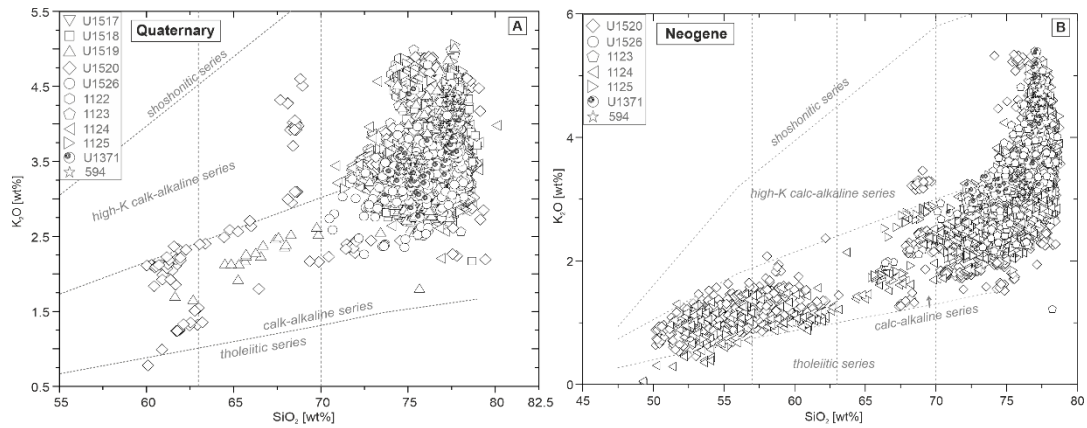


Figure 2-3 K₂O vs. SiO₂ classification diagram for the (A) Quaternary and (B) Neogene.

Quaternary glass shards follow the calc-alkaline and high-K calc-alkaline series after Peccerillo and Taylor (1976), with one glass shard of tholeiitic character. Neogene glass shards mostly follow the calc-alkaline series, a few glass shards straddle along the boundary between tholeiitic series and calc-alkaline series and silica-rich glass shards (>75 wt%) tend toward and plot within the high-K calcalkaline series.

Quaternary-derived high-SiO₂ glass shards are roughly equally distributed between the calc-alkaline and high-K calcalkaline field (Figure 2-3A). Glass shards with 60–70 wt% SiO₂ follow the calc-alkaline series, straddle around the division line to the high-K calc-alkaline field or plot within the latter. Two individual glass shards tend toward or plot within the tholeiitic series (Figure 2-3A) and are the result of a slightly geochemically zoned, silica-poor tephra layer.

2.5 Acknowledgements

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3 Study II

The subsequent chapter is currently in preparation for resubmission to Journal of Quaternary Science. The supplementary material is reported in Appendix A.

Advances in New Zealand's tephrochronostratigraphy using marine drill sites: The Quaternary.

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3.1 Abstract

Marine deposits of large explosive eruptions have generally a better preservation potential than their terrestrial counterparts resulting in the potential for a near continuous marine archive of past local eruptions. Here, we present an unprecedented record of major and trace element glass shard compositions (EMP and LA-ICP-MS) of 546 Quaternary marine tephra samples from IODP Exp. 375 and 372, ODP Leg 181, IODP Leg 329 and DSDP Leg 90 east and southeast of New Zealand.

Based on the geochemical signatures and stratigraphic contexts of these deposits we identified 331 of these tephra deposits as primary (the remainder are defined as redeposited), and by establishing a comprehensive tephrochronostratigraphic network of 254 tie-lines between different cores, we identify a total number of 165 Quaternary volcanic events.

In addition, we present new direct U-Pb zircon ages for ten tephra layers, and in combination with published existing age models for the cores, we apply indirect age estimates to all other marine tephra layers by applying marine sedimentation rates.

Thirty-five of these volcanic events are correlated to onshore deposits using chronological, stratigraphic, and geochemical constraints. Based on these results we compare and contrast the validity of the offshore record in comparison to the existing onshore record and produce a consolidated record of events for large rhyolitic eruptions ($M \geq 5$) from New Zealand.

3.2 Plain Language Summary

The North Island of New Zealand hosts one of the world's most frequently erupting volcanic systems, the Taupō Volcanic Zone. In order to understand its overall hazardous volcanic potential studies about the volcanic evolution are important. Past studies recognised that volcanic deposits from large, explosive, rhyolitic eruptions are often better preserved in marine sediments. During five deep-sea drilling expeditions the marine sediments east and southeast of New Zealand were drilled up to a depth of ~1000 m below the seafloor, recovering 546 ash-bearing samples. All samples were geochemically analysed for their major and trace element glass compositions resulting in a geochemical fingerprint of each deposit. We correlated deposits of the same eruption between individual drill sites, resulting in 165 Quaternary volcanic events. When combined with the existing onshore record they result in the most complete time series of eruptive events from New Zealand's explosive volcanic activity for the last c. 2.6 Myr and allow comments to be made on the recurrence times of these large explosive rhyolitic eruptions.

3.3 Introduction

New Zealand's Quaternary volcanoes are known for being highly explosive, producing mainly rhyolitic compositions with several eruptions being associated with the formation of caldera structures (e.g., Houghton et al., 1995; Wilson et al., 1995a). Active volcanism is still characteristic for the North Island today and a potential future eruption poses a threat to New Zealand's population (e.g. Houghton et al., 1987; Newnham et al., 1999). In order to understand the hazardous potential of New Zealand's Quaternary volcanoes, and to support future risk assessments, it is crucial to investigate the long-term evolution of its volcanic systems (Connor et al., 2001).

The volcanic evolution of the Taupō Volcanic Zone (TVZ) for the last ~61 ka has been intensely studied and is well established, mostly based on the onshore tephra record (e.g. Barker et al., 2021; Danišik et al., 2020; Houghton et al., 1995; Shane, 2000; Smith et al., 2005). However, due to a number of factors including post-depositional erosion and burial of deposits by subsequent eruptions the onshore record > ~61 ka is likely to be incomplete. The reconstruction of the early volcanic history of the TVZ lacks continuity because many studies focus on specific eruptions or tephra deposits and comprehensive studies of the continuous eruptive history of the TVZ (>61 ka) have only recently become the focus of research (e.g. Hopkins et al., 2021b; Pank et al., 2023b; Pittari et al., 2021).

Global tephra studies (e.g. Carey, 2000; Carey and Sigurdsson, 2000; Carter et al., 1995; Freundt et al., 2022; Keller et al., 1978; Kutterolf et al., 2008a; 2008b; 2021a; 2021b; Ledbetter, 1985; Lowe, 2014; Schindlbeck et al., 2016a; 2016b; 2018) have shown, that none-erosive marine and lacustrine environments have the potential to provide a more complete record of widely distributed volcanic ash from large eruptions. This is dominantly due to the high preservation potential in these environments, which are commonly distal from the source volcanoes and are therefore often not impacted by subsequent eruptions. However, the distal nature of these depo-centres can also bias the preservation record, for example, to only the largest eruptions, or to only eruptions that occur during favourable weather conditions for preservation. Additionally, deposition of ash-rich material into the marine environment can be impacted by a number of syn- and post- depositional mechanisms, which can lead to inconsistencies and complexities within the resulting deposits. Therefore, to provide the most comprehensive record possible it is favourable to combine multiple marine core records from a range of locations to create a comprehensive and accurate consolidated record.

The climatic setting of New Zealand with a dominant prevailing Westerly wind, mean marine tephra studies off the east coast of New Zealand have the potential to be an important tool when

building a holistic picture of New Zealand's volcanism. Westerly to south-westerly winds disperse the ash plumes and tephras towards the east, likely leading to an incomplete tephra record on land, but a potentially more complete record offshore (e.g. Allan et al., 2008; Alloway et al., 2005; Barker et al., 2019; Hopkins et al., 2020; Lowe, 2011; Shane et al., 1996; 2000; 2006).

In this study we present the major and trace element geochemistry of the Quaternary marine tephra record recovered by IODP Expeditions 375 and 372 (proximal marine tephra record), and we revisit the geochemistry and chronology of the marine tephra samples from ODP Leg 181, IODP Leg 329 and DSDP Leg 90 (distal marine tephra record). We connect and integrate these proximal and distal marine tephra records with the existing terrestrial tephrostratigraphic record of the Quaternary, which ultimately allows us to establish the most complete, integrated tephrochronostratigraphy of New Zealand's Quaternary explosive volcanism.

3.4 Geological setting

Beneath the North Island of New Zealand, the Pacific Plate subducts beneath the Indo-Australian Plate leading to subduction zone related volcanism currently expressed as the Taupō Volcanic Zone (TVZ), but previously seen in the now extinct Coromandel Volcanic Zone (CVZ, e.g. Cole, 1990; Wilson and Rowland, 2016; Figure 3-1 A). The TVZ is a c. 300 km long and c. 60 km wide volcanic system aligned NE-SW in the centre of the North Island, reflecting the northwest-directed subduction (Figure 3-1 A; Houghton et al., 1995; Wilson et al., 1995a; Wilson and Rowland, 2016). It is an active rift arc which extends ~7 mm/yr and is generally characterised by a faulted, thinned crust (~30 km; Smith et al., 2005). The TVZ is known as the world's most frequently active rhyolitic system responsible for the production of at least 10,000 km³ of magma or >90% of the late Pliocene to Quaternary eruptives known in New Zealand (Wilson et al., 1995a). It is associated with thirty-four caldera-forming eruptions from nine prominent rhyolitic volcanic centres (Figure 3-1 B; e.g. Allan et al., 2008; Houghton et al., 1995; Pittari et al., 2021). The nine volcanic centres, partly associated with calderas recognised within the central TVZ include (Figure 3-1 B): Mangakino (1.6 - 0.9 Ma); Kapenga (0.9 Ma to 47 ka); Whakamaru (0.35 - 0.32 Ma); Reporoa (~0.23 Ma); Rotorua (0.32 - 0.22 Ma); Ohakuri (0.44 - 0.22 Ma); Maroa (0.32 - 0.013 Ma); Taupō (0.32 Ma to 1.8 ka); and Okataina (0.28 - 0 Ma) (Briggs et al., 2005; Hopkins et al., 2021a; Houghton et al., 1995; Wilson et al., 1995; Lowe et al., 2001, and references therein). Two of these calderas are considered to

be currently active; the Taupō Volcanic Centre (TVC) and Okataina Volcanic Centre (OVC; Figure 3-1 B) (Smith et al., 2005).

The onset of volcanic activity at the TVZ includes a flare-up of andesitic calc-alkaline volcanism, roughly dated to about 2 Ma (Carter et al., 2003; Houghton et al., 1995; Stipp, 1968; Wilson et al., 1995a; Wilson and Rowland, 2016). However, a recent study by Pittari et al. (2021) proposes three stages of temporal transitional evolution from CVZ to TVZ between 3.0 - 1.9 Ma, c. 1.9 - 1.6 Ma, and c. 1.6 - 0.9 Ma, with each stage representing a new configuration of volcanic centres and fields in the arc and intraplate setting. Therefore, at present, the exact age of transition from volcanic activity located at the CVZ to TVZ is yet to be resolved.

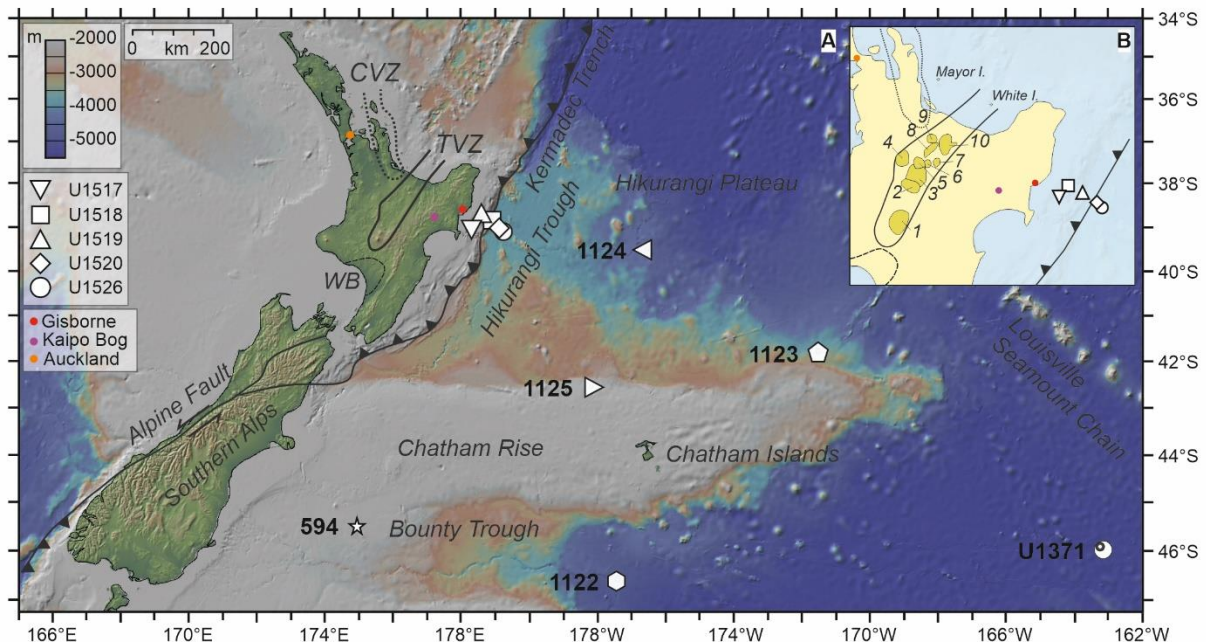


Figure 3-1 Overview map of New Zealand with simplified tectonic setting and volcanic centres of the TVZ.

A) Map indicating DSDP, ODP and IODP drilling sites as well as the locations of the Taupō Volcanic Zone (TVZ) and Coromandel Volcanic Zone (CVZ). “WB” (black dashed line) is the location of the Whanganui Basin on the North Island. Map created with GeoMapApp, GMRT (Ryan et al., 2009). The inset (B) shows volcanic centres or calderas of the TVZ in the centre of the North Island (modified after Briggs et al., 2005 and Hopkins et al., 2021a and references therein); 1: Tongariro Volcanic Centre (TgVC), 2: Taupō (0.32 Ma to 1.8 ka), 3: Whakamaru (0.35-0.32 Ma), 4: Mangakino (1.6-0.9 Ma), 5: Maroa (0.32 Ma to 16.5 ka), 6: Ohakuri (0.44-0.22 Ma), 7: Reporoa (0.23-0.21 Ma), 8: Kapenga (0.9 Ma to 47 ka), 9: Rotorua (0.32-0.22 Ma), 10: Okataina (0.28-0 Ma). Ages are from Briggs et al., 2005; Hopkins et al., 2021a; Houghton et al., 1995; Lowe et al., 2001; Wilson et al., 1995, and references therein.

3.4.1 Location of drill sites

The drill sites of IODP Expedition 375 (U1518, U1519, U1520, U1526) are located along a transect offshore of the North Island of New Zealand, covering different areas of the subduction margin (Figure 3-1). Drill Site U1517 (IODP Exp. 372) is located slightly south of Site U1519. The drill sites of ODP Leg 181 (Sites 1122, 1123, 1124, 1125; Figure 3-1) are located on the incoming Pacific Plate far offshore to the E and SSE of New Zealand. DSDP Leg 90 Site 594 is located south of the North Island about 800km south of Gisborne and Site U1371 (IODP Leg 329) is the southeasternmost drill site located about 1750 km SE of Gisborne and c. 840 km SE of Site 1123 (Figure 3-1). A detailed description of the drill sites including recovered lithologies and tephra deposits are reported in Pank et al. (2023a).

3.5 Previous Quaternary tephra studies

3.5.1 Onshore tephrostratigraphy

The field of tephra studies, pioneered by Paul Froggatt and David J. Lowe, has a long history in New Zealand and many late Quaternary volcanic deposits are well studied, dated, and geochemically characterised (e.g. Froggatt, 1983; Froggatt and Lowe, 1990; Hopkins et al., 2021b; Lowe et al., 2008; Manning, 1996; Shane, 2000; Smith et al., 2005). A compilation of major (widespread) onland tephra deposits is presented in Table 3-1, however their variable and partly unknown eruption sizes do not ensure a widespread deposition in the marine environment east to southeast of New Zealand. At several locations on North Island, New Zealand, undisturbed sediment successions with numerous intercalated tephra beds comprise fragments of continuous onland volcanic records representing different time periods, e.g. in the Whanganui Basin, at Kaipo Bog, in the Auckland maars, or around Hawke Bay (Table 3-1, e.g. Lowe et al., 1999; 2013; Naish et al., 1996; Pillans et al., 2005; Shane et al., 1996b; Shane et al., 2003a,b). Some of these intercalated tephra beds form distinctive geochemical or temporal marker horizons on North Island, e.g. Tuhua Tephra (Tuhua Volcanic Centre, Mayor Island) or the Rotoehu ash associated with the Rotoiti ignimbrite (Okataina Volcanic Centre; Table 3-1), providing important stratigraphic context, and thus enabling correlations of volcanic deposits between study areas (e.g. Buck et al., 1981; Cooper et al., 2012; Froggatt, 1983; Froggatt and Lowe, 1990; Hogg and McCraw, 1983; Hopkins et al., 2021a; 2021b; Lowe et al., 1999; Shane et al., 2006; Wilson et al., 1995b; Wilson et al., 2006). Although there are numerous studies about the Quaternary evolution of the TVZ using the tephra deposits, only the volcanic history of the last c. 61 ka is well constrained (e.g. Lowe, 2011; Wilson et al., 2009) because older units

are poorly preserved onland (either buried or destroyed), have poor stratigraphic control with unknown ages, or are biased towards only the largest eruptions (e.g. Table 3-1; Allan et al., 2008; Hopkins et al., 2021a; Shane, 2000; Wilson et al., 1995a). In addition, only limited numbers of geochemical analyses on glass shards, especially of trace element compositions, are available, hindering present and future studies to access and use the data for correlations (Hopkins et al., 2021b).

3.5.2 Previous marine tephra studies

Several deep-sea drilling campaigns have been conducted around New Zealand in order to complement the onshore volcanic record. One of these campaigns (ODP Leg 181) recovered marine sediments with intercalated tephra layers from ~630 mbsf (metres below sea floor) (Carter et al., 1999). The drill sites from ODP 181 (including 1122, 1123, 1124 and 1125) span a large study area (Figure 3-1 A), and have been the subject of a number of tephra-specific studies, identifying key marker horizons (Table 3-1; e.g. Carter et al., 2003; 2004; Alloway et al., 2005; Allan et al., 2008). The analysis of trace element compositions in the study from Allan et al. (2008) allowed the authors to interrogate some of the previous correlations between the marine sediments from ODP Leg 181 sites to onland deposits and/or between holes, generally highlighting the difficulty in confident correlation caused by a lack of trace element analyses published for many of the onshore deposits.

In addition to these large scale drilling campaigns, several smaller studies exist (e.g. gravity coring) including for example studies at the Hikurangi Subduction Margin (HSM), or in the Bay of Plenty (BOP) presenting several intercalated tephra layers (Table 3-1; e.g. Pillans and Wright, 1992; Hopkins et al., 2020; Schwarze et al., 2022, Shane et al., 2006).

3.6 Methods

3.6.1 Deep Sea Drilling Cores

During IODP Legs 372/375 five proximal deep-sea sites (Sites U1517, U1518, U1519, U1520 and U1526) were drilled along a transect across the Hikurangi subduction margin ~40-100 km offshore of the North Island of New Zealand. Macroscopic, discrete tephra layers were sampled onboard resulting in 295 ash-rich samples. In order to have an internally consistent data set the distal deep-sea Sites 1122, 1123, 1124 and 1125 (ODP Leg 181) on the Hikurangi Plateau ~500-1000 km offshore to the (south-) east, were re-visited and sampled at the IODP Gulf Coast

Study II

Table 3-1 Compilation of widespread Quaternary tephra deposits from New Zealand.

Tephra name	Source	Age (cal yr BP±1SD)	Location (onshore/offshore)	Reference
Kaharoa Tephra	Okataina	636±12	Kaipo Bog, N TVZ	3, 4, 32
Taupō T.	Taupo	1718±10	Kaipo Bog, central TVZ, <i>Bay of Plenty</i>	3, 5, 6, 32, 33
Waimihia T.	Taupo	3382±50	Kaipo Bog	3, 7, 32
Whakatāne T.	Okataina	5542±48	Kaipo Bog / N TVZ, <i>Bay of Plenty</i>	3, 7, 32, 33
Eg-6-8 T.	Egmont	5250-5900	NW North Island	21
Tuhua T.	Mayor Island	7637±100	Kaipo Bog, Auckland maars	3, 8, 29, 32
Mamaku T.	Okataina	7992±58	Kaipo Bog, Auckland maars, Bay of Plenty	3, 7, 29, 32, 33
Rotoma T.	Okataina	9472±40	central TVZ / Kaipo Bog, Auckland maars, <i>Bay of Plenty</i>	3, 7, 29, 32, 33
Ōpepe T.	Taupo	10004±122	Kaipo Bog, Auckland maars	3, 7, 29, 32
Ruapehu T.	Tongariro	10500*	S TVZ	22
Poronui T.	Taupo	11195±51	Kaipo Bog	3, 7, 32
Karapiti T.	Taupo	11501±104	Kaipo Bog	3, 7, 32
Okupata T.	Tongariro	11620±190	Kaipo Bog	20, 32
Waihau T.	Okataina	14018±91	Kaipo Bog / N TVZ, Auckland maars, <i>Bay of Plenty</i>	3, 7, 29, 32, 33
Rotorua T.	Okataina	15738±263	Kaipo Bog, Auckland maars	3, 7, 29, 31
Rerewhakaaitu T.	Okataina	17209±249	Kaipo Bog / N TVZ, Auckland maars, <i>Bay of Plenty</i>	3, 7, 29, 32, 33
Okareka T.	Okataina	23455±300	N TVZ, Auckland maars, <i>Bay of Plenty</i>	3, 14, 29, 33
Te Rere T.	Okataina	25171±964	N TVZ, Auckland maars, <i>Bay of Plenty</i>	3, 7, 29, 33
KOT T.	Taupo	25358±162	central TVZ, Auckland maars, <i>ODP Leg 181, GeoB20824-4, Bay of Plenty</i>	3, 9, 25, 26, 27, 29, 33
Omataroa T.	Okataina	28200±630	N TVZ, <i>ODP Leg 181, Bay of Plenty</i>	19, 25, 26, 33
Poihipi T.	Taupo	28446±670	N TVZ, Auckland maars	3, 7, 28, 29
Okaia T.	Taupo	28545±345	central TVZ, Auckland maars, <i>Bay of Plenty</i>	3, 14, 28, 33
Awakeri T.	Okataina	31000±900	N TVZ	3, 10
Mangaone T.	Okataina	31100±1000	NTVZ	3, 10
Hauparu T.	Okataina	35200±1000	N TVZ, <i>Bay of Plenty</i>	3, 10, 33
Maketu T.	Okataina	36100±900	N TVZ, Auckland maars, <i>Bay of Plenty</i>	3, 10, 30, 33
Tahuna T.	Taupo	38400±1700	N TVZ, Auckland maars, <i>Bay of Plenty</i>	3, 10, 30, 33
Ngamotu T.	Okataina	39600±4500	N TVZ	3, 10
Earthquake Flat Ignimbrite	Kapenga	45160±2900	N TVZ	3, 11
Rotoehu Ash / Rotoiti Ignimbrite	Okataina	45170±3300	N TVZ, Auckland maars, <i>ODP Leg 181, Bay of Plenty</i>	3, 11, 25, 30, 33
Ararātā Gully T.	Rotorua?	0.235 Ma	SW North Island	3, 12
Fordell T.	Whakamaru?	0.31 Ma	WB	3
Upper / Lower Griffin Road T.	Whakamaru?	0.3-0.4 Ma	WB	3
Rangitawa T.	Whakamaru?	0.35±0.05 Ma	NW North Island, <i>ODP Leg 181, GeoB20846-1</i>	23, 24, 26, 27
Onepuhi T.		0.57 Ma	WB, <i>GeoB20846-1</i>	1, 17, 27
Kupe T.		0.63±0.10 Ma	WB, S North Island	1, 2, 13, 17
Kaukatea T.		0.63±0.08 Ma	WB, S North Island, <i>ODP Leg 181, GeoB20846-1, GeoB20824-4</i>	1, 2, 13, 17, 26, 27
Kidnappers-B T.	Mangakino	1.06±0.09 Ma	WB, S North Island, <i>ODP Leg 181, GeoB20846-1</i>	1, 2, 26, 27
Potaka T.	Mangakino	1.00±0.02 Ma	WB, S North Island, <i>ODP Leg 181, GeoB20824-4</i>	1, 2, 17, 18, 25
Rewa T.	Mangakino?	1.20±0.14 Ma	WB, S North Island, <i>ODP Leg 181, GeoB20824-4</i>	1, 2, 13, 16, 17, 26, 27
Sub-Rewa T.		1.201 Ma	WB, <i>ODP Leg 181, GeoB20824-4</i>	1, 26, 27
Overlying Mangapipi T.	Mangakino?	1.534 Ma*	WB, <i>ODP Leg 181</i>	1, 25
Mangapipi T.	Mangakino	1.51±0.16 Ma	WB, S North Island, <i>ODP Leg 181</i>	1, 2, 13, 16, 17, 25
Ridge T.		1.56 Ma	WB	1
Pakihikura T.	Mangakino	1.58±0.08 Ma	WB, S North Island, <i>ODP Leg 181</i>	1, 2, 16, 17, 26
Birdgrove T.		1.6 Ma	WB	1
Mangahou T.		1.63 Ma	WB	1
Maranoa T.		1.63 Ma	WB	1
Ototoka T.		1.72±0.32 Ma	WB, <i>ODP Leg 181</i>	1, 17, 26
Table Flat T.		1.71±0.12 Ma	WB, <i>ODP Leg 181</i>	1, 26
Vinegar Hill T.		1.75±0.20 Ma	WB	1
Waipuru T.		1.79±0.15 Ma	WB	1
Hikuroa Pumice Member		2.00±0.6 Ma	E North Island	3, 15
Lower Papamoa Ignimbrite	Tauranga (CVZ)	2.4 Ma	NW North Island	15

Table 3-1 continued

Tephra highlighted in bold font were identified in the marine sediments. * this study; ¹ Pillans et al. (2005); ² Shane et al. (1996a); ³ Hopkins et al. (2021b); ⁴ Hogg et al. (2003); ⁵ Hogg et al. (2012); ⁶ Hogg et al. (2019); ⁷ Lowe et al. (2013); ⁸ Lowe (2019); ⁹ Vandergoes et al. (2013); ¹⁰ Danišik et al. (2020); ¹¹ Danišik et al. (2012); ¹² Bussell et al. (1997); ¹³ Rees et al. (2019); ¹⁴ Peti et al. (2021); ¹⁵ Hopkins and Seward (2019); ¹⁶ Pittari et al. (2021); ¹⁷ Rees et al. (2020); ¹⁸ Shane et al. (1996b); ¹⁹ Smith et al. (2002); ²⁰ Lowe et al. (2008); ²¹ Lowe (1988); ²² Moebis et al. (2011); ²³ Holt et al. (2010); ²⁴ Lowe et al. (2001); ²⁵ Allan et al. (2008); ²⁶ Alloway et al. (2005); ²⁷ Schwarze et al. (2022); ²⁸ Alloway et al. (2007); ²⁹ Sandiford et al. (2011); ³⁰ Peti et al. (2020); ³¹ Shane et al. (2003a); ³² Lowe et al. (1999); ³³ Shane et al. (2006). WB: Whanganui Basin; N: northern; NW: northwestern; S: southern; SW: southwestern; E: east

Repository at Texas A&M University, College Station, Texas resulting in another ~250 ash-rich samples, complementing the proximal tephra record of IODP Exp. 372/375. Additionally, Sites 594 (DSDP Leg 90) and U1371 (IODP Leg 329) were resampled at the Gulf Coast Repository providing another eight tephra samples. In total, our Quaternary data set includes ~550 ash-rich samples.

3.6.2 Sample preparation

The marine tephra samples were disaggregated in an ultrasonic bath, if necessary, and then wet-sieved with demineralised water into different grain size fractions (63 - 125 μm , >125 μm and where necessary 32 - 63 μm fraction) and subsequently dried at ~50°C for at least twelve hours. The 63 - 125 μm fraction is used for the compositional analysis of glass shards with the electron microprobe (EMP) and Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS). The samples were embedded with epoxy resin in predrilled holes on acrylic tablets which were then initially ground on sandpaper (four grit sizes, each about two minutes) to remove excess resin, bubbles or scratches. A smooth surface of the samples was ensured by polishing the tablets with the TegraPol-31 (Struers) using three diamond suspensions (9 μm , 3 μm and 1 μm) and corresponding polishing discs for four minutes each. Before the analysis with the EMP or LA-ICP-MS the tablets are carbon-coated. To guarantee that the same glass shards are measured for major and trace element compositions backscattered electron images are taken at the microprobe and the glass shards of interest are unequivocally labelled.

U-Pb dating of zircons from selected samples was carried out at the University of Heidelberg. Sample fractions were treated using hydraulic and magnetic separation followed by hand-picking of zircon under the microscope.

3.6.3 Analytical Techniques

3.6.3.1 EPMA and data reduction

Major and minor element compositions were analysed at GEOMAR Helmholtz Centre for Ocean Research Kiel, on a JEOL JXA 8200 wavelength dispersive EMP following modified methods after Kutterolf et al. (2011) (e.g. 6 nA current, 10 μm electron beam, alkalis analysed first to avoid their loss). The accuracy was monitored by repeated measurements every 80 individual glass shard measurements using the standard materials Lipari (Obsidian rhyolite; Hunt and Hill, 2001) and VGA-99 (basalt from Makaopuhi Lava Lake; Jarosewich et al., 1980; 2002). The resulting standard deviations are generally <6% for all oxides except for MnO (Supplementary Tables S4 and S5). Where possible 20 glass shards were analysed per sample and then averaged in order to geochemically characterize each individual tephra layer. Analyses with total oxides less than 90 wt% were usually excluded from the data set to avoid effects of alteration. In addition, accidentally measured microcrystals, for example very high Al_2O_3 contents of >20 wt%, and geochemical outliers (exotic compositions when compared to the average of each tephra layer) were excluded from the final data set. The data was normalized to 100% to eliminate possible effects of post-depositional hydration and/or deviations of the electron beam (e.g. defocused beam).

For the Quaternary, a total of ~10,358 individual glass shard analyses from 546 samples were performed and ~9,061 analyses passed the quality check as described above.

3.6.3.2 LA-ICP-MS and data reduction

About 198 samples were selected for trace element analysis and per sample approximately five glass shards were measured, resulting in a total number of ~950 individual analyses. The samples were analysed at the Institute of Earth Sciences, Academia Sinica in Taipei, Taiwan using a Photon Machines Analyte G2 (193 nm) excimer laser ablation system linked to a high-resolution ICP-MS (Agilent 7900) and following the methods described in Kutterolf et al. (2021a). The spot size was set to 24–30 μm using 5–10 J/cm^2 energy density at 4–10 Hz repetition rate. Blank acquisition was 45 seconds followed by typical ablation times of ~75 seconds. Data reduction was performed using GLITTER © software (van Achterberg et al., 2001) immediately following each ablation analysis. Calcium and silica concentrations previously measured by EPMA on the same glass shards were used as internal standard to calibrate the trace element analyses. The accuracy was monitored by repeated analysis of the international glass standard BCR-2G after every ten sample measurements. Repeated

measurements of standard material assured the correction of matrix effects and signal drift of the LA-ICP-MS just as it monitors the differences of the ablation efficiency between sample and reference material (Günther et al., 1999). The reference material NIST SRM612 was used for external calibration (Supplementary Table S6), with reference data taken from Norman et al. (1996). The limits of detection (LOD) for most trace elements is <100 ppb, for rare earth elements (REE) the LOD is ~10 ppb. The analytical precision compared to the international glass standard BCR-2G is generally better than 10% (except for Ta) over the entire measurement period (Supplementary Table S7).

3.6.4 U-Pb zircon geochronology

Zircon crystals were embedded in epoxy at Heidelberg University, Germany, sectioned using SiC and diamond abrasives, and imaged using a Gatan MiniCL cathodoluminescence detector (LEO 440 scanning electron microscope). Zircon U-Pb dating was conducted on a CAMECA IMS 1280-HR secondary ion mass spectrometer (SIMS) with a ~20 nA primary beam focused to a ~40 µm diameter spot. Relative sensitivities of U and Pb were calibrated using zircon reference Temora 2 (417 Ma, Black et al., 2004) and individual $^{206}\text{Pb}/^{238}\text{U}$ ages were calculated after correction for common Pb using measured ^{207}Pb with a zero-age model Pb composition of $^{207}\text{Pb}/^{206}\text{Pb} = 0.836$ (Stacey and Kramers, 1975). The ages were adjusted for initial disequilibrium with correction factors $D_{230} = 0.2$ and $D_{231} = 3$. Abundances for U and Th were estimated from measured $^{238}\text{U}/^{94}\text{Zr}_2\text{O}$ and Th/U with relative sensitivities of 0.00689 and 0.690 determined on reference zircon 91500 and Temora 2, respectively. Accuracy was confirmed through replicate analyses of reference zircon 91500 for which an average of 1064 ± 8 Ma ($n = 3$) was obtained, in close agreement with the reported age of 1065 Ma (Wiedenbeck et al., 1995). The U-Pb ages are reported in Table 3-2 and in the Supplementary Tables S2 and S3.

3.6.5 Identification of primary and reworked marine tephra layers

The reconstruction of a most complete eruption chronology of Quaternary volcanism in New Zealand requires inclusion of primary tephra only, therefore all tephra deposits identified were assessed and identified as either primary or re-worked. The geochemical composition in combination with the visual appearance of each tephra sample were checked for homogeneity, first individually, and subsequently within the context of the core and neighbouring tephra layers to avoid incorporation of reworked tephra. Tephra with homogeneous glass compositions are potentially primary, whereas those with mixed and genetically unrelated glass compositions

(e.g., intra-sample variations of >0.5 wt%) are interpreted as reworked deposits. In general, tephra layers with mixed geochemical signatures are likely to be caused by reworking of volcanic material. However, we classified several geochemically bimodal and zoned tephra layers as primary based on the details outlined below. Bimodal tephra layers are characterised by clearly distinguishable geochemical groups, whereas analysed glass shards of compositionally zoned tephra layers form a systematic geochemical trend potentially reproducing parental differentiation trends or cogenetic relationships. Independently, the primary origin of these compositionally bimodal or zoned tephra layers is also constrained by the overall integrity (e.g. stratigraphic context, and visual appearance). In addition, most of the bimodal and zoned tephra layers are correlated between several distant drill sites, supporting their primary origin.

In sediment intervals with repeatedly intercalated, geochemically homogeneous tephra layers, the lowermost or most discrete tephra layer is usually characterised as primary, whereas the subsequent tephra layers are characterised as reworked. These subsequent layers are often identified by a larger proportion of microfossils and lithic clasts to glass shards within the deposit. Where necessary, or when in doubt, the mineralogic and volcanoclastic components of the samples were classified and compared, in order to exclude reworked tephra. This thorough screening of individual tephra layers and their assignment to categories of “primary” or “reworked” ultimately results in a comprehensive eruption chronology.

3.6.6 Tephra ages

Indirect and direct dating methods were used to establish marine tephrostratigraphic age models. Indirect ages for the cores are obtained from published studies, including those focussing on radiocarbon dating (Barnes et al., 2019b), biostratigraphy (Crundwell and Woodhouse, 2022a, 2022b; Woodhouse et al., 2022), and paleomagnetic data (Carter et al., 1999a, 1999b; Wallace et al., 2019b). Direct dating was undertaken by this study through U-Pb zircon analysis.

The direct and indirect age constraints are used to calculate sedimentation rates and produce an age-depth model, allowing us to calculate approximate ages for each marine tephra layer. We note however that the calculated indirect ages of the marine tephra layers are highly dependent on the precision and resolution of the shipboard or post-cruise biostratigraphy combined with paleomagnetic datums.

Between two key horizons we applied linear interpolation resulting in average sedimentation rates throughout the sediment record. Kutterolf et al. (2021b) propose that this method results

in a tephra age uncertainty of ~1 to 14% of their age, which is generally comparable to the analytical error of direct age methods like U-Pb dating or better. We note that the sedimentation rates, are most likely an overestimate due to a number of factors including: (1) small-scale drilling disturbances and (2) small-scale reworking leading to excess sediment in the cores, and (3) the thickness of the tephra layers not being removed from the record. We have chosen not to remove these “event horizons” in line with previous contributions to the deep-sea drilling program. These studies suggest the cumulative thickness of tephra layers (~30 metres) compared to the entire sediment recovery (~3500 metres) is negligible (<1%) and that the resulting ages would still be within the analytical error of direct dating methods.

In addition to creating new age-depth models for the IODP Exp. 375 and 372 cores, we reassessed the age-depth models for the existing cores. The quality of the age models varies from site to site. For example, the Sites 1122, 1125, U1371 and 594 are poorly studied and so have relatively poor age constraints, whereas sites U1520, 1123 and 1124 are well studied with solid age models due to the combination of different dating methods (e.g. Allan et al., 2008; Alloway et al., 2005; Barnes et al., 2019b; Carter et al., 1999b; Carter et al., 2003; Crundwell and Woodhouse, 2022a, 2022b; Woodhouse et al., 2022).

We found that previous tephra studies often use non-uniform depth units (metres below sea floor, “*mbsf*”; metres composite depths, “*mcd*”; revised metres composite depths “*rmcd*”), and detailed explanations on how these sediment/tephra depths were established are often missing leading to an inability to compare the records accurately. For example, a composite stratigraphy exists for Site 1123 using splices of three drilled holes with the age model developed for the composite profile. Therefore, the sediment/tephra depths between the individual drilled holes and the composite profile are often not the same with up to several meters of disparity. As a result, the associated depths and age models of the composite profile cannot be adopted for the individual hole depths (see Table 12 in Carter et al., 1999b). Therefore, in order to allow comparison of the existing records to the IODP Exp. 375 and 372 record, we have adjusted the depths of all ODP Leg 181 cores from all sites and holes. For each site each sediment interval was corrected for its offset in respect to the composite profiles. The offsets vary strongly between the recovered sediment intervals, ranging from only a few centimetres to many metres. For example, in Hole 1123A sediments in the interval from 25.1 to 34.7 mbsf have to be corrected for -2.44 m in comparison to the composite site stratigraphy, whereas the offset in the interval from 82.1 to 91.73 mbsf is roughly 7 m. In Hole 1124D sediments in the interval from 22.6-31.97 mbsf have to be corrected for an offset of -3.62 m, and sediments between 70.1-79.1 mbsf have an offset of 3.16 m (Shipboard Scientific Party ODP Leg 181, 1999a, 1999b, 1999c).

However, the resulting age difference is mostly within the analytical error of direct age dating methods (up to ~100 ka) and thus, for the purpose of our study, negligible. In addition, our calculated tephra ages are in good agreement with a recent study of Crundwell and Woodhouse (2022a) who established a detailed biostratigraphic framework between 0 to 1.2 Ma for Site 1123.

The resulting age models are complemented and verified with U-Pb zircon ages of selected marine tephra layers from Site U1520 or sediment intervals from Site U1518, and unambiguous correlations to dated onshore key tephra deposits (Table 3-2 and Supplementary Table S1). Deviations between indirect and direct ages can be explained by 1) the U-Pb zircon ages most likely do not represent eruption ages, but the usually older crystallisation ages of the analysed zircons, and 2) U-Pb zircon analyses from Site U1518 were not specifically analysed from tephra layers, but from sediments above or below the tephras. Generally, the direct and indirect dating results match well or are within the analytical error of each other (Table 3-2).

3.6.7 Correlation techniques and establishment of volcanic events

The tephra layers were correlated based primarily on their geochemistry, ages and stratigraphic relationships, supported by sedimentary structures, deposit colours, and where applicable the shape, vesicularity and vesicle texture of glass shards and pumiceous fragments, and the mineral content of the tephra layers. All correlations are confirmed by their characteristic geochemical fingerprint by using discrimination diagrams based on major and trace element compositions and their ratios. If the compositions of the tephra layers overlap within analytical error the correlation is accepted. If more than three to four geochemical values (majors, traces or ratios) do not overlap a correlation is dismissed, as recommended by previous tephra studies (e.g. Kutterolf et al., 2021a).

All correlated marine tephra layers (between holes, sites and to onshore correlatives) are summarised in volcanic events labelled from *s1* to *s98* (Table 3-2). Volcanic events which include geochemically bimodal tephra layers are highlighted with an asterisk, e.g. *s97** (Table 3-2). In addition, 67 marine tephra layers were not correlated. Each of them is interpreted as an individual volcanic event, labelled *u1* to *u67* (Supplementary Table S1).

3.7 Tephra inventory

Recovered tephras are intercalated in hemipelagic (IODP Exp. 375) to pelagic (mainly ODP Leg 181) marine sediments. For discrete tephra layers the thickness varies from <1 to 90 cm,

but ash-pods and intervals of dispersed tephra in the marine sediments occur throughout the cores. Intact, discrete tephra layers (examples shown in Figure 3-2 C-E) were sampled at the same priority as pods or disturbed layers (Figure 3-2 A, B and F). Most tephra layers are light grey, slightly pinkish, yellowish to dark grey and black in colour and have sharp lower contacts to the surrounding sediment and more diffuse upper contacts, often caused by bioturbation or erosion. The analysed glass shards are mostly fresh and transparent with varying textures from highly vesicular to pumiceous with tubular and elongated bubbles (Figure 3-2 G, I), or blocky, cusped, flat and y-shaped (Figure 3-2 J) shards with few vesicles only.

In total, 550 Quaternary ash-rich deposits were sampled, and of these 331 were identified as primary tephra layers (Supplementary Table S1). The geochemical compositions of all Quaternary tephra are reported in the Supplementary Tables S1, S8 - S18, and were previously published in an IODP Data Report (Pank et al., 2023a).

The Quaternary tephra deposits are dominated by rhyolites with ~74.0 to 78 wt% SiO₂ and 7 to 8.5 wt% Na₂O+K₂O (Figure 3-3 A). Roughly two geochemical groups within the rhyolitic field are present (Figure 3-3 B) and we define a SiO₂-poor rhyolitic tephra group between ~74 - 76.5 wt%, with Na₂O+K₂O between 7.5 - 8.5 wt% (multivariate kernel density estimation of ~0.2 to 0.3), and a SiO₂-enriched rhyolitic tephra group (~77.5 wt%), which has slightly lower alkalis with ~7.5 - 8.0 wt% Na₂O+K₂O (multivariate kernel density estimation of ~0.55; Figure 3-3 B). In addition, a number of andesitic, dacitic and trachytic tephra are present in the proximal drill sites only (Figure 3-3 A; Supplementary Table S1) dated at c. 900 ka and <200 ka.

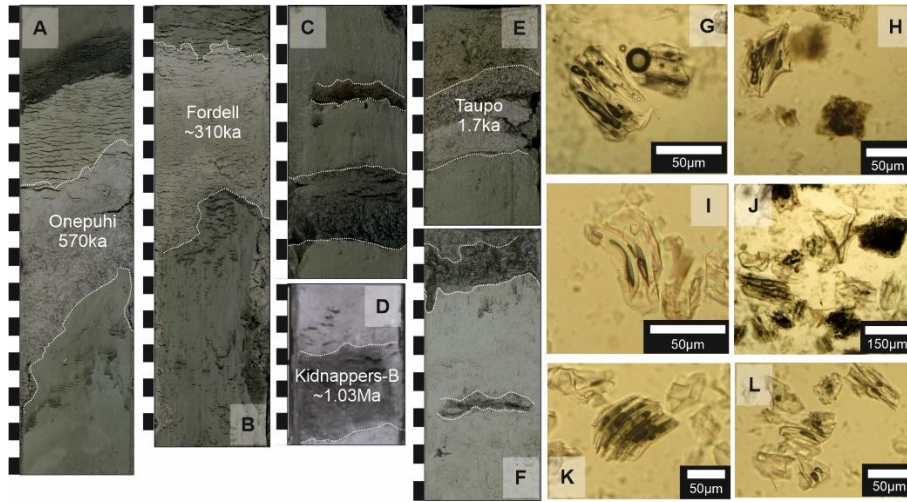


Figure 3-2 Photographs of selected tephra layers and smear slide microphotographs of glass shards.

A) Felsic tephra layer disturbed by drilling at the bottom and top, in interval U1518E-2H-1, 107-134 cm further correlated to Onepuhi tephra. B) Disturbed felsic tephra layer in interval U1520D-25F-2, 0-26 cm correlated to Fordell tephra. C) Two mafic ash layers in interval U1520D-2H-3, 70-84 cm. The upper tephra layer is reworked from the primary tephra layer at the bottom. D) Felsic tephra layer 1124D-2H-5, 140-150 cm correlated to the terrestrial Kidnappers-B tephra. The contacts to the surrounding sediments are relatively undisturbed. E) Reversely graded Taupō tephra in interval U1519E-1H-2, 0-12 cm, with sharp contacts at the bottom and top. F) Two felsic tephra layers in interval U1526B-3H-5, 0-15 cm. The layers are geochemically distinct and considered as primary tephra. G) Blocky glass shard with elongated vesicles in sample U1518E-2H-4A, 29 cm. H) Blocky glass shard with elongated vesicles in sample U1520D-2H-3A, 75 cm. I) Curved glass shard with elongated vesicles in sample U1519C-16R-4A, 69 cm. J) Tubular pumices, cusped glass shard, and blocky glass shards in sample U1518E-5HA-1, 40 cm. K) Tubular pumice in sample U1520D-26F-2A, 20 cm. L) Variety of glass shards, most with elongated vesicles, in sample U1520D-26F-2A, 20 cm.

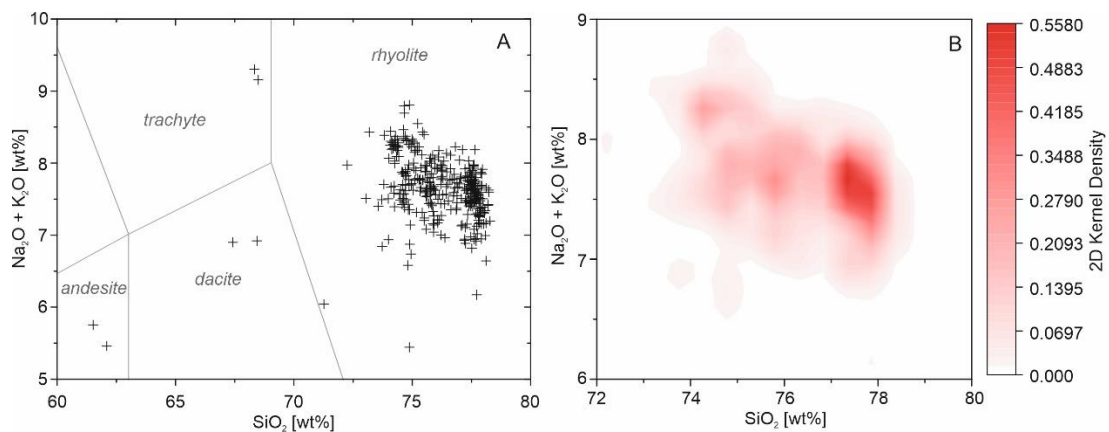


Figure 3-3 TAS diagram and multivariate kernel density diagram.

A) Total Alkali versus Silica diagram after Le Maitre et al. (2002) showing the average geochemical compositions of all primary marine tephra layers from all drill sites. Rhyolitic tephras clearly predominate the Quaternary marine tephra inventory. B) Multivariate kernel density diagram graphically shows the distribution of rhyolitic marine tephras as a density function. This approach reveals roughly two silica groups, a high and a low SiO_2 group.

3.7.1 Marine tephra correlations

Geochemical fingerprinting (major and trace element compositions and ratios), as well as the stratigraphic contexts and age models of the individual sites, was used to establish (isochronous) tie-lines between the cores. Following this approach, 254 tie-lines between individual marine tephra layers across the study area are established. These tie-lines of correlated marine tephra layers between different holes and sites are summarised as volcanic events (*s1* - *s3*, *s5*, *s9* - *s12*, *s14* - *s33*, *s35** - *s57*, *s59* - *s80*, *s82* - *s87*, *s89** - *s98*; Table 3-2, Figure 3-5). Most of these events were established between cores of either proximal or distal sites, however some correlations were established by linking tephra layers from proximal to distal (e.g., *s23**, *s30*, *s36*, *s44*, *s65*, *s71**, *s89**; Table 3-2).

In the following, we outline exemplars for the correlation process.

The youngest volcanic event *s1* was correlated between two proximal drill sites of IODP Exp. 375 in Holes U1519E and D, and Hole U1520D (Table 3-2) and is indirectly dated (sedimentation rates based on biostratigraphy; see subsection 3.6.6) to c. 1.7 ka. The tephra layers of volcanic event *s1* (U1519D-1H-2, 15-17 cm, U1519E 1H-2 7-9cm and U1520D-1H-1, 119-120 cm) are characterised by 75.5 wt% SiO₂, 0.2 wt% MgO, and 1.5 wt% CaO (Supplementary Table S1). Furthermore, all three tephra layers are reversely graded with fine ash (white to beige) at the bottom and coarse material at the top, with a thickness of roughly 3 to 4 cm (Figure 3-2 E).

The second volcanic event *s2* (Table 3-2) was correlated between the same drill sites (Holes U1519E/D and U1520D) as volcanic event *s1* and is located roughly 2 to 3 metres deeper in the sediments, corresponding to an age of c. 3.4 ka (sedimentation rates based on biostratigraphy; see subsection 3.6.6). It differs from volcanic event *s1* in its visual appearance and in the major element compositions, e.g. slightly enriched in silica (~76.1 wt% SiO₂; Figure 3-6 A₁) and slightly more depleted in CaO (~1.3 wt%). Tephra layers of volcanic event *s2* consist of coarse to fine-grained (bottom to top) white to beige ash, with a thickness of ~5.5 cm (U1520D-1H-3, 26-30 cm). Both volcanic events (*s1* and *s2*) have very similar trace element compositions (Supplementary Table S1), potentially suggesting a common source volcano.

Volcanic events *s1* to *s36* (Table 3-2) are all established between cores located east to southeast of the North Island (Figure 3-1 A).

The first volcanic event to the most distal southwestern study area is *s37*, connecting Holes U1518E and 1125B and Site 594. This volcanic event is indirectly dated to c. 791 ka and is of rhyolitic composition.

The first correlation to the most distal south-easterly Site U1371 is volcanic event *s38*, indirectly dated to c. 793 ka, and it is correlated to marine tephra layers in Holes 1124C and D (Table 3-2). No correlatives for *s38* are found either in the proximal record of IODP Exp. 375, nor in Site 1123 (Figure 3-1 A).

Volcanic event *s64* is only identified in distal cores, correlated between Holes 1123C, 1124C and D and U1371D and is indirectly dated to c. 1.27 Ma. The rhyolitic tephra layers form a prominent dark grey (base, ~2.5 cm) to grey-brown (~7.5 cm) ash layer with sharp contacts to the surrounding whiteish sediments.

An example for correlations between IODP Exp. 375 and ODP Leg 181 is volcanic event *s65*, which links marine tephra layers from Holes U1519C, U1520D, U1526B, 1123C and 1124D. This event is indirectly dated to c. 1.28 Ma and geochemically characterised as rhyolitic. The tephra is 5 cm thick in the most distal site, light grey to grey and coarse grained.

The oldest established correlation linking the proximal and distal record is volcanic event *s97** which is indirectly dated to c. 2.45 Ma (Table 3-2). Two bimodal and one unimodal tephra layers were correlated between Hole U1520D and Holes A and B of Site 1125. The bimodal tephra layers are rhyolitic with a silica-poor group at ~76.3 wt% SiO₂ and a silica-rich group at ~77.2 wt% SiO₂. The silica composition of the unimodal tephra of Hole 1125B is more or less the averaged composition of the bimodal tephra layers, with 76.8 wt% SiO₂ (Figure 3-4 A).

Volcanic event *s98*, correlated between the holes A and B of Site 1125, is the oldest event in our Quaternary marine tephra record, indirectly dated to c. 2.57 Ma (Table 3-2). The tephra layers are light grey coloured and roughly 5 cm thick. This event is rhyolitic with ~77.4 wt% SiO₂ and slightly enriched K₂O compositions (~3.8 - 3.9 wt%) compared to volcanic event *s97** (Supplementary Table S1), and the minor element compositions are slightly lower (~1.1 wt% FeO, 0.07 wt% TiO₂, 0.04 wt% MgO, and ~0.8 wt% CaO),

3.7.2 Bimodal and compositionally zoned marine tephra

In our marine data set 27 of the 331 primary tephra layers are identified as bimodal and approximately 90 tephra layers are compositionally zoned, assisting and expanding previous observations of New Zealand's bimodal or compositionally zoned volcanism (e.g. Hopkins et al., 2021b; Shane et al., 2008). The overall integrity of the associated tephra layers (e.g.

stratigraphically non-repeating geochemical compositions, discrete layers) indicates that these bimodal and compositionally zoned tephra are primary and that their geochemical signatures might reflect source related processes like geochemical evolution (e.g. Shane et al., 2008). On the other hand, an ultimate proof for the depositional processes of each tephra is beyond the scope of this manuscript. Therefore, we would like to argue that even if these tephra layers are reworked, most of them support correlations and provide stratigraphic lines within the cores, and therefore they are considered as primary deposits.

In the following, we show examples of bimodal and compositionally zoned marine tephra layers and how their geochemical characteristics assist correlations between holes and sites (Figure 3-4).

The tephra layers 1124C-6H-1, 37-39 cm, U1518E-25F-2, 30-32 cm, 594-13H-CC, 0-2 cm and 594A-8H-3, 49-51 cm were correlated and summarised in volcanic event *s71** (Table 3-2). Two clearly distinguishable compositional groups were identified in all four tephra layers at ~77.0 wt% SiO₂ with ~0.8 wt% CaO and at ~75.0 wt% SiO₂ with ~1.1 wt% CaO (Figure 3-4 A). This bimodal composition is visible in most major and minor element oxides (Supplementary Table S1). The correlation of these four tephra layers is supported by the stratigraphic context of the tephra layers.

An example of a bimodal volcanic event established between different holes of the same drill site is *s93** (Table 3-2). The correlated tephra layers are 1124C-7H-5, 92-94 cm and 1124D-6H-1, 142-144 cm. These layers have similar silica compositions (~77.6 wt%) but a consistent geochemical bimodality in all other major and minor element oxides (e.g. CaO with ~1.3 wt% and ~0.9 wt%; Figure 3-4 A).

An example of a more complex correlation is volcanic event *s97** that includes three correlated tephra layers; two bimodal layers, U1520D-54X-2, 3-5 cm and 1125A-6H-5, 71-73 cm, and a unimodal tephra layer 1125B-6H-1, 147-149 cm (Table 3-2, Figure 3-4 A). The bimodal tephra layers have two compositional groups, one at ~77.5 wt% SiO₂ with ~1.2 wt% CaO and one at 76.4 wt% SiO₂ with ~1.4 wt% CaO, whereas the unimodal layer has 76.9 wt% SiO₂ with ~1.3 wt% CaO, thus covering the geochemical gap between both compositional groups (Figure 3-4 A).

Compositionally zoned tephra layers occur throughout the Quaternary marine tephra record and due to the systematic geochemical variation of individual glass shard measurements, and following the previously outlined criteria (sub-section 3.6.5), we characterise them as primary.

For example, the glass shards of the volcanic event s65 (correlated between marine tephra layers U1519C-20R-3, 29-31 cm, U1520D-48X-CC, 22-24 cm, U1526B-3H-5, 1-3 cm, 1123C-6H-4, 96-95 cm, 1124D-4H-2, 116-118cm; Table 3-2 and Supplementary Table S1) span a broad compositional range from ~73.0 to ~77.5 wt% SiO₂, while the FeO_t compositions trend from ~2.6 to 1.25 wt% with increasing silica (Figure 3-4 B). Interestingly, only the proximal marine tephra deposits correlated with this event record the highest silica concentrations (~76.0 - 77.5 wt%; Figure 3-4 B), and no alternate eruptions are known for the age of this event which is indirectly dated at c. 1.29 Ma (Table 3-2).

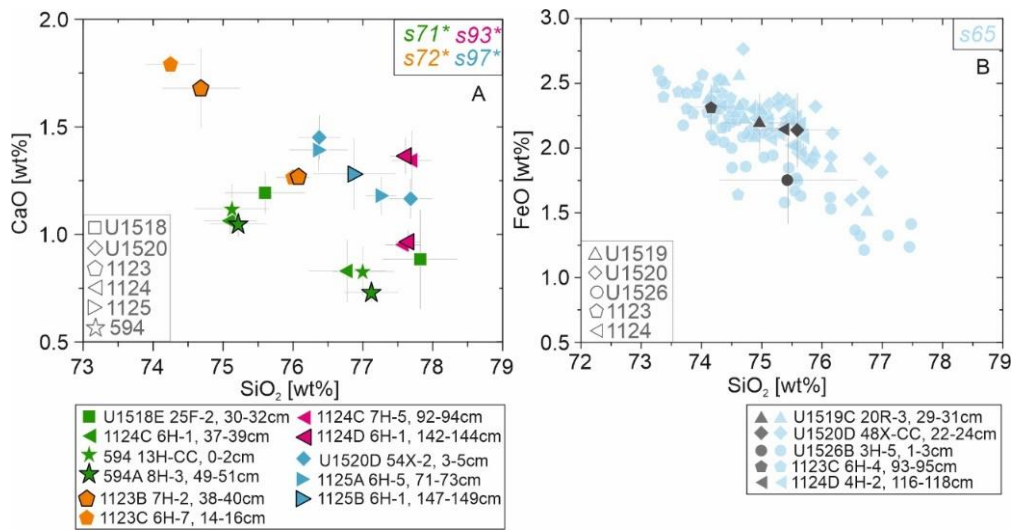


Figure 3-4 Exemplary bimodal tephra layers in (A) and zoned tephra layers in (B).

In (A) average compositions of the tephra layers are shown on a SiO₂ versus CaO diagram, the colours portray volcanic events correlated between tephra layers of different holes (pink and orange signature) or sites (blue and green signature). In (B) geochemical averages (dark grey symbols) with error bars and individual glass shard analyses of volcanic event s65 are shown on a SiO₂ versus FeO_t diagram. Individual glass shard analyses from Pank et al. (2023a) are given in the supplementary tables and shall illustrate the compositional zonation of the tephra layers.

3.7.3 Uncorrelated marine tephra layers

Sixty-seven marine tephra layers could not be correlated either between holes or sites, and each tephra layer is interpreted as individual volcanic event defined as *u1* to *u67* (Supplementary Table S1).

The majority of uncorrelated tephra were identified at Site U1520 Hole D (27 marine tephra layers). Most of these uncorrelated tephra layers occur in specific time intervals, between c. 145 to 213 ka, c. 310 to 319 ka and c. 1.84 Ma (Figure 3-5). In Site 1124 we identified 17 uncorrelated marine tephra layers (Hole A: 2, Hole C: 9 and Hole D: 6), which are distributed across the sediment record. Six uncorrelated tephra layers were identified in Site 1125, equally

distributed between c. 110 ka to 1.4 Ma and Holes A and B. In Hole U1518E five marine tephra layers are uncorrelated, dated at c. 500 - 510 ka, and at c. 1.4 - 1.45 Ma. In Hole U1519C four tephra layers remain uncorrelated (three at c. 909 ka and one at c. 1.3 Ma; Figure 3-5). Another four uncorrelated tephra layers were identified in Hole U1526B and dated to c. 111ka (two tephra), 560 ka, and 1.02 Ma. In Site 1123 (Hole A) three tephra layers are uncorrelated (c. 665 ka, 1.4 Ma and 1.43 Ma), and in Hole U1517C one tephra layer with an age of c. 460 ka is uncorrelated.

3.7.4 Correlations to terrestrial tephra deposits

Of the total 165 Quaternary volcanic events in the marine record, 35 are correlated to known onshore deposits (Table 3-2). In the following we briefly present the established correlations from youngest to oldest.

Taupō tephra and Waimihia tephra

The youngest identified volcanic events in the marine sedimentary record, *s1* and *s2* (Table 3-2), are correlated to Taupō tephra (Unit Y, c. 1.7 ka; Table 3-1; Hogg et al., 2012; Hogg et al., 2019) and Waimihia tephra (Unit S, c. 3.4 ka; Table 3-1; Lowe et al., 2013) respectively, both derived from Taupō Volcanic Centre (TVC; Figure 3-1 B). Due to the same volcanic source these deposits share several geochemical similarities in major and trace element compositions (Figure 3-6 A₁ and A₂) and are therefore best distinguished based on their stratigraphic context. In the marine sediments *s2* is located ~2.5 m deeper than *s1*. In addition, the marine record allows to distinguish between both deposits based on their grain size characteristics. The marine tephra layers correlated to Taupō tephra (*s1*) show a reverse gradation, with fine material at the bottom and coarse material at the top (Figure 3-2 E), whereas the tephra layers correlated to Waimihia tephra (*s2*) are normally graded.

Whakatāne tephra

Volcanic event *s3* (Table 3-2) is correlated to Whakatāne tephra (c. 5.5 ka; Table 3-1; Lowe et al., 2013) derived from Okataina Volcanic Centre (OVC; Figure 3-1 B). Hopkins et al. (2021b) identified a geochemical difference in major element oxides between proximal (e.g. ~77.0 - 77.5 wt% SiO₂) and distal (e.g. ~78.0 - 78.5 wt% SiO₂) deposits of Whakatāne tephra. The marine tephra layers of *s3*, with ~78.0 wt% SiO₂, correlate best with the distal geochemical signature of Whakatāne tephra (Figure 3-6 A₁ and A₂). Based on the trace element compositions of volcanic event *s3*, which compositionally overlap with the proximal signature of Whakatāne

tephra (no trace element compositions available for the distal unit), we conclude that the trace element compositions show no geochemical variance with increasing distance to source.

Eg-6, Eg-7, Eg-8 tephra

Volcanic event *s4* comprises a trachytic tephra layer from Hole U1520D (Table 3-2) and is linked to onshore correlatives of Taranaki Maunga, either to Eg-6 (5.25 ka), Eg-7 (5.85 ka), or Eg-8 (5.2 - 5.9 ka; Table 3-1; Figure 3-6 B₁ and B₂; Lowe, 1988). Eg-6 is described as a yellow fine ash, Eg-7 as a fine-medium ash of greyish-brown colour and Eg-8 as an indistinct pale-yellow fine ash, and all tephra deposits are <1 cm in the Waikato region (Lowe, 1988) south of Auckland (Figure 3-1 A). Our marine tephra is ~1 cm thick, although slightly disturbed by drilling, fine grained and light grey to yellowish in colour. A more precise correlation to either Eg-6, -7 or -8 is not possible due to very limited existing geochemical data.

Rotoma tephra

Volcanic event *s5* (Table 3-2) is established between Holes U1520D and U1526B and is further correlated to Rotoma tephra (OVC, c. 9.47 ka; Lowe et al., 2013; Figure 3-6 A₁ and A₂). Rotoma tephra is characterised by high SiO₂ compositions (~78 wt%) and the proximal and distal deposits are described as homogeneous (Hopkins et al., 2021b).

Ōpepe tephra

We identified Ōpepe tephra (c. 10 ka, TVC; Lowe et al., 1999; Hopkins et al., 2021b) at Hole U1520D (Figure 3-6 C₁ and C₂). Volcanic event *s6* is indirectly dated to 10.4 ka, and a ~10 cm thick fine to coarse grained volcanic ash layer.

Ruapehu tephra

Volcanic event *s7* comprises one tephra layer from Hole U1520D of andesitic composition which is correlated to Ruapehu tephra from Tongariro Volcanic Centre (c. 10.5 ka, TgVC; Moebis et al., 2011; Figure 3-6 B₁ and B₂). The indirect age of the marine tephra with c. 15.3 ka is slightly older than the proposed age in literature (Tables 3-1 and 3-2).

Okupata tephra

Okupata tephra (c. 11.6 ka; Lowe et al., 1999; 2008) was erupted from TgVC and was identified in Hole U1520D (volcanic event *s8*) as a 5.5 cm thick, black ash layer. The indirect age of the dacitic tephra layer U1520D-4H-4, 117-119 cm is c. 19.5 ka, however the age model within

this sediment interval is less reliable due to several small-scaled turbidites. Despite the age difference, the stratigraphic context and unique geochemical composition support a correlation to Okupata tephra (Figure 3-6 B₁ and B₂).

Kawakawa/Oruanui (KOT) tephra

One of the youngest known caldera-forming events of New Zealand's Quaternary volcanism is the Oruanui eruption (c. 25.4 ka, TVC; Table 3-1), interpreted as one of the two biggest eruptions over the last 230 kyr in New Zealand (Allan et al., 2008). The eruption is well studied and generated plinian and phreatoplinian fall deposits, dispersing volcanic ash >1000 km from the vent (Wilson, 2001; Smith et al., 2005). However, in the marine sedimentary record we identified KOT tephra in two locations only, summarised as volcanic event *s9* (Figure 3-6 C₁ and C₂; Table 3-2). In both cores, the KOT tephra forms an inconspicuous layer, fine to coarse grained, and only few cms thick. Interestingly, KOT tephra is thicker in the more distal Hole 1125A (~5 cm) and thinner in the more proximal Hole U1526B (~1 cm). KOT tephra was previously identified Hole 1123A and Site 1124 (Alloway et al., 2005; Allan et al., 2008) but could not be verified in our study, because the sediments were already sampled to exhaustion by the time we sampled at the Gulf Coast Repository (College Station, Texas). Our findings and potential implications are discussed in more detail in section 3.9.3.

Omataroa tephra

The first volcanic event solely identified in the distal drill sites (Sites 1122, 1123 and 1124) is *s10* (Table 3-2), correlated to Omataroa tephra (c. 28.2 ka, OVC; Smith et al., 2002; Figure 3-6 C₁ and C₂). It is a 3 to 4 cm thick, fine grained, white volcanic ash in the marine sediments with an indirect age of c. 34 to 35.8 ka, thus slightly older than the proposed age in the literature.

Rotoehu ash

We identified Rotoehu ash at the distal Sites 1123 and 1124, summarised in volcanic event *s11* (Table 3-2; Figure 3-6 C₁ and C₂). The Rotoehu ash (c. 45.2 ka, OVC; Danišik et al., 2012) is associated with the Rotoiti eruptions, interpreted as the second biggest eruptive events in New Zealand over the last 230 kyr (Allan et al., 2008). At Site 1124 the Rotoehu ash is ~2 cm thick whereas in Site 1123 drilling disturbance led to an unreliable tephra thickness. The indirect age of volcanic event *s11* is c. 50 ka (Supplementary Table S1).

Ararātā Gully tephra

Volcanic event *s13*, indirectly dated to c. 223 ka (Table 3-2), comprises a marine tephra layer from Hole U1520D which is correlated to Ararātā Gully tephra, probably sourced from Rotorua Volcanic Centre (c. 235 ka; Table 3-1; Bussell et al., 1997; Hopkins et al., 2021b). In the marine environment this volcanic event led to the deposition of a 1.5 cm thick, light grey and fine-grained ash of rhyolitic composition (Figure 3-6 D₁ and D₂).

Fordell tephra

Fordell tephra (c. 310 ka, potentially derived from Whakamaru Volcanic Centre; Hopkins et al., 2021b) was identified in the marine tephra record in Holes U1520D and U1526B and is summarised as volcanic event *s17* (Table 3-2, Figure 3-6 D₁ and D₂). This event is indirectly dated at c. 301 ka (Supplementary Table S1) with direct U-Pb ages of 363 ± 33 ka (Table 3-2). At Hole U1520D the rhyolitic Fordell tephra is 9 cm thick, fine-grained and of beige to light brownish colour (Figure 3-2 B).

Lower Griffin Road tephra

Volcanic event *s19* comprises rhyolitic tephra layers from Sites U1520 and 1125 and is correlated to Lower Griffin Road tephra (0.3 - 0.4 Ma, potentially derived from Whakamaru Volcanic Centre; Hopkins et al., 2021b; Figure 3-6 D₁ and D₂). This volcanic event deposited roughly 90 cm of fine to coarse grained white ash at Site U1520 and 20 cm of fine-grained white ash at the distal Site 1125. The indirect age of volcanic event *s19* is c. 319 ka and the direct U-Pb age is 347 ± 22 ka (Table 3-2), potentially allowing to fine-tune the age range of the terrestrial reference.

Rangitawa tephra

We identified Rangitawa tephra (c. 350 ka, Holt et al., 2010) in the proximal marine Sites U1518 and U1520, summarised in volcanic event *s20* and indirectly dated at c. 321 ka (Figure 3-6 D₁ and D₂, Table 3-2). Both tephra layers were slightly disturbed by drilling, therefore no thickness data is available. Our marine tephra correlation now provides trace element compositions for Rangitawa tephra which might facilitate future identification and correlation of this deposit. In previous studies, Rangitawa tephra was identified in ODP Leg 181 Sites (Alloway et al., 2005), however, we could not reproduce this correlation, either due to unclear sample nomenclature in the literature, previous misidentification, or missing sample material.

In addition, Rangitawa tephra was identified in the marine environment south of IODP Exp. 375 sites at Rock Garden east of southern Hawke Bay (Schwarze et al., 2022).

Onepuhi tephra

The volcanic event *s23** represents a correlation between proximal and distal drill sites, which are correlated to Onepuhi tephra (c. 570 ka, unknown volcanic source; Pillans et al., 2005; Figure 3-6 E₁ and E₂). The marine tephra layers of *s23** are indirectly dated at c. 504 ka (Table 3-2) and either bimodal (e.g. marine tephra U1526B-2H-3, 101-103cm) or strongly tend towards a bimodality (e.g. marine tephra U1520D-35X-7, 72-74cm; Supplementary Table S1). A heterogeneous geochemical composition has already been described for terrestrial deposits of Onepuhi tephra (e.g. Hopkins et al., 2021b), assisting a correlation. In our cores Onepuhi tephra is thickest at Site 1125 (~10 cm) and at Site U1518 (~7 cm), and thinner at Site U1526 (~2 cm). Its grain size is coarsest at Site U1518 and finer grained at Site 1125, and of white to pinkish colour (Figure 3-2 A).

Kupe tephra

Kupe tephra (c. 630 ka; e.g. Pillans et al., 2005; Table 3-1) was identified in the marine sediments of Site U1520 and is summarised in volcanic event *s34*, indirectly dated at c. 725 ka (Figure 3-6 E₁ and E₂; Table 3-2). The source volcano of Kupe tephra is unknown (Table 3-1). The age difference of c. 100 ka between onshore and offshore record might be best explained by sparse numbers of direct ages of Kupe tephra. In Site U1520 the tephra layer consists of fine-grained white volcanic ash of ~3 cm thickness.

Kaukatea tephra

Volcanic event *s41* (indirectly dated at c. 807 ka; Table 3-2) comprises tephra layers from Sites U1520 (~2 cm thick volcanic ash layer) and 1122 (~1 cm thick layer) and is correlated to Kaukatea tephra (c. 0.86 Ma, unknown volcanic source; Table 3-1; Figure 3-6 E₁ and E₂).

Kidnappers-B tephra

We identified a 7 cm thick, dark grey volcanic ash associated with the Kidnappers-B tephra (c. 1.03 Ma, Mangakino Volcanic Centre; Table 3-1, Figure 3-6 E₁ and E₂ and Figure 3-2 D) in the distal Site 1124, summarised in volcanic event *s49* (indirectly dated at 910 ka; Table 3-2). Interestingly, volcanic event *s48*, indirectly dated to c. 909 ka (Table 3-2), seems to

geochemically match with “Tephra B” (1.0 ± 0.10 Ma) identified at Cape Kidnappers, North Island, New Zealand (Shane et al., 1996a).

Potaka tephra

Potaka tephra was identified at Sites U1518, U1520, 1123 and 1124 and summarised in volcanic event *s51*, indirectly dated to c. 912 ka (Table 3-2; Figure 3-6 *F*₁ and *F*₂). Potaka tephra (c. 1.0 Ma; Table 3-1; e.g. Pillans et al., 2005) was sourced by Mangakino Volcanic Centre (Figure 3-1 B) and was previously identified in other ODP Leg 181 Sites, and in the cores investigated by Schwarze et al. (2022). In our marine tephra record, the volcanic ash associated with Potaka tephra is thickest in the proximal cores (~5 cm), and 3 to 4 cm thick in the distal cores and is white to beige coloured.

Rewa B tephra, Sub-Rewa tephra, overlying Mangapipi tephra, Mangapipi tephra, and Ridge tephra

The volcanic events *s56**, *s58**, *s78*, *s79*, and *s81* are associated with Rewa B tephra, Sub-Rewa tephra, overlying Mangapipi tephra, Mangapipi tephra, and Ridge tephra respectively (Tables 3-1 and 3-2, Figure 3-6 *F*₁ and *F*₂ and *G*₁ and *G*₂) and were previously established by Allan et al. (2008) and Alloway et al. (2005). These volcanic deposits are associated with Mangapipi Volcanic Centre (Figure 3-1 B), except for Ridge tephra where the volcanic source is unknown. The ages of these deposits range between c. 1.2 Ma to 1.6 Ma (Table 3-1; e.g. Pillans et al., 2005). Our marine tephra record generally supports these correlations, and indirect age dating for the individual deposits results in very similar ages (Table 3-2).

Ototoka tephra

Correlatives of Ototoka tephra (c. 1.72 Ma; Pillans et al., 2005) were previously identified in Sites 1123 and 1124 (Alloway et al., 2005). Although we did not find correlatives of Ototoka tephra in Site 1124 (e.g. due to oversampling or previous misidentification), we verified the identification at Site 1123 and additionally identified Ototoka tephra at Site U1520 (Table 3-1). This correlation is summarised in volcanic event *s83* (Table 3-2; Figure 3-6 *G*₁ and *G*₂) with an indirect age of c. 1.64 Ma (Table 3-2). The tephra layer is ~17 cm thick in Hole U1520D, and 5 to 7 cm thick in Site 1123.

Table Flat tephra

Volcanic event *s86* (indirect age of c. 1.6 Ma, Supplementary Tables S1) comprises two tephra layers from distal Sites 1122 and 1124, which are correlated to Table Flat tephra (c. 1.7 Ma; Pillans et al., 2005) (Tables 3-1 and 3-2; Figure 3-6 G₁ and G₂). At Site 1124 the tephra is ~10 cm thick, whereas at Site 1122 only 4 cm were deposited.

Vinegar Hill tephra

We identified Vinegar Hill tephra (c. 1.75 Ma; Pillans et al., 2005) (unknown source, Table 3-1; Figure 3-6 H₁ and H₂) in Hole U1520D as a <0.5 cm layer. This correlation is summarised as volcanic event *s88*, which is indirectly dated to c. 1.84 Ma (Supplementary Table S1). This is the first identification of Vinegar Hill tephra in the marine environment.

Hikuroa Pumice member

Volcanic event *s89** is found in proximal and distal drill sites (Table 3-2) and further correlated to Hikuroa Pumice member (also called Darkys Spur tephra, 2.0±0.6 Ma; Hopkins et al., 2021a; Figure 3-6 H₁ and H₂). Prentice et al. (2022) correlated Hikuroa Pumice member to the Waiteariki Ignimbrite (2.1 Ma), potentially related to Omanawa caldera (CVZ; Pittari et al., 2021). This volcanic event is one of the few which was correlated across the study area (Holes U1520D, U1526B, and Sites 1122, 1124 and 1125). The volcanic ash layer is thickest at Site 1125 (~8 - 10 cm), ~9 cm at Site 1124, ~3.5 cm at Site 1122 and only ~2 cm at Site U1520. At Site U1526 the tephra layer was slightly disturbed by drilling, therefore no thickness was determined. The marine tephra layers indicate a geochemical bimodality, which is not yet represented in the literature for this eruption (Hopkins et al., 2021b) and has an indirect age of c. 2.0 Ma (Table 3-2).

Lower Pāpāmoa Ignimbrite

We identified marine tephra layers with the geochemical signature of Lower Pāpāmoa Ignimbrite (c. 2.4 Ma; Briggs et al., 2005; Hopkins and Seward, 2019) in three drill sites summarised as volcanic event *s95* (c. 2.36 Ma; Sites U1526, 1123 and 1124; Figure 3-6 H₁ and H₂), additionally being constrained by coincident onshore and offshore ages. Lower Pāpāmoa Ignimbrite is linked to Tauranga Volcanic Centre, a volcanic centre of the CVZ (3.0 - 1.9 Ma; Briggs et al., 2005; Pittari et al., 2021; Prentice et al., 2022). In addition, our data supports a correlation to PU-16-04, (Hopkins and Seward, 2019), a 15 cm thick, coarse grained pumice rich terrestrial deposit sampled close to Hawke Bay, south of Gisborne (Figure 3-1 A) associated with the Lower Pāpāmoa Ignimbrite. In the marine sediments the tephra layers

consist of grey and fine grained volcanic ash, varying in thickness from ~11 - 12 cm thick at Site (1124), ~9 cm thick at Site U1526, and ~3 to 4 cm at Site 1123.

TUK-16-16 tephra

The oldest correlation of Quaternary age is established in volcanic event s96 between Sites 1123 and 1124 and further correlated to the terrestrial TUK-16-16 tephra (Hopkins and Seward, 2019; Figure 3-6 H₁ and H₂). TUK-16-16 is described as an 18 - 30 cm thick deposit at northern Hawke Bay, very coarse grained and pumiceous and is dated to 3.0 ± 1.6 Ma (Hopkins and Seward, 2019). Preliminary correlations to marine tephra in Site 1124 were established by Hopkins and Seward (2019), and are supported by our study with the addition of two more tephra layers from Site 1123. The correlated marine tephra layers are dark grey and about 4 cm thick at Site 1123, and brownish and ~11 - 12 cm thick at Site 1124. The indirect age of volcanic event s96 is c. 2.4 Ma (Table 3-2).

3.8 Discussion

3.8.1 Identification of phases with increased volcanic activity

Large eruptions which last several days to weeks are likely to cause the deposition of several volcanic products (e.g., ash fallout, pyroclastic density currents or surges, ignimbrites and co-ignimbritic ash fallout) due to varying styles of eruptions or eruption pulses (e.g. Cisneros de León et al., 2021). In addition, while volcanic activity progresses the magmatic residue evolves/fractionates leading to geochemically distinct eruptive products over time within eruptions occurring in quick succession over decades to centuries from the same magma chamber (e.g. Kutterolf et al., 2008a; 2020). Such eruptive pulses and their deposits have been identified and described for some eruptions of New Zealand's Quaternary volcanism, e.g. the 25.4 ka Oruanui eruption (Wilson, 2001; Allan et al., 2017).

The Oruanui eruption was characterised by short-lived but intense activity depositing several fall units bracketed by up to several weeks to months of quiescence (Wilson, 2001; Allan et al., 2017). Many of these fall units are described as “poorly preserved onland” (Wilson, 2001) likely due to their age. Conversely, the recent Taupō eruption included seven subunits (Barker et al., 2020 and references therein) that are very well preserved onshore and have been studied in detail for their geochemical, temporal, and spatial variations (e.g. Barker et al., 2015, 2016). As yet, no studies have explored in detail the evidence for these short-lived phases within the offshore tephra deposits.

We identify three key marine sediment intervals which show increased volcanic activity over very short time periods, potentially linked to eruptive pulses or independent eruptions from the same volcanic centre or even from the same source volcano. The most pronounced high intensity intervals are identified at 1) c. 300 ka, 2) c. 900 ka, and 3) c. 1.8 Ma (dashed circles in Figure 3-8).

The first of these intervals at c. 300 ka overlaps with a period described as a volcanic flare up at around 310 ka, producing the Whakamaru group (e.g. Houghton et al., 1995). Within 44 kyrs, between c. 290 to 334 ka, we identified 13 volcanic events in the marine tephra record (*s16* to *s21** and *u15* to *u21*; Table 3-2 and Supplementary Table S1) of which we correlate three to onshore deposits (Fordell tephra, Lower Griffin Road tephra, and Rangitawa tephra).

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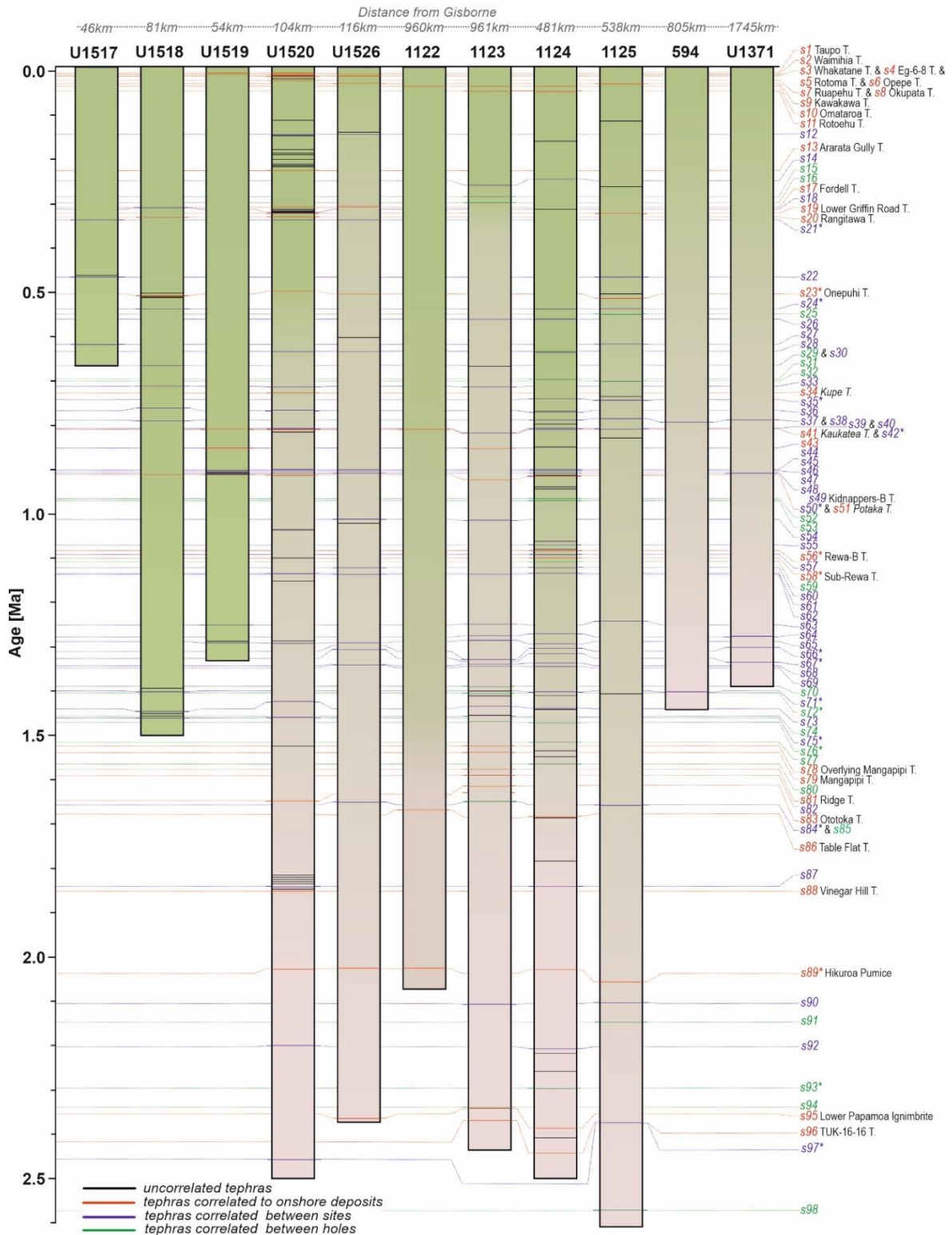


Figure 3-5 Stratigraphic columns showing the marine tephra layers of the Quaternary.

Stratigraphic columns (age versus drill sites) showing the uncorrelated and correlated marine tephra within hemipelagic (green) to pelagic (pinkish) background sediment. The correlated tephra layers are assigned to volcanic events, s1 to s98 (Table 3-2). Where applicable, the onshore correlatives are given. Uncorrelated volcanic events are shown by black bars (Supplementary Table S1).

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Table 3-2 Ninety-eight Quaternary volcanic events are established (s1 to s98) based on correlations between holes and sites.

<i>code</i>	Comment	Age ka	FeO_t wt%	U/Gd ppm	Zr/Rb ppm	Correlatives		<i>code</i>	Comment	Age ka	FeO_t wt%	U/Gd ppm	Zr/Rb ppm	Correlatives					
<i>s1</i>	1520D-1H-1 119-120	1.71	1.87	0.49	2.01	Taupō T. (Unit Y) (1)		<i>s14</i>	1123B 2H-6 91-93		1.39	0.6	1.12						
	1519D 1H-2 15-17		1.89						1123C 2H-2 104-109		1.44								
	1519E 1H-2 7-9		1.89					0.51	2.08	<i>s15</i>	1123A 2H-6 18-20	276.63	1.37						
<i>s2</i>	1520D-1H-3 26-30	3.38	1.83	0.58	1.89	Waimihia T. (1)		1123C 2H-3 69-71	1.35		0.75	1.04							
	1519D 1H-CC 4-6		1.8					0.52	2.03	<i>s16</i>				1123A 2H-6 70-72	289.65	1.32			
	1519E 1H-3 95-97		1.82					0.44	2.1					1123C 2H-3 132-134		1.3			
<i>s3</i>	1520D-1H-3 67-69	5.54	1.23	0.46	0.84	Whakatāne T. (1)		<i>s17</i>	U1520D 25F-2 10-14	310.00 / 363±33	1.27	0.67	1.17	Fordell T. (1)					
	1526B 1H-1 93-95		0.96						0.65		0.88				1526B 2H-2 92-93	1.2	0.59	0.89	
<i>s4</i>	1520D-1H-4 35-37	8.3	2.52	0.7	1.38	Eg-6-8 T. 5.2-5.9ka (9)		<i>s18</i>	U1520D 27F-1 44-46	317.18	1.26	0.88	1.06						
<i>s5</i>	1520D-1H-4 87-90	9.47	1.12	0.89	0.97	Rotoma T. (1)			1518F-13R-1 113-115		1.27				0.77	1.09			
	1526B 1H-1 122-124		0.97				<i>s19</i>	U1520D 27F-2 92-96	319.33 / 347±22	1.12	0.82	1.15	Lower Griffin Road T. 300-400 ka (1)						
<i>s6</i>	1520D-2H-1 15-19	10	1.76	0.53	1.89	Ōpepe T. (1)		U1520D 27F-3 74-78		1.11				0.76	1.15				
<i>s7</i>	1520D-2H-3 77-79	10.5	6.57	0.48	1.6	Ruapehu T. (8)		1125B 2H-3 143-145		1.14									
<i>s8</i>	1520D-4H-4 117-119	11.51	4.7	0.57	1.58	Okupata T. (7)		1125A 3H-2 67-69		1.11				1.18	0.8				
<i>s9</i>	1125A 1H-1 71-73	25.35	1.25			Kawakawa/ Oruanui T. (1)	<i>s20</i>	U1520D 28F-1 93-95	321.04	1.1	1.09	0.62	Rangitawa T. 350±50 ka (5)						
	1526B 1H-3 36-38		1.29					U1518E-1H-4 16-18		1.02				1.41	0.52				
<i>s10</i>	1123C 1H-1 148-150	32.5	1.24	0.45	1.26	Omataroa T. (6)	<i>s21*</i>	U1520D 33X-3 60-62-I	334.16	1.66	1.01	1.01							
	1123B 1H-2 5-7		1.11					0.43		1.45				U1520D 33X-3 60-62-II	1.23	1.01			
	1123A 1H-2 6-8		1.21											1526B 2H-3 83-85	1.19				
	1124B 1H-2 43-45		1.17					0.44		1.44				1517C 35F-3 12-14	1.12	0.72	0.76		
	1122A 1H-4 26-28		1.2																
<i>s11</i>	1123C 1H-2 69-71	45.17	0.92	0.77	0.86	Rotoehu T. (1)	<i>s22</i>	1517C 35F-4 125-127	463.2	1.4									
	1124B 1H-3 15-17		0.94					0.76		0.85				1125A 3H-4 64-66	1.19				
	1124A 1H-1 71-73		0.89				0.71	0.84	<i>s23*</i>	U1520D 35X-7 72-74	504	1.53	0.6	1.3	Onepuhi T. 570 ka (1)				
<i>s12</i>	U1520D 15H-4 71-73	141	1.31	0.9	0.89			1125A 3H-6 57-59-II		1.55		1.86							
	1526B 2H-1 94-96		1.15					1.08		0.63		1526B 2H-3 101-103-II				1.49			
<i>s13</i>	U1520D 23F-3 6-8	223.1	1.22	0.71	0.82	Ararātā Gully T. 235ka (1)	<i>s24*</i>	1125A 3H-6 57-59-I	535	1.7									
<i>s14</i>	1124C 1X-1 80-82	249.55	1.15	0.5	1.08			1124D 1H-2 70-72		1.64									
	1123A 2H-5 66-68		1.31					U1518E-3H-1 92-93		1.6				0.64	1.58				

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Table 3-2 continued

<i>code</i>	<i>Comment</i>	<i>Age</i> ka	<i>FeO_t</i> wt%	<i>U/Gd</i> ppm	<i>Zr/Rb</i> ppm	<i>Correlatives</i>		<i>code</i>	<i>Comment</i>	<i>Age</i> ka	<i>FeO_t</i> wt%	<i>U/Gd</i> ppm	<i>Zr/Rb</i> ppm	<i>Correlatives</i>
s25	1125B 3H-1 32-34 1125A 3H-6 105-107	546.95	1.71 1.7					s37	1125B 4H-1 27-29 1518E-9H-2 0-1 594 5H-2 36-38	791.57	0.9 1.04 1.07	1.48 0.73 1.19	0.33 1.04 0.67	
s26	1123C 3H-4 84-86 1124D 1H-2 148-150	558.47	1.14 1.1	1.21 0.93	0.78 0.87			s38	1124D 2H-1 128-130 1124C 3H-5 56-58 1371D 1H-CC 2-4	793.79	1.22 1.3 1.1		1.13	
s27	1125B 3H-3 26-28 1517C 36F-2 3-5	618.93	1.15 1.19	0.93 0.62	0.63 0.77			s39	U1520D 40X-1 60-62 1124D 2H-2 53-55 1124C 3H-5 141-143 1123C 4H-6 68-70	808.74	2.11 2.15 1.85 2.01	0.6 0.46 0.58	1.88 2.41 1.89	
s28	U1520D 35X-CC 2-4 1526B 2H-6 78-80	631.78	1.11 1.04	1.26 1.3	0.61 0.63			s40	U1520D 40X-1 77-79 1124D 2H-2 121-123 1124C 3H-6 61-63	807.88	1.28 1.19 1.11	0.63	1.03	
s29	1124D 1H-3 50-52 1124C-2X-6 53-55	661.93	1.1 1.15	1.4 0.99	0.72 0.85			s41	U1520D 40X-CC 38-40 1122C 37X-1 37-38	807.91	1.77 1.61	0.54 0.5	1.86 1.4	Kaukatea T. 860±80 ka (1)
s30	1124D-1H-4 86-88 U1518E-3H-3 36-40 1517C 36F-2 100-101	665	1.05 1 1.26		1.55 0.54			s42*	1125A 4H-4 115-117-I 1125A 4H-4 115-117-II 1125A 4H-4 115-117-III 1125B 4H-1 59-61-I 1125B 4H-1 59-61-II 1125B 4H-2 11-13 1519C 14R-2 48-50	807.94	1.64 2.2 1.96 2.11 1.53 2.04 1.87		1.67 1.86	
s31	1124C 3H-1 85-87 1124D 1H-5 79-81	693.06	1.06 1.09	1.11 1.09	0.67 0.67			s43	1123C 5H-1 90-92 1123B 5H-3 3-5 1123A 5H-2 98-100 1519C 15R-1 71-73	857.18	1.73 1.84 1.79 1.99	0.66 0.57 0.66	2.23 2.04 1.85	
s32	1125A 4H-2 52-54 1125B 3H-5 86-88	703.35	1.32 1.28					s44	1124D 2H-4 88-90 U1520D 44X-1 5-7-II	894.51	1.95 1.94		1.74	
s33	U1520D 38X-CC 37-39 1123A 4H-6 125-127 U1518E-3H-6 16-18	711.14	1.98 2.03 1.83	0.52 0.63	2.11 1.97									
s34	U1520D 39X-3 20-22	725.69	1.38	0.72	1.11	Kupe T. 630±80 ka (1)								
s35*	1124D 1H-7 24-26-I 1124D 1H-7 24-26-II 1124C 3H-3 54-56 1125A 4H-3 73-75	739.72	1.54 2 1.92 2.12		0.55 0.53	2.56 2.3								
s36	U1520D 39X-5 64-66 1124C 3H-4 107-109 1124D 2H-1 42-44 U1518E-5H-2 66-70	772.8	1.36 1.49 1.48 1.06											

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Table 3-2 continued

<i>code</i>	Comment	Age ka	FeO_t wt%	U/Gd ppm	Zr/Rb ppm	Correlatives	<i>code</i>	Comment	Age ka	FeO_t wt%	U/Gd ppm	Zr/Rb ppm	Correlatives
<i>s44</i>	1519C 15R-5 20-22 1526B 3H-2 48-50		2.14 1.92				<i>s55</i>	1124C 5H-1 91-93 1124D 3H-4 145-147	1067.5	2.08 2.05	0.45 0.5	2.33 2.17	
<i>s45</i>	1124C 4H-1 26-28 1124D 2H-4 128-130	896.5	1.2 1.2	0.69	0.99		<i>s56*</i>	1124C 5H-2 45-47-I 1124C 5H-2 45-47-II 1124D 3H-5 60-62	1083	1.81 2.32 2.19			Rewa B T. 1.20±0.14 Ma (1)
<i>s46</i>	1124D 2H-5 87-89 U1520D 44X-1 43-45 1519C 16R-1 146-148 1526B 3H-2 64-66	901.9	1.92 1.99 2.28 1.97	0.56 0.52	2.65 2.35		<i>s57</i>	1124C 5H-2 65-67 1124D 3H-5 112-114	1089	2.32 2.31	 0.42	 2.3	
<i>s47</i>	1519C 19R-3 33-35 1526B 3H-2 85-87	909.3	2.39 2.02	0.43 0.45	2.47 2.53		<i>s58*</i>	1124D 3H-6 5-7-I 1124D 3H-6 5-7-II	1098	1.71 1.9	0.47 0.47	1.61 1.61	Sub-Rewa T. (3)
<i>s48</i>	1124C 4H-2 17-19 U1520D 44X-1 47-49 1371D 2H-2 137-139	909.39	1.58 1.62 1.47	0.49 0.56	2.27 1.5		<i>s59</i>	1124D 3H-6 46-48 1124C 5H-3 13-15	1105.6	1.7 1.79	 0.48	 1.58	
<i>s49</i>	1124D 2H-5 146-148 1124C 4H-2 81-83	910	1.73 1.61	 0.48	 1.56	Kidnappers-B T. 1.0±0.07 Ma (3)	<i>s60</i>	1124C 5H-3 107-109 1124D 3H-6 116-118 1526B 3H-3 133-135	1120.9	2.1 2.09 2.12	0.56 0.55	2.1 2.11	
<i>s50*</i>	1124D 2H-CC 10-12-I 1124C 4H-2 118-120 1519C 19R-3 122-125 1124D 2H-CC 10-12-II	910.5	1.7 1.7 2.08 1.35	0.52 0.53 0.52	1.43 1.72 1.43		<i>s61</i>	1124C 5H-4 9-11 U1520D 47X-3 0-2	1132.9	1.3 1.04	0.67 0.68	0.94 0.74	
<i>s51</i>	U1520D 44X-1 96-98 1123A 5H-3 66-68 1124C 4H-3 48-50 1518E-9H-CC 14-16	912.7	1.31 1.17 1.23 1.19	 0.82	 0.75	Potaka T. 1.0±0.05 Ma (1)	<i>s62</i>	1123C 6H-1 77-79 1123B 6H-6 50-52 1526B 3H-4 38-40	1171	1.9 2.01 1.59	 0.43	 2.37	
<i>s52</i>	1124C 4H-4 81-83 1124D 3H-1 3-5	960	1.23 1.2	 0.84	 0.85		<i>s63</i>	1125B 4H-2 124-126 1123C 6H-3 128-130 1123B 6H-6 137-139 U1519C 19R-5 100-102	1252.2	2.32 2.37 2.09 2.38	 0.48 0.59	 2.36 1.98	
<i>s53</i>	1124C 4H-4 111-113 1124D 3H-1 27-29	965	1.43 1.43				<i>s64</i>	1123C 6H-4 62-64 1124D 4H-2 69-71 1124C 5H-6 57-59 1371D 3H-3 56-58	1279	2.24 2.2 2.26 2.13	0.48 0.47	2.32 2.21	
<i>s54</i>	1123C 5H-5 121-123 1526B 3H-2 105-107	1011.5	2.07 1.99	0.7	1.71								

Study II

Table 3-2 continued

<i>code</i>	Comment	Age ka	FeO_t wt%	U/Gd ppm	Zr/Rb ppm	Correlatives		<i>code</i>	Comment	Age ka	FeO_t wt%	U/Gd ppm	Zr/Rb ppm	Correlatives
s65	1123C 6H-4 93-95 1124D 4H-2 116-118 U1520D 48X-CC 22-24 1519C 20R-3 29-31 1526B 3H-5 1-3	1289.3	2.32	0.56	2.32			s71*	594A 8H-3 49-51-II		1.38			
			2.15	0.47	2.06			s72*	1123C 6H-7 14-16-I 1123B 7H-2 38-40-II 1123C 6H-7 14-16-II 1123B 7H-2 38-40-I	1405	1.69 1.67 1.99 2.12	0.66	1.69	
s66*	1124D 4H-2 137-139-I 1124C 5H-6 131-133 1123A 6H-4 131-131 1371D 3H-6 2-4	1309.8	2.28 2.39 2.21 2.2	0.56 0.54 0.64	1.66 2.47 2.29			s73	1123A 6H-6 125-127 1124D 4H-5 12-14 U1520D 49X-1 15-17 U1518E 29X-2 66-68	1441.2	1.04 1.12 1.59 1.29	1.42 0.57	0.4 1.23	
s67*	1124D 4H-2 137-139-II 1124C 5H-7 60-62 1526B 3H-5 8-10 1371D 3H-6 63-65	1326.3	1.2 1.27 1.42 1.27	0.56 0.69	1.66 0.63 0.61			s74	1123B 7H-2 88-90 1123C 6H-7 64-66 1123A 7H-1 52-54	1448.6	1.32 1.33 1.34	0.71	0.84	
s68	1123C 6H-5 110-112 1123A 6H-5 18-20 1124C 5H-CC 10-12	1358.3	2.3 2.3 2.13	0.61 0.47	2.03 2.42			s75*	1518E-32X-1 20-24-I U1520D 49X-1 28-30 1518E-32X-1 20-24-II	1455.7	1.18 1.75 1.75	0.83	1.26	
s69	1123C 6H-5 123-125 1124C 6H-1 26-28 1124D 4H-3 70-72 1526B 3H-5 51-53	1355.2	1.03 0.99 1.28 1.1	1.51	0.39			s76*	1124C 6H-2 27-29-I 1124C 6H-2 27-29-II 1124D 4H-5 77-79	1469.8	2.29 1.91 2.16	0.54 0.51	1.78 1.9	
s70	1123B 7H-1 129-131 1123C 6H-6 118-120	1388.1	1.7 1.75	0.62 0.55	1.21 1.2			s77	1124D 4H-6 18-20 1124C 6H-2 127-129	1516.5	2.3 2.27	0.56	2.07	
s71*	1124C 6H-1 37-39-I 1518E-25F-2 30-32-I 594 13H-CC 0-2-II 594A 8H-3 49-51-I 1124C 6H-1 37-39-II U1518E-25F-2 30-32-II 594 13H-CC 0-2-I	1400.7	2.1 1.95 2.08 2.03 1.66 1.17 1.35	0.6 0.57 0.82	1.73 1.97 1.19			s78	1123C 7H-2 62-64 1123B 7H-4 93-95 1123A 7H-3 48-50	1534.3	2.24 2.23 2.22	0.53	2.15	overlying Mangapipi T. (4)
								s79	1123B 7H-4 145-147 1123C 7H-2 120-122 1123A 7H-3 108-110	1540	2.33 2.31 2.36	0.53	2.13	Mangapipi T. (4)
								s80	1124D 4H-6 117-119 1124C 6H-3 90-92	1568.4	1.89 1.94	0.67 0.7	1.44 1.4	
								s81	1123B 7H-5 115-117	1576.1	2.13			Ridge T. 1.56 Ma (3)

Study II

Table 3-2 continued

<i>code</i>	Comment	Age ka	FeO_t wt%	U/Gd ppm	Zr/Rb ppm	Correlatives	<i>code</i>	Comment	Age ka	FeO_t wt%	U/Gd ppm	Zr/Rb ppm	Correlatives
s82	1123C 7H-3 132-134 1123B 7H-6 13-15 1123A 7H-4 108-110	1603.9	0.99 1.04 0.98	1.39 1.43	0.41 0.43	(low-Ti T.)	s91	1125A 6H-1 23-25		1.49			
s83	1123C 7H-4 60-62 1123B 7H-6 87-89 1123A 7H-5 33-35 U1520D 50X-CC 37-39	1649.78 / 1690±110	2.22 2.23 2.22 2.22	0.68 2.23 2.22 0.55	1.74 1.74 1.84	Ototoka T. 1.72±0.32 Ma (1)	s92	U1520D 53X-1 31-33 1124C 7H-4 60-62	2203	1.35 1.25	0.92	1.06	
s84*	1125A 5H-3 13-15-I 1125A 5H-3 13-15-II 1526B 4H-1 103-105	1653.5	1.13 1.58 1.89				s93*	1124C 7H-5 92-941 1124C 7H-5 92-942 1124D 6H-1 142-144-I	2295.8	1.41 1.15 1.36		1.18 0.57	
s85	1123C 7H-5 11-13 1123A 7H-5 125-127	1665.7	2.35 2.36	0.62 0.62	2.26 1.97		s93*	1124D 6H-1 142-144-II		1.15	0.97	0.7	
s86	1124C 6H-4 52-54 1122C 44X-2 57-59	1710	1.95 1.96	0.76 0.8	1.22 1.16	Table Flat T. (3)	s94	1123C 9H-5 33-35 1123B 10H-1 36-38 1123A 9H-5 141-143	2332.5	1.86 1.92 1.83	0.51 0.56	1.79 1.72	
s87	1124C 6H-5 37-39 U1520D 51X-1 55-56	1845	1.17 1.22	1.34 1.58	0.71 0.86		s95	1123B 10H-1 97-99 1123C 9H-5 99-101 1123A 9H-6 58-60 1124D 6H-3 27-29 1124C 7H-6 143-145 1526A 2R-CC 28-29	2368.1	1.9 1.84 1.9 1.64 1.62 1.75	0.55 0.77 0.56	1.55 1.31 1.88	Lower Papamoa Ignimbrite 2.4Ma (2)
s88	U1520D 51X-1 64-65-2	1846.8	1.55	1.09	0.86	Vinegar Hill T. 1.75±0.2 Ma (3)	s96	1123B 10H-2 32-34 1123A 9H-7 7-9 1124D 6H-4 29-31 1124C 8H-1 104-106	2424.9	1.44 1.34 1.43 1.36		1.27 1.34 0.95	TUK-16-16 3.0±1.6 Ma (2)
s89*	1125A 5H-6 36-38-I 1125A 5H-6 36-38-II U1520D 52X-1 8-10 1125B 5H-2 131-133 1124D 5H-7 12-14 1124C 7H-3 117-119 1526B 4H-2 57-59 1122C 50X-5 5-7	2027.2	1.45 1.66 1.56 1.73 1.43 1.25 1.77 1.76			Hikuroa Pumice 2.0±0.6 Ma (1)	s97*	1125B 6H-1 147-149 1125A 6H-5 71-73-I 1125A 6H-5 71-73-II U1520D 54X-2 3-5-I U1520D 54X-2 3-5-II	2457	1.35 1.21 1.45 1.28 1.55	0.74 0.73	1.43 1.3	
s90	1125A 5H-6 65-67 1125B 5H-3 120-122 1123A 9H-5 99-101	2136.9	1.61 1.85 1.67	0.9 0.64 0.77	1.31 1.53 1.31		s98	1125A 7H-1 138-140 1125B 6H-5 133-135	2575.2	1.18 1.12	0.8	0.55	
s91	1125B 5H-4 64-66	2143.9	1.32	1.38	0.54								

Table 3-2 continued

67 volcanic events were not correlated (*u1* to *u67*, Supplementary Table S1), * highlights bimodal or compositionally zoned events. 34 volcanic events were correlated to onshore correlatives. Ages for each volcanic event are either the ages of onshore correlatives or the averages of indirect dating methods. Individual ages for the marine tephra layers are reported in Supplementary Table S1. Where available, direct U-Pb ages are reported. 1) Hopkins et al. (2021b) and references therein, 2) Hopkins and Seward (2019), 3) Pillans et al. (2005), 4) Allan et al. (2008) and references therein, 5) Holt et al. (2010), 6) Smith et al. (2002), 7) Lowe et al. (2008), 8) Moebis et al. (2011), 9) Lowe (1988)

These volcanic events are mainly present in the proximal marine drill sites, and share geochemical similarities (Supplementary Table S1) likely indicating a similar volcanic source. The second interval of increased volcanic activity at c. 900 ka (between c. 860 - 910 ka; Figure 3-8), includes correlatives to the Potaka and Kidnappers super-eruptions sourced from Mangakino Volcanic Centre (Figure 3-1 B; Table 3-2). Within this interval, we identified a sequence of geochemically related volcanic events, *s48* to *s43*, including correlatives to the Potaka (*s51*; Table 3-2) and Kidnappers-B onshore deposits (*s49*; Table 3-2). The Kidnappers super-eruption (Mangakino Volcanic Centre; Figure 3-1 B) is the second largest TVZ derived eruption dated to c. 1.0 Ma (Cooper et al., 2012) and its onshore deposits consist of three components: (1) a voluminous phreatomagmatic fall unit, (2) overlain by an exceptionally widespread and non-welded ignimbrite, and (3) a >1.8 km thick poorly-welded hydrothermally altered tuff (Cooper et al., 2012; Wilson et al., 2008). The main fall unit of the Kidnappers eruption hosts at least three geochemically distinctive types of glass shards which is interpreted as the result of systematic tapping during the eruption and the involvement of more than one eruptive vent (Cooper et al., 2012).

The volcanic events *s48* to *s43* are correlated between proximal and distal drill sites and form a geochemical trend with the Kidnappers-B tephra and Potaka tephra with varying geochemical compositions (Figure 3-7). We interpret these geochemical jumps along the compositional trend to correspond to subsequent eruptive pulses following the Kidnappers-B eruption with several magma batches and vents involved, or at least they represent increased volcanic activity at Mangakino Volcanic Centre.

The oldest interval of increased volcanic activity at c. 1.8 Ma is bracketed by times of volcanic quiescence (Figure 3-8, subsection 3.9.2). During a time span of c. 6 kyr eight volcanic events are present in the marine tephra record, mostly identified at proximal Site U1520 (*s87* and *s88*, *u59* to *u64*; Supplementary Table S1). Volcanic event *s87* (Table 3-2) is only correlated between marine sites, whereas volcanic event *s88* can be correlated to the onshore deposit Vinegar Hill Tephra (Pillans et al., 2005) (Table 3-2). These eight volcanic events are geochemically different or at least they do not form obvious geochemical trends (Supplementary Table S1), potentially indicating that different volcanic centres were active at that time.

Study II

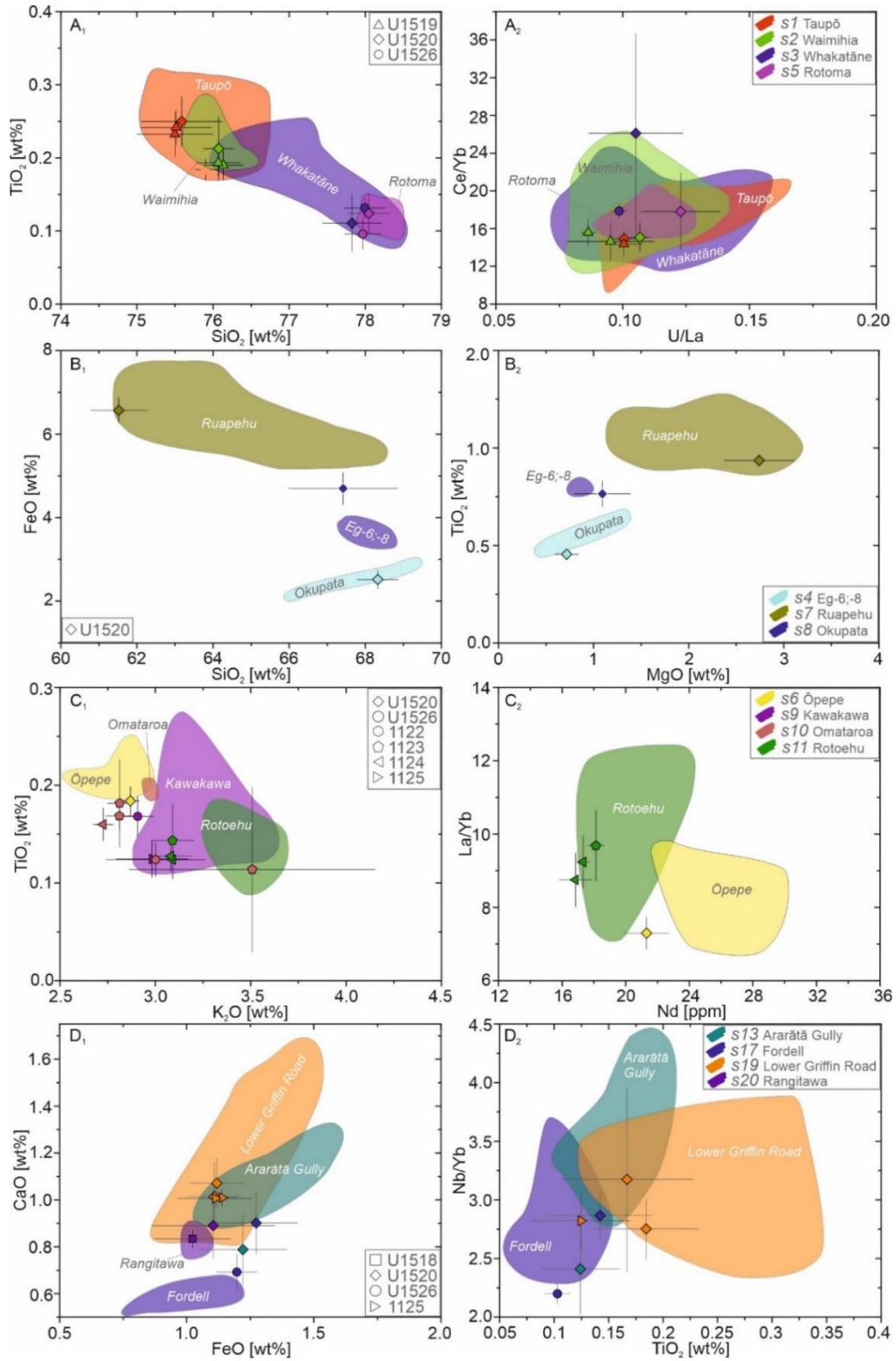


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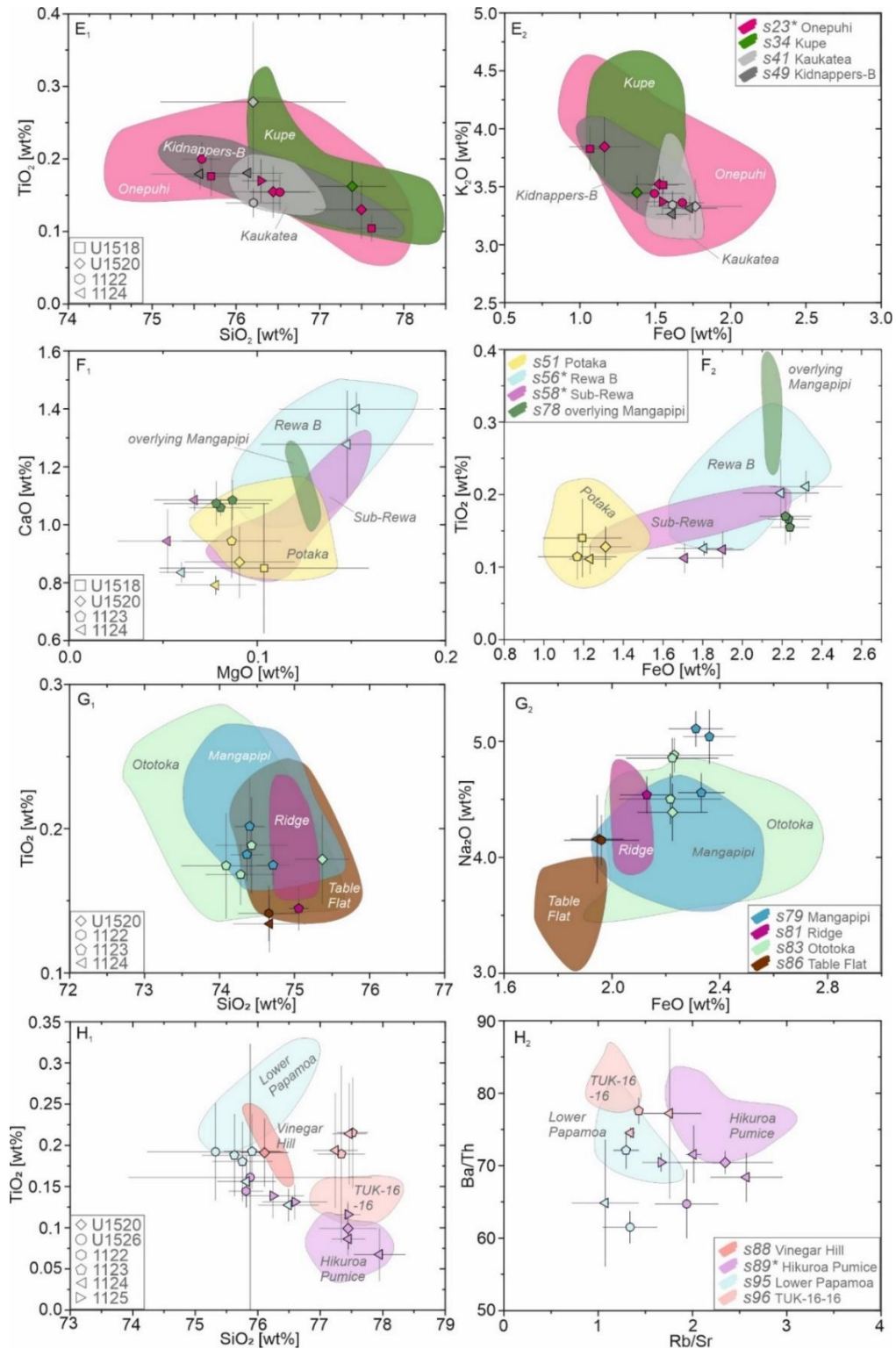


Figure 3-6 Geochemical diagrams of marine tephra correlated to onshore correlatives derived from New Zealand's Quaternary volcanism.

We refer to Table 3-2 for full names of onshore correlatives; $\text{FeO} = \text{FeO}_i$. The data is normalised to 100 wt% anhydrous compositions. The compositional fields represent onshore correlatives (Cooper et al., 2012; Holt et al., 2010; Hopkins et al., 2021b; Hopkins and Seward, 2019; Lowe, 1988; 2008; Moebis et al., 2011; Pillans et al., 2005; Schwarze et al., 2022; Smith et al., 2002). Where possible trace element compositions or ratios are shown, however not all marine tephra layers or terrestrial correlatives were analysed for trace element compositions (e.g. Omataroa in C_2 or Rangitawa in D_2).

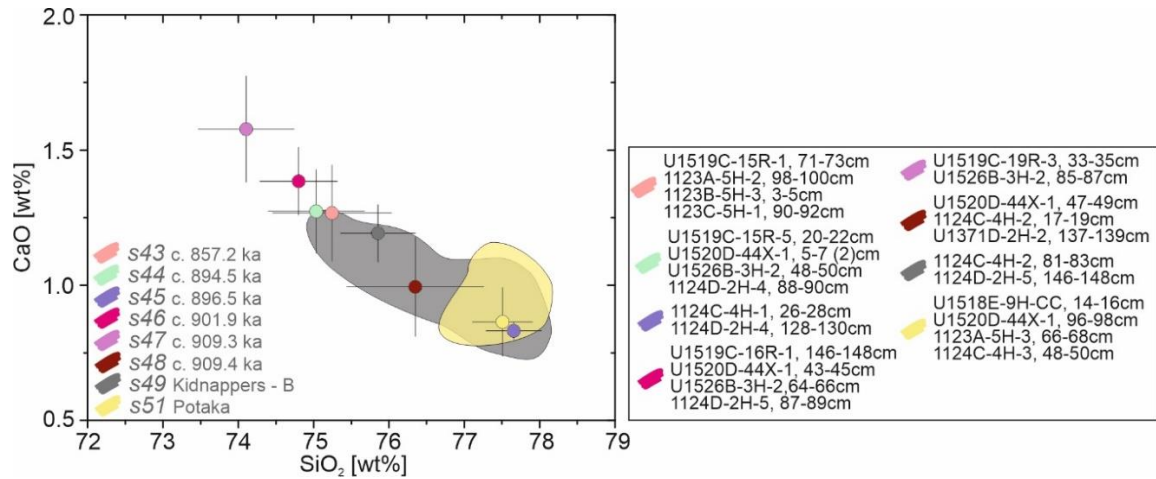


Figure 3-7 Interval of increased volcanic activity at c. 900 ka.

The individual volcanic events *s43* to *s48* form a geochemical trend with Potaka tephra and Kidnappers-B tephra.

3.8.2 Quaternary tephrochronostratigraphy and repose times

The Quaternary marine tephra record shows three phases of increased volcanism (see subsection 3.9.1) and four phases of volcanic quiescence (Figures 3-5 and 3-8). Four dominant intervals of volcanic quiescence are identified, each lasting about 100 to 200 kyr: between c. 340 ka to 460 ka, c. 1.15 Ma to 1.25 Ma, c. 1.68 Ma to 1.83 Ma, and c. 1.85 Ma to 2.0 Ma (Figure 3-8; Supplementary Table S1). These gaps in the marine tephra record partly overlap with previous observations. For example, Houghton et al. (1995) propose a period of volcanic quiescence between c. 0.3 to 0.7 Ma, followed by a flare up and formation of the Whakamaru group at c. 310 ka. This gap is present in the marine tephra record, but shortens the interval to c. 100 kyr (0.34 to 0.46 Ma) instead of ~400 kyr. Interestingly, the second oldest gap in volcanic activity observed in the marine tephra record coincides with an interpreted period of increased explosive volcanic activity between c. 1.6 to 1.8 Ma (Shane et al., 1996a). The interpretation of increased volcanic activity during this time interval is based on the occurrence of several tephra beds at the East Coast of North Island, deposited by the paleodrainage system from the central volcanic centres of North Island. The description of this depositional regime might imply that (1) most tephra beds were not deposited by primary airfall, or (2) the eruptions were small (eruption magnitudes of $M < 5$) and did not reach the marine environment, generally explaining the lack of dominant tephra layers in the marine sediments between c. 1.6 to 1.8 Ma.

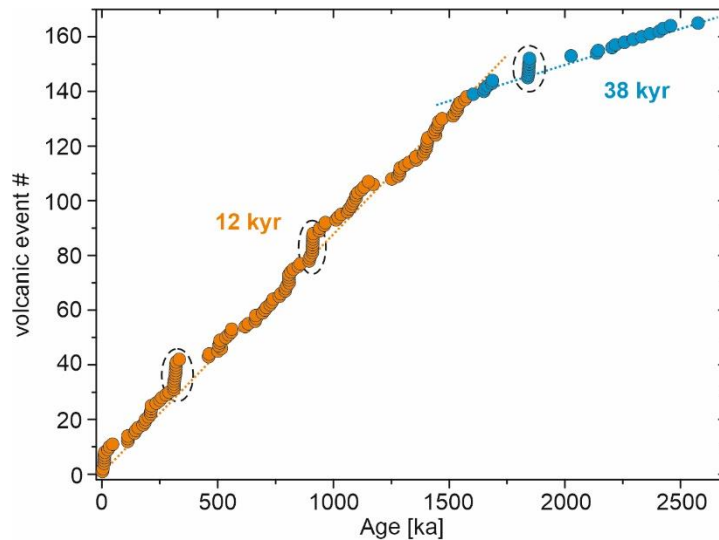


Figure 3-8 Repose times of New Zealand's explosive volcanism during the Quaternary.

Two intervals (blue and orange) with varying repose times were identified based on the marine tephra record. Major phases of increased volcanic activity are present at c. 300 ka, c. 900 ka, and c. 1.8 ka (dashed circles). Please find the calculations in Supplementary Table S19.

The overall volcanic activity of New Zealand's Quaternary volcanism results in two main intervals with varying eruption frequencies. These two intervals allow for a holistic estimation of repose times during the Quaternary (Figure 3-8). Between c. 2.6 to 1.6 Ma 27 volcanic events (s82 to s98, and u58 to u67; Supplementary Table S1) are identified in the marine tephra record, which result in a repose time of one eruption occurring every 38 kyr (Figure 3-8). In comparison, Neogene repose times between c. 9.7 to 2.6 Ma are longer with 47 kyr per eruption (Pank et al., 2023b), potentially implying a volcanic reorganisation from CVZ to TVZ volcanism including an overall increased volcanic activity of the TVZ during the Quaternary. This interpretation is underlined by shorter repose times for the last 1.6 Myr, with one eruption occurring every 12 kyr (Figure 3-8). However, a comparison of Neogene and Quaternary repose times might be biased due to the decreasing distance between volcanic source and drill sites on the incoming Pacific Plate from Neogene to recent. During the Quaternary, however, the distance between the volcanic arc and drill sites did not change significantly (~100 km; Lamb, 2015) therefore the amount of tephras in the marine sediments should not be affected.

Previous repose time estimations for the Quaternary are based on the tephra record at Site 1124 and resulted in one eruption every 35 kyr, and for Site 1123 even longer repose times of one eruption every 53 kyr were calculated (Carter et al., 2003). In addition, repose time estimations from the onshore tephra record in southern North Island, New Zealand, reveal that one eruption

occurred every 19 kyr between 2.0 to 0.6 Ma (Shane et al., 1996b). Thus, these previous estimations are roughly within the same order as our estimations for the last 1.6 Myr.

Although our repose time estimations should be considered as maximum intervals because the marine tephra record lack deposits of smaller explosive or effusive eruptions (see subsection 3.9.3) our results based on the proximal and distal marine tephra record are the most accurate ones to date, revealing details and variabilities over time.

3.8.3 Tephra volumes, magma masses and eruption magnitudes of widespread explosive eruptions

3.8.3.1 Tephra volumes and magma masses

We calculated tentative and rough tephra volumes for all volcanic events where associated marine tephra layers were undisturbed and reliable thicknesses could be determined. For volcanic events with more than one reliable tephra layer thickness we established isopach maps and calculated the tephra volumes following the Weibull model (Bonadonna and Costa, 2012; 2013). Additionally, we applied the Legros model (Legros, 2000) to calculate first-order estimates of minimum eruptive volumes for volcanic events with one single reliable thickness datapoint only. The Legros model constructs a teardrop-shaped isopach considering different aperture angles and calculates the volume assuming that the available thickness is at the farthest from source.

Based on the tephra volumes equivalent magma masses, magma volumes (DRE) and eruptive magnitudes (using the equation from Pyle, 2000) are calculated. We refer to the Supplementary Tables S20 and S21 for all results. Please note, previously reported thicknesses of onshore deposits (e.g. Pillans et al., 2005) or calculated tephra volumes (e.g. Froggatt & Lowe, 1990) were not considered in any of the models or estimations. Therefore, our estimates of tephra volumes and associated DRE magma volumes may differ from previous estimates and can be considered as minimum values.

The here presented volume and magma mass estimates represent merely the continuous marine tephra record and therefore allow for interpretations of respective variations with time.

For 30 events, partly correlated to onshore tephra deposits, it was possible to create isopach maps in order to calculate well-constraint tephra volumes using the Weibull model (Bonadonna and Costa, 2012; 2013).

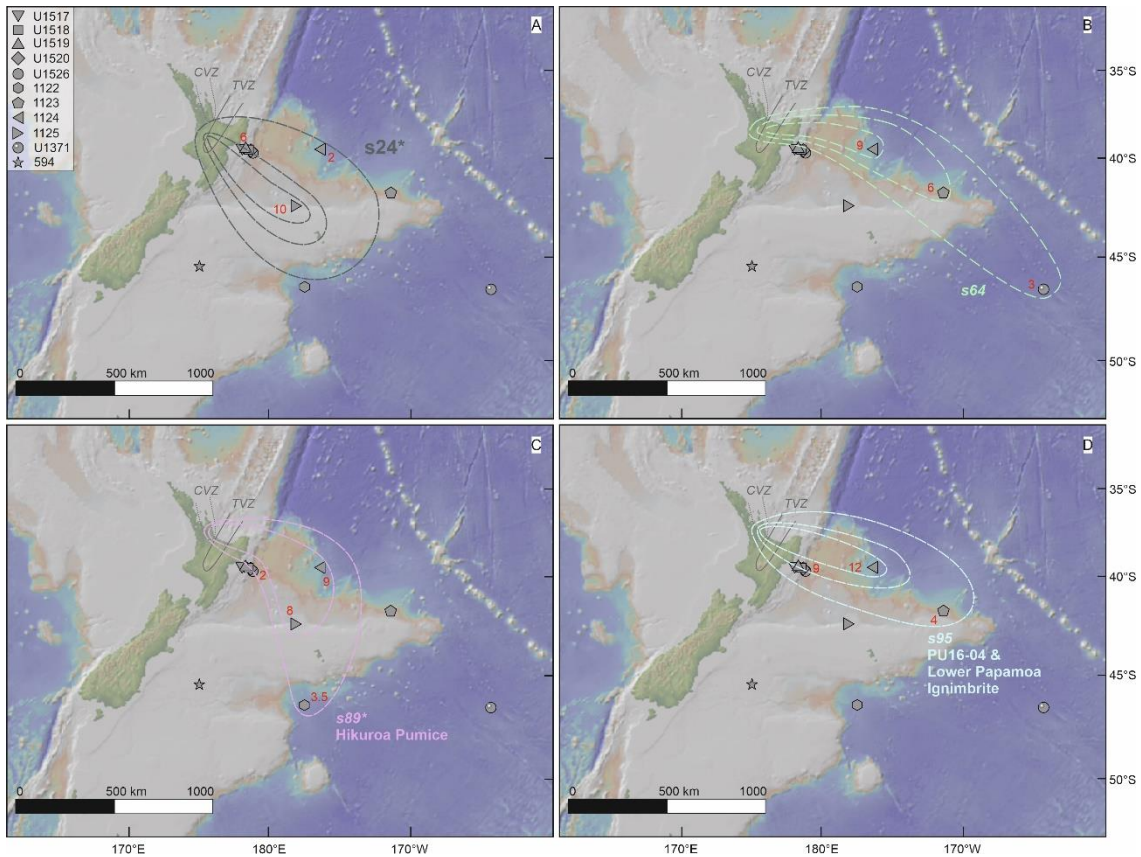


Figure 3-9 Isopach maps of volcanic events s24*, s64, s89* and s95.

The isopach maps show the dominant tephra dispersal towards the east and southeast of North Island. Please find the estimated tephra volumes, magma masses and magnitudes in Supplementary Table S21.

Here, the marine tephra record provides new insights into the eruptive volumes of some Quaternary eruptions with potentially more realistic erupted volumes than provided by their onshore counterparts alone. This for example applies to Omataroa tephra where previous estimates resulted in a tephra volume of $\sim 16 \text{ km}^3$ and a DRE magma volume equivalent of 10 km^3 (Froggatt & Lowe, 1990; Jurado-Chichay & Walker, 2000; Smith et al., 2005). The associated volcanic event s10 yields an area of $\sim 8.3 \times 10^5 \text{ km}^2$ within the 3 cm isopach, equivalent to a tephra volume of 134.5 km^3 corresponding to a DRE magma volume of 96 km^3 or $\sim 2 \times 10^{14} \text{ kg}$ erupted magma mass and a magnitude of $M \sim 7.3$ (Supplementary Table S21). Based on the marine tephra record and following the same approach as outlined above we are able to present first estimates of tephra volumes for Lower Griffin Road tephra (s19), Onepuhi tephra (s23*), Kaukatea tephra (s41), Potaka tephra (s51), Ototoka tephra (s83), Table Flat tephra (s86), Hikuroa Pumice (s89*; Figure 3-9 C), Lower Papamoa Ignimbrite (s95; Figure 3-9 D), and TUK-16-16 (s96). These tephra volumes range between $\sim 9 \text{ km}^3$ (Kaukatea tephra) and $\sim 235 \text{ km}^3$ (Potaka tephra), equivalent to DRE magma volumes of 6.1 km^3 to 168 km^3 or

magma masses of 1.3×10^{13} kg to $\sim 3.5 \times 10^{14}$ kg, and corresponding to magnitudes of M 6 to 7.5 with distribution areas of $>2 \times 10^5$ km² within the several cm isopachs (Supplementary Table S21).

Nineteen of these volcanic events result in eruption magnitudes M 6 to 7, and eleven volcanic events have magnitudes of M >7 (Figure 3-10 A; Supplementary Table S21). Exemplary isopach maps are shown in Figure 3-9.

For 100 events the tephra volume estimates were calculated using the Legros model (Legros, 2000), resulting in minimum estimates at different opening angles. We chose a conservative estimation approach and present volume ranges from opening angles between 30° to 60°. Therefore, and due to the model itself, all results should be considered as minimum values. Based on the marine tephra record we provide new first-order estimates of tephra volumes for Eg-6-8 (s4), Ararātā Gully tephra (s13), Fordell tephra (s17), Kupe tephra (s34), Kidnappers-B tephra (s49), Rewa - B and Sub-Rewa tephra (s56* / s58*), overlying Mangapipi tephra and Mangapipi tephra (s78 / s79), and Vinegar Hill tephra (s88; Supplementary Table S20). Overall, the tephra volume estimates range from $\sim 0.4 - 0.8$ km³ (e.g. s88 correlated to Vinegar Hill tephra; Table 3-2) to $\sim 290 - 540$ km³ (e.g. u30). These volumes correspond to erupted magma masses of 5.9×10^{11} kg to 1.1×10^{12} kg (s88) and 4.2×10^{14} kg to 7.9×10^{14} kg (u30), and eruption magnitudes of M 4.8 to 5.0 (s88) and M 7.6 to 7.9 (u30; Supplementary Tables S1 and S20).

In summary, the marine tephra record during the last c. 220 kyr comprises volcanic events with magnitudes of M 5 to 6, except for Ōpepe tephra (volcanic event s6), Rotoehu ash (volcanic event s11) and volcanic event u1 which have magnitudes of M 6 to 7 (Supplementary Table S20). Before c. 300 ka most volcanic events identified in the marine tephra record have magnitudes of M >6, seven volcanic events have magnitudes of M >7 and two events have M ≤ 5 (Figure 3-10; Supplementary Table S20).

3.8.3.2 Eruption magnitudes and cumulative erupted magma mass

The erupted magma masses calculated from the tephra volumes result in eruption magnitudes M ≥ 5 (n=130; Figure 3-10 A). Roughly 58% of all investigated volcanic events represent eruptions of the eruption magnitude M7 (range between $6.5 \leq M \leq 7.5$), $\sim 30\%$ range in the eruption magnitude of M6, $\sim 9\%$ in the range of M5 and $\sim 3\%$ in the range of magnitude M8 (Figure 3-10 A). This overall lack of deposits of smaller eruptions might indicate that eruptions of magnitudes M <5 did not reach the drill sites, or at least they were too small to form discrete tephra layers in the marine environment. These observations generally imply an incomplete

volcanic record of smaller eruptions in the marine sediments, in particular of volcanic events with magnitudes $M \leq 5$. Larger eruptions (eruption magnitudes of $M \geq 5$), however, are well represented in the marine sediments and we therefore consider the tephra record of eruptions with magnitudes $M > 5$ complete and reliable.

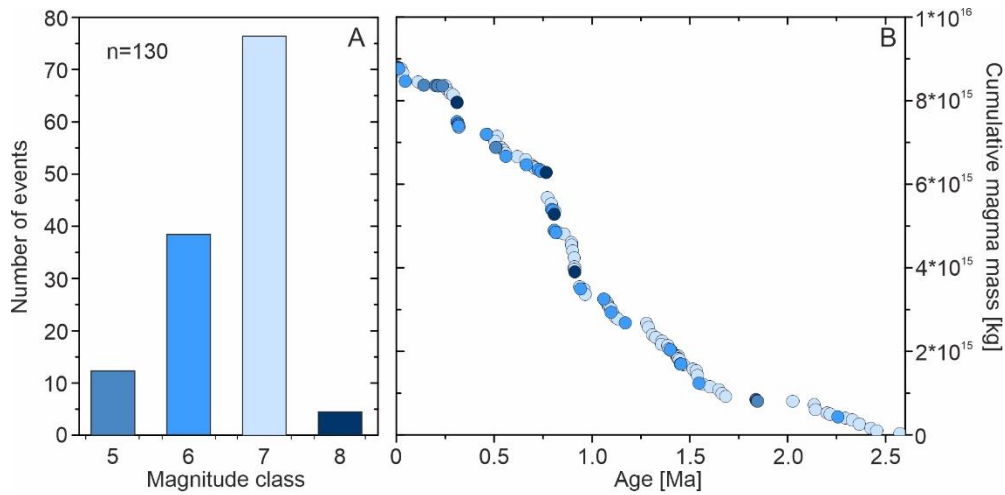


Figure 3-10 Eruptive magnitudes and cumulative erupted magma mass for the Quaternary.

A) Distribution of volcanic events ($n = 130$) based on their eruptive magnitude. The magnitude bins, for example M5, include magnitudes between $4.5 \leq M \leq 5.5$. B) Cumulative erupted magma mass for Quaternary volcanic events ($n = 130$). The colour code of the volcanic events corresponds to the colours of the magnitude bins in panel A. Details for both panels are given in Supplementary Tables S20, S21 and S22.

The respective volcanic events in the marine sediments are responsible for the production of at least $\sim 8.8 \times 10^{15}$ kg of cumulative magma mass since the Quaternary (Figure 3-10 B). The cumulative magma mass curve for the last 2.6 Myr (Figure 3-10 B) allows to suggest a link between eruption magnitudes and (cumulative) erupted magma mass. Four volcanic events with eruption magnitudes of M 8 ($7.5 \leq M \leq 8.5$) were identified and occur at (1) c. 310 ka (volcanic event *u15*), (2) c. 766 ka (volcanic event *u30*), (3) c. 808 ka (volcanic event *s40*), and (4) c. 913 ka (volcanic event *s51*) and all four examples are followed by a series of volcanic events. In addition, two of these events (*s40*, *s51*), if not three (*u15*) mark the onset of increased magma mass productions in a relatively short period of time leading to sharp jumps in the cumulative magma mass curve (Figure 3-10 B). Volcanic events *u15* and *s51* fall within the previously proposed times of increased volcanic activity (see subsection 3.9.1) and are responsible for an erupted cumulative magma masses of $\sim 6.0 \times 10^{14}$ kg at c. 300 ka and $\sim 9.0 \times 10^{14}$ kg at c. 900 ka. In comparison, the third period of increased volcanism at c. 1.8 Ma only produced a cumulative magma mass of $\sim 3.6 \times 10^{13}$ kg (Supplementary Table S22). The observed periods of increased volcanism (at c. 300 ka, c. 900 ka and 1.8 Ma) were each bracketed by periods of volcanic quiescence, or at least suppressed abundance of tephra deposits from eruptions $M > 5$. We

therefore interpret, that times of volcanic quiescence in New Zealand's marine Quaternary tephrochronostratigraphy are most likely times of volcanic recharge, where eruptions of magnitudes $M < 5$ are likely to be present before an ultra-Plinian eruption with a magnitude of $M 8$ occurs, which potentially triggers subsequent eruptions of smaller magnitudes ($M 5 - 7$). These large eruptions then potentially trigger subsequent eruptions of smaller magnitudes ($M 5 - 7$).

3.8.4 Potential mass transport deposits in Hole U1520D - perspective of the marine tephra record

One objective of drilling Hole U1520D was to identify sequences of mass transport deposits (MTDs), including the Ruatoria MTD (Barnes et al., 2019b), which was likely caused due to slope failure of the landward trench (Collot et al., 2001; Lewis et al., 1998). The Ruatoria MTD consists of several units, for example a blocky, debris avalanche ($3150 \pm 630 \text{ km}^3$) associated with a debris flow deposit (Collot et al., 2001) reaching over 100 km south and towards the present day location of Hole U1520D. Although mesoscopic evidence for a MTD deposit was not identified in the cores onboard of IODP Exp. 375, Unit II (110.5 to 220.0 mbsf) from Hole U1520D is interpreted as an intact regional block of the Ruatoria MTD (Barnes et al., 2019b). Such MTDs, especially when interpreted as an intact slide deposit, would usually lead to a “doubling” of specific features, like repeated sequences of tephra in sediment packages or repetitions of biostratigraphic marker horizons. This, however, is so far not described in proceeding studies. For example, within the proposed Ruatoria MTD, we identified several marine tephra layers. Three of these have an exotic and less evolved geochemistry when compared to the general rhyolitic TVZ: volcanic events *u6* (U1520D-18H-2, 108-110 cm, 158.81 mbsf, indirect age of 177.4 ka) with 68.9 wt% SiO_2 , *u7* (U1520D-18H-5, 123-125 cm, 163.51 mbsf, indirect age of 185.7 ka) with 71.27 wt% SiO_2 , and *u9* (U1520D-20F-1, 125-127 cm, 171.75 mbsf, indirect age of 200.5 ka) with 62.09 wt% SiO_2 (Supplementary Table S1). Following the assumptions that the Ruatoria MTD is an intact remobilised block, we would expect to recognise these geochemically exotic volcanic events somewhere deeper or shallower of the proposed MTD in the sediments of Hole U1520D, which is not the case. Our observation is in line with recently revisited biostratigraphic age-depth models that result in a continuous age-depth curve for Hole U1520D and no repetition of biostratigraphic marker horizons above or below the proposed Ruatoria MTD (Crundwell and Woodhouse, 2022b). In addition, the bulk-rock geochemical compositions of sediments of Hole U1520D (unpublished data, S.

Kutterolf and K. Pank) or clay assemblages (Underwood, 2020) do not show signs of a debris flow or MTD at Site U1520.

The presence of smaller-scale slides (<10 m) in Hole U1520D, however, can neither be excluded nor supported based on the tephra record, because high sedimentation rates at Site U1520 would probably mask those. In addition, some sediment successions were not recovered (either drilled through or washed down) leading to depth intervals with no recovery.

3.9 Conclusions

We established a comprehensive tephrochronostratigraphy for New Zealand's Quaternary volcanism based on intercalated marine tephra layers from IODP Exp. 375/372, ODP Leg 181, IODP Exp. 329 and DSDP Leg 90 east to southeast of New Zealand. All marine tephra layers were analysed for their major element compositions and selected tephras were additionally analysed for their trace element compositions. The resulting geochemical fingerprint, together with the stratigraphic context and indirect and direct age constraints of each marine tephra, enabled us to correlate between individual holes and drill sites across the study area, and to onshore deposits.

We identified 331 primary tephra layers in the marine sediments that correspond to 165 Quaternary volcanic events (*s1* to *s98* and *u1* to *u67*) and of these 35 were correlated to widespread Quaternary terrestrial tephra deposits. Several periods of increased volcanic activity were identified in the marine record and some of these are linked to an increased magma mass production, for example at c. 300 ka and at c. 900 ka. In addition, each onset of volcanism at c. 300 ka and at c. 900 ka is characterised by a volcanic event with an eruption magnitude of M 8, each occurring after times of volcanic quiescence or at least no visible tephra layer occurrence in the marine sediments. First tentative interpretations imply that periods of volcanic quiescence are followed by periods with increased volcanic activity, or vice versa, partly associated with large eruption magnitudes and erupted magma mass rates, potentially indicating an interlinked system of volcanic recharge and depletion before and after periods of volcanic highs or quiescence.

It should be noted, however, that these gaps in the marine tephra record might be artificial because first-order estimates of eruptive magnitudes show that the investigated volcanic events were deposited by eruptions with magnitudes of M 5 - 8. Ongoing volcanic activity with eruption magnitudes of M <5 might have occurred during the proposed times of volcanic quiescence without reaching in the marine environment or at least without forming discrete tephra layers. We therefore believe that the marine tephra record underestimates the volcanic

history of the TVZ, especially for volcanic events with eruptions magnitudes of $M < 5$. However, for most identified volcanic events our first-order estimates of tephra volumes are the only ones available, therefore they will be of value for future studies.

Even though our marine volcanic record is limited to deposits from magnitude $M \geq 5$ eruptions, holistic repose time estimates result in one eruption occurring every ~ 12 kyr for the last 1.6 Myr, and one eruption occurring every ~ 38 kyr between 1.6 to 2.6 Ma, and are therefore shorter than previous estimates for the TVZ.

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3.11 Data Availability Statement

All data produced during this study is publicly available in the Proceedings of the International Ocean Discovery Program (Pank et al., 2023a). The Neogene data set is published in Pank et al. (2023b).

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4 Study III

The subsequent chapter is published in *Geochemistry, Geophysics, Geosystems*. The supplementary data is provided in the original version of this manuscript.

Advances in New Zealand's tephrochronostratigraphy using marine drill sites: The Neogene.

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4.1 Abstract

Three volcanic arcs have been the source of New Zealand's volcanic activity since the Neogene: Northland arc, Coromandel Volcanic Zone (CVZ) and Taupō Volcanic Zone (TVZ). The eruption chronology for the Quaternary, sourced by the TVZ, is well studied and established, whereas the volcanic evolution of the precursor arc systems, like the CVZ (central activity c. 18 to 2 Ma) is poorly known due to limited accessibility to, or identification of, onshore volcanic deposits and their sources.

Here we investigate the marine tephra record of the Neogene mostly sourced by the CVZ, of cores from IODP Exp. 375 (Sites U1520 and U1526), ODP Leg 181 (Sites 1123, 1124 and 1125), IODP Leg 329 (Site U1371) and DSDP Leg 90 (Site 594) offshore of New Zealand.

In total, we identify 306 primary tephra layers in the marine sediments. Multi-approach age models (e.g. biostratigraphy, zircon ages) are used in combination with geochemical fingerprinting (major and trace element compositions) and the stratigraphic context of each marine tephra layer, to establish 168 tie-lines between marine tephra layers from different holes and sites. Following this approach, we identify 208 explosive volcanic events in the Neogene between c. 17.5 Ma to 2.6 Ma. This is the first comprehensive study of New Zealand's Neogene explosive volcanism established from tephrochronostratigraphic studies which reveals continuous volcanic activity between c. 12 Ma to 2.6 Ma with an abrupt compositional change at c. 4.5 Ma, potentially associated with the transition from CVZ to TVZ.

4.2 Plain Language Summary

Since 18 Ma volcanic activity at New Zealand is dominantly sourced by the Coromandel Volcanic Zone (CVZ). Most caldera systems of the CVZ identified so far are located on Coromandel Peninsula in the NW of North Island, New Zealand, but studies of the CVZ are rare mainly due to the limited accessibility of its volcanic deposits, as well as missing stratigraphic continuity between different outcrops and the volcanic source. Here, our ocean drilling tephra record - mainly volcanic ash from explosive eruptions, distributed and falling out over the ocean - has a great potential to reveal the eruption history of the CVZ, because it is preserved in marine sediments in a nearly undisturbed stratigraphic context. We analysed ~400 marine tephra layers from multiple ocean sediment cores off the coast of New Zealand for their geochemical glass compositions and identified 306 as largely undisturbed ash deposits. These primary ash deposits correspond to a total number of 208 Neogene volcanic events. Different dating methods result in a continuous marine tephra record for the last 12 Ma,

equivalent to a unique and most complete eruptive history for the CVZ. This enables us to further unravel changes in the composition of the associated magmas with time.

4.3 Introduction

Volcanic arc systems along plate boundaries are persistent systems that can exist in a relatively steady state over millions of years (e.g. active margin of South America; Booden et al., 2012). However, if subduction parameters change the associated arc volcanism can also change in space and time, ultimately affecting the geochemical and eruptive character of the corresponding magmatism. The plate boundary between the Pacific and Australian Plate in the southwestern Pacific is an example of an unstable convergent plate boundary with associated evolving arc systems since the Late Cenozoic (Booden et al., 2012) and New Zealand has been under the influence of the re-adjusting plate boundaries between the Pacific and Australian plates for the last 40 Myr years. Since 25 Ma years these tectonic changes are documented by evolving arc volcanism. The earliest subduction-related volcanic activity on the Zealandia continent was probably located along the Northland arc (Northland Peninsula, Figure 4-1A) with relatively silica-poor volcanism producing mainly basalts and andesites (Smith et al., 1989). Over time, the geochemical composition of the arc shifted towards andesitic and rhyolitic volcanism in the Coromandel Volcanic Zone (CVZ; Skinner, 1986), and finally to highly silicic volcanism in the Taupō Volcanic Zone (TVZ; Figure 4-1), which still represents the zone of active volcanism in New Zealand today (Booden et al., 2012; King, 2000; Wilson et al., 1995a). The TVZ is considered one of the most frequently active rhyolitic systems worldwide, having produced many caldera-forming eruptions from several prominent volcanic centres over the last two million years (e.g. Allan et al., 2008; Houghton et al., 1995; Pittari et al., 2021). In order to understand the full volcanic potential of the TVZ, estimate possible future shifts in geochemistry and thus explosive character of this volcanic arc, it is important to study the evolution of its precursory activity. Studies about the volcanic evolution of the Northland arc and volcanism at the Neogene CVZ are limited mostly due to the restricted subaerial accessibility of volcanic deposits and source volcanoes, or even their identification because of geomorphological, tectonic, and hydrothermal modifications over millions of years. However, the overall interest in the geochemical evolution of precursory arcs is rising and recent studies (e.g. Booden et al., 2012; Pittari et al., 2021) present detailed insights into the spatiotemporal evolution of CVZ volcanism. In order to study the long-term evolution of the CVZ and possible geochemical differences between the Quaternary and Neogene volcanic arcs, the establishment of a comprehensive eruptive history is required. Examples from other arc systems (e.g. Hellenic

arc, Central American Volcanic Arc; e.g. Kutterolf et al., 2021a; Schindlbeck et al., 2016a) have shown that nonerosive marine environments provide the most complete eruptive record of volcanic zones by preserving widely distributed volcanic ash (Carey, 2000; Carey and Sigurdsson, 2000; Keller et al., 1978; Kutterolf et al., 2008a, 2008b; Ledbetter, 1985; Schindlbeck et al., 2016a, 2016b, 2018b). Marine sediments can even conserve small eruptions which might not be preserved in the onshore sedimentary record, allowing the establishment of the most complete eruptive histories of volcanic regions found within these distal marine locations (Freundt et al., 2022).

In this study, we present new marine tephra layers from IODP Expedition 375 (proximal marine tephra record), and we revisit marine tephra layers from ODP Leg 181, IODP Leg 329 and DSDP Leg 90 (distal marine tephra record). The proximal and distal submarine tephra records are connected and integrated, allowing us to establish the most complete tephrochronostratigraphy of New Zealand's Neogene explosive volcanism.

4.4 Geological Setting

Neogene (23 - 2.6 Ma) volcanic-arc related edifices and volcanic deposits are found on the northwesternmost tips of the North Island, New Zealand; more specifically on Northland Peninsula and on Coromandel Peninsula, two parallel peninsulas associated with continental arc systems (Figure 4-1A; e.g. Adams et al., 1994; Booden et al., 2012; Briggs et al., 2005; Hayward et al., 2001; Herzer, 1995). On Northland Peninsula basalt- and andesite-dominated shield and cone volcanism with limited silicic activity were identified as products of the Northland volcanic arc (Smith et al., 1989). The onset of volcanic activity along the Northland arc is dated to c. 23.5 Ma (Hayward et al., 2001). From c. 18 Ma, while volcanic activity along the Northland arc decreased, the Coromandel Volcanic Zone (CVZ) became active and produced more evolved andesite- to rhyolite-dominated volcanism (Skinner, 1986).

Most subaerially identified volcanic deposits and edifice structures of the CVZ are located on Coromandel Peninsula. The Coromandel Peninsula is located at the continental tip of the extinct Colville Ridge which trends NNE and was active as early as c. 17 Ma. This coeval arc volcanism led to the interpretation of a single NNE-trending Miocene volcanic arc with a total length of ~2500 km (Herzer, 1995). From c. 12 Ma on, volcanism of the CVZ migrated over time from the NNW toward the SSE and ultimately to the central North Island (Figure 4-1B). Simultaneously the geochemistry of volcanism shifted from initially andesitic compositions to mixed basaltic, andesitic and rhyolitic compositions (Booden et al., 2012). These changes in geochemical compositions are most likely due to variations in the tectonic setting, e.g. during

phases of extension silica-rich volcanism is likely to occur (Booden et al., 2012). Since 3 Ma the spatiotemporal evolution of North Island volcanism reflects a south-eastward migration of the volcanic arc towards its present position on the central North Island along the TVZ. The temporal transition of volcanic activity from CVZ to TVZ is assigned to the onset of andesitic calc-alkaline volcanism, roughly dated to between 4 to 2 Ma (Carter et al., 2003; Houghton et al., 1995; Stipp, 1968; Wilson et al., 1995a; Wilson and Rowland, 2016), and the first volcanic activity attributed to the TVZ occurred at c. 2 Ma at Mangakino Volcanic Centre (MVC, Figure 4-1B) with increased silica-rich volcanism.

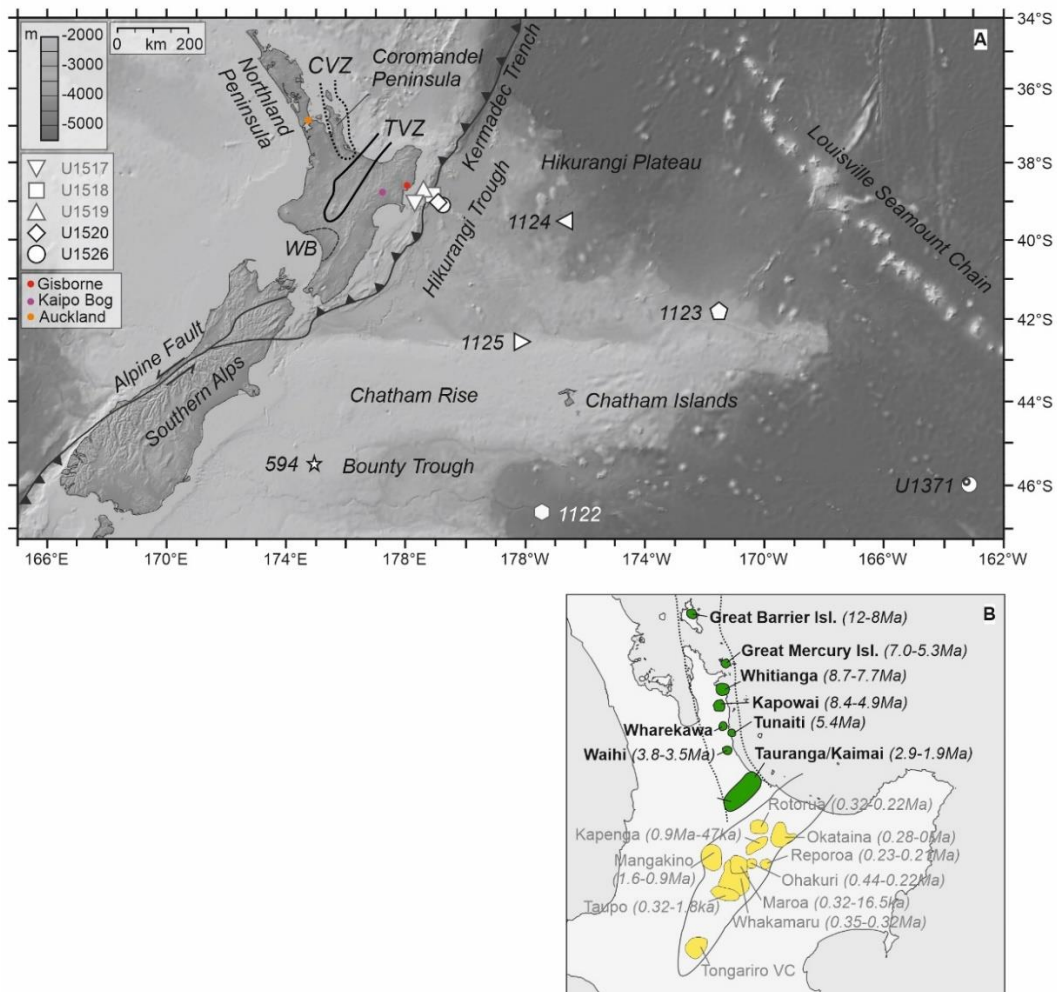


Figure 4-1 Overview map of New Zealand (A) with identified volcanic centres (B).

A) Overview map of New Zealand including simplified plate boundaries. Neogene sediments with intercalated tephra layers were recovered from Sites U1520 and U1526 (IODP Exp. 375), Sites 1123, 1124 and 1125 (ODP Leg 181), Site 594 (DSDP Leg 90) and Site U1371 (IODP Leg 329). CVZ: Coromandel Volcanic Zone, TVZ: Taupō Volcanic Zone, WB: Whanganui Basin. Map created with GeoMapApp, GMRT (Ryan et al., 2009). B) Identified volcanic centres of the Neogene CVZ (green signature) and Quaternary TVZ (yellow signature) after Briggs et al. (2005), Hopkins and Seward (2019) and Pittari et al. (2021).

4.4.1 Evolution of the CVZ

Earliest descriptions of volcanic deposits on North Island, New Zealand, are attributed to the discovery of gold in the mid to late nineteenth century and exploration of mineralised volcanic zones at Coromandel Peninsula. Skinner (e.g. 1976; 1986; 1993) regionally mapped and characterised volcanic deposits, but stratigraphic work concentrating on deposits and geochemistry was established more recently, mostly by Adams et al. (1994), Briggs et al. (2005) and Booden et al. (2012). The volcanism evolved through time erupting a range of calc-alkaline basaltic andesites, andesites and dacites. At c. 12 Ma the first rhyolitic eruptions have been identified, however there remains evidence of basaltic through to dacitic eruptions throughout the life-time of the CVZ (e.g. Adams et al., 1994; Booden et al., 2012; Skinner, 1986). Volcanism in the CVZ is thought to have initiated close to Great Barrier Island (Figure 4-1B) as basaltic (Mercury basalts) and andesitic rocks at c. 18 Ma, with Booden et al. (2012) concluding that volcanism in the CVZ occurred continuously until the inception of the TVZ. The authors state that the basalts and andesites of the early and later series of the CVZ are geochemically and isotopically comparable, likely indicating related magmatic processes or similar sources for the c. 16 Ma eruptive life-time of the CVZ.

Several silicic volcanic centres or calderas are currently recognised in the CVZ which have evolved in a southward progression through time: Great Barrier Island (c. 12 - 8 Ma), Great Mercury Island (c. 7 - 5.3 Ma), Whitianga (c. 8.7 - 7.7 Ma), Kapowai (c. 8.4 - 4.9 Ma), Wharekawa (not dated), Tunaiti (c. 5.4 Ma), Waihi (c. 4.5 - 3.0 Ma), Tauranga and Kaimai (Omanawa caldera, c. 2.9 - 1.9 Ma) (Figure 4-1B; Booden et al., 2012; Briggs et al., 2005; Hopkins and Seward, 2019; Pittari et al., 2021).

Studies about specific caldera systems of the CVZ are rare, however, the youngest two volcanic systems have more in depth studies published: (1) Waihi caldera (Figure 4-1B) dated as 4.5 - 3.0 Ma (Briggs et al., 2005), and 4.5 - 3.5 Ma (Julian, 2016) has been shown to have two eruptive episodes with associated ignimbrite deposits; Owharoa (c. 3.8 Ma) and Waikino (c. 3.5 Ma) (Brathwaite and Christie, 1996; Julian, 2016), and (2) Tauranga Volcanic Centre (TgaVC; Figure 4-1B) dated as c. 2.7 - 1.9 Ma (Briggs et al., 2005), and 2.95 - 1.9 Ma (Pittari et al., 2021 and references therein) consisted of andesitic to rhyolitic volcanism from two previously recognised volcanic centres (Tauranga and Kaimai, Figure 4-1B), with several ignimbrite-forming eruptions towards its end that may be related to the Omanawa caldera (Pittari et al., 2021 and references therein). The spatiotemporal transition of volcanic activity located at the CVZ to TVZ is still under debate, but Pittari et al. (2021) identified volcanic

deposits of potentially contemporaneous volcanic activity from the TgaVC (CVZ) and Mangakino Volcanic Centre (TVZ; Figure 4-1B).

4.4.2 Dispersal of volcanic material

Explosive arc volcanism is usually associated with large eruptions that widely disperse volcanic material, such as tephra, lahars and pyroclastic flows across land and oceans 10s to 1000s kilometres from source (e.g. Freundt et al., 2022 and references therein).

In New Zealand, westerly to south-westerly stratospheric winds transport tephra far offshore into the Pacific Ocean where the tephra is preserved in the marine sediments off the east coast (e.g. Carter et al., 2004; Allan et al., 2008). Additionally, rivers and re-entrants towards the open ocean cause a high terrigenous sedimentary input into the Pacific also transporting potentially reworked volcanic material from onland (Pouderoux et al., 2012). However, so far these studies (e.g. Pouderoux et al., 2012) mostly focus on the Quaternary tephra dispersal. During the Neogene, the dispersal of tephra might have been different to what is known for the Quaternary, for example, due to the influence of paleowinds and/or plate tectonics, but studies about regional-specific paleoclimate including wind directions for New Zealand are rare and mostly focus on glacial and interglacial cycles, or are poorly resolved in terms of local effects (e.g. Pole, 2003; Rea and Bloomstine, 1986). A comparison of tephra occurrence in drill sites from ODP Leg 181 (Figure 4-1A) and DSDP Leg 90 (Site 594 in Figure 4-1A, and Sites 592 and 593 west of New Zealand, not shown) shows the overall predominating westerly winds in New Zealand, leading to numerous macroscopic tephra layers in sediments from ODP Leg 181 and only very few macroscopic tephra layers in Sites 592 and 593 (Carter et al., 2004; Gardner et al., 1986; Nelson et al., 1986). Moreover, the arrangement of ODP Leg 181 drill sites provides insights into regional changes of paleowinds over the last twelve million years due to the occurrence or absence of tephras in the marine sediments of Sites 1123, 1124 and 1125. For example, between 11 to 9 Ma most tephras are present in Site 1125 (Figure 4-1A), whereas tephras are rare in Site 1124 or absent in Site 1123, indicating predominant winds towards the southeast (Carter et al., 2004). From 9 Ma on, most tephras are present in drill sites to the east (Sites 1123 and 1124), explained by increasing westerly winds, whereas from 7 Ma on intensified dispersal of tephra towards the south is observed (Carter et al., 2004).

Even though there seem to be shifts of tephra occurrence in the drill sites over time, the ODP Leg 181 sites were located further offshore from the volcanic source due to plate rearrangements until at least 4 Ma ago, generally limiting the ability of fallout tephra and

pyroclastic flows to reach the depositional environment (see subsection 4.9.2; Carter et al., 2004; King, 2000; Strogon et al., 2022).

4.5 Previous Neogene tephra studies

4.5.1 Onshore tephrostratigraphy

New Zealand has been in the focus of numerous tephra studies for >100 years, pioneered for example by Froggatt (1983) and Lowe (1990) who established the first approach for the geochemical fingerprinting of individual tephra layers of New Zealand's Quaternary volcanism using electron-probe microanalysis (EMP). Several detailed studies led to a precise reconstruction of the volcanic record of the last 61 ka (e.g. Hopkins et al., 2021b). Older Quaternary TVZ deposits and especially those older than the Whakamaru group ignimbrites (c. 0.35 Ma; Whakamaru Volcanic Centre; Figure 4-1B) are poorly constrained due to the fragmentary terrestrial record of volcanic deposits and the limited stratigraphic control of terrestrial deposits with unknown ages (Allan et al., 2008; Hopkins et al., 2021a; Shane, 2000; Wilson et al., 1995a). Moreover, the data of most studies are sparsely or not at all published, and often limited to major element compositions, hindering present studies to access and use the data. Studies with a specific focus on the Neogene volcanic history of New Zealand are even more rare and neither systematic, nor truly comprehensive as discussed in Hopkins and Seward (2019). However, in recent years more volcanological studies have been undertaken (e.g. Booden et al., 2012; Briggs et al., 2005; Hopkins and Seward, 2019; Julian, 2016; Pittari et al., 2021), improving the knowledge of volcanic onshore deposits, and therefore further facilitating the use of existing data for distant correlation purposes.

Entire tephra successions and cycles of volcanic activity can be investigated on North Island, New Zealand, because uninterrupted, marine sediment intervals were uplifted, e.g. in the Whanganui Basin and at Mahia Peninsula (Figure 4-1A). The Whanganui Basin contains a stratigraphic record of marine sediments with several intercalated tephra beds from c. 0.5 - 3.1 Ma (Grant et al., 2018; Naish et al., 1996; Pillans et al., 2005; Sefton, 2015), and Mahia Peninsula contains an up-lifted sequence of tephra deposits within marine sediments from c. 7 to 9 Ma (Shane et al., 1998). In addition, Hopkins and Seward (2019) sampled late Miocene to Pleistocene marine sediments from several terrestrial locations around Hawke's Bay (Figure 4-1A, large bay of the eastern North Island), and acquired a comprehensive Neogene terrestrial tephra data set including major and trace element compositions of volcanic deposits, and where possible direct ages of individual tephra beds (c. 1.6 - 7.0 Ma).

4.5.2 Previous marine tephra studies

Marine tephra studies have focused on tephra layers within marine sediments from ODP Leg 181 (~700 - 1100 km offshore; Figure 4-1A) covering the Quaternary (e.g. Allan et al., 2008; Alloway et al., 2005) and part of the Neogene (Carter et al., 2003, 2004; Stevens, 2010). Carter et al. (2003, 2004) established a c. 12 Myr long record for ODP Leg 181 Sites and analysed discrete tephra beds greater than 1 cm for their major element compositions and used combined paleomagnetic records, biostratigraphic datums and an orbitally tuned, benthic $\delta^{18}\text{O}$ record to obtain age models for the tephra record at Sites 1122, 1123 and 1124. These are assisted by direct age dating from glass isothermal plateau fission track ages from tephras of Site 1124. Site 1125 has a less-well constrained age model but the well-established biostratigraphic markers and paleomagnetic records of Sites 1123 and 1124, partly found in Site 1125 as well, enable an adaption of the age model for Site 1125 (Carter et al., 2004). Site 1125 records the oldest phase of increased CVZ volcanic activity between c. 10.6 to 10 Ma (Adams et al., 1994; Carter et al., 2004). The sediment record of Site 1123 is considered uninterrupted to 15 Ma and reliable to 20 Ma, except for two hiatuses each of <100 kyr. The record of Site 1124 is continuous to 11 Ma and reliable to 27 Ma, except for three mid-late Miocene hiatuses of 1.5 to 5.0 Myr duration (Carter et al., 2004). The most regular volcanic activity throughout the last c. 12 Ma is recorded in Site 1124, probably due to its proximity to the volcanic source area (Carter et al., 2004).

Stevens (2010) re-visited cores from Site 1124, sampled discrete tephra layers, and conducted major and trace element analyses which partly overlap between c. 2.1 Ma and c. 8.4 Ma with the ones studied by Carter et al. (2004). Periods of volcanic quiescence during the Miocene continued for c. 0.8 Myr, whereas non-tephra deposition during the Pliocene (late Neogene) was only <0.5 Myr (Stevens, 2010). Based on the number of eruptive events in Site 1124 Stevens (2010) calculated eruption frequencies of one eruption per 99 kyr for the late Miocene and one per 74 kyr for the Pliocene, however, Shane et al. (1998) suggest that the records of both depositional environments, terrestrial and marine, probably underestimate the volcanic activity of the CVZ.

4.6 Methods

4.6.1 Deep Sea Drilling Cores

During IODP Expedition 375, five proximal deep-sea sites (Sites U1517, U1518, U1519, U1520 and U1526) were drilled along a transect across the Hikurangi subduction margin ~40 -

100 km offshore of the North Island of New Zealand (Figure 4-1A). For this study, the drill sites U1520 (holes C and D), located in the Hikurangi Trough, and U1526 (hole A), located on Tūrangānui Knoll, are relevant. Sampling of discrete tephra layers occurred during the expedition. The proximal sediment record of IODP Exp. 375 is complemented by the distal deep-sea drill sites 1122, 1123, 1124 and 1125 from ODP Leg 181 located on the Hikurangi Plateau ~700 - 1100 km offshore to the south and southeast of the IODP Exp. 375 drill sites (Figure 4-1A). Tephra of Neogene age were identified mostly based on shipboard data and previous studies (e.g. Carter et al., 2004; Alloway et al., 2005; Allan et al., 2008) in Sites 1123, 1124 and 1125, and sampled at the IODP Gulf Coast Repository at Texas A&M University, College Station, Texas. Additionally, Neogene age deposits from cores from Sites 594 (DSDP Leg 90) and U1371 (IODP Leg 329) were resampled at the Gulf Coast Repository.

Our Neogene data set includes ~400 ash-rich samples. The complete data set (Quaternary and Neogene) including a detailed description of recovered sediments from individual drill sites, methods, and geochemical compositions is published in a data report by Pank et al. (2023).

4.6.2 Sample preparation

All marine tephra samples were disaggregated in an ultrasonic bath and, where applicable, carefully crushed with a mortar, and then wet-sieved with deionized water into the grain size fractions 63 - 125 μm , >125 μm and where necessary 32 - 63 μm . The samples were subsequently dried at ~50°C for at least twelve hours.

For the compositional analysis of the samples by electron probe microanalysis (EPMA) and laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) the 63 - 125 μm fraction of each sample is embedded with epoxy resin in a predrilled hole on an acrylic tablet (twelve samples per mount). The mounts are ground on sandpaper (four grit sizes) for two minutes each in order to remove excess resin, bubbles or scratches on the sample's surfaces. Subsequently and in order to ensure a smooth surface of each sample, the mounts were polished on a TegraPol-31 (Struers) using three diamond suspensions (9 μm , 3 μm and 1 μm) and corresponding polishing discs for four minutes each. The mounts were carbon-coated before analysis with the electron microprobe to ensure proper electron flow.

4.6.3 Analytical Techniques

4.6.3.1 Electron microprobe (EMP) and data reduction

Individual glass shard analyses, ~7,500 analyses in total, for major and minor (Na₂O, K₂O, FeO, SiO₂, Al₂O₃, CaO, TiO₂, MgO, MnO, P₂O₅) elements were conducted on epoxy embedded samples using a JEOL JXA 8200 wavelength dispersive electron microprobe (EMP) at GEOMAR Helmholtz Centre for Ocean Research Kiel (Germany) adopting the methods from Kutterolf et al. (2011). For every 80 individual glass shard analyses the standard materials Lipari Obsidian (rhyolite; Hunt and Hill, 2001) and VGA-99 (basalt from Makaopuhi Lava Lake; Jarosewich et al., 1980; Jarosewich, 2002) were repeatedly analysed (two measurements per standard) to monitor the accuracy of measurements. The resulting standard deviations over the entire measurement period are <6% for all oxides except for MnO (Supplementary Tables S3 and S4). Per sample, if possible, 20 individual glass shards were analysed and the compositions were averaged in order to geochemically characterize each individual tephra layer. In rare cases, for example if the sample was too altered, less than 20 glass shards were selected for analyses. Analyses with total oxides less than 90 wt% were excluded from the data set to avoid effects of alteration. However, exceptions were made for some tephra layers in Site U1520C where data acquisition was comparably difficult and some analyses resulted in totals <90 wt%. Accidentally measured microcrystals and glass shards with exotic compositions, compared to the average composition of the tephra layer, were excluded. All analyses were normalised to 100 wt% to eliminate possible effects of post-depositional hydration and minor deviations in the focus of the electron beam.

In total ~6,900 individual analyses passed the quality check as described above. Publication relevant geochemical data are given in the Supplementary Tables S1, and S7-S13.

4.6.3.2 Laser Ablation - Inductively Coupled - Mass Spectrometry (LA-ICP-MS) and data reduction

For each sample five glass shards were selected for trace element analysis. These glass shards were previously measured on the EMP in order to obtain their individual calcium and silica concentrations, which are used as internal standards to calibrate each trace element analysis. The trace element compositions were analysed on a Photon Machines Analyte G2 (193 nm) excimer laser ablation system linked to a high-resolution ICP-MS (Agilent 7900) at the Institute of Earth Sciences, Academia Sinica in Taipei (Taiwan) using the methods described in Kutterolf et al. (2021a). Data reduction was performed using GLITTER © software immediately

following each ablation analysis (van Achterberg et al., 2001). The international glass standard BCR-2G (Jochum et al., 2005) was analysed every ten individual measurements in order to monitor the accuracy. The repeated analyses of the standard material assured the correction of matrix effects and signal drift of the LA-ICP-MS, just as it monitors the differences of the ablation efficiency between sample and reference material (Günther et al., 1999). The reference material NIST SRM612 was used for external calibration, with reference data taken from Norman et al. (1996) (Supplementary Table S5). The limits of detection (LOD) for most trace elements is <100 ppb, for rare earth elements (REE) the LOD is around 10 ppb. The analytical precision compared to the international glass standard BCR-2G is generally better than 10% (except for Ta) over the entire measurement period (Supplementary Table S6).

We analysed ~170 Neogene samples for their trace element compositions, resulting in ~780 individual analyses. All data are reported in the Supplementary Tables S1, and S7-S13.

4.6.4 U-Pb zircon geochronology

U-Pb zircon ages were collected for selected tephra layers at Heidelberg University, Germany (Supplementary Table S2). Zircon crystals were embedded in epoxy, sectioned using SiC and diamond abrasives, and then imaged using a Gatan MiniCL cathodoluminescence detector (LEO 440 scanning electron microscope). Zircon U-Pb dating was conducted on a CAMECA IMS 1280-HR secondary ion mass spectrometer (SIMS) with a ~20 nA primary beam focused to a ~40 µm diameter spot. The zircon reference Temora 2 (417 Ma; Black et al., 2004) was used to calibrate relative sensitivities of U and Pb and after correction for common Pb using measured ^{207}Pb with a zero-age model Pb composition of $^{207}\text{Pb}/^{206}\text{Pb} = 0.836$ (Stacey and Kramers, 1975), individual $^{206}\text{Pb}/^{238}\text{U}$ ages were calculated. The ages were adjusted for initial disequilibrium with correction factors $D_{230} = 0.2$ and $D_{231} = 3$. Abundances for U and Th were estimated from measured $^{238}\text{U}/^{94}\text{Zr}_2\text{O}$ and Th/U with relative sensitivities of 0.00689 and 0.690 determined on reference zircon 91500 and Temora 2, respectively. Replicate analyses of reference zircon 91500 were performed to assure accuracy and obtained an average of 1064 ± 8 Ma ($n = 3$), in close agreement with the reported age of 1065 Ma (Wiedenbeck et al., 1995).

4.6.5 Correlation techniques and establishment of volcanic events

Correlating tephra layers between individual holes and sites is the foundation of our study, the establishment of an eruption chronology based on the marine tephra record. The correlations are primarily established on geochemical data (major and trace element compositions and their

ratios) and stratigraphic relationships (vertically within the recovered sediment) between neighbouring tephra. In addition, we compared the marine tephra by their visual appearance, for example macroscopically visible sedimentary structures, deposit colours, and grain size gradation. Before correlation, shipboard age models or previously published age models for the individual sites were applied, where applicable, and the approximate age of each tephra layer was calculated (see subsection 4.7.1). At first, correlations were established between the individual holes of a drill site (e.g. between Holes C and D of Site 1124) by comparing the geochemical compositions (e.g. Figure 4-4) with respect to their calculated ages. If more than three to four geochemical values (majors, traces or ratios) do not overlap within the analytical error, a correlation is excluded (individual exceptions may occur). When a tephra correlation between individual holes was proven solid (by applying the above-mentioned criteria of e.g. age, geochemical homogeneity and visual appearance), we tried to find correlatives in closely neighbouring drill sites. Subsequently, correlations to more distant drill sites were established. Ultimately, all correlated and uncorrelated tephra layers are ascribed to volcanic events for which individual correlation codes are assigned (*s1* - *s69* for correlated, *u1* - *u139* for uncorrelated events; Table 4-1 and Supplementary Table S1).

4.7 Results

4.7.1 Tephra ages

The marine sediments and tephra were dated indirectly and directly. Indirect dating methods are based on shipboard age-depth models mostly derived from biostratigraphic and paleomagnetic data for each site (e.g. Carter et al. 1999a, 1999b; Barnes et al., 2019b; Wallace et al., 2019b). Direct dating relies on U-Pb zircon ages for selected marine tephra layers (Table 4-1 and Supplementary Table S2), acknowledging that zircon crystallisation recorded by these ages can predate tephra deposition. Where possible, indirect age models were verified or improved with direct U-Pb ages.

Indirect age constraints were converted into age-dependent sedimentation rates, which were ultimately used for the age calculation of marine tephra layers. Linear interpolation was applied between two key tephra horizons resulting in average sedimentation rates throughout the sediment record. This method has an uncertainty between 1 to 14% of their age, which is comparable to the analytical error of direct age methods like U-Pb dating or better (Kutterolf et al., 2013, 2021b). The thickness of the tephra layers was not corrected for, potentially leading to an overestimation of the sedimentation rates. In addition, sediment compaction and drilling

disturbances, and possible small-scaled local reworking events cause difficulties in age calculations for different holes and sites leading to an over- or underestimation of the sedimentation rates. However, in line with previous contributions to the deep-sea drilling program, we chose to ignore corrections for the thickness of individual tephra layers, because their cumulative thickness of ~30 m compared to ~3500 m total recovery (Quaternary and Neogene tephra record) is negligible, and the resulting ages would still be within the analytical error of direct dating methods.

The Quaternary age models for IODP Exp. 375 sites are well established and proceeding studies resulted in high-resolution age models (e.g. ^{14}C -dating; Barnes et al., 2019b; Crundwell and Woodhouse, 2022a, 2022b; Woodhouse et al., 2022). Age models of the Neogene record of Exp. 375, however, have so far not been specifically addressed in preceding studies and we applied the shipboard age models for the calculation of the Neogene tephra record of Exp. 375 sites. In addition, few biostratigraphic marker horizons allowed to fine-tune the age model for tephras from Site U1520 (pers. comm. Martin Crundwell). For ODP Leg 181 Sites 1123, 1124 and 1125, Carter et al. (2004) established age models back to the Neogene and used a combined approach of paleomagnetic records, biostratigraphic datums, and an orbitally tuned benthic $\delta^{18}\text{O}$ record. These are assisted by glass isothermal plateau fission track ages from tephras of Site 1124. However, we found that previous studies use non-uniform depth units (metres below sea floor, “*mbsf*”; metres composite depths, “*mcd*”; revised metres composite depths “*rmcd*”) without further explanation. In addition, the shipboard composite profiles of drill sites from ODP Leg 181 (Carter et al., 1999b), with revised depths and ages, were probably not applied. Implications are discussed in subsection 4.9.1.

4.7.2 Tephra inventory and identification of primary tephra layers

The recovered Neogene sediments of IODP Exp. 375 and ODP Leg 181 are mostly pelagic and transition to hemipelagic towards the top. All available intercalated and discrete tephra layers or pods were sampled. In addition, discrete and intact tephra layers or pods of selected sediment intervals of Site 594 and Site U1371 were included in this study.

The thickness of tephra layers varies from a few mm to several cm, but ash-pods or dispersed ash are present as well. The tephra layers occur in several colours (Figure 4-2A - G) and the contacts to the surrounding sediments vary from sharp to wavy or diffuse, which are often the consequence of drilling or bioturbation, respectively (Figure 4-2A - G; c.f. Jutzeler et al., 2014). Analysed glass shards are mostly fresh and transparent (Figure 4-2H + K), however in some older sediment intervals (e.g., Hole U1520C) the glass shards were slightly altered (Figure 4-

2J). Intact and discrete tephra layers (Figure 4-2A + E) were not prioritized over disrupted or bioturbated tephra layers or pods (Figure 4-2B - D).

The integrity of each individual tephra layer was screened intensely, because only primary deposits are relevant for this study. The identification of primary tephra deposits is crucial because falsely identified primary tephra layers would increase the number of volcanic events during the Neogene. Vice versa, falsely identified reworked deposits, would lower the number of total events. Therefore, the geochemical composition and visual appearance of each tephra layer was checked first individually, and secondary within the stratigraphic context of the core and neighbouring tephra layers. Geochemically homogeneous, multi-modal or compositionally zoned tephra layers are considered primary, if surrounding (vertically) tephra layers differ in visual appearance and geochemistry. Tephra layers with mixed and genetically unrelated glass compositions are interpreted as reworked, especially when the tephra layers show visual signs of remobilisation for example due to bioturbation and drilling disturbances. If tephra layers with the same geochemical composition and visual appearance occur repeatedly in sediment intervals, usually the lowermost or most discrete tephra layer is considered as primary, whereas the other tephra layers are characterised as reworked (exceptions may apply).

The intense screening of each tephra layer, its surrounding sediment and vertically neighbouring tephra layers, ultimately allows us to establish a robust tephrochronostratigraphy of New Zealand's Neogene explosive volcanism based on primary marine tephra layers, that were deposited either by fallout, vertical density flows, PDCs, or syneruptive tephra driven coastal mass transports continuing as submarine turbidites (Carey, 1997; Jutzeler et al., 2017; Manville and Wilson, 2004). Despite our multi-proxy approach to identify primary versus reworked deposits, it is possible that not all primary tephra layers were identified, or reworked tephra layers were mistakenly characterised as primary ones. However, due to the large number of investigated tephra layers in our study, our time series for the Neogene is still the most comprehensive to date.

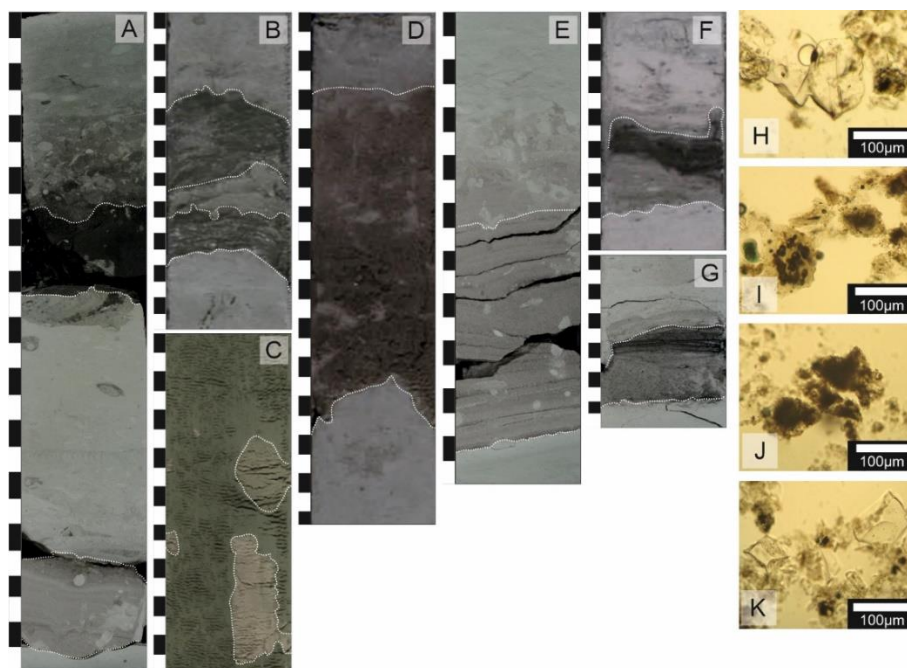


Figure 4-2 Examples of core sections with tephra layers and glass shards of marine tephra layers.

Please see Table 4-1 and Supplementary Table S1 for further explanations. A) Two tephra layers in U1520C-8R-5, 68-94 cm: mafic tephra with bioturbation (upper layer, *u133*), and undisturbed rhyolitic layer (*u134*). B) Rhyolitic tephra layer in 1125B-41X-5, 10-30 cm (*s60*) disturbed by drilling. Most likely the background sediment was squeezed into the tephra layer. C) Tephra layer, rhyolitic, in U1371D-11H-3, 40-58 cm (*s59**) disrupted by drilling. D) Sharp lower and diffuse upper contact of the rhyolitic tephra 1124C-16H-2, 0-27.5 cm (*s56*). E) Light grey tephra U1520C-9R-2, 2-22 cm (*u136*) of rhyolitic composition. The tephra layer shows an internal structure (slightly changing colours and grain sizes) that resembles bedding. However, the sample was taken from the lowermost part of the bed, ensuring its original composition. Towards the top the tephra layer was bioturbated. F) Rhyolitic tephra layer 1123B-24X-5, 60-75 cm (*s41*) with relatively sharp contacts to the surrounding sediment, a light grey coloured base and black top. G) Light grey, rhyolitic tephra layer U1520D-58X-1, 22-34 cm (*s12*) with a dark coloured top. The upper contact shows signs of drilling disturbance. H) Glass shard (left) with round vesicle in tephra U1520D-62X-2, 190 cm. I) Brownish glass with many vesicles in sample U1520C-4R-5, 109 cm. J) Glass shards in sample U1520C-11R-5, 63 cm. K) Y-shaped glass shards with remnant bubbles in tephra layer U1520D-62X-2, 190 cm.

402 ash-rich Neogene samples were recovered from the marine sediments and 306 of these are identified as primary. The primary tephras of the Neogene span a range from basaltic to rhyolitic compositions, however, the majority of tephras are rhyolitic with 73 to 78 wt% SiO₂ and 6.5 to 8 wt% Na₂O+K₂O (Figure 4-3A). 33 tephras are basaltic or basaltic andesites with ~50 to 61 wt% SiO₂ and 3 to 6 wt% Na₂O+K₂O. Four tephras have a dacitic composition with 64 to 68 wt% SiO₂ and ~5.5 to 6.5 wt% Na₂O+K₂O (Figure 4-3A). Two trachytic samples with ~69 wt% SiO₂ and ~8 wt% Na₂O+K₂O were identified in Holes U1520C and 1125B.

On a K₂O - SiO₂ classification diagram (Peccerillo and Taylor, 1976) most marine tephras fall within the calc-alkaline field (Figure 4-3B). Tephras with highest silica compositions trend towards and/or plot within the high-K calc-alkaline series (Figure 4-3B).

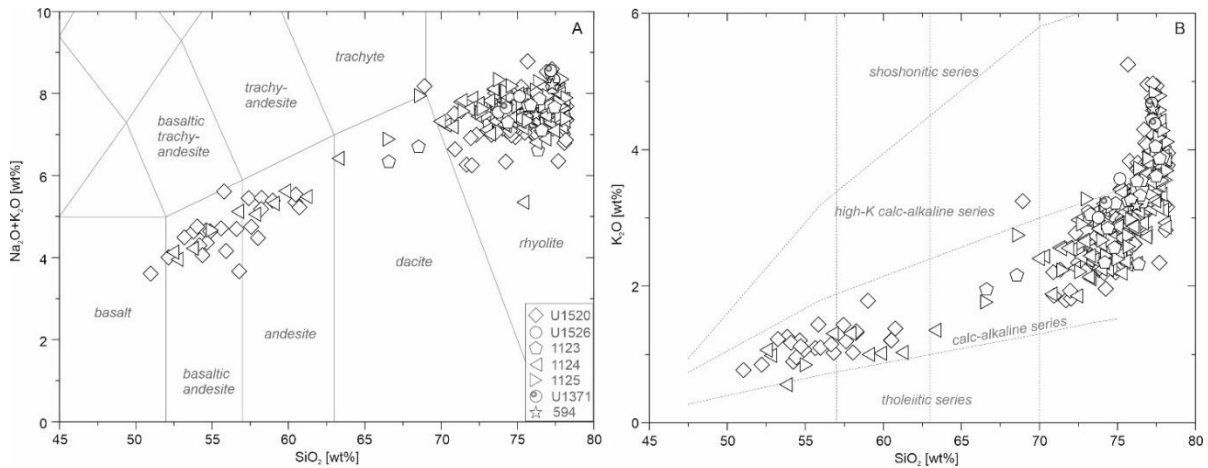


Figure 4-3 Total alkali versus silica diagram and K_2O - SiO_2 classification diagram.

A) Total alkali versus silica diagram after Le Maitre et al. (2002) showing the geochemical range of the primary marine tephra layers. Rhyolitic tephra layers clearly dominate at all sites, whereas basaltic to andesitic tephra layers are limited to Sites U1520, 1124 and 1125. Dacitic and trachytic compositions are rare (Sites U1520, 1123, 1124, 1125). B) K_2O - SiO_2 classification diagram after Peccerillo and Taylor (1976). The majority of marine tephra layers follow the calc-alkaline trend, some rhyolitic glass shards with high silica (≥ 75 wt%) tend towards the high-K calc-alkaline series.

4.7.2.1 Multi-modal and compositionally zoned marine tephra layers

26 tephra layers are identified as geochemically multi-modal characterised by two to three geochemical groups in at least one major/minor element. Volcanic events which include multi-modal tephra layers are highlighted with an asterisk (“*”, Table 4-1 and Supplementary Table S1). In addition, ~29 tephra layers with a zoned geochemical composition were identified. Compositionally zoned tephra layers are usually, but not exclusively, characterised by comparably heterogeneous compositions which form a geochemical trend in at least one major or minor element, resulting in exceptionally large standard deviations of >0.8 wt% (Supplementary Table S1). Based on the overall integrity of these multi-modal and zoned tephra layers (e.g. visual appearance and unique geochemical compositions in stratigraphic context) we interpret them as primary. In addition, most of these tephra layers are correlated across the study area underlining their primary origin.

Of all identified multi-modal tephra layers 14 were correlated between holes and sites ($s14^*$, $s24^*$, $s29^*$, $s33^*$, $s38^*$, $s39^*$, $s48^*$ - $s50^*$, $s52^*$, $s53^*$, $s57^*$ - $s59^*$, $s63^*$, $s64^*$; Table 4-1). The remaining twelve multi-modal tephra layers are uncorrelated, individual volcanic events ($u7^*$, $u11^*$, $u21^*$, $u29^*$, $u65^*$, $u101^*$, $u107^*$, $u119^*$, $u124^*$, $u126^*$; Supplementary Table S1). Sometimes, only one geochemical group of a multi-modal tephra layer was successfully correlated, whereas the second or third geochemical group has a different composition which is not repeated in

vertically neighbouring tephra layers (e.g. s64*). In other cases, one tephra layer spans the geochemical gap between correlated geochemical groups (e.g. s24*, s38*).

In the following some key correlated bimodal and compositionally zoned tephra layers are presented.

The youngest multi-modal volcanic event is s14* (c. 3.68 Ma; Figure 4-4A; Table 4-1) correlated between a bimodal tephra layer from Site 1123 (1123A-14H-3, 90-92 cm) and a compositionally zoned tephra layer in the neighbouring hole B (1123B-14H-5, 72-74 cm). The geochemical bimodality of this volcanic event is especially shown in SiO₂: the bimodal tephra has two compositional groups, one at 73.1 wt% SiO₂ (prominent group) and the second at 74.8 wt% SiO₂ (slightly less pronounced), whereas the zoned tephra is characterised by 73.2±1.6 wt% SiO₂ (Figure 4-4A). The individual glass shard analyses of 1123B-14H-5, 72-74 cm show no prominent geochemical grouping, but cover the entire compositional range of the bimodal tephra 1123A-14H-3, 90-92 cm. Volcanic event s29* (c. 4.88 Ma; Figure 4-4A; Table 4-1) comprises the bimodal marine tephra layers 1124D-10H-5W, 84-86 cm and 1124C-12H-2, 35-37 cm. The bimodality is especially shown in SiO₂, TiO₂, K₂O and FeO_t. For example, the low-silica group (~73.3 wt% SiO₂) has 0.5 wt% TiO₂, 2.1 wt% K₂O and 2.3 wt% FeO_t, whereas the high-silica group (~74.6 wt% SiO₂) has 0.45 wt% TiO₂, ~2.23 wt% K₂O and ~2.08 wt% FeO_t (Figure 4-4A). Volcanic event s50* is correlated across the study area between proximal Site U1520 (Hole D) and the distal Site 1124 (Hole C) and is indirectly dated to 7.06 Ma (Table 4-1). In Hole U1520D this volcanic event comprises a tephra layer that consists of two horizons which vary in colour and geochemistry. The bottom part of the tephra layer (U1520D-67X-1, 116-117 cm) is of brownish colour (~1 cm) with ~76.5 wt % SiO₂, 1.6 wt% FeO_t and ~3.5 wt% K₂O, whereas the upper part of the tephra layer (U1520D-67X-1, 115-116 cm) is grey-brown in colour (~1 cm) with ~ 75.6 wt% SiO₂, ~2.2 wt% FeO_t and 3.2 wt% K₂O (Figure 4-4A). Its correlative is the bimodal tephra layer 1124C-15H-5, 69-71 cm with one compositional group at ~76.5 wt% SiO₂, 1.6 wt% FeO_t, 3.4 wt% K₂O, and the second group at ~75.4 wt% SiO₂, 2.2 wt% FeO_t and 3.1 wt% K₂O (Figure 4-4A). The volcanic events s52* (c. 7.10 Ma) and s53* (c. 7.11 Ma) are established between a bimodal tephra layer from Hole 1124C (1124C-15H-5, 131-133 cm) and two neighbouring unimodal tephra layers from Hole 1124D (1124D-14H-3, 76-78 cm and 1124D-14H-3, 88-90 cm; Table 4-1), and are characterised by low silica compositions of ~74 wt% SiO₂ in volcanic event s52* whereas s53* has higher silica with ~76.5 wt% SiO₂ (Figure 4-4A). We believe that the bimodal character of the tephra in Hole 1124C is artificial potentially caused by drilling disturbance, whereas in Hole 1124D the geochemical signatures of both tephra layers remained intact.

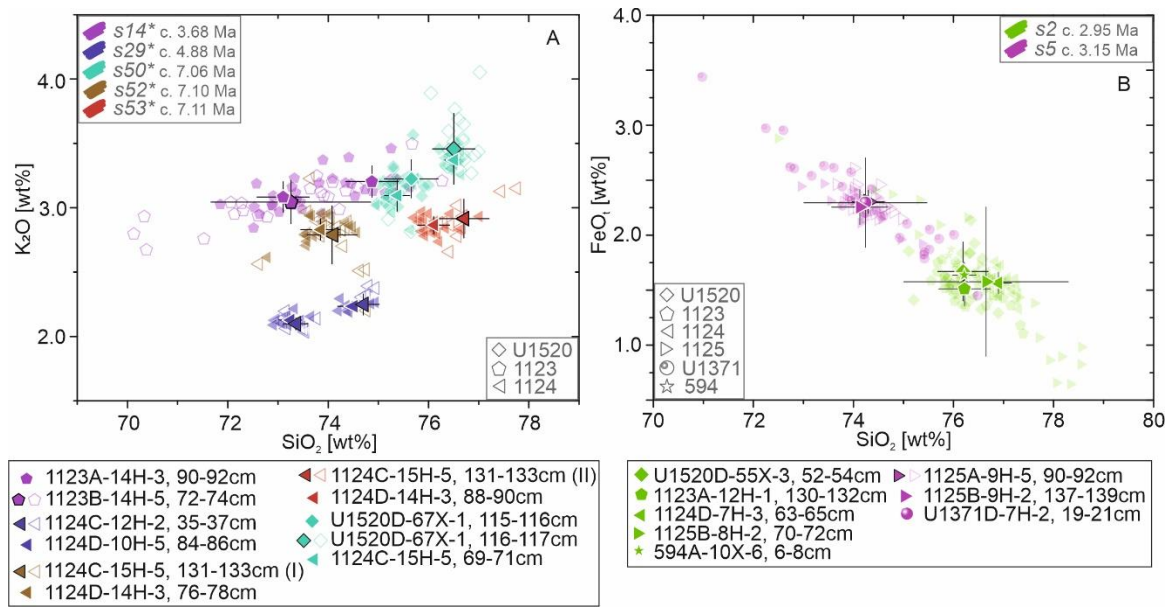


Figure 4-4 Examples of multi-modal volcanic events (A) and volcanic events with at least one compositionally zoned marine tephra layer (B).

The coloured and slightly transparent symbols (filled and open symbols) are single glass shard analyses and illustrate the overall geochemistry of correlated tephra layers. The larger symbols with error bars represent the average geochemical composition of the respective tephra layers.

Compositionally zoned tephra layers occur throughout the Neogene and many of these are uncorrelated with comparably low SiO₂ compositions (e.g. *u10*, U1520D-60X-1, 14-16 cm; *u42*, 1124D-13H-4W, 127-129 cm; Supplementary Table S1). But, zoned low-silica rhyolites (e.g. *s26*) with ~71.3 to 72.3 wt% SiO₂, or medium- to high-silica rhyolites (e.g. *s2* and *s5*; Figure 4-4B; Table 4-1) with ~76 wt% SiO₂ and ~74 wt% SiO₂, respectively, occur as well.

The youngest compositionally zoned tephra layer was identified in Hole 1125B (*s2*, c. 2.95 Ma; Table 4-1). *S2* is correlated between five holes (Holes U1520D, 1123A, 1124D, 1125B and 594A; Figure 4-1 A, Figure 4-4B). The tephra 1125B-8H-2, 70-72 cm is zoned in SiO₂, Na₂O, K₂O and FeO_t. While silica increases from ~72.5 to 78.5 wt%, K₂O increases from ~2.5 to 4.3 wt%, whereas Na₂O (~5.3 to 3.7 wt%) and FeO_t (~2.9 to 0.6 wt%; Figure 4-4B) decrease. The correlative marine tephra layers are not classically zoned, but largely overlap with the mean composition of the zoned tephra (Figure 4-4B). Volcanic event *s5* also comprises a zoned tephra layer (U1371D-7H-2, 19-21 cm) which spans a compositional range from ~71 to 76.5 wt% SiO₂ with ~3.5 to 1.5 wt% FeO_t (Figure 4-4B). Its correlatives, two tephra layers from Site 1125, are comparably homogeneous (~74 wt% SiO₂ and 2.3 wt% FeO_t) and only the tephra layer from Hole 1125B shows a slight geochemical trend dependent on mostly silica and iron.

4.7.2.2 Distribution of silica-poor tephra layers

35 Neogene marine tephra layers are characterised by <70 wt% SiO₂, and thus geochemically differ from the vast majority of analysed marine tephras with rhyolitic compositions (>70 wt% SiO₂; Figure 4-3). In total, these 35 silica-poor marine tephras correspond to 33 individual volcanic events (Table 4-1 and Supplementary Table S1).

The majority of silica-poor marine tephras occur in the proximal Site U1520, with four volcanic events (youngest to oldest: *u10*, *u35*, *u37*, *u45*; Supplementary Tables S1 and S7) between c. 4.99 Ma to 6.93 Ma in Hole U1520D, and 19 volcanic events between c. 8.21 Ma to 10.8 Ma in Hole U1520C (youngest to oldest: *u53*, *u69*, *u76*, *u82*, *u83*, *u85*, *u88*, *u94*, *u102*, *u103*, *u105*, *u107**, *u114*, *u115*, *u118*, *u121*, *u124**, *u132*, *u133*, *u135*; Supplementary Table S1). One silica-poor volcanic event was identified in distal Hole 1123B (*s63**) and was indirectly dated at c. 8.4 Ma. Two volcanic events were identified in Hole 1125B (*u7**, *u131*) and were indirectly dated at c. 3.84 Ma and 10.4 Ma. Another six silica-poor events are present between c. 5.0 Ma to 8.02 Ma in Site 1124 (hole C: *u11**, *u48*, *u51*; holes C/D: *s38**, *s47*; hole D: *u42*; Table 4-1 and Supplementary Tables S1, S9-S11).

The most continuous record of silica-poor explosive eruptions is preserved in the proximal marine Site U1520 (hole C) between 9.22 Ma to 10.8 Ma.

4.8 Correlations of marine tephras

Geochemical fingerprinting allows for the correlation between volcanic deposits of an unknown origin, like marine tephra layers, because magmatic processes, for example assimilation of continental crust or fractional crystallisation, leave behind unique geochemical signatures (Lowe, 2011). These processes are stored in the major and trace element compositions of volcanic glass. However, for New Zealand's volcanism it has been shown that the geochemical fingerprinting of volcanic deposits is not unambiguous but requires additional stratigraphic relationships and age constraints to produce confident correlations between volcanic deposits (Lowe, 2011). We therefore correlated the marine tephras using their geochemical fingerprint (major and trace element compositions, and trace element ratios), their stratigraphic contexts and site-specific age models, to establish (isochronous) tie-lines between the cores.

Following this approach, we established 168 tie-lines, correlating the marine tephra layers between holes and across the study area. The majority of correlations were established at Site 1124, followed by correlations at Sites U1520, 1123 and 1125. These 168 tie-lines of marine

tephra layers between holes or sites correspond to 69 individual volcanic events (*s1* to *s69*; Table 4-1).

In the following, key correlations from youngest to oldest are highlighted.

The youngest identified volcanic event was correlated between the Holes U1520D and 1124C, and is indirectly dated to c. 2.77 Ma (*s1*). In Hole U1520D *s1* consists of a ~3 cm thick tephra layer, whereas the thickness of the tephra in Hole 1124C is ~1 cm. The tephra is whitish to grey in colour and characterised by comparably high silica compositions (~77.4 wt% SiO₂; Figure 4-5A₁ and A₂). The second volcanic event (*s2*, indirectly dated to c. 2.95 Ma) was identified and correlated across the study area between Holes U1520D, 1123A, 1124D, 1125B and 594A. It is characterised for example by 76.2 to 76.9 wt% SiO₂, 1.51 to 1.67 wt% FeO_t and 1.12 to 1.69 wt% CaO (Figure 4-4B). In Site 1124, for instance, volcanic event *s2* was identified as a ~5 cm thick grey to brown tephra layer, whereas in proximal Hole U1520D the colour is brownish and the layer is slightly disrupted and <1 cm.

Four marine tephra layers, two from Site 1124 (holes C and D) and two from Site 1123 (holes A and C), were correlated and summarised in volcanic event *s4* (Table 4-1, Figure 4-5A₁ and A₂). In Site 1124 this volcanic event formed a c. 10 to 15 cm thick brown tephra layer, whereas in the more distal Site 1123 only 2.5 - 5 cm of volcanic ash were deposited. Volcanic event *s4* is characterised by ~76.4 wt% SiO₂, ~1.4 wt% FeO_t, ~3.2 wt % K₂O, and comparably high U/Er (~1.2 - 1.3) and Ce/Gd (~12 - 14.5; Figure 4-5A₁ and A₂). Volcanic event *s5* (c. 3.15 Ma) summarises three marine tephra layers correlated between Site 1125 (holes A and B) and the southeastermost Site U1371. It is the youngest Neogene volcanic event with ~74.2 wt% SiO₂, and comparably high FeO_t (2.3 wt%) and TiO₂ (~0.29 wt%) (Table 4-1). In Hole U1371D the tephra layer is compositionally zoned (Figure 4-4 B), of brown colour and ~2 cm thick. The volcanic event *s41*, indirectly dated to c. 6.08 Ma, was correlated between Hole 1123B and Site 1124 (holes C and D; Table 4-1). It is characterised by high SiO₂ (~78 wt%) and low FeO_t (~0.7 wt%; Figure 4-5B₁), and high U/Er (~1.7) and Ce/Gd (17.3 - 18.1; Figure 4-5B₂). In Hole 1123B the marine tephra is ~5 cm thick with a light grey bottom and dark grey coloured top (Figure 4-2F), whereas in Holes 1124C and D the tephra layers are roughly 10 cm thick, with a dark grey coloured base and a brown to beige coloured top. Volcanic event *s54* is correlated across the distal sites of the study area between Sites 1124 (holes C and D) and 594 (Table 4-1). It is indirectly dated to c. 7.13 Ma and has high silica compositions (~77.6 wt% SiO₂) with low FeO_t (~1.05 wt%) and Na₂O (~3.7 wt%) (Figure 4-5C₁ and C₂). In Holes 1124C and D this volcanic event is characterised by <10 cm of beige to light brown volcanic ash. The volcanic events *s58** (indirect age: 7.48 Ma) and *s59** (indirect age: 7.54 Ma) are correlated between Holes 1124C

and 1125B, and 1123B, 1125B and U1371D, respectively (Table 4-1). The marine tephra layer 1125B-40X-1, 148-150 cm is bimodal, with a low-silica group at ~ 75.6 wt% SiO_2 (s58*; Figure 4-5C₁) and a high-silica group at ~ 77.6 wt% SiO_2 (s59*; Figure 4-5D₁). The low-silica group is characterised by ~ 4.6 wt% Na_2O and ~ 1.8 wt% FeO_t , whereas the high-silica group has a lower Na_2O (~ 4 wt%) and FeO_t composition (~ 1.0 wt%; Figure 4-5C₂ and D₂). In Hole 1123B this volcanic event is characterised by a light grey colour with < 2.5 cm thickness, whereas in Hole U1371D s59* was identified as a disturbed beige coloured tephra layer (Figure 4-2C). The oldest volcanic event, s69, was indirectly dated to c. 11.3 Ma and correlated between Holes U1520C and 1123B (Table 4-1). This volcanic event is characterised by ~ 0.9 wt% FeO_t compositions and ~ 4.75 wt% Na_2O (Figure 4-5D₁ and D₂) at ~ 77.2 wt% SiO_2 . Volcanic event s69 deposited < 2 cm of volcanic ash, varying in colour from beige (Hole U1520C) to grey (Hole 1123B). Direct ages derived from U-Pb give an age of 11.9 ± 1.44 Ma for the marine tephra in Hole 1123B (Table 4-1), overlapping well with the indirect age.

4.8.1 Uncorrelated marine tephtras

139 marine tephtras could not be correlated, neither between holes nor sites and each uncorrelated tephra layer is interpreted as individual volcanic event (*u1* to *u139*; Supplementary Table S1).

The majority of uncorrelated tephtras are present in Site U1520 (95 marine tephra layers, 21 tephra layers in hole D and 74 in hole C). Most of these uncorrelated tephra layers occur between c. 10.8 Ma to 8.8 Ma (Hole U1520C), and thus represent the oldest continuous tephra record in our study (Figure 4-6). In Site 1124 we identified 24 uncorrelated marine tephra layers (hole C: 15, hole D: 9). The youngest uncorrelated tephra in Site 1124 was indirectly dated to c. 3.3 Ma (Hole 1124C) and the oldest to c. 17.4 Ma (Hole 1124C; Figure 4-6). 17 uncorrelated marine tephra layers were identified in Site 1125 (hole A: 2, hole B: 15). The youngest volcanic event in Site 1125 was indirectly dated to c. 2.6 Ma and the oldest to 10.4 Ma (Figure 4-6). In Hole 1123B one uncorrelated tephra is present (c. 5.13 Ma). One uncorrelated tephra was identified in Hole U1526A indirectly dated to c. 3.04 Ma, and one in Hole U1371D indirectly dated to 8.09 Ma (Figure 4-6).

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Table 4-1 Key major elements and trace element ratios for correlated marine tephra layers.

code	Sample ID	Age Ma	FeO _t wt%	SiO ₂ wt%	Ba/La	Rb/Nd
s1	U1520D 55X-1 111-113 1124C 8H-7 126-128	2.78	1.35 1.13	77.18 77.62	38.02	6.40
s2	U1520D 55X-3 52-54 1124D 7H-3 63-65 1125B 8H-2 70-72 1123A 12H-1 130-132 594A 10X-6 6-8	2.95	1.67 1.57 1.58 1.51 1.64	76.19 76.90 76.65 76.22 76.22	36.98 40.96	5.99 6.97
s3	1123C 11H-7 38-40 1526A 3R-1 78-79	3.00	1.84 2.06	75.69 75.15	33.18	5.42
s4	1124C 9H-3 17-19 1124D 7H-5 54-56 1123C 12H-2 74-76 1123A 12H-3 56-58	3.09	1.40 1.43 1.43 1.37	76.26 76.42 76.59 76.33	41.04 40.48 41.52	6.98 6.59 7.22
s5	1125B 9H-2 137-139 1125A 9H-5 90-92 U1371D 7H-2 19-21	3.16	2.26 2.30 2.29	74.13 74.30 74.24	32.19 32.40	5.80 5.57
s6	U1520D 56X-1 28-30 1124D 7H-6 92-94 1124C 9H-4 75-77	3.18	1.82 1.87 1.84	75.75 75.64 75.77	34.35 33.88	5.45 5.60
s7	1124D-7H-7 48-50 1124C 9H-5 33-35	3.25	3.80 3.66	70.03 70.37	37.48 36.85	3.36 3.52
s8	1124D 8H-1 17-19 1124C 9H-6 68-70 1123C 13H-4 67-69 1123A 13H-5 98-100	3.40	1.70 1.74 1.77 1.73	76.54 76.33 76.45 76.57	29.19 28.46	4.26 4.66
s9	1124C 9H-6 129-131 1124D 8H-1 73-75	3.40	1.61 1.57	76.11 76.47		
s10	1124C 9H-7 23-25 1124D 8H-1 117-119 1123B 14H-2 4-6	3.46	1.67 1.65 1.63	76.68 76.70 76.55	29.09 28.91	4.80 4.57
s11	1124C 10H-1 97-99 1124D 8H-3 96-98	3.58	2.15 2.08	75.21 75.34	30.33 30.14	5.50 5.40
s12	U1520D 58X-1 31-33 1124C 10H-1 124-126 1124D 8H-3 122-124 1123B 14H-3 140-145	3.60	1.40 1.20 1.16 1.25	77.33 77.20 77.51 77.48	35.12 33.24	6.53 6.37
s13	1124C 10H-2 48-50 1124D 8H-4 45-47 U1520D 58X-2 61-63	3.64	1.87 1.90 2.22	76.02 75.75 76.20	32.01	5.31
s14*	1123B 14H-5 72-74 1123A 14H-3 90-92 I 1123A 14H-3 90-92 II	3.68	2.58 2.70 2.19	73.26 73.10 74.87	30.01 31.21	5.32 5.50
s15	1124D 8H-5 2-4 1124C 10H-3 5-7	3.70	1.47 1.51	77.20 76.94	31.66	5.20
s16	1125B 11H-4 61-63 1125A 11H-7 52-54	3.72	1.76 1.73	77.06 77.22		
s17	1124D 8H-5W 120-122 1124C 10H-3 124-125	3.77	1.08 1.09	77.59 77.61	47.64	11.73
s18	1124D 8H-5W 136-138 1124C 10H-3 141-143	3.78	2.74 2.81	73.67 73.35	25.60	4.90
s19	1124D 8H-6W 4-6 1124C 10H-4 7-9	3.79	3.19 3.22	72.75 72.54	36.75	2.62
s20	1124C 10H-4 26-28 1124D 8H-6W 25-27	3.80	1.37 1.39	77.47 77.34	30.26	5.42
s21	1124C 10H-4 129-131 1124D 8H-6 128-130	3.86	2.28 2.24	73.55 73.56		
s22	1123B 15H-5 63-65 1123C 15H-4 50-57	3.99	2.08 1.99	76.11 75.86	28.75 29.06	4.38 4.57
s23	1124D 9H-1 83-85 1124C 10H-6 12-14	4.04	1.21 1.18	77.64 77.60	33.55 37.72	5.77 6.15
s24*	1124C 11H-2 130-132 1124D 9H-6 8-10 I 1124D 9H-6 8-10 II 1125A 15H-6 142-144 1124C 11H-3 40-42 1124D 9H-6W 69-71	4.34	1.88 2.24 1.29 1.27 1.26 1.23	75.33 73.52 77.42 77.97 77.67 77.82	26.65 44.75	4.06 7.25
s26	1124C 11H-6 91-93 1125B 19H-4 47-49	4.67	2.53 2.90	72.34 71.37	26.65	2.1

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Table 4-1 continued

code	Sample ID	Age Ma	FeO _t wt%	SiO ₂ wt%	Ba/La	Rb/Nd
s27	1124C 11H-7 30-32 1124D 10H-3W 109-111	4.72	3.07 3.05	73.93 73.76		
s28	1125A 20H-3 30-32 1124D 10H-4 66-68	4.78	1.99 2.09	74.50 74.90	28.87	2.16
s29*	1124D 10H-5W 84-86 I 1124D 10H-5W 84-86 II 1124C 12H-2 35-37 I 1124C 12H-2 35-37 II	4.89	2.11 2.30 2.37 2.05	74.48 73.24 73.35 74.70	26.41	1.87
s30	1124D 10H-6W 23-25 1124C 12H-2 119-121	4.94	1.25 1.31	77.23 77.34	38.82	8.81
s31	1124D 10H-6W 57-59 1124C 12H-2 143-145	4.95	2.79 2.79	72.54 72.95	28.12	2.81
s32	1124D 11H-1 33-35 1124C 12H-4 141-143	5.13	1.31 1.34	76.95 76.64		
s33*	1124D 11H-1W 49-51 I 1124D 11H-1W 49-51 II 1124C 12H-5 5-7	5.13	1.56 1.80 1.74	75.29 74.21 74.71	28.76	3.18
s34	1124C 12H-5 103-105 1124A 11H-2W 13-15	5.20	1.04 1.01	78.12 78.18		
s35	1124C 12H-6 121-123 1124D 11H-3W 65-67	5.30	2.05 2.10	75.34 75.15	28.37	4.47
s36	1125B 24X-4 84-86 U1520D 61X-2 42-43	5.41	2.69 2.57	72.39 73.36	26.88	2.10
s37	1124C 13H-4 74-76 U1520D 63X-3 32-34	5.74	2.01 1.96	74.32 74.88	28.02	3.84
s38*	1124C 13H-5 68-70 1124D 12H-2W 139-141 I 1124D 12H-2W 139-141 II	5.85	8.38 10.63 6.54	59.13 53.85 63.40	20.96 30.34 30.34	1.24 2.45 2.45
s39*	1124C 13H-6 20-22 1124C 13H-6 24-26 U1520D 64X-1 69-71 I U1520D 64X-1 69-71 II	5.87	1.62 1.28 1.48 2.05	75.45 76.95 76.79 74.45		
s40	1124C 13H-6 100-102 1124D 12H-3 28-30	5.91	1.27 1.30	78.01 77.67		
s41	1124C 13H-7 53-55 1124D 12H-4W 25-27 1123B 24X-5 69-71	6.08	0.70 0.73 0.77	78.04 78.18 77.93	35.96 35.46	9.13 9.18
s42	1124C 14H-1 111-113 U1520D 64X-3 36-38	6.14	1.13 1.04	77.44 77.77		
s43	U1520D 65X-1 110-114 1124C 14H-1 135-137 1124D 12H-5W 133-135	6.28	1.90 2.05 2.03	75.12 75.08 75.09	29.55 22.43	3.92 3.27
s44	U1520D 66X-2 88-90 1124C 14H-6 122-124 1124D 13H-4W 2-4	6.34	2.89 2.97 3.03	71.39 71.35 71.46	25.85 50.92	3.02 2.44
s45	1124C 15H-2 119-121 1124D 13H-6W 135-137	6.83	0.79 0.79	77.84 77.87		
s46	1124D 13H-7W 53-55 1124C 15H-3 38-40	6.87	2.31 2.36	71.90 71.81		
s47	1124D 14H-1W 135-137 1124C 15H-4 90-92	6.98	12.42 12.10	52.56 52.85	61.82 62.35	1.03 1.23
s48*	U1520D 67X-1 83-85 1124D 14H-2 16-18 II 1124D 14H-2 16-18 I 1124C 15H-4 106-108 U1520D 67X-1 91-92 1124C 15H-4 141-143	7.00	2.51 2.84 3.28 3.18 2.64 2.43	74.50 74.13 72.98 72.94 74.09 74.64	25.04 27.00	3.07 3.92
s49*	1124C 15H-5 38-40 I 1124C 15H-5 38-40 II 1124D 14H-2W 117-119	7.05	2.17 2.45 2.44	74.34 73.09 73.30	57.64	3.03
s50*	U1520D 67X-1 115-116 1124C 15H-5 69-71 II U1520D 67X-1 116-117 1124C 15H-5 69-71 I	7.06	2.18 2.21 1.60 1.58	75.66 75.37 76.50 76.51	26.35 38.15	4.33 6.88
s51	U1520D 67X-CC 17-19 1124C 15H-5 101-103	7.07	1.43 1.44	77.98 77.67	25.81	3.47
s52*	1124C 15H-5 131-133 I 1124D 14H-3 76-78	7.11	2.88 2.76	74.08 73.85	26.66 28.03	3.76 3.99

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Table 4-1 continued

code	Sample ID	Age Ma	FeO _t wt%	SiO ₂ wt%	Ba/La	Rb/Nd
s53*	1124C 15H-5 131-133 II 1124D 14H-3W 88-90	7.11	1.68 1.73	76.70 76.10	26.66	3.76
s54	1124C 15H-6 35-37 1124D 14H-3 132-134 594 36X-CC 10-12	7.14	1.05 1.05 0.98	77.31 77.41 77.27	38.39 30.41	8.82 6.97
s55	1125B 39X-3 136-138 1124C 16H-1 145-147 1124D 14H-6 35-37	7.30	2.52 2.71 2.74	75.18 74.20 74.16	23.07	3.48
s56	1124C 16H-2 18-20 1124D 14H-6W 51-53	7.36	1.46 1.53	75.72 75.55	23.07	2.21
s57*	1124C-16H-2 115-117 I 1124C-16H-2 115-117 II 1124D 14H-7W 20-22	7.42	1.93 1.43 1.22	75.67 77.02 77.08	75.09	6.95
s58*	1125B 40X-1 148-150 I 1124C 16H-3 134-136	7.48	1.93 1.76	75.58 75.26		
s59*	1125B 40X-1 148-150 II 1123B 29X-7 4-7 U1371D 11H-3 51-53	7.55	1.09 1.02 1.01	77.61 77.20 77.39	44.38 10.97 9.98	7.90 10.46 9.76
s60	1124C 16H-4 130-132 1123B 30X-3 100-102 1125B 41X-5 22-24	7.59	2.66 2.77 2.71	74.26 74.17 74.15	20.01 22.21	1.80 2.05
s61	1124C 17X-1 107-109 1123B 31X-4 67-69	7.94	1.48 1.53	76.32 76.36	32.41 34.09	4.32 4.57
s62	1124C 17X-5 11-13 1123B 32X-2 87-89	8.20/ 8.28±0.33	0.98 1.02	77.85 77.70	34.73 33.78	7.74 7.86
s63*	1123B 32X-5 47-49 I 1123B 32X-5 47-49 II 1123B 32X-5 47-49 III U1520C-2R-2 31-34 1124C 17X-5 116-118	8.23	4.22 4.91 2.16 2.10 2.15	68.53 66.57 74.38 74.70 74.20	27.96 27.96 27.96 27.41	3.76 3.76 3.76 3.61
s64*	1124C 18X-5 136-138 I 1124C 18X-5 136-138 II 1123B 34X-3 29-31	8.90	2.34 1.48 1.87	73.20 76.12 76.24	24.33 22.98	4.21 4.11
s65	U1520C 3R-2 70-72 1124C 18X-6 116-118	8.98	1.82 1.78	75.55 75.49		
s66	1125B 46X-3 72-74 U1520C 4R-1 0-2	9.45	0.94 1.11	78.10 78.21	23.14	4.59
s67	1125B 47X-4 65-67 U1520C-4R-1 54-56	9.53	1.83 2.21	75.84 75.71	27.17	3.19
s68	U1520C 8R-4 70-72 1125B 52X-5 117-19 1123B 40X-6 119-121	10.49	1.30 1.26 1.27	77.10 77.62 77.44	27.69 28.15	4.69 5.58
s69	U1520C 8R-5 133-135 1123B 43X-1 77-79	11.36/ 11.9±1.44	0.99 0.84	77.20 77.29	20.86 30.02	12.36 12.84

These correlations correspond to 69 individual volcanic events (s1 to s69). Volcanic events comprising bimodal or trimodal tephra layers (Sample ID plus “I”, “II” or “III”) are marked with an asterisk. Indicated ages per volcanic event are averages of indirect ages and, where applicable, direct U-Pb ages are given (s62, s69). We refer to the supplementary tables for geochemical data, standard deviations and ages of individual marine tephra layers.

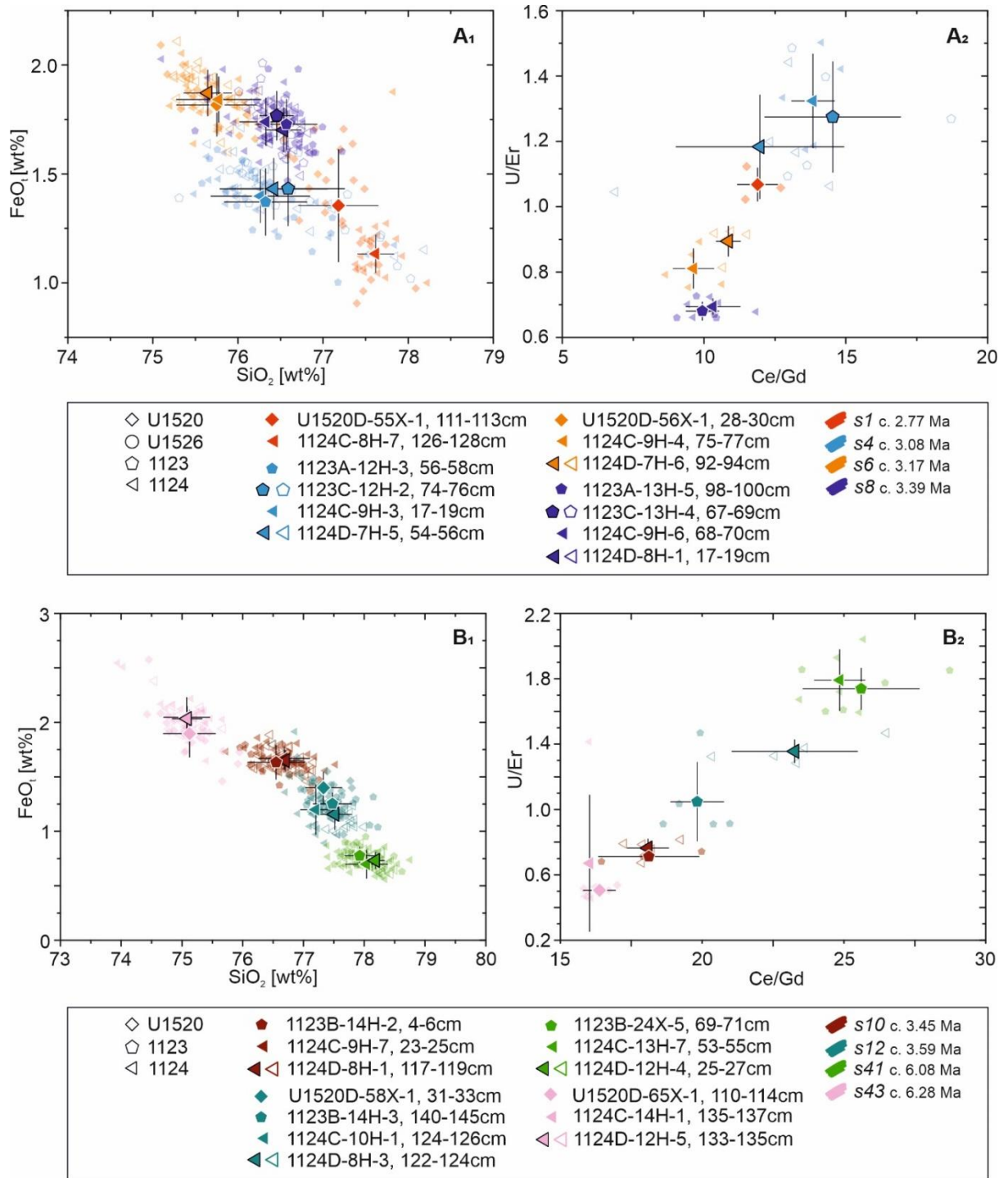


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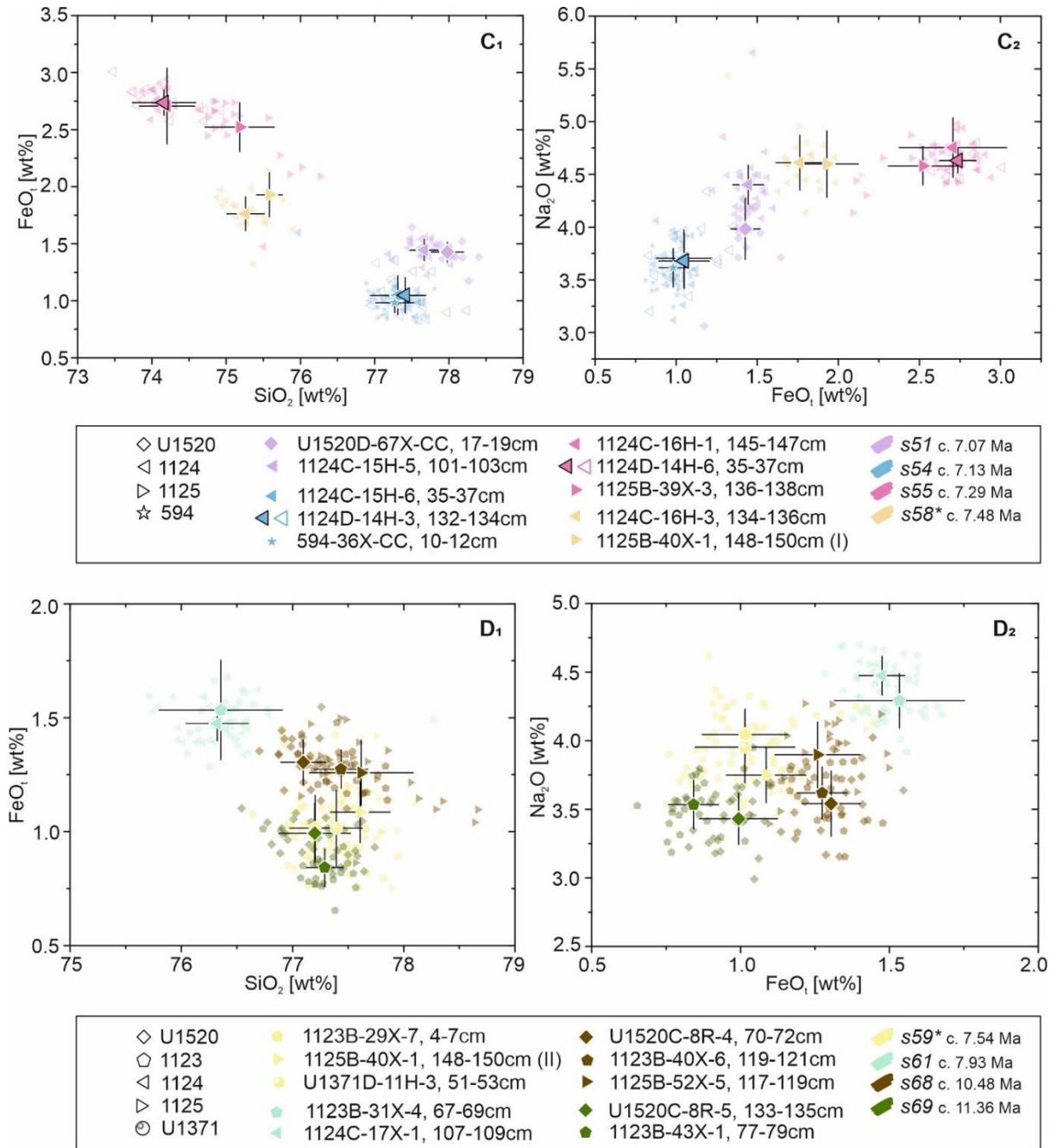


Figure 4-5 Harker and discrimination diagrams of Neogene tephra layers.

The tephra layers exemplarily show correlations between sites ascribed to 16 volcanic events (*s1*, *s4*, *s6*, *s8*, *s10*, *s12*, *s41*, *s43*, *s51*, *s54*, *s55*, *s58**, *s59**, *s61*, *s68*, *s69*; Table 4-1). The slightly transparent symbols (open and filled) are single glass shard analyses, whereas larger symbols (filled, black and white frames) with error bars are geochemical averages. Please note, not all tephra layers were analysed for trace element compositions (e.g. volcanic event *s1*, *A₂*).

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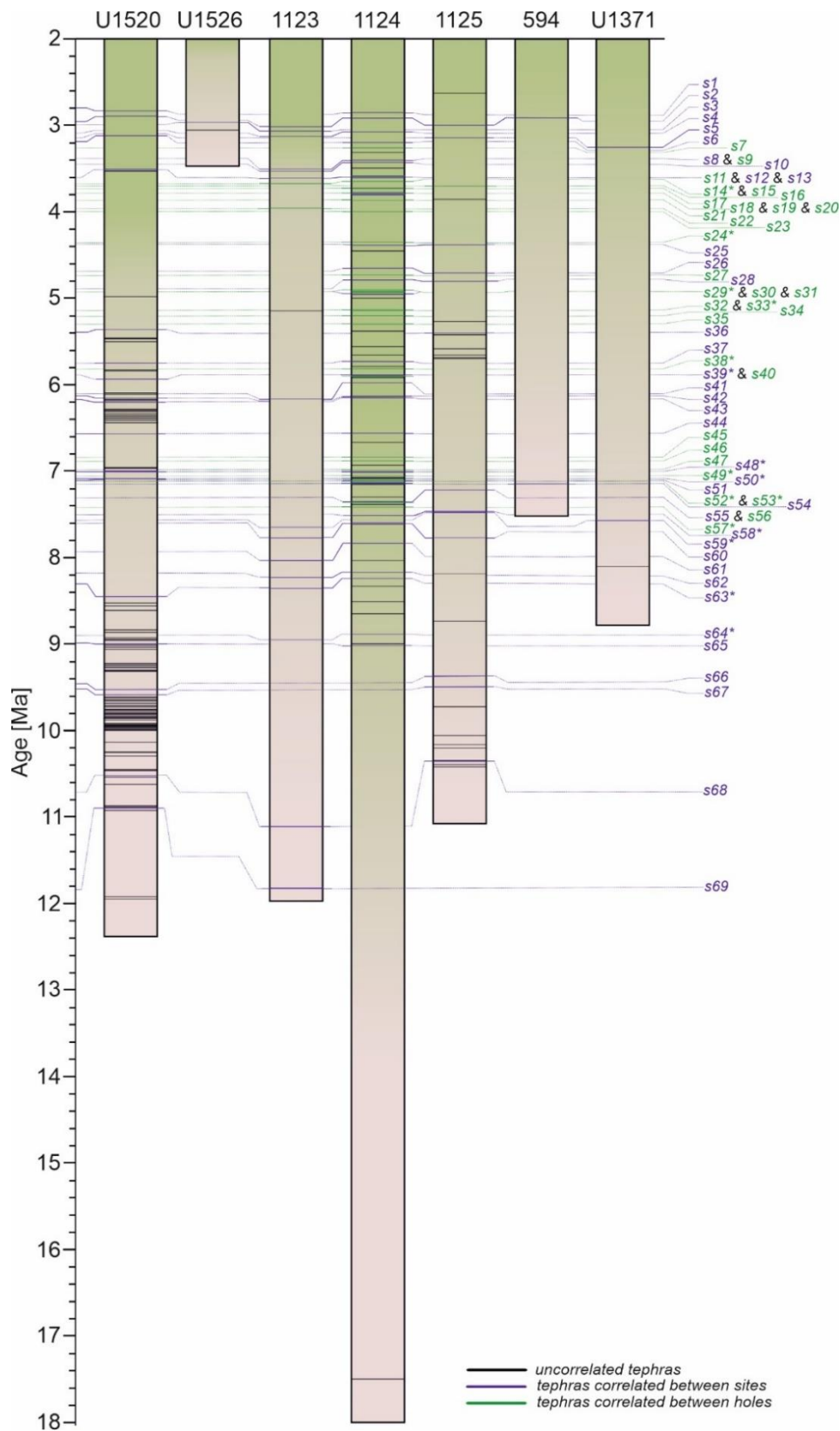


Figure 4-6 Core profiles showing the individual Neogene tephra layers.

Uncorrelated tephra (black), tephra correlated between holes (green) and between sites (blue) in hemipelagic (green) to pelagic (light pink) background sediment of Sites U1520, U1526, 1123, 1124, 1125, 594 and U1371. Explanations of correlation codes (s1 to s69) are given in Table 4-1, labels for uncorrelated tephra (u1 to u139, Supplementary Table S1) are not shown.

4.9 Discussion

4.9.1 Precision of age models

Neogene sediments with intercalated tephra layers were recovered from Site U1520 (Holes D and C), Site 1123 (Holes A, B and C), Site 1124 (Holes A, C and D), Site 1125 (Holes A and B), Sites 594 and U1371 (Figure 4-1A). For each drill site age models have been determined by micropaleontology and paleomagnetism for the respective expedition (subsection 4.7.1 Tephra ages) and, where applicable, subsequent studies improved the indirect dated age-depth models by direct dating or detailed biostratigraphic work. This is, for example, the case for age models of ODP Leg 181 sites, revisited in previous studies (e.g. Carter et al., 2004; Alloway et al., 2005). The ages for sediments from Site U1520 and Hole U1526A are mostly based on shipboard age models of IODP Exp. 375.

Exemplary observations are discussed in the following.

1) Reported offsets between splices of sites and individual holes of ODP Leg 181 sediments were most likely not corrected for in subsequent studies (e.g. Allan et al., 2008) and are therefore difficult to translate to our study. We have corrected the tephra depths of individual ODP Leg 181 sites from the composite stratigraphy site depths by applying the given offsets in Carter et al. (1999a), and as a result observe slight to significant age shifts. For example, the offset in the sediment interval where tephra layer 1123A-12H-1, 130-132 cm (s₂; Table 4-1) occurs, is an addition of +7.84 m to the mbsf-depths of each intercalated tephra layer in the sediment interval between 101.1 - 110.63 mbsf. This correction leads to an age of 3.05 Ma (with offset correction), whereas the age without offset-correction would be 2.84 Ma. Another example is volcanic event s₁₄* (Table 4-1), correlated between the marine tephras 1123A-14H-3, 90-92 cm and 1123B-14H-5, 72-74 cm. Without offset-correction from the composite depth, indirect dating of these tephra layers results in c. 3.43 Ma (Hole 1123A) and 3.43 Ma (Hole 1123B). With offset-correction, however, they are ~260 ka older and the individual ages result in 3.69 Ma (Hole 1123A; addition of +9.88 m in the sediment interval between 120.1-129.54 mbsf) and 3.66 Ma (Hole 1123B; addition of +8.6 m for the sediment interval between 117.4-126.88 mbsf). In general, the resulting age differences between offset-corrected and uncorrected ages increase with increasing depths of the sediments from <100 ka (interval: 0 to 50 mbsf), to c. 230 ka to c. 350 ka (interval: ~118 to 290 mbsf), or even 411 ka (interval: ~310 to 395 mbsf) for the deepest tephra layers in Hole 1123B. A direct comparison to previous studies focusing on Neogene tephras (Carter et al., 2004) is difficult because these authors do not refer to sampling depths of the tephras but use their own nomenclature. However, comparisons to the Quaternary tephra record show that the established ages for tephras studied in Carter et al.

(2004) and Allan et al. (2008) differ from our calculations. For example, the marine Quaternary tephra 1123B- 5H-3, 3-5 cm has an offset-corrected age of c. 857 ka. Its age without offset-correction is c. 792 ka and Allan et al. (2008) report an age of c. 991 ka. Based on the publicly available data we were not able to ultimately resolve this issue. However, the resulting age differences are generally within analytical error of direct dating methods, thus not relevant for the correlation purpose of this study, although it is important to use the consistently calculated corrected tephra ages in further studies.

2) A missing isotopic cycle in Site 1123 leads to an addition of 2.72 m to all data from sediment intervals deeper than cores 5H from Holes 1123A, 1123B and 1123C. Starting at cores 8H at Holes 1123C as well as 9H at Hole 1123A and 1123B an addition of 0.14 m to the cores is added on top of the previous given extensions (Hall et al., 2001; Harris, 2002). When applying these additional depth corrections, the re-calculated ages of marine tephras vary strongly from previously established age-depth constraints, with or without offset-correction, and become older, for example from 8.93 Ma to 9.03 Ma (1123B-34X-3, 29-31 cm, s64*; Table 4-1). This age shift alone would not be a problem, but the effects on established site to site correlations in the region (previously or within this study), for example between Sites 1123 and 1124, are large. Previous studies (e.g. Carter et al., 2004; Allan et al., 2008) refer to these corrections proposed by Hall et al. (2001) and Harris (2002). However, their indirect ages do not include the depth adjustments after Hall et al. (2001) and Harris (2002). Thus, we decided to follow their example and did not explicitly apply the corrections. Re-visiting previously and newly established correlations between ODP Leg 181 sites, in combination with direct zircon ages (this study, Supplementary Tables S1 and S2), support our approach.

3) Direct U-Pb age dating of zircons was carried out for five Neogene marine tephra layers (Table 4-1 and Supplementary Tables S1 and S2). For example, marine tephra 1123B-32X-2, 87-89 cm (s62, Table 4-1) was indirectly dated to 8.24 Ma (without offset-correction 7.91 Ma) and its direct U-Pb zircon age resulted in 8.28 ± 0.33 Ma, more closely aligned with the age assigned when the offset-correction is applied. This volcanic event was correlated to a tephra layer in Hole 1124C (1124C-17X-5, 11 - 13 cm) indirectly dated to 8.16 Ma, thus slightly younger than the proposed indirect age of this volcanic event in Hole 1123B, but still within the analytical error of the direct U-Pb zircon age. For Site U1520, however, the Neogene shipboard age model was less well constrained, leading to an offset of up to 2.5 Ma for the deepest tephra layers between the indirectly calculated ages and direct U-Pb zircon ages. Here, we adjusted the age-depth model by applying our direct U-Pb zircon ages and newly revised

biostratigraphic datums (pers. comm. M. Crundwell), resulting in a most robust age model for the Neogene sediments at Site U1520 to date.

4.9.2 Preservation of marine tephras

The drill sites cover a wide study area east to southeast to south of New Zealand and thus enable to establish first constraints regarding tephra dispersal and tephra preservation during the Neogene. Strogon et al. (2022) show the tectonic evolution of the continent of Zealandia and suggest that at 19 Ma our study sites in the East Coast Basin (Sites U1520 and U1526) would have been closer to the CVZ and Northland arc source volcanism than today. Between 19 Ma and 10 Ma, the East Coast Basin rotated clockwise away from the CVZ and Northland arc sources, and by 10 Ma the sites would have been close to their present-day locations (Strogon et al., 2022). Rifting of the TVZ occurs since c. 2 Ma and increases the distance between volcanic source and IODP Exp. 375 drill sites, however these small-scale plate motions are negligible for the purpose of this study. The drill sites from ODP Leg 181 are located on the incoming Pacific Plate which is subducted beneath North Island (New Zealand) since at least 20 Ma. The plate reconstructions from Strogon et al. (2022) imply that for example Site 1124 would have been located ~650 km further to the east from its present-day location at c. 10 Ma. Between c. 10 to 4 Ma the distance generally decreases but at c. 4 Ma Site 1124 would still have been ~300 km to the east from its present-day location (Strogon et al., 2022). Our oldest tephra layers from Site 1124 have therefore been deposited in sediments ~900 km more distal than today. This observation, which affects all distal drill sites, is considered in our discussions below.

Most marine tephras, correlated or uncorrelated, were identified in Site U1520 (116 tephra layers; at present c. 104 km E from Gisborne; Figure 4-1A) and Site 1124 (127 tephra layers; at present c. 486 km E from Gisborne), and to a lesser extent in Site 1125 (35 tephra layers; at present c. 540 km SE from Gisborne) and Site 1123 (22 tephra layers; at present c. 960 km SE from Gisborne). The tephra layers in Site U1520 occur between c. 2.68 Ma and c. 11.9 Ma with the highest concentrations between c. 6.1 to 6.4 Ma, and between c. 8.8 to 10.8 Ma (Figure 4-6). The latter time interval in Site U1520 is the oldest continuous Neogene tephra record present in our study (Figure 4-6). In comparison, the oldest continuous tephra record in Site 1124 ends at c. 9 Ma, in Site 1125 it extends to c. 10.5 Ma, whereas Site 1123 does not contain a continuous record, but more sporadic tephra occurrence back to c. 11.8 Ma (Figure 4-6). For Site 1124 intensified deposition of volcanic material is observed between c. 3 to 9 Ma resulting in a continuous tephra record during that time period (Figure 4-6). These changes in tephra

occurrence between the individual drill sites are most likely explained by re-arranging plate boundaries and plate motions during the Neogene (Carter et al., 2004; King, 2000; Strogon et al., 2022), (1) potentially hindering volcanic material reaching the depositional areas, (2) potentially favouring the deposition of volcanic material at one location over another, and (3) generally limiting the deposition of fallout at the very distal drill sites of ODP Leg 181 to only very large eruptions. An alternate explanation could be variations in dominant paleowind directions with time, leading to local accumulation (e.g. at Site 1124) or absence (e.g. at Sites 594 and U1371) of tephra layers in the marine sediments. Most likely both factors played a fundamental role in the distribution of volcanic material towards the marine environment east and southeast of New Zealand.

Marine tephra layers in the most southwestern Site 594 and southeastern Site U1371 are condensed in two intervals, between c. 2.9 - 3.1 Ma and between c. 7.1 - 8.08 Ma. At c. 2.95 Ma and 3.15 Ma two volcanic events are preserved at Sites 594 (s2) and U1371 (s5), then ~4 Myr pass without a single marine tephra layer in both sites in our tephra records. At c. 7.1 Ma we identified a tephra layer in Site 594 (s54), followed by two volcanic events forming marine tephra layers at U1371 (s59* and u52), indirectly dated to c. 7.54 Ma and c. 8.09 Ma, respectively (Figure 4-6, Table 4-1 and Supplementary Table S1). These marine tephra reaching the southwesternmost and southeasternmost study areas might be the deposits of exceptionally large eruptions similar to the recent Kawakawa/Oruanui super eruption that deposited volcanic ash as far as Antarctica (Dunbar et al., 2017). Examples from large eruptions of the Central American volcanic arc and the Japanese arcs show that those eruptions are able to influence and even modify or suspend the prevailing wind regimes even up to the stratosphere and therefore also the dispersal of ash in the known distribution pattern of smaller eruptions (e.g. Brenna et al., 2021; Cisneros de León et al., 2021). However, the thicknesses of respective tephra layers within the cores do not differ significantly, if at all, from other tephra layers, excluding this assumption. An alternate hypothesis for these periods of heightened tephra preservation is changes in the paleowinds transporting volcanic ash more dominantly towards the SW and SE of New Zealand. Both time intervals, between c. 2.9 - 3.1 Ma and between c. 7.1 - 8.08 Ma, are present in both distal drill sites, likely indicating the deposition of these tephra layers while the prevailing wind directions were unstable and changing.

4.9.3 Spatiotemporal compositional variations and new insights into the geochemical evolution from CVZ to TVZ volcanism

Next to the above discussed dispersal of volcanic material and probable changes in paleowinds, the extensive tephra record allows for a spatiotemporal geochemical comparison of the marine tephra layers present in the drill sites.

4.9.3.1 Spatiotemporal compositional variations

Generally, the marine tephra record from all drill sites show that New Zealand's Neogene explosive volcanism mainly produced silica-rich volcanic material of rhyolitic composition with only a few geochemical exceptions being silica-poor to mafic (Figure 4-3A).

We found that most silica-poor (<70 wt% SiO_2) volcanic events of the Neogene are present in the proximal Site U1520, and sporadically present in the distal Sites 1124, 1125 and 1123 (see subsection 4.7.2.2). The high abundance of silica-poor tephra in the proximal Site U1520 is most likely explained by the site's proximity to the volcanic source in the CVZ, because dense silica-poor tephra is not likely to travel as far as silica-rich tephra leading to a natural accumulation of silica-poor tephra closest to source (e.g. Pearce et al., 2020).

During the late Pliocene (c. 3.8 to 2.58 Ma) silica-poor marine tephra layers are absent in the marine sediments, except for one volcanic event at c. 3.84 ($u7^*$) present in Site 1125. Between c. 4.9 Ma to c. 8.2 Ma silica-poor volcanic events are equally rare, but present at c. 4.99 Ma ($u10$, Hole U1520D), c. 5.0 Ma ($u11^*$, Site 1124), c. 5.84 Ma ($s38^*$, Site 1124), c. 6.33 Ma ($u35$, Hole U1520D), c. 6.36 Ma ($u37$, Hole U1520D), c. 6.65 Ma ($u42$, Site 1124), c. 6.93 Ma ($u45$, Hole U1520D), c. 6.98 Ma ($s47$, Site 1124), c. 7.28 Ma ($u48$, Site 1124), c. 8.02 Ma ($u51$, Site 1124), c. 8.21 Ma ($u53$; Hole u1520D), and c. 8.23 Ma ($s63^*$, Site 1123; Supplementary Table S1). These volcanic events are characterised by varying silica compositions between ~ 51 - 66.4 wt% SiO_2 (Supplementary Table S1). Between c. 8.2 Ma to 9.2 Ma silica-poor volcanic events are absent again, before they become abundant and continuous until c. 10.8 Ma (Supplementary Table S1). The volcanic events during this 1.6 Myr time interval are characterised by low silica compositions mostly ranging between ~ 52.1 - 58.2 wt% SiO_2 (except for four volcanic events with ~ 60.4 to 68.9 wt% SiO_2). The temporal distribution of silica-poor tephra in the marine record is most continuous between c. 9.2 to 10.8 Ma and might reflect the overall geochemical evolution of the CVZ from a more mafic volcanic arc towards a more evolved silicic arc. An alternate explanation is an overall increased incidence of explosive silica-poor eruptions during the early stages of CVZ volcanism, large enough to reach

the submarine depositional areas. The absence of silica-poor volcanic events during shorter time periods, for example between c. 8.2 to 9.2 Ma, might be explained by local rearrangements between volcanic centres, maybe associated with fewer explosive eruptions.

Between c. 10.2 to 9.6 Ma silica-poor volcanic events are most frequent in the marine tephra record (Supplementary Table S1) and their abundance implies that mafic explosive eruptions occurred every ~12 kyr within this time interval. A more detailed study about eruption frequency, with regard to silica-poor volcanism, eruption magnitudes and potential climate interactions, will be addressed in a future study by the authors.

4.9.3.2 Geochemical evolution from CVZ to TVZ volcanism

The established detailed marine tephrochronostratigraphy allows preliminarily investigation into the temporal compositional variations within the respective record of New Zealand's volcanism.

Three periods of lower abundances of marine tephra layers from the Miocene to the Pleistocene are identified in our records (Figure 4-7). These are in the Late Miocene (9 - 8.5 Ma), the Middle Pliocene (4.7 - 4 Ma), and between the Pliocene and Pleistocene (2.9 - 2.5 Ma). This reduced tephra abundance in the marine sediments may be due to an incomplete tephra record within these time intervals, but also due to fundamental changes in the arc systems like local and regional tectonic rearrangements or global climate (e.g. Kutterolf et al., 2019; Schindlbeck et al., 2018a), which must be further investigated. Next to these times of quiescence, compositional trends are observed that may be related to either general trends of New Zealand's subduction systems, changes between the arc systems with time, or contribution from other volcanic sources. Tentative interpretations can be made on the base of the variations within trace element ratios regarding increasing or decreasing fluid and/or crustal contamination/interaction or variable melting degree (e.g., crust: Chen et al., 2020; Walker et al., 2007; Waight et al., 2017; fluids: Bolge et al., 2009; Carr et al., 1990; Elliott, 2003; Plank, 2014; Zamboni et al., 2016; melting degree: Münker, 2000; Pfänder et al., 2012; Zirakparvar, 2016).

1) Starting in the early Late Miocene (11 Ma) until the second and most pronounced gap in our tephra record, two (Figure 4-7C) to three (Figure 4-7E) distinct compositions can be identified within the tephra time series possibly indicating a different volcanic source for the related tephra associated with higher fluid (Figure 4-7C) and lower crustal (Figure 4-7E, F) interaction. This may be evidence for either an ultra-distal volcanic source (e.g. Smith et al.,

2016) for example one decoupled from the overall New Zealand subduction zone magmatism, or it represents a source that is placed behind the arc present in the respective time interval, facilitating a different fluid contribution to magma generation and less pronounced access to crustal contamination. In the scope of the regional tectonic setting as well as the thicknesses and grain sizes of the ash layers an ultra-distal volcanic source can be excluded and the second latter interpretation seems favourable. This group of different tephra compositions within this oldest time interval is accompanied by tephra layers with compositions that follow a similar trend/composition than shown by tephra related to the Taupō Volcanic Zone.

2) From the Late Miocene on, one can identify pronounced (Figure 4-7A, B, D) to vague (Figure 4-7C, E, F) continuous compositional trends within the entire tephra time series. An increasing signal of crustal interaction is paralleled by a decreasing degree of melting (Figure 4-7A, B, D, F).

3) The tephra compositions after the 0.7 Ma gap in the Middle Pliocene towards the Pleistocene have overall higher Li/Y, La/Yb, La/Sm, Nb/Yb and lower Zr/Rb ratios, indicating an overall decreasing signal of fluids and melting degree at the time with increasing influence of crustal interaction (Figure 4-7A, B, D - F).

4) Considering the geochemical signatures of the trace element ratios with time (Figure 4-7A, B, D), it seems that after a short period of volcanic quiescence at c. 4.5 Ma, the geochemical signature changed towards more TVZ-like compositions, potentially indicating that the geochemical transition from CVZ to TVZ started at around that time. This geochemical shift may be correlated with major changes in the degree of melting and crustal interaction as described above.

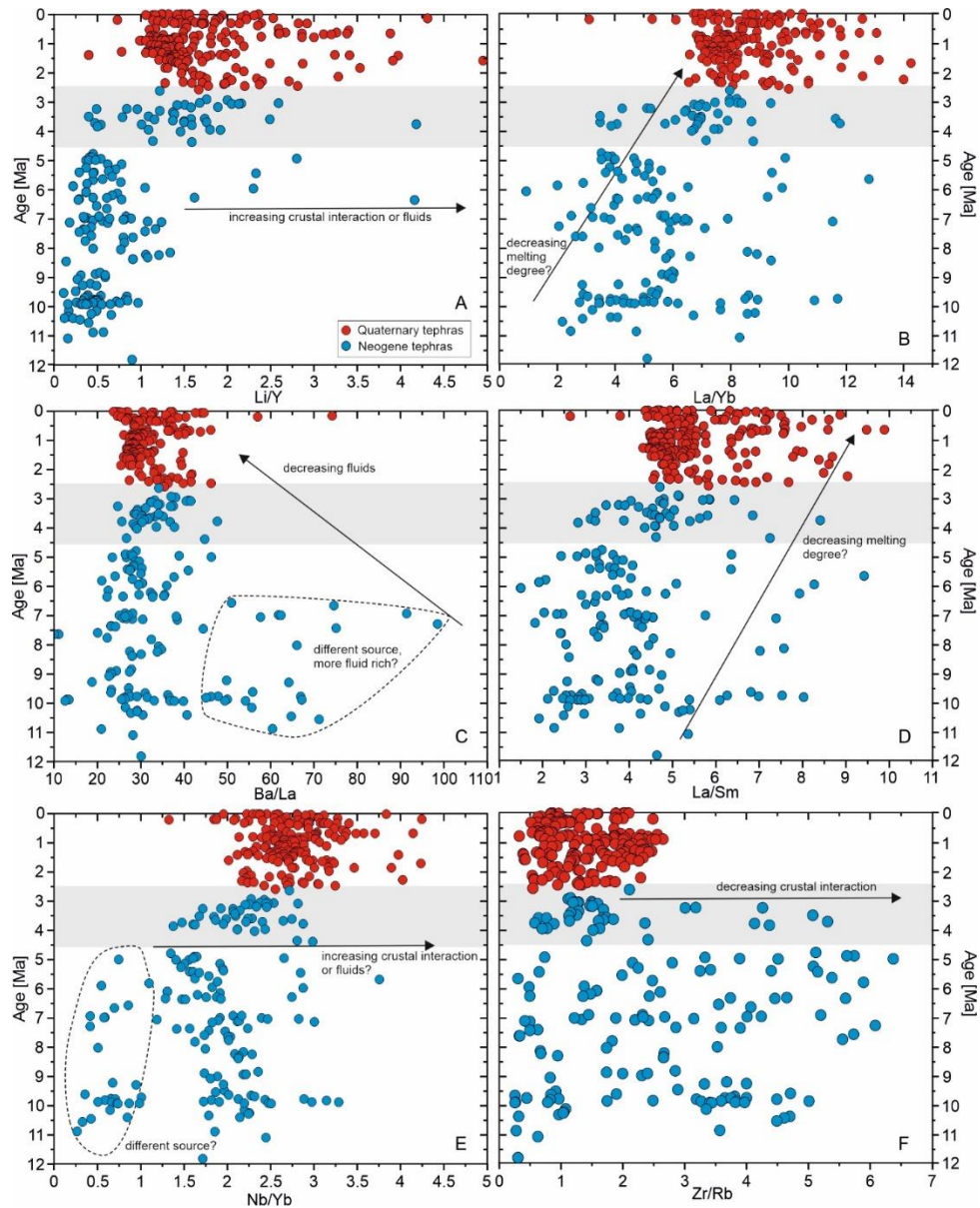


Figure 4-7 Geochemical evolution from the Neogene to Quaternary based on the marine tephra record.

Neogene volcanic events (blue circles) and Quaternary volcanic events (red circles). Quaternary marine tephra data from Pank et al. (2023). The grey bar extends from c. 4.5 to 2.5 Ma and probably represents a time of geochemical transition from CVZ to TVZ. Other volcanic sources contributing to the marine sediments are possible, as indicated by varying trace element compositions and ratios of some marine tephra between c. 11 to 5 Ma.

4.9.4 Neogene tephrochronostratigraphy and repose times

The marine tephra record of the Neogene presents intervals with increased numbers of intercalated marine tephra versus intervals of tephra absence within the marine sediments, which might be an indicator for increased explosive volcanic activity compared to no or only very few volcanic events (Figure 4-6). Overall, four main intervals with varying eruption

frequencies were identified and allow for a first holistic estimation of repose times for New Zealand's Neogene volcanism (Figure 4-8; Supplementary Table S14).

The oldest interval with fewest tephra abundance in the marine sediments is between c. 11.9 Ma to 10.6 Ma with one eruption occurring approximately every 310 kyr (Figure 4-8). This number is most likely not representative for New Zealand's volcanism at that time, since onshore records indicate continuous volcanic activity (e.g. Booden et al., 2012). We believe that the marine tephra inventory during this interval is incomplete, probably due to the distance between volcanic source and drill sites, and that the calculated repose time represents a maximum value. From c. 10.5 to 2.6 Myr the marine tephra record indicates continuous explosive volcanic activity with frequent tephra layers mostly in Sites U1520 and 1124 (Figure 4-6). Calculated repose times reveal that for the interval between c. 10.5 to 10.0 Ma one eruption occurred approximately every 36 kyr, and for the interval between c. 9.7 to 2.6 Ma slightly longer repose times with one eruption occurring every 47 kyr (Figure 8). Between c. 9.9 to 9.7 Ma, however, the calculated repose times are significantly shorter with one eruption occurring every 5.5 kyr (Figure 4-8). During this time interval of c. 200 kyr 38 volcanic events are present at Site U1520, probably indicating a short period of increased volcanism with comparably small eruptions only reaching the most proximal marine drill site.

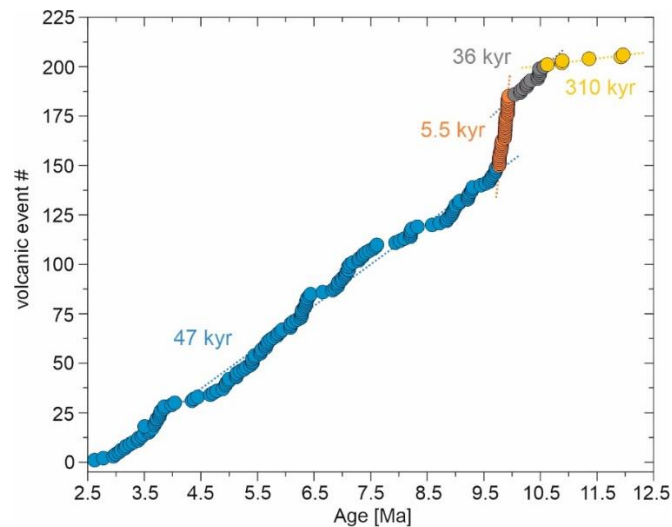


Figure 4-8 Repose times of New Zealand's explosive volcanism during the Neogene.

Four intervals (yellow, grey, orange and blue) with varying repose times over time were identified (e.g. between c. 9.6 Ma to 2.6 Ma one eruption occurred every 47 kyr) in the marine tephra record. Please find the calculations in Supplementary Table S14.

The calculated repose times give insights into New Zealand's Neogene explosive volcanism, but should be considered as maximum intervals of recurrence because the marine tephra record most likely lack deposits of small explosive and effusive eruptions. However, compared to

previous studies from Carter et al. (2003) and Stevens (2010) where the authors propose one eruption per 163 kyr (Carter et al., 2003) and one per 99 kyr (Stevens, 2010) for the Miocene and one eruption per 86 kyr and one per 74 kyr during the Pliocene, our repose times are the most accurate and detailed to date, revealing better variabilities over time, but overall are comparable and within the same order of magnitude.

4.10 Conclusions

We established a comprehensive tephrochronostratigraphy for New Zealand's Neogene volcanism based on marine tephra layers from IODP Exp. 375, ODP Leg 181, IODP Leg 329 and DSDP Leg 90, covering the proximal and distal marine environment to the east and southeast of North Island, New Zealand.

All ash-rich samples were analysed for their major element compositions, and selected samples were further analysed for trace element compositions, resulting in a geochemical fingerprint for each marine tephra. We combined the geochemical fingerprints, with the stratigraphic context and indirect and/or direct ages of each marine tephra layer, and identified 306 as primary. Correlations between marine tephra layers from individual holes and sites revealed 168 tie-lines, corresponding to 208 Neogene volcanic events. Of these, 69 were identified in several holes/sites (*s1* to *s69*), whereas the other 139 marine tephras are single hole or site-specific tephras (uncorrelated volcanic events *u1* to *u139*).

The marine tephra record is continuous until c. 12 Ma, with one additional volcanic event at c. 17.5 Ma (Site 1124). The most continuous tephra record was identified in Site 1124 between c. 2.8 to 9 Ma, whereas the tephra record from Sites U1526, 1123, 1125, 594 and U1371 are fragmentary but complementary, partly filling gaps or extending the record. In Site U1520 the tephra record is continuous between c. 5.8 to 6.5 Ma and between c. 8.8 to 10 Ma but fragmentary outside these intervals. Repose time calculations during the Neogene reveal four intervals with one eruption every 310 kyr between 11.9 Ma to 10.6 Ma, one eruption every 36 kyr between 10.5 Ma to 10.0 Ma, one eruption every 5.5 kyr between 9.9 Ma to 9.7 Ma, and one eruption every 47 kyr between 9.7 Ma to 2.6 Ma.

The preservation of marine tephra layers in different drill sites (proximal or distal) reflects plate motions since the Neogene and associated distances between volcanic source and depositional area, but also allows the interpretation of changes in paleowind directions with time. The preservation of tephras in the sediment record also allows for a general interpretation of phases with increased volcanic activity versus phases with decreased volcanic activity. These phases will be compared and contrasted with existing knowledge of the volcanic activity of the TVZ

in a future study by the authors to investigate patterns in eruptive behaviour with regard to climatic events.

The marine tephra layers of the Neogene span a compositional range from rhyolitic to basaltic, which has not been described before for New Zealand's Neogene explosive volcanism. In addition, some geochemical parameters, for example contamination specific trace elements and their ratios, show an abrupt geochemical change from c. 4.5 Ma on, likely related to the transition from the Neogene volcanic system (CVZ) to the Quaternary volcanic system (TVZ).

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4.12 Data Availability Statement

All raw data of geochemical microanalyses are published in the IODP Proceedings of IODP Exp. 372/375 in Pank et al. (2023).

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5 Study IV

The subsequent chapter is in preparation for submission to *Journal of Applied Volcanology*.
The supplementary data is provided in Appendix B.

From core to correlation: a methodical approach for marine tephrostratigraphy.

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5.1 Abstract

Over the decades the benefits of tephrochronology have increasingly been recognized in a variety of partly interdisciplinary studies where tephras, the deposits of explosive volcanism, were used as for example marker beds for correlations, time lines, event layers that caused slope failures, or indicators for changing subduction zone conditions with time. The recovery and preparation of tephras for mainly compositional analyses, however, is still challenging and a standardised or preferred procedure has not been uniformly presented.

Sea-going expeditions and the development of coring and drilling techniques enable the recovery of marine sediments. When operating close to volcanically active regions (i.e. individual volcanoes, volcanic arcs or centres) these marine sediments have shown to preserve deposits from volcanic eruptions in a stratigraphically intact context, and complement or extend the volcanic onshore records which are often incomplete due to burial or erosion. Several scientific coring and drilling techniques were developed over the years and specialised for the needs of scientific ocean coring (shallow marine coring) or drilling (deep ocean drilling), and each technique comes with its own benefits (e.g. core recovery, grade of disturbance) and limitations (e.g. in terms of sediment properties, core length and diameter). However, overall the benefits for marine tephrostratigraphic studies predominate and most sea-going expeditions, either shallow marine coring or deep ocean drilling, usually result in large sample numbers, often exceeding capabilities. Further treatment of the recovered tephras are comparably diverse ranging from single glass shard extraction (i.e. hand-picking of glass shards) to the bulk analysis of fractions and up to now both approaches were overall limited to a manageable number of tephras. In absence of procedures that also allow preparation and analyses of large quantities of tephras enabling research of entire volcanic arcs/fields/provinces during one short to medium term project.

We present a revised methodical approach covering core recovery, sample preparation, geochemical analyses, and ultimately the establishment of correlations between individual cores or to onland deposits. This approach is specifically designed and optimised for studies focussing on large sample quantities ($200 < \text{samples} < 1000$) and is therefore suitable for the investigation of entire volcanic arcs, centres and provinces during a comparably short to medium-term project. However, if needed otherwise, it can be easily adapted to fulfil the needs of any sample number and research discipline that is similar in terms of sample preparation and analytical instruments.

5.2 Introduction

The research field of tephrostratigraphy has a long history (e.g. Walker, 1971, 1973; Huang and Watkins, 1976; Ledbetter and Sparks, 1979; Westgate and Gorton, 1981; Ledbetter, 1985; Lowe, 1990) and targets volcanic deposits (tephra) that originate from explosive volcanic eruptions and that are deposited on the exposed earth's surface (terrestrial), in lakes (lacustrine) or on the seafloor (marine). Once deposited they occur as intercalated volcanic layers, also called tephra layers, within background sediments and can be used to correlate sediment successions, date sediments (*tephrochronology*; e.g. Thorarinsson, 1981; Shane, 2000; Lowe, 2011, 2014), and establish reliable and most complete explosive eruption records of entire volcanic arcs or individual volcanoes.

Previous tephra studies in volcanically active regions indicate that the terrestrial record is often incomplete mainly due to erosion or insufficient exposure of volcanic deposits (e.g. Carter et al., 2004; Kutterolf et al., 2008b; Hopkins and Seward, 2019; Freundt et al., 2022). Here, the research field of marine and lacustrine tephrostratigraphy is of growing interest. When operating close to volcanically active regions submarine environments have shown to provide better preservation and less erosion of sediments and therefore complement and even chronologically extend the terrestrial volcanic record (e.g. Carter et al., 2004; Kutterolf et al., 2008b; Stevens, 2010; Kutterolf et al., 2016; Schindlbeck et al., 2016; Pank et al., 2023b). For such studies, sea-going expeditions operating in the open ocean or on lakes as well as appropriate coring and drilling techniques are required. The sediment recovery generally depends on the applied coring/drilling technique in combination with the sediment properties, and usually ranges between several meters (coring) and up to several hundred meters (drilling) of sediments which corresponds to some hundred thousand years and up to several million years of sedimentation. The resultant number of tephra samples usually ranges between some tens to several hundred samples per study area and therefore often exceeds expectations, and preparation and analytical capabilities. Various methods to sample, analyse and interpret tephra samples are given in relevant literature (e.g. Watson et al., 2011; Wulf, 2014) but they are often limited to a very brief summary in the methods section of respective publications or they are entirely hidden. In addition, most approaches are often not viable for large sample quantities.

In this study we present an efficient methodical approach for marine (and lacustrine) tephrostratigraphic studies based on decades of experience in the fields of terrestrial, marine and lacustrine tephrostratigraphy. Our approach matches the needs of studies dealing with large sample quantities and mainly focuses on the topics: sampling, sample preparation, analyses, data quality control and data reduction, and correlations. Furthermore, we will describe

different coring and drilling techniques and highlight their benefits and limitations for marine and lacustrine tephrostratigraphic studies particularly using three exemplary tephrostratigraphic studies from New Zealand, the Aegean Sea, and Sumatra/Indian Ocean for illustration.

5.2.1 Brief introduction: tephrostratigraphy

Tephrostratigraphy describes the arrangement of volcanic deposits like tephra layers or pyroclastic flows from explosive eruptions within the background sediments indicating a temporal succession (e.g. Fisher and Schmincke, 1984).

Tephra (Greek: ash; Lowe, 2011) is a generic term for solid pyroclastic material like volcanic glass, crystals and lithics that is generated due to magma fragmentation during explosive eruptions. During such explosive eruptions, tephra is ejected through the vent and into the stratosphere potentially forming eruption clouds that can rise up to several tens of kilometres (>20 km). Once the eruption cloud reaches its level of neutral buoyancy it spreads laterally, predominantly in the direction of prevailing winds, and the tephra load starts to rain down (fall-out tephra) and settle on the earth's surface or seafloor. This dispersal mechanism can lead to the formation of tephra deposits up to several hundred even up to thousand kilometres away from the volcanic source (Pyle, 1989). Another depositional mechanism is associated with unstable and collapsing eruption columns that produce pyroclastic density currents which lead to the deposition of flow deposits (Lowe and Hunt, 2001) instead of fall-out tephra. Pyroclastic flow deposits usually occur very localised and close to the volcanic source, however, there is evidence for onshore and offshore pyroclastic flows travelling up to several hundred kilometres away from source (e.g. Los Chocoyos, Rose et al., 1987; Peach Spring Tuff, Roche et al., 2016; Kidnappers, Wilson et al., 1995). A relatively novel study field within tephrostratigraphy has evolved over the last three decades: the identification and classification of cryptotephra. Cryptotephra deposits are non-visible with the bare eye (Lowe, 2011) and require for example microscopic analyses or modern technology like CT imaging or XRF elemental analyses (e.g. Hopkins et al., 2021b) for successful identification. Although the term does not specifically refer to a grain size (Lowe and Hunt, 2001), cryptotephra deposits usually range between fine to very fine ash and mineral particles <125 µm. These fine volcanic particles are concentrated in different kinds of background material (lacustrine, marine and onshore sediments or ice) depending on the location of the volcanic source and predominant dispersal direction (Lowe and Hunt, 2001; White and Houghton, 2006; Alloway et al., 2007b; Lowe, 2011).

Probably most interesting for regional and supra-regional distributions are, however, fall deposits because their wide aerial distribution across sedimentary facies boundaries, instant emplacement after the eruption, (unique) geochemical composition that enables stratigraphic correlations, and their content of dateable minerals allocate fall-out tephra as excellent stratigraphic marker beds (Fisher and Schmincke, 1984). In combination with other volcanic deposits (e.g. pyroclastic flow and cryptotephra deposits) and age constraints the research field of tephrochronostratigraphy is a great tool for the establishment of entire eruptive histories of individual volcanoes or volcanic arcs and furthermore contributes to other geoscientific disciplines (marine geology and geophysics, palaeontology, paleoenvironment etc.; e.g. Harders et al., 2010; Pérez et al., 2021; Martínez-Abarca et al., 2022; Woodhouse et al., 2022; Luo et al., 2023).

5.2.2 History of marine coring and drilling

Sea-going scientific expeditions commenced at least in the 1900s century for example on the British vessel *HMS Challenger* which was used to investigate the ocean floor between 1871 to 1876 (e.g. Becker et al., 2019). The principles for scientific marine (and lacustrine) coring campaigns, however, blossomed since the early 1950s and developed ever since in order to recover longer and intact sediment successions in increasing water depths (e.g. Emery and Dietz, 1941; Mortimer, 1942; Kullenberg, 1947; Phleger, 1951; Livingstone, 1955; Craib, 1965; Wright, 1967; Patterson et al., 1978; Gilbert and Glew, 1985; Reasoner, 1986; Nesje, 1992). Mainly piston corers and gravity corers were used at that time and further developed to fulfil different scientific needs until present (e.g. larger core diameters, lighter coring equipment). Over the last years, advanced techniques were developed (e.g. Giant Piston Corer or MARUM-MeBo drill rig) and enable the recovery of up to 80 m of marine sediments (Weaver and Schultheiss, 1990; Freudenthal and Wefer, 2013).

First drilling projects were performed at around 1940, operated on the Swedish research vessel *Albatross* using a piston corer (worldwide expeditions and recovery of long piston cores from the seafloor; e.g. Bornmalm et al., 2023). In 1961 one of the first US scientific deep ocean drilling campaigns, financed by the National Science Foundation (NSF), was conducted under the name Project Mohole (targeting the Mohorovičić discontinuity between the earth's crust and mantle, e.g. Riedel and Ladd J., 1961). This campaign used the drilling platform *CUSS* that firstly enabled scientific work in deep waters because the vessel was equipped with a dynamic positioning system (Riedel and Ladd J., 1961). Although this project was not completely

successful (Greenberg, 1964), it had a great impact on the scientific community as it was the predecessor of the following Deep Sea Drilling Project (DSDP), the first official scientific ocean drilling program.

DSDP commenced in 1966 and was a cooperation between four major US oceanographic institutions (e.g. Becker et al., 2019). Expeditions took place since 1968 on the newly built scientific drill ship *Glomar Challenger* and mainly operated in the Atlantic, Pacific, and Indian Ocean, as well as in the Mediterranean and Red Seas. DSDP pioneered and advanced ocean drilling and coring operations and one of the most important scientific discoveries of DSDP was the proof for plate tectonics, continental drift and rifting as proposed by Alfred Wegener (Expedition DSDP Leg 3; e.g. http://deepseadrilling.org/i_reports.htm and Becker et al., 2019). Furthermore, technological advances like the re-entry cone (1970), hydraulic piston corer (1979), or the extended use of holes after drilling (e.g. instalment of long-term seismic equipment) were developed during the time of DSDP. In total, 96 expeditions were completed and the deepest penetration was about 1.74 km below the seafloor (<http://deepseadrilling.org/about.htm>). In 1975 first international collaborations arose, including contributions from Germany, Japan, UK and France aboard the *Glomar Challenger* and in postcruise research. These international contributions were intensified during the proceeding deep ocean drilling program, the Ocean Drilling Program (ODP), financed by NSF and international collaborations (Smith et al., 2010). The program was specifically designed for science and started in 1983. The expeditions were conducted on the scientific drill vessel *Joides Resolution* which had a number of onboard laboratories for first analyses (e.g. Becker et al., 2019). ODP conducted 110 expeditions with about 2000 drill holes in the world's ocean basins all over the world (<http://www-odp.tamu.edu/sched.html>) and aimed for global scientific problems, for example the sea level rise and periods of extreme climate (Smith et al., 2010). A detailed summary of DSDP and ODP achievements is presented in Coffin and McKenzie (2001).

In 2003 the Integrated Ocean Drilling Program (*IODP*) was initiated, a program that was financed by 26 participating nations. This program was built upon international collaborations and the scientific success of preceding drilling projects and included operations from multiple drilling platforms (refurbished *Joides Resolution*, new Japanese marine-riser vessel *Chikyu*, and specialised Mission-Specific-Platforms; Becker et al., 2019 and references therein). The new fleet enabled more expeditions to yet unexplored areas of the ocean (e.g. explore high-latitudes or shallow waters; Smith et al., 2010). Major achievements of the first phase of IODP are summarised in Stein et al. (2014). Since 2013 to present drilling operations are conducted under

a new name, the International Ocean Discovery Program (*IODP*), to facilitate the international funding of 24 member-countries (Becker et al., 2019). This second phase of IODP for example enabled drilling near the poles and within the Great Barrier Reef to investigate past climatic and tectonic changes (Smith et al., 2010). In 2009, the entire fleet (*Joides Resolution*, *Chikyu*, and a mission-specific-platform) was active at the same time but in different research areas, marking a high point for the program and providing new insights on fundamental scientific questions (Smith et al., 2010).

5.3 Offshore investigations - a recipe for successful tephra recovery

5.3.1 Pre-site surveys

Coring and drilling campaigns require pre-site surveys in order to find promising coring/drilling locations. During gravity coring campaigns, these surveys are usually undertaken while being at sea without the need of a preceding research expedition whereas deep ocean drilling campaigns require the information long before the start of the expedition, acquired during preceding research expeditions, as they are mandatory for cruise proposals.

The success of especially gravity coring relies on a good bathymetry complemented by sub-bottom echosounder data of the study area. Both are usually taken shortly before the gravity cores are deployed and offer insights into the nature of the seafloor and its sediments. The bathymetry data is used as first parameter, if available even before the start of the expedition. For choosing a coring location bathymetric heights or depressions are usually promising for gravity cores, whereas slope settings or erosional canyons are not. Bathymetric lows often result in a better recovery in terms of distinguishable layers in the marine sediments and usually high-resolution age models due to higher sedimentation rates, but inhibit the risk of remobilised sediments (i.e. turbidites) from surrounding slopes. Bathymetric heights are usually characterised by condensed sediment successions (long time scales of sedimentation preserved within reduced stratigraphic thicknesses) but inhibit the risk of being too compacted for penetration, often resulting in short recovery, and having indistinguishable tephra layers due to low sedimentation rates. The bathymetry should be complemented by sub-bottom echosounder (parasound) data which enables to identify individual layers or sediment packages as it penetrates up to several tens of metres into the subsurface on a dm resolution scale, and therefore visualises for example stratified sediments or chaotic sediment packages (Figure 5-1).

Study IV

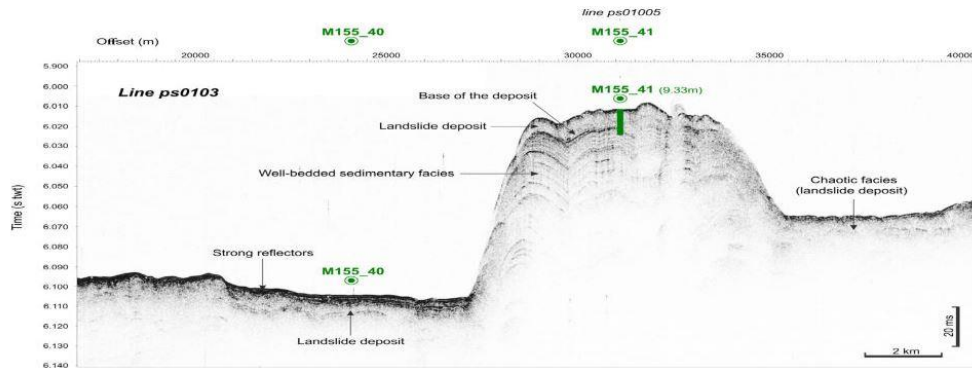


Figure 5-1 Exemplary sub-bottom echosounder profile used for the selection of coring locations during M155.

During the R/V Meteor expedition M155 in 2019 the pre-site survey for an IODP proposal was conducted. Therefore, sub-bottom echosounder data was complemented by a seismic survey and several gravity corer locations. Gravity corer location M155_40 was not successful, as the corer could not penetrate into the strong reflecting sediments. Location M155_41, located on a bathymetric high, recovered 930 cm of stratified deposits. Image from Krastel (2019a).

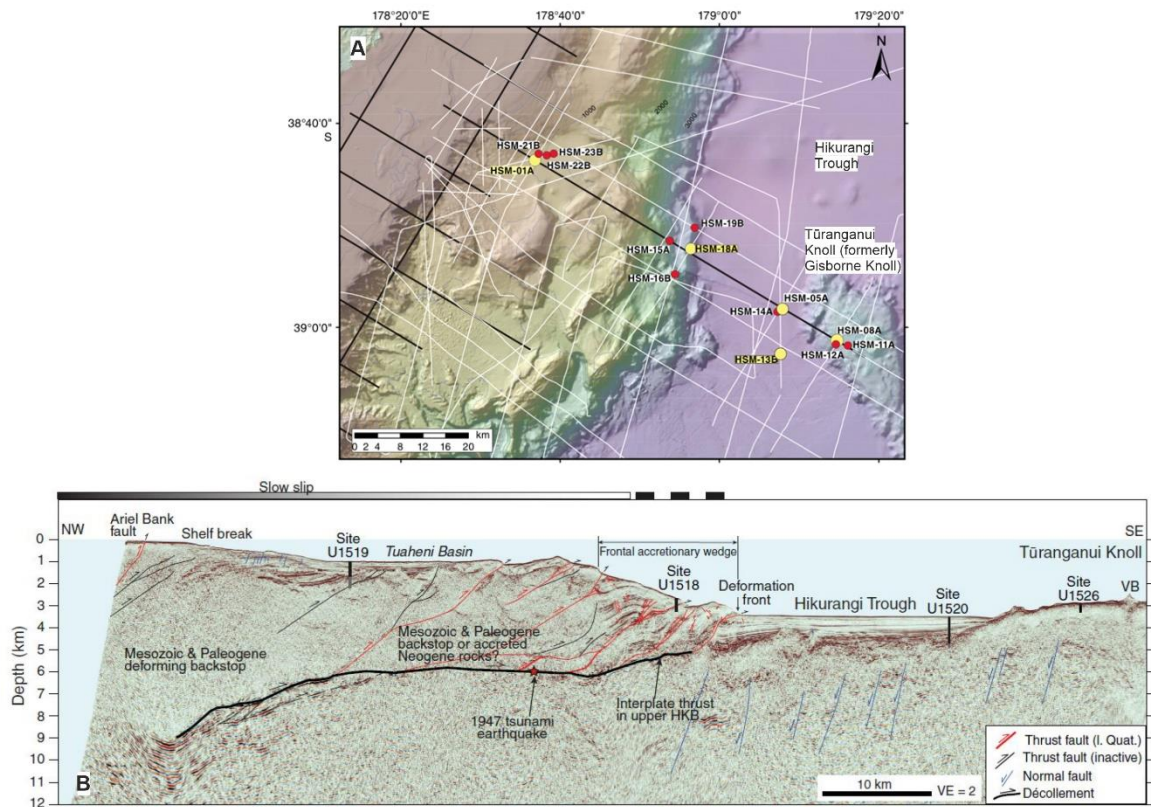


Figure 5-2 Bathymetry and seismic profile used for the selection of site locations for IODP Exp. 375.

A) Bathymetric map across the Hikurangi Subduction Margin (New Zealand) including proposed site locations and the seismic profile 05CM-04 (black, other lines in white). Yellow circles represent approved preliminary drill sites and alternate sites are shown in red. Map slightly modified from Saffer et al. (2017). B) Seismic profile 05CM-04 showing the drill sites and penetration depths (black vertical lines) during IODP Exp. 375, as well as structural interpretations (e.g. red lines; Barker et al., 2018). Map from Saffer et al. (2019a).

For deep ocean drilling campaigns, it is mandatory to complement the bathymetry and echosound data with a dense array of high-resolution seismic profiles of the seafloor. The data (bathymetry, echosound data and seismic profiles) must overlap and, more importantly, cover the proposed drill sites by two crossing seismic lines. Seismic images usually result in a lower resolution compared to echosound data, but can penetrate up to thousands of metres into the seafloor visualising sediment successions deposited over a geologically longer time period (Myr-scale; Figure 5-2 B). Therefore, the seismic images enable to adhere to safety guidelines derived from industrial drilling which imply to minimize potential risks of for example gas breakouts or leakage of hydrocarbons into the ocean due to drilling.

5.3.2 Coring and drilling techniques

Since the onset of marine coring and drilling, different coring and drilling techniques were developed and their usage is mainly based on their potential to recover different types of marine (and lacustrine) sediments. For example, soft or lithified sediments require a less destructive approach for a successful recovery compared to hard rocks, like igneous rocks. The here presented methodical approach is based on the experience of several preceding tephra studies (e.g. Kutterolf et al., 2008b; Schindlbeck et al., 2016), but in particular three tephra studies shall serve for illustration: New Zealand (Pank et al., in preparation for resubmission; Pank et al., 2023b; Pank et al., 2023a), the Aegean Sea (Kutterolf et al., 2021a; Kutterolf et al., 2021b), and Sumatra/Indian Ocean (Kutterolf et al., 2023b; Kutterolf et al., 2023c; Kutterolf et al., 2023a).

In the following, we describe different coring and drilling techniques that have the greatest scientific value for marine tephrostratigraphic studies and that were applied in the case studies (Table 5-3). For more information about other coring and drilling techniques, e.g. box-coring or kasten-coring, we refer to sources like <https://www.ga.gov.au/scientific-topics/marine/survey-techniques/sedimentary-coring-drilling>.

5.3.2.1 Gravity coring and advanced gravity coring

The gravity corer enables shallow marine coring and is composed of a steel coring pipe attached to a lead weight (~1.5 to 6 tons; Figure 5-3 B). Inside the pipe, a plastic liner (diameter: ~6 to 10 cm) is placed to contain the sediments, closed by a crown or a cutter bit including a core catcher at the end of the liner and steel pipe. The core catcher is made of variable thick brass or copper plates which can be adapted according to the sediment properties (e.g. soft or stiff

sediments). The individual steel pipe segments are usually 3 or 5 m long, but the entire length of the steel pipe can be adjusted by combining individual pipes. The ultimate length is depending on the equipment of the ship and the properties of the sediments. For example: stiff sediments which are generally difficult to penetrate in combination with a long steel pipe might cause bending of the pipe (“banana”) and a potential low recovery of sediments. For easier handling of the gravity corer (e.g. during deployment) and for storage on deck, a core rack is used (Figure 5-3 B).

The used lead weight in combination with the veering velocities of the winch, which also depend on the specifications of the research vessel, play a fundamental role during coring campaigns as they largely determine the depth of penetration. For example: high veering velocities often bear the risk of bending the steel pipe or causing disturbances in the sediments (e.g. up-arching of intercalated layers, disruption of layers etc.; Jutzeler et al., 2014). In addition, the impact of penetration during free fall or controlled falling of the gravity corer might cause coring disturbances in the sediments as well. Different approaches have been undertaken (e.g. Tommasi et al., 2019) to modify the setup of the conventional gravity corer in order to control the penetration speed and lower the disturbance potential. This issue, however, can be overcome for tephrostratigraphic studies by coring in a relatively dense array and laterally correlate the individual tephra layers and their contacts to the surrounding background sediment. In general, a balanced interplay between the length of steel pipe (3 to 15 m), used lead weight (1 to 2 t), and winch speed (1 to 5 m/s) are required for a successful coring campaign.

Advanced gravity coring uses the similar standard setup as the gravity corer with the addition of a trigger mechanism (scissor) that releases the steel pipe into free fall from roughly three metres above the seafloor (Figure 5-3 A). The standard setup of the gravity corer is complemented by a trigger lever and a trigger weight which are easily assembled onboard when needed. As soon as the weight touches the seafloor, the lever opens and the steel pipe falls under its gravitational force. This approach creates higher impact speeds than provided during gravity coring where the standard approach is to penetrate with a maximum velocity of 1.5 m/s (e.g. Freundt, 2017) according to the winch properties on most research vessels.

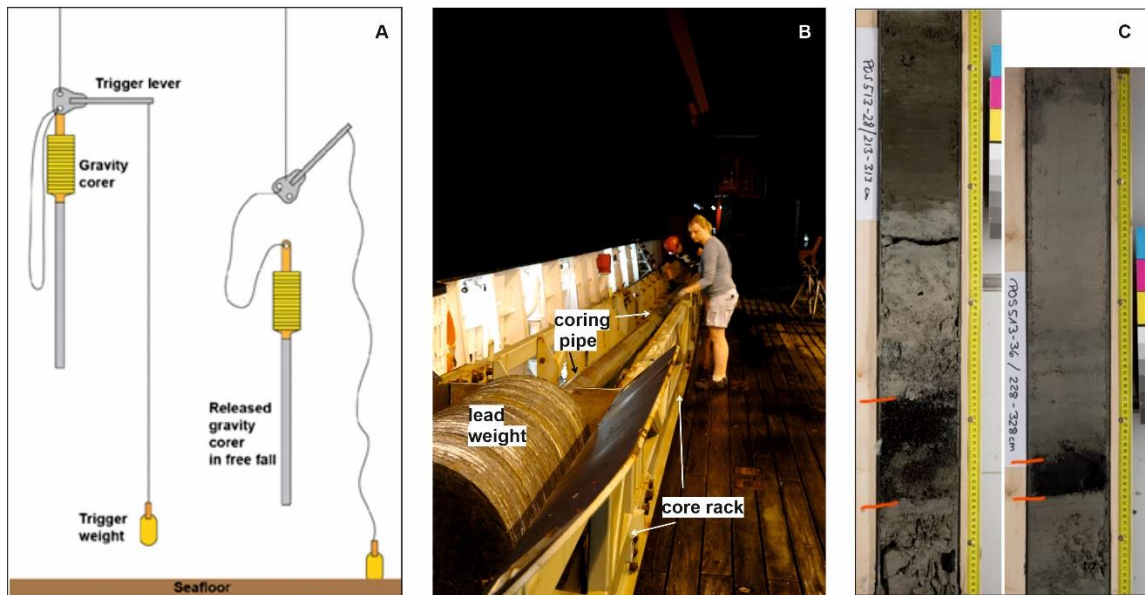


Figure 5-3 Schematic illustration of advanced gravity coring, images of a gravity corer on deck and exemplary core sections.

A) The setup for advanced gravity coring is the same as for gravity coring, but a trigger lever and weight are attached in order to create a free-fall to create a higher impact during penetration of the steel pipe into the sediments. Illustration from Freundt (2017). B) Exemplary image of a gravity corer stored in the core rack on deck. Colleague J. Belo for scale. Photo taken by S. Furst during expedition SO299_2. C) Exemplary core sections from POS513 to the Aegean Sea showing a black lapilli layer (left) and a black ash layer (right) that are located at the same depths below seafloor but 45 km apart therefore indicating a lateral variation of this volcanic deposit with distance to volcanic source. Photographs and interpretation from Freundt and Scientific Party POS513 (2017).

5.3.2.2 Piston coring

The main setup of Piston coring is comparable to a gravity corer. A plastic liner recovers the sediment, emplaced in a steel tube with a weight on top. Within the plastic liner, however, a piston is installed. A lead weight is attached to a lever arm that counterweights the piston corer itself with a cable. The lever arm and cable allow vertical movements of the piston within the liner. Before coring, the piston is lowered to the bottom of the steel tube and liner, close to the core catcher and the cable is tightened up to the lever arm, forming an external loop at the upper part of the construction. The length of the cable is equivalent to the free fall (1 - 3 m) of the piston corer.

The instrument is lowered to the seafloor and penetrates into the sediment. As soon as the counterweight touches the ground it releases the lead weight, the loop in the cable unwinds and the piston corer falls under its gravitational weight.

When landing, the piston is positioned at the water/sediment interface and with progressing penetration into the sediments the cables will cause the piston to stay at this interface, vertically

sliding up and down the liner and causing a slight negative pressure. This negative pressure facilitates further penetration, while the coring pipes are forced down by simple gravity. When pulling out, the piston acts as a plug hindering strong suction of the sediment.

5.3.2.3 Hydraulic or advanced piston coring (APC) and half-length APC (HLAPC)

Over decades of marine ocean drilling (DSDP, ODP, and both phases of IODP), the drilling techniques APC and HLAPC were developed and basically perfectionated for the needs of scientific ocean drilling and the recovery of very soft to firm sediments. APC and HLAPC combine the classical piston corer (see subsection 5.3.2.2) with the strong force of hydraulic pressure.

The APC steel core pipe (or barrel) also includes a plastic liner (9.5 metres long) and is run via a wire to the bottom of the hole. There, the barrel is held in the bottom hole assembly by shear pins while the hydraulic pressure of the drill fluid is slowly increased within the drill pipe. The hydraulic pressure is increased in the drill pipe until it reaches the foreseen pressure to penetrate the formation (sediments), and the shear pins fail (Figure 5-4 A) to release the inner core barrel like a lance into the sediments (full stroke). The inner core barrel, including the plastic liner with the recovered sediment, is then retrieved by a wire to the surface. After that, rotary drilling opens the hole down to the level previously reached by the stroke of the piston corer followed by the deployment of a new piston core barrel which is shot into the next section of the sediment succession (Jutzeler et al., 2014).

If the sediments become too dense or if soft and hard sediments are intercalated, often resulting in partial strokes (<9.5 m recovery) and disturbed recovered sediments due to overpressure, half-length advanced piston coring (HLAPC) is applied. HLAPC has the same operational procedure, although limited to a 4.7 m long barrel and different pressure values, and therefore allows to extend the depth of a piston core hole without other operational changes.

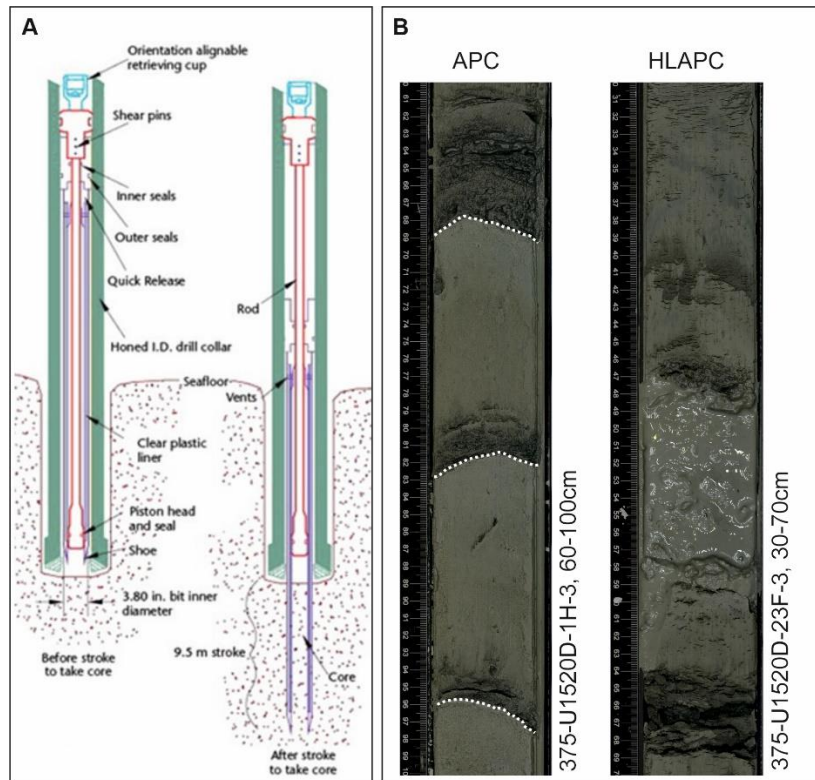


Figure 5-4 Schematic illustration of advanced piston coring and exemplary core sections of APC and HLAPC coring.

A) Advanced piston coring is a drilling technique used by IODP and enables the recovery of soft sediments. Illustration from <http://iodp.tamu.edu/tools/index.html>. B) Two exemplary core sections cored with APC and HLAPC at Site U1520 (IODP Exp. 375) offshore of New Zealand. Both techniques recover intercalated volcanic deposits (black and light grey) with very little disturbance by drilling (slightly bend contacts shown by white dashed line). Even textural differences stay intact during HLAPC (light grey soupy ash).

5.3.2.4 Extended Core Barrel (XCB)

The extended core barrel is a technique that can recover 9.5 m long cores from soft to moderately hard formations. It is used when sediments become too stiff and APC failed, but the sediments are still too soft to use the normal rotary core barrel system (RCB; see subsection 5.3.2.5). In order to advance the hole, XCB relies on the rotation of the drill string while the core liner remains stationary.

The XCB cutting shoe extends through the APC drill bit and trims the core. It is located 15 to 35 cm in front of the roller cones of the rotary device to avoid destruction of the sediment's stratigraphy. It automatically retreats and extends like a spring, depending on the stiffness of the sediment, to avoid bending in harder sediments and facilitating better recovery in softer sediments (Figure 5-5).

XCB and APC are interchangeable depending on the properties of the sediments as they use the same drill pipe and drill bit, therefore no time is spent for time-consuming operational changes.

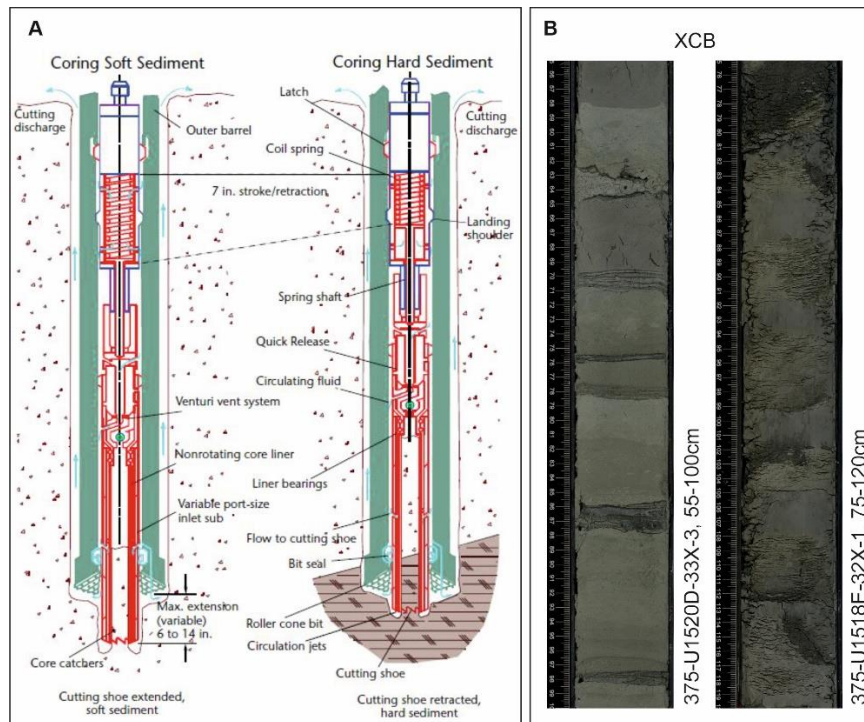


Figure 5-5 Illustration of XCB coring and exemplary core sections of XCB coring.

A) XCB uses the same setup as ACP coring complemented by a cutting shoe which extends ahead of the drill bit on a cm-scale depending on the sediment properties (between ~15 to 35 cm). Illustration from <http://iodp.tamu.edu/tools/index.html>. B) Two exemplary core sections from Sites U1520 (left) and U1518 (right; IODP Exp. 375) offshore of New Zealand. The left core section (375-U1520D-33X-3, 55-100cm) shows well preserved intercalated tephra layers (dark and light grey) within background sediments, whereas the right core section (375-U1518E-32X-1, 75-120cm) illustrates the limits of XCB coring when sediments become too stiff. Internal structures of the sediments and intercalated tephra layers were destroyed by coring and after this core section, drilling operations at Site U1518 switched to RCB (Saffer et al., 2019b) in order to ensure the recovery of undisturbed sediments.

5.3.2.5 Rotary Core Barrel (RCB)

The rotary core barrel is designed to recover firm to hard sediments, and igneous basement. Therefore, it has a unique coring bit which basically mills into the hard sediments by rotation maintaining a $\varnothing \sim 6$ cm sediment section in its centre which is recovered by the inner barrel (Figure 5-6).

The drill bit, outer core barrel and drill string rotate, whereas the inner core barrel stays stationary. The drill bit is specifically designed for abrasive and hard sediments and therefore can achieve greater coring depths at fewer mechanical problems. This technique can recover 9.5 m of sediments and rocks.

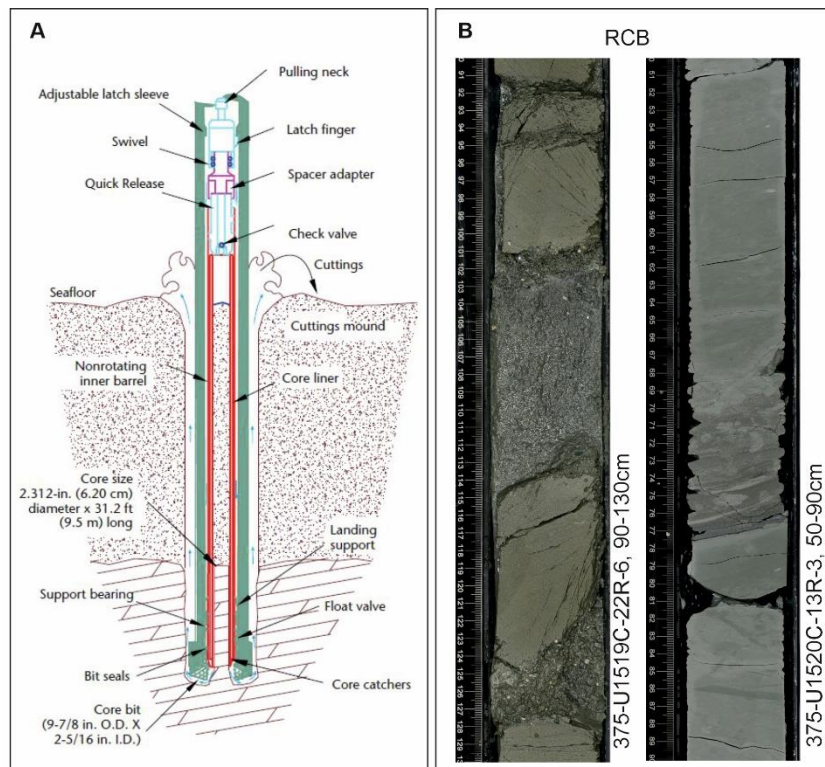


Figure 5-6 Schematic illustration of the RCB coring system and exemplary core sections of RCB coring.

A) This technique uses a different drill bit and therefore leads to slightly smaller (in diameter) recovered core sections. Illustration from <http://iodp.tamu.edu/tools/index.html>. B) Two exemplary core sections from Sites U1519 (left) and U1520 (right) from IODP Exp. 375 offshore New Zealand. Overall, RCB coring is likely to disturb the sediments (e.g. cracks in both core sections), however, internal structures like contacts between intercalated tephra layers (central, dark grey, 14 cm thick layer in 375-U1519C-22R-6, 90-130cm) and background sediments can stay intact. The sediments in core section 375-U1520C-13R-3, 50-90cm (right) are relatively stiff and therefore preserve the mills of the RCB drill bit. The tephra layer (dark grey) is bioturbated, but the bottom contact to the background sediments is intact.

5.4 Revised methodical approach

This section presents the workflow and revised methodical approach from core recovery to correlation. The work steps “work in the lab” and “analytics and data reduction” are particularly designed for large sample quantities (>>50 samples), applicable to small sample quantities as well (<50 samples), and enable an efficient and high-quality workflow.

5.4.1 Work onboard and sampling

Once the core is on deck, similar procedures are applied during “simple” gravity coring and “more complicated” drilling campaigns. However, during marine drilling campaigns most of these steps are done by the drilling personnel and technicians, whereas during smaller coring campaigns the scientists are responsible for each step. We will focus on the latter scenario.

1. Open the core pipe by removing the coring head and the core catcher and pull the core (plastic) liner out of the steel tube until both ends of the liner can be closed with caps. Secure material from the core catcher by putting it into a clean bucket (label if necessary). Several core liners might be connected if longer recoveries were targeted during gravity coring, if so, remove the connecting piece at the tie-point, cut the sediment with a fishing line, pull the liners slightly apart and put caps (e.g. blue cap visually indicates top of segment whereas a yellow cap indicates the bottom) on both ends. Ensure that no material falls out by handling the core pipe and core liner carefully. Store plastic liners on chocks.
2. Dry and clean the plastic liner as it might be wet and muddy from the coring/drilling operations. Measure the recovered core length and mark segment boundaries where the plastic liner should be cut (e.g. subdivide into 1- or 1.5-meter pieces from bottom to top, or from top to bottom). Draw a horizontal line along each segment to subdivide the core into two halves (working and archive). This line will later serve as sawing template. Subsequently, the segments should be labelled appropriately, indicating the working station and segment number and depth below seafloor, and the top and base for each segment. The segment length generally depends on the storage facilities during and after the expedition (e.g. size of storing containers commonly named as D-Tubes), but it should be noted that longer segments are significantly more difficult to handle alone.
3. Cut the plastic liner at the segment boundaries with a pipe cutter and use a fishing line to cut through the sediment. Slightly pull apart the plastic liners and close each segment with plastic caps. Fix the position of the caps with plastic tape. Label each plastic cap again with all segment information, including the top and base of each segment. Make sure to use proper plastic tape or even acetone to fix the position of the caps as leaking water or condensation might interact with the tape. Handle the segments horizontally and try to avoid to unnecessarily tilt the segments.
4. If applicable, conduct logging at the whole round core. Core logging techniques are an additional tool for core description and became popular in tephrostratigraphic studies of marine (and lacustrine) environments since they can help in the identification of discrete layers and dispersed ashes in the recovered sediments. Such techniques have for example shown to enable the identification and mapping of cryptotephra deposits (e.g. Peters et al., 2010). The analytical facilities include field (portable and hand-held, for example on regular research vessels) or ship-board (permanently installed on scientific drill vessels) instruments such as core scanners and magnetic susceptibility scanners.

Standard core logging parameters include P-wave velocity, sediment densities from gamma-wave attenuation, magnetic susceptibility, XRF-based core scanning, and scanning X-ray tomography. Please find exemplary applications of different logging parameters in the literature (e.g. Hunt et al., 1995; Blum, 1997; Kutterolf et al., 2008b for magnetic susceptibility)

5. If applicable, pore waters (interstitial waters) can be extracted now since most pore water samples are taken from the closed core segments to avoid contamination. Squeeze-samples require 10 to 20 cm of sediment cut from the liner without knowing the stratigraphy of the recovered core inside. Usually this approach leads to a “gap” in the stratigraphy because the pore water samples are squeezed immediately after cutting and internal structures, important for other research fields, are lost. A less destructive approach are rhizon moisture samplers which work like artificial roots. Small holes (<5 mm) are drilled into the closed core segments in the required spacing and the rhizon samplers are inserted like a syringe (~4 cm). This approach might disturb internal structures like contacts between volcanic material and background sediment, but does not remove any sediments. Please find more detailed instructions for pore water sampling in the respective literature (e.g. Lange et al., 1992; Shotbolt, 2010; Schmidt et al., 2020).
6. Open the core segments: cut the core segments along the horizontal line (drawn in step 2) with a table saw. A hand-held vibration saw can be used to cut the end caps. If needed, the hand-held vibration saw can be used to open entire core segments, however, this approach is time-consuming, causes uneven cutting traces, and might cause sediment disturbance close to the plastic liner due to vibrations. In any case, avoid cutting into the sediments. Use a fishing line to cut the sediment and then divide the two halves with the help of a long knife. Often, the sediment halves split best when slightly knocking the segment on the table to reduce the cohesive connection between the split halves, allowing the halves to fall apart.
7. If applicable, pore waters from the open core segment (working half) can be extracted now. See step 5 for more information.
8. Image the archive half of each core segment with a scale beside the segment, and, if possible, add a reference colour chart (e.g. black-grey-white) for later quality control. If applicable, smooth the surface of the sediment using a long blade knife before taking the core pictures in order to create a smooth surface and/or increase the visibility of

internal structures and contacts. Work from top down (young to old) and vertically (to the long side of the core) to avoid contamination.

9. Description of the core segments: macroscopically describe the archive halves in terms of textural and structural changes, include colour if needed (e.g. Cochrane, 2014). Descriptions should be objective; therefore, it is prudent to use a description template (computer or paper based; Appendix B - F1) when working in a team. Regularly produce smear slides for example one every core segment or on a cm-scale, and of important or interesting intervals (e.g. tephra layers, sudden colour changes) to report microscopic changes (e.g. componentry, grain size etc.) of the sediments. Please find an introduction into smear slides, their use, and preparation in Rothwell (1989) and a template for smear slide descriptions in the Appendix B - F2. The smear slide descriptions can assist the macroscopic core descriptions when done immediately, but they can also assist later interpretations. Digitalize macroscopic descriptions if necessary.
10. Sampling of relevant intervals and background sediments: take samples only from the working halves to ensure the integrity of at least one core half at later times. Thin tephra layers and pods should be sampled with care to avoid contamination with background sediments, thicker tephra layers (>5 cm) could be sampled stratigraphically in order to detect geochemical variations (potential indicator for eruptive processes) or grain size distributions (potential indicator for emplacement processes). If applicable, take samples from the background sediments (one per segment) to detect general changes in the marine environment. Samples can be taken with any tool (e.g. regular spoons and small spatulas, or plastic tubes and scoops as used by the IODP) depending on the required sample size. Usually, 20 cc per sample are sufficient for later geochemical analyses (major and trace element analyses) of the samples, and often even for U-Pb age dating of zircons. Fill gaps with for example styrofoam to avoid sediment collapse during transport. Indicate on description sheet (step 10) where samples were taken.
11. Once finished, wrap the core segments, archive and working halves, with cling film to avoid desiccation of the sediments. Then store the segments in appropriately labelled D-Tubes (see step 2) and fix both end caps with tape or acetone before transport.

5.4.2 Work in the laboratory

Wet-sieve tephra samples into different grain size fractions, 63-125 and >125 μm , using deionized water (if necessary, subdivide further into 32-63 μm , 125-250 and >250 μm). Clean

the sieves in an ultrasonic bath after each use to avoid cross-contamination of samples. Samples consisting of coarse ash or lapilli clasts should be gently crushed using a hammer or mortar before sieving. Once clean, fill the fractions into labelled bowls and put these into a drying cabinet at $\sim 50^{\circ}\text{C}$ until completely dry (<24 hrs). Then fill the fractions into labelled sample containers and proceed to next step: embedding the fractions.

For the compositional analysis of glass shards with an electron microprobe (EMP) and Laser Ablation Inductively Coupled Plasma-Mass Spectrometer (LA-ICP-MS) the 63-125 μm fraction, and if available the 125-250 μm fraction, have shown to be suitable. The fractions of twelve samples are embedded with epoxy resin (Araldite) into one 1-inch pre-drilled acrylic tablet (mount) that has twelve 4 mm $\varnothing$ holes (Figure 5-7). Time-consuming hand-picking of glass shards is not required or recommended when following this revised methodical approach.

The production of pre-drilled mounts is relatively easy and should be viable (e.g. size and number of holes) at each research institute (1. purchase 1-inch acrylic round bar, 2. cut into ~ 0.5 - 0.7 cm slides, 3. drill holes with a speed column drill, for example twelve holes in a 2 - 4 - 4 - 2 pattern or sixteen holes in a 4 - 4 - 4 - 4 pattern, e.g. Figure 5-7, and 4. try to already ensure a relatively smooth surface of the slide). The number and hole diameters can be individually customised depending on the scientific requirements.

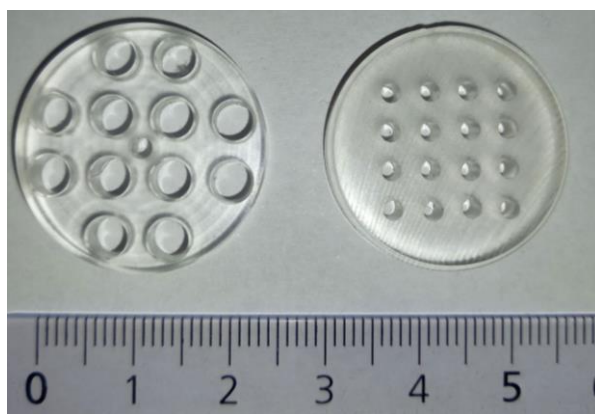


Figure 5-7 Two 1-inch pre-drilled acrylic tablets (mounts) for illustration.

The left mount has twelve holes (pattern: 2 - 4 - 4 - 2) with a diameter of each ~ 4 mm. The right mount has sixteen holes (pattern: 4 - 4 - 4 - 4) with a diameter of ~ 2 mm each.

The most efficient embedding procedure is as follows: label the mount with a specific name and clearly mark the top of the mount by for example a colour marking or a notch. Then close one side of the mount with adhesive tape and fix the mount with the closed side on a solid surface (e.g. plate, tablet) using double-faced adhesive tape (Figure 5-8). Close the upper side

of the mount with another piece of tape, preferably masking tape that can be cut, removed, and taped again. Cut the tape around each hole and remove the cut piece (e.g. by using a tweezer; Figure 5-8) just before inserting the sample (using a spatula) and close the hole afterwards again with the cut piece of tape. About $\frac{1}{3}$ to $\frac{1}{2}$ of the holes should be filled with sample material to ensure a proper resin distribution afterwards. If more than $\frac{1}{2}$ of the holes are filled with sample material the resin might not drape the sample material sufficiently potentially leading to useless mounts. Proceed until all twelve samples are inserted. Clean spatulas or any other used tools before proceeding to the next sample to avoid cross-contamination.

Keep record of the samples by creating an overview of the mount (Appendix B - F3).



Figure 5-8 Illustration of embedding procedure.

The mount is labelled and the top is indicated. The bottom of the mount is closed with adhesive tape and then fixed with double-sided adhesive tape on a solid surface. The holes are closed using masking tape, the tape around each hole is pre-cut and can be removed with a tweezer. Use a small spatula to insert sample, fill about $\frac{1}{3}$ to $\frac{1}{2}$ of each hole with a different sample.

Compound the epoxy resin, then carefully remove the tape from the mount and drip one or two droplets of resin into each hole (e.g. using a plastic toothpick). Remove potential air bubbles by gently stirring the sample-resin mixture using a (wooden) toothpick. Wooden toothpicks can be used on both sides, however, make sure to avoid cross-contamination and discard used (one-sided or two-sided) toothpicks. Then fill up all holes with resin. The resin dries fastest in a drying cabinet for one or two days at $\sim 50^{\circ}\text{C}$, if such cabinet is not available it takes a couple of days for the resin to be completely dry.

Once dry, the mount can be ground and polished. Grinding with water occurs on four different grain sizes (240, 320, 400, and 600; Figure 5-9 A) each for ~60 seconds. Try to grind in both directions (clockwise and anti-clockwise) and apply equal pressure on the mount to ensure an even surface. Check the surface by holding the mount against the light: when the light is evenly reflected from the samples surface, it is suitable for the next step, if not, repeat grinding steps until the surface is smooth.

Polishing is most efficient using an instrument like the Struers “TegraPol-21” and “TegraForce-5” (Figure 5-9 B) where six mounts can be polished at the same time.

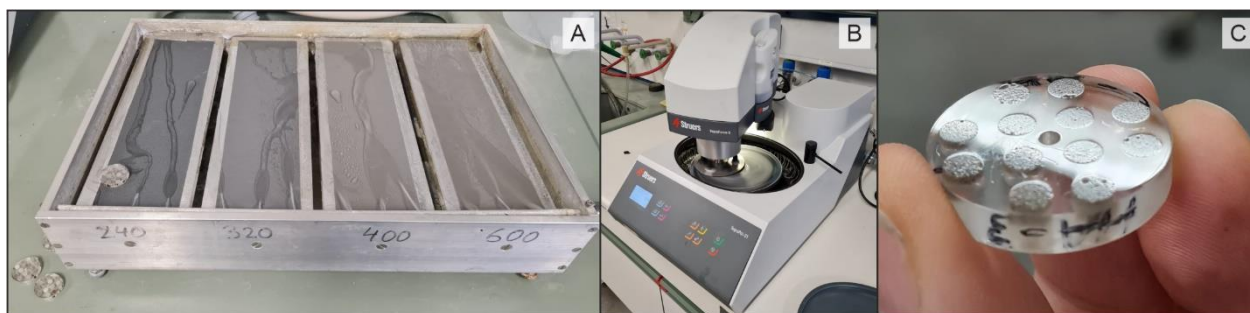


Figure 5-9 Illustration of grinding and polishing steps.

A) Grind the mounts on four sandpapers (from left to right) with water, start with the coarsest one (P240) and finish with the finest one (P600). The surface of the mount should be smooth after grinding, comparable to the mount shown in C. B) Most efficient polishing can be achieved with an instrument like the Struers TegraPol (1 to 6 mounts per run) using three different polishing liquids (9, 3, 1 μm diamond suspensions). C) The resultant ultra-smooth sample surface after grinding and polishing the mounts following our revised approach.

The mounts are polished three times using different polishing liquids (9, 3, and 1 μm) each for about 4 minutes following pre-installed programs that control the applied pressure and turning speed of the instrument. Check the samples surfaces after each run for potential scratches and clean the polishing liquids off the mounts before proceeding to the next grain size by rinsing it with deionized water. Do not use a brush to clean off the polishing liquid as it might cause scratches. Please note, that the labels of the mounts might be removed by the polishing liquid, therefore check labels (name and orientation) after each run.

Once the samples surfaces are completely smooth (Figure 5-9 C), wipe it carefully with alcohol to remove potential residues of the polishing liquid. Then, the mount is ready for carbon-coating and subsequent geochemical analyses with the EMP and LA-ICP-MS.

5.4.3 Analytics

At first, the glass shards of the samples are analysed with the electron microprobe for their individual major element compositions. Our experience showed that 20 glass shards per sample result in a good statistic, even if samples are geochemically zoned or bimodal. If present, it is recommended to select a variety of glass shards (e.g. different shard sizes within fraction, different shard morphologies) for analyses in order to achieve a representative geochemical composition. At GEOMAR Helmholtz Centre for Ocean Research, we use a JEOL JXA 8200 wavelength dispersive EMP that can hold up to six tablets at the same time and is equipped with five spectrometers holding TAP, TAPH, PET, PETH, and LIF analysing crystals. The EMP runs with a 15 keV accelerating voltage, a 6 nA strong and 5 - 10 μm wide electron beam and a calibrated measuring program using VG568 Rhyolite (Si, Al, K), VGA99 (Ti, Fe, Mg, Ca, P), Rhodonite (Mn) and Scapolite (Na) as calibrating standards, as well as 20 to 40 seconds of peak counting, and 10 to 20 of background counting on both sides of the peak. The usage of a low current of 6 nA ensures no sodium loss during analyses if the sodium content is $<7\text{ wt}\%$; for high alkali samples (e.g. Phonolites) the current is reduced to 3 nA while the counting time is increased to compensate the resulting decreased amount of x-ray counts.

Oxides are determined using the ZAF correction method and the accuracy of the measurements is monitored by the repeated analyses of the standards Lipari (Obsidian rhyolite; Hunt and Hill, 2001) and VGA99 (basalt from Makaopuhi Lava Lake; Jarosewich et al., 1980), twice each every 80 data points and at the beginning and end of each session. We refer to Kutterolf et al. (2011) for more information. Following this recommendation, it takes about 3 days to analyse the major element compositions of 72 samples (including standard analyses), and probably one entire working day (8 - 10 hours) to select the glass shards to be analysed. Such a time-consuming run is recommended over weekends, if allowed by internal regulations and stability of the EMP, in order to save lab-time during regular working hours. If the microprobe is unstable and needs regular calibration, we recommend to plan from day to day by calculating the resultant analyses time (2.7 minutes per data point) and plan the lab-time from there.

Secondly, the glass shards of the samples are analysed for their trace element compositions with a LA-ICP-MS. Our experience showed that the analyses of five glass shards per sample result in a good statistic and time-consuming additional analyses are not necessarily required for the geochemical characterisation of a tephra layer. At the Institute of Earth Sciences in Taiwan, we use a Photon Machines Analyte G2 (193 nm) excimer laser ablation system linked to a high-resolution inductively coupled plasma-mass spectrometer (ICP-MS) (Agilent 7900) following

the methods described in Kutterolf et al. (2021b). The spot size is usually set to 30 μm , but can be adjusted to 25 μm if needed (e.g. very fine glass shards within the fraction). It uses a 5 - 10 J/cm^2 energy density at 4 - 10 Hz repetition rate. Blank acquisition is usually between 30 to 45 s, followed by ablation times around 70 s. Data reduction is performed immediately after each ablation analysis using GLITTER software (version 4.0; van Achterberg et al., 2001). Accuracy is monitored by repeated measurements of the international glass standard BCR-2G before each run. Repeated measurements of BCR-2G assures the correction of matrix effects and signal drift of the instrument just as it monitors the differences in the ablation efficiency between sample and reference material (Günther et al., 1999). The reference material NIST SRM612 is analysed as external calibration (Norman et al., 1996; Jochum et al., 2011) after each run. Usually one run comprises three NIST standard measurements and one BCR standard measurement, followed by up to 15 glass shard measurements and finally another three NIST standard measurements. For subsequent runs the last three NIST standard measurements can usually be used as first three NIST measurements of the following run.

GLITTER requires the individual CaO compositions of each analysed glass shard as internal standard to calibrate the analyses, therefore a good documentation for each sample and analysed glass shard is necessary. For example, take back-scatter-electron (BSE) images at the EMP of each sample (or glass shard) that is planned for future LA-ICP-MS analyses. Document ten of the total 20 glass shards by highlighting their position in the BSE images of the sample (Appendix B - F4 bottom) and label them according to their EMP-data point name (e.g. sample1_1 to sample1_10). Take a photo showing the microscopic overview with highlighted glass shards (Appendix B - F4 top) planned for trace element analyses, because at the LA-ICP-MS the only available visual image of the sample will be microscopic. We recommend to involve this documentation for samples that are planned for LA-ICP-MS analyses in the “regular microprobe workflow” by taking pictures (BSE and microscopic images of glass shards) with the camera of a mobile phone, as the quality of the pictures is usually sufficient (AppendixB - F5). This approach slightly slows down the “regular microprobe workflow”, however, overall it drastically reduces preparation time because no second microprobe session is needed for adequate LA-ICP-MS documentation.

Prepare a well-organised data spreadsheet with all samples planned for trace element analyses and pre-select five out of ten glass shards based on their geochemical results (representative for the geochemical signature of each sample; see subsection 5.4.3.1) and prepare a folder per sample with BSE and microscopic images of glass shards. Following this approach, it is realistic

to conduct ten runs per day (≤ 1 hour per run and ~ 10 working hours) which corresponds to thirty samples á five glass shards (150 individual glass shard analyses).

Other analytical approaches, like the overall componentry (e.g. minerals, glass shards, bioclasts, lithics) or glass shard populations (e.g. morphology, vesicle shape and content) of the samples might be needed in order to unequivocally distinguish between tephra layers, especially in study areas with a relatively homogeneous geochemical signature of the volcanoes or volcanic arc (e.g. New Zealand; Hopkins et al., 2021a). The most successful approach for such studies might be the step-counter which is installed on a regular microscope and enables systematic counting of sample components in a smear slide. Please find applied examples in the respective literature (e.g. Schindlbeck et al., 2013; Menke et al., 2018).

5.4.3.1 Quality control and data reduction

Per sample 20 glass shards, if possible, were analysed with the EMP for their major element oxide compositions consisting of Na_2O , K_2O , FeO , SiO_2 , TiO_2 , MnO , CaO , MgO , and Al_2O_3 . The data is normalised to 100% to eliminate possible effects of minor post-depositional hydration and/or deviations of the electron beam (e.g. defocused beam), and per sample the average compositions and mean deviations are calculated. Then the quality control starts with 1) checking if any unnormalized totals are < 90 wt%, 2) check the individual analyses for geochemical outliers, and 3) check the mean deviations of each normalised oxide (should be < 0.5). Analyses with totals < 90 wt%, accidentally analysed minerals (e.g. Al_2O_3 compositions of > 20 wt%) and completely exotic compositions should be discarded or at least taken out of the calculations for the average composition and mean deviation. Generally, we recommend to work in separate spreadsheets: one with raw and normalised data and discarded analyses highlighted in a different colour, and a second one after quality check (outliers removed) that is ready to use. High mean deviations (> 0.5) might be explained by geochemical zonation or bimodality, therefore check for systematic geochemical variations before discarding glass shards and, if bimodal, calculate two geochemical averages for one sample.

The quality control and data reduction of individual trace element analyses starts immediately after each ablation by using GLITTER (van Achterberg et al., 2001). GLITTER is a real-time interactive data reduction tool and displays each analyte mass in a table and a unique pixel-row image that allows a quick recognition and exclusion of data spikes for example caused by microcrystals. When selecting different integration intervals within the pixel-row image, the

tabular data display changes automatically. Therefore, the individual glass shard analyses can be checked in real-time for observed mismatches, and, if needed, remeasured during the next run. This approach enables to unify glass shard measurements within a sample when for example the thickness of analysed glass shards caused slight geochemical differences. Later on, the trace element and major element compositions should be compiled into the same spreadsheet, including the average compositions and mean deviations per sample. Check for exotic outliers in the trace element compositions. Here, trace element ratios might help because they usually eliminate signal variations from the measurements (e.g. varying signal length due to thickness of glass shards and resultant increased variability in concentrations) by equalising falsely increased or decreased signals, resulting in more comparable glass shard compositions. Truly exotic glass shard compositions should be deleted from the “ready to use”-spreadsheet.

5.4.4 Dating tephtras directly and indirectly

A well-constrained succession of explosive eruptive events of a volcano, volcanic field or volcanic arc requires the establishment of a tephrochronology. Tephtras can be dated directly or indirectly using a range of techniques (Table 5-1), however, these different approaches are common practise in volcanology and discussed in great detail in preceding studies. Therefore, we will only present a very short summary of common techniques and refer to literature (e.g. Ledbetter and Sparks, 1979; Drexler et al., 1980; Schmincke, 2004; Wulf et al., 2004; Kutterolf et al., 2008a; Lowe, 2011).

Several dating techniques for marine (and lacustrine) tephtra are available including radiometric (e.g. radiocarbon, single mineral dating, fission track, luminescence), incremental (e.g. ice cores, varves, dendrochronology), age-equivalence (e.g. orbital tuning, paleomagnetism, palynostratigraphy, sedimentation rates), and historical observations.

The most common method to date tephtras includes direct radiometric dating (^{14}C , U/Th, K/Ar and single-crystal laser fusion $^{40}\text{Ar}/^{39}\text{Ar}$ analysis, zircon- and glass-based fission-track analysis) using minerals and biogenic matter (such as zircon, hornblende, K-feldspar, biotite, quartz, foraminifers) from the tephtra layer or surrounding background sediment. For tephtras with an age of <55 ka, the ^{14}C dating method still remains the most reliable technique (Alloway et al., 2007a), but new developments in Ar/Ar dating and particularly U/Th as well as U/Th-He zircon dating open new possibilities to date younger deposits (e.g. Cisneros de León et al., 2023).

Indirect dating via sedimentation rates, oxygen isotope stratigraphy, varve chronology and paleomagnetism can be used to make first order estimates of tephra ages by applying constant age models in the background sedimentation.

Ideally, a combination of direct (tephras) and indirect (sedimentation rates) dating approaches is applied, potentially resulting in the most reliable and feasible high-resolution age model to constrain unknown tephra ages even in variable depositional settings.

Table 5-1 Summary of age dating methods after Alloway et al. (2007a), Lowe (2011) and Lowe and Alloway (2015).

Method	Application
Radiometric	¹⁴ C-dating, fission-track dating (zircon, glass-ITPFT dating), argon isotopes (K/Ar, Ar/Ar including SCLP/F, LIH), luminescence dating (TL, OSL, IRSL), U-series including (U-Th)/He dating and ²³⁸ U/ ²³⁰ Th zircon dating (via SIMS/TIMS), electron spin resonance (ESR), ²¹⁰ Pb, ¹³⁷ Cs, ³ He and ²¹ Ne surface exposure dating.
Incremental	Dendrochronology, varve chronology, layering in ice cores (ice sheets/caps, glaciers)
Age-equivalence	Paleomagnetism, palaeomagnetic secular variation (PSV), orbital (astronomical) tuning, correlation with marine oxygen isotope stages, palynostratigraphy, palaeopedology, sedimentation rates
Historical	Eye-witness accounts or observations (written, oral).
Age models	Various statistical methods, periodic time-series, combined age models.

AMS, accelerator mass spectrometry; ITPFT, isothermal-plateau fission-track; SCLP/F, single-crystal laser probe or fusion; LIH, laser incremental heating; TL, thermoluminescence; OSL, optically stimulated luminescence; IRSL, infra-red stimulated luminescence; SIMS, secondary ionization mass spectrometry; TIMS, thermal ionization mass spectrometry.

5.4.5 Correlation techniques

Tephra characterisation or ‘fingerprinting’ uses several analytical methods that are applied to individual glass shards and magmatic minerals (Table 5-2), always complemented by stratigraphic, paleoenvironmental (sometimes archaeological), and chronological criteria (Lowe, 2011). The most preferred and powerful tools to establish correlations between marine (and lacustrine) and terrestrial tephra for tephrostratigraphic studies are geochemical and petrographic analyses.

Geochemical fingerprinting (characteristic major and trace element compositions), under consideration of the overall stratigraphy and chronology of the deposits, might be the most valuable approach to correlate between tephra deposits (marine-marine, marine-terrestrial, lacustrine-terrestrial, marine-lacustrine) since it is one of the most efficient techniques available (Lowe et al., 2017). In many volcanic areas, major element compositions of tephra deposits are unique enough for successful and reliable correlation or distinction of individual deposits (e.g. Kutterolf et al., 2008b; Schindlbeck et al., 2018; Kutterolf et al., 2021b). For other volcanic

areas, often not even trace element compositions are distinctive enough for a smooth and straightforward correlation, nonetheless they usually enable distinction of individual deposits (e.g. Donoghue et al., 2007; Hopkins et al., 2021a; Kutterolf et al., 2023b). In some cases, other techniques, like petrography, might be necessary as a supporting tool for correlation or distinction of tephra deposits. Petrographic techniques identify typical mineral assemblages of a tephra or morphological characteristics of the glass shards (e.g. vesicle texture) and are therefore suitable to support geochemical correlations. For studies focussing on large sample quantities, however, a petrographic description of each tephra is too time-consuming. Nevertheless, this approach has the capability to establish well-described (stratigraphically, geochemically, petrographically) marker horizons at stratigraphically well-chosen positions within the cores which will then serve as orientation for future correlations based on geochemistry and stratigraphy.

Table 5-2 Summary of commonly used analytical fingerprinting techniques applied in tephrostratigraphy (after Lowe, 2011).

Tephra components and properties	Analysed components	Methods of analysis
Glass shards	Major- and trace elements	EMP, LA-ICP-MS, SIMS
Shard morphology	Glass shard shape, vesicle structures	Optical microscope, SEM
Fe-Ti oxides	Major- and minor elements, crystallization temperatures, oxygen fugacity	EMP, Mössbauer spectroscopy
Ferromagnesian minerals (px, am, ol, bi)	Major-, minor and trace elements, crystallization temperatures, pressures, water content	Petrographic microscope, EMP, LA-ICP-MS, SIMS
Feldspars	Major-, minor and trace elements, crystallization temperatures, pressures, water content	EMP

px, pyroxene; am, amphibole; ol, olivine; bi, biotite; SEM, Scanning electron microscopy

Geochemical fingerprinting between tephra is mainly conducted spreadsheet-based by simply comparing the geochemical compositions of potential correlative candidates, of course always under consideration of the stratigraphic and chronological contexts. Within such spreadsheets, geochemical diagrams can be used to visually compare individual tephra layers for example on a bi- or trivariate plot. It might be useful to compare not only geochemical averages but also individual analyses, especially when graphically comparing potential correlatives as geochemical trends (zonations or bimodality) might be hidden in geochemical averages and respective errors.

Often, this simple and graphic correlation approach is sufficient for the establishment of sturdy correlations, however, statistical correlation methods (e.g. hierarchical cluster analysis) enable

a less subjective technique (Lowe et al., 2017) and should therefore be seen as great advantage for tephrostratigraphic studies (e.g. Kutterolf et al., 2008b; Kutterolf et al., 2021b).

5.5 Discussion

5.5.1 Methodical approach and its practicability

Our established revised methodical approach covers all required working steps from core to correlation, or in other words: from recovering and sampling the marine sediments to the establishment of marine tephrochronostratigraphies of individual volcanoes, volcanic fields, or volcanic arcs. In the following, we will highlight and discuss the most important advantages, disadvantages, and the practicability of our revised methodical approach.

Although we optimised the workflow onboard and later on in the laboratory by wet-sieving the samples, these parts of the workflow might not differ strongly from the approaches of other research groups that also target marine sediments and intercalated volcanic deposits. Nevertheless, for the work onboard particularly the usage of our revised templates for core and smear slide description should enable a smooth workflow as they were developed during numerous research cruises (gravity/piston/box coring, MARUM-MeBo drill rigs; e.g. Freundt, 2017; Hansteen, 2017; Huhn, 2019; Krastel, 2019b; Jutzeler, 2022; Urlaub, 2023) as well as several IODP expeditions (e.g. Reagan et al., 2015; Tamura et al., 2015; Kutterolf et al., 2023a; Pank et al., 2023a). These description templates, together with smear slide atlases like the IODP Digital Reference for Smear Slide Analysis of Marine Mid Part 1 and 2 (Marsaglia et al., 2013; Marsaglia et al., 2015), enable an objective and basically standardised description of sediments and smear slides across different expeditions with varying expedition scientists at different levels of expertise. Due to this approach, the sediment and smear slide descriptions of different expeditions are usually uniform and can assist interpretations (e.g. changes in texture and colour, contacts between layers, grain size distribution) immediately, if needed. With respect to wet-sieving the samples the main advantage of our introduced method is probably our experience to handle large sample quantities and the resultant work routine that has developed over the years. Possibly one true benefit that saves time, however, is the limitation of grain size fractions to 63 - 125 μm and >125 μm . Per sample, several minutes can be saved when only two fractions are sieved because swamping of the sieves (overflow of water due to negative pressure between individual sieves usually occurring when stacking three sieves) does usually not occur when sieving two fractions. In addition, smaller fractions are generally not suitable

for geochemical analyses, particularly true for LA-ICP-MS analyses, and therefore their preparation-time can be saved. However, if the overall grain size distribution of a sample is very fine (silty to clayey) a limitation to grain sizes $>63\ \mu\text{m}$ results in (complete) sample loss and should be avoided. If needed for additional analysis, the $>125\ \mu\text{m}$ fraction can be further subdivided (e.g. $125 - 250\ \mu\text{m}$ and $>250\ \mu\text{m}$ fraction) by dry-sieving with hand-held sieves at later times.

Following our workflow, the most valuable benefit of our revised methodical approach is the development and usage of pre-drilled mounts. The number of holes per mount can be adapted according to the individual needs (e.g. sample number and required diameter), however, our experience shows that twelve holes per mount are the ideal compromise between sample number and diameter. We embed bulk fractions ($63 - 125\ \mu\text{m}$) of the samples, and do not recommend time-consuming hand-picking of individual glass shards, which is generally not feasible for studies focussing on large sample quantities. In addition, the pre-selection of glass shards (e.g. largest versus smallest shards, round versus elongated vesicles etc.) might lead to an artificial or false geochemical composition because morphologically different glass shards are often characterised by different geochemical compositions. Furthermore, the bulk fraction is indicative for the overall characteristics of a sample (e.g. depositional processes, age) because for example bioclasts, minerals, and potential alteration of glass shards are visible in the BSE and microscopic images and can be documented for further interpretation of the sample (e.g. primary versus reworked, airfall tephra versus flow deposition). The usage of pre-drilled mounts generally facilitates and accelerates the workflow as they enable to summarise twelve samples (if not adjusted otherwise) per subsequent preparation step (i.e. grind and polish twelve samples at the same time) and analysis, because the mounts fit into common sample holders of EMPs and LA-ICP-MS' instruments and therefore reduce time-consuming mount changes during lab time. As outlined earlier, we fine-tuned our methodical approach over the years and in this contribution, we use examples from particularly three most recent independent marine tephra studies for illustration and demonstration of the advantages and limitations. These studies established the marine tephrostratigraphies including correlations to existing literature data and complemented the eruption record (e.g. New Zealand: Pank et al., in preparation for resubmission; Pank et al., 2023b; Aegean Sea: Kutterolf et al., 2021b; Kutterolf et al., 2021a; and Sumatra/Indian Ocean: Kutterolf et al., 2023b; Kutterolf et al., 2023c). The investigated sediments were recovered during several deep ocean drilling campaigns (DSDP, ODP, both IODP phases; Table 5-3) or a shallow marine coring expedition (Table 5-3), and the sample numbers ranged between 310 (Sumatra/Indian Ocean), 474 (Aegean Sea), and 1,005 individual

samples (New Zealand; e.g. Table 5-3 and respective literature). These marine tephra samples were prepared, analysed, and interpreted following our revised methodical approach in a relatively short period of time (e.g. establishment of New Zealand's tephrostratigraphy within a 3-year PhD-project).

We would like to highlight one last advantage of our revised methodical approach: the limitation of individual glass shard analyses at the EMP and LA-ICP-MS. Our experience showed, that the geochemical characterisation of a tephra requires ~20 glass shard measurements for major element compositions of which five shards are subsequently analysed for trace element compositions. These “few” data points (especially so for LA-ICP-MS) are usually sufficient to geochemically characterise marine tephra deposits and are able to reliably identify geochemical bimodalities or compositional zonations of volcanic deposits (e.g. Pank et al., in preparation for resubmission; Pank et al., 2023b). We understand, that this analytical approach might appear “tunnel vision”-like, but it was successful for all three case studies, and several preceding marine (and lacustrine) tephra studies. In addition, in most cases, especially so for New Zealand and Sumatra/Indian Ocean, the limiting factor for further correlations was not the marine tephrochronostratigraphy, but the incomplete onshore record or lack of geochemical data.

Nevertheless, each volcano, volcanic field, or volcanic arc is different and our experience and exemplary case studies show, that it might be necessary to adapt some steps of the revised methodical approach to the individual sample and project needs, or to the availability of laboratory equipment and instruments.

Table 5-3 Overview of drilling and coring techniques applied during three marine tephra case studies used for illustration.

Study area	Expeditions	Applied coring and drilling techniques	References for coring and drilling	Number of investigated drill sites or coring locations/Number of holes	Total number of samples/Analysed with LA-ICP-MS/Classified as primary deposits
New Zealand	IODP Exp. 375/372	APC, HLAPC, XCB, RCB	Wallace et al. (2019a)	11/21	1,005/419/640
	IODP* 329	APC	D'Hondt et al. (2010)		
	ODP Leg 181	APC, XCB	Carter et al. (1999)		
	DSDP Leg 90	HLAPC, XCB	Kennett et al. (1986)		
Aegean Sea	POS513	GC / AGC / Box cores	Freundt (2017)	50	474/150/348
Sumatra/ Indian Ocean	IODP Exp. 353	APC, HLAPC, XCB	Clemens et al. (2016)	23/40	310/214/235
	IODP Exp. 362	APC, HLAPC, XCB, RCB	McNeill et al. (2017)		
	ODP Leg 183	RCB	Coffin et al. (2000)		
	ODP Leg 121	APC, XCB, RCB	Peirce et al. (1989)		
	ODP Leg 120	APC, XCB, RCB	Schlich et al. (1989)		
	ODP Leg 119	APC, XCB, RCB	Barron et al. (1989)		
	ODP Leg 116	APC, XCB	Cochran et al. (1988)		
	ODP Leg 115	APC, XCB	Backman et al. (1988)		
	DSDP Leg 22		Borch et al. (1974)		
IODP: International Ocean Discovery Program; IODP*: Integrated Ocean Drilling Program; ODP: Ocean Drilling Program; DSDP: Deep Sea Drilling Project; APC: Advanced Piston Corer; HLAPC: Half-length APC; XCB: Extended Core Barrel; RCB: Rotary Core Barrel; GC: Gravity corer; AGC: Advanced gravity corer. All samples were analysed for major element compositions: “Total number of samples” corresponds to EMP-analysed samples. References for New Zealand (e.g. Pank et al., 2023a), Aegean Sea (e.g. Kutterolf et al., 2021b), and Sumatra/Indian Ocean (Kutterolf et al., 2023a; Kutterolf et al., 2023c).					

5.5.2 Advantages and disadvantages of different coring and drilling techniques

Several different coring and drilling techniques were developed over time and were optimised to fulfil scientific needs (e.g. longer cores, greater diameter, less disturbance). A simplified overview of benefits and limitations of sea-going expeditions and different coring and drilling campaigns is summarised in Table 5-4.

To our experience, the most common and successful coring technique is (Advanced) Gravity Coring, followed by Piston Coring. The gravity corer is relatively simple to use as it only requires a research vessel with a suited winch. The assemblage of weight, steel pipe, liner and core catcher is fast and therefore a dense network of coring stations can be achieved within days or weeks (e.g. Krastel, 2019b; Kutterolf et al., 2021b), comparable to the traditional field mapping on land. This also applies for advanced gravity coring, since it only requires to combine the standard gravity corer with the trigger lever and weight, although a bit more time is needed to prepare the instrument for deployment (layout and attach the steel wires to the

coring device). For both approaches, several attempts might be necessary in order to recover long and therefore most complete sediment successions. This, however, is no true disadvantage because each recovered core enables additional lateral correlations of volcanic deposits (e.g. Kutterolf et al., 2021b) and therefore enables to investigate differences between proximal and distal deposits of volcanic eruptions (e.g. geochemical, structural, or textural; Figure 5-3 C). Nevertheless, the sediment recovery usually ranges on a meter scale (e.g. 0 < metres recovery < 30 m; Freundt, 2017; Hansteen, 2017; Krastel, 2019b), corresponding to some ten to hundred thousand of years of sedimentation.

Compacted sediments are difficult to recover with the gravity corer as the penetration speed is limited to the winch's specifications and might not provide enough force to penetrate. Here, the advanced gravity corer offers a better potential to recover more compacted sediments, due to the higher penetration momentum. Both approaches usually recover ash and lapilli layers (e.g. Eisele et al., 2015; Freundt, 2017; Krastel, 2019b), especially when intercalated between background sediments. Nevertheless, not all winches are made for the gravitational forces on the rope and therefore this technique might not be viable on every research vessel. In addition, the advanced gravity corer system requires more effort and cautious handling from the ship's crew especially after heaving to bring the instrument back on deck. A disadvantage of both techniques is the effect of negative pressure when releasing the intruded core pipe from the seafloor, potentially leading to the loss of recovered sediments when the core catcher is too weak to hold the sediments. The Piston corer can also be operated from regular research vessels with a suited winch and ship's crew, and has the great advantage of usually recovering relatively undisturbed marine sediments. However, the assembly of the coring system can last up to several hours and the deployment from the ship is comparably difficult. In addition, this technique bears the risk of failures due to early release of the counter weight or incomplete penetration due to more consolidated layers. Therefore, we recommend the (advanced) gravity corer as the most efficient and reliable coring instrument of choice for the recovery of marine sediments and subsequent tephra studies.

The recovery of longer sediment successions that cover several million years of sedimentation requires deep ocean drilling (APC, HLAPC, XCB, and RCB; subsection 5.3.2). Usually these drilling campaigns start with APC or HLAPC coring (subsection 5.3.2.3; Table 5-3), however, if the sediment properties are not suitable for APC or HLAPC (e.g. igneous rocks), the drilling strategy needs to be adapted and more advanced drilling techniques are required (e.g. RCB; subsection 5.3.2.5; Table 5-3).

The APC and HLAPC systems are the fastest coring method on a drill ship, able to recover 20 to 40 meters of sediment per hour depending on the water depth. If applied to only short hole length of ~100 mbsf [meter depth below the seafloor], it could be the perfect bridging tool between shallow marine coring and deep coring with the drill ship providing the possibility for deeper penetration while the shallow marine coring provides lateral coverage. APC and HLAPC are designed to recover high quality cores of soft to firm sediments and have proved to recover sediments where nearly no recovery, loss, or coring disturbance have occurred with other techniques than that ones used by IODP (Figure 5-4 B). HLAPC recovers shorter cores than APC coring and it requires more operational time. Neither of both approaches are able to penetrate or recover massive (more than decimetre-sized packages) granular sediments, such as sands, or hard layers, such as chert, as they might stick in the firm sediments and require drillover (loss of sediment intervals). Nevertheless, one of the most striking advantage over all other coring and drilling methods is the relatively well-preserved core stratigraphy until deep into the soft to semi-consolidated sediment which is not achieved by any other coring method. As soon as APC or HLAPC fail because the sediment properties become unsuitable, XCB drilling is performed. One of the main advantages is, that XCB and APC use the same operational setup and can be exchanged without time-consuming pipe trips. XCB does not recover very soft sediments or sedimentary rocks, granular formations, fractured rock or hard igneous formations. The top of such intervals (e.g. stiff sediments, Figure 5-5 B), however, can be cored until the cutting shoe is destroyed (e.g. Saffer et al., 2019b). One disadvantage of XCB is the relatively high probability of creating core disturbance, especially in soft and moderately hard sediments, due to drill fluid intrusion during the drilling operation. Once XCB fails (e.g. due to destroyed cutting shoe) or changing sediment properties, an operational change to RCB coring enables deeper penetration into the sediments. Although RCB is generally slower, it allows to drill without recovery by simply exchanging the core barrel. Sediment intervals of interest can therefore be recovered at any time (“spot coring” to fill in gaps) without significant time loss. In general, this technique requires an operational setup change (“pipe trip”) and exchange of drill bit which is per se time-consuming, especially when operating in deep water. Compared to the other techniques the overall recovery is low (~35%, e.g. Wallace et al., 2019b), however, the recovered sediments are of great value as this is the only technique that successfully recovers hard rock and firm sediments from deep oceanic basin fillings.

Deep ocean drilling campaigns are comparably expensive because specific drilling vessels are required, just as drilling personnel and technical staff. The expeditions are usually long (~8 weeks) and often limited to some drill locations per expedition, since the deep-water column,

increasing penetration depths and changes of the operational setup set strict time constraints throughout the expedition. In general, successful IODP proposals require years of preparation and pre-site surveys in order to justify the operational expenditure and therefore, in some parts, deep ocean drilling campaigns heavily rely on the results of previous shallow marine gravity coring campaigns.

Table 5-4 Overview of coring and drilling campaigns, different techniques and their (dis-)advantages.

	Marine coring campaign	Marine drilling campaign	(Advanced) Gravity coring	Piston coring	APC / HLAPC	XCB	RCB
Personnel	++	++++					
Costs	++	+++					
Preparation time for sea-going expedition (e.g. pre-site surveys, proposals etc.)	+	++++					
Time at sea	++	+++					
Needed equipment onboard	++	++++					
Classical mapping (flexible sites)	++++	+					
Length of sediment archive	+ to ++	++++					
Practicability (e.g. how fast and handy is the technique)?			++++	++	++++	+++	++
Sediment properties			soft to compacted sediments, ash and lapilli	soft to compacted sediments, ash and lapilli	soft to firm, ash and lapilli	soft to moderately hard	lithified sediments, hard rock
Penetration potential			+ to ++	+ to ++	++ to +++	+++	++++
Overall sediment recovery			+++	++	++++	++ to +++	+
Sediment disturbance			++	+	+	++ to +++	+++

Expenditure and/or outcome: + “low”, ++ “moderate”, +++ “high”; ++++ “extreme”. Please note: this overview is strongly simplified and shall serve as first overview for the practicability of marine tephra studies.

5.5.2.1 Overall benefits and limitations for tephrostratigraphic studies

Each presented coring technique comes with its own advantages and disadvantages (Table 5-4), however, without a doubt the advantages of each technique are dominating because without seagoing expeditions and coring equipment the research field of marine tephra studies would not exist.

The approach of shallow marine (advanced) gravity coring is ideal for fundamental research, for example in a study area where no marine tephra studies were performed so far or in order to close existing gaps. In addition, these shallow marine coring campaigns might serve as pre-site surveys for further drilling campaigns. Depending on the sedimentation setting, this approach gives first insights into the volcanic evolution of an arc or individual volcanoes up to 10^5 years. Although relatively short (geological time scale), these time intervals might even lead to surprises (e.g. Freundt, 2017), as onshore records are often incomplete due to

overprinting and burial, or erosion of volcanic deposits. In addition, (advanced) gravity coring allows to investigate the lateral dispersal of volcanic deposits, similar to the approach of geological mapping onland, as it is a comparably fast approach and therefore allows multiple core location in a short time period, potentially resulting in a 2D or 3D distribution map of volcanic deposits. Another great advantage is the flexibility of (smaller) research vessels regarding the distance to the volcanic source, meaning: very proximal coring is generally possible (e.g. Freundt, 2017; Krastel, 2019b). In general, (advanced) gravity coring campaigns require a proper ship-time proposal, but once approved most vessels with a winch could do gravity coring. In addition, the ship-time and needed material (e.g. coring pipe, weight, core catcher, plastic liner, material for transport and storage of the core sections etc) is not overly expensive compared to other techniques.

Deep ocean drilling performed by IODP usually pursues bigger research questions compared to shallow marine gravity coring campaigns, as these drilling techniques enable the recovery of 100s to 1000s of metres of coherent marine sediment successions equivalent to some 10^6 years of marine sedimentation. Therefore, these expeditions always enable ground-truthing science. In addition, the nature of these expeditions (e.g. international participation of scientists from different disciplines) evokes multidisciplinary research that provides benefits for all involved research disciplines often culminating in joint synthesis. For tephrostratigraphic studies in particular, and when operating close to volcanic arcs or volcanoes, deep ocean drilling campaigns enable the establishment of records often since the onset of volcanism, using the full advantage of the recovered, long sediment archives dated onboard by combined biostratigraphic and paleomagnetic records. For these time-scales, the onshore records are usually incomplete due to erosion, or not at all accessible due to burial, and therefore the marine sediments are the only possibility to reconstruct this part of the eruptive history. Nevertheless, IODP expeditions usually operate distal to ultra-distal from the volcanic sources and therefore the tephra inventory in the recovered sediments is often limited to deposits of large eruptions ($VEI > 5$; Pank et al., in preparation for resubmission; Kutterolf et al., 2023c). Exception to this is the recent IODP Expedition 398 to the Hellenic Arc Volcanic Field, where proximal to medial deposits have been drilled (Druitt et al., 2022). The recovered sediments and intercalated tephra from this expedition will allow a direct comparison of results from deep ocean drilling techniques and extensive shallow marine gravity coring for the first time (e.g. Wulf et al., 2020; Kutterolf et al., 2021b; Kutterolf et al., 2021a).

5.6 Summary and conclusion

The discipline of marine tephra studies depends on the recovery of coherent marine sediment successions, and therefore sea-going expeditions. Several different scientific coring and drilling techniques were developed over time and are usually linked to different coring or drilling campaigns, and sedimentary properties (e.g. soft sediments, hard rock) as well as different dimensions of involved research vessels (i.e. regular research vessels to high-tech drilling operation platforms). For tephrostratigraphic studies, the gravity corer has shown to have the greatest benefit because its onboard usage is relatively uncomplicated and fast. The recovery of marine sediments is limited to some tens of metres (<30 m), but most recoveries range between >0 to 10 m, which can correspond to thousand and up to hundred thousand of years of sedimentation. Shallow marine gravity coring campaigns are best for lateral tephra studies (investigation of proximal and medial tephra deposits), whereas “deep ocean drilling” campaigns target a deep penetration, often reaching several hundred to thousand meters into the seafloor and covering up to millions of years of sedimentation. Deep ocean drilling campaigns enable the recovery of soft sediments and hard rock (i.e. basement rocks, lava etc) due to specialised drilling techniques. However, they are limited to a few site locations per expedition only because most drilling operations are very time-consuming (e.g. due to penetration depth, water depth) and expensive. In general, each campaign or technique comes with its own benefits and limitations and a combination would have the greatest advantage for marine tephrostratigraphy as it would cover both, the lateral extension of volcanic deposits and the potentially earliest traces of volcanism preserved in the marine sediments.

In any case, most of these sea-going expeditions result in hundreds of individual tephra samples, which usually exceed preparation and analytical capabilities.

We present a revised methodical approach designed for marine tephrostratigraphy that enables a smooth workflow from core recovery to geochemical analyses, and ultimately to the establishment of tephrostratigraphies of individual volcanoes, volcanic centres, or volcanic arcs. This revised methodical approach is optimised to fulfil the needs of marine tephra studies that focus on large sample quantities, their preparation and geochemical characterisation. It potentially has its greatest benefit in terms of efficiency and practicability for studies with >200 samples, however the general approach is universal and can therefore be adjusted to the needs of any research discipline that has a similar sample preparation approach and plans analyses with the EMP and LA-ICP-MS.

The most important advantages of our revised methodical approach are summarised in the following:

- Detailed description of a workflow onboard from “core on deck” to sediment description and sampling.
- Usage of standardised templates for core and smear slide descriptions that enable a comparison of descriptions from different expeditions and scientists, and therefore are designed to support later interpretations.
- Pre-drilled mounts enable to embed twelve samples at once, and “summarise” further preparation steps (e.g. grinding, polishing, and carbon-coating of the mounts). In addition, less time is lost at the instruments (EMP and LA-ICP-MS) due to time-consuming mount changes.
- Semi-automated polishing instrument that enables to polish up to six mounts at the same time.
- The analysis of 20 glass shards for major element composition and five glass shards for trace element composition results in a good statistic and is sufficient to geochemically characterise marine tephras, even if geochemically bimodal or zoned. Glass shards planned for trace element analyses should be well documented (images showing the glass shards) in order to save time at the LA-ICP-MS.

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6 Conclusion

The investigation of the marine tephra record from several deep ocean drilling campaigns offshore New Zealand allowed the establishment of a most complete marine tephrochronostratigraphy of New Zealand reaching back to the Neogene. Therefore, this thesis offers new insights into New Zealand's eruption record, because, as in many other research areas, the volcanic onshore record lacks continuity and is partly incomplete due to for example erosion and inaccessibility of deposits. This particularly applies to the tephra inventory of eruptions >61 ka as shown by several preceding onshore tephra studies, and therefore the marine tephrostratigraphy, continuous until c. 12 Ma, is a major step towards understanding New Zealand's volcanic arc systems. In addition, the studies served as case study for the establishment of a revised methodical approach designed and optimised for marine tephrostratigraphic studies with large sample numbers (>>200) where a recipe from core to correlation is introduced including coring techniques, sample preparation steps, analytics and data reduction, as well as tephra correlation.

In total 1,005 marine samples from eleven drill sites (21 holes; ~200 to 1900 km from source) were prepared and analysed for their major element composition following the revised methodical approach. In combination with trace element compositions, the overall stratigraphic context of the sediments, and age models for the cores, ~640 marine tephras (Quaternary: 331, Neogene: 306) were identified as primary. Most of these primary tephras were classified as fallout tephra, indicated by their internal structure (e.g. grain size distribution) and contacts to the surrounding background sediment (e.g. sharp lower and grading upper boundary), most likely directly linked to an ash cloud of an erupting volcano that dispersed volcanic material in the direction of the prevailing winds. A few tephras, however, were internally chaotic and/or disturbed by drilling (e.g. mixed with background sediment) and therefore labelled as "primary event deposits" if they fulfilled all other characteristic criteria (e.g. geochemical uniqueness within the stratigraphic context, correlations between holes and sites) for a primary volcanic deposit. This classification approach is comparably conservative as it might misidentify originally primary tephra deposits as secondary (reworked), potentially leading to a slight underestimation of primary deposits in the resultant data set. However, due to the large sample quantity in this study more detailed analyses (e.g. component analyses) were limited to stratigraphically important sediment intervals (e.g. important intervals for other research disciplines involved in IODP Exp. 375) only. Nevertheless, the majority of these "primary event deposits" were correlated between holes and drill sites, supporting their primary origin.

Correlations of the in total identified ~640 primary tephra layers between cores and drill sites generally followed the revised methodical approach and resulted in 165 volcanic events during the Quaternary (corresponding to 254 tie-lines between holes and sites; <2.58 Ma) and 208 volcanic events during the Neogene (168 tie-lines between cores and sites; c. 2.58 - 17 Ma) preserved in the marine sediments. Further correlations to onshore deposits were successful for 35 Quaternary volcanic events, for example to Taupō tephra (c. 1.7 ka), Kawakawa tephra (c. 25.4 ka), Kidnappers-B and Potaka tephra (c. 1.0 Ma), and Lower Papamoa Ignimbrite (c. 2.4 Ma), whereas no reliable correlation was established for the Neogene record. The most likely explanation for these comparably few correlations is 1) the overall limited terrestrial comparative data availability which is often restricted to a few major element compositions per deposit only, 2) little stratigraphic context between rather poorly dated onshore deposits, 3) limited knowledge about volcanic sources at the Coromandel Volcanic Zone (main activity between c. 18 - 4 Ma), one of New Zealand's Neogene volcanic arcs, and 4) a potentially better (or different) preservation of volcanic deposits in the marine environment from eruptions that were not preserved or identified onland. Nevertheless, especially the last point should be taken with caution because first-order estimates of eruptive magnitudes showed that the preserved volcanic events of the Quaternary are of eruption magnitudes $5 \leq M \leq 8$, indicating that smaller eruptions ($M < 5$) either did not reach the drill sites (> 200 km from any volcanic source) or did not form discrete tephra layers.

Although the established marine tephrostratigraphy only comprises eruptions with magnitudes $M \geq 5$, and could consequentially be considered as incomplete, it is the most continuous marine tephrochronostratigraphy established up to now and enables first temporal investigations of the volcanic arcs.

- During the Quaternary, several shorter intervals of increased volcanism and volcanic quiescence were identified, some of these overlap with previously described periods of increased or decreased volcanic activity based on the onshore record. The overall eruption frequency during the Quaternary can be grouped into two main periods between c. 2.58 to 1.6 Ma and <1.6 Ma, and first holistic estimates show that these intervals correspond to repose times of one eruption every 38 kyr and 12 kyr, respectively.
- During the Neogene, four main intervals of varying eruption frequencies were identified at c. 11.9 to 10.6 Ma, c. 10.5 to 10.0 Ma, c. 9.9 to 9.7 Ma, and c. 9.7 to 2.6 Ma. These correspond to repose times of one eruption occurring every 310 kyr, 36 kyr, 5.5 kyr, and

47 kyr, respectively. These results show, that New Zealand's volcanism is characterised by frequencies of volcanic highs and lows, but more importantly that the volcanic activity seem to have increased since the Quaternary.

- Several intervals of “stacked tephra deposits” were identified in the Quaternary marine sediments that have not been described in literature so far. These “stacked tephra deposits” are present at c. 300 ka, c. 900 ka, and at c. 1.8 Ma and interpreted as the deposits of increased volcanic activity, either due to eruptive pulses from the same volcano or simultaneous volcanic activity at different volcanic centres. The potentially most interesting interval is linked to the Potaka and Kidnappers super-eruptions dated at c. 1.0 Ma.
- The marine volcanic events indicate a temporal compositional variation from c. 12 Ma to present most likely related to changes of magmatic source(s). From c. 4.5 Ma on, however, the composition of the marine volcanic events shows a more drastic geochemical change which most likely corresponds to the shift of volcanic activity from one arc (Neogene Coromandel Volcanic Zone) to the other (Quaternary Taupō Volcanic Zone). Preceding studies proposed that this transition occurred at around 2.5 to 2.0 Ma, however, most recent studies, including this thesis, indicate that both volcanic arcs overlapped in time and that the transition started earlier, at around 4.5 Ma.

The marine tephra record generally complements and extends the onshore record, and a combination of both and further future research (onshore and offshore) will potentially result in the most complete eruption record of New Zealand's volcanic arcs. Here, the utility of further research highly depends on precise sampling strategies, and documentations of samples and stratigraphic contexts between samples and, where applicable, outcrops (onshore or offshore). In addition, geochemical analyses of New Zealand's volcanic deposits should include major and trace element compositions, and where possible, reliable age constraints (indirect or direct dating methods) should be established. The resultant high workload due to large sample numbers and different analytical approaches could be reduced by following the revised methodical approach established in this thesis. For the greatest benefit to the scientific community the resultant information, from sampling to interpretation, should be made available to enable further future research to use and build on previously established data and interpretations.

7 Scientific Outlook

In the scope of this thesis, I established New Zealand's marine tephrostratigraphy. The resultant data set consists of major element compositions for all investigated marine tephras and trace element compositions for most of them, and therefore enables further future research on different topics.

In the following, I will highlight the most surprising findings and potential research questions.

What is the provenance of the silica-poor marine tephras?

Since the onset of volcanism in the Neogene, New Zealand is dominated by evolved and silica-rich, rhyolitic eruptions whereas basaltic and andesitic eruptions are rare. However, compared to the onshore record, the established marine tephra record of New Zealand comprises a relatively high number of silica-poor (<70 wt% SiO₂) tephra layers that are present throughout the record (Neogene to present; Figure 7-1). Between c. 10.8 to 9.2 Ma, we identified a period of c. 1.6 Myrs which is characterised by an increased number of silica-poor explosive volcanic events (Figure 7-1) that were preserved in the marine sediments.

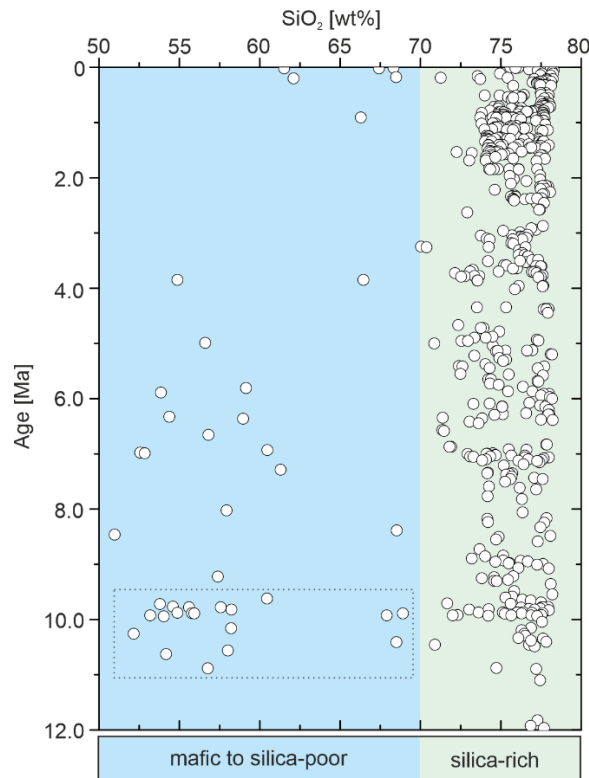


Figure 7-1 Silica compositions of the marine tephrostratigraphy of New Zealand for the last 12 Myr.

New Zealand's volcanism is clearly rhyolite dominated (colored in green). Silica-poor to mafic volcanic events (colored in blue) are rare and generally more present during the Neogene (>2.58 Ma). Between c. 9 to 11 Ma mafic to silica-poor volcanic events occur more frequently (dotted rectangle).

First correlations to onshore deposits (e.g. Booden et al., 2012) were not successful, most likely due to the poor resolution of volcanic sources of the volcanic arc at that time and limited data availability. Nevertheless, it is important to identify the volcanic provenance of these silica-poor marine tephra because their marine occurrence in the sediments indicates frequent silica-poor to mafic (highly) explosive volcanism with eruption magnitudes of $M \geq 5$, which has thus far not been described for New Zealand's volcanic history and which is generally a rare volcanological phenomena. Other volcanic sources that contribute to the marine sediments in the Southwest Pacific (e.g. the Louisville seamount chain, Kermadec trench) have been considered, however, a reliable identification was beyond the scope of this thesis.

Based on the unsuccessful geochemical correlation approaches, my suggestion to address this research question is to focus on the identification of the eruptive setting at first. Glass shard morphologies in combination with volatile analyses of the volcanic glass are a reliable tool for the identification of and distinction between submarine and subaerial eruptions and could therefore support the identification of the provenance or at least narrow down potential volcanic sources. In addition, it might be necessary to conduct field work on New Zealand and surrounding islands (e.g. Chatham islands) targeting silica-poor volcanic deposits in order to establish a consistent geochemical data set that can be used for correlation purposes. Once the provenance is identified, it would be interesting to investigate the eruptive frequency of these silica-poor explosive eruptions and whether the main deposition of the associated volcanic material occurred offshore or onshore.

Is New Zealand's volcanism controlled by climatic events? Are other parameters pre-dominating?

New Zealand's marine tephrostratigraphy is the first continuous volcanic record from the southern hemisphere that covers the last 12 Myr. Over the last 12 Myr, the marine tephrostratigraphy indicates volcanic cyclicities with phases of high and low volcanic activity (Figure 7-2). Therefore, this data set is a good candidate to test the hypothesis whether global climate change (in terms of glacial and interglacial periods and their consequences, e.g. sea level changes) forces volcanic activity (causing volcanic cyclicities), or vice versa.

Such links have been previously proposed based on continuous eruption records from the northern hemisphere due to a coincidence between periodic fluctuations of volcanic activity and periods of orbitally controlled climate change, overall following a 23 kyr, 41 kyr and 100 kyr periodicity (e.g. Paterne et al., 1990; Schindlbeck et al., 2018; Kutterolf et al., 2019). In addition, these studies from the northern hemisphere identified a correlation between the

eruption record and the “global LR04 $\delta^{18}\text{O}$ reference stack” (Lisiecki and Raymo, 2005), which is a climate proxy for ice volume and sea level changes.

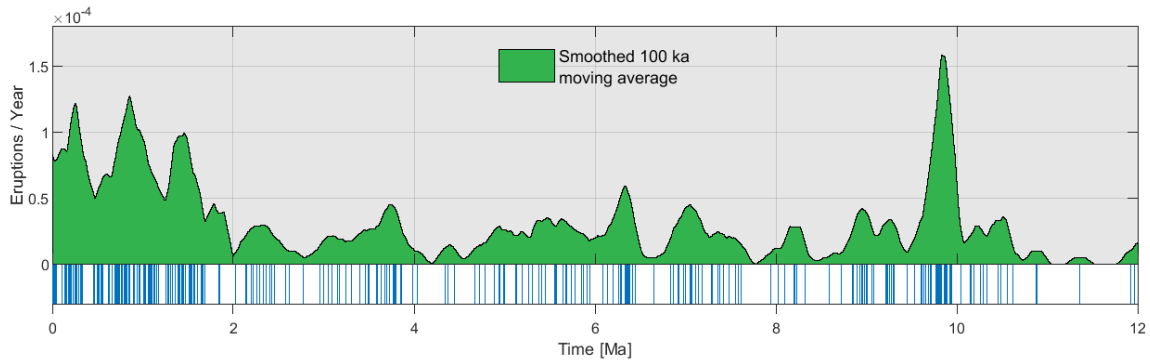


Figure 7-2 Preliminary eruption frequency of New Zealand for the last 12 Myr.

The eruption frequency (highlighted in green) is computed using New Zealand’s marine tephrostratigraphy and a smoothed running average for a 100 kyrs bin size. The bar code (blue bars) represents the distribution of volcanic events (each tickmark represents one volcanic event) over time. The preliminary results indicate cyclicities throughout the record which can be further investigated in terms of potential volcano-climate interactions.

The marine tephrostratigraphy of New Zealand, however, does not smoothly fit into the picture drawn by preceding studies from for example Schindlbeck et al. (2018) and Kutterolf et al. (2019). We observed a prominent periodicity at 100 kyr, comparable to preceding studies, as well as two shorter ones at 34.8 kyr and 50 kyr that are less prominent. The shorter periodicities, however, are slightly offset by about 11.8 kyr and 9 kyr compared to the results of preceding studies. In addition, obvious correlations between the eruption record and the “global LR04 $\delta^{18}\text{O}$ reference stack” (as shown in Schindlbeck et al., 2018; Kutterolf et al., 2019) could not be duplicated for New Zealand’s marine tephrostratigraphy.

One simple explanation for our preliminary observations could be that the southern hemisphere reacts differently to climatic changes compared to the northern hemisphere, for example due to the unequal distribution of landmass around the globe. Another explanation, however, could be that other geological parameters, for example tectonic processes, generally dominate over climate at New Zealand or at least mask existing correlations.

The answer to these research questions will be an important piece of the puzzle in order to understand the Earth’s climate and how it is influenced by geological events or vice versa.

How were the tephras now exposed at Mahia Peninsula deposited, what is their provenance, and are these tephras reliable correlatives for the marine tephrostratigraphy?

Onshore records that preserve several million years of continuous sedimentation with intercalated tephra layers are rare on the North Island (e.g. Whanganui Basin, Pillans et al.,

2005; Mahia Peninsula, Shane et al., 1998). Making matters worse, available geochemical data of intercalated volcanic deposits are usually limited to major element compositions which were analysed decades ago, and background information about sampling procedures and stratigraphic contacts are usually missing in the respective publications.

One very valuable onshore record is located at the East Coast of the North Island at Mahia Peninsula where tephras from late Miocene volcanism (c. 9 to 7.5 Ma) sourced from the Coromandel Volcanic Zone are preserved (Shane et al., 1998). However, given information in the respective literature about stratigraphic contexts, geochemical compositions of individual layers, and transport mechanisms is of limited use. In addition, there have been no efforts made for the identification of the provenance of these marine tephras.

Therefore, the Neogene sediment successions at Mahia Peninsula were revisited and resampled during a field campaign in March 2022, directed and operated by J. L. Hopkins and S. Eaves (and students), and sent to me for preparation and geochemical analyses. Based on the analyses, I established a consistent and comprehensive data set comprising major and trace element compositions. This data set will enable future studies to identify the transport mechanisms that led to the deposition of the volcanic material now exposed at Mahia Peninsula. Potential outcomes are particularly interesting as they might be the first solid (dis-) proof for the capability of primary pyroclastic density currents to have reached (or not reached) the marine environments east of New Zealand during Neogene times. In addition, the findings might put detailed time constraints on the formation of the axial mountain range which nowadays forms a natural boundary between central North Island (New Zealand) and the marine environment towards the East.

Most importantly, however, is the potential of the establishment of reliable correlations between the marine tephrostratigraphy and revised Mahia tephra record. These correlations will complement our knowledge about New Zealand's Neogene volcanism and are therefore of very high value to the scientific, volcanological community.

Understanding future volcanic developments by looking into the past: what is the true eruptive potential of New Zealand's volcanic arcs?

Since the Neogene the North Island is characterised by frequent and highly explosive volcanism and several volcanoes still count as active today (e.g. Hobden et al., 2002; Kilgour et al., 2021) posing a potential threat to New Zealand's community. Therefore, a well-established eruption record is required as it might be helpful for risk mitigation plans. More importantly, the volcanic

past is indicative for the overall volcanic potential and therefore future developments of volcanic arc systems.

The marine tephrostratigraphy established in this thesis complements and extends the volcanic onshore record of New Zealand that was mainly established based on onshore deposits in preceding studies (e.g. Houghton et al., 1995; Pillans et al., 2005; Smith et al., 2005; Booden et al., 2012; Pittari et al., 2021). However, if examined separately, the marine tephra record is incomplete.

Two examples for illustration:

1. Estimations showed that the marine sediments at the existing drill sites only preserved deposits from eruptions with magnitudes $M \geq 5$ (subsection 3.8.3) generally underrepresenting the explosive eruptive history of New Zealand's volcanoes.
2. Several "new" volcanic events and intervals of "stacked tephra deposits" (which I interpreted as phases of increased or pulsed volcanic activity; subsection 3.8.1) have been identified in the marine sediments which have not been described in the onshore records.

Both issues, the overall incompleteness and the identification of "new" volcanic deposits, could be addressed during further future expeditions and coring/drilling campaigns. These campaigns should target the geographical gaps, onshore and offshore, between the existing drill sites and volcanic source. The offshore record, for example, could be complemented by a dense array of gravity and piston cores which can be operated from regular research vessels. Both techniques can recover some tens of metres (usually <30 m) of marine sediments, corresponding to an age of ≤ 10 ka at the proximal Site U1520 and ≤ 250 ka at the most distal Site 1123 (e.g. Figure 2-1). The additional usage of a Giant Piston Corer or drilling-equipment like MARUM-MeBo drill rig (also feasible from regular research vessels) could extend the recovery to up to several tens of metres (≤ 80 m; e.g. Weaver and Schultheiss, 1990; Freudenthal and Wefer, 2013), corresponding to an age of <100 ka at the proximal Site 1520 and ~ 1.6 to 2.3 Ma at the distal Site 1123.

The results of these potential future expeditions would proof or disproof the results established in this thesis, but more importantly, complement the tephra record and ultimately lead to a revised most complete tephrostratigraphy of New Zealand's volcanism.

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Associated work

Following work was prepared contemporaneously but is not part of this thesis.

Peer-reviewed publications

Kutterolf, S., Freundt, A., Hansteen, T.H., Dettbarn, R., Hampel, F., Sievers, C., Wittig, C., Allen, S.R., Druitt, T.H., McPhie, J., Nomikou, P., **Pank, K.**, Schindlbeck-Belo, J.C., Wang, K.-L., Lee, H.-Y., Friedrichs, B., 2021a. *The Medial Offshore Record of Explosive Volcanism Along the Central to Eastern Aegean Volcanic Arc: 1. Tephrostratigraphic Correlations*. *Geochem. Geophys. Geosyst.* 22.

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Pank, K., Hansteen, T. H., Geldmacher, J., Hauff, F., Jicha, B., Nomikou, P., Garbe-Schönberg, D. and Hoernle, K., 2022. *Mineralogy and geochemistry of lavas from the submarine lower caldera walls of Santorini Volcano (Greece)*. *Journal of Volcanology and Geothermal Research*, Volume 427, doi: 10.1016/j.jvolgeores.2022.107556.

Woodhouse, A., Barnes, P. M., Shorrock, A., Strachan, L. J., Crundwell, M., Bostock, H. C., Hopkins, J., Kutterolf, S., **Pank, K.**, Behrens, E., Greve, A., Bell, R., Cook, A., Petronotis, K., LeVay, L., Jamieson, R. A., Aze, T., Wallace, L., Saffer, D. and Pecher, I., 2022. *Trench floor depositional response to glacio-eustatic changes over the last 45 ka, northern Hikurangi subduction margin, New Zealand*. *New Zealand Journal of Geology and Geophysics*, pp. 1-24, doi: 10.1080/00288306.2022.2099432.

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Kutterolf, S., Schindlbeck, J. C., **Pank, K.**, Wang, K. L. and Lee, H. Y., 2023a. *Data report: chemical compositions of marine tephra layers in the Indian Ocean, IODP Expeditions 353 and 362*. In: *Sumatra Subduction Zone - Proceedings of the International Ocean Discovery Program, 362*. IODP, College Station, TX, pp. 1-7, doi: 10.14379/iodp.proc.362.207.2023.

Kutterolf, S., Schindlbeck-Belo, J.C., Müller, F., **Pank, K.**, Lee, H.-Y., Wang, K.-L., Schmitt, A.K., 2023b. *Revisiting the occurrence and distribution of Indian Ocean Tephra: Quaternary marine Toba ash inventory*. Journal of Volcanology and Geothermal Research 441, 107879.

Kutterolf, S., Schindlbeck-Belo, J.C., **Pank, K.**, Schmitt, A.K., Lee, H.-Y., Wang, K.-L., 2023c. *The cenozoic marine tephra record in Indian Ocean deep drill sites*. Journal of Volcanology and Geothermal Research 441, 107875.

Conference abstracts

Oral presentations:

Pank, K., Hansteen, T., Geldmacher, J., Garbe-Schönberg, D., Jicha, B., Hauff, F., Hoernle, K.: *Origin and evolution of the lowermost lava successions at Santorini volcano*. EGU General Assembly 2021, online, 19-30 Apr 2021, EGU21-2096, <https://doi.org/10.5194/egusphere-egu21-2096>.

Pank, K., Hansteen, T., Geldmacher, J., Garbe-Schönberg, D., Jicha, B., Hoernle, K., and Nomikou, P., 2022. *Geochemistry of lavas from the submarine lower caldera walls of Santorini Volcano (Greece)*. Cities on Volcanoes Conference 2022 in Heraklion, Crete, Session: S2.05.

and further contributions as co-author.

Poster presentations:

Pank, K., Hopkins, J. L., Kutterolf, S., 2022. *Tephrochronostratigraphy in marine and terrestrial sediments of New Zealand: Benchmark for Miocene to Quaternary explosive volcanism*. Cities on Volcanoes Conference 2022 in Heraklion, Crete. Poster ID: PP073.

Pank, K., Kutterolf, S., Hopkins, J. L., Schindlbeck-Belo, J. C., Wang, K.-L., Lee, H.-Y., 2023. *Insights into New Zealand's Quaternary tephrochronostratigraphy using marine tephra*. XXI INQUA Congress 2023 in Rome, Italy. Poster ID: 4404. Presented by J. L. Hopkins.

and further contributions during smaller workshops (e.g. Science Day at GEOMAR Kiel, IODP Kolloquium in Potsdam) and as co-author.

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Curriculum Vitae

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Education

2016 - 2019	M. Sc. Geoscience at Kiel University Topic of Master thesis: Origin and evolution of the lowermost lava successions at Santorini volcano (Greece): insights from major and trace element composition of rocks from the submarine caldera wall. (Referees: Prof. Dr. K. Hoernle, Dr. J. Geldmacher, Dr. T.H. Hansteen)
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Appendix A

Supplementary material for Study II:

Advances in New Zealand's tephrochronostratigraphy using marine drill sites: The Quaternary.

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Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

volcanic event	volcanic event	Sample ID	Age [ka]	Quaternary eruption chronology [ka]	Onshore correlatives	std	P205	Al ₂ O ₃	std	MnO	std	CaO	std	MgO	std	TR02	std	SiO ₂	std	FeO	std	K ₂ O	std	Na ₂ O
s1	uncorrelated	U1520D-1H-1_119-120 U1519D-1H-2_15-17 U1519E-1H-2_7-9	2.03	1.71	Taupo 1718±10a ¹	0.02	0.03	1.335	0.05	0.08	0.05	1.51	0.03	0.24	0.03	0.25	0.53	75.59	0.41	1.87	0.07	2.76	0.09	4.32
	correlated					0.02	0.02	1.340	0.04	0.08	0.11	1.45	0.04	0.22	0.03	0.23	0.50	75.50	0.12	1.89	0.09	2.82	0.17	4.38
						0.02	0.03	1.328	0.03	0.09	0.10	1.48	0.03	0.23	0.02	0.24	0.46	75.51	0.12	1.89	0.11	2.80	0.21	4.44
s2		U1520D-1H-3_26-30 U1519D-1H-CC_4-6 U1519E-1H-3_95-97	5.59	3.38	Waimihia 3382±50a ¹	0.02	0.03	1.307	0.04	0.12	0.04	1.33	0.02	0.17	0.04	0.21	0.19	76.07	0.11	1.83	0.05	2.85	0.11	4.32
						0.02	0.02	1.307	0.03	0.09	0.03	1.32	0.03	0.17	0.02	0.19	0.26	76.13	0.10	1.80	0.06	2.82	0.16	4.19
						0.02	0.02	1.309	0.04	0.08	0.05	1.34	0.02	0.17	0.02	0.19	0.29	76.07	0.09	1.82	0.05	2.82	0.18	4.19
s3		U1520D-1H-3_67-69 U1526B-1H-1_93-95	6.27	5.54	Whakatane 5542±48a ¹	0.03	0.02	1.241	0.04	0.04	0.25	0.99	0.07	0.11	0.04	0.11	0.39	77.83	0.21	1.23	0.49	3.51	0.16	3.74
						0.01	0.01	1.247	0.04	0.06	0.04	0.93	0.02	0.13	0.01	0.13	0.27	78.00	0.08	0.96	0.11	3.26	0.16	4.06
						0.02	0.14	1.623	0.07	0.13	0.23	2.14	0.12	0.72	0.01	0.46	0.54	86.53	0.22	2.52	0.15	4.40	0.13	4.99
s5		U1520D-1H-4_87-90 U1526B-1H-1_122-124	9.13	9.47	Rotoma 9472±40a ¹	0.02	0.01	1.236	0.04	0.06	0.13	0.87	0.02	0.11	0.03	0.12	0.27	78.05	0.18	1.12	0.49	3.47	0.33	3.83
						0.01	0.01	1.239	0.04	0.06	0.06	0.82	0.03	0.10	0.02	0.10	0.24	77.97	0.07	0.97	0.36	3.58	0.18	3.81
						0.02	0.02	1.332	0.03	0.06	0.02	1.52	0.02	0.19	0.01	0.18	0.14	75.90	0.10	1.76	0.05	2.87	0.11	4.17
s7		U1520D-2H-3_77-79	15.25	10.50	Opepe 10004±122a ¹	0.02	0.16	1.602	0.02	0.12	0.44	6.19	0.37	2.74	0.03	0.94	0.74	61.52	0.30	6.57	0.18	2.20	0.14	3.56
s8		U1520D-4H-4_117-119	19.57	11.51	Ruapehu ⁽⁸⁾	0.03	0.15	1.518	0.04	0.10	0.56	3.69	0.29	1.09	0.07	0.76	1.43	67.42	0.38	4.70	0.22	2.89	0.16	4.01
s9		1125A-1H-1_71-73 U1526B-1H-3_36-38	17.47	25.35	Kawakawa/Oruanui 25358±162a ¹	0.02	0.02	1.222	0.03	0.06	0.07	1.13	0.03	0.11	0.02	0.12	0.37	77.82	0.09	1.25	0.19	2.98	0.17	4.28
						0.02	0.03	1.293	0.05	0.08	0.11	1.09	0.04	0.17	0.02	0.17	0.24	77.11	0.11	1.29	0.08	2.91	0.20	4.23
						0.02	0.02	1.281	0.04	0.06	0.06	1.08	0.03	0.17	0.04	0.18	0.38	76.89	0.09	1.24	0.06	2.81	0.16	4.73
s10		1123B-1H-2_5-7 1123A-1H-2_6-8 1124B-1H-2_43-45 1122A-1H-4_26-28	33.97 35.56 35.78 53.15	32.50	Omatiroa 32.5ka ⁶	0.01	0.01	1.259	0.04	0.06	0.14	1.03	0.05	0.10	0.08	0.11	0.30	77.45	0.15	1.11	0.64	3.51	0.42	4.02
						0.02	0.02	1.293	0.04	0.06	0.05	1.11	0.02	0.17	0.01	0.17	0.23	76.75	0.08	1.21	0.07	2.81	0.12	4.78
						0.02	0.02	1.258	0.04	0.08	0.03	1.09	0.02	0.15	0.02	0.16	0.17	77.30	0.10	1.17	0.05	2.73	0.16	4.73
s11		1123C-1H-2_69-71 1124B-1H-3_15-17 1124A-1H-1_71-73	50.05 86.74 83.44	45.17	Rotoehu 45170±3300a ¹	0.01	0.01	1.252	0.04	0.04	0.11	1.06	0.02	0.11	0.02	0.12	0.12	77.49	0.06	1.20	0.26	3.00	0.15	4.43
						0.01	0.02	1.232	0.04	0.07	0.04	0.92	0.02	0.13	0.04	0.14	0.20	78.29	0.07	0.92	0.11	3.09	0.15	4.10
						0.02	0.02	1.224	0.04	0.06	0.06	0.88	0.02	0.13	0.02	0.12	0.28	78.20	0.10	0.94	0.10	3.09	0.21	4.32
u1		1125B-1H-2_147-149	110.99	110.99		0.01	0.01	1.228	0.03	0.06	0.02	0.87	0.03	0.13	0.02	0.13	0.24	78.21	0.08	0.89	0.11	3.08	0.17	4.34
u2		U1526B-1H-3_111-113	111.20	111.20		0.01	0.01	1.262	0.04	0.04	0.09	0.87	0.02	0.08	0.02	0.09	0.19	78.24	0.09	1.04	0.17	3.47	0.15	4.13
u3		U1526B-1H-3_116-118	111.80	111.80		0.02	0.02	1.258	0.03	0.03	0.03	1.03	0.01	0.13	0.02	0.14	0.25	77.56	0.09	1.11	0.09	3.82	0.15	3.58
						0.02	0.03	1.395	0.04	0.09	0.32	1.92	0.11	0.40	0.06	0.29	1.18	78.94	0.26	1.64	0.11	2.48	0.14	4.26

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

<i>s/2</i>	U1520D_15H-4_71-73 U1526B_2H-1_94-96	141.00	141.00	141.00	0.02	0.02	0.25	12.49	0.03	0.05	0.16	1.01	0.04	0.11	0.05	0.15	0.42	77.47	0.22	1.31	0.32	3.66	0.24	3.74
<i>u4</i>	U1520D_16H-2_65-67	145.90	145.90	145.90	0.02	0.02	0.17	12.24	0.03	0.04	0.06	1.39	0.05	0.18	0.02	0.16	0.25	78.11	0.06	1.22	0.08	3.31	0.14	3.34
<i>u5</i>	U124A_1H-3_35-37	156.13	156.13	156.13	0.02	0.02	0.20	12.80	0.04	0.07	0.06	1.96	0.02	0.20	0.02	0.22	0.29	78.37	0.15	1.75	0.05	3.04	0.18	4.36
<i>u6</i>	U1520D_18H-2_108-110	177.40	177.40	177.40	0.02	0.02	0.12	12.83	0.07	0.13	0.10	2.43	0.04	0.26	0.05	0.43	0.12	78.49	0.11	1.66	0.09	3.96	0.14	5.20
<i>u7</i>	U1520D_18H-5_123-125	185.70	185.70	185.70	0.02	0.02	0.82	14.71	0.04	0.06	0.63	3.39	0.34	0.84	0.11	0.51	1.86	71.27	0.39	3.07	0.17	2.30	0.93	3.74
<i>u8</i>	U1520D_18H-6_107-109	188.20	188.20	188.20	0.02	0.02	0.21	12.22	0.03	0.04	0.04	1.59	0.03	0.12	0.03	0.16	0.36	78.42	0.20	2.11	0.12	3.41	0.21	3.90
<i>u9</i>	U1520D_20F-1_125-127	200.50	200.50	200.50	0.03	0.03	1.20	16.80	0.04	0.12	0.72	5.88	0.31	2.17	0.13	0.85	0.88	62.09	0.83	6.48	0.20	1.27	0.27	4.19
<i>u10</i>	U1520D_21F-4_6-8	210.30	210.30	210.30	0.02	0.02	0.36	12.54	0.03	0.03	0.16	1.25	0.04	0.08	0.03	0.15	0.58	77.07	0.20	1.73	0.13	3.45	0.19	3.68
<i>u11</i>	U1520D_21F-4_48-50	210.80	210.80	210.80	0.01	0.01	0.19	12.23	0.04	0.05	0.14	0.82	0.04	0.08	0.04	0.13	0.42	77.87	0.22	1.34	0.36	3.72	0.34	3.75
<i>u12</i>	U1520D_22F-2_60-62	213.10	213.10	213.10	0.01	0.01	0.27	11.95	0.04	0.05	0.02	0.72	0.02	0.07	0.04	0.12	0.49	78.22	0.08	1.23	0.08	3.48	0.17	4.14
<i>u13</i>	U1520D_22F-2_80-82	213.30	213.30	213.30	0.02	0.02	0.21	11.37	0.03	0.07	0.08	2.31	0.06	0.42	0.03	0.37	0.46	78.73	0.14	2.84	0.05	3.12	0.35	3.72
<i>s/3</i>	U1520D_23F-3_6-8 Awarua Gully (Mamaku?) 0.235Ma ¹	223.10	223.10	223.10	0.01	0.01	0.24	12.23	0.04	0.05	0.15	0.79	0.04	0.08	0.04	0.12	0.41	77.90	0.17	1.22	0.34	3.67	0.31	3.92
<i>s/4</i>	U124C_1X-1_80-82 U123A_2H-5_66-68 U123B_2H-6_91-93 U123C_2H-2_104-109	242.30 248.62 251.15 256.13	242.30 248.62 251.15 256.13	242.30 248.62 251.15 256.13	0.01 0.01 0.01 0.01	0.01 0.01 0.01 0.01	0.19 0.15 0.15 0.22	12.12 12.13 12.10 12.28	0.04 0.03 0.03 0.03	0.06 0.05 0.06 0.05	0.15 0.09 0.08 0.10	1.18 0.69 0.75 0.81	0.04 0.03 0.02 0.02	0.14 0.07 0.05 0.05	0.03 0.03 0.02 0.03	0.13 0.12 0.11 0.13	0.38 0.38 0.32 0.39	78.12 77.92 77.61 77.60	0.09 0.12 0.14 0.17	1.08 1.15 1.31 1.44	0.08 0.14 0.29 0.19	3.28 3.55 3.51 3.50	0.17 0.34 0.33 0.28	3.89 4.16 4.35 4.31
<i>s/5</i>	U123A_2H-6_18-20 U123C_2H-3_69-71	271.76 281.50	271.76 281.50	271.76 281.50	0.01 0.01	0.01 0.01	0.20 0.22	12.57 12.55	0.05 0.04	0.06 0.05	0.05 0.09	1.04 1.03	0.03 0.03	0.11 0.11	0.02 0.03	0.14 0.17	0.55 0.54	78.99 77.25	0.18 0.18	1.37 1.35	0.10 0.22	3.55 3.55	0.26 0.26	3.93
<i>s/6</i>	U123A_2H-6_70-72 U123C_2H-3_132-134	283.54 295.77	283.54 295.77	283.54 295.77	0.02 0.02	0.02 0.02	0.18 0.24	12.47 12.54	0.04 0.04	0.04 0.04	0.09 0.11	0.99 1.01	0.02 0.03	0.09 0.10	0.02 0.03	0.13 0.12	0.31 0.44	77.31 77.27	0.09 0.11	1.32 1.30	0.21 0.11	3.26 3.35	0.13 0.15	4.37
<i>s/7</i>	U1520D_25F-2_10-14 U1526B_2H-2_92-93	301 / 363±33 310.00	301 / 363±33 310.00	301 / 363±33 310.00	0.01 0.01	0.01 0.01	0.25 0.14	12.27 12.31	0.03 0.04	0.05 0.04	0.13 0.08	0.90 0.69	0.03 0.03	0.10 0.06	0.05 0.01	0.14 0.10	0.61 0.27	77.81 77.90	0.16 0.08	1.27 1.20	0.31 0.22	3.60 3.67	0.20 0.19	3.84 4.02
<i>u15</i>	U124A_1H-7_25-27	310.10	310.10	310.10	0.01	0.01	0.15	12.11	0.03	0.06	0.09	0.71	0.03	0.07	0.02	0.12	0.32	77.90	0.12	1.15	0.19	3.48	0.21	4.39
<i>u16</i>	U1520D_26F-1_103-105	310.6 / 330±37	310.6 / 330±37	310.6 / 330±37	0.01	0.01	0.26	12.26	0.04	0.05	0.11	0.92	0.02	0.08	0.05	0.15	0.52	77.73	0.19	1.31	0.20	3.49	0.18	4.00
<i>u17</i>	U1520D_26F-2_23-27	312.2 / 346±33	312.2 / 346±33	312.2 / 346±33	0.01	0.01	0.23	12.31	0.04	0.06	0.12	0.93	0.03	0.08	0.03	0.13	0.48	77.66	0.19	1.34	0.21	3.45	0.23	4.03
<i>u18</i>	U1520D_26F-3_29-31	314.55	314.55	314.55	0.02	0.02	0.25	12.35	0.03	0.05	0.11	0.98	0.03	0.10	0.03	0.14	0.50	77.52	0.18	1.33	0.11	3.50	0.14	4.01
<i>u19</i>	U1520D_26F-4_51-55	316.27 / 336±38	316.27 / 336±38	316.27 / 336±38	0.01	0.01	0.17	12.31	0.03	0.05	0.08	0.90	0.03	0.10	0.03	0.14	0.34	77.88	0.14	1.23	0.17	3.58	0.17	3.79
<i>s/8</i>	U1520D_27F-1_44-46 U1518F-13R-1_113-115	317.18 310.00	317.18 310.00	317.18 310.00	0.01 0.01	0.01 0.01	0.30 0.17	12.59 12.62	0.03 0.03	0.04 0.05	0.10 0.03	1.03 0.97	0.04 0.03	0.13 0.12	0.02 0.02	0.15 0.15	0.44 0.19	77.38 77.39	0.13 0.09	1.26 1.27	0.18 0.13	3.71 3.60	0.18 0.16	3.78 3.80
<i>u20</i>	U1520D_27F-1_96-98	317.89 / 235-300	317.89 / 235-300	317.89 / 235-300	0.01	0.01	0.13	12.45	0.03	0.04	0.11	1.09	0.02	0.11	0.03	0.11	0.28	77.84	0.10	1.17	0.29	3.51	0.30	3.67
<i>u21</i>	U1520D_27F-2_78-80	319.26 / 347±22	319.26 / 347±22	319.26 / 347±22	0.01	0.01	0.02	12.37	0.04	0.06	0.14	0.98	0.05	0.13	0.06	0.14	0.35	77.86	0.14	1.13	0.21	3.37	0.20	3.74

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s19	U1520D_27F-2_92-96	319.33 / 347±22		0.02	0.02	0.14	1244	0.04	0.06	0.11	1.07	0.04	0.16	0.05	0.18	0.31	77.82	0.10	4.12	0.21	3.37	0.19	3.78
	U1520D_27F-3_74-78	319.75	Lower Corliffm Road 0.3-0.4Ma ¹	0.01	0.02	0.20	1242	0.03	0.04	0.14	1.01	0.05	0.14	0.06	0.17	0.44	77.81	0.10	1.11	0.25	3.45	0.18	3.83
	1125B_2H-3_143-145	388.34		0.02	0.02	0.12	1225	0.04	0.04	0.04	1.01	0.02	0.12	0.02	0.14	0.20	77.73	0.06	1.14	0.07	3.56	0.14	3.99
	1125A_3H-2_67-69	390.31		0.01	0.01	0.17	1221	0.03	0.05	0.03	1.01	0.03	0.13	0.05	0.12	0.18	77.65	0.15	1.11	0.09	3.54	0.15	3.97
	U1520D_28F-1_93-95	321.04	Rangiaawa 350±50ka ⁵	0.02	0.01	0.23	1239	0.04	0.04	0.14	0.89	0.04	0.10	0.04	0.14	0.39	77.75	0.24	1.10	0.44	4.11	0.30	3.47
s20	U1518E_1H-4_16-18	320.00		0.01	0.02	0.26	1246	0.03	0.05	0.04	0.83	0.02	0.10	0.02	0.10	0.33	77.47	0.15	1.02	0.08	4.09	0.14	3.65
	U1520D_33X-3_60-62a I	334.16		0.02	0.02	0.25	1218	0.03	0.06	0.12	1.26	0.05	0.21	0.07	0.23	0.53	78.77	0.17	1.66	0.39	3.48	0.29	4.14
	U1520D_33X-3_60-62 II	334.11		0.02	0.02	0.22	1236	0.04	0.05	0.20	0.98	0.04	0.11	0.05	0.16	0.43	77.62	0.26	1.23	0.30	3.71	0.34	3.77
	U1526B_2H-3_83-85			0.01	0.01	0.25	1255	0.03	0.04	0.15	0.84	0.04	0.08	0.04	0.11	0.53	77.60	0.15	1.19	0.18	3.71	0.18	3.87
	U1517C_35F-3_12-14	334.00		0.01	0.01	0.15	1218	0.03	0.05	0.07	0.73	0.03	0.06	0.02	0.10	0.35	78.12	0.13	1.12	0.11	3.78	0.17	3.87
s22	U1517C_35F-4_61-63	460.00		0.02	0.02	0.23	1220	0.04	0.04	0.07	0.86	0.04	0.08	0.04	0.13	0.31	77.80	0.12	1.31	0.08	3.63	0.16	3.94
	U1517C_35F-4_125-127	463.00		0.01	0.01	0.26	1225	0.03	0.05	0.11	0.91	0.02	0.08	0.02	0.12	0.52	77.52	0.20	1.40	0.19	3.54	0.16	4.12
	1125A_3H-4_64-66	463.40		0.02	0.02	0.19	1235	0.03	0.04	0.04	0.85	0.02	0.11	0.03	0.15	0.38	77.48	0.13	1.19	0.16	3.57	0.19	4.25
	U1518E_1H-4_118-120	500.00		0.02	0.02	0.09	1239	0.03	0.05	0.05	0.85	0.03	0.10	0.02	0.11	0.16	77.99	0.10	0.99	0.12	3.97	0.10	3.53
	1125A_3H-5_124-126	515.08		0.01	0.02	0.15	1200	0.04	0.06	0.08	1.02	0.03	0.12	0.02	0.15	0.24	78.95	0.10	1.63	0.08	3.32	0.21	4.73
s23*	U1520D_35X-7_72-74	496.78		0.02	0.01	0.25	1290	0.04	0.06	0.11	1.03	0.03	0.11	0.04	0.15	0.51	78.44	0.17	1.53	0.16	3.52	0.22	4.15
	1125A_3H-6_57-59 II	535.51		0.02	0.02	0.14	1284	0.03	0.06	0.06	1.15	0.03	0.14	0.03	0.17	0.22	78.39	0.11	1.55	0.11	3.37	0.16	4.42
	U1526B_2H-3_101-101 II			0.02	0.02	0.17	1290	0.05	0.05	0.06	1.18	0.03	0.13	0.02	0.15	0.36	78.52	0.20	1.49	0.11	3.44	0.05	4.03
	U1518E-2H-1_136-138	508±109	Oneputhi 0.57Ma ¹	0.02	0.02	0.13	1249	0.03	0.05	0.06	1.38	0.03	0.19	0.03	0.18	0.32	78.70	0.10	1.55	0.08	3.53	0.13	3.92
	1526B_2H-3_101-103 I			0.01	0.03	0.07	1238	0.03	0.05	0.05	1.34	0.06	0.20	0.02	0.20	0.22	78.59	0.14	1.68	0.06	3.56	0.13	4.17
s25	U1520D_35X-7_86-88	496.84		0.02	0.02	0.28	1257	0.03	0.04	0.10	1.01	0.03	0.12	0.04	0.13	0.56	77.49	0.23	1.16	0.26	3.85	0.32	3.60
	U1518E-2H-4_26-28	>508±109		0.01	0.01	0.14	1265	0.05	0.06	0.10	0.96	0.03	0.10	0.02	0.10	0.30	77.61	0.07	1.07	0.19	3.83	0.12	3.61
	U1518E-2H-6_109-111	508.00		0.01	0.03	0.15	1240	0.03	0.06	0.07	2.12	0.04	0.33	0.01	0.27	0.32	74.00	0.10	1.96	0.06	2.86	0.16	4.08
	U1518E-3H-1_73-75	510.00		0.02	0.03	0.23	1293	0.03	0.05	0.13	1.76	0.06	0.30	0.02	0.28	0.41	74.92	0.12	1.59	0.10	3.24	0.13	3.90
	1125A_3H-6_57-59 I	535.51		0.01	0.01	0.18	1231	0.05	0.05	0.04	1.35	0.03	0.17	0.02	0.20	0.19	75.45	0.11	1.70	0.08	3.24	0.14	4.52
s26	1124D_1H-2_70-72	583.00		0.02	0.02	0.09	1215	0.03	0.06	0.03	1.36	0.03	0.19	0.02	0.17	0.18	75.66	0.09	1.64	0.07	3.45	0.19	4.30
	U1518E-3H-1_92-93	<585±39		0.02	0.02	0.27	1217	0.04	0.06	0.13	1.56	0.06	0.20	0.05	0.19	0.41	76.21	0.16	1.60	0.08	3.17	0.15	3.83
	1123B_3H-1_32-34	546.58		0.02	0.02	0.18	1267	0.04	0.06	0.11	1.10	0.03	0.13	0.04	0.18	0.34	76.25	0.15	1.71	0.12	3.32	0.23	4.57
	1125A_3H-6_105-107	547.32		0.01	0.01	0.15	1207	0.03	0.06	0.02	1.02	0.03	0.12	0.02	0.17	0.22	75.77	0.09	1.70	0.08	3.33	0.13	4.73
	1123C_3H-4_84-86	558.47		0.01	0.01	0.17	1238	0.03	0.06	0.13	1.23	0.03	0.15	0.03	0.16	0.31	77.92	0.11	1.14	0.12	3.29	0.16	3.65
s27	1124D_1H-2_148-150	659.70		0.02	0.02	0.16	1238	0.03	0.05	0.15	1.14	0.04	0.13	0.02	0.13	0.28	77.92	0.10	1.10	0.23	3.42	0.20	3.73
	U1526B_2H-3_126-128	560.00		0.01	0.02	0.13	1248	0.04	0.06	0.10	0.86	0.03	0.07	0.02	0.11	0.22	77.71	0.14	1.23	0.12	3.59	0.15	3.86
	1123B_3H-3_26-28	618.93		0.01	0.01	0.13	1238	0.04	0.05	0.12	0.88	0.03	0.09	0.03	0.11	0.24	77.52	0.14	1.15	0.27	3.70	0.18	4.12
	1517C_36F-2_3-5			0.01	0.01	0.17	1227	0.03	0.04	0.11	0.79	0.03	0.08	0.02	0.11	0.39	77.81	0.15	1.19	0.17	3.79	0.18	3.90

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s28	U1520D_35X-CC_2-4	631.78	631.78	0.02	0.01	0.15	0.229	0.03	0.04	0.06	1.03	0.02	0.13	0.04	0.15	0.28	77.90	0.06	1.11	0.08	3.95	0.12	3.39
	U1520B_2H-6_78-80			0.02	0.02	0.16	0.258	0.03	0.04	0.17	0.94	0.03	0.11	0.02	0.13	0.30	77.49	0.14	1.04	0.32	4.06	0.18	3.60
s29	1124D_1H-3_50-52	661.07	661.93	0.02	0.02	0.18	0.216	0.03	0.05	0.14	1.21	0.03	0.14	0.02	0.14	0.26	78.02	0.11	1.10	0.17	3.61	0.15	3.54
	1124C-2X-6_53-55	662.80		0.02	0.02	0.27	0.253	0.03	0.05	0.19	1.08	0.05	0.13	0.04	0.14	0.50	77.72	0.15	1.15	0.32	3.44	0.22	3.94
n28	1123A_4H-5_71-73	665.59	665.59	0.02	0.01	0.13	0.223	0.03	0.04	0.06	1.04	0.02	0.13	0.03	0.15	0.23	77.66	0.09	1.14	0.09	3.57	0.15	4.04
	1124D-1H-4_86-88	665.00		0.01	0.01	0.15	0.231	0.03	0.04	0.04	0.81	0.02	0.11	0.02	0.13	0.17	77.58	0.08	1.05	0.10	4.09	0.15	3.88
s30	U1518E-3H-3_36-40	585±39	665.00	0.02	0.02	0.27	0.265	0.03	0.05	0.03	0.89	0.02	0.10	0.02	0.10	0.33	77.54	0.09	1.00	0.10	3.89	0.15	3.75
	U1517C_36F-2_100-101			0.01	0.01	0.23	0.229	0.03	0.05	0.13	0.88	0.04	0.08	0.03	0.11	0.46	77.48	0.20	1.26	0.26	3.85	0.25	3.99
s31	1124C_3H-1_85-87	691.98	693.06	0.01	0.02	0.15	0.224	0.03	0.04	0.02	1.02	0.02	0.13	0.02	0.14	0.27	77.64	0.06	1.06	0.11	3.98	0.16	3.75
	1124D_1H-5_79-81	694.13		0.02	0.02	0.23	0.226	0.03	0.04	0.04	1.03	0.02	0.12	0.02	0.13	0.25	77.79	0.07	1.09	0.10	3.88	0.17	3.64
s32	1125A_4H-2_52-54	699.16	703.35	0.01	0.02	0.18	0.265	0.03	0.04	0.03	1.38	0.03	0.17	0.02	0.17	0.34	77.73	0.09	1.32	0.08	3.35	0.15	3.77
	1125B_3H-5_86-88	707.53		0.02	0.02	0.12	0.189	0.02	0.01	0.03	1.37	0.03	0.17	0.02	0.18	0.21	78.08	0.07	1.28	0.07	3.33	0.12	3.67
s33	U1520D_38X-CC_37-39	711.64		0.02	0.03	0.26	0.364	0.03	0.07	0.11	1.39	0.04	0.26	0.06	0.33	0.48	74.60	0.15	1.98	0.10	3.21	0.14	4.49
	1123A_4H-6_125-127	711.79	711.14	0.02	0.03	0.21	0.333	0.05	0.07	0.15	1.45	0.08	0.30	0.04	0.32	0.57	74.59	0.22	2.03	0.11	3.06	0.14	4.81
	U1518E-3H-6_16-18	710.00		0.02	0.03	0.29	0.390	0.04	0.07	0.32	1.92	0.08	0.28	0.04	0.21	0.52	74.89	0.18	1.83	0.31	2.90	0.23	3.97
s34	U1520D_39X-3_20-22	725.69	725.69	0.02	0.01	0.21	0.252	0.04	0.06	0.08	0.92	0.02	0.09	0.03	0.16	0.40	77.39	0.11	1.38	0.15	3.45	0.13	4.02
n29*	1125B_3H-6_43-45 I	733.86	733.86	0.02	0.02	0.14	0.175	0.02	0.05	0.07	0.68	0.02	0.03	0.01	0.09	0.42	77.96	0.13	1.49	0.04	3.42	0.12	4.49
	1125B_3H-6_43-45 II			0.02	0.01	0.10	0.256	0.03	0.09	0.02	1.05	0.03	0.09	0.02	0.17	0.21	78.04	0.10	2.06	0.07	3.14	0.12	4.78
s35*	1124D_1H-7_24-26 I	737.89		0.02	0.03	0.12	0.286	0.04	0.04	0.12	0.99	0.05	0.12	0.02	0.18	0.43	78.27	0.13	1.54	0.08	3.37	0.12	4.59
	1124D_1H-7_24-26 II		739.72	0.02	0.04	0.18	0.326	0.04	0.07	0.11	1.35	0.04	0.24	0.03	0.33	0.35	74.82	0.13	2.00	0.09	3.17	0.19	4.73
	1124C_3H-3_54-56	740.03		0.03	0.03	0.19	0.327	0.04	0.08	0.14	1.32	0.05	0.24	0.05	0.31	0.56	74.86	0.18	1.92	0.13	3.13	0.15	4.85
	1125A_4H-3_73-75	741.25		0.02	0.03	0.18	0.279	0.04	0.07	0.09	1.30	0.03	0.10	0.02	0.15	0.50	78.65	0.16	2.12	0.13	3.10	0.22	4.09
n30	1124C_3H-4_50-52	766.11	766.11	0.02	0.01	0.16	0.244	0.04	0.05	0.05	0.94	0.03	0.09	0.02	0.14	0.28	77.24	0.10	1.58	0.09	3.39	0.17	4.41
	U1520D_39X-5_64-66	763.85		0.02	0.02	0.21	0.244	0.03	0.06	0.10	0.92	0.02	0.11	0.04	0.16	0.36	77.49	0.18	1.56	0.26	3.66	0.20	3.78
s36	1124C_3H-4_107-109	776.29	772.80	0.01	0.01	0.15	0.219	0.04	0.05	0.02	0.86	0.03	0.11	0.02	0.18	0.30	77.34	0.11	1.49	0.07	3.52	0.19	4.24
	1124D_2H-1_42-44	778.25		0.02	0.02	0.24	0.211	0.04	0.05	0.18	0.92	0.05	0.13	0.03	0.19	0.53	77.35	0.14	1.48	0.12	3.48	0.12	4.27
	U1518E-3H-2_66-70			0.02	0.01	0.23	0.263	0.03	0.04	0.16	1.04	0.04	0.13	0.04	0.11	0.37	77.69	0.12	1.06	0.27	3.67	0.13	3.62
s37	1125B_4H-1_27-29	791.2		0.01	0.01	0.18	0.241	0.03	0.05	0.09	0.73	0.02	0.03	0.03	0.04	0.49	77.65	0.21	0.90	0.30	4.48	0.27	3.71
	U1518E-9H-2_0-1	792.0	791.57	0.01	0.01	0.12	0.241	0.04	0.05	0.06	0.75	0.03	0.10	0.02	0.13	0.17	77.88	0.15	1.04	0.24	4.36	0.18	3.49
	594_5H-2_36-38	791.5		0.01	0.01	0.11	0.239	0.03	0.04	0.04	0.81	0.02	0.09	0.02	0.14	0.30	77.58	0.07	1.07	0.12	4.52	0.18	3.64
s38	1124D_2H-1_128-130	793.61		0.02	0.02	0.10	0.271	0.04	0.05	0.03	1.09	0.03	0.14	0.02	0.17	0.16	78.83	0.07	1.22	0.07	3.60	0.12	4.07
	1124C_3H-5_56-58	793.97	793.79	0.02	0.01	0.17	0.247	0.03	0.05	0.07	1.06	0.04	0.13	0.02	0.16	0.25	77.03	0.10	1.30	0.12	3.56	0.15	4.23
	U1371D_1H-CC_2-4			0.01	0.01	0.22	0.249	0.04	0.05	0.16	0.92	0.06	0.09	0.03	0.12	0.59	77.48	0.19	1.10	0.35	3.66	0.29	4.07
n31	1124C_3H-5_90-92	800.04	800.04	0.02	0.01	0.25	0.256	0.03	0.05	0.16	1.09	0.05	0.13	0.03	0.16	0.40	78.89	0.12	1.38	0.08	3.42	0.18	4.10

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s39	U1520D_40X-1_60-62	782.69	0.02	0.04	0.19	1.45	0.03	0.06	0.05	1.76	0.03	0.36	0.08	0.43	0.59	74.33	0.11	2.16	0.09	3.27	0.17	4.15
	1124D_2H-2_53-55	807.01	0.02	0.04	0.17	1.87	0.05	0.08	0.12	1.79	0.05	0.33	0.03	0.38	0.53	74.89	0.20	2.15	0.09	2.99	0.21	4.56
	1124C_3H-5_141-143	809.15	0.05	0.03	0.12	1.29	0.04	0.06	0.07	1.66	0.04	0.33	0.04	0.38	0.25	75.08	0.09	2.09	0.06	2.98	0.14	4.40
	1123C_4H-6_68-70	836.12	0.05	0.04	0.27	1.59	0.04	0.07	0.16	1.48	0.06	0.28	0.06	0.36	0.77	74.63	0.27	2.01	0.10	3.06	0.17	4.37
	U1520D_40X-1_77-79	782.84	0.01	0.01	0.25	1.26	0.03	0.05	0.17	0.85	0.04	0.09	0.04	0.14	0.49	77.68	0.22	1.28	0.26	3.77	0.17	3.87
s40	1124D_2H-2_121-123	819.15	0.02	0.01	0.12	1.22	0.04	0.05	0.03	1.00	0.02	0.13	0.02	0.14	0.15	77.64	0.07	1.19	0.10	3.51	0.13	4.12
	1124C_3H-6_61-63	821.65	0.02	0.02	0.10	1.26	0.03	0.07	0.08	0.98	0.03	0.12	0.02	0.14	0.23	77.63	0.10	1.11	0.23	3.63	0.19	4.05
	U1520D_40X-CC_38-40	783.35	0.02	0.02	0.43	1.28	0.03	0.06	0.28	1.20	0.08	0.20	0.11	0.28	1.10	76.29	0.31	1.77	0.23	3.33	0.19	4.11
s41	1122C_37X-1_37-38	800.00	0.02	0.01	0.14	1.29	0.04	0.07	0.05	0.98	0.02	0.10	0.02	0.14	0.33	76.21	0.10	1.61	0.12	3.34	0.21	4.63
	1125A_4H-4_115-117 I	808.00	0.01	0.02	0.29	1.26	0.04	0.05	0.09	0.79	0.02	0.06	0.04	0.12	0.31	76.63	0.16	1.64	0.61	3.82	0.18	4.28
	1125A_4H-4_115-117 II		0.02	0.02	0.20	1.28	0.04	0.07	0.05	1.10	0.02	0.09	0.01	0.16	0.30	74.62	0.15	2.29	0.12	3.44	0.13	5.02
	1125A_4H-4_115-117 III		0.01	0.01	0.20	1.17	0.05	0.08	0.09	1.05	0.02	0.08	0.03	0.15	0.49	75.28	0.24	1.96	0.21	3.63	0.21	4.59
	1125B_4H-1_59-61a I	799.08	0.01	0.01	0.19	1.11	0.03	0.10	0.07	1.11	0.03	0.07	0.02	0.16	0.42	75.02	0.19	2.11	0.10	3.52	0.19	4.78
s42*	1125B_4H-1_59-61 II		0.02	0.02	0.20	1.25	0.05	0.06	0.06	0.76	0.02	0.04	0.02	0.09	0.36	76.82	0.06	1.53	0.15	3.84	0.24	4.39
	1125B_4H-2_11-13	824.18	0.02	0.02	0.52	1.30	0.03	0.05	0.23	1.08	0.06	0.10	0.05	0.17	1.25	75.30	0.37	1.99	0.21	3.57	0.24	4.72
	U1519C_14R-2_48-50	800.50	0.01	0.01	0.17	1.26	0.03	0.07	0.06	0.82	0.03	0.06	0.02	0.13	0.28	76.68	0.10	1.87	0.15	3.48	0.14	4.29
	U1520D_42X-1_97-99 I	815.50	0.02	0.04	0.12	1.29	0.05	0.09	0.10	1.44	0.04	0.32	0.05	0.42	0.40	75.18	0.17	2.25	0.06	3.27	0.21	4.04
	U1520D_42X-1_97-99 II		0.02	0.02	0.18	1.27	0.04	0.05	0.10	1.17	0.03	0.17	0.04	0.17	0.42	76.86	0.18	1.35	0.12	3.56	0.13	3.79
s43	1125A_4H-5_120-122	826.64	0.01	0.02	0.14	1.23	0.03	0.08	0.06	1.29	0.02	0.17	0.02	0.21	0.24	73.81	0.13	2.30	0.10	3.47	0.13	4.92
	1124D_2H-3_128-130	847.19	0.01	0.01	0.24	1.26	0.04	0.06	0.05	1.05	0.05	0.15	0.03	0.20	0.45	76.06	0.11	1.71	0.09	3.12	0.22	4.80
	1123C_5H-1_90-92	850.61	0.02	0.02	0.52	1.45	0.03	0.05	0.22	1.32	0.06	0.21	0.07	0.25	1.18	75.16	0.28	1.75	0.20	3.49	0.26	4.30
	1123B_5H-3_3-5	857.18	0.02	0.04	0.24	1.51	0.04	0.07	0.15	1.40	0.05	0.24	0.05	0.28	0.59	74.85	0.18	1.44	0.32	3.45	0.32	4.32
	1125A_5H-2_98-100	863.75	0.02	0.02	0.39	1.44	0.04	0.05	0.24	1.35	0.07	0.21	0.06	0.25	0.87	75.11	0.24	1.79	0.13	3.45	0.23	4.31
s44	U1519C_15R-1_71-73		0.02	0.03	0.24	1.29	0.04	0.06	0.10	0.99	0.02	0.10	0.03	0.18	0.52	75.89	0.19	1.99	0.32	3.49	0.30	4.31
	1124D_2H-4_88-90	866.8	0.02	0.03	0.16	1.27	0.03	0.09	0.03	1.21	0.02	0.18	0.02	0.23	0.30	75.15	0.15	1.95	0.11	3.13	0.16	4.76
	U1520D_44X-1_5-7_2	906.60	0.02	0.02	0.27	1.34	0.04	0.09	0.20	1.27	0.08	0.22	0.05	0.29	0.80	74.97	0.31	1.94	0.18	3.16	0.19	4.56
	U1519C_15R-5_20-22	900.60	0.02	0.01	0.15	1.25	0.04	0.07	0.08	1.14	0.04	0.14	0.03	0.21	0.35	75.29	0.16	2.14	0.08	3.28	0.15	4.48
	U1526B_3H-2_48-50	904.00	0.02	0.04	0.42	1.65	0.04	0.06	0.31	1.47	0.11	0.30	0.08	0.32	1.11	74.75	0.33	1.92	0.22	3.13	0.16	4.36
s45	1124C_4H-1_26-28	851.12	0.02	0.01	0.18	1.29	0.03	0.04	0.03	0.83	0.02	0.10	0.01	0.13	0.34	77.63	0.07	1.29	0.10	3.46	0.23	4.29
	1124D_2H-4_128-130	873.98	0.01	0.01	0.18	1.21	0.03	0.04	0.04	0.84	0.02	0.10	0.02	0.14	0.39	77.68	0.15	1.29	0.08	3.43	0.14	4.36
	1124D_2H-5_87-89	893.45	0.02	0.03	0.15	1.25	0.05	0.07	0.07	1.48	0.03	0.27	0.04	0.31	0.27	74.86	0.11	1.92	0.06	3.04	0.21	4.66
s46	U1520D_44X-1_43-45	909.13	0.02	0.02	0.28	1.60	0.04	0.08	0.08	1.23	0.04	0.19	0.05	0.23	0.56	75.04	0.18	1.99	0.11	3.22	0.16	4.41
	U1519C_16R-1_146-148	900.00	0.01	0.03	0.25	1.51	0.03	0.08	0.13	1.32	0.04	0.19	0.02	0.26	0.52	74.72	0.20	2.28	0.12	3.22	0.19	4.39
	U1526B_3H-2_64-66	905.00	0.03	0.04	0.20	1.65	0.03	0.07	0.22	1.51	0.08	0.32	0.06	0.33	0.70	74.60	0.27	1.97	0.16	3.13	0.13	4.37

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

<i>u35</i>	U1519C_16R-5_111-114	909.20	909.20	0.02	0.01	0.12	0.62	0.04	0.08	0.05	1.56	0.03	0.15	0.03	0.20	0.20	74.65	0.11	2.33	0.39	3.35	0.30	4.23
<i>u36</i>	U1519C_17R-1_9-11	909.25	909.25	0.08	0.24	0.95	15.54	0.04	0.13	0.90	4.13	0.44	1.32	0.17	0.88	2.12	86.30	0.79	4.99	0.26	2.23	0.16	4.46
<i>s47</i>	U1519C_19R-3_33-35	909.30	909.30	0.02	0.02	0.31	13.55	0.04	0.09	0.17	1.39	0.06	0.20	0.02	0.23	0.45	74.51	0.23	2.39	0.27	2.94	0.27	4.68
	U1526B_3H-2_85-87	909.30	909.30	0.02	0.05	0.38	14.16	0.03	0.07	0.23	1.77	0.06	0.36	0.04	0.36	0.82	53.72	0.29	2.02	0.13	3.01	0.39	4.48
<i>s48</i>	1124C_4H-2_17-19	892.74		0.02	0.02	0.59	12.90	0.04	0.07	0.20	0.97	0.04	0.15	0.04	0.18	0.93	78.24	0.30	2.58	0.24	3.37	0.15	4.52
	U1520D_44X-1_47-49	909.39	909.39	0.02	0.02	0.26	13.69	0.03	0.07	0.13	1.01	0.04	0.11	0.06	0.18	0.71	78.20	0.19	1.62	0.13	3.40	0.23	4.31
<i>s49*</i>	U1371D_2H-2_137-139	800.00		0.02	0.02	0.47	12.65	0.04	0.05	0.21	1.00	0.06	0.12	0.04	0.16	1.07	78.62	0.29	1.47	0.48	3.58	0.31	4.34
	1124D_2H-5_146-148	904.0		0.01	0.01	0.23	13.18	0.04	0.07	0.10	1.20	0.03	0.17	0.02	0.18	0.57	75.57	0.18	1.73	0.11	3.31	0.21	4.57
<i>s49</i>	1124C_4H-2_81-83	904.17		0.02	0.02	0.23	13.10	0.04	0.05	0.11	1.18	0.04	0.14	0.02	0.18	0.41	78.14	0.11	1.61	0.12	3.26	0.17	4.30
	1124D_2H-CC_10-12 I	907.74		0.01	0.02	0.13	13.05	0.02	0.07	0.02	1.06	0.02	0.12	0.02	0.18	0.27	75.80	0.06	1.70	0.12	3.26	0.25	4.58
<i>s50*</i>	1124C_4H-2_118-120	910.78		0.02	0.02	0.22	13.10	0.04	0.06	0.08	1.05	0.03	0.14	0.03	0.17	0.48	75.73	0.16	1.70	0.12	3.30	0.17	4.72
	U1519C_19R-3_122-125	908.00		0.02	0.02	0.19	13.40	0.03	0.08	0.18	1.20	0.04	0.11	0.04	0.16	0.50	75.33	0.27	2.08	0.14	3.27	0.26	4.54
	1124D_2H-CC_10-12 II			0.02	0.01	0.17	12.62	0.05	0.05	0.04	0.88	0.03	0.09	0.02	0.14	0.28	77.06	0.10	1.35	0.12	3.51	0.22	4.29
	U1519C_19R-4_35-36	910.00	911.00	0.02	0.03	0.19	13.53	0.04	0.07	0.17	1.30	0.06	0.16	0.05	0.20	0.55	74.72	0.21	2.29	0.19	3.16	0.17	4.52
<i>s51</i>	U1520D_44X-1_96-98	912.65		0.01	0.01	0.32	12.69	0.03	0.05	0.12	0.87	0.03	0.09	0.03	0.13	0.56	77.21	0.13	1.31	0.20	3.76	0.25	3.89
	1123A_5H-3_66-68	890.47		0.01	0.01	0.23	12.24	0.03	0.04	0.13	0.84	0.03	0.09	0.03	0.11	0.37	77.57	0.20	1.17	0.27	3.74	0.25	3.97
	1124C_4H-3_48-50	925.07		0.02	0.01	0.11	12.30	0.03	0.04	0.03	0.79	0.02	0.08	0.02	0.11	0.16	77.54	0.11	1.23	0.10	3.62	0.17	4.27
	U1518E-9H-CC_14-16	910.00		0.01	0.01	0.28	12.46	0.04	0.03	0.22	0.85	0.06	0.10	0.05	0.14	0.50	77.72	0.20	1.19	0.59	3.83	0.34	3.66
<i>u38</i>	1124C_4H-3_121-123	938.10		0.02	0.02	0.35	12.95	0.04	0.05	0.19	1.17	0.05	0.16	0.05	0.20	0.88	75.96	0.30	1.55	0.17	3.47	0.25	4.47
<i>u39</i>	1124C_4H-3_162-144	941.85		0.02	0.02	0.38	13.02	0.04	0.06	0.13	1.03	0.04	0.12	0.03	0.14	0.64	78.25	0.20	1.45	0.17	3.56	0.25	4.34
<i>s52</i>	1124C_4H-4_81-83	957.75		0.01	0.01	0.15	12.24	0.04	0.05	0.07	1.03	0.02	0.10	0.01	0.12	0.35	77.64	0.13	1.23	0.11	3.48	0.19	4.10
	1124D_3H-1_3-5	963.47		0.01	0.01	0.16	12.40	0.03	0.04	0.07	1.02	0.02	0.10	0.02	0.12	0.26	77.65	0.13	1.20	0.15	3.52	0.19	3.94
<i>s53</i>	1124C_4H-4_111-113	963.11		0.02	0.02	0.13	12.37	0.04	0.04	0.27	1.36	0.05	0.16	0.04	0.16	0.27	77.31	0.13	1.43	0.24	3.19	0.16	3.96
	1124D_3H-1_27-29	967.75		0.01	0.01	0.12	12.48	0.04	0.06	0.18	1.54	0.04	0.18	0.02	0.18	0.25	77.20	0.12	1.43	0.13	3.06	0.20	3.87
<i>s54</i>	1123C_5H-5_121-123	1012.80		0.02	0.03	0.33	13.59	0.04	0.05	0.20	1.65	0.05	0.25	0.06	0.27	0.55	74.64	0.20	2.07	0.11	3.21	0.24	4.24
	U1526B_3H-2_105-107	1010.00		0.02	0.03	0.11	13.74	0.03	0.05	0.06	1.57	0.03	0.31	0.03	0.32	0.23	74.50	0.11	1.99	0.08	3.08	0.15	4.40
<i>u40</i>	U1526B_3H-3_37-39	1020.00		0.02	0.04	0.16	13.74	0.04	0.09	0.11	1.61	0.06	0.34	0.04	0.38	0.41	75.80	0.17	2.31	0.07	3.04	0.11	4.66
<i>u41</i>	U1520D_46X-1_11-12	1033.90		0.01	0.01	0.10	12.40	0.03	0.05	0.03	1.03	0.02	0.11	0.02	0.12	0.24	77.76	0.08	1.20	0.06	3.65	0.14	3.66
<i>u42</i>	1124D_3H-4_96-98	1060.45		0.02	0.01	0.12	13.14	0.04	0.07	0.05	1.09	0.02	0.10	0.02	0.14	0.23	75.97	0.13	1.86	0.13	3.26	0.16	4.37
<i>s55</i>	1124C_5H-1_91-93	1066.34		0.02	0.02	0.32	12.89	0.04	0.08	0.09	1.07	0.02	0.12	0.02	0.17	0.46	75.61	0.15	2.08	0.18	3.20	0.20	4.76
	1124D_3H-4_145-147	1069.20		0.01	0.02	0.12	13.06	0.04	0.09	0.03	1.05	0.02	0.10	0.03	0.17	0.20	75.73	0.11	2.05	0.08	3.12	0.14	4.61
<i>u43</i>	1124C_5H-2_5-7	1077.77	Reva C	0.02	0.03	0.34	13.26	0.04	0.08	0.21	1.25	0.06	0.15	0.04	0.22	0.81	74.88	0.17	2.20	0.14	3.05	0.22	4.90
<i>s56*</i>	1124C_5H-2_45-47 I	1085.00		0.02	0.01	0.17	12.49	0.06	0.08	0.04	0.84	0.01	0.06	0.01	0.13	0.09	78.45	0.15	1.81	0.50	3.79	0.54	4.34
	1124C_5H-2_45-47 II	1083	Reva B 1.20±0.14Ma ¹	0.02	0.03	0.12	13.25	0.04	0.07	0.06	1.40	0.04	0.15	0.02	0.21	0.35	74.72	0.18	2.12	0.07	3.15	0.11	4.72
	1124D_3H-5_60-62	1081.00		0.03	0.02	0.28	13.61	0.04	0.08	0.19	1.28	0.05	0.15	0.05	0.20	0.63	74.62	0.19	2.19	0.15	2.98	0.18	4.87

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s57	1124C_5H-2_65-67	1088.49	Reva A	1089.00	0.02	6.02	0.10	13.33	0.03	6.07	0.03	1.35	0.01	6.13	0.01	6.18	0.21	74.71	0.11	2.22	0.06	3.17	0.21	4.78
	1124D_3H-5_112-114	1090.10			0.02	6.02	0.27	13.36	0.05	6.07	0.06	1.35	0.03	6.12	0.02	6.19	0.31	74.75	0.15	2.11	0.10	3.08	0.20	4.74
s58*	1124D_3H-6_5-71	1097.78	Sub-Reva ³	1098.00	0.01	6.01	0.27	12.75	0.03	6.06	0.11	6.94	0.03	6.05	0.02	6.11	0.45	76.33	0.19	1.71	0.13	3.50	0.18	4.53
	1124D_3H-6_5-7 II	1097.78			0.02	6.02	0.16	13.17	0.04	6.06	0.04	1.09	0.02	6.07	0.02	6.12	0.29	75.62	0.11	1.90	0.07	3.29	0.16	4.67
u44	U1520D_47X-1_17-19	1098.08		1098.08	0.02	6.02	0.28	12.77	0.04	6.06	0.21	1.32	0.04	6.16	0.06	6.19	0.74	76.63	0.21	1.50	0.23	3.60	0.22	3.75
	1124D_3H-6_46-48	1105.10		1105.55	0.01	6.01	0.14	12.69	0.03	6.05	0.07	1.03	0.03	6.07	0.02	6.12	0.38	76.46	0.18	1.70	0.10	3.48	0.19	4.39
s59	1124C_5H-3_13-15	1105.99			0.02	6.02	0.13	12.87	0.04	6.06	0.06	1.09	0.02	6.08	0.01	6.12	0.15	75.86	0.07	1.79	0.03	3.46	0.08	4.65
	1124C_5H-3_107-109	1122.78			0.02	6.03	0.22	13.71	0.04	6.05	0.08	1.76	0.03	6.28	0.03	6.26	0.34	74.23	0.15	2.10	0.10	3.18	0.20	4.40
s60	1124D_3H-6_116-118	1120.00		1120.93	0.02	6.04	0.30	13.57	0.03	6.04	0.12	1.72	0.04	6.27	0.02	6.25	0.44	74.46	0.14	2.09	0.09	3.15	0.21	4.41
	U1526B_3H-3_133-135	1120.00			0.04	6.04	0.70	13.91	0.05	6.06	0.57	1.74	0.22	6.32	0.15	6.31	2.12	73.99	0.62	2.12	0.31	3.11	0.28	4.39
s61	1124C_5H-4_9-11	1132.07		1132.90	0.02	6.01	0.31	12.21	0.03	6.03	0.06	6.93	0.03	6.10	0.02	6.12	0.35	77.48	0.12	1.30	0.17	3.82	0.17	3.99
	U1520D_47X-3_0-2	1133.73			0.01	6.01	0.14	12.28	0.03	6.04	0.07	6.65	0.03	6.08	0.03	6.11	0.19	77.93	0.11	1.64	0.20	4.07	0.15	3.78
s62	1123C_6H-1_77-79	1134.32			0.02	6.03	0.22	13.14	0.04	6.05	0.16	1.48	0.07	6.19	0.05	6.19	0.42	75.37	0.14	1.90	0.11	3.13	0.17	4.53
	1123B_6H-6_50-52	1242.66		1171.00	0.02	6.02	0.21	12.97	0.04	6.08	0.08	1.06	0.03	6.10	0.02	6.17	0.53	75.92	0.19	2.01	0.21	3.22	0.30	4.46
s63	U1526B_3H-4_38-40	1136.00			0.02	6.02	0.33	13.30	0.03	6.05	0.15	1.15	0.04	6.15	0.04	6.18	0.67	75.76	0.19	1.59	0.20	3.45	0.19	4.35
	U1520D_47X-3_111-113	1150.95		1150.95	0.02	6.01	0.21	12.41	0.04	6.04	0.15	6.76	0.04	6.07	0.03	6.11	0.52	77.61	0.22	1.22	0.29	3.82	0.24	3.95
s64	1125B_4H-2_124-126	1241.04			0.02	6.03	0.23	13.42	0.04	6.07	0.08	1.41	0.04	6.15	0.02	6.20	0.40	74.10	0.14	2.32	0.06	3.64	0.14	4.66
	1123C_6H-3_128-130	1247.17		1252.21	0.01	6.03	0.30	13.50	0.06	6.08	0.09	1.19	0.02	6.12	0.05	6.21	0.35	74.29	0.11	2.37	0.37	3.28	0.34	4.95
s64	1123B_6H-6_137-139	1270.63			0.02	6.03	0.23	13.79	0.03	6.05	0.07	1.74	0.03	6.28	0.02	6.25	0.31	74.10	0.11	2.09	0.10	3.21	0.16	4.46
	U1519C_19R-5_100-102	1250.00			0.02	6.03	0.31	13.72	0.04	6.10	0.13	1.45	0.02	6.18	0.02	6.23	0.43	74.24	0.15	2.38	0.09	3.01	0.17	4.67
s64	1123C_6H-4_62-64	1274.17			0.01	6.01	0.13	13.34	0.04	6.08	0.05	1.07	0.02	6.09	0.04	6.18	0.27	75.07	0.15	2.24	0.18	3.39	0.25	4.53
	1124D_4H-2_69-71	1269.49		1279.02	0.02	6.02	0.10	13.22	0.04	6.08	0.02	1.08	0.02	6.07	0.01	6.17	0.17	74.90	0.11	2.20	0.12	3.37	0.14	4.89
s65	1124C_5H-6_57-59	1272.42			0.02	6.02	0.17	13.21	0.04	6.08	0.05	1.07	0.02	6.08	0.03	6.17	0.33	74.82	0.14	2.26	0.13	3.37	0.22	4.92
	1371D_3H-3_56-58	1300.00			0.02	6.02	0.10	12.94	0.04	6.09	0.05	1.04	0.03	6.10	0.02	6.18	0.28	75.53	0.11	2.13	0.11	3.18	0.24	4.78
u46	U1520D_48X-2_47-49	1285.76		1285.76	0.01	6.01	0.34	12.32	0.04	6.08	0.16	6.74	0.03	6.06	0.02	6.11	0.56	77.32	0.11	1.57	0.16	3.49	0.20	4.31
	U1519C_19R-6_86-88	1287.00		1287.00	0.01	6.01	0.35	12.59	0.03	6.05	0.05	6.85	0.02	6.06	0.02	6.12	0.27	76.77	0.09	1.61	0.27	3.66	0.32	4.18
s66*	1123C_6H-4_93-95	1284.14			0.02	6.02	0.28	13.65	0.04	6.09	0.06	1.18	0.03	6.12	0.07	6.19	0.40	74.16	0.18	2.22	0.17	3.26	0.25	5.02
	1124D_4H-2_116-118	1292.50			0.01	6.01	0.26	12.93	0.05	6.08	0.03	1.08	0.02	6.07	0.02	6.16	0.32	75.40	0.11	2.15	0.13	3.61	0.21	4.50
s65	U1520D_48X-CC-22-24	1291.35		1289.33	0.02	6.01	0.34	13.01	0.03	6.06	0.18	1.19	0.05	6.13	0.08	6.23	0.72	75.59	0.28	2.14	0.16	3.10	0.21	4.34
	U1519C_20R-3_29-31				0.02	6.02	0.41	13.44	0.03	6.06	0.15	1.32	0.04	6.13	0.03	6.18	0.61	74.96	0.23	2.19	0.23	3.22	0.21	4.48
s66*	U1526B_3H-5_11-3				0.02	6.02	0.46	13.35	0.03	6.05	0.26	1.23	0.08	6.19	0.06	6.21	1.14	75.43	0.33	1.75	0.34	3.57	0.31	4.19
	1124D_4H-2_137-139 I	1302.78			0.02	6.02	0.15	13.79	0.04	6.09	0.05	1.16	0.03	6.12	0.02	6.17	0.29	74.21	0.14	2.28	0.08	3.22	0.22	5.04
s66*	1124C_5H-6_131-133	1308.66		1309.82	0.02	6.03	0.22	13.47	0.04	6.09	0.11	1.17	0.04	6.13	0.04	6.18	0.50	74.29	0.15	2.39	0.08	3.22	0.30	5.04
	1123A_6H-4_131-131	1327.86			0.02	6.02	0.16	13.28	0.03	6.09	0.03	1.05	0.02	6.08	0.04	6.18	0.34	74.76	0.13	2.21	0.14	3.43	0.31	4.90
	U1371D_3H-6_2-4	1300.00			0.03	6.02	0.11	13.30	0.05	6.09	0.10	1.12	0.04	6.11	0.02	6.18	0.26	74.61	0.16	2.20	0.10	3.42	0.20	4.92

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s67*	1124D_4H-2_137-139 II 1124C_5H-7_60-62 1326.28	1302.78	0.01	0.01	0.18	1255	0.03	0.04	0.05	0.86	0.02	0.04	0.02	0.06	0.25	77.41	0.17	1.29	0.35	3.81	0.33	4.01
		1347.34	0.01	0.01	0.14	1246	0.03	0.03	0.05	0.91	0.02	0.04	0.02	0.06	0.31	77.40	0.11	1.27	0.10	3.64	0.20	4.04
		1305.00	0.01	0.02	0.28	1264	0.03	0.04	0.24	1.17	0.04	0.14	0.04	0.16	0.57	78.44	0.18	1.42	0.19	3.61	0.20	3.96
		1350.00	0.01	0.01	0.15	1254	0.03	0.05	0.11	0.87	0.02	0.04	0.02	0.07	0.50	77.66	0.11	1.27	0.51	3.55	0.20	3.95
		1337.82	0.02	0.02	0.18	1282	0.04	0.08	0.07	1.27	0.05	0.13	0.05	0.21	0.47	74.01	0.16	2.19	0.09	3.52	0.24	4.35
s68	1123A_6H-5_110-112 1123A_6H-5_18-20 1124C_5H-CC_10-12	1339.75	0.04	0.02	0.18	1248	0.04	0.08	0.10	1.17	0.05	0.12	0.10	0.19	0.50	74.41	0.27	2.19	0.12	3.25	0.25	4.97
		1397.28	0.02	0.02	0.15	1226	0.03	0.07	0.02	1.07	0.02	0.10	0.02	0.16	0.45	74.97	0.09	2.13	0.10	3.57	0.52	4.65
		1342.00	0.01	0.01	0.13	1272	0.03	0.03	0.15	0.97	0.02	0.06	0.03	0.05	0.27	77.60	0.19	1.63	0.31	3.96	0.10	3.57
s69	1123C_6H-5_123-125 1124C_6H-1_26-28 1355.19 1124D_4H-3_70-72 U1526B_3H-5_51-53	1395.33	0.01	0.01	0.15	1280	0.03	0.04	0.16	0.86	0.02	0.05	0.02	0.04	0.19	77.17	0.13	0.99	0.31	4.06	0.11	3.68
		1343.42	0.01	0.01	0.16	1243	0.03	0.03	0.05	0.92	0.02	0.04	0.02	0.06	0.24	77.66	0.11	1.28	0.09	3.57	0.14	4.02
		1340.00	0.02	0.02	0.16	1255	0.03	0.04	0.05	0.92	0.03	0.09	0.01	0.11	0.28	77.67	0.09	1.10	0.17	3.89	0.13	3.61
		1387.65	0.02	0.02	0.24	1283	0.04	0.05	0.08	1.04	0.03	0.08	0.04	0.13	0.51	78.22	0.16	1.79	0.12	3.53	0.22	4.41
		1388.62	0.01	0.01	0.12	1299	0.03	0.05	0.07	1.06	0.02	0.07	0.03	0.14	0.30	78.22	0.13	1.75	0.16	3.52	0.11	4.26
s71*	1123B_7H-1_129-131 1123C_6H-6_118-120 U1518E_24F-3_71-73 1124C_6H-1_37-39 I U1518E-25F-2_30-32a I 594_13H-CC_0-2 II 594A_8H-3_49-51 I 1124C_6H-1_37-39 II U1518E-25F-2_30-32 II 594_13H-CC_0-2 I 594A_8H-3_49-51 II	1392.00	0.01	0.02	0.43	1299	0.03	0.04	0.13	0.99	0.06	0.11	0.06	0.16	0.82	78.74	0.35	1.48	0.34	3.64	0.31	3.90
		1400.71	0.01	0.01	0.32	1226	0.05	0.08	0.06	1.06	0.02	0.08	0.02	0.16	0.37	78.10	0.09	2.19	0.12	3.48	0.26	4.67
		1400.71	0.02	0.02	0.30	1229	0.04	0.08	0.09	1.19	0.08	0.14	0.07	0.20	0.57	78.60	0.32	1.95	0.33	3.39	0.34	4.22
		1400.71	0.02	0.02	0.22	1216	0.04	0.07	0.11	1.12	0.02	0.09	0.02	0.16	0.52	78.13	0.13	2.08	0.08	3.47	0.18	4.70
		1400.71	0.01	0.01	0.15	1221	0.05	0.07	0.06	1.05	0.02	0.09	0.01	0.15	0.40	78.22	0.10	2.03	0.09	3.47	0.19	4.71
		1400.71	0.02	0.02	0.36	1269	0.04	0.07	0.14	0.83	0.03	0.05	0.03	0.11	0.54	78.78	0.31	1.66	0.20	3.71	0.27	4.05
		1400.71	0.01	0.01	0.44	1245	0.03	0.04	0.23	0.88	0.06	0.11	0.12	0.14	0.53	77.82	0.24	1.17	0.26	3.87	0.36	3.59
		1400.71	0.01	0.01	0.40	1261	0.04	0.06	0.11	0.83	0.02	0.03	0.03	0.08	0.44	77.80	0.12	1.35	0.23	3.91	0.25	4.12
		1400.71	0.01	0.01	0.11	1241	0.04	0.05	0.05	0.73	0.02	0.03	0.01	0.09	0.38	77.12	0.11	1.38	0.09	3.90	0.23	4.29
		1402.76	0.02	0.02	0.20	1252	0.05	0.08	0.14	1.20	0.03	0.12	0.05	0.18	0.58	74.25	0.22	2.12	0.30	3.35	0.27	4.97
		1404.56	0.02	0.01	0.12	1201	0.04	0.05	0.06	1.07	0.03	0.08	0.02	0.14	0.29	74.88	0.12	1.95	0.12	4.60	0.13	4.20
		1403.41	0.02	0.03	0.13	1205	0.04	0.04	0.02	1.27	0.02	0.17	0.01	0.18	0.08	76.08	0.11	1.69	0.06	3.40	0.08	4.09
		1405.01	0.02	0.02	0.11	1205	0.04	0.06	0.03	1.26	0.03	0.17	0.05	0.20	0.23	76.00	0.08	1.67	0.13	3.42	0.14	4.13
s72*	1123B_7H-2_38-40 II 1123C_6H-7_14-16 II 1123B_7H-2_38-40 II	1405.01	0.02	0.03	0.25	1266	0.03	0.07	0.18	1.68	0.05	0.26	0.03	0.24	0.55	74.68	0.17	1.99	0.08	3.27	0.19	4.12
		1406.62	0.02	0.03	0.15	1277	0.04	0.06	0.05	1.79	0.03	0.29	0.06	0.30	0.35	74.25	0.12	2.12	0.09	3.19	0.17	4.20
		1408.06	0.02	0.01	0.21	1231	0.03	0.04	0.13	1.06	0.04	0.08	0.03	0.09	0.32	77.88	0.13	1.12	0.21	3.61	0.20	3.70
		1422.38	0.01	0.01	0.18	1268	0.04	0.06	0.13	0.95	0.02	0.05	0.03	0.05	0.33	77.33	0.13	1.04	0.29	3.99	0.14	3.83
		1441.15	0.02	0.02	0.12	1252	0.05	0.06	0.10	0.91	0.02	0.03	0.02	0.07	0.22	77.52	0.21	1.12	0.40	3.89	0.27	3.87
s73	U1520D_49X-1_15-17 U1518E_29X-2_66-68	1453.80	0.01	0.01	0.20	1279	0.03	0.04	0.08	0.96	0.02	0.05	0.02	0.10	0.49	76.80	0.17	1.59	0.18	3.64	0.20	4.01
		1450.00	0.01	0.02	0.46	1268	0.04	0.03	0.19	0.85	0.04	0.08	0.04	0.12	0.90	77.35	0.37	1.29	0.36	4.01	0.32	3.58
		1435.23	0.02	0.02	0.16	1275	0.03	0.07	0.03	1.06	0.02	0.17	0.02	0.16	0.20	77.08	0.07	1.19	0.06	2.77	0.14	4.74
		1440.37	0.01	0.01	0.14	1214	0.03	0.06	0.03	1.06	0.02	0.10	0.02	0.16	0.18	74.99	0.10	2.16	0.07	3.60	0.20	4.73

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s74	1123B_7H-2_88-90	1422.70	1448.63	0.01	0.01	0.11	12.38	0.05	0.05	0.93	0.02	6.10	0.02	0.12	0.27	77.48	0.10	1.32	0.18	3.86	0.18	3.77
	1123C_6H-7_64-66	1455.49		0.02	0.02	0.17	12.35	0.05	0.04	0.90	0.02	6.10	0.02	0.12	0.36	77.45	0.10	1.33	0.12	3.86	0.14	3.83
	1123A_7H-1_52-54	1467.70		0.01	0.01	0.17	12.32	0.05	0.04	0.90	0.03	6.10	0.04	0.14	0.25	77.23	0.08	1.34	0.19	3.87	0.17	4.05
	U1518E-29X-6_7-9	1452.00	1452.00	0.02	0.02	0.40	12.85	0.04	0.05	1.02	0.06	6.08	0.05	0.13	1.03	78.89	0.47	1.51	0.33	3.67	0.45	3.78
s75*	U1518E-32X-1_20-24 I	1455.00		0.01	0.00	0.30	12.40	0.03	0.03	0.86	0.03	6.09	0.04	0.12	0.35	77.76	0.14	1.18	0.35	4.09	0.25	3.46
	U1520D_49X-1_28-30	1456.40	1455.70	0.02	0.01	0.25	13.20	0.04	0.05	1.18	0.03	6.10	0.04	0.15	0.58	78.94	0.18	1.75	0.15	3.56	0.21	4.06
	U1518E-32X-1_20-24a II	1455.00		0.02	0.01	0.25	13.28	0.02	0.05	1.17	0.05	6.15	0.03	0.17	0.49	78.77	0.18	1.75	0.47	3.59	0.47	4.05
	1124C_6H-2_27-29 I	1469.26		0.02	0.03	0.21	13.66	0.04	0.08	1.27	0.02	6.12	0.02	0.17	0.27	74.18	0.10	2.29	0.10	3.46	0.20	4.74
s76*	1124C_6H-2_27-29 II	1469.75		0.02	0.02	0.22	13.33	0.03	0.08	1.00	0.03	6.08	0.02	0.15	0.27	78.21	0.12	1.91	0.08	3.62	0.14	4.61
	1124D_4H-5_77-79	1470.24		0.02	0.02	0.25	13.63	0.04	0.07	1.18	0.03	6.11	0.03	0.16	0.62	74.40	0.20	2.16	0.10	3.55	0.21	4.73
	1124D_4H-6_18-20	1514.80		0.02	0.02	0.20	13.45	0.04	0.07	1.28	0.02	6.14	0.02	0.20	0.27	74.37	0.12	2.08	0.10	3.66	0.17	4.51
	1124C_6H-2_127-129	1518.23		0.01	0.01	0.17	13.79	0.04	0.07	1.27	0.02	6.13	0.02	0.20	0.14	74.25	0.11	2.27	0.04	3.59	0.18	4.40
s77	U1520D_49X-CC_29-31	1523.85	1523.85	0.02	0.02	0.31	13.05	0.05	0.05	1.15	0.04	6.15	0.04	0.19	0.56	78.29	0.15	1.54	0.14	3.61	0.27	3.95
	1124D_4H-6_57-59	1533.89	1533.89	0.02	0.06	0.28	14.05	0.05	0.08	1.15	0.05	6.42	0.03	0.44	0.55	72.25	0.20	2.78	0.10	3.45	0.16	4.32
	1123C_7H-2_62-64	1519.14		0.01	0.01	0.08	13.32	0.04	0.07	1.06	0.02	6.08	0.02	0.15	0.23	74.75	0.10	2.24	0.07	3.34	0.18	4.97
	1123B_7H-4_93-95	1520.75	1534.25	0.02	0.02	0.19	13.24	0.05	0.06	1.09	0.02	6.09	0.01	0.17	0.44	74.85	0.10	2.23	0.10	3.42	0.64	4.84
s78	1123A_7H-3_48-50	1562.86		0.01	0.01	0.19	13.29	0.04	0.08	1.07	0.03	6.08	0.04	0.17	0.31	74.71	0.13	2.22	0.16	3.43	0.20	4.95
	1123B_7H-4_145-147	1537.47		0.02	0.02	0.13	13.54	0.03	0.09	1.19	0.03	6.12	0.01	0.17	0.22	74.72	0.09	2.33	0.12	3.26	0.17	4.56
	1123C_7H-2_120-122	1537.79	1540.00	0.02	0.02	0.11	13.48	0.04	0.09	1.14	0.02	6.10	0.02	0.18	0.22	74.76	0.10	2.31	0.06	3.21	0.15	5.11
	1123A_7H-3_108-110	1582.15		0.02	0.01	0.14	13.41	0.05	0.09	1.16	0.02	6.12	0.03	0.20	0.20	74.40	0.10	2.16	0.07	3.20	0.23	5.04
s79	1124D_4H-C_86-88 I	1548.09		0.01	0.02	0.14	14.03	0.03	0.04	1.46	0.03	6.16	0.02	0.20	0.37	73.19	0.10	2.47	0.09	3.84	0.11	4.58
	1124D_4H-6_86-88 II			0.02	0.02	0.20	13.26	0.04	0.06	0.93	0.03	6.06	0.02	0.10	0.44	75.44	0.15	1.79	0.13	4.07	0.26	4.36
	1124D_4H-6_117-119	1563.27		0.01	0.01	0.11	12.97	0.04	0.06	0.92	0.03	6.08	0.02	0.17	0.26	75.49	0.11	1.89	0.07	4.35	0.18	4.05
	1124C_6H-3_90-92	1573.56	1568.41	0.02	0.02	0.12	13.06	0.04	0.05	0.90	0.02	6.09	0.02	0.17	0.29	75.23	0.09	1.94	0.09	4.39	0.19	4.16
s80	1123B_7H-5_115-117	1576.05	1576.05	0.01	0.02	0.15	13.45	0.04	0.07	1.04	0.02	6.09	0.02	0.14	0.13	75.06	0.10	2.13	0.10	3.46	0.16	4.54
	1123C_7H-3_132-134	1589.87		0.01	0.00	0.11	12.64	0.03	0.06	0.91	0.02	6.05	0.02	0.05	0.21	77.60	0.13	0.99	0.30	4.09	0.15	3.62
	1123B_7H-6_87-89	1615.27	1603.91	0.01	0.01	0.15	12.60	0.03	0.04	0.97	0.02	6.06	0.03	0.06	0.23	77.50	0.13	1.64	0.35	3.92	0.19	3.80
	1123A_7H-5_33-35	1630.38		0.01	0.01	0.10	12.63	0.03	0.05	1.13	0.03	6.06	0.02	0.05	0.19	77.41	0.13	0.98	0.25	4.09	0.12	3.84
s81	U1520D_50X-CC_37-39	1649.78 / 1.69±0.11		0.01	0.01	0.22	13.06	0.04	0.06	1.08	0.02	6.08	0.03	0.18	0.36	78.37	0.13	2.22	0.11	3.55	0.25	4.19
	1123C_7H-4_60-62	1614.95		0.02	0.02	0.20	13.67	0.04	0.08	1.19	0.04	6.12	0.03	0.19	0.48	74.43	0.19	2.22	0.12	3.59	0.22	4.50
	1123B_7H-6_87-89	1615.27		0.02	0.02	0.24	13.61	0.04	0.08	1.17	0.06	6.13	0.04	0.17	0.59	74.09	0.22	2.23	0.17	3.56	0.15	4.88
	1123A_7H-5_33-35	1654.49		0.02	0.02	0.24	13.55	0.04	0.07	1.20	0.03	6.12	0.02	0.17	0.46	74.28	0.17	2.22	0.12	3.52	0.17	4.86
s82	U1520D_50X-CC_37-39	1649.78 / 1.69±0.11		0.01	0.01	0.22	13.06	0.04	0.06	1.08	0.02	6.08	0.03	0.18	0.36	78.37	0.13	2.22	0.11	3.55	0.25	4.19
	1123C_7H-3_132-134	1589.87		0.01	0.00	0.11	12.64	0.03	0.06	0.91	0.02	6.05	0.02	0.05	0.21	77.60	0.13	0.99	0.30	4.09	0.15	3.62
	1123B_7H-6_87-89	1615.27	1603.91	0.01	0.01	0.15	12.60	0.03	0.04	0.97	0.02	6.06	0.03	0.06	0.23	77.50	0.13	1.64	0.35	3.92	0.19	3.80
	1123A_7H-5_33-35	1630.38		0.01	0.01	0.10	12.63	0.03	0.05	1.13	0.03	6.06	0.02	0.05	0.19	77.41	0.13	0.98	0.25	4.09	0.12	3.84
s83	U1520D_50X-CC_37-39	1649.78 / 1.69±0.11		0.01	0.01	0.22	13.06	0.04	0.06	1.08	0.02	6.08	0.03	0.18	0.36	78.37	0.13	2.22	0.11	3.55	0.25	4.19
	1123C_7H-4_60-62	1614.95		0.02	0.02	0.20	13.67	0.04	0.08	1.19	0.04	6.12	0.03	0.19	0.48	74.43	0.19	2.22	0.12	3.59	0.22	4.50
	1123B_7H-6_87-89	1615.27		0.02	0.02	0.24	13.61	0.04	0.08	1.17	0.06	6.13	0.04	0.17	0.59	74.09	0.22	2.23	0.17	3.56	0.15	4.88
	1123A_7H-5_33-35	1654.49		0.02	0.02	0.24	13.55	0.04	0.07	1.20	0.03	6.12	0.02	0.17	0.46	74.28	0.17	2.22	0.12	3.52	0.17	4.86
s84**	U1520D_50X-CC_37-39	1649.78 / 1.69±0.11		0.01	0.01	0.22	13.06	0.04	0.06	1.08	0.02	6.08	0.03	0.18	0.36	78.37	0.13	2.22	0.11	3.55	0.25	4.19
	1123C_7H-3_132-134	1589.87		0.01	0.00	0.11	12.64	0.03	0.06	0.91	0.02	6.05	0.02	0.05	0.21	77.60	0.13	0.99	0.30	4.09	0.15	3.62
	1123B_7H-6_87-89	1615.27	1603.91	0.01	0.01	0.15	12.60	0.03	0.04	0.97	0.02	6.06	0.03	0.06	0.23	77.50	0.13	1.64	0.35	3.92	0.19	3.80
	1123A_7H-5_33-35	1630.38		0.01	0.01	0.10	12.63	0.03	0.05	1.13	0.03	6.06	0.02	0.05	0.19	77.41	0.13	0.98	0.25	4.09	0.12	3.84
s85	U1520D_50X-CC_37-39	1649.78 / 1.69±0.11		0.01	0.01	0.22	13.06	0.04	0.06	1.08	0.02	6.08	0.03	0.18	0.36	78.37	0.13	2.22	0.11	3.55	0.25	4.19
	1123C_7H-4_60-62	1614.95		0.02	0.02	0.20	13.67	0.04	0.08	1.19	0.04	6.12	0.03	0.19	0.48	74.43	0.19	2.22	0.12	3.59	0.22	4.50
	1123B_7H-6_87-89	1615.27		0.02	0.02	0.24	13.61	0.04	0.08	1.17	0.06	6.13	0.04	0.17	0.59	74.09	0.22	2.23	0.17	3.56	0.15	4.88
	1123A_7H-5_33-35	1654.49		0.02	0.02	0.24	13.55	0.04	0.07	1.20	0.03	6.12	0.02	0.17	0.46	74.28	0.17	2.22	0.12	3.52	0.17	4.86
s86*	U1520D_50X-CC_37-39	1649.78 / 1.69±0.11		0.01	0.01	0.22	13.06	0.04	0.06	1.08	0.02	6.08	0.03	0.18	0.36	78.37	0.13	2.22	0.11	3.55	0.25	4.19
	1123C_7H-3_132-134	1589.87		0.01	0.00	0.11	12.64	0.03	0.06	0.91	0.02	6.05	0.02	0.05	0.21	77.60	0.13	0.99	0.30	4.09	0.15	3.62
	1123B_7H-6_87-89	1615.27	1603.91	0.01	0.01	0.15	12.60	0.03	0.04	0.97	0.02	6.06	0.03	0.06	0.23	77.50	0.13	1.64	0.35	3.92	0.19	3.80
	1123A_7H-5_33-35	1630.38		0.01	0.01	0.10	12.63	0.03	0.05	1.13	0.03	6.06	0.02	0.05	0.19	77.41	0.13	0.98	0.25	4.09	0.12	3.84
s87	U1520D_50X-CC_37-39	1649.78 / 1.69±0.11		0.01	0.01	0.22	13.06	0.04	0.06	1.08	0.02	6.08	0.03	0.18	0.36	78.37	0.13	2.22	0.11	3.55	0.25	4.19
	1123C_7H-4_60-62	1614.95		0.02	0.02	0.20	13.67	0.04	0.08	1.19	0.04	6.12	0.03	0.19	0.48	74.43	0.19	2.22	0.12	3.59	0.22	4.50
	1123B_7H-6_87-89	1615.27		0.02	0.02	0.24	13.61	0.04	0.08	1.17	0.06	6.13	0.04	0.17	0.59	74.09	0.22	2.23	0.17	3.56	0.15	4.88
	1123A_7H-5_33-35	1654.49		0.02	0.02	0.24	13.55	0.04	0.07	1.20	0.03	6.12	0.02	0.17	0.46	74.28	0.17	2.22	0.12	3.52	0.17	4.86
s88**	U1520D																					

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

<i>s86</i>	1124C_6H-4_52-54	1628.40	1628.40	Table Flat Tephra 1.71±0.12Ma ³	0.01	0.01	0.17	1.344	0.04	0.06	0.02	0.97	0.02	0.08	0.02	0.13	0.48	74.67	0.10	4.95	0.09	4.54	0.38	4.16
	1122C_44X-2_57-59	1628.00	1628.00		0.02	0.02	0.17	1.331	0.03	0.05	0.06	0.97	0.02	0.08	0.02	0.14	0.41	74.66	0.14	4.96	0.13	4.65	0.22	4.15
<i>u58</i>	1124C_6H-5_20-22	1686.17	1686.17		0.03	0.06	0.39	14.23	0.05	0.19	0.05	1.91	0.03	0.35	0.02	0.27	0.51	75.04	0.12	5.32	0.06	5.22	0.15	4.29
<i>u59</i>	U1520D_51X-1_26-28	1839.18	1839.18		0.02	0.02	0.24	13.68	0.05	0.08	0.10	1.26	0.05	0.15	0.05	0.22	0.48	74.25	0.18	5.31	0.19	5.41	0.22	4.61
<i>u60</i>	U1520D_51X-1_35-37	1840.98	1840.98		0.02	0.02	0.23	13.61	0.04	0.05	0.09	1.72	0.04	0.23	0.02	0.22	0.51	74.83	0.19	4.97	0.09	5.57	0.15	3.78
<i>u61</i>	U1520D_51X-1_49-50	1843.77	1843.77		0.01	0.01	0.23	13.65	0.03	0.05	0.13	0.79	0.03	0.06	0.03	0.12	0.43	76.12	0.15	4.63	0.12	3.93	0.16	4.24
<i>u62</i>	U1520D_51X-1_51-52	1844.17	1844.17		0.02	0.02	0.28	13.67	0.04	0.05	0.14	1.26	0.03	0.14	0.03	0.19	0.51	74.56	0.17	2.22	0.22	3.70	0.16	4.18
<i>u63</i>	U1520D_51X-1_54-55	1844.77	1844.77		0.02	0.01	0.17	13.43	0.04	0.06	0.26	1.04	0.06	0.08	0.04	0.13	0.90	75.54	0.13	1.83	0.16	3.97	0.85	3.91
<i>s87</i>	1124C_6H-5_37-39	1694.50	1694.50		0.02	0.03	0.19	12.71	0.02	0.04	0.10	1.48	0.05	0.23	0.02	0.19	0.45	77.21	0.14	1.17	0.09	3.18	0.14	3.77
	U1520D_51X-1_55-56	1844.97	1844.97		0.02	0.02	0.23	12.84	0.04	0.04	0.22	1.37	0.07	0.21	0.05	0.17	0.53	77.25	0.14	1.22	0.32	3.40	0.22	3.49
<i>u64</i>	U1520D_51X-1_64-65	1846.76	1846.76		0.01	0.02	0.22	13.74	0.05	0.07	0.18	1.23	0.05	0.13	0.05	0.19	0.57	74.84	0.39	2.19	0.33	3.63	0.31	4.46
<i>s88</i>	U1520D_51X-1_64-65(2)	1846.80	1846.80	Vinegar Hill Tephra 1.75±0.2Ma ³	0.02	0.02	0.25	12.79	0.03	0.04	0.14	1.09	0.03	0.13	0.04	0.19	0.38	76.11	0.11	1.55	0.33	4.72	0.31	3.37
	1125A_5H-6_36-38 I	1951.88	1951.88		0.02	0.03	0.18	12.29	0.02	0.01	0.07	0.99	0.01	0.07	0.01	0.12	0.20	77.44	0.09	1.45	0.12	3.58	0.13	4.12
	1125A_5H-6_36-38 II	2027.18	2027.18		0.02	0.01	0.37	12.78	0.04	0.06	0.13	1.19	0.04	0.10	0.03	0.14	0.49	76.24	0.16	1.66	0.19	3.42	0.15	4.39
	U1520D_52X-1_8-10	2059.35	2059.35		0.01	0.01	0.16	12.35	0.04	0.05	0.11	0.96	0.04	0.05	0.03	0.10	0.46	77.44	0.18	1.56	0.17	3.47	0.20	4.00
<i>s89*</i>	1125B_5H-2_131-133	2155.25	2155.25	Hikuroa Pumice 2.0±0.6Ma ¹	0.01	0.02	0.27	12.47	0.03	0.03	0.10	1.18	0.03	0.09	0.02	0.13	0.52	76.59	0.13	1.73	0.15	3.43	0.17	4.34
	1124D_5H-7_12-14	2160.64	2160.64		0.02	0.01	0.17	12.38	0.03	0.04	0.06	0.92	0.03	0.04	0.01	0.09	0.26	77.45	0.17	1.43	0.18	3.46	0.13	4.18
	1124C_7H-3_117-119				0.01	0.01	0.19	12.07	0.04	0.04	0.06	0.87	0.02	0.05	0.03	0.07	0.41	77.95	0.43	1.25	0.20	3.54	0.15	4.14
	U1520B_4H-2_57-59				0.01	0.01	0.57	13.11	0.03	0.05	0.22	1.09	0.06	0.08	0.06	0.12	1.52	78.24	0.47	1.64	0.23	3.59	0.44	4.06
	1122C_50X-5_5-7	2025.00	2025.00		0.03	0.02	0.12	13.08	0.05	0.04	0.06	1.18	0.02	0.11	0.02	0.14	0.28	78.81	0.10	1.76	0.08	3.27	0.14	4.58
<i>s90</i>	1125A_5H-6_65-67	1962.07	1962.07		0.02	0.02	0.29	13.42	0.02	0.06	0.02	1.49	0.02	0.29	0.02	0.16	0.29	75.54	0.10	1.41	0.06	3.27	0.12	4.31
	1125B_5H-3_120-122	2108.16	2108.16		0.01	0.01	0.19	13.12	0.04	0.05	0.17	1.43	0.06	0.17	0.05	0.19	0.36	76.63	0.14	1.83	0.11	3.15	0.18	4.39
	1125A_9H-5_99-101	2340.54	2340.54		0.02	0.02	0.28	13.22	0.03	0.05	0.11	1.37	0.05	0.18	0.04	0.18	0.44	75.88	0.20	1.67	0.14	3.56	0.27	3.97
<i>s91</i>	1123B_5H-4_64-66	2141.17	2141.17		0.02	0.02	0.21	11.97	0.03	0.03	0.25	1.31	0.07	0.17	0.08	0.18	0.24	77.80	0.22	1.42	0.37	3.44	0.17	3.77
	1125A_6H-1_23-25	2146.79	2146.79		0.02	0.02	0.09	11.97	0.03	0.04	0.17	1.49	0.06	0.22	0.05	0.22	0.24	77.61	0.16	1.49	0.23	3.17	0.26	3.77
<i>s92</i>	U1520D_53X-1_31-33	2199.88	2199.88		0.01	0.01	0.20	12.29	0.03	0.04	0.22	1.24	0.05	0.14	0.06	0.16	0.31	77.74	0.16	1.35	0.45	3.45	0.18	3.57
	1124C_7H-4_60-62	2206.17	2206.17		0.01	0.01	0.13	12.39	0.04	0.04	0.09	1.08	0.02	0.10	0.02	0.10	0.20	77.48	0.12	1.25	0.14	3.56	0.15	4.00
<i>u65</i>	1124C_7H-4_85-87	2218.41	2218.41		0.02	0.03	0.22	13.16	0.03	0.07	0.11	1.62	0.02	0.14	0.02	0.18	0.39	74.62	0.20	2.62	0.06	3.10	0.11	4.47
<i>u66</i>	1124C_7H-5_15-17	2257.59	2257.59		0.02	0.01	0.24	12.25	0.04	0.04	0.03	1.03	0.02	0.11	0.02	0.09	0.49	78.07	0.22	1.06	0.19	3.69	0.33	3.65
	1124C_7H-5_92-94a I	2295.29	2295.29		0.01	0.01	0.20	12.23	0.04	0.05	0.14	1.34	0.04	0.16	0.03	0.17	0.28	77.70	0.07	1.41	0.23	3.23	0.23	3.69
<i>s93*</i>	1124C_7H-5_92-94 II	2295.78	2295.78		0.01	0.02	0.12	12.45	0.03	0.04	0.02	0.95	0.02	0.08	0.02	0.10	0.25	77.58	0.07	1.15	0.15	4.01	0.17	3.63
	1124D_6H-1_142-144 I	2296.27	2296.27		0.01	0.01	0.18	12.23	0.03	0.04	0.08	1.36	0.03	0.16	0.04	0.17	0.21	77.61	0.13	1.36	0.13	3.15	0.11	3.93
	1124D_6H-1_142-144 II				0.01	0.01	0.18	12.40	0.03	0.04	0.05	0.97	0.03	0.07	0.02	0.09	0.18	77.65	0.08	1.15	0.11	3.93	0.14	3.70
<i>s94</i>	1123C_9H-5_33-35	2321.25	2321.25		0.02	0.02	0.26	12.99	0.04	0.05	0.14	1.44	0.04	0.19	0.05	0.22	0.47	78.78	0.16	1.06	0.25	3.03	0.23	4.42
	1123B_10H-1_36-38	2322.22	2322.22		0.01	0.02	0.24	13.09	0.03	0.05	0.11	1.49	0.04	0.19	0.03	0.20	0.44	78.88	0.13	1.92	0.21	3.03	0.22	4.13
	1123A_9H-5_141-143	2354.04	2354.04		0.01	0.02	0.21	13.16	0.04	0.05	0.11	1.47	0.04	0.19	0.04	0.22	0.48	78.92	0.13	1.83	0.24	2.99	0.23	4.15

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s95	1123B_10H-1_97-99	2341.83	2368.09	PU-16-04 ² & Lower Papanoa Ignimbrite	2.4 Ma ²	0.02	0.02	0.22	1.501	0.04	0.05	0.19	1.41	0.07	0.17	0.05	0.19	0.52	75.63	0.14	4.90	0.13	3.14	0.14	4.48
	1123C_9H-5_99-101	2342.47				0.02	0.02	0.18	1.512	0.03	0.05	0.17	1.43	0.05	0.17	0.05	0.19	0.45	75.91	0.16	4.84	0.10	3.15	0.19	4.12
	1123A_9H-6_58-60	2375.58				0.02	0.02	0.19	1.296	0.03	0.06	0.17	1.41	0.06	0.17	0.05	0.18	0.48	75.75	0.19	4.90	0.15	3.18	0.19	4.39
	1124D_6H-2_27-29	2386.85				0.01	0.01	0.20	1.273	0.03	0.04	0.17	1.15	0.02	0.17	0.02	0.13	0.48	76.49	0.14	4.64	0.09	3.45	0.18	4.26
	1124C_7H-6_143-145	2393.71				0.02	0.02	0.33	1.320	0.04	0.05	0.17	1.30	0.05	0.17	0.03	0.16	0.47	75.82	0.14	4.62	0.13	3.39	0.18	4.26
	U1526A_2R-CC_28-29					0.02	0.02	0.43	1.342	0.04	0.06	0.17	1.30	0.07	0.17	0.06	0.19	1.09	75.12	0.33	4.75	0.16	3.42	0.24	4.36
s96	1124D_6H-3_70-72	2407.91	2407.91			0.03	0.03	0.14	1.299	0.03	0.06	0.19	1.47	0.04	0.19	0.03	0.20	0.34	75.83	0.13	4.83	0.17	2.96	0.24	4.44
	1123B_10H-2_32-34	2369.15				0.01	0.02	0.13	1.232	0.03	0.04	0.20	1.43	0.06	0.20	0.07	0.22	0.25	77.52	0.20	4.44	0.30	3.34	0.14	3.48
	1123A_9H-7_7-9	2407.41	2424.90			0.02	0.02	0.17	1.237	0.04	0.05	0.17	1.26	0.07	0.17	0.11	0.19	0.38	77.34	0.24	4.34	0.41	3.49	0.17	3.79
	1124D_6H-4_29-31	2461.28				0.02	0.03	0.15	1.222	0.03	0.05	0.21	1.43	0.05	0.21	0.06	0.21	0.27	77.47	0.20	4.43	0.32	3.30	0.18	3.68
s97*	1124C_8H-1_104-106	2461.77				0.02	0.02	0.21	1.249	0.03	0.06	0.19	1.36	0.06	0.19	0.07	0.19	0.35	77.24	0.24	4.36	0.31	3.41	0.19	3.69
	1125B_6H-1_147-149	2372.95				0.01	0.01	0.25	1.272	0.04	0.05	0.18	1.28	0.05	0.18	0.03	0.16	0.59	76.87	0.16	4.35	0.10	3.03	0.19	4.14
	1125A_6H-5_71-73 I	2374.35				0.01	0.01	0.12	1.255	0.03	0.04	0.15	1.18	0.04	0.15	0.04	0.14	0.21	77.56	0.07	4.21	0.37	3.25	0.23	4.20
	1125A_6H-5_71-73a II		2457.00			0.01	0.02	0.23	1.291	0.02	0.06	0.19	1.39	0.03	0.19	0.02	0.18	0.41	76.37	0.12	4.45	0.06	2.99	0.08	4.44
	U1520D_54X-2_3-5 I	2457.00				0.01	0.02	0.14	1.258	0.03	0.03	0.14	1.17	0.02	0.14	0.03	0.14	0.31	77.68	0.14	4.28	0.25	3.14	0.15	3.80
	U1520D_54X-2_3-5a II					0.02	0.03	0.16	1.221	0.04	0.05	0.20	1.45	0.03	0.20	0.02	0.18	0.29	76.18	0.13	4.55	0.09	2.97	0.11	3.99
s98	1125A_7H-1_138-140	2571.71	2575.23			0.01	0.01	0.19	1.249	0.04	0.05	0.04	0.86	0.02	0.04	0.02	0.07	0.30	77.44	0.12	4.18	0.09	3.82	0.14	4.05
	1125B_6H-5_133-135	2578.74				0.01	0.01	0.18	1.249	0.03	0.04	0.04	0.81	0.02	0.04	0.01	0.07	0.32	77.39	0.08	4.12	0.16	3.91	0.14	4.12

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[illegible]

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s12	U1520D_15H-4_71-73	141.00	141.00	5.3	194	1.19	5.38	10.36	80.9	4.20	24.1	75.9	775.6	0.78	5.84	1.72	7.85	36.2	124.6	6.99	23.3	15.74	70.4	12.23	140.3	0.12	0.85	0.61	3.43	2.67	7.40	7.61	42.8
	U1520B_21H-1_94-96			1.8	162	0.41	4.80	4.14	46.1	1.75	23.0	40.5	741.0	0.49	7.04	0.63	6.11	12.0	38.3	2.40	19.9	11.03	65.3	7.61	141.3	0.34	0.81	1.08	2.96	0.82	10.22	2.11	47.5
u4	U1520D_16H-2_65-67	145.90	145.90	0.4	94	0.17	2.87	1.23	29.5	0.63	16.0	45.9	1188.9	0.38	6.21	0.11	5.01	4.4	109.9	0.53	11.6	1.35	95.4	4.95	114.6	0.08	0.93	0.58	3.02	0.22	5.47	2.24	50.0
u5	1124A_1H-3_35-37	156.13	156.13	2.3	252	0.40	6.47	3.39	57.4	1.03	27.5	38.2	676.3	0.58	6.51	0.73	7.69	11.8	222.7	1.61	31.4	7.60	130.0	9.76	117.2	0.04	1.80	0.40	2.58	1.44	14.40	3.29	54.2
u6	U1520D_18H-2_108-110	177.40	177.40		145		4.21		36.7		17.4		988.4		4.33		5.87		105.9		11.1		394.7		88.9		2.93		5.76		3.73		24.7
u7	U1520D_18H-5_123-125	185.70	185.70	1.3	139	0.40	3.12	2.64	27.3	1.71	12.2	62.3	491.3	0.56	4.65	0.34	4.25	12.3	144.2	2.63	20.6	16.97	147.9	9.90	72.2	1.24	6.27	0.33	2.83	0.70	10.12	6.86	29.7
u8	U1520D_18H-6_107-109	188.20	188.20	3.4	237	0.74	6.08	7.64	54.3	2.99	23.7	77.9	604.4	0.83	7.38	0.91	6.40	23.9	175.1	4.34	30.7	4.91	82.5	15.49	131.8	0.06	1.27	0.41	3.78	1.19	10.09	8.47	58.4
u9	U1520D_20F-1_125-127	200.50	200.50	12.4	282		2.82		21.0		9.0		339.7		2.37		3.83		97.9		24.2		192.0		39.3		17.50		5.01		20.70		17.8
u10	U1520D_21F-4_6-8	210.30	210.30																														
u11	U1520D_21F-4_48-50	210.80	210.80	3.3	211	0.90	5.73	6.97	52.9	2.42	24.9	38.6	763.6	0.82	5.82	1.24	7.42	24.2	112.8	6.23	24.2	16.30	49.3	1.07	134.8	0.31	0.53	0.32	3.82	1.65	7.37	12.12	42.1
u12	U1520D_22F-2_60-62	213.10	213.10	1.6	265	0.47	6.93	3.03	60.6	1.29	28.0	28.2	786.0	0.47	5.34	0.51	9.90	9.4	133.1	2.75	34.7	1.89	43.5	8.94	127.6	0.06	0.43	0.91	5.63	0.75	9.12	3.83	42.2
u13	U1520D_22F-2_80-82	213.30	213.30	1.2	243	0.16	6.02	0.99	80.8	0.45	23.4	22.5	901.7	0.36	6.13	0.88	7.93	4.1	137.1	0.76	32.6	3.20	149.2	2.53	113.7	0.67	3.11	11.38	11.49	0.31	13.96	2.17	37.3
s13	U1520D_23F-3_6-8	223.10	223.10	3.1	179	0.91	4.71	5.61	41.5	2.26	19.7	72.6	572.8	0.72	4.51	0.88	6.31	19.1	83.6	5.91	22.8	4.51	38.0	16.35	95.5	0.24	0.63	0.54	3.23	1.47	6.43	6.36	33.7
	1124C_1X-1_80-82	242.30	242.30	2.0	284	0.37	7.27	4.79	61.5	2.04	29.5	61.5	792.4	0.46	5.59	0.82	9.70	8.2	135.0	2.54	36.1	5.67	41.2	11.88	125.4	0.06	0.43	0.84	2.63	0.65	8.85	3.81	43.3
s14	1123A_2H-5_66-68	248.62	248.62																														
	1123B_2H-6_91-93	251.15	251.15																														
	1123C_2H-2_104-109	256.13	256.13	0.8	259	0.34	6.88	3.60	61.6	1.61	29.1	34.9	781.3	0.29	5.71	0.29	9.08	15.1	149.4	1.11	31.8	7.85	61.5	7.44	133.8	0.07	0.33	0.57	3.17	1.06	11.17	3.87	43.1
u14	1125A_2H-4_17-19	259.39	259.39																														
s15	1123A_2H-6_18-20	271.76	271.76																														
	1123C_2H-3_69-71	281.50	281.50	1.3	214	0.51	5.68	4.47	52.0	1.81	23.8	43.2	708.8	0.53	5.40	0.81	8.08	16.5	135.2	1.88	24.5	11.86	75.0	10.30	129.3	0.13	0.85	0.36	3.26	0.92	9.56	3.77	39.9
s16	1123A_2H-6_70-72	283.54	283.54																														
	1123C_2H-3_132-134	295.77	295.77																														
s17	U1520D_25F-2_10-14	301 / 363±33	310.00	1.0	240	0.14	6.27	2.40	56.4	0.91	25.6	38.4	761.6	0.30	5.86	0.36	9.19	46.6	155.6	1.34	28.1	7.51	45.0	10.44	135.9	0.05	0.54	0.83	5.01	0.48	10.39	4.35	40.0
	U1520B_2H-2_92-93			2.3	267	0.40	6.76	3.51	58.7	1.76	27.2	37.6	717.5	0.44	5.43	0.50	8.51	8.2	109.0	2.58	32.7	4.19	35.3	8.40	123.3	0.08	0.27	1.45	3.17	0.67	7.33	2.80	41.3
u15	1124A_1H-7_25-27	310.10	310.10																														
u16	U1520D_26F-1_103-105	310.6 / 330±37	310.60	0.8	219	0.23	5.68	2.44	50.7	1.49	24.0	31.3	701.9	0.39	5.22	0.34	8.21	16.5	140.0	0.73	26.6	9.52	65.8	11.83	121.1	0.08	0.34	0.35	3.23	0.40	12.52	1.81	39.1
u17	U1520D_26F-2_23-27	312.2 / 346±33	312.20	1.3	227	0.42	5.80	2.86	54.0	1.46	25.4	30.1	732.9	0.41	5.61	0.54	8.35	8.6	126.0	1.65	26.6	5.82	61.6	6.84	135.5	0.06	0.42	0.49	3.77	0.87	11.57	6.77	36.7
u18	U1520D_26F-3_29-31	314.55	314.55	2.7	229	0.60	6.00	5.51	54.6	2.08	25.7	39.2	743.8	0.35	5.56	0.84	8.31	13.1	132.5	2.85	25.4	8.23	68.2	14.13	137.4	0.17	0.56	0.54	3.08	1.19	11.09	2.62	42.9
u19	U1520D_26F-4_51-55	316.27 / 336±38	316.27	2.3	200	0.36	5.46	3.74	52.8	1.69	23.9	83.1	815.8	0.35	6.62	0.34	8.01	25.0	108.4	2.15	22.3	6.00	70.3	8.04	147.5	0.11	0.48	0.44	3.95	0.69	10.88	6.40	52.4
s18	U1520D_27F-1_44-46	317.18	317.18	2.4	176	0.76	4.87	7.02	43.8	3.76	22.4	108.2	743.7	0.59	4.45	1.20	7.16	21.4	138.5	2.99	19.2	10.08	85.9	16.79	120.9	0.09	0.55	0.45	2.39	1.49	9.14	5.59	39.1
	U1518F-13R-1_113-115	310.00	310.00	0.9	196	0.22	5.27	1.79	47.4	0.87	23.3	25.4	705.4	0.08	5.34	0.33	6.93	6.0	134.5	1.11	23.5	3.60	76.5	1.55	123.4	0.04	0.49	0.14	1.93	0.27	7.66	1.95	40.7
u20	U1520D_27F-1_96-98	317.89 / 235-300	317.89																														
	U1520D_27F-2_78-80	319.26 / 347±22	319.26	0.6	166	0.23	4.55	2.20	43.0	0.81	21.2	22.8	681.7	0.23	6.38	0.35	6.00	4.4	94.3	0.58	17.6	3.66	87.4	3.93	127.0	0.13	0.83	0.38	3.95	0.28	5.35	4.00	49.6
u21	U1520D_27F-2_78-80	319.26 / 347±22	319.26																														

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s19	319.33	Lower Griffin Road 0.3-0.4Ma ¹	U1520D_27F-2_92-96	319.33 / 347±2.2	319.75	388.34	390.31	0.6	17.1	0.14	4.64	0.77	41.6	0.50	21.1	11.0	0.798	0.25	5.01	0.23	6.71	4.2	139.6	0.62	22.1	4.50	90.2	9.60	121.1	0.01	0.47	0.45	3.64	0.11	8.79	0.83	37.0
			U1520D_27F-3_74-78	319.75	388.34	390.31	1.3	17.1	0.58	4.74	4.15	44.0	1.93	20.9	06.6	701.6	0.34	5.06	0.65	7.07	10.5	138.1	1.61	21.7	9.66	96.0	8.55	120.5	0.25	0.72	4.41	6.68	0.41	7.47	2.68	40.1	
			U1520D_27F-3_74-78	319.75	388.34	390.31	1.3	17.1	0.58	4.74	4.15	44.0	1.93	20.9	06.6	701.6	0.34	5.06	0.65	7.07	10.5	138.1	1.61	21.7	9.66	96.0	8.55	120.5	0.25	0.72	4.41	6.68	0.41	7.47	2.68	40.1	
			U1520D_27F-3_74-78	319.75	388.34	390.31	1.3	17.1	0.58	4.74	4.15	44.0	1.93	20.9	06.6	701.6	0.34	5.06	0.65	7.07	10.5	138.1	1.61	21.7	9.66	96.0	8.55	120.5	0.25	0.72	4.41	6.68	0.41	7.47	2.68	40.1	
s20	321.04	Rangiaawa 350±50ka ⁵	U1520D_28F-1_93-95	321.04	320.00	334.16	3.5	18.7	0.86	5.20	6.25	90.2	2.97	23.2	108.8	775.7	1.22	6.33	0.45	7.69	40.9	124.5	5.25	20.6	19.97	71.1	17.54	130.5	0.26	0.80	0.63	2.99	1.83	6.10	2.11	35.2	
			U1518E-1H-4_16-18	320.00	334.16	334.16	1.7	17.2	0.44	4.78	4.57	48.0	2.00	23.3	89.6	853.3	1.45	7.51	1.19	7.07	22.2	96.3	1.71	19.3	7.62	57.3	27.34	185.2	0.35	0.79	0.80	3.27	1.00	7.26	13.73	41.3	
			U1518E-1H-4_16-18	320.00	334.16	334.16	2.1	12.3	0.59	3.60	3.95	35.8	3.03	18.7	110.1	092.0	0.95	6.18	1.05	5.56	11.5	69.1	2.24	13.4	5.18	54.8	21.52	133.0	0.63	0.93	0.34	2.08	1.26	6.31	9.05	39.4	
			U1520D_33X-3_60-62a.1	334.16	334.16	334.16	0.8	22.9	0.20	6.06	1.65	54.6	0.48	25.8	44.2	761.3	0.19	5.56	0.37	8.02	3.7	104.1	0.70	26.0	1.60	54.9	4.64	136.3	0.06	0.33	1.18	2.78	0.30	8.21	4.57	39.4	
s21*	334.11	U1520D_33X-3_60-62a.1	U1517C_35F-3_12-14	334.00	460.00	463.40	1.1	23.1	0.24	6.29	1.84	54.7	0.02	26.2	17.6	73.9	0.19	5.50	0.33	8.20	10.5	118.3	1.13	36.2	4.86	64.0	4.07	130.5	0.05	0.37	0.15	2.26	0.20	8.82	1.20	40.0	
			U1517C_35F-4_125-127	463.00	463.20	463.40	1.2	24.9	0.22	6.46	2.44	54.6	0.80	26.9	39.5	772.8	0.39	5.55	0.39	8.23	30.8	209.4	1.11	31.2	9.91	97.0	10.62	114.6	0.06	0.82	1.29	3.46	0.15	9.42	6.97	34.4	
			U1526B_2H-3_101-103 I	504.00	508±109	508±109	2.8	14.1	0.80	3.96	7.31	37.5	3.55	19.4	133.0	715.0	1.09	5.74	1.11	5.78	14.9	79.4	2.60	14.7	10.19	71.0	23.02	125.9	0.84	1.06	1.00	2.49	0.67	4.09	7.04	37.9	
			U1518E-2H-1_136-138	508±109	508.00	508.00	u25	U1518E-2H-6_109-111	508.00	510.00	510.00	u26	U1518E-3H-1_73-75	510.00	535.51	583.00	<585±39	1125B_3H-1_32-34	546.58	547.32	1125A_3H																

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s28	U1520D_35X-CC_2-4	631.78	631.78	0.3	13.9	0.17	4.13	1.85	42.8	0.65	20.1	23.3	926.8	0.28	7.39	0.34	6.41	2.9	94.0	0.31	15.9	2.72	65.1	4.58	154.2	0.05	0.92	0.39	3.39	0.35	8.03	4.50	51.7
	U1520B_2H-6_78-80		631.78	0.7	15.8	0.26	4.59	2.71	44.5	1.18	32.7	42.3	823.0	0.41	7.30	0.44	6.72	3.2	96.2	0.35	17.8	2.21	54.8	8.15	153.0	0.11	0.71	0.21	2.08	0.63	8.97	3.98	47.6
s29	1124D_1H-3_50-52	661.07	661.93	0.8	13.1	0.13	3.93	1.77	38.1	1.02	20.3	26.7	835.7	0.43	6.47	0.39	5.81	9.4	95.3	0.65	13.3	1.02	81.8	6.42	131.9	0.10	0.84	0.38	2.22	0.32	5.87	4.54	51.7
	1124C-2X-6_53-55	662.80	661.93	2.1	18.1	0.55	4.93	3.22	47.0	2.48	33.2	111.8	860.2	1.12	6.41	0.56	7.40	35.4	115.5	2.36	20.2	20.95	76.5	22.38	139.7	0.20	0.61	0.50	3.91	0.64	6.61	6.98	52.3
u28	1123A_4H-5_71-73	665.59	665.59	3.7	8.9	1.10	2.65	12.45	27.0	3.44	12.9	207.4	475.0	1.96	4.27	2.16	4.47	29.8	67.2	4.34	10.5	12.35	56.5	39.94	84.8	0.17	0.38	0.81	1.93	1.63	3.60	12.25	27.5
	1124D_1H-4_86-88	665.00	665.00																														
s30	U1518E-3H-3_36-40	585±39	665.00	0.3	13.3	0.28	3.94	1.62	39.4	0.84	21.1	37.3	766.8	0.67	6.61	0.16	5.99	3.1	77.3	0.41	13.6	2.34	68.3	12.09	144.6	0.05	0.55	0.67	2.59	0.64	5.72	6.53	46.1
	U1517C_36F-2_100-101																																
s31	1124C_3H-1_85-87	691.98	693.06	1.6	14.5	0.40	4.12	3.11	40.6	1.90	21.1	98.0	922.3	0.70	6.66	0.40	5.74	9.8	92.7	1.90	16.4	3.85	65.6	16.63	138.0	0.20	1.12	1.60	3.00	0.54	5.85	6.70	50.8
	1124D_1H-5_79-81	694.13	711.14	2.1	15.6	0.78	4.58	2.19	42.6	0.87	21.0	123.9	866.2	0.96	6.21	0.81	5.48	13.0	84.4	1.17	16.0	8.47	59.2	20.95	126.1	0.13	0.73	0.54	2.49	1.17	6.88	9.01	50.6
s32	1125A_4H-2_52-54	699.16	703.35																														
	1125B_3H-5_86-88	707.53	703.35																														
s33	U1520D_38X-CC_37-39	711.64	711.64	3.2	23.8	0.91	6.23	7.59	53.0	2.66	24.4	29.4	765.8	0.28	5.14	1.73	9.39	51.2	239.1	5.12	29.3	1.79	114.6	5.84	113.0	0.01	1.10	0.12	4.21	1.37	11.31	1.59	36.3
	1123A_4H-6_125-127	711.79	711.14																														
s34	U1518E-3H-6_16-18	710.00	710.00	0.3	15.8	0.21	4.27	1.39	36.6	0.72	18.8	25.6	729.9	0.54	3.85	0.37	6.21	4.9	178.2	0.97	19.4	4.81	150.2	10.48	91.2	0.14	1.08	0.42	2.34	0.46	8.34	1.38	40.1
	U1520D_39X-3_20-22	725.69	725.69	1.3	22.3	0.25	5.96	1.90	54.5	1.37	24.8	35.0	752.5	0.39	6.14	0.31	8.23	13.6	144.2	1.33	27.4	3.57	64.2	4.17	130.5	0.10	0.65	0.39	3.14	0.22	7.89	3.60	45.7
u29*	1125B_3H-6_43-45 I	733.86	733.86																														
	1125B_3H-6_43-45 II																																
s35*	1124D_1H-7_24-26 I	737.89																															
	1124D_1H-7_24-26 II	739.72		4.3	24.8	1.09	6.89	7.78	54.1	4.24	26.0	120.9	729.8	0.94	4.93	1.23	10.03	32.0	290.8	5.16	34.3	12.55	102.5	22.97	115.6	0.42	1.17	1.10	2.84	1.62	11.98	3.72	38.2
s36	1124C_3H-3_54-56	740.03		1.0	26.2	0.21	6.61	2.23	57.1	1.41	25.7	24.8	745.9	0.13	5.27	0.39	9.36	39.4	264.3	1.77	31.6	11.50	98.1	8.50	115.7	0.14	1.05	2.87	3.91	1.20	11.87	3.65	36.2
	1125A_4H-3_73-75	741.25																															
u30	1124C_3H-4_50-52	766.11	766.11	1.0	22.5	0.22	5.83	1.73	51.7	0.84	24.4	30.0	701.4	0.23	5.84	0.13	7.98	3.8	147.9	1.07	27.9	2.05	65.8	5.79	123.1	0.10	0.62	0.20	2.39	0.37	13.70	2.31	45.0
	U1520D_39X-5_64-66	763.85																															
s37	1124C_3H-4_107-109	776.29	772.80																														
	1124D_2H-1_42-44	778.25																															
s38	U1518E-5H-2_66-70			1.7	14.5	0.49	4.03	4.32	39.1	1.60	20.4	49.7	817.4	0.56	6.16	0.69	5.81	7.6	94.3	1.45	14.9	1.83	79.8	11.48	130.6	0.05	0.66	0.20	2.88	0.54	5.09	9.83	35.7
	1125B_4H-1_27-29	791.2		1.0	15.0	0.21	4.33	0.91	40.2	0.99	20.2	150.3	668.5	1.18	10.84	0.44	5.14	2.0	55.7	1.72	21.1	6.15	36.4	17.52	170.0	0.05	0.21	2.02	3.48	0.31	4.26	8.77	60.0
s39	U1518E-9H-2_0-1	792.0	791.57	3.2	21.8	1.29	5.87	6.23	51.6	1.80	25.5	21.4	759.8	0.37	6.32	1.36	7.91	31.3	136.1	6.57	26.5	0.62	61.4	0.45	131.5	0.46	0.81	0.06	2.22	2.69	7.05	16.51	34.0
	594_5H-2_36-38	791.5		0.6	16.2	0.18	4.67	1.21	45.5	0.68	23.0	20.9	889.6	0.29	7.41	0.24	6.81	2.7	104.8	0.58	18.0	0.80	51.7	3.47	156.7	0.03	0.68	0.42	2.43	0.17	7.12	1.74	54.0
s40	1124D_2H-1_128-130	793.61																															
	1124C_3H-5_56-58	793.97	793.79	2.0	16.7	0.61	4.74	3.93	43.1	1.56	22.6	39.2	730.7	0.49	5.89	0.41	6.99	8.9	138.9	4.32	20.5	8.52	76.6	10.33	123.7	0.09	0.70	0.88	2.71	1.47	5.22	2.84	38.5
u31	U1371D_1H-CC_2-4																																
	1124C_3H-5_90-92	800.04	800.04																														

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

[illegible]

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[illegible]

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s37	Rewa A										1088.49	1089.00																		
	1.1	2.5	0.23	0.61	1.87	5.2	0.89	2.4	26.1	69.4	0.19	0.49	0.31	0.86	7.6	21.7	1.06	2.9	3.31	8.8	3.55	9.5	0.02	0.05	0.08	0.22	0.42	1.16	1.31	3.7
	1.3	27.6	0.44	7.12	3.21	0.1	2.27	28.4	46.3	792.1	0.55	5.96	0.49	9.30	13.2	180.1	1.63	33.0	5.83	68.3	9.89	112.9	0.06	0.39	0.09	2.01	0.88	10.94	2.51	45.1
s38*	Sub-Rewa ³										1097.78	1098.00																		
	1.3	27.6	0.44	7.12	3.21	0.1	2.27	28.4	46.3	792.1	0.55	5.96	0.49	9.30	13.2	180.1	1.63	33.0	5.83	68.3	9.89	112.9	0.06	0.39	0.09	2.01	0.88	10.94	2.51	45.1
u44											1098.08	1098.08																		
	1.1	16.6	0.20	4.65	1.73	43.6	1.00	21.3	38.2	735.3	0.60	6.30	0.29	7.10	20.3	153.7	0.67	19.6	11.36	98.3	10.80	127.1	0.06	1.11	0.70	4.32	0.32	7.66	2.75	43.8
	11240D_3H-6_46-48										1105.10																			
s39	11240C_5H-3_13-15										1105.99																			
	1.1	23.6	0.28	6.16	1.74	52.6	0.96	25.7	20.4	762.9	0.33	5.64	0.22	7.48	8.1	232.2	0.91	28.8	4.17	120.7	5.79	110.8	0.61	2.53	0.17	2.17	0.22	9.08	3.34	41.5
s60	1120.93										1120.00																			
	2.0	22.7	0.35	6.18	0.76	51.1	0.85	24.9	40.8	758.2	0.21	5.55	0.58	7.66	11.5	229.3	1.21	28.2	5.32	120.7	6.16	108.8	0.33	1.83	0.49	2.66	0.70	8.70	3.68	40.8
	U1526B_3H-3_133-135										1120.00																			
s61	1134.32										1132.07																			
	1.0	23.0	0.17	6.40	2.98	56.8	2.11	28.4	59.8	814.6	0.38	6.76	0.41	8.41	7.5	120.8	2.27	31.4	3.05	56.3	7.87	128.1	0.40	0.73	0.23	2.05	0.20	5.29	1.73	50.0
	1.9	25.1	0.60	6.26	4.05	62.0	1.68	28.1	40.6	793.1	0.44	7.54	0.81	10.22	16.7	108.8	3.68	31.5	3.49	41.1	8.54	148.1	0.23	0.61	0.32	4.59	1.39	6.98	9.34	41.0
s62	1171.00										1136.00																			
	1.5	29.2	0.34	7.40	1.88	61.3	1.29	30.4	32.7	784.2	0.31	5.60	0.52	9.94	10.3	259.4	1.34	35.7	2.10	77.9	4.06	109.6	0.06	0.41	0.19	2.08	1.04	13.44	3.29	63.1
	U1526B_3H-4_38-40										1150.95																			
u45	1241.04										1241.04																			
	2.9	19.8	2.02	5.19	16.09	46.4	8.47	21.6	229.2	588.9	2.02	5.84	2.79	7.08	34.1	86.1	10.02	25.0	11.05	37.6	38.89	101.1	0.32	0.33	1.01	2.69	2.39	5.77	15.06	32.2
	1252.21										1270.63																			
s63	1270.63										1250.00																			
	4.8	27.7	1.33	6.85	11.62	89.3	5.11	27.6	144.9	784.7	0.84	5.79	1.73	10.41	40.2	255.5	5.68	33.8	10.23	82.8	19.24	108.7	0.11	0.37	1.33	3.35	1.96	11.87	8.17	36.7
	0.8	24.6	0.30	6.19	1.06	53.2	0.35	25.6	14.2	755.7	0.44	6.01	0.43	7.48	4.9	204.3	0.22	28.8	8.86	117.6	7.57	116.7	0.39	1.82	4.39	4.59	0.63	10.32	0.86	44.8
s64	1272.42										1269.49																			
	2.1	27.6	0.41	7.14																										

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Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s67*	1124D_4H+2_137-139 II	1302.78	2.8	24.7	0.80	6.41	5.91	55.2	2.36	25.5	53.1	784.0	0.68	6.12	1.89	8.38	81.5	185.3	4.94	29.8	15.67	71.9	11.78	114.8	0.97	1.13	0.39	3.01	1.54	11.84	5.39	43.2
	1124C_5H+7_60-62	1347.34	2.6	21.6	0.70	5.83	7.01	51.9	3.45	25.3	113.0	829.8	0.96	7.18	0.93	6.42	10.5	80.7	3.03	25.2	7.67	52.5	19.38	128.0	0.17	0.42	0.27	2.01	0.90	7.15	7.75	50.3
	U1526B_3H-5_8-10	1305.00																														
	U1371D_3H-6_63-65	1350.00	0.3	23.3	0.10	5.95	0.79	53.5	0.61	25.5	21.8	844.4	0.28	7.41	0.17	6.57	2.7	83.9	0.60	25.3	2.90	57.3	7.14	137.3	0.04	0.28	0.36	2.48	0.34	8.10	7.30	52.7
s68	1123C_6H-5_110-112	1337.82	0.8	26.6	0.22	6.91	2.37	60.2	0.79	28.1	19.6	769.8	0.43	6.70	0.33	10.47	3.2	256.3	0.80	32.6	5.69	92.6	5.80	126.4	0.10	0.67	0.29	3.00	0.21	12.04	2.87	40.6
	1123A_6H-5_18-20	1339.75	2.3	27.4	0.35	6.99	4.84	57.9	2.27	27.0	61.3	734.4	0.41	5.44	0.80	9.83	23.3	254.6	2.87	33.3	7.38	82.5	7.03	185.1	0.25	0.57	15.60	15.55	1.02	12.99	3.43	38.0
	1124C_5H+CC_10-12	1397.28																														
	1123C_6H-5_123-125	1342.00																														
s69	1124C_6H-1_26-28	1395.33	2.6	15.1	0.86	4.32	7.30	42.2	4.32	21.9	138.4	673.8	1.24	9.33	0.66	4.88	9.2	58.6	1.84	17.2	19.52	51.8	17.59	151.0	0.43	0.71	0.73	2.44	0.43	5.21	16.52	56.0
	1124D_4H+3_70-72	1343.42																														
	U1526B_3H-5_51-53	1340.00																														
	1123B_7H-1_129-131	1387.65	3.1	28.5	1.34	7.25	11.19	63.4	3.86	27.7	30.3	788.0	0.44	6.51	0.97	9.29	16.2	155.9	4.23	32.3	11.20	68.2	24.66	131.4	0.24	0.74	0.83	3.15	0.75	8.90	7.69	46.7
s70	1123C_6H-6_118-120	1388.62	0.9	26.3	0.16	6.83	3.92	63.5	0.54	28.3	20.2	808.5	0.22	6.42	0.36	9.14	17.2	155.2	1.33	31.9	6.32	70.6	10.12	130.5	0.28	0.81	1.28	3.10	0.59	12.15	2.94	44.3
	U1518E_24F-3_71-73	1392.00	3.4	20.1	0.77	5.27	6.18	48.2	2.87	24.1	109.9	791.5	0.73	6.73	1.08	7.03	37.8	107.2	4.29	22.5	20.21	70.0	15.19	129.4	0.34	0.92	0.35	2.58	2.63	6.33	5.85	42.6
	1124C_6H-1_37-39 I	1400.71																														
	U1518E-25F-2_30-32a I		2.7	26.3	0.57	6.65	3.09	58.9	1.76	27.9	35.1	779.3	0.63	6.67	0.75	10.27	42.2	214.4	1.86	31.8	13.29	61.6	8.67	123.8	0.13	0.46	0.54	2.66	1.00	11.08	3.80	42.1
s71*	594_13H+CC_0-2 II		8.2	25.0	1.82	6.27	11.12	52.6	4.23	24.6	76.7	679.0	1.97	5.74	3.02	8.37	131.5	217.4	15.33	34.2	22.32	69.0	27.37	118.5	0.76	0.92	1.08	2.80	2.22	8.26	11.02	11.8
	594A_8H-3_49-51 I		5.4	24.3	1.45	6.32	12.57	57.6	5.77	26.4	152.8	788.3	2.09	7.60	2.71	10.35	72.9	147.1	8.23	27.5	18.45	56.7	33.28	133.6	0.08	0.29	0.48	2.13	2.55	9.09	6.73	42.9
	1124C_6H-1_37-39 II																															
	U1518E-25F-2_30-32 II		2.7	26.3	0.57	6.65	3.09	58.9	1.76	27.9	35.1	779.3	0.63	6.67	0.75	10.27	42.2	214.4	1.86	31.8	13.29	61.6	8.67	123.8	0.13	0.46	0.54	2.66	1.00	11.08	3.80	42.1
s72*	594_13H+CC_0-2 I		8.2	25.0	1.82	6.27	11.12	52.6	4.23	24.6	76.7	679.0	1.97	5.74	3.02	8.37	131.5	217.4	15.33	34.2	22.32	69.0	27.37	118.5	0.76	0.92	1.08	2.80	2.22	8.26	11.02	11.8
	594A_8H-3_49-51 II		5.4	24.3	1.45	6.32	12.57	57.6	5.77	26.4	152.8	788.3	2.09	7.60	2.71	10.35	72.9	147.1	8.23	27.5	18.45	56.7	33.28	133.6	0.08	0.29	0.48	2.13	2.55	9.09	6.73	42.9
	1123A_6H-6_64-66	1402.76																														
	1123B_4H-4_74-76	1404.56																														
s73*	1123C_6H+7_14-16 I	1403.41																														
	1123B_7H-2_38-40 II	1405.01	1.6	22.6	0.32	6.03	2.11	55.3	1.28	24.7	41.0	789.6	0.33	6.49	0.37	8.00	14.0	213.1	1.50	27.2	17.72	103.8	10.14	126.3	0.35	1.73	0.33	2.72	0.62	9.83	1.95	49.3
	1123C_6H-7_14-16 II																															
	1123B_7H-2_38-40 II	1406.62																														
s75	1124D_4H-4_100-102	1408.06	1.2	16.1	0.33	4.79	1.48	45.3	0.96	22.7	33.2	903.1	0.37	6.85	0.34	5.54	2.1	87.4	1.21	16.4	2.96	78.3	9.92	133.8	0.05	0.71	1.05	2.68	0.36	4.30	6.31	55.5
	1123A_6H-6_125-127	1422.38																														
	1124D_4H+5_12-14	1438.41	1.2	17.0	0.37	5.01	2.42	49.0	1.31	23.8	33.6	760.9	0.73	9.01	0.35	5.07	4.9	63.9	1.38	17.3	15.12	65.5	6.06	158.1	0.14	0.49	0.54	3.61	0.24	4.58	6.65	68.8
	U1520D_49X-1_15-17	1453.80	1.3	25.6	0.54	6.74	4.55	58.1	1.92	26.7	35.2	761.4	0.49	6.36	0.44	8.36	8.3	151.0	2.44	29.7	5.15	68.3	9.77	123.5	0.04	0.62	0.47	2.24	0.88	14.13	4.37	40.4
s76	U1518E_29X-2_66-68	1450.00																														
	1123A_6H+7_15-17	1435.23																														
	1124C_6H-1_118-120	1440.37																														

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Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

[illegible]

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[illegible]

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

[illegible]

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

volcanic event	volcanic event	Sample ID	Age [ka]	Quaternary eruption chronology [ka]	Onshore correlatives
	uncorrelated		indirect / direct	relying on most solid age models or average	references listed below
s1		U1520D-1H-1_119-120	2.03	1.71	Taupo 1718±10a ¹
		U1519D_1H-2_15-17			
		U1519E_1H-2_7-9			
s2		U1520D-1H-3_26-30	5.59	3.38	Waimihia 3382±50a ¹
		U1519D_1H-CC_4-6			
		U1519E_1H-3_95-97			
s3		U1520D-1H-3_67-69	6.27	5.54	Whakatuane 5542±48a ¹
		U1526B_1H-1_93-95			
s4		U1520D-1H-4_35-37	8.30	8.30	Eg-6-8, 5.2 - 5.9ka ⁹
s5		U1520D-1H-4_87-90	9.13	9.47	Rotoma 9472±40a ¹
		U1526B_1H-1_122-124			
s6		U1520D-2H-1_15-19	10.40	10.00	Opepe 10004±122a ¹
s7		U1520D-2H-3_77-79	15.25	10.50	Raupehu ⁽⁸⁾
s8		U1520D-4H-4_117-119	19.57	11.51	Okupata Tephra 11.51ka ⁷
s9		1125A_1H-1_71-73	17.47	25.35	Kawakawa/Oruanui 25358±162a ¹
		U1526B_1H-3_36-38			
s10		1123C_1H-1_48-150	33.97	32.50	Onatiroa 32.5ka ⁶
		1123B_1H-2_5-7	35.56		
		1123A_1H-2_6-8	35.78		
		1124B_1H-2_43-45	53.15		
s11		1122A_1H-4_26-28		45.17	Rotoehu 45170±3300a ¹
		1123C_1H-2_69-71	50.05		
u1		1124B_1H-3_15-17	86.74	110.99	
		1124A_1H-1_71-73	83.44		
u2		1125B_1H-2_147-149	110.99	111.20	
u3		U1526B_1H-3_111-113	111.20	111.80	
		U1526B_1H-3_116-118	111.80		

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Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s/2	U1520D_15H-4_71-73	141.00	141.00	0.3	3.0	1.18	14.8	3.90	17.8	0.14	0.63	1.12	3.80	0.12	0.40	0.55	2.58	0.09	0.54	0.03	2.44	0.23	0.76	1.32	3.70	0.20	0.58	1.25	3.55	0.20	0.62	1.24	3.89
	U1526B_2H-1_94-96		141.00	0.3	3.0	1.06	13.0	2.06	15.5	0.07	0.60	0.24	2.92	0.04	0.36	0.21	2.40	0.08	0.29	0.33	1.95	0.13	0.70	0.46	2.78	0.04	0.46	0.45	2.79	0.05	0.41	0.49	3.22
u/4	U1520D_16H-2_65-67	145.90	145.90	0.1	2.4	0.12	16.3	0.26	12.2	0.07	0.47	0.19	3.41	0.06	0.28	0.21	1.55	0.04	0.17	0.08	1.27	0.07	0.43	0.18	2.00	0.03	0.28	0.13	1.70	0.05	0.37	0.17	1.82
u/5	1124A_1H-3_35-37	156.13	156.13	0.2	2.6	0.68	11.2	1.36	17.9	0.09	0.62	0.41	6.48	0.04	0.54	0.31	3.69	0.04	0.51	0.32	3.48	0.13	1.21	0.33	5.64	0.08	0.91	0.22	4.87	0.09	1.09	0.17	6.09
u/6	U1520D_18H-2_108-110	177.40	177.40		2.2		7.3		17.7		0.36		4.90		0.26		1.38		0.19		1.51		0.43		1.88		0.38		1.31		0.81		2.31
u/7	U1520D_18H-5_123-125	185.70	185.70	0.6	2.0	0.37	5.5	5.68	15.8	0.02	0.35	0.37	3.80	0.05	0.34	0.27	2.30	0.06	0.32	0.29	1.97	0.12	0.68	0.37	3.21	0.07	0.53	0.27	3.32	0.02	0.76	0.41	3.22
u/8	U1520D_18H-6_107-109	188.20	188.20	0.4	2.8	1.56	11.0	2.93	19.6	0.08	0.50	0.78	4.90	0.07	0.47	0.42	3.40	0.07	0.47	0.44	3.37	0.14	1.11	0.81	5.36	0.11	0.82	0.65	4.85	0.11	0.75	0.57	5.17
u/9	U1520D_20F-1_125-127	200.50	200.50		0.9		2.8		8.8		0.23		2.80		0.39		2.88		0.35		2.65		0.93		3.96		0.60		3.38		1.05		3.40
u/10	U1520D_21F-4_6-8	210.30	210.30																														
u/11	U1520D_21F-4_48-50	210.80	210.80	0.0	3.1	0.62	12.7	2.60	18.5	0.06	0.68	0.80	3.83	0.11	0.40	0.56	2.64	0.12	0.38	0.09	2.61	0.24	0.94	1.10	4.20	0.18	0.62	0.31	3.81	0.17	0.62	0.84	4.06
u/12	U1520D_22F-2_60-62	213.10	213.10	0.2	2.9	0.67	11.5	1.34	18.6	0.05	0.73	0.30	4.36	0.07	0.56	0.33	3.79	0.06	0.51	0.31	3.82	0.09	1.21	0.41	5.80	0.10	0.88	0.38	5.18	0.09	0.69	0.30	6.01
u/13	U1520D_22F-2_80-82	213.30	213.30	0.1	2.5	0.29	11.0	0.77	18.2	0.06	0.55	0.29	6.06	0.03	0.57	0.29	3.84	0.03	0.54	0.03	3.72	0.08	1.17	0.33	5.66	0.03	0.85	0.25	5.44	0.07	0.92	0.17	5.29
s/3	U1520D_23F-3_6-8	223.10	235.00	Auraria Gully (Mamaku?) 0.2355Ma ⁻¹	0.3	2.2	1.24	9.3	13.1	0.07	0.51	0.63	2.80	0.10	0.41	0.83	2.67	0.10	0.36	0.46	2.42	0.20	0.79	0.79	3.94	0.14	0.56	0.91	3.53	0.10	0.47	0.93	3.68
s/4	1124C_1X-1_80-82	242.30		0.2	2.9	0.81	12.4	3.32	20.5	0.11	0.77	0.44	4.59	0.05	0.65	0.48	4.37	0.08	0.59	0.73	4.01	0.18	1.28	0.80	6.22	0.09	0.93	0.61	5.79	0.13	0.73	0.58	5.93
	1123A_2H-5_66-68	248.62																															
	1123B_2H-6_91-93	251.15	249.55																														
	1123C_2H-2_104-109	256.13		0.2	3.0	0.75	12.7	1.16	22.3	0.07	0.74	0.45	4.96	0.05	0.54	0.31	3.51	0.06	0.51	0.23	3.39	0.15	1.16	0.53	5.52	0.12	0.89	0.41	5.13	0.07	0.83	0.35	5.52
u/14	1125A_2H-4_17-19	259.39	259.39																														
s/5	1123A_2H-6_18-20	271.76																															
	1123C_2H-3_69-71	281.50	276.63	0.2	2.9	0.54	11.1	2.29	19.8	0.06	0.65	0.33	4.13	0.05	0.39	0.23	2.73	0.05	0.39	0.16	2.54	0.09	0.86	0.33	4.14	0.04	0.63	0.19	3.86	0.07	0.71	0.56	4.42
s/6	1123A_2H-6_70-72	283.54																															
	1123C_2H-3_132-134	295.77	289.65																														
s/7	U1520D_25F-2_10-14	301 / 363±33		0.3	3.1	0.87	12.0	2.27	21.4	0.03	0.70	0.86	4.48	0.04	0.45	0.23	3.22	0.03	0.45	0.09	2.99	0.07	0.97	0.46	4.79	0.03	0.75	0.22	4.71	0.11	0.75	0.11	4.94
	U1526B_2H-2_92-93		310.00	Fordell 0.31Ma ⁻¹	0.2	3.0	0.80	12.4	0.98	19.0	0.09	0.78	0.42	4.40	0.05	0.57	0.20	3.87	0.04	0.50	0.48	3.74	0.18	1.32	0.49	5.30	0.14	0.86	0.36	5.06	0.13	0.61	0.62
u/15	1124A_1H-7_25-27	310.10	310.10																														
u/16	U1520D_26F-1_103-105	310.6 / 330±37	310.60	0.2	2.7	0.98	11.1	2.16	18.2	0.05	0.68	0.15	4.30	0.03	0.47	0.15	3.04	0.01	0.42	0.10	2.79	0.02	0.97	0.39	4.59	0.04	0.71	0.14	4.55	0.09	0.74	0.21	4.74
u/17	U1520D_26F-2_23-27	312.2 / 346±33	312.20	0.1	2.9	0.53	11.6	1.59	21.0	0.04	0.71	0.23	4.40	0.03	0.44	0.17	2.83	0.03	0.41	0.25	2.75	0.08	0.94	0.42	4.38	0.04	0.71	0.37	4.46	0.06	0.69	0.40	4.66
u/18	U1520D_26F-3_29-31	314.55	314.55	0.3	3.1	1.04	12.4	2.24	20.7	0.06	0.66	0.37	4.15	0.04	0.42	0.48	2.86	0.04	0.39	0.34	2.77	0.09	0.90	0.44	4.33	0.09	0.69	0.23	4.29	0.07	0.72	0.23	4.71
u/19	U1520D_26F-4_51-55	316.27 / 336±38	316.27	0.3	3.3	1.11	12.0	2.33	20.4	0.03	0.66	0.76	3.58	0.03	0.38	0.23	2.61	0.08	0.40	0.26	2.41	0.07	0.79	0.39	3.83	0.10	0.62	0.36	3.70	0.09	0.62	0.47	3.96
s/8	U1520D_27F-1_44-46	317.18		0.4	2.7	1.83	11.1	2.58	15.7	0.10	0.60	0.65	3.78	0.05	0.37	0.35	2.30	0.07	0.34	0.41	2.12	0.09	0.72	0.39	3.31	0.08	0.53	0.48	3.04	0.10	0.66	0.53	3.60
	U1518F-13R-1_113-115	310.00	317.18	0.2	2.8	0.48	11.7	1.10	16.7	0.06	0.61	0.45	4.29	0.04	0.41	0.28	2.75	0.02	0.35	0.27	2.43	0.12	0.90	0.27	3.89	0.07	0.62	0.51	3.70	0.05	0.68	0.48	4.28
n/20	U1520D_27F-1_96-98	317.89 / 235-300	317.89	0.2	2.6	0.52	10.9	0.73	14.5	0.05	0.52	0.13	3.40	0.04	0.29	0.19	1.94	0.03	0.28	0.09	1.78	0.08	0.59	0.16	2.75	0.03	0.65	0.45	2.71	0.03	0.50	0.33	3.00
n/21	U1520D_27F-2_78-80	319.26 / 347±22	319.26																														

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s19	319.33	Lower Griffin Road 0.3-0.4Ma ¹	U1520D_27E-2_92-96	319.33 / 347±22	0.2	2.6	0.49	18.9	0.90	15.0	0.04	0.53	0.17	4.00	0.02	0.43	0.30	2.46	0.06	0.34	0.09	2.29	0.04	0.72	0.20	3.63	0.03	0.55	0.20	3.19	0.06	0.70	0.13	3.52
			U1520D_27E-3_74-78	319.75	0.2	2.7	0.66	18.6	0.45	16.4	0.12	0.64	0.41	3.83	0.08	0.41	0.38	2.29	0.10	0.41	0.25	2.17	0.24	0.82	0.70	3.62	0.07	0.51	0.72	3.64	0.08	0.70	1.07	2.80
			1125B_2H-3_143-145	388.34																														
			1125A_3H-2_67-69	390.31	0.2	2.8	1.13	11.8	2.31	15.7	0.06	0.53	0.26	3.28	0.04	0.37	0.13	2.24	0.06	0.28	0.09	1.78	0.03	0.53	0.21	2.59	0.05	0.37	0.32	2.39	0.01	0.40	0.29	2.77
s270	321.04	Ranglawa 350±50ka ⁵	U1520D_28F-1_93-95	321.04	0.5	3.2	2.03	12.9	2.70	16.7	0.10	0.61	0.39	3.00	0.03	0.34	0.29	2.18	0.06	0.32	0.32	2.11	0.08	0.67	0.45	3.07	0.08	0.45	0.23	2.93	0.07	0.46	0.35	3.28
			U1518E-1H-4_16-18	320.00	0.5	2.8	1.87	11.6	5.95	17.7	0.10	0.54	0.39	2.21	0.04	0.24	0.23	1.63	0.06	0.21	0.24	1.36	0.08	0.48	0.35	1.96	0.05	0.22	0.37	2.02	0.06	0.35	0.32	2.27
s271*	334.11	U1520D_33X-3_60-62a I	334.16																															
			U1520D_33X-3_60-62 II		0.5	3.1	2.11	11.8	2.14	17.9	0.04	0.64	1.02	3.90	0.12	0.41	0.38	2.69	0.06	0.35	0.62	2.29	0.20	0.76	0.99	3.52	0.18	0.56	0.95	3.33	0.17	0.57	0.85	3.72
			U1526B_2H-3_83-85		0.2	3.0	0.38	11.8	0.56	20.5	0.03	0.65	0.12	3.52	0.02	0.44	0.12	2.95	0.02	0.40	0.10	2.82	0.04	0.94	0.18	4.13	0.05	0.68	0.46	4.13	0.02	0.63	0.13	4.78
			U1517C_35F-3_12-14	334.00	0.1	2.9	0.31	11.7	0.92	20.4	0.03	0.67	0.40	3.86	0.03	0.47	0.15	3.13	0.03	0.40	0.28	2.91	0.04	0.95	0.23	4.41	0.04	0.72	0.31	4.24	0.03	0.74	0.28	5.13
s22	463.20	U1517C_35F-4_125-127	463.00																															
			1125A_3H-4_64-66																															
s23*	504.00	Onephi 0.57Ma ¹	504.00																															
			U1518E-1H-4_118-120	500.00																														
			U1518E-3H-5_124-126	515.08																														
			U1520D_35X-7_72-74	496.78	0.3	3.2	0.95	12.9	2.97	21.4	0.10	0.76	0.53	5.21	0.04	0.39	0.37	2.38	0.06	0.46	0.41	3.26	0.09	1.15	0.49	5.45	0.09	0.85	0.78	5.27	0.19	0.66	0.49	5.30
s24*	535.00	U1526B_2H-3_101-103 I	535.51	0.2	2.																													

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s28	U1520D_35X-CC_2-4	631.78	631.78	0.2	3.0	0.34	11.6	0.88	16.5	0.01	0.56	0.18	2.74	0.02	0.29	0.08	1.90	0.03	0.26	0.11	1.58	0.04	0.54	0.12	2.46	0.01	0.38	0.05	2.38	0.05	0.39	0.13	2.65
	U1520B_2H-6_78-80		631.78	0.3	3.5	0.78	14.3	1.30	17.9	0.04	0.66	0.21	3.24	0.02	0.36	0.12	2.21	0.02	0.29	0.19	1.74	0.01	0.62	0.23	2.88	0.02	0.41	0.13	2.68	0.02	0.41	0.44	3.33
s29	1124D_1H-3_50-52	661.07	661.07	0.2	2.8	0.70	12.3	1.21	15.8	0.06	0.58	0.21	2.83	0.03	0.22	0.19	1.64	0.06	0.25	0.10	1.39	0.04	0.48	0.23	1.97	0.02	0.30	0.30	2.02	0.04	0.41	0.39	2.10
	1124C-2X-6_53-55	662.80	662.80	0.4	3.1	1.88	12.4	1.13	19.1	0.06	0.66	0.71	3.55	0.04	0.38	0.27	2.34	0.03	0.33	0.27	2.19	0.06	0.72	0.40	3.18	0.07	0.50	0.36	3.11	0.11	0.57	0.32	3.51
n28	1123A_4H-5_71-73	665.59	665.59	0.8	1.8	3.21	7.2	4.60	10.3	0.15	0.36	1.10	2.46	0.11	0.21	0.37	1.27	0.08	0.18	0.40	1.07	0.16	0.35	0.66	1.67	0.09	0.25	0.56	1.53	0.14	0.28	0.86	1.84
	1124D-1H-4_86-88	665.00	665.00																														
s30	U1518E-3H-3_36-40	585±39	585±39	0.2	3.2	0.57	11.4	1.47	15.6	0.06	0.60	0.08	2.52	0.03	0.26	0.27	1.65	0.02	0.22	0.16	1.38	0.03	0.46	0.14	1.50	0.03	0.32	0.13	2.09	0.06	0.33	0.33	2.27
	U1517C_36F-2_100-101																																
s31	1124C_3H-1_85-87	691.98	691.98	0.3	2.8	0.68	12.2	0.73	15.8	0.05	0.54	0.27	3.40	0.03	0.21	0.28	1.91	0.03	0.27	0.11	1.74	0.05	0.56	0.15	2.52	0.05	0.40	0.38	2.58	0.07	0.36	0.47	3.01
	1124D_1H-5_79-81	694.13	694.13	0.3	2.7	1.75	11.8	2.31	15.6	0.13	0.55	0.62	2.94	0.03	0.22	0.16	2.00	0.03	0.28	0.03	1.73	0.06	0.55	0.32	2.60	0.06	0.45	0.55	2.62	0.03	0.38	0.36	3.09
s32	1125A_4H-2_52-54	699.16	699.16																														
	1125B_3H-5_86-88	707.53	707.53																														
	U1520D_38X-CC_37-39	711.64	711.64	0.2	2.5	0.86	10.3	1.93	16.4	0.04	0.62	1.22	4.10	0.06	0.53	0.54	3.10	0.09	0.49	0.54	3.06	0.13	0.98	0.99	5.14	0.21	0.78	0.75	4.85	0.12	1.05	0.83	4.64
s33	1123A_4H-6_125-127	711.79	711.79																														
	U1518E-3H-6_16-18	710.00	710.00	0.1	1.9	0.19	8.2	3.27	13.9	0.13	0.52	0.10	4.58	0.11	0.40	0.17	2.47	0.02	0.29	0.08	1.95	0.02	0.70	0.10	3.04	0.03	0.50	0.19	2.96	0.08	0.76	0.36	3.41
s34	U1520D_39X-3_20-22	725.69	725.69	0.1	3.0	0.62	11.9	0.61	18.2	0.06	0.66	0.44	4.55	0.06	0.46	0.14	3.18	0.03	0.46	0.14	3.03	0.07	1.03	0.18	4.71	0.06	0.71	0.23	4.14	0.10	0.70	0.22	4.72
n29*	1125B_3H-6_43-45 I	733.86	733.86																														
	1125B_3H-6_43-45 II																																
	1124D_1H-7_24-26 I	737.89	737.89																														
s35*	1124D_1H-7_24-26 II	739.72	739.72	0.4	2.8	1.67	11.4	2.70	17.5	0.10	0.63	1.30	5.55	0.11	0.52	0.28	3.35	0.03	0.47	0.68	4.01	0.19	1.16	1.44	5.79	0.09	0.87	0.57	5.02	0.37	1.04	0.74	5.44
	1124C_3H-3_54-56	740.03	740.03	0.1	2.7	0.38	10.6	1.19	18.4	0.08	0.63	0.82	4.68	0.09	0.56	0.17	3.76	0.06	0.53	0.23	3.40	0.05	1.10	0.21	5.31	0.03	0.86	0.52	5.05	0.08	0.98	0.17	5.69
	1125A_4H-3_73-75	741.25	741.25																														
n30	1124C_3H-4_50-52	766.11	766.11	0.2	2.7	0.81	11.6	0.94	17.5	0.06	0.62	0.46	4.40	0.04	0.50	0.20	3.13	0.06	0.47	0.22	3.00	0.04	1.01	0.39	4.58	0.12	0.71	0.56	4.65	0.09	0.79	0.43	4.88
	U1520D_39X-5_64-66	763.85	763.85																														
s36	1124C_3H-4_107-109	776.29	776.29																														
	1124D_2H-1_42-44	778.25	778.25																														
	U1518E-5H-2_66-70			0.3	2.5	0.84	10.8	1.71	14.5	0.05	0.52	0.29	2.65	0.04	0.32	0.14	1.73	0.02	0.24	0.17	1.66	0.04	0.50	0.23	2.43	0.02	0.35	0.41	2.46	0.07	0.48	0.22	2.79
s37	1125B_4H-1_27-29	791.2	791.2	0.4	4.1	1.06	17.0	1.01	20.6	0.16	0.74	0.25	2.37	0.06	0.39	0.23	2.42	0.03	0.36	0.30	2.12	0.12	0.68	0.18	3.17	0.05	0.53	0.16	2.77	0.05	0.24	0.51	3.03
	U1518E-9H-2_0-1	792.0	791.37	0.2	2.8	0.71	12.5	1.65	18.5	0.03	0.67	1.24	4.16	0.08	0.45	1.00	3.14	0.17	0.44	1.04	2.89	0.31	0.98	1.61	4.54	0.19	0.68	0.98	3.96	0.28	0.65	1.25	4.84
	594_5H-2_36-38	791.5	791.5	0.1	3.4	0.47	14.1	0.71	16.5	0.02	0.67	0.33	3.25	0.02	0.31	0.10	2.10	0.01	0.29	0.09	1.85	0.04	0.62	0.15	3.00	0.03	0.44	0.12	2.84	0.06	0.39	0.18	3.06
	1124D_2H-1_128-130	793.61	793.61																														
s38	1124C_3H-5_56-58	793.97	793.97	0.3	2.7	0.84	11.8	0.58	15.3	0.11	0.66	0.34	4.14	0.08	0.35	0.45	2.36	0.07	0.32	0.30	2.06	0.11	0.70	0.64	3.43	0.16	0.53	0.40	3.13	0.11	0.61	0.68	3.51
	U1371D_1H-CC_2-4																																
n31	1124C_3H-5_90-92	800.04	800.04																														

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s39	U1520D_40X-1_60-62	782.69	0.3	2.6	0.82	9.8	1.54	16.4	0.06	0.58	0.07	5.48	0.04	0.43	0.13	2.69	0.05	0.41	0.29	2.61	0.06	0.88	0.30	4.48	0.02	0.68	0.35	4.17	0.09	0.85	0.29	4.55
	1124D_2H-2_53-55	807.01	0.2	2.3	0.54	18.0	0.16	14.6	0.06	0.60	0.13	6.22	0.02	0.52	0.23	3.42	0.03	0.47	0.17	3.20	0.08	1.05	0.52	5.28	0.06	0.80	0.36	4.99	0.04	1.01	0.16	5.06
	1124C_3H-5_141-143	809.15																														
	1123C_4H-6_68-70	836.12	0.4	2.8	0.74	18.7	2.22	17.2	0.11	0.72	0.85	6.28	0.02	0.50	0.36	3.27	0.05	0.48	0.29	3.22	0.12	1.08	0.39	4.95	0.08	0.78	0.62	4.76	0.09	0.98	0.23	4.79
s40	U1520D_40X-1_77-79	782.84	0.4	3.0	1.31	13.1	2.37	19.1	0.08	0.72	0.69	4.35	0.04	0.53	0.38	3.59	0.06	0.50	0.46	3.28	0.10	1.07	0.21	4.97	0.07	0.80	0.57	4.81	0.14	0.89	0.36	5.22
	1124D_2H-2_121-123	819.15																														
	1124C_3H-6_61-63	821.65																														
s41	U1520D_40X-CC_38-40	783.35	0.2	2.5	0.83	18.4	1.32	16.6	0.05	0.59	1.16	5.99	0.03	0.49	0.31	3.39	0.04	0.47	0.23	3.16	0.17	1.04	0.52	4.87	0.04	0.76	0.42	4.66	0.19	0.81	0.41	5.02
	1122C_37X-1_37-38	800.00	0.2	2.6	0.35	11.0	4.86	24.3	0.04	0.66	0.27	4.81	0.06	0.50	0.09	3.38	0.03	0.46	0.13	3.21	0.05	1.10	0.16	5.18	0.01	0.85	0.22	5.21	0.03	0.98	0.15	5.72
	1125A_4H-4_115-117 I	808.00																														
	1125A_4H-4_115-117 II																															
s42*	1125A_4H-4_115-117 III		0.2	3.2	1.10	13.5	0.73	21.0	0.10	0.77	1.09	6.08	0.02	0.54	0.32	3.66	0.05	0.56	0.28	3.41	0.08	1.20	0.28	5.45	0.07	0.85	0.33	5.27	0.17	0.93	0.69	5.93
	1125B_4H-1_59-61 I	799.08																														
	1125B_4H-1_59-61 II																															
	1125B_4H-2_11-13	824.18																														
s43	U1519C_14R-2_48-50	800.50	0.2	2.7	0.90	11.6	1.54	19.6	0.07	0.75	0.52	6.18	0.03	0.41	0.35	4.28	0.07	0.62	0.63	4.04	0.10	1.37	0.48	6.37	0.07	0.98	0.70	6.38	0.08	1.00	0.35	6.61
	U1520D_42X-1_97-99 I	815.50																														
	U1520D_42X-1_97-99 II																															
	1125A_4H-5_120-122	826.64																														
s44	U1520D_42X-1_97-99 I	815.50																														
	U1520D_42X-1_97-99 II																															
	1125A_4H-5_120-122	826.64																														
	1124D_2H-3_128-130	847.19																														
s45	U1520D_42X-1_97-99 I	815.50	0.2	2.9	0.64	11.8	1.23	17.3	0.08	0.66	1.19	6.80	0.07	0.52	0.21	3.63	0.04	0.41	0.29	3.01	0.06	1.07	0.51	4.58	0.12	0.78	0.60	4.40	0.06	0.84	0.55	4.71
	1123C_5H-1_90-92	850.61	0.3	2.4	1.61	9.8	2.43	16.6	0.06	0.55	0.77	5.36	0.08	0.44	0.63	2.72	0.08	0.40	0.37	2.54	0.10	0.86	0.78	4.22	0.13	0.66	0.81	4.40	0.19	0.89	0.71	4.54
	1123B_5H-3_3-5	857.18																														
	1123A_5H-2_98-100	863.75	0.3	2.8	0.97	11.1	0.93	16.3	0.08	0.66	1.23	5.09	0.04	0.47	0.18	2.84	0.10	0.45	0.10	2.71	0.07	0.93	0.33	4.41	0.08	0.71	0.61	4.23	0.11	0.77	0.76	4.80
s46	U1519C_15R-1_71-73																															
	1124D_2H-4_88-90	866.8																														
	U1520D_44X-1_5-7_2	906.60	0.6	2.9	2.23	11.8	3.16	18.0	0.10	0.75	1.20	6.08	0.07	0.57	0.50	3.94	0.07	0.56	0.42	3.83	0.18	1.28	0.53	5.95	0.14	0.85	0.66	5.73	0.18	1.03	0.90	6.19
	U1519C_15R-5_20-22	900.60																														
s47	U1526B_3H-2_48-50	904.00																														
	1124C_4H-1_26-28	851.12	0.1	2.8	0.39	12.0	0.70	17.4	0.05	0.71	0.22	4.68	0.02	0.50	0.10	3.28	0.03	0.45	0.07	3.02	0.07	1.03	0.29	4.49	0.05	0.69	0.21	4.07	0.05	0.57	0.12	4.57
	1124D_2H-4_128-130	873.98																														
	1124D_2H-5_87-89	893.45	0.2	2.3	0.58	10.3	1.32	14.9	0.09	0.65	0.26	6.59	0.04	0.49	0.30	2.92	0.06	0.42	0.17	2.70	0.07	0.95	0.28	4.46	0.03	0.71	0.47	4.16	0.10	0.91	0.11	4.16
s48	U1520D_44X-1_43-45	909.13																														
	U1519C_16R-1_146-148	900.00	0.3	2.4	1.15	9.6	1.82	16.4	0.05	0.57	0.79	6.11	0.06	0.49	0.48	3.27	0.10	0.41	0.51	3.06	0.13	0.97	0.78	4.86	0.10	0.75	0.58	4.71	0.14	1.05	0.82	5.11
	U1526B_3H-2_64-66	905.00																														

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

<i>u35</i>	U1519C_16R-5_111-114	909.20	909.20	0.4	2.3	1.90	16.5	6.59	21.0	0.11	0.66	0.66	5.40	0.13	0.50	0.61	3.50	0.10	0.45	0.58	3.15	0.19	1.11	0.76	5.19	0.18	0.78	0.61	5.39	0.09	1.02	0.62	5.25
<i>u36</i>	U1519C_17R-1_9-11	909.25	909.25	0.1	2.4	0.53	16.0	1.09	16.7	0.10	0.64	0.34	6.41	0.06	0.55	0.28	3.79	0.09	0.52	0.25	3.55	0.10	1.15	0.37	5.41	0.08	0.84	0.57	5.66	0.06	1.25	0.62	5.71
<i>s47</i>	U1519C_19R-3_33-35	909.30	909.30	0.3	2.3	1.42	16.0	1.91	14.4	0.03	0.60	0.63	6.40	0.04	0.50	0.51	3.07	0.10	0.48	0.37	3.23	0.09	1.06	0.68	4.88	0.03	0.81	0.58	5.00	0.22	1.09	0.48	5.64
	U1526B_3H-2_85-87	909.30																															
<i>s48</i>	1124C_4H-2_17-19	892.74			0.1	2.7	16.7	3.61	16.7	0.04	0.71	0.43	6.83	0.03	0.57	0.42	3.88	0.02	0.54	0.11	3.63	0.07	1.22	0.22	5.67	0.03	0.87	0.42	5.46	0.05	1.16	0.44	5.91
	U1520D_44X-1_47-49	909.39	909.39	0.6	2.5	2.33	16.4	3.61	17.5	0.17	0.64	1.24	4.54	0.13	0.45	0.80	3.27	0.09	0.47	0.65	3.09	0.27	0.99	1.13	4.84	0.18	0.75	1.34	4.56	0.17	0.82	1.28	5.12
	U1371D_2H-2_137-139	800.00																															
<i>s49</i>	1124D_2H-5_146-148	904.0																															
	1124C_4H-2_81-83	904.17		0.2	2.4	0.65	11.4	0.94	17.5	0.09	0.61	0.52	4.78	0.03	0.43	0.76	3.22	0.11	0.45	0.35	3.22	0.05	1.11	0.26	4.87	0.09	0.79	0.68	5.14	0.04	0.99	0.64	5.65
<i>s50*</i>	1124D_2H-CC_10-12 I	907.74		0.1	2.7	0.74	11.9	1.17	19.6	0.04	0.71	0.51	5.05	0.03	0.53	0.20	3.53	0.02	0.49	0.14	3.18	0.06	1.13	0.29	5.25	0.08	0.81	0.37	5.25	0.12	0.85	0.42	5.46
	1124C_4H-2_118-120	910.78		0.3	2.9	0.38	11.6	1.31	19.8	0.12	0.73	0.38	5.78	0.04	0.51	0.35	3.53	0.02	0.48	0.24	3.57	0.08	1.19	0.47	5.60	0.07	0.86	0.55	5.52	0.15	0.93	0.22	5.92
	U1519C_19R-3_122-125	908.00																															
	1124D_2H-CC_10-12 II			0.1	2.7	0.74	11.9	1.17	19.6	0.04	0.71	0.51	5.05	0.03	0.53	0.20	3.53	0.02	0.49	0.14	3.18	0.06	1.13	0.29	5.25	0.08	0.81	0.37	5.25	0.12	0.85	0.42	5.46
	U1519C_19R-4_35-36	910.00	911.00																														
<i>s51</i>	U1520D_44X-1_96-98	912.65																															
	1123A_5H-3_66-68	890.47		0.1	2.9	0.82	11.8	1.14	17.4	0.12	0.61	0.33	2.99	0.06	0.40	0.42	2.47	0.09	0.30	0.30	2.30	0.07	0.72	0.20	3.43	0.03	0.67	0.43	3.60	0.01	0.49	0.14	3.72
	1124C_4H-3_48-50	925.07																															
	U1518E-9H-CC_14-16	910.00																															
	1124C_4H-3_121-123	938.10	938.10																														
<i>u39</i>	1124C_4H-3_142-144	941.85	941.85	0.1	3.0	0.37	12.0	0.59	18.0	0.07	0.68	0.40	4.88	0.03	0.45	0.20	3.09	0.06	0.42	0.27	2.79	0.08	0.94	0.23	4.56	0.02	0.69	0.33	4.54	0.07	0.71	0.26	4.81
<i>s52</i>	1124C_4H-4_81-83	957.75																															
	1124D_3H-1_3-5	963.47	960.00	0.2	2.8	0.58	11.8	0.97	17.1	0.08	0.64	0.31	3.47	0.03	0.37	0.54	2.48	0.03	0.32	0.21	2.11	0.09	0.74	0.12	3.40	0.06	0.58	0.35	3.31	0.04	0.52	0.30	3.75
<i>s53</i>	1124C_4H-4_111-113	963.11																															
	1124D_3H-1_27-29	967.75																															
<i>s54</i>	1123C_5H-5_121-123	1012.80	1011.50	0.3	3.1	0.31	11.7	1.83	19.7	0.05	0.64	0.53	5.78	0.02	0.44	0.28	3.00	0.09	0.39	0.09	3.08	0.07	1.02	0.29	4.84	0.05	0.70	0.13	4.50	0.03	0.84	0.38	4.66
<i>u40</i>	U1526B_3H-2_105-107	1010.00																															
	U1526B_3H-3_37-39	1020.00	1020.00																														
<i>u41</i>	U1520D_46X-1_11-12	1033.90	1033.90																														
<i>u42</i>	1124D_3H-4_96-98	1060.45	1060.45	0.1	2.62	0.61	11.0	2.56	17.6	0.17	0.66	0.42	5.32	0.04	0.52	0.49	3.18	0.06	0.45	0.32	3.37	0.13	1.14	0.49	5.52	0.03	0.82	0.60	5.09	0.12	0.95	0.33	5.65
<i>s55</i>	1124C_5H-1_91-93	1066.34		0.1	2.65	0.50	11.2	1.38	17.8	0.09	0.66	0.33	6.71	0.06	0.58	0.25	3.81	0.05	0.55	0.34	3.77	0.08	1.21	0.49	6.09	0.07	0.93	0.37	5.99	0.10	1.04	0.33	6.16
	1124D_3H-4_145-147	1069.20		0.2	2.72	0.45	11.1	0.79	16.7	0.08	0.70	0.36	6.86	0.04	0.57	0.34	3.83	0.04	0.54	0.22	3.86	0.05	1.22	0.23	5.85	0.07	0.88	0.36	5.46	0.10	1.09	0.35	6.06
<i>u43</i>	1124C_5H-2_5-7	1077.77	1077.77	0.1	2.61	0.29	10.7	0.97	17.9	0.04	0.66	0.21	5.98	0.02	0.54	0.10	3.79	0.03	0.52	0.17	3.55	0.05	1.19	0.19	5.59	0.02	0.88	0.15	5.60	0.03	1.03	0.32	5.87
<i>s56*</i>	1124C_5H-2_45-47 I	1085.00																															
	1124C_5H-2_45-47 II	1083																															
	1124D_3H-5_60-62	1081.00																															

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s57	1124C_5H-2_65-67 1124D_3H-5_112-114	1088.49 1090.10	Revua A	0.1	0.22	0.35	1.0	0.60	1.6	0.02	0.66	0.22	6.09	0.02	0.05	0.14	0.35	0.02	0.04	0.10	0.32	0.04	0.11	0.22	0.53	0.03	0.08	0.29	0.53	0.04	0.10	0.20	0.52
s58*	1124D_3H-6_5-71 1124D_3H-6_5-71I	1097.78 1097.78	Sub-Rewa ³	0.3	2.82	1.16	2.23	1.83	20.0	0.15	0.79	0.32	5.18	0.03	0.51	0.25	3.57	0.03	0.57	0.28	3.50	0.09	1.25	0.65	5.70	0.09	0.85	0.20	5.96	0.09	1.01	0.20	5.73
n44	U1520D_47X-1_17-19	1098.08		0.3	2.82	1.16	2.23	1.83	20.0	0.15	0.79	0.32	5.18	0.03	0.51	0.25	3.57	0.03	0.57	0.28	3.50	0.09	1.25	0.65	5.70	0.09	0.85	0.20	5.96	0.09	1.01	0.20	5.73
s59	1124D_3H-6_46-48 1124C_5H-3_13-15	1105.10 1105.99		0.2	2.53	0.57	76.6	1.23	16.0	0.04	0.57	0.47	4.05	0.02	0.44	0.19	2.27	0.02	0.63	0.12	2.06	0.03	0.67	0.13	3.06	0.03	0.47	0.27	2.97	0.06	0.58	0.16	3.35
s60	1124C_5H-3_107-109 1124D_3H-6_116-118 U1526B_3H-3_133-135	1122.78 1120.00 1120.00		0.3	2.64	0.88	11.7	2.32	19.9	0.03	0.68	0.60	5.58	0.06	0.51	0.28	3.67	0.03	0.51	0.25	3.54	0.12	1.21	0.30	5.08	0.08	0.93	0.61	5.46	0.18	0.96	0.50	5.94
s61	1124C_5H-4_9-11 U1520D_47X-3_0-2	1132.07 1133.73		0.2	2.73	0.58	11.6	1.20	19.0	0.04	0.63	0.45	6.22	0.02	0.47	0.24	3.20	0.04	0.47	0.31	3.06	0.05	1.05	0.20	5.00	0.07	0.75	0.39	4.06	0.09	0.92	0.16	4.92
s62	1123B_6H-6_50-52 U1526B_3H-4_38-40	1242.66 1136.00		0.0	2.57	0.46	11.5	0.46	17.5	0.05	0.60	0.24	6.31	0.07	0.47	0.35	3.28	0.04	0.42	0.17	2.93	0.10	1.08	0.23	4.94	0.07	0.80	0.39	4.00	0.15	0.89	0.46	4.34
s63	1123C_6H-1_77-79 1123B_6H-6_50-52 U1519C_19R-5_100-102	1134.32 1242.66 1250.00		0.1	2.91	0.73	13.7	1.50	18.4	0.07	0.61	0.27	5.62	0.11	0.56	0.66	3.27	0.07	0.42	0.27	3.09	0.08	1.04	0.65	4.88	0.08	0.69	0.27	4.34	0.08	0.48	0.74	5.21
s64	1124D_4H-2_69-71 1124C_5H-6_57-59 1371D_3H-3_56-58	1269.49 1272.42 1300.00		0.2	3.18	0.73	13.3	0.93	19.5	0.06	0.75	0.33	3.77	0.06	0.53	0.40	3.68	0.06	0.50	0.44	3.50	0.12	1.07	0.71	5.29	0.09	0.84	0.44	4.68	0.08	0.51	0.85	5.30
n46	U1520D_48X-2_47-49	1285.76		0.1	2.70	0.54	11.5	0.99	18.3	0.08	0.72	0.37	7.16	0.04	0.61	0.69	3.87	0.04	0.61	0.16	3.98	0.15	1.34	0.36	6.24	0.05	1.00	0.39	6.32	0.05	1.09	0.45	6.18
n47	U1519C_19R-6_86-88	1287.00		0.9	2.19	3.67	9.4	5.37	14.1	0.27	0.59	1.32	3.00	0.16	0.41	1.09	2.87	0.18	0.41	1.06	2.60	0.37	0.89	1.73	4.25	0.24	0.63	1.56	3.82	0.21	0.49	1.67	4.08
s65	1123C_6H-4_62-64 1124D_4H-2_69-71 1124C_5H-6_57-59	1274.17 1269.49 1272.42		0.6	2.74	2.21	11.3	3.81	18.8	0.13	0.73	1.29	6.96	0.19	0.64	0.68	3.85	0.09	0.54	0.73	3.76	0.24	1.31	1.23	6.17	0.18	0.99	1.19	5.78	0.21	1.14	1.06	6.00
s66*	U1519C_20R-3_29-31 U1526B_3H-5_1-3	1300.00 1285.76		0.3	2.86	0.34	11.8	1.41	18.0	0.07	0.57	0.22	6.30	0.02	0.53	0.37	3.28	0.06	0.52	0.12	3.11	0.04	1.02	0.20	4.80	0.04	0.75	0.24	4.84	0.09	0.90	0.44	5.24
n47	U1519C_19R-6_86-88	1287.00		0.2	2.76	0.72	11.9	1.15	19.0	0.09	0.75	0.45	6.98	0.07	0.62	0.55	4.08	0.02	0.56	0.31	3.88	0.12	1.33	0.32	5.07	0.10	0.94	0.69	5.66	0.02	1.04	0.65	6.45
s66*	1123C_6H-4_93-95 1124D_4H-2_116-118 U1520D_48X-CC_22-24 U1519C_20R-3_29-31 U1526B_3H-5_1-3	1284.14 1292.50 1291.35 1289.33		0.3	2.45	0.42	10.8	1.42	18.1	0.05	0.65	0.31	6.35	0.04	0.58	0.44	3.69	0.06	0.57	0.20	3.60	0.02	1.20	0.40	5.89	0.11	0.91	0.42	5.23	0.12	1.01	0.59	5.60
s66*	1124D_4H-2_137-139 I 1124C_5H-6_131-133 1123A_6H-4_131-131 U1371D_3H-6_2-4	1302.78 1308.66 1309.82 1300.00		0.2	2.89	0.48	12.6	0.63	20.0	0.06	0.75	0.46	5.45	0.04	0.58	0.23	3.84	0.04	0.55	0.15	3.72	0.05	1.27	0.31	6.07	0.03	0.94	0.28	5.64	0.11	0.92	0.56	5.93
s66*	1124D_4H-2_137-139 I 1124C_5H-6_131-133 1123A_6H-4_131-131 U1371D_3H-6_2-4	1302.78 1308.66 1309.82 1300.00		0.2	3.03	0.75	11.5	0.99	18.9	0.04	0.74	0.43	6.90	0.08	0.61	0.31	3.81	0.06	0.51	0.42	3.79	0.08	1.24	0.39	5.96	0.09	0.93	0.39	5.44	0.12	1.13	0.53	6.20
s66*	1124D_4H-2_116-118 U1520D_48X-CC_22-24 U1519C_20R-3_29-31 U1526B_3H-5_1-3	1292.50 1291.35 1289.33		0.1	2.74	0.88	13.8	0.76	20.5	0.03	0.65	0.74	7.27	0.07	0.60	0.72	4.29	0.06	0.61	0.60	4.02	0.09	1.39	0.39	6.66	0.10	1.03	1.02	5.94	0.08	0.86	0.57	6.62
s66*	1124D_4H-2_116-118 U1520D_48X-CC_22-24 U1519C_20R-3_29-31 U1526B_3H-5_1-3	1292.50 1291.35 1289.33		0.1	2.60	0.55	10.4	1.16	17.7	0.06	0.62	0.56	6.48	0.04	0.50	0.28	3.41	0.02	0.50	0.27	3.28	0.08	1.12	0.62	5.31	0.08	0.82	0.27	4.90	0.07	1.09	0.25	5.78
s66*	1124D_4H-2_116-118 U1520D_48X-CC_22-24 U1519C_20R-3_29-31 U1526B_3H-5_1-3	1292.50 1291.35 1289.33		0.2	2.45	0.40	9.8	2.15	18.5	0.02	0.64	0.78	5.82	0.11	0.55	0.26	3.16	0.07	0.48	0.20	3.20	0.09	1.05	0.22	5.06	0.06	0.75	0.19	4.73	0.19	1.02	1.02	5.58
s66*	1124D_4H-2_116-118 U1520D_48X-CC_22-24 U1519C_20R-3_29-31 U1526B_3H-5_1-3	1292.50 1291.35 1289.33		0.7	2.24	3.22	9.3	4.61	14.9	0.16	0.52	2.19	4.31	0.11	0.38	0.81	2.42	0.12	0.36	0.64	2.34	0.26	0.79	1.28	3.70	0.21	0.55	1.22	3.77	0.24	0.64	1.13	3.76
s66*	1124D_4H-2_116-118 U1520D_48X-CC_22-24 U1519C_20R-3_29-31 U1526B_3H-5_1-3	1292.50 1291.35 1289.33		0.2	2.70	0.82	11.3	1.50	18.0	0.07	0.61	1.73	5.21	0.08	0.48	0.57	3.31	0.09	0.46	0.62	3.20	0.19	1.09	0.73	5.16	0.15	0.82	0.61	4.85	0.23	0.82	0.98	5.56
s66*	1124D_4H-2_116-118 U1520D_48X-CC_22-24 U1519C_20R-3_29-31 U1526B_3H-5_1-3	1292.50 1291.35 1289.33		0.2	2.90	1.03	11.8	3.02	21.0	0.09	0.75	0.62	7.40	0.09	0.71	0.25	4.02	0.07	0.58	0.42	3.81	0.16	1.33	0.58	6.38	0.18	0.94	1.12	5.56	0.10	1.17	0.73	6.19
s66*	1124D_4H-2_116-118 U1520D_48X-CC_22-24 U1519C_20R-3_29-31 U1526B_3H-5_1-3	1292.50 1291.35 1289.33		1.6	3.52	0.49	11.3	1.53	18.8	0.04	0.70	0.42	6.79	0.07	0.59	0.25	5.74	0.04	0.52	0.25	3.72	0.11	1.24	0.42	5.71	0.07	0.89	0.40	5.40	0.07	0.94	0.51	6.12

Appendix A

Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s67*	1124D_4H-2_137-139 II	1302.78		0.2	2.70	0.82	11.3	1.50	18.0	0.07	0.61	1.73	5.21	0.08	0.48	0.37	3.31	0.09	0.46	0.62	3.20	0.19	1.09	0.73	5.36	0.15	0.82	0.61	4.85	0.33	0.82	0.90	5.56	
	1124C_5H-7_60-62	1347.34	1326.28	0.4	2.81	1.70	12.3	2.60	17.5	0.09	0.57	0.36	3.14	0.02	0.40	0.32	2.84	0.08	0.42	0.56	2.70	0.19	1.00	0.60	4.36	0.10	0.72	0.30	4.05	0.12	0.66	0.73	4.99	
	U1526B_3H-5_8-10	1305.00																																
	U1371D_3H-6_63-65	1350.00		0.1	2.92	0.24	12.2	0.90	19.0	0.05	0.60	0.18	3.08	0.04	0.40	0.15	2.63	0.06	0.42	0.11	2.66	0.04	0.93	0.09	4.28	0.05	0.70	0.14	4.17	0.06	0.49	0.39	4.81	
				0.2	3.22	0.31	12.8	1.08	20.3	0.04	0.73	0.26	4.65	0.03	0.55	0.24	3.78	0.04	0.50	0.18	3.46	0.05	1.17	0.39	5.73	0.05	0.86	0.28	5.27	0.07	0.99	0.40	6.13	
s68	1123A_6H-5_18-20	1339.75	1358.29	0.2	2.74	1.08	11.5	0.58	17.4	0.07	0.68	0.63	4.71	0.06	0.58	0.33	3.80	0.04	0.54	0.33	3.51	0.12	1.22	0.66	5.97	0.09	0.91	0.60	5.96	0.11	1.00	0.80	5.85	
	1124C_5H-CC_10-12	1397.28																																
s69	1123C_6H-5_123-125	1342.00																																
	1124C_6H-1_26-28	1395.33	1355.19	0.6	3.55	1.57	15.0	2.38	19.5	0.15	0.67	0.32	2.46	0.07	0.56	0.32	2.19	0.04	0.29	0.24	1.77	0.04	0.61	0.29	2.40	0.05	0.64	0.20	2.36	0.11	0.35	0.38	2.77	
	1124D_4H-3_70-72	1343.42																																
	U1526B_3H-5_51-53	1340.00																																
				0.7	3.25	2.40	12.6	4.43	22.9	0.08	0.64	0.34	4.77	0.03	0.51	0.63	3.54	0.08	0.53	0.46	3.34	0.17	1.12	0.95	5.38	0.13	0.87	0.64	5.31	0.04	0.82	0.81	5.85	
s70	1123B_7H-1_129-131	1387.65	1388.14	0.1	2.99	0.30	12.1	1.30	21.9	0.05	0.64	0.68	4.66	0.04	0.52	0.11	3.43	0.07	0.43	0.18	3.40	0.02	1.11	0.36	5.54	0.05	0.87	0.47	5.49	0.11	0.85	0.21	5.61	
	1123C_6H-6_118-120	1388.62																																
	U1518E_24F-3_71-73	1392.00	1392.00	0.3	2.82	1.04	12.2	3.04	18.5	0.03	0.63	1.22	3.74	0.08	0.43	0.51	2.66	0.05	0.37	0.61	2.45	0.18	0.76	0.76	3.80	0.16	0.58	1.00	3.67	0.16	0.54	0.38	3.85	
	1124C_6H-1_37-39 I	1400.71		0.2	3.03	0.65	13.2	2.01	20.2	0.03	0.74	1.26	4.15	0.10	0.51	0.22	3.73	0.07	0.51	0.26	3.38	0.05	1.20	0.42	5.46	0.13	0.84	0.71	5.16	0.14	0.88	0.47	6.13	
	U1518E-25F-2_30-32a I			0.5	2.52	2.43	10.9	2.71	17.0	0.18	0.64	2.41	5.62	0.23	0.58	1.62	4.00	0.26	0.55	1.91	3.75	0.55	1.21	2.92	5.81	0.39	0.88	2.35	5.17	0.49	0.93	2.18	5.07	
s71*	594_13H-CC_0-2 II			0.9	3.39	3.01	13.5	4.18	20.7	0.21	0.81	1.74	4.90	0.16	0.45	1.03	3.07	0.11	0.42	0.87	2.73	0.32	1.02	1.54	4.08	0.27	0.80	1.65	4.79	0.22	0.75	1.02	5.02	
	594A_8H-3_49-51 I		1400.71																															
	1124C_6H-1_37-39 II			0.2	3.03	0.65	13.2	2.01	20.2	0.03	0.74	1.26	4.15	0.10	0.51	0.22	3.73	0.07	0.51	0.26	3.38	0.05	1.20	0.42	5.46	0.13	0.84	0.71	5.16	0.14	0.88	0.47	6.13	
	U1518E-25F-2_30-32 II			0.5	2.52	2.43	10.9	2.71	17.0	0.18	0.64	2.41	5.62	0.23	0.58	1.62	4.00	0.26	0.55	1.91	3.75	0.55	1.21	2.92	5.81	0.39	0.88	2.38	5.17	0.49	0.93	2.18	5.07	
	594_13H-CC_0-2 I			0.9	3.39	3.01	13.5	4.18	20.7	0.21	0.81	1.74	4.90	0.16	0.45	1.03	3.07	0.11	0.42	0.87	2.73	0.32	1.02	1.54	4.08	0.27	0.80	1.68	4.79	0.22	0.75	1.02	5.02	
s72*	594A_8H-3_49-51 II																																	
	1123A_6H-6_64-66	1402.76	1402.76																															
	1125B_4H-4_74-76	1404.56	1404.56																															
	1123C_6H-7_14-16 I	1403.41																																
	1123B_7H-2_38-40 II		1405.01	0.2	2.96	0.80	11.4	2.12	19.6	0.06	0.61	0.68	5.90	0.03	0.46	0.26	3.18	0.04	0.47	0.20	3.00	0.11	1.01	0.25	4.76	0.08	0.73	0.26	4.48	0.07	0.88	0.23	4.98	
s73	1123C_6H-7_14-16 II																																	
	1123B_7H-2_38-40 II	1406.62																																
	1124D_4H-4_100-102	1408.06	1408.06	0.3	2.68	0.80	11.7	4.12	18.8	0.10	0.58	0.20	3.16	0.06	0.31	0.23	1.92	0.08	0.27	0.21	1.80	0.07	0.60	0.28	2.40	0.08	0.65	0.20	2.58	0.09	0.42	0.34	3.31	
	1123A_6H-6_125-127	1422.38		0.4	3.59	1.06	15.1	1.08	19.9	0.05	0.63	0.18	2.41	0.02	0.32	0.16	2.16	0.02	0.29	0.14	1.73	0.06	0.62	0.29	2.78	0.02	0.61	0.27	2.54	0.08	0.36	0.20	2.99	
	1124D_4H-5_12-14	1438.41	1441.15																															
s75	U1520D_49X-1_15-17	1453.80		0.2	2.84	0.97	11.9	1.06	20.9	0.06	0.66	0.30	4.75	0.03	0.48	0.46	3.36	0.03	0.46	0.40	3.20	0.09	1.05	0.25	5.04	0.08	0.79	0.24	4.99	0.06	0.84	0.35	5.46	
	U1518E_29X-2_66-68	1450.00																																
s76	1123A_6H-7_15-17	1435.23	1435.23																															
	1124C_6H-1_118-120	1440.37	1440.37																															

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Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s74	1123B_7H-2_88-90 1123C_6H-7_64-66 1123A_7H-1_52-54	1422.70 1455.49 1467.70	1448.63	0.1	3.60	1.16	12.2	1.18	19.0	0.05	0.73	0.52	3.64	0.07	0.51	0.38	3.46	0.07	0.46	0.34	3.13	0.06	1.04	0.43	4.78	0.11	0.73	0.56	4.12	0.07	0.60	0.39	5.65
n54	U1518E-29X-6_7-9 1452.00	1452.00	1452.00	0.1	2.65	0.12	2.5	0.78	18.3	0.03	0.68	0.35	2.79	0.04	0.41	0.25	2.73	0.02	0.34	0.05	2.48	0.02	0.76	0.07	3.78	0.02	0.59	0.38	3.56	0.06	0.68	0.36	3.81
s75*	U1518E-32X-1_20-24 I 1455.00 U1520D_49X-1_28-30 1456.40 U1518E-32X-1_20-24a II 1455.00	1455.00 1456.40 1455.00	1455.70	0.3	3.36	1.79	14.3	2.29	22.3	0.10	0.64	1.35	5.02	0.11	0.47	0.69	3.26	0.10	0.41	0.65	2.97	0.19	1.00	1.08	4.28	0.18	0.74	0.93	4.34	0.11	0.77	1.04	5.00
s76*	1124C_6H-2_27-29 I 1469.26 1124C_6H-2_27-29 II 1469.75 1124D_4H-5_77-79 1470.24	1469.26 1469.75 1470.24	1469.75	0.2	3.31	0.75	16.2	1.56	23.0	0.04	0.80	0.70	6.58	0.08	0.58	0.20	3.99	0.05	0.58	0.18	3.86	0.07	1.26	0.37	5.97	0.05	0.98	0.44	6.12	0.10	0.97	0.30	6.53
s77	1124D_4H-6_18-20 1514.80 1124C_6H-2_127-129 1518.23	1514.80 1518.23	1516.51	0.3	3.14	0.83	13.3	1.93	21.2	0.01	0.74	0.71	6.89	0.06	0.56	0.23	3.80	0.05	0.54	0.29	3.57	0.08	1.22	0.44	5.58	0.04	0.86	0.48	5.58	0.09	0.98	0.49	5.85
n55	U1520D_49X-CC_29-31 1523.85	1523.85	1523.85	0.3	2.98	0.71	13.1	1.17	21.6	0.04	0.59	0.99	5.68	0.06	0.45	0.38	2.98	0.07	0.45	0.48	2.74	0.16	0.92	0.99	4.41	0.16	0.66	0.83	4.05	0.11	0.69	0.93	4.36
n56	1124D_4H-6_57-59 1533.89	1533.89	1533.89	0.2	3.13	0.30	12.8	0.37	18.9	0.04	0.67	0.21	7.06	0.04	0.53	0.30	3.72	0.06	0.51	0.45	3.28	0.13	1.13	0.38	5.45	0.09	0.82	0.62	4.81	0.04	1.19	0.38	5.55
s78	1123C_7H-2_62-64 1519.14 1123B_7H-4_93-95 1520.75 1123A_7H-3_48-50 1562.86	1519.14 1520.75 1562.86	1534.25	0.1	2.83	0.38	11.8	0.57	19.8	0.03	0.76	0.77	6.80	0.04	0.59	0.30	3.75	0.02	0.54	0.22	3.78	0.06	1.27	0.41	6.02	0.06	0.94	0.49	5.53	0.12	0.96	0.22	6.26
s79	1123B_7H-4_145-147 1537.47 1123C_7H-2_120-122 1537.79 1123A_7H-3_108-110 1582.15	1537.47 1537.79 1582.15	1540.00	0.0	2.82	0.57	10.4	0.83	19.6	0.04	0.72	0.25	6.38	0.05	0.51	0.15	3.57	0.02	0.51	0.10	3.61	0.11	1.13	0.08	5.52	0.04	0.85	0.40	5.32	0.02	1.06	0.21	5.81
n57*	1124D_4H-6_86-88 I 1548.09 1124D_4H-6_86-88 II	1548.09	1548.09	0.4	3.63	1.27	13.7	1.72	21.5	0.11	0.72	0.21	5.25	0.03	0.55	0.40	3.78	0.06	0.58	0.48	3.44	0.11	1.20	0.37	5.91	0.09	0.89	0.27	5.52	0.07	0.78	0.56	6.19
s80	1124D_4H-6_117-119 1563.27 1124C_6H-3_90-92 1573.56	1563.27 1573.56	1568.41	0.1	3.94	1.10	17.2	1.18	22.8	0.12	0.78	0.28	6.35	0.07	0.57	0.15	3.84	0.05	0.49	0.41	3.36	0.11	1.23	0.41	5.09	0.10	0.93	0.29	5.87	0.07	0.78	0.39	6.42
s81	1123B_7H-5_115-117 1576.05 Ridge Tephra 1.56Ma ³	1576.05	1576.05	0.1	4.06	0.72	16.9	0.50	24.0	0.10	0.82	0.39	6.40	0.07	0.58	0.28	3.81	0.02	0.53	0.21	3.62	0.09	1.22	0.28	5.77	0.11	0.92	0.18	5.77	0.02	0.76	0.42	5.82
s82	1123C_7H-3_132-134 1589.87 1123B_7H-6_13-15 1591.48 1123A_7H-4_108-110 1630.38	1589.87 1591.48 1630.38	1603.91	0.3	3.92	1.09	16.3	1.63	20.7	0.09	0.68	0.13	2.77	0.04	0.40	0.12	2.40	0.02	0.31	0.20	2.05	0.08	0.63	0.29	3.21	0.06	0.49	0.21	2.81	0.03	0.39	0.32	3.21
s83	1123C_7H-6_87-89 1615.27 1123A_7H-5_33-35 1654.49 U1520D_50X-CC_37-39 1649.78 / 1.69±0.11	1615.27 1654.49 1649.78	1649.78	0.1	3.87	0.06	13.9	0.36	21.5	0.04	0.65	0.24	2.51	0.02	0.30	0.10	1.97	0.04	0.27	0.08	1.63	0.04	0.51	0.03	2.32	0.02	0.38	0.15	2.57	0.06	0.43	0.12	2.97
s84*	1125A_5H-3_13-151 1657.05 1125A_5H-3_13-15a II 1653.53 U1526B_4H-1_103-105 1650.00	1657.05 1653.53 1650.00	1653.53	0.2	3.44	0.67	13.7	2.14	21.0	0.08	0.81	0.21	6.40	0.04	0.58	0.37	3.75	0.03	0.53	0.27	3.63	0.06	1.16	0.47	5.91	0.07	0.86	0.46	4.96	0.09	0.93	0.28	5.72
s85	1123C_7H-5_11-13 1647.42 1123A_7H-5_125-127 1684.07	1647.42 1684.07	1665.74	0.2	3.25	0.67	11.4	1.21	19.6	0.07	0.70	0.59	7.19	0.04	0.53	0.28	3.79	0.05	0.56	0.24	3.48	0.08	1.16	0.45	5.35	0.05	0.87	0.39	5.23	0.07	1.02	0.40	5.99
				0.2	3.08	0.89	12.2	1.82	20.7	0.01	0.73	0.47	6.52	0.03	0.51	0.37	3.27	0.05	0.47	0.41	3.22	0.08	1.07	0.89	5.25	0.05	0.80	0.70	5.00	0.07	0.96	0.59	5.51

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Supplementary Table S1: Quaternary volcanic record of New Zealand based on the marine tephra record.

s86	1124C_6H-4_52-54	1628.40	Table Flat Tephra 1.71±0.12Ma ³	4.13	0.35	48.3	1.41	23.7	0.06	0.84	0.31	6.33	0.03	0.53	0.22	3.59	0.04	0.49	0.27	3.41	0.05	1.14	0.36	5.31	0.07	0.85	0.49	5.45	0.08	0.85	0.17	6.17
	1122C_44X-2_57-59	1628.00		4.42	0.77	17.7	0.86	24.5	0.06	0.83	0.31	6.40	0.03	0.51	0.14	3.45	0.03	0.49	0.10	3.15	0.06	1.14	0.29	5.46	0.03	0.86	0.33	5.51	0.05	0.86	0.13	6.00
n58	1124C_6H-5_20-22	1686.17		2.26	2.41	9.2	3.90	14.5	0.13	0.59	0.86	2.20	0.09	0.39	0.66	1.98	0.08	0.27	0.42	1.73	0.29	0.64	0.31	2.89	0.13	0.48	0.49	2.45	0.19	0.56	0.39	3.19
n59	U1520D_51X-1_26-28	1839.18		3.31	0.75	12.8	1.62	20.2	0.06	0.76	0.50	6.82	0.03	0.55	0.19	3.57	0.05	0.50	0.20	3.36	0.05	1.17	0.38	5.50	0.04	0.89	0.49	5.08	0.10	0.95	0.36	5.61
n60	U1520D_51X-1_35-37	1840.98																														
n61	U1520D_51X-1_49-50	1843.77		3.92	0.71	16.1	1.47	23.3	0.08	0.85	0.19	5.02	0.03	0.61	0.26	4.63	0.03	0.57	0.14	4.01	0.07	1.38	0.26	6.25	0.06	0.96	0.50	6.09	0.12	0.62	0.17	6.65
n62	U1520D_51X-1_51-52	1844.17																														
n63	U1520D_51X-1_54-55	1844.77		3.69	0.82	15.0	1.57	21.3	0.04	0.79	0.39	4.99	0.07	0.54	0.32	3.54	0.06	0.51	0.19	3.40	0.07	1.19	0.33	5.52	0.08	0.88	0.28	5.43	0.09	0.75	0.38	5.92
s87	1124C_6H-5_37-39	1694.50		2.89	0.75	11.1	1.00	13.9	0.03	0.59	0.38	2.74	0.01	0.25	0.88	1.37	0.00	0.19	0.10	1.24	0.01	0.47	0.21	2.08	0.03	0.36	0.40	2.19	0.05	0.42	0.23	2.33
	U1520D_51X-1_55-56	1844.97		2.88	0.33	11.0	1.64	14.3	0.08	0.59	0.16	3.04	0.03	0.24	0.88	1.49	0.01	0.29	0.10	1.32	0.04	0.39	0.23	2.04	0.03	0.31	0.25	1.84	0.03	0.37	0.12	2.05
n64	U1520D_51X-1_64-65	1846.76		3.36	1.44	13.2	6.12	24.1	0.08	0.81	0.47	6.20	0.07	0.52	0.17	3.66	0.05	0.50	0.16	3.51	0.14	1.19	0.39	5.65	0.06	0.88	0.43	4.92	0.17	0.92	0.67	5.58
s88	U1520D_51X-1_64-65(2)	1846.80	Vinegar Hill Tephra 1.75±0.2Ma ³	4.43	1.06	17.7	3.26	24.8	0.05	0.88	0.10	4.45	0.03	0.43	0.17	2.91	0.03	0.39	0.24	2.59	0.05	0.91	0.09	4.02	0.04	0.67	0.21	4.06	0.08	0.52	0.39	4.38
	1125A_5H-6_36-38 I	1951.88																														
	1125A_5H-6_36-38 II			2.68	0.54	11.7	1.57	20.8	0.08	0.59	0.26	5.02	0.04	0.47	0.25	3.23	0.02	0.47	0.27	3.21	0.06	1.04	0.15	4.84	0.04	0.79	0.37	4.95	0.03	0.69	0.24	5.09
	U1520D_52X-1_8-10	2027.18		2.82	1.05	12.1	2.83	19.6	0.18	0.59	0.58	4.00	0.14	0.45	0.37	3.52	0.03	0.46	0.47	3.16	0.04	1.12	0.77	4.76	0.11	0.77	0.28	5.01	0.12	0.55	1.32	4.83
s89*	1125B_5H-2_131-133	2059.35	Hikuroa Pumice 2.0±0.6Ma ¹	2.44	0.51	8.65	1.75	18.0	0.09	0.52	0.43	3.50	0.09	0.45	0.69	2.87	0.07	0.38	0.31	2.76	0.06	0.86	0.22	4.21	0.04	0.68	0.63	4.02	0.03	0.56	0.59	4.44
	1124D_5H-7_12-14	2155.25		2.89	1.08	11.7	1.23	19.0	0.07	0.59	0.38	3.65	0.04	0.46	0.24	3.11	0.04	0.42	0.12	2.79	0.07	0.91	0.24	4.21	0.04	0.69	0.18	4.17	0.06	0.49	0.12	4.37
	1124C_7H-3_117-119	2160.64		2.97	1.18	12.2	1.63	19.2	0.12	0.69	1.77	5.20	0.12	0.53	0.55	3.21	0.11	0.48	0.76	3.40	0.15	1.10	0.83	5.29	0.10	0.87	0.72	4.99	0.37	0.78	0.68	5.04
	U1520B_4H-2_57-59																															
	1122C_50X-5_5-7	2025.00																														
s90	1125A_5H-6_65-67	1962.07		2.75	0.09	11.6	0.54	16.6	0.05	0.64	0.26	4.67	0.05	0.36	0.29	2.53	0.02	0.32	0.17	2.12	0.04	0.66	0.20	3.32	0.02	0.52	0.46	3.19	0.04	0.71	0.39	3.61
	1125B_5H-3_120-122	2108.16		2.47	0.76	10.4	0.86	17.3	0.03	0.52	0.21	4.94	0.03	0.45	0.34	2.94	0.05	0.40	0.11	2.69	0.05	0.93	0.30	4.50	0.07	0.73	0.24	3.89	0.07	0.79	0.13	4.44
	1123A_9H-5_99-101	2340.54		2.54	1.18	10.7	2.27	16.8	0.08	0.53	0.46	4.25	0.10	0.39	0.43	2.44	0.08	0.38	0.58	2.39	0.17	0.79	0.69	3.56	0.22	0.62	0.79	3.48	0.13	0.68	0.87	3.91
s91	1125B_5H-4_64-66	2141.17		2.80	0.91	12.7	4.90	19.3	0.04	0.46	0.29	2.40	0.02	0.27	0.12	1.66	0.02	0.22	0.05	1.36	0.05	0.46	0.14	2.06	0.04	0.32	0.07	2.40	0.05	0.38	0.49	2.57
	1125A_6H-1_23-25	2146.79																														
s92	U1520D_53X-1_31-33	2199.88		2.76	0.28	9.8	1.14	17.9	0.04	0.51	0.35	2.85	0.03	0.35	0.13	2.35	0.02	0.33	0.02	2.20	0.08	0.68	0.12	3.29	0.04	0.51	0.16	3.02	0.02	0.51	0.16	3.31
	1124C_7H-4_60-62	2206.17																														
n65	1124C_7H-4_85-87	2218.41		2.26	0.39	9.8	1.13	19.8	0.07	0.55	0.39	6.38	0.07	0.54	0.18	3.56	0.06	0.52	0.22	3.43	0.09	1.15	0.18	5.61	0.03	0.85	0.38	5.14	0.12	0.96	0.38	5.28
n66	1124C_7H-5_15-17	2257.59		2.78	1.20	12.3	1.24	13.7	0.06	0.63	0.24	2.37	0.03	0.24	0.28	1.45	0.02	0.22	0.17	1.50	0.05	0.44	0.19	2.16	0.03	0.37	0.07	1.99	0.05	0.37	0.39	2.23
	1124D_6H-1_142-144 I	2296.27																														
s93*	1124C_7H-5_92-94a I	2295.29		3.20	0.72	14.0	0.90	20.9	0.06	0.60	0.39	3.16	0.04	0.40	0.28	2.35	0.04	0.30	0.12	2.18	0.06	0.66	0.22	3.11	0.04	0.45	0.33	2.73	0.19	0.44	0.32	3.48
	1124C_7H-5_92-94 II	2295.78																														
	1124D_6H-1_142-144 I																															
	1124D_6H-1_142-144 II																															
s94	1123C_9H-5_33-35	2321.25		2.83	1.55	12.9	1.96	20.5	0.08	0.53	0.87	3.52	0.04	0.38	0.13	2.57	0.09	0.33	0.17	2.43	0.13	0.72	0.40	2.96	0.05	0.50	0.42	2.98	0.07	0.48	0.53	3.43
	1123B_10H-1_36-38	2322.22		2.89	0.22	8.2	0.84	18.0	0.03	0.48	0.17	4.80	0.01	0.43	0.11	2.65	0.03	0.40	0.07	2.63	0.04	0.93	0.06	4.27	0.06	0.64	0.19	4.09	0.05	0.75	0.24	4.11
	1123A_9H-5_141-143	2354.04		2.40	0.32	9.5	1.39	20.6	0.04	0.49	0.10	5.31	0.00	0.44	0.18	3.19	0.00	0.41	0.23	2.94	0.02	1.00	0.10	4.54	0.04	0.77	0.32	4.27	0.07	0.92	0.26	4.58

1123B_10H-1_97-99	2341.83
1123C_9H-5_99-101	2342.47
1123A_9H-6_58-60	2375.58
1124D_6H-3_27-29	2386.85
1124C_7H-6_143-145	2393.71
U1526A_2R-CC_28-29	
1124D_6H-3_70-72	2407.91
1123B_10H-2_32-34	2369.15
1123A_9H-7_7-9	2407.41
1124D_6H-4_29-31	2461.28
1124C_8H-1_104-106	2461.77
1125B_6H-1_147-149	2372.95
1125A_6H-5_71-73 I	2374.35
1125A_6H-5_71-73a II	
U1520D_54X-2_3-5 I	2457.00
U1520D_54X-2_3-5a II	
1125A_7H-1_138-140	2571.71
1125B_6H-5_133-135	2578.74

¹ Hopkins et al. (2021), and references therein; Tephra NZ

² Hopkins and Seward (2019)

³ Pillans et al. (2005)

⁴ Allan et al. (2008), and references therein

⁵Holt et al. (2010)

⁶ Smith et al. (2002)

⁷ Lowe et al. (2008)

⁸ Moebis et al. (2011)

⁹ Lowe et al. (1988)

Appendix A

Supplementary Table S2: U-Pb measurements on zircons (Nov 2020).

Sample name		U1520D 25H2 3- 15	U1520D 25H2 3- 15	U1520D 25H2 3- 15	U1520D 25H2 3- 15	U1520D 25H2 3- 15	U1520D 25H2 3- 15	U1520D 25H2 3- 15
Age [Ma] 206Pb/238U		0.430	0.271	0.300	0.363	0.291	0.490	0.463
Age [Ma] 206Pb/238U	1 s.e.	0.069	0.094	0.055	0.032	0.067	0.132	0.157
Radiogenic 206Pb [%]		63.9	53.9	67.7	77.8	63.3	52.1	48.7
206Pb/238U		0.0000823	0.0000535	0.0000493	0.0000570	0.0000484	0.000116	0.000116
206Pb/238U	1 s.e.	0.0000085	0.0000117	0.0000065	0.0000042	0.0000063	0.000014	0.000017
207Pb/235U		0.00381	0.00306	0.00207	0.00176	0.00227	0.00687	0.00732
207Pb/235U	1 s.e.	0.00077	0.00103	0.00064	0.00031	0.00098	0.00177	0.00201
207Pb/206Pb/		0.335	0.415	0.304	0.224	0.340	0.430	0.457
207Pb/206Pb/	1 s.e.	0.056	0.136	0.088	0.041	0.131	0.107	0.082
Correlation of Concordia Ellipses		0.562	0.366	0.363	0.0642	0.506	0.300	0.793
204Pb/206Pb		0.0696	0.0423	0.0301	0.0420	0.0531	0.0546	b.d.
204Pb/206Pb	1 s.e.	0.0406	0.0426	0.0303	0.0275	0.0378	0.0550	b.d.
Th/U	mass	0.717	0.937	0.925	1.25	0.596	0.360	0.459
U	ppm	272	181	353	609	422	92.1	79.6

Sample name		U1520D 25H2 3- 15	U1520D 25H2 3- 15	U1520D 25H2 3- 15	U1520D 25H2 3- 15	U1520D 25H2 3- 15	U1520D 25H2 3- 15	U1520D 25H2 3- 15
Age [Ma] 206Pb/238U		0.380	0.350	0.459	0.244	0.304	0.279	0.422
Age [Ma] 206Pb/238U	1 s.e.	0.054	0.060	0.065	0.054	0.120	0.078	0.071
Radiogenic 206Pb [%]		75.4	60.1	70.3	52.4	44.3	43.3	70.0
206Pb/238U		0.0000599	0.0000675	0.0000806	0.0000477	0.0000738	0.0000672	0.0000723
206Pb/238U	1 s.e.	0.0000070	0.0000070	0.0000079	0.0000047	0.0000124	0.0000079	0.0000082
207Pb/235U		0.00201	0.00340	0.00316	0.00281	0.00501	0.00463	0.00286
207Pb/235U	1 s.e.	0.00055	0.00072	0.00073	0.00082	0.00165	0.00108	0.00085
207Pb/206Pb/		0.244	0.366	0.284	0.427	0.492	0.500	0.287
207Pb/206Pb/	1 s.e.	0.065	0.051	0.043	0.143	0.102	0.127	0.082
Correlation of Concordia Ellipses		0.267	0.825	0.887	-0.295	0.847	0.0669	0.302
204Pb/206Pb		0.161	0.142	0.0414	0.121	0.124	0.149	0.0181
204Pb/206Pb	1 s.e.	0.074	0.055	0.0321	0.071	0.061	0.076	0.0219
Th/U	mass	0.753	0.794	0.594	1.03	0.618	0.682	0.500
U	ppm	313	448	293	385	332	246	236

Appendix A

Supplementary Table S2: U-Pb measurements on zircons (Nov 2020).

Sample name		U1520D 25H2 34 15	U1520D 25H2 34 15	U1520D 26F1 95-105	U1520D 26F1 95-105	U1520D 26F1 95-105	U1520D 26F1 95-105	U1520D 26F1 95-105
Age [Ma] 206Pb/238U		0.305	0.411	0.421	0.325	0.288	0.407	0.301
Age [Ma] 206Pb/238U	1 s.e.	0.030	0.134	0.598	0.038	0.098	0.056	0.046
Radiogenic 206Pb [%]		83.2	49.9	19.6	72.7	54.5	59.9	64.7
206Pb/238U		0.0000414	0.0000993	0.000261	0.0000512	0.0000579	0.0000839	0.0000504
206Pb/238U	1 s.e.	0.0000043	0.0000164	0.000068	0.0000049	0.0000121	0.0000069	0.0000050
207Pb/235U		0.00103	0.00612	0.0248	0.00187	0.00327	0.00425	0.00228
207Pb/235U	1 s.e.	0.00022	0.00149	0.0075	0.00038	0.00108	0.00062	0.00060
207Pb/206Pb/		0.180	0.447	0.690	0.265	0.410	0.368	0.328
207Pb/206Pb/	1 s.e.	0.040	0.109	0.045	0.046	0.148	0.057	0.079
Correlation of Concordia Ellipses		0.139	0.345	0.984	0.501	0.155	0.159	0.403
204Pb/206Pb		0.0135	0.186	0.0452	0.0522	0.0977	0.104	b.d.
204Pb/206Pb	1 s.e.	0.0164	0.134	0.0119	0.0372	0.0649	0.044	b.d.
Th/U	mass	0.995	0.690	0.688	0.934	0.940	0.994	0.694
U	ppm	893	113	603	438	330	336	364

Sample name		U1520D 26F1 95-105	U1520D 26F1 95-105	U1520D 26F1 95-105	U1520D 26F1 95-105	U1520D 26F1 95-105	U1520D 26F1 95-105	U1520D 26F1 95-105
Age [Ma] 206Pb/238U		0.308	0.300	0.336	0.232	0.255	0.389	0.516
Age [Ma] 206Pb/238U	1 s.e.	0.047	0.071	0.061	0.070	0.356	0.126	0.118
Radiogenic 206Pb [%]		70.3	50.7	42.7	44.2	5.73	54.0	58.7
206Pb/238U		0.0000494	0.0000645	0.0000930	0.0000497	0.000426	0.0000852	0.000112
206Pb/238U	1 s.e.	0.0000059	0.0000064	0.0000060	0.0000087	0.000038	0.0000123	0.000013
207Pb/235U		0.00193	0.00392	0.00647	0.00338	0.0471	0.00487	0.00584
207Pb/235U	1 s.e.	0.00052	0.00106	0.00085	0.00076	0.0047	0.00178	0.00157
207Pb/206Pb/		0.284	0.441	0.505	0.493	0.801	0.415	0.377
207Pb/206Pb/	1 s.e.	0.061	0.111	0.073	0.106	0.088	0.116	0.068
Correlation of Concordia Ellipses		0.619	0.354	0.0300	0.445	0.334	0.720	0.882
204Pb/206Pb		0.0268	0.0262	0.0317	0.100	0.0558	0.0321	0.0324
204Pb/206Pb	1 s.e.	0.0270	0.0263	0.0184	0.088	0.0270	0.0323	0.0230
Th/U	mass	0.956	0.793		0.732	0.466	0.632	0.673
U	ppm	388	354	862	288	156	173	341

Appendix A

Supplementary Table S2: U-Pb measurements on zircons (Nov 2020).

Sample name		U1520D 26F1 95-105	U1520D 26F1 95-105	U1520D 26F1 95-105	U1520D 26F2 0- 30	U1520D 26F2 0- 30	U1520D 26F2 0- 30	U1520D 26F2 0- 30
Age [Ma] 206Pb/238U		1.70	0.316	0.276	0.420	0.348	0.202	0.358
Age [Ma] 206Pb/238U	1 s.e.	6.72	0.055	0.049	0.055	0.074	0.053	0.018
Radiogenic 206Pb [%]		6.92	69.3	53.6	80.8	54.5	41.1	92.6
206Pb/238U		0.00363	0.0000507	0.0000534	0.0000627	0.0000745	0.0000459	0.0000467
206Pb/238U	1 s.e.	0.00076	0.0000058	0.0000056	0.0000075	0.0000086	0.0000060	0.0000025
207Pb/235U		0.396	0.00204	0.00307	0.00173	0.00422	0.00328	0.000676
207Pb/235U	1 s.e.	0.084	0.00073	0.00059	0.00049	0.00090	0.00065	0.000164
207Pb/206Pb/		0.792	0.292	0.418	0.200	0.411	0.518	0.105
207Pb/206Pb/	1 s.e.	0.020	0.087	0.079	0.063	0.079	0.077	0.025
Correlation of Concordia Ellipses		0.993	0.625	0.310	-0.109	0.439	0.658	0.210
204Pb/206Pb		0.0964	0.0283	0.0544	0.0604	0.0356	0.0978	0.217
204Pb/206Pb	1 s.e.	0.0239	0.0343	0.0388	0.0473	0.0358	0.0652	0.040
Th/U	mass	1.12	0.755	0.673	0.611	0.854	1.09	1.18
U	ppm	545	372	378	292	211	273	1640

Sample name		U1520D 26F2 0- 30	U1520D 26F2 0- 30	U1520D 26F2 0- 30	U1520D 26F2 0- 30	U1520D 26F2 0- 30	U1520D 26F2 0- 30	U1520D 26F2 0- 30
Age [Ma] 206Pb/238U		0.336	0.270	0.418	0.353	0.331	0.255	0.333
Age [Ma] 206Pb/238U	1 s.e.	0.035	0.099	0.061	0.063	0.054	0.032	0.029
Radiogenic 206Pb [%]		72.7	37.2	64.7	64.8	74.5	69.2	78.7
206Pb/238U		0.0000566	0.0000727	0.0000855	0.0000622	0.0000491	0.0000400	0.0000508
206Pb/238U	1 s.e.	0.0000041	0.0000087	0.0000082	0.0000074	0.0000074	0.0000032	0.0000039
207Pb/235U		0.00207	0.00551	0.00388	0.00281	0.00169	0.00161	0.00151
207Pb/235U	1 s.e.	0.00043	0.00148	0.00056	0.00075	0.00046	0.00044	0.00024
207Pb/206Pb/		0.265	0.549	0.329	0.328	0.250	0.293	0.216
207Pb/206Pb/	1 s.e.	0.042	0.155	0.038	0.083	0.049	0.074	0.030
Correlation of Concordia Ellipses		0.773	0.105	0.588	0.322	0.716	0.419	0.498
204Pb/206Pb		0.109	0.0535	0.282	0.0164	0.0326	b.d.	0.0445
204Pb/206Pb	1 s.e.	0.020	0.0539	0.056	0.0198	0.0252	b.d.	0.0200
Th/U	mass	1.49	0.538	1.83	0.600	0.532	1.28	1.30
U	ppm	3020	152	505	453	609	795	1430

Appendix A

Supplementary Table S2: U-Pb measurements on zircons (Nov 2020).

Sample name		U1520D 26F2 0-30	U1520D 26F2 0-30	U1520D 26F2 0-30	U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42
Age [Ma] 206Pb/238U		0.356	0.476	0.581	0.555	0.571	0.582	1.07
Age [Ma] 206Pb/238U	1 s.e.	0.036	0.160	0.176	0.209	0.342	0.025	0.39
Radiogenic 206Pb [%]		72.2	47.5	44.0	40.4	33.1	89.6	44.4
206Pb/238U		0.0000607	0.000124	0.000171	0.000180	0.000226	0.0000901	0.000343
206Pb/238U	1 s.e.	0.0000049	0.000017	0.000021	0.000017	0.000039	0.0000033	0.000042
207Pb/235U		0.00225	0.00796	0.0117	0.0130	0.0182	0.00161	0.0232
207Pb/235U	1 s.e.	0.00033	0.00210	0.0020	0.0032	0.0042	0.00024	0.0050
207Pb/206Pb/		0.269	0.467	0.494	0.523	0.582	0.129	0.491
207Pb/206Pb/	1 s.e.	0.044	0.090	0.108	0.104	0.103	0.019	0.065
Correlation of Concordia Ellipses		0.0520	0.709	-0.0521	0.665	0.644	0.322	0.829
204Pb/206Pb		0.0726	0.114	0.116	0.0424	0.108	0.0142	0.0574
204Pb/206Pb	1 s.e.	0.0292	0.060	0.062	0.0302	0.063	0.0074	0.0316
Th/U	mass	1.39	0.427	0.560	0.912	0.801	1.84	0.673
U	ppm	830	179	99.2	298	263	4490	227

Sample name		U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42
Age [Ma] 206Pb/238U		0.872	0.698	0.628	0.557	0.602	0.131	0.287
Age [Ma] 206Pb/238U	1 s.e.	0.508	0.352	0.779	0.224	0.392	0.577	0.626
Radiogenic 206Pb [%]		36.6	35.8	20.0	21.6	26.7	2.28	8.34
206Pb/238U		0.000333	0.000263	0.000418	0.000360	0.000296	0.000260	0.000357
206Pb/238U	1 s.e.	0.000060	0.000045	0.000069	0.000025	0.000034	0.000050	0.000050
207Pb/235U		0.0255	0.0204	0.0396	0.0335	0.0258	0.0297	0.0384
207Pb/235U	1 s.e.	0.0061	0.0037	0.0117	0.0029	0.0059	0.0087	0.0098
207Pb/206Pb/		0.554	0.560	0.687	0.674	0.634	0.829	0.780
207Pb/206Pb/	1 s.e.	0.089	0.084	0.094	0.048	0.126	0.136	0.129
Correlation of Concordia Ellipses		0.739	0.636	0.984	0.590	0.499	0.853	0.796
204Pb/206Pb		0.0414	0.0409	0.0105	0.0688	b.d.	0.109	0.0559
204Pb/206Pb	1 s.e.	0.0272	0.0317	0.0128	0.0232	b.d.	0.056	0.0434
Th/U	mass	0.916	0.683	0.793	2.06	0.620	0.619	0.524
U	ppm	200	237	182	449	212	231	154

Appendix A

Supplementary Table S2: U-Pb measurements on zircons (Nov 2020).

Sample name		U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42	U1518E 1H6 32-42
Age [Ma] 206Pb/238U		1.38	1.10	0.906	0.473	1.20	1.13	0.708
Age [Ma] 206Pb/238U	1 s.e.	0.74	0.30	0.446	0.566	0.58	0.60	0.170
Radiogenic 206Pb [%]		39.1	48.9	33.1	16.0	37.4	36.5	50.6
206Pb/238U		0.000510	0.000324	0.000382	0.000375	0.000458	0.000438	0.000192
206Pb/238U	1 s.e.	0.000082	0.000034	0.000045	0.000069	0.000074	0.000043	0.000017
207Pb/235U		0.0375	0.0204	0.0306	0.0372	0.0346	0.0335	0.0117
207Pb/235U	1 s.e.	0.0094	0.0038	0.0061	0.0065	0.0062	0.0098	0.0023
207Pb/206Pb/		0.534	0.455	0.582	0.719	0.548	0.554	0.441
207Pb/206Pb/	1 s.e.	0.073	0.060	0.133	0.122	0.030	0.135	0.075
Correlation of Concordia Ellipses		0.869	0.729	0.0372	0.545	0.952	0.628	0.511
204Pb/206Pb		0.0772	0.0301	b.d.	0.0422	0.0326	0.0195	0.0186
204Pb/206Pb	1 s.e.	0.0391	0.0185	b.d.	0.0370	0.0327	0.0195	0.0186
Th/U	mass	0.540	1.21	0.684	0.897	0.652	0.559	1.10
U	ppm	169	472	247	221	156	206	451

Sample name		U1518E 2H1 121-126	U1518E 2H1 121-126	U1518E 2H1 121-126	U1518E 2H1 121-126	U1518E 2H1 121-126	U1518E 3H3 26-40	U1518E 3H3 26-40
Age [Ma] 206Pb/238U		0.454	0.622	0.849	1.11	0.454	0.376	0.610
Age [Ma] 206Pb/238U	1 s.e.	0.056	0.106	0.765	0.86	0.512	0.108	0.137
Radiogenic 206Pb [%]		64.2	59.3	17.2	22.6	11.1	38.9	51.1
206Pb/238U		0.0000909	0.000140	0.000678	0.000698	0.000509	0.000115	0.000160
206Pb/238U	1 s.e.	0.0000058	0.000014	0.000082	0.000098	0.000048	0.000009	0.000019
207Pb/235U		0.00417	0.00718	0.0662	0.0641	0.0531	0.00851	0.00962
207Pb/235U	1 s.e.	0.00076	0.00101	0.0101	0.0105	0.0075	0.00164	0.00114
207Pb/206Pb/		0.333	0.372	0.709	0.666	0.758	0.536	0.438
207Pb/206Pb/	1 s.e.	0.054	0.050	0.090	0.095	0.053	0.080	0.034
Correlation of Concordia Ellipses		0.494	0.427	0.595	0.576	0.899	0.689	0.780
204Pb/206Pb		0.0267	b.d.	0.0885	0.0633	0.0646	0.0488	0.0175
204Pb/206Pb	1 s.e.	0.0163	b.d.	0.0429	0.0369	0.0307	0.0256	0.0135
Th/U	mass	1.19	0.843	0.495	0.657	0.768	0.861	0.941
U	ppm	891	461	89.2	75.4	204	489	361

Appendix A

Supplementary Table S2: U-Pb measurements on zircons (Nov 2020).

Sample name		U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40
Age [Ma] 206Pb/238U		0.523	0.395	0.494	0.598	0.424	0.474	0.638
Age [Ma] 206Pb/238U	1 s.e.	0.092	0.680	0.050	0.077	0.225	0.059	0.042
Radiogenic 206Pb [%]		68.5	5.77	61.3	73.8	37.6	58.8	90.9
206Pb/238U		0.000103	0.000816	0.000108	0.000110	0.000136	0.000106	0.0000947
206Pb/238U	1 s.e.	0.000012	0.000057	0.000006	0.000007	0.000019	0.000007	0.0000059
207Pb/235U		0.00424	0.0901	0.00529	0.00387	0.0102	0.00549	0.00155
207Pb/235U	1 s.e.	0.00094	0.0104	0.00051	0.00111	0.0035	0.00065	0.00032
207Pb/206Pb/		0.298	0.801	0.356	0.256	0.546	0.376	0.119
207Pb/206Pb/	1 s.e.	0.049	0.064	0.026	0.066	0.171	0.041	0.022
Correlation of Concordia Ellipses		0.694	0.734	0.660	0.514	0.383	0.430	0.511
204Pb/206Pb		0.0113	0.0636	0.0162	0.0225	0.0324	0.0320	0.0285
204Pb/206Pb	1 s.e.	0.0113	0.0167	0.0093	0.0138	0.0283	0.0177	0.0165
Th/U	mass	1.58	0.678	1.60	1.23	0.516	1.39	1.01
U	ppm	853	287	1400	906	279	601	863

Sample name		U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40
Age [Ma] 206Pb/238U		0.575	0.595	0.580	0.584	0.685	0.538	0.586
Age [Ma] 206Pb/238U	1 s.e.	0.116	0.110	0.112	0.062	0.063	0.236	0.083
Radiogenic 206Pb [%]		51.8	70.7	57.6	71.4	66.6	42.0	61.7
206Pb/238U		0.000144	0.000118	0.000134	0.000111	0.000144	0.000165	0.000126
206Pb/238U	1 s.e.	0.000013	0.000010	0.000011	0.000008	0.000006	0.000026	0.000011
207Pb/235U		0.00854	0.00456	0.00712	0.00420	0.00623	0.0116	0.00612
207Pb/235U	1 s.e.	0.00151	0.00166	0.00161	0.00063	0.00086	0.0030	0.00083
207Pb/206Pb/		0.432	0.281	0.385	0.276	0.314	0.511	0.353
207Pb/206Pb/	1 s.e.	0.055	0.081	0.068	0.031	0.036	0.091	0.045
Correlation of Concordia Ellipses		0.739	0.935	0.733	0.687	0.650	0.735	0.420
204Pb/206Pb		0.0153	0.0129	0.0785	0.0107	0.0310	0.0478	0.0362
204Pb/206Pb	1 s.e.	0.0154	0.0091	0.0344	0.0107	0.0141	0.0340	0.0233
Th/U	mass	0.531	1.95	1.03	1.30	1.64	0.728	0.878
U	ppm	306	1450	444	605	1190	261	531

Appendix A

Supplementary Table S2: U-Pb measurements on zircons (Nov 2020).

Sample name		U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 3H3 26-40	U1518E 5H2 66-70	U1518E 5H2 66-70	U1518E 5H2 66-70
Age [Ma] 206Pb/238U		0.365	0.709	0.564	0.670	0.394	0.608	0.556
Age [Ma] 206Pb/238U	1 s.e.	0.149	0.488	0.068	0.142	0.145	0.097	0.021
Radiogenic 206Pb [%]		26.5	45.9	73.8	52.1	41.8	74.8	93.5
206Pb/238U		0.000156	0.000210	0.000102	0.000177	0.000111	0.000107	0.0000802
206Pb/238U	1 s.e.	0.000016	0.000066	0.000009	0.000020	0.000014	0.000011	0.0000029
207Pb/235U		0.0137	0.0138	0.00361	0.0105	0.00787	0.00366	0.00108
207Pb/235U	1 s.e.	0.0019	0.0043	0.00066	0.0012	0.00208	0.00115	0.00018
207Pb/206Pb/		0.634	0.479	0.256	0.430	0.513	0.248	0.0980
207Pb/206Pb/	1 s.e.	0.059	0.058	0.038	0.047	0.155	0.066	0.0152
Correlation of Concordia Ellipses		0.748	0.927	0.582	0.538	-0.0982	0.582	0.438
204Pb/206Pb		0.0400	0.0366	0.00830	0.00907	0.102	0.0180	0.0126
204Pb/206Pb	1 s.e.	0.0315	0.0213	0.00831	0.00791	0.063	0.0128	0.0060
Th/U	mass	0.442	0.793	1.23	1.22	0.564	0.737	1.39
U	ppm	205	370	994	657	143	573	2660

Sample name		U1518E 5H2 66-70	U1518E 5H2 66-70	U1518E 5H2 66-70	U1518E 5H2 66-70	U1518E 5H2 66-70	U1518E 5H2 66-70	U1518E 5H2 66-70
Age [Ma] 206Pb/238U		0.648	0.599	0.519	0.558	0.580	0.542	0.635
Age [Ma] 206Pb/238U	1 s.e.	0.081	0.103	0.063	0.024	0.048	0.019	0.070
Radiogenic 206Pb [%]		79.8	72.6	67.8	94.0	74.5	95.7	79.0
206Pb/238U		0.000108	0.000108	0.0000984	0.0000811	0.000109	0.0000783	0.000108
206Pb/238U	1 s.e.	0.000011	0.000011	0.0000069	0.0000033	0.000006	0.0000028	0.000008
207Pb/235U		0.00309	0.00395	0.00412	0.00105	0.00378	0.000867	0.00318
207Pb/235U	1 s.e.	0.00075	0.00134	0.00081	0.00020	0.00048	0.000093	0.00084
207Pb/206Pb/		0.208	0.266	0.304	0.0942	0.250	0.0802	0.214
207Pb/206Pb/	1 s.e.	0.048	0.089	0.052	0.0155	0.021	0.0068	0.057
Correlation of Concordia Ellipses		0.341	0.175	0.518	0.716	0.860	0.728	0.115
204Pb/206Pb		0.0809	0.0171	0.0168	0.00489	0.0168	0.00732	0.0143
204Pb/206Pb	1 s.e.	0.0366	0.0172	0.0169	0.00301	0.0047	0.00339	0.0143
Th/U	mass	0.613	0.551	0.776	1.65	2.11	1.94	0.879
U	ppm	289	284	384	4280	4290	4710	415

Appendix A

Supplementary Table S2: U-Pb measurements on zircons (Nov 2020).

Sample name		U1518E 5H2 66-70	U1518E 5H2 66-70	U1518E 5H2 66-70	U1518E 5H2 66-70	U1518E 5H2 66-70	U1518E 5H2 66-70	U1518E 5H2 66-70
Age [Ma] 206Pb/238U		0.605	0.546	0.553	0.614	0.480	0.558	0.618
Age [Ma] 206Pb/238U	1 s.e.	0.036	0.020	0.031	0.048	0.145	0.099	0.038
Radiogenic 206Pb [%]		89.2	93.3	89.5	78.3	49.5	63.1	91.2
206Pb/238U		0.0000895	0.0000772	0.0000837	0.000107	0.000121	0.000115	0.0000919
206Pb/238U	1 s.e.	0.0000049	0.0000029	0.0000041	0.000006	0.000013	0.000011	0.0000051
207Pb/235U		0.00163	0.00106	0.00151	0.00325	0.00753	0.00541	0.00148
207Pb/235U	1 s.e.	0.00031	0.00010	0.00028	0.00055	0.00216	0.00129	0.00036
207Pb/206Pb/		0.132	0.0995	0.131	0.220	0.450	0.342	0.116
207Pb/206Pb/	1 s.e.	0.022	0.0102	0.023	0.033	0.104	0.059	0.026
Correlation of Concordia Ellipses		0.565	0.00957	0.360	0.526	0.656	0.793	0.515
204Pb/206Pb		b.d.	0.00586	0.00540	0.0202	0.0998	0.0231	0.00379
204Pb/206Pb	1 s.e.	b.d.	0.00358	0.00540	0.0117	0.0506	0.0168	0.00458
Th/U	mass	0.725	1.06	1.51	1.40	0.630	0.676	1.20
U	ppm	1270	3470	1350	913	229	338	1410

Sample name		U1520D 26F4 0-57	U1520D 26F4 0-57	U1520D 26F4 0-57	U1520D 26F4 0-57	U1520D 26F4 0-57	U1520D 26F4 0-57	U1520D 27F3 0-11
Age [Ma] 206Pb/238U		0.391	0.298	0.408	0.346	0.383	0.633	0.314
Age [Ma] 206Pb/238U	1 s.e.	0.038	0.014	2.130	0.027	0.087	0.257	0.038
Radiogenic 206Pb [%]		77.4	94.0	14.1	86.9	83.7	51.2	75.6
206Pb/238U		0.0000606	0.0000371	0.000343	0.0000454	0.0000558	0.000164	0.0000503
206Pb/238U	1 s.e.	0.0000046	0.0000021	0.000229	0.0000035	0.0000129	0.000025	0.0000037
207Pb/235U		0.00190	0.000482	0.0347	0.000943	0.00136	0.00986	0.00168
207Pb/235U	1 s.e.	0.00043	0.000091	0.0280	0.000267	0.00049	0.00368	0.00054
207Pb/206Pb/		0.227	0.0943	0.734	0.151	0.177	0.437	0.242
207Pb/206Pb/	1 s.e.	0.047	0.0175	0.111	0.042	0.077	0.137	0.067
Correlation of Concordia Ellipses		0.415	0.226	0.997	0.221	-0.0485	0.563	0.662
204Pb/206Pb		0.0207	0.0347	0.0177	0.00911	0.0554	0.00735	0.0219
204Pb/206Pb	1 s.e.	0.0208	0.0168	0.0117	0.01110	0.0363	0.00491	0.0155
Th/U	mass	0.781	1.39	0.531	0.679	1.05	0.643	1.53
U	ppm	421	1610	262	889	482	409	883

Appendix A

Supplementary Table S2: U-Pb measurements on zircons (Nov 2020).

Sample name		U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11
Age [Ma] 206Pb/238U		0.366	0.337	1.21	0.245	0.302	0.387	0.344
Age [Ma] 206Pb/238U	1 s.e.	0.016	0.034	4.14	0.060	0.090	0.110	0.095
Radiogenic 206Pb [%]		91.6	77.9	4.57	46.0	51.0	54.5	56.7
206Pb/238U		0.0000488	0.0000499	0.00385	0.0000536	0.0000688	0.0000881	0.0000707
206Pb/238U	1 s.e.	0.0000022	0.0000044	0.00048	0.0000052	0.0000076	0.0000107	0.0000127
207Pb/235U		0.000764	0.00154	0.430	0.00354	0.00416	0.00499	0.00383
207Pb/235U	1 s.e.	0.000140	0.00034	0.050	0.00092	0.00137	0.00157	0.00089
207Pb/206Pb/		0.113	0.223	0.811	0.479	0.439	0.411	0.393
207Pb/206Pb/	1 s.e.	0.022	0.050	0.016	0.128	0.145	0.095	0.109
Correlation of Concordia Ellipses		-0.168	0.163	0.989	0.101	0.156	0.796	0.112
204Pb/206Pb		0.0152	0.0366	0.0539	0.158	0.0315	b.d.	0.0954
204Pb/206Pb	1 s.e.	0.0152	0.0284	0.0062	0.072	0.0317	b.d.	0.0754
Th/U	mass	1.21	0.874	1.33	0.874	1.27	1.19	0.894
U	ppm	1310	581	322	346	191	136	183

Sample name		U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11
Age [Ma] 206Pb/238U		0.395	0.341	0.340	0.264	0.355	0.316	0.331
Age [Ma] 206Pb/238U	1 s.e.	0.091	0.065	0.030	0.051	0.037	0.045	0.110
Radiogenic 206Pb [%]		62.5	67.0	76.1	49.6	80.2	68.7	48.0
206Pb/238U		0.0000748	0.0000568	0.0000541	0.0000540	0.0000513	0.0000512	0.0000790
206Pb/238U	1 s.e.	0.0000122	0.0000069	0.0000035	0.0000047	0.0000046	0.0000049	0.0000090
207Pb/235U		0.00357	0.00243	0.00177	0.00335	0.00145	0.00209	0.00504
207Pb/235U	1 s.e.	0.00082	0.00087	0.00036	0.00075	0.00040	0.00059	0.00171
207Pb/206Pb/		0.346	0.310	0.238	0.450	0.205	0.297	0.463
207Pb/206Pb/	1 s.e.	0.058	0.100	0.040	0.107	0.058	0.080	0.138
Correlation of Concordia Ellipses		0.682	0.450	0.621	0.0124	0.0353	0.279	0.518
204Pb/206Pb		0.112	b.d.	0.00752	0.0769	0.00898	0.00570	0.222
204Pb/206Pb	1 s.e.	0.068	b.d.	0.00753	0.0427	0.01600	0.01010	0.102
Th/U	mass	0.614	0.521	1.32	0.698	0.753	0.773	0.870
U	ppm	219	276	1220	326	487	504	164

Appendix A

Supplementary Table S2: U-Pb measurements on zircons (Nov 2020).

Sample name		U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 27F3 0-11	U1520D 50X-CC	U1520D 50X-CC	U1520D 50X-CC
Age [Ma] 206Pb/238U		0.287	1.47	0.252	0.303	1.69	1.56	1.66
Age [Ma] 206Pb/238U	1 s.e.	0.060	4.65	0.072	0.038	0.06	1.47	0.30
Radiogenic 206Pb [%]		55.7	3.81	43.4	68.0	83.8	4.60	14.4
206Pb/238U		0.0000544	0.00563	0.0000596	0.0000500	0.000297	0.00500	0.00169
206Pb/238U	1 s.e.	0.0000070	0.00050	0.0000069	0.0000041	0.000007	0.00016	0.00003
207Pb/235U		0.00301	0.633	0.00411	0.00208	0.00711	0.552	0.168
207Pb/235U	1 s.e.	0.00073	0.061	0.00104	0.00049	0.00062	0.019	0.004
207Pb/206Pb/		0.401	0.817	0.499	0.302	0.174	0.799	0.722
207Pb/206Pb/	1 s.e.	0.080	0.011	0.121	0.068	0.015	0.004	0.018
Correlation of Concordia Ellipses		0.570	0.993	0.330	0.308	0.225	0.989	0.349
204Pb/206Pb		0.0435	0.0542	0.250	0.103	0.0682	0.0520	0.0520
204Pb/206Pb	1 s.e.	0.0438	0.0042	0.106	0.054	0.0068	0.0018	0.0039
Th/U	mass	0.676	0.842	0.928	0.960	0.727	1.15	0.612
U	ppm	204	465	371	409	624	483	254

Appendix A

Supplementary Table S2: U-Pb measurements on zircons (Nov 2020).

Sample preparation and treatment before SIMS analysis	Work procedure (<i>for Epoxy Mounts</i>) 1. Ground down & polished with SiC paper (FEPA# 800, 1200, 2400, 4000) & diamond paste (1µm, 1/4µm) 2. Cleaned with distilled water & methanol (before CL imaging at SEM) 3. Carbon-coated (Quorum Q150T ES); thickness of carbon coating: 18 nm 4. CL imaged at SEM 5. Carbon-coating removed by polishing 6. Cleaned with EDTA+NH₃, distilled water & methanol (before SIMS analysis) 7. Gold-coated (Quorum Q150T ES); Thickness of gold coating: 50 nm
Information about the zircons	Zircons were imaged with CL prior to analysis. Zircons show oscillatory and sector zoning typical of magmatic zircon. Ion probe spots preferentially targeted CL dark domains because these typically have higher U abundances
Number of analyzed standards	66
Analytical conditions (U-Pb)	Beam diameter: ~15 µm (Köhler Ap.: 200 µm) Primary beam intensity: U-Th ~8 nA Secondary beam transmission (field aperture): 3000 µm Mass resolution (M/DM): ~5000 Raster conditions: U-Pb 10 µm, 20 s
Software to calculate ages	ZIPS 3.1.1 (data reduction) IsoplotR (regression and intercept ages)
Method to calculate age	linear regression of Pb-uncorrected ²³⁸ U/ ²⁰⁶ Pb and ²⁰⁷ Pb/ ²⁰⁶ Pb (Schmitt et al. 2003)
Primordial lead model	common Pb composition of Stacey and Kramers (1975) for ages of standards and ²⁰⁷ Pb/ ²⁰⁶ Pb = 0.8469 for unknowns (modern surface contamination)
Statistical test	MSWD
Primary calibration	U-Pb: UO₂/U vs. U/Pb calibration using Temora 2 (417 Ma, Black et al., 2004), m = 0.619, b = 0.956, n = 66, rel. uncertainty = 1.6% (1 s.d.) Th-U: relative sensitivity factor = 0.617 U conc.: U/⁹⁴Zr₂O using 91500 (81 ppm U), relative sensitivity factor = 0.00598
Secondary reference	U-Pb: 91500 = 1061±8Ma (n = 10) relative to 1065 Ma (Wiedenbeck et al., 1995)
References	Black, L. P., Kamo, S. L., Allen, C. M., Davis, D. W., Aleinikoff, J. N., Valley, J. W., Mundil, R., Campbell, I. H., Korsch, R. J., Williams, I. S. & Foudoulis, C. (2004). Improved ²⁰⁶Pb/²³⁸U microprobe geochronology by the monitoring of a trace-element-related matrix effect; SHRIMP, ID-TIMS, ELA-ICP-MS and oxygen isotope documentation for a series of zircon standards. <i>Chemical Geology</i>, 205(1-2), 115-140. Paces JB, Miller JD, Jr. (1993) Precise U-Pb ages of Duluth Complex and related mafic intrusions, northeastern Minnesota: geochronological insights to physical, petrogenetic, paleomagnetic, and tectonomagnetic processes associated with the 1.1 Ga Midcontinent Rift System. <i>Journal of Geophysical Research</i> 98(13):997-914. Schmitt, A. K., Grove, M., Harrison, T. M., Lovera, O., Hulen, J., & Walters, M. (2003). The Geysers-Cobb Mountain Magma System, California (Part 1): U-Pb zircon ages of volcanic rocks, conditions of zircon crystallization and magma residence times. <i>Geochimica et Cosmochimica Acta</i>, 67(18), 3423-3442. Schmitt, A. K. (2011). Uranium series accessory crystal dating of magmatic processes. <i>Annual Review of Earth and Planetary Sciences</i>, 39, 321-349. Stacey, J. T., & Kramers, I. (1975). Approximation of terrestrial lead isotope evolution by a two-stage model. <i>Earth and planetary science letters</i>, 26(2), 207-221. Vermeech, P. (2018). IsoplotR: A free and open toolbox for geochronology. <i>Geoscience Frontiers</i>, 9(5), 1479-1493. Wiedenbeck M., Allé P., Corfu F., Griffin W.L., Meier M., Oberli F., von Quadt A., Roddick J.C., Spiegel W. (1995) Three natural zircon standards for U–Th–Pb, Lu–Hf, trace element and REE analyses. <i>Geostand. News</i>, 19, 1–23.

Appendix A

Supplementary Table S3: U-Pb measurements on zircons (Oct 2022).

Sample name		U1520D 50X- CC	U1520D 50X- CC	U1520D 50X- CC
Age [Ma] 206Pb/238U		1.69	1.56	1.66
Age [Ma] 206Pb/238U	1 s.e.	0.06	1.47	0.30
Radiogenic 206Pb [%]		83.8	4.60	14.4
206Pb/238U		0.000297	0.00500	0.00169
206Pb/238U	1 s.e.	0.000007	0.00016	0.00003
207Pb/235U		0.00711	0.552	0.168
207Pb/235U	1 s.e.	0.00062	0.019	0.004
207Pb/206Pb/		0.174	0.799	0.722
207Pb/206Pb/	1 s.e.	0.015	0.004	0.018
Correlation of Concordia Ellipses		0.225	0.989	0.349
204Pb/206Pb		0.0682	0.0520	0.0520
204Pb/206Pb	1 s.e.	0.0068	0.0018	0.0039
Th/U	mass	0.727	1.15	0.612
U	ppm	624	483	254

Appendix A

Supplementary Table S3: U-Pb measurements on zircons (Oct 2022).

Sample preparation and treatment before SIMS analysis	Work procedure (<i>for Epoxy Mounts</i>) 1. Ground down & polished with SiC paper (FEPA# 800, 1200, 2400, 4000) & diamond paste (1µm, 1/4µm) 2. Cleaned with distilled water & methanol (before CL imaging at SEM) 3. Carbon-coated (Quorum Q150T ES); thickness of carbon coating: 18 nm 4. CL imaged at SEM 5. Carbon-coating removed by polishing 6. Cleaned with EDTA+NH₃, distilled water & methanol (before SIMS analysis) 7. Gold-coated (Quorum Q150T ES); Thickness of gold coating: 50 nm
Information about the zircons	Zircons were imaged with CL prior to analysis. Zircons show oscillatory and sector zoning typical of magmatic zircon. Ion probe spots preferentially targeted CL dark domains because these typically have higher U abundances
Number of analyzed standards	66
Analytical conditions (U-Pb)	Beam diameter: ~15 µm (Köhler Ap.: 200 µm) Primary beam intensity: U-Th ~8 nA Secondary beam transmission (field aperture): 3000 µm Mass resolution (M/DM): ~5000 Raster conditions: U-Pb 10 µm, 20 s
Software to calculate ages	ZIPS 3.1.1 (data reduction) IsoplotR (regression and intercept ages)
Method to calculate age	linear regression of Pb-uncorrected ²³⁸ U/ ²⁰⁶ Pb and ²⁰⁷ Pb/ ²⁰⁶ Pb (Schmitt et al. 2003)
Primordial lead model	common Pb composition of Stacey and Kramers (1975) for ages of standards and ²⁰⁷ Pb/ ²⁰⁶ Pb = 0.8469 for unknowns (modern surface contamination)
Statistical test	MSWD
Primary calibration	U-Pb: UO₂/U vs. U/Pb calibration using Temora 2 (417 Ma, Black et al., 2004), m = 0.619, b = 0.956, n = 66, rel. uncertainty = 1.6% (1 s.d.) Th-U: relative sensitivity factor = 0.617 U conc.: U/⁹⁴Zr₂O using 91500 (81 ppm U), relative sensitivity factor = 0.00598
Secondary reference	U-Pb: 91500 = 1061±8Ma (n = 10) relative to 1065 Ma (Wiedenbeck et al., 1995)
References	Black, L. P., Kamo, S. L., Allen, C. M., Davis, D. W., Aleinikoff, J. N., Valley, J. W., Mundil, R., Campbell, I. H., Korsch, R. J., Williams, I. S. & Foudoulis, C. (2004). Improved ²⁰⁶Pb/²³⁸U microprobe geochronology by the monitoring of a trace-element-related matrix effect; SHRIMP, ID-TIMS, ELA-ICP-MS and oxygen isotope documentation for a series of zircon standards. <i>Chemical Geology</i>, 205(1-2), 115-140. Paces JB, Miller JD, Jr. (1993) Precise U-Pb ages of Duluth Complex and related mafic intrusions, northeastern Minnesota: geochronological insights to physical, petrogenetic, paleomagnetic, and tectonomagnetic processes associated with the 1.1 Ga Midcontinent Rift System. <i>Journal of Geophysical Research</i> 98(13):997-914. Schmitt, A. K., Grove, M., Harrison, T. M., Lovera, O., Hulen, J., & Walters, M. (2003). The Geysers-Cobb Mountain Magma System, California (Part 1): U-Pb zircon ages of volcanic rocks, conditions of zircon crystallization and magma residence times. <i>Geochimica et Cosmochimica Acta</i>, 67(18), 3423-3442. Schmitt, A. K. (2011). Uranium series accessory crystal dating of magmatic processes. <i>Annual Review of Earth and Planetary Sciences</i>, 39, 321-349. Stacey, J. T., & Kramers, I. (1975). Approximation of terrestrial lead isotope evolution by a two-stage model. <i>Earth and planetary science letters</i>, 26(2), 207-221. Vermeech, P. (2018). IsoplotR: A free and open toolbox for geochronology. <i>Geoscience Frontiers</i>, 9(5), 1479-1493. Wiedenbeck M., Allé P., Corfu F., Griffin W.L., Meier M., Oberli F., von Quadt A., Roddick J.C., Spiegel W. (1995) Three natural zircon standards for U–Th–Pb, Lu–Hf, trace element and REE analyses. <i>Geostand. News</i>, 19, 1–23.

Appendix A

Supplementary Table S4: EMP standard measurements on reference material Lipari Obsidian.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
20.11.2019	Lipari	3.99	5.10	1.46	74.51	0.09	0.01	0.69	0.11	13.34	0.01	99.32
	Lipari	3.91	5.12	1.50	74.55	0.08	0.07	0.75	0.10	13.57	0.00	99.65
	Lipari	4.22	5.13	1.40	74.05	0.09	0.02	0.73	0.10	13.40	0.01	99.14
	Lipari	4.02	5.11	1.39	74.11	0.07	0.04	0.75	0.04	13.39	0.00	98.92
	Lipari	3.60	5.08	1.53	73.86	0.09	0.02	0.74	0.13	13.06	0.00	98.11
	Lipari	4.05	5.08	1.61	73.83	0.07	0.01	0.77	0.05	13.32	0.01	98.80
	Lipari	4.01	5.19	1.47	74.91	0.12	0.04	0.73	0.13	13.17	0.00	99.77
	Lipari	3.96	5.12	1.40	74.80	0.09	0.07	0.73	0.06	13.07	0.03	99.33
	Lipari	3.82	5.12	1.68	74.09	0.07	0.04	0.76	0.03	13.05	0.03	98.69
	Lipari	3.97	5.14	1.40	74.40	0.08	0.05	0.78	0.06	12.94	0.01	98.83
	Lipari	4.08	5.06	1.66	74.38	0.09	0.03	0.77	0.08	13.15	0.01	99.30
	Lipari	3.99	5.13	1.68	73.85	0.06	0.03	0.72	0.09	13.16	0.01	98.71
	Lipari	3.90	5.04	1.41	74.13	0.10	0.02	0.80	0.01	13.08	0.02	98.51
	Lipari	3.99	5.11	1.36	74.62	0.08	0.01	0.75	0.07	13.28	0.00	99.27
	Lipari	3.91	5.08	1.55	74.31	0.11	0.04	0.75	0.09	12.98	0.00	98.81
21.11.2019	Lipari	4.01	5.12	1.61	73.62	0.12	0.02	0.73	0.07	13.15	0.00	98.46
	Lipari	3.93	5.10	1.65	74.66	0.08	0.00	0.79	0.02	13.28	0.01	99.52
	Lipari	3.87	5.05	1.38	74.31	0.06	0.02	0.80	0.04	13.10	0.03	98.65
	Lipari	3.81	5.11	1.45	74.07	0.07	0.01	0.73	0.09	13.36	0.01	98.71
	Lipari	3.92	5.08	1.57	73.95	0.08	0.05	0.76	0.07	13.18	0.00	98.66
	Lipari	4.25	5.13	1.42	74.31	0.07	0.04	0.73	0.08	13.18	0.00	99.21
	Lipari	3.97	5.10	1.63	74.28	0.07	0.01	0.75	0.13	13.34	0.00	99.27
	Lipari	4.00	5.04	1.44	74.02	0.08	0.01	0.80	0.08	13.28	0.00	98.75
	Lipari	3.90	5.03	1.61	74.55	0.06	0.04	0.76	0.11	13.39	0.03	99.49
	Lipari	4.03	5.04	1.71	74.18	0.06	0.06	0.75	0.03	13.41	0.01	99.28
	Lipari	3.99	5.08	1.39	74.02	0.08	0.03	0.69	0.11	13.17	0.02	98.58
	Lipari	3.92	5.12	1.49	74.16	0.08	0.04	0.73	0.05	13.37	0.04	99.00
	Lipari	4.01	5.08	1.72	74.19	0.07	0.03	0.76	0.08	13.48	0.00	99.42
	Lipari	3.91	5.13	1.59	73.75	0.07	0.02	0.72	0.00	13.10	0.04	98.32
	Lipari	4.02	5.15	1.55	74.30	0.07	0.05	0.66	0.04	13.10	0.03	98.97
	Lipari	4.05	5.10	1.48	73.96	0.08	0.03	0.74	0.11	13.21	0.00	98.75
22.11.2019	Lipari	3.91	5.09	1.54	73.94	0.08	0.06	0.77	0.07	13.19	0.02	98.67
	Lipari	4.03	5.11	1.49	74.04	0.09	0.05	0.74	0.08	13.28	0.00	98.92
	Lipari	4.00	5.09	1.56	73.60	0.07	0.02	0.73	0.02	12.98	0.00	98.07
	Lipari	3.96	5.08	1.39	74.15	0.10	0.01	0.72	0.12	13.21	0.00	98.75
	Lipari	3.97	5.13	1.50	73.94	0.08	0.02	0.70	0.08	13.04	0.00	98.47
	Lipari	4.06	5.12	1.49	74.11	0.08	0.06	0.74	0.06	13.29	0.01	99.02
	Lipari	3.94	4.99	1.64	73.88	0.11	0.02	0.77	0.07	13.25	0.02	98.68
	Lipari	3.88	5.06	1.52	73.87	0.09	0.02	0.76	0.02	12.93	0.02	98.18
	Lipari	3.90	5.00	1.59	74.13	0.05	0.05	0.74	0.08	13.27	0.03	98.85
	Lipari	3.91	5.09	1.66	74.28	0.06	0.00	0.76	0.07	13.39	0.00	99.23
	Lipari	3.92	5.03	1.65	73.97	0.06	0.02	0.78	0.12	13.14	0.01	98.69
	Lipari	4.02	5.02	1.58	74.03	0.09	0.06	0.74	0.11	13.09	0.03	98.76
	Lipari	4.01	5.05	1.54	73.82	0.08	0.01	0.74	0.08	13.14	0.01	98.48
	Lipari	4.06	5.10	1.51	74.30	0.09	0.00	0.76	0.05	13.42	0.04	99.32
	Lipari	4.05	5.16	1.59	75.19	0.08	0.04	0.78	0.08	13.69	0.03	100.68
	Lipari	3.67	5.05	1.54	74.46	0.09	0.02	0.72	0.06	13.51	0.02	99.15
25.11.2019	Lipari	3.95	5.10	1.51	74.46	0.08	0.00	0.76	0.10	13.58	0.00	99.54
	Lipari	4.13	5.09	1.58	74.02	0.08	0.05	0.75	0.03	13.14	0.00	98.86
	Lipari	4.14	5.07	1.51	74.38	0.08	0.04	0.77	0.04	13.46	0.00	99.48
	Lipari	3.87	5.03	1.31	75.07	0.07	0.00	0.76	0.03	13.42	0.01	99.57
	Lipari	4.02	5.13	1.53	74.57	0.07	0.04	0.69	0.00	13.49	0.02	99.57
	Lipari	4.03	5.06	1.47	74.62	0.08	0.05	0.71	0.07	13.29	0.02	99.40
	Lipari	3.87	5.09	1.53	74.03	0.12	0.05	0.74	0.05	12.98	0.01	98.46
	Lipari	3.99	5.14	1.48	75.24	0.06	0.07	0.77	0.11	13.34	0.00	100.20
	Lipari	4.15	5.10	1.63	75.13	0.10	0.00	0.75	0.09	13.40	0.01	100.36
	Lipari	4.06	5.09	1.48	75.36	0.10	0.04	0.73	0.10	13.44	0.00	100.40
	Lipari	3.82	5.15	1.59	75.44	0.08	0.05	0.76	0.00	13.18	0.00	100.07
	Lipari	3.83	5.13	1.49	75.80	0.07	0.01	0.75	0.08	13.26	0.01	100.43
	Lipari	3.87	5.05	1.51	75.09	0.07	0.03	0.75	0.12	13.33	0.02	99.84
	Lipari	4.01	5.09	1.59	75.55	0.11	0.00	0.76	0.08	13.39	0.00	100.59
	Lipari	4.02	5.08	1.48	75.15	0.07	0.05	0.76	0.07	13.31	0.00	99.99
16.12.2019	Lipari	4.00	5.13	1.65	74.16	0.09	0.06	0.77	0.10	13.17	0.00	99.13
	Lipari	3.90	5.17	1.70	73.85	0.08	0.05	0.62	0.08	13.25	0.02	98.72
	Lipari	3.86	5.12	1.57	74.21	0.07	0.03	0.70	0.04	13.00	0.00	98.60
	Lipari	3.94	5.07	1.66	74.40	0.06	0.06	0.79	0.07	12.99	0.01	99.04
	Lipari	3.92	5.12	1.48	73.06	0.08	0.03	0.64	0.05	13.14	0.02	97.54
	Lipari	4.00	5.11	1.66	74.79	0.06	0.03	0.71	0.03	13.05	0.00	99.44
	Lipari	3.77	5.13	1.70	72.36	0.08	0.05	0.72	0.14	13.07	0.00	97.04
	Lipari	3.80	5.07	1.61	72.26	0.08	0.06	0.75	0.10	13.12	0.03	96.88

Appendix A

Supplementary Table S4: EMP standard measurements on reference material Lipari Obsidian.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
17.12.2019	Lipari	3.92	5.09	1.67	73.87	0.06	0.03	0.79	0.07	12.88	0.01	98.40
	Lipari	3.92	5.12	1.57	73.89	0.05	0.02	0.80	0.02	13.00	0.01	98.39
	Lipari	3.84	5.11	1.42	74.71	0.09	0.01	0.72	0.02	12.88	0.00	98.80
	Lipari	3.85	5.10	1.52	74.91	0.09	0.04	0.80	0.07	12.95	0.01	99.33
	Lipari	3.90	5.02	1.66	74.61	0.07	0.00	0.80	0.13	12.90	0.02	99.11
	Lipari	4.01	5.06	1.57	74.35	0.05	0.03	0.74	0.12	13.00	0.00	98.93
	Lipari	3.97	5.05	1.64	74.65	0.08	0.04	0.76	0.09	13.13	0.00	99.41
	Lipari	3.84	5.07	1.68	74.31	0.07	0.03	0.74	0.08	12.92	0.02	98.77
	Lipari	3.93	5.06	1.79	75.05	0.12	0.05	0.75	0.04	12.95	0.00	99.75
	Lipari	3.84	5.10	1.68	74.83	0.07	0.02	0.77	0.09	13.12	0.00	99.54
	Lipari	3.35	5.03	1.53	74.82	0.10	0.06	0.77	0.05	13.11	0.00	98.82
	Lipari	3.79	5.08	1.73	74.28	0.07	0.03	0.77	0.05	12.97	0.00	98.77
	Lipari	3.82	5.11	1.57	74.86	0.09	0.04	0.78	0.01	13.01	0.00	99.28
	Lipari	3.87	5.05	1.38	74.36	0.09	0.04	0.77	0.13	12.72	0.00	98.41
	Lipari	3.77	5.07	1.46	75.19	0.05	0.00	0.72	0.05	13.08	0.00	99.40
	Lipari	3.84	5.07	1.72	74.36	0.08	0.05	0.75	0.10	13.05	0.01	99.03
	Lipari	3.94	5.04	1.75	74.66	0.08	0.02	0.76	0.06	13.25	0.02	99.59
	Lipari	3.96	5.13	1.49	74.92	0.06	0.02	0.76	0.08	13.11	0.02	99.54
	Lipari	3.66	5.04	1.46	74.89	0.07	0.02	0.81	0.00	12.96	0.00	98.92
	Lipari	4.09	5.07	1.50	74.70	0.07	0.03	0.77	0.04	12.88	0.02	99.17
19.12.2019	Lipari	3.94	5.05	1.74	74.16	0.04	0.07	0.74	0.04	12.96	0.01	98.74
	Lipari	3.90	5.08	1.49	73.51	0.07	0.01	0.73	0.15	12.99	0.00	97.94
	Lipari	3.75	5.04	1.52	73.43	0.09	0.01	0.79	0.06	13.10	0.01	97.79
	Lipari	3.73	5.06	1.49	74.19	0.08	0.04	0.76	0.09	13.03	0.02	98.48
	Lipari	3.84	5.02	1.65	74.47	0.08	0.02	0.75	0.07	13.15	0.00	99.05
	Lipari	3.79	5.06	1.47	73.87	0.09	0.02	0.78	0.08	12.90	0.03	98.09
	Lipari	3.85	5.10	1.61	74.33	0.06	0.04	0.75	0.04	13.04	0.00	98.82
	Lipari	3.89	5.11	1.56	72.51	0.09	0.01	0.76	0.08	13.06	0.05	97.12
	Lipari	4.18	5.05	1.53	73.40	0.10	0.02	0.79	0.12	13.00	0.01	98.21
	Lipari	3.90	5.12	1.53	73.40	0.07	0.02	0.75	0.12	13.06	0.00	97.96
	Lipari	3.91	5.11	1.59	73.52	0.09	0.04	0.77	0.11	13.18	0.00	98.31
	Lipari	3.95	5.09	1.50	73.51	0.07	0.02	0.75	0.09	13.26	0.00	98.24
	Lipari	3.84	4.97	1.74	74.09	0.07	0.04	0.78	0.00	12.80	0.01	98.34
	Lipari	3.80	5.01	1.70	73.72	0.08	0.03	0.75	0.05	12.76	0.01	97.92
	Lipari	3.78	5.11	1.72	73.67	0.07	0.04	0.73	0.15	12.73	0.00	97.99
24.01.2020	Lipari	3.76	5.05	1.60	73.94	0.08	0.07	0.74	0.06	12.69	0.00	97.99
	Lipari	3.75	5.07	1.76	74.26	0.10	0.01	0.73	0.00	12.77	0.00	98.45
	Lipari	3.79	5.11	1.49	73.76	0.08	0.03	0.78	0.04	12.78	0.01	97.87
	Lipari	3.98	5.05	1.61	73.43	0.10	0.02	0.78	0.04	12.88	0.02	97.90
	Lipari	3.86	5.07	1.60	73.60	0.09	0.01	0.75	0.02	12.99	0.00	98.00
	Lipari	3.70	5.02	1.60	72.88	0.08	0.06	0.75	0.04	12.87	0.02	97.02
	Lipari	3.73	5.04	1.71	73.82	0.07	0.02	0.78	0.07	12.72	0.00	97.96
	Lipari	3.76	5.03	1.61	73.70	0.09	0.07	0.73	0.11	12.86	0.01	97.97
	Lipari	3.93	5.10	1.35	73.58	0.09	0.02	0.76	0.06	12.63	0.01	97.52
	Lipari	4.05	5.05	1.64	73.41	0.08	0.00	0.74	0.01	12.86	0.00	97.84
	Lipari	3.78	5.05	1.44	73.65	0.09	0.03	0.82	0.01	12.90	0.02	97.79
	Lipari	3.88	5.08	1.62	73.91	0.09	0.04	0.81	0.06	12.64	0.05	98.19
	Lipari	4.04	5.03	1.54	74.28	0.07	0.03	0.75	0.00	12.78	0.00	98.51
	Lipari	3.65	5.06	1.61	73.82	0.08	0.02	0.80	0.09	12.84	0.01	97.97
	Lipari	3.93	5.05	1.63	73.46	0.06	0.06	0.78	0.06	12.82	0.00	97.84
14.02.2020	Lipari	3.73	5.12	1.59	73.75	0.09	0.03	0.77	0.06	12.91	0.00	98.06
	Lipari	3.80	5.08	1.48	74.58	0.09	0.03	0.74	0.07	12.65	0.00	98.52
	Lipari	3.68	5.06	1.72	74.57	0.08	0.04	0.77	0.15	12.45	0.00	98.53
	Lipari	3.71	5.04	1.64	73.86	0.08	0.03	0.76	0.01	12.85	0.00	97.98
	Lipari	3.90	5.13	1.60	75.74	0.09	0.01	0.75	0.06	13.07	0.00	100.36
	Lipari	3.75	5.16	1.50	75.29	0.08	0.03	0.81	0.14	13.28	0.00	100.05
	Lipari	3.81	5.10	1.60	75.66	0.08	0.03	0.75	0.07	12.89	0.00	99.99
	Lipari	3.88	5.12	1.43	75.33	0.07	0.05	0.75	0.12	12.96	0.00	99.71
	Lipari	4.01	5.13	1.61	75.19	0.10	0.06	0.75	0.04	12.80	0.00	99.70
	Lipari	4.00	5.16	1.55	75.84	0.09	0.02	0.72	0.04	12.86	0.01	100.29
	Lipari	3.92	5.04	1.58	75.48	0.05	0.02	0.73	0.08	13.00	0.02	99.93
	Lipari	4.06	0.84	0.88	84.16	0.07	0.02	1.25	0.08	8.67	0.00	100.04
	Lipari	4.01	5.16	1.56	75.64	0.08	0.03	0.62	0.03	12.79	0.00	99.92
	Lipari	3.80	5.07	1.89	75.77	0.10	0.00	0.73	0.12	12.48	0.02	99.98
	Lipari	3.93	5.06	1.49	74.99	0.05	0.04	0.75	0.09	12.71	0.02	99.14
	Lipari	3.66	5.08	1.63	74.50	0.06	0.03	0.77	0.06	12.72	0.00	98.51
	Lipari	3.84	5.07	1.50	74.73	0.12	0.03	0.77	0.12	12.81	0.00	98.98
	Lipari	3.91	5.14	1.71	74.55	0.06	0.05	0.74	0.08	12.75	0.02	99.01
	Lipari	3.87	5.11	1.57	73.49	0.09	0.01	0.76	0.05	12.55	0.03	97.52
	Lipari	3.65	5.08	1.60	73.45	0.11	0.04	0.77	0.09	12.62	0.00	97.40

Appendix A

Supplementary Table S4: EMP standard measurements on reference material Lipari Obsidian.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
25.02.2020	Lipari	3.63	5.10	1.68	73.42	0.10	0.06	0.75	0.10	12.50	0.00	97.35
	Lipari	3.75	5.09	1.61	73.28	0.09	0.04	0.74	0.03	12.71	0.01	97.35
	Lipari	3.71	5.08	1.65	74.36	0.11	0.04	0.76	0.09	13.13	0.00	98.93
	Lipari	3.76	5.12	1.62	74.23	0.08	0.03	0.77	0.13	13.07	0.00	98.80
	Lipari	4.02	5.13	1.53	75.22	0.11	0.05	0.80	0.11	13.17	0.03	100.16
	Lipari	3.66	4.99	1.81	74.26	0.10	0.02	0.78	0.04	13.03	0.00	98.69
	Lipari	3.67	5.04	1.55	74.21	0.09	0.04	0.77	0.05	13.04	0.01	98.47
	Lipari	3.79	5.02	1.56	73.67	0.12	0.02	0.75	0.03	13.09	0.00	98.06
	Lipari	3.77	5.05	1.54	74.49	0.05	0.04	0.74	0.12	12.87	0.00	98.66
	Lipari	3.60	5.00	1.77	73.59	0.07	0.03	0.74	0.03	12.89	0.02	97.74
	Lipari	3.95	5.07	1.58	74.51	0.11	0.02	0.78	0.10	12.87	0.00	98.97
	Lipari	3.94	5.09	1.54	74.20	0.07	0.01	0.76	0.01	13.03	0.00	98.65
	Lipari	3.73	5.03	1.44	74.03	0.06	0.00	0.76	0.00	12.99	0.05	98.09
	Lipari	3.92	5.05	1.68	74.05	0.07	0.04	0.79	0.10	12.96	0.04	98.70
	Lipari	3.81	4.97	1.67	74.76	0.09	0.05	0.71	0.06	12.89	0.00	99.01
25.02.2020	Lipari	3.70	5.07	1.56	74.74	0.10	0.00	0.76	0.06	13.02	0.01	99.02
	Lipari	3.91	5.00	1.72	73.65	0.11	0.02	0.77	0.05	12.84	0.02	98.09
	Lipari	3.79	5.08	1.46	73.66	0.08	0.04	0.75	0.06	12.91	0.00	97.83
	Lipari	3.63	5.02	1.57	73.84	0.08	0.05	0.74	0.09	13.01	0.00	98.03
	Lipari	3.84	4.97	1.57	73.92	0.07	0.02	0.76	0.03	12.89	0.03	98.11
	Lipari	3.81	4.97	1.72	73.60	0.08	0.03	0.75	0.11	12.77	0.00	97.85
	Lipari	3.93	4.98	1.56	74.14	0.07	0.04	0.77	0.03	12.98	0.01	98.51
	Lipari	3.80	4.99	1.56	73.71	0.07	0.04	0.74	0.12	12.65	0.00	97.67
	Lipari	3.77	5.09	1.59	73.97	0.09	0.06	0.78	0.09	13.05	0.06	98.55
	Lipari	3.67	4.94	1.57	73.94	0.09	0.04	0.71	0.00	12.79	0.00	97.76
	Lipari	3.88	5.03	1.49	73.85	0.07	0.04	0.72	0.05	12.99	0.00	98.13
	Lipari	3.81	5.05	1.56	74.09	0.07	0.00	0.78	0.03	13.02	0.02	98.42
	Lipari	3.71	5.02	1.67	74.29	0.08	0.05	0.75	0.07	13.00	0.00	98.64
	Lipari	3.71	4.95	1.68	74.51	0.08	0.04	0.76	0.08	12.84	0.03	98.68
	Lipari	3.90	5.01	1.82	74.06	0.08	0.07	0.77	0.00	12.97	0.01	98.69
27.04.2020	Lipari	3.88	5.02	1.58	73.96	0.06	0.01	0.77	0.03	12.94	0.00	98.26
	Lipari	3.89	4.99	1.67	73.69	0.08	0.05	0.78	0.05	12.76	0.02	97.97
	Lipari	3.95	5.04	1.69	74.07	0.10	0.05	0.78	0.09	12.91	0.01	98.68
	Lipari	3.92	5.06	1.67	73.94	0.06	0.05	0.77	0.05	12.78	0.02	98.31
	Lipari	3.86	5.04	1.48	73.89	0.08	0.03	0.74	0.05	13.05	0.00	98.21
	Lipari	3.95	5.08	1.69	74.26	0.07	0.03	0.77	0.07	12.98	0.03	98.94
	Lipari	3.68	5.09	1.60	74.44	0.06	0.04	0.74	0.08	12.95	0.03	98.71
	Lipari	3.89	5.09	1.42	73.89	0.06	0.06	0.73	0.01	13.25	0.02	98.43
	Lipari	3.89	5.01	1.54	74.30	0.08	0.05	0.72	0.00	13.05	0.00	98.64
	Lipari	3.80	5.04	1.72	74.30	0.06	0.02	0.74	0.04	13.20	0.00	98.91
	Lipari	3.84	5.04	1.62	74.48	0.05	0.03	0.78	0.06	12.95	0.03	98.88
	Lipari	3.79	4.99	1.70	73.78	0.09	0.04	0.78	0.07	13.12	0.02	98.37
	Lipari	3.96	5.11	1.59	73.55	0.08	0.04	0.72	0.00	12.82	0.00	97.88
	Lipari	3.70	5.06	1.56	74.13	0.08	0.04	0.77	0.11	12.81	0.02	98.28
	Lipari	3.89	5.01	1.69	74.35	0.07	0.00	0.75	0.06	12.94	0.00	98.76
27.04.2020	Lipari	3.96	5.12	1.62	73.74	0.06	0.05	0.75	0.02	13.08	0.00	98.41
	Lipari	3.61	5.06	1.77	73.30	0.08	0.05	0.78	0.07	12.95	0.00	97.66
	Lipari	3.91	5.04	1.54	73.58	0.08	0.01	0.73	0.08	12.92	0.02	97.90
	Lipari	4.00	5.03	1.60	73.23	0.10	0.05	0.76	0.10	12.78	0.00	97.65
	Lipari	3.85	5.00	1.61	73.89	0.08	0.01	0.74	0.07	12.76	0.00	98.01
	Lipari	3.64	5.02	1.57	73.61	0.09	0.04	0.77	0.04	12.92	0.00	97.69
	Lipari	3.90	5.14	1.53	73.22	0.05	0.00	0.76	0.03	12.97	0.00	97.60
	Lipari	3.99	5.09	1.50	72.66	0.07	0.06	0.76	0.00	12.99	0.00	97.12
	Lipari	3.79	5.10	1.55	73.64	0.07	0.03	0.77	0.03	13.06	0.03	98.07
	Lipari	3.67	5.06	1.44	73.44	0.10	0.04	0.75	0.09	12.91	0.00	97.50
	Lipari	3.85	5.08	1.70	74.05	0.09	0.05	0.74	0.04	12.95	0.00	98.55
	Lipari	3.79	5.11	1.70	73.43	0.07	0.03	0.75	0.06	12.70	0.03	97.67
	Lipari	3.96	5.14	1.72	73.76	0.05	0.02	0.76	0.01	13.08	0.02	98.52
	Lipari	4.08	5.16	1.59	73.69	0.10	0.01	0.73	0.02	13.12	0.01	98.51
	Lipari	3.85	5.07	1.40	72.90	0.08	0.03	0.76	0.11	12.81	0.00	97.01
27.04.2020	Lipari	3.81	5.07	1.46	73.42	0.07	0.03	0.76	0.12	13.05	0.02	97.82
	Lipari	3.67	5.08	1.56	73.57	0.07	0.02	0.76	0.08	12.83	0.00	97.64
	Lipari	3.70	5.01	1.61	72.98	0.13	0.03	0.75	0.10	12.85	0.05	97.20
11.05.2020	Lipari	3.94	5.09	1.56	73.06	0.07	0.05	0.77	0.09	13.01	0.00	97.63
	Lipari	3.94	5.07	1.46	74.14	0.06	0.03	0.75	0.03	12.89	0.01	98.39
	Lipari	4.04	5.07	1.73	73.59	0.08	0.06	0.75	0.07	12.63	0.03	98.05
27.04.2020	Lipari	3.78	4.93	1.48	73.92	0.04	0.03	0.81	0.04	12.94	0.01	97.97
	Lipari	3.95	5.00	1.54	74.04	0.09	0.03	0.78	0.07	12.81	0.00	98.31
	Lipari	3.96	4.99	1.76	73.82	0.08	0.01	0.74	0.08	12.88	0.00	98.32
11.05.2020	Lipari	4.04	5.02	1.47	74.07	0.05	0.07	0.77	0.04	13.17	0.01	98.69

Appendix A

Supplementary Table S4: EMP standard measurements on reference material Lipari Obsidian.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
15.05.2020	Lipari	3.75	5.01	1.59	74.49	0.07	0.07	0.75	0.00	12.93	0.07	98.72
	Lipari	3.71	5.08	1.57	73.30	0.07	0.05	0.75	0.01	12.96	0.00	97.50
	Lipari	3.72	5.09	1.74	73.47	0.07	0.06	0.72	0.06	13.05	0.01	98.00
	Lipari	3.85	5.06	1.68	73.89	0.07	0.02	0.77	0.11	12.97	0.02	98.44
	Lipari	3.50	5.04	1.56	73.59	0.06	0.03	0.79	0.05	12.96	0.02	97.60
	Lipari	3.94	5.08	1.50	74.12	0.11	0.04	0.79	0.07	13.01	0.00	98.65
	Lipari	3.68	4.97	1.59	73.98	0.06	0.02	0.76	0.05	12.96	0.00	98.08
	Lipari	3.77	5.03	1.71	70.84	0.06	0.06	0.74	0.04	13.07	0.00	95.33
	Lipari	3.83	5.03	1.63	71.17	0.07	0.02	0.73	0.06	13.08	0.02	95.65
	Lipari	3.67	5.00	1.55	72.03	0.06	0.01	0.75	0.05	13.21	0.00	96.34
	Lipari	3.96	5.03	1.69	73.61	0.09	0.05	0.73	0.00	13.03	0.00	98.19
	Lipari	4.04	5.07	1.71	72.07	0.07	0.02	0.75	0.08	12.85	0.04	96.70
	Lipari	3.82	5.05	1.50	72.18	0.07	0.01	0.75	0.04	12.87	0.02	96.31
	Lipari	3.80	5.07	1.53	73.45	0.08	0.05	0.77	0.04	13.08	0.00	97.86
	Lipari	4.03	5.02	1.62	73.90	0.10	0.04	0.78	0.13	13.14	0.00	98.76
	Lipari	3.49	5.01	1.36	73.13	0.09	0.02	0.73	0.05	12.95	0.01	96.85
	Lipari	3.83	5.11	1.30	73.41	0.09	0.06	0.73	0.07	12.91	0.00	97.52
	Lipari	3.89	5.02	1.55	73.90	0.09	0.02	0.75	0.07	13.02	0.00	98.31
	Lipari	3.66	5.06	1.58	73.62	0.08	0.07	0.77	0.02	12.91	0.00	97.77
	Lipari	3.76	5.06	1.71	74.04	0.08	0.03	0.77	0.04	13.38	0.00	98.87
	Lipari	3.83	5.06	1.67	74.56	0.10	0.02	0.75	0.05	12.96	0.01	99.01
	Lipari	3.51	4.97	1.69	74.53	0.08	0.03	0.76	0.09	12.96	0.00	98.63
	Lipari	3.80	4.98	1.52	73.94	0.04	0.03	0.77	0.02	12.82	0.00	97.93
	Lipari	3.87	4.95	1.70	74.31	0.09	0.07	0.72	0.01	13.18	0.00	98.90
	Lipari	3.88	5.08	1.65	73.82	0.07	0.01	0.71	0.08	13.20	0.06	98.55
	Lipari	3.85	5.01	1.72	73.69	0.09	0.03	0.77	0.10	13.16	0.01	98.43
	Lipari	3.78	4.98	1.59	74.12	0.06	0.00	0.70	0.03	12.89	0.00	98.16
	Lipari	3.83	5.03	1.76	73.95	0.13	0.02	0.74	0.10	13.26	0.01	98.83
	Lipari	3.70	4.98	1.63	73.16	0.08	0.04	0.75	0.11	12.95	0.00	97.39
	Lipari	3.55	5.02	1.33	73.71	0.05	0.02	0.73	0.04	13.03	0.02	97.50
	Lipari	3.66	5.02	1.54	73.95	0.05	0.04	0.76	0.04	13.08	0.02	98.16
	Lipari	3.81	5.09	1.47	74.31	0.07	0.01	0.71	0.02	13.09	0.00	98.59
	Lipari	4.08	4.96	1.33	74.10	0.08	0.03	0.72	0.09	12.92	0.01	98.33
	Lipari	3.78	4.96	1.63	74.31	0.09	0.02	0.75	0.07	13.21	0.02	98.85
	Lipari	3.79	5.02	1.53	74.21	0.09	0.02	0.71	0.04	13.17	0.00	98.58
	Lipari	3.67	4.97	1.61	74.01	0.05	0.02	0.77	0.07	13.11	0.03	98.31
	Lipari	3.59	5.01	1.51	73.53	0.08	0.04	0.78	0.12	12.89	0.01	97.56
	Lipari	3.73	5.06	1.69	74.75	0.07	0.05	0.76	0.03	13.11	0.04	99.28
	Lipari	3.78	5.02	1.62	74.33	0.09	0.02	0.76	0.08	13.11	0.00	98.82
	Lipari	3.74	5.04	1.69	73.97	0.06	0.02	0.78	0.07	12.94	0.00	98.32
	Lipari	3.93	5.05	1.58	73.91	0.09	0.05	0.73	0.12	13.03	0.00	98.49
	Lipari	3.59	5.06	1.47	74.47	0.09	0.04	0.73	0.07	13.03	0.03	98.57
	Lipari	3.80	5.08	1.64	74.28	0.07	0.01	0.76	0.02	12.93	0.00	98.60
	Lipari	3.86	5.03	1.65	74.22	0.08	0.02	0.76	0.05	12.94	0.02	98.62
	Lipari	3.72	5.02	1.63	74.47	0.07	0.06	0.76	0.10	12.91	0.03	98.77
	Lipari	3.69	4.98	1.40	74.79	0.05	0.03	0.73	0.05	13.09	0.02	98.83
	Lipari	3.81	4.99	1.63	74.44	0.11	0.02	0.71	0.04	13.13	0.00	98.88
	Lipari	3.68	5.04	1.54	74.37	0.02	0.02	0.77	0.08	12.90	0.02	98.45
	Lipari	3.80	4.95	1.56	74.60	0.06	0.05	0.74	0.12	13.07	0.00	98.95
	Lipari	3.76	5.03	1.77	74.76	0.08	0.00	0.75	0.04	12.83	0.01	99.03
15.05.2020	Lipari	3.90	5.02	1.56	74.74	0.05	0.02	0.74	0.06	12.90	0.02	99.02
	Lipari	3.85	5.06	1.69	74.64	0.11	0.05	0.73	0.04	13.13	0.03	99.33
	Lipari	3.99	4.96	1.48	74.38	0.08	0.03	0.72	0.05	13.09	0.01	98.79
	Lipari	3.72	5.03	1.52	74.73	0.10	0.05	0.73	0.13	12.95	0.00	98.95
	Lipari	3.62	5.01	1.52	74.38	0.11	0.05	0.73	0.05	13.17	0.02	98.65
	Lipari	3.72	5.01	1.61	74.26	0.09	0.06	0.73	0.10	12.98	0.00	98.56
	Lipari	3.78	5.01	1.48	74.18	0.06	0.02	0.78	0.09	13.19	0.00	98.60
	Lipari	4.17	5.05	1.68	74.80	0.09	0.02	0.67	0.10	12.69	0.02	99.30
	Lipari	4.08	5.05	1.51	74.51	0.11	0.03	0.77	0.03	13.02	0.01	99.12
	Lipari	4.15	5.07	1.75	73.90	0.08	0.01	0.74	0.01	13.09	0.02	98.81
12.06.2020	Lipari	4.36	5.01	1.74	73.57	0.07	0.03	0.76	0.11	13.15	0.02	98.83
	Lipari	4.29	5.06	1.55	73.78	0.08	0.03	0.79	0.03	12.74	0.00	98.34
	Lipari	4.24	5.05	1.58	73.81	0.11	0.05	0.77	0.02	13.14	0.03	98.79
	Lipari	4.31	4.99	1.53	75.00	0.08	0.04	0.77	0.13	13.09	0.00	99.94
	Lipari	4.16	5.02	1.48	74.43	0.09	0.01	0.74	0.00	12.90	0.02	98.85
	Lipari	4.43	5.10	1.67	73.76	0.07	0.06	0.72	0.09	13.15	0.03	99.08
	Lipari	4.25	5.02	1.51	73.71	0.07	0.04	0.75	0.06	12.74	0.02	98.17
	Lipari	4.48	5.05	1.50	74.01	0.08	0.03	0.75	0.06	13.20	0.02	99.17
	Lipari	4.34	5.00	1.46	73.85	0.08	0.02	0.76	0.04	13.09	0.01	98.64
	Lipari	4.15	5.00	1.46	74.52	0.06	0.04	0.71	0.13	13.28	0.02	99.37

Appendix A

Supplementary Table S4: EMP standard measurements on reference material Lipari Obsidian.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
16.06.2020	Lipari	3.92	5.03	1.65	74.29	0.08	0.05	0.75	0.03	12.88	0.02	98.71
	Lipari	4.02	5.11	1.50	74.89	0.09	0.05	0.77	0.10	13.11	0.01	99.65
	Lipari	4.30	5.04	1.58	74.35	0.11	0.02	0.75	0.14	13.23	0.00	99.52
	Lipari	4.26	5.02	1.61	74.44	0.07	0.02	0.76	0.06	13.35	0.00	99.60
	Lipari	4.20	5.03	1.52	74.41	0.09	0.03	0.75	0.00	13.10	0.01	99.14
	Lipari	4.17	5.04	1.61	74.01	0.09	0.07	0.75	0.00	13.04	0.00	98.79
	Lipari	4.23	5.07	1.54	74.92	0.10	0.03	0.75	0.06	13.06	0.03	99.78
	Lipari	4.49	5.02	1.44	75.06	0.06	0.03	0.80	0.08	13.10	0.00	100.09
	Lipari	4.33	5.02	1.62	74.15	0.10	0.01	0.74	0.04	12.97	0.02	99.00
	Lipari	4.36	5.04	1.56	74.36	0.09	0.00	0.74	0.16	13.13	0.00	99.45
	Lipari	4.33	5.04	1.72	74.51	0.07	0.04	0.76	0.11	13.31	0.00	99.90
	Lipari	4.23	5.04	1.59	73.72	0.07	0.03	0.71	0.11	12.99	0.00	98.49
	Lipari	4.26	5.00	1.59	73.80	0.11	0.06	0.77	0.03	13.02	0.02	98.65
	Lipari	3.95	5.06	1.68	75.15	0.06	0.02	0.68	0.06	13.18	0.00	99.84
	Lipari	3.98	5.06	1.41	74.81	0.09	0.04	0.72	0.10	13.16	0.02	99.38
	Lipari	3.84	5.06	1.61	75.20	0.11	0.04	0.72	0.08	13.19	0.01	99.86
	Lipari	3.95	5.00	1.40	75.10	0.09	0.06	0.75	0.03	12.93	0.00	99.30
	Lipari	3.97	5.01	1.70	73.75	0.08	0.05	0.77	0.09	13.29	0.00	98.70
	Lipari	3.90	5.03	1.52	74.85	0.05	0.02	0.75	0.05	13.21	0.01	99.39
	Lipari	3.95	5.12	1.62	74.87	0.07	0.02	0.76	0.07	13.28	0.01	99.78
	Lipari	4.08	5.04	1.63	74.96	0.10	0.05	0.78	0.05	13.29	0.01	99.99
	Lipari	4.25	5.03	1.60	74.66	0.06	0.02	0.74	0.08	13.16	0.00	99.59
	Lipari	4.07	5.01	1.64	75.02	0.06	0.02	0.77	0.10	12.97	0.00	99.66
	Lipari	3.89	5.02	1.58	74.36	0.09	0.01	0.69	0.00	13.04	0.01	98.69
	Lipari	4.08	5.10	1.65	74.68	0.07	0.06	0.73	0.07	13.00	0.00	99.45
	Lipari	3.68	5.05	1.74	74.75	0.06	0.05	0.74	0.05	13.21	0.04	99.38
	Lipari	3.92	5.00	1.67	74.83	0.10	0.05	0.71	0.08	13.02	0.00	99.38
	Lipari	4.15	5.05	1.81	74.66	0.08	0.03	0.74	0.08	12.99	0.00	99.60
	Lipari	4.15	5.07	1.45	74.18	0.10	0.05	0.73	0.07	13.27	0.00	99.07
	Lipari	4.03	5.02	1.48	74.54	0.06	0.01	0.75	0.12	13.03	0.00	99.04
	Lipari	4.23	4.99	1.71	75.02	0.07	0.06	0.73	0.01	13.21	0.00	100.03
	Lipari	4.01	5.05	1.60	73.91	0.07	0.03	0.75	0.06	13.26	0.00	98.74
	Lipari	3.89	5.02	1.42	73.87	0.10	0.05	0.74	0.02	13.22	0.00	98.33
	Lipari	4.21	5.03	1.57	74.15	0.10	0.03	0.73	0.07	13.10	0.01	98.99
	Lipari	4.11	5.07	1.62	74.35	0.08	0.04	0.77	0.02	13.26	0.00	99.32
	Lipari	4.10	5.00	1.44	73.88	0.07	0.01	0.71	0.04	13.32	0.02	98.58
	Lipari	3.97	5.00	1.50	73.51	0.08	0.02	0.76	0.01	13.08	0.02	97.96
16.06.2020	Lipari	3.85	5.05	1.37	73.94	0.08	0.00	0.68	0.08	13.21	0.05	98.30
	Lipari	3.94	5.03	1.49	74.24	0.06	0.02	0.74	0.08	13.21	0.00	98.80
	Lipari	4.19	5.04	1.55	74.82	0.09	0.02	0.78	0.07	13.22	0.00	99.77
	Lipari	4.04	5.04	1.51	74.54	0.07	0.06	0.75	0.05	13.08	0.00	99.14
	Lipari	4.08	5.02	1.56	73.93	0.07	0.02	0.73	0.05	13.08	0.01	98.54
	Lipari	4.12	5.06	1.72	73.71	0.07	0.06	0.77	0.05	13.33	0.00	98.89
	Lipari	3.99	5.08	1.56	74.42	0.07	0.05	0.79	0.07	13.30	0.00	99.33
	Lipari	4.02	5.13	1.62	74.70	0.09	0.08	0.73	0.07	13.15	0.00	99.59
	Lipari	4.08	5.03	1.66	74.75	0.05	0.03	0.71	0.10	13.00	0.02	99.42
	Lipari	3.93	5.10	1.63	74.60	0.09	0.04	0.72	0.09	13.39	0.05	99.64
	Lipari	3.94	5.03	1.48	72.43	0.10	0.02	0.71	0.09	13.33	0.00	97.13
	Lipari	4.05	5.13	1.49	72.52	0.09	0.06	0.71	0.06	13.23	0.00	97.34
	Lipari	3.99	5.03	1.60	73.79	0.07	0.00	0.77	0.11	13.33	0.00	98.69
	Lipari	4.01	5.13	1.49	73.94	0.05	0.00	0.73	0.03	13.32	0.00	98.69
	Lipari	3.72	5.04	1.58	75.00	0.07	0.04	0.75	0.08	13.04	0.02	99.34
	Lipari	4.13	5.09	1.63	72.45	0.07	0.01	0.75	0.04	13.30	0.04	97.51
	Lipari	3.92	5.08	1.48	75.24	0.08	0.05	0.75	0.09	13.12	0.00	99.80
	Lipari	4.14	5.05	1.74	74.94	0.10	0.03	0.74	0.01	13.13	0.06	99.95
	Lipari	4.26	5.04	1.47	74.70	0.07	0.02	0.74	0.01	13.29	0.03	99.63
	Lipari	4.08	5.06	1.78	75.16	0.06	0.07	0.70	0.03	13.05	0.00	99.98
	Lipari	3.97	4.98	1.62	75.10	0.06	0.05	0.73	0.05	13.35	0.05	99.96
	Lipari	4.21	5.03	1.66	74.92	0.09	0.03	0.72	0.04	13.19	0.00	99.89
	Lipari	4.07	5.01	1.48	74.76	0.09	0.02	0.78	0.13	13.19	0.00	99.52
	Lipari	4.10	5.08	1.52	75.08	0.12	0.04	0.77	0.08	13.22	0.04	100.04
	Lipari	4.02	5.02	1.83	75.18	0.08	0.03	0.74	0.08	13.11	0.00	100.09
	Lipari	4.23	4.99	1.63	75.03	0.08	0.01	0.75	0.14	13.00	0.02	99.89
	Lipari	4.02	5.04	1.61	75.09	0.08	0.03	0.73	0.00	13.24	0.04	99.89
	Lipari	3.99	5.04	1.59	74.78	0.13	0.01	0.74	0.08	13.03	0.01	99.40
	Lipari	4.18	5.02	1.56	74.89	0.05	0.00	0.73	0.11	13.17	0.02	99.74
	Lipari	4.07	4.98	1.65	74.97	0.06	0.07	0.77	0.11	13.10	0.00	99.79
	Lipari	4.09	5.13	1.66	74.95	0.06	0.04	0.69	0.05	13.58	0.00	100.25
	Lipari	3.25	5.12	1.69	74.34	0.06	0.02	0.74	0.05	13.42	0.00	98.68
	Lipari	4.02	4.99	1.62	74.93	0.05	0.03	0.77	0.07	13.05	0.00	99.53

Appendix A

Supplementary Table S4: EMP standard measurements on reference material Lipari Obsidian.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
22.06.2020	Lipari	4.18	5.03	1.59	74.56	0.07	0.06	0.72	0.08	13.13	0.00	99.43
	Lipari	4.20	5.13	1.62	74.06	0.08	0.02	0.77	0.12	13.20	0.01	99.19
	Lipari	4.19	5.02	1.44	74.35	0.07	0.01	0.74	0.08	13.22	0.04	99.16
	Lipari	4.01	5.03	1.64	74.58	0.10	0.02	0.74	0.12	13.39	0.02	99.65
	Lipari	4.02	5.01	1.64	74.07	0.06	0.03	0.75	0.08	13.15	0.01	98.82
	Lipari	4.18	4.97	1.54	73.51	0.07	0.02	0.73	0.16	13.20	0.00	98.37
	Lipari	4.23	5.05	1.63	74.29	0.09	0.03	0.72	0.03	13.13	0.00	99.19
	Lipari	4.09	5.05	1.53	74.07	0.08	0.03	0.73	0.07	13.33	0.05	99.02
	Lipari	4.26	5.03	1.70	73.83	0.10	0.03	0.75	0.14	13.12	0.00	98.97
	Lipari	4.22	5.04	1.66	74.47	0.08	0.03	0.74	0.05	13.38	0.01	99.67
	Lipari	4.09	5.03	1.46	74.55	0.10	0.04	0.74	0.09	13.17	0.03	99.30
	Lipari	4.09	5.00	1.48	73.65	0.11	0.05	0.76	0.06	13.18	0.02	98.40
	Lipari	4.12	5.04	1.66	73.87	0.07	0.04	0.77	0.10	13.33	0.05	99.05
	Lipari	3.97	5.08	1.63	73.99	0.06	0.05	0.76	0.04	13.11	0.02	98.71
22.06.2020	Lipari	4.24	4.99	1.70	73.79	0.08	0.02	0.76	0.11	13.13	0.00	98.82
24.08.2020	Lipari	3.98	5.07	1.52	74.20	0.10	0.00	0.76	0.10	13.08	0.01	98.83
	Lipari	3.84	5.06	1.56	73.94	0.06	0.02	0.76	0.07	13.12	0.00	98.42
	Lipari	3.96	5.00	1.64	74.43	0.10	0.02	0.72	0.08	12.59	0.04	98.57
	Lipari	3.86	5.00	1.44	74.38	0.08	0.05	0.78	0.08	12.59	0.03	98.28
	Lipari	3.85	5.01	1.57	73.97	0.08	0.02	0.73	0.05	12.39	0.00	97.67
	Lipari	3.70	5.02	1.46	74.06	0.09	0.05	0.74	0.06	12.56	0.00	97.74
	Lipari	4.00	5.00	1.56	73.54	0.11	0.05	0.74	0.05	12.88	0.00	97.93
	Lipari	4.08	4.99	1.64	73.43	0.11	0.01	0.78	0.04	12.62	0.00	97.70
	Lipari	3.83	5.03	1.56	74.02	0.05	0.03	0.76	0.05	12.72	0.01	98.06
	Lipari	4.01	5.01	1.78	73.58	0.09	0.01	0.76	0.04	12.60	0.03	97.92
	Lipari	3.95	5.02	1.62	74.45	0.07	0.02	0.77	0.07	12.75	0.01	98.74
	Lipari	3.79	5.05	1.56	73.82	0.10	0.02	0.74	0.10	12.58	0.04	97.79
	Lipari	4.11	5.00	1.70	74.40	0.05	0.02	0.75	0.04	12.64	0.02	98.73
	Lipari	3.97	5.03	1.66	73.46	0.08	0.06	0.77	0.06	12.42	0.01	97.51
	Lipari	3.88	5.01	1.70	74.48	0.07	0.01	0.73	0.05	12.74	0.06	98.73
27.08.2020	Lipari	3.88	5.05	1.72	74.62	0.08	0.02	0.78	0.10	12.43	0.01	98.68
	Lipari	3.79	5.04	1.68	73.81	0.07	0.04	0.77	0.06	12.63	0.02	97.91
	Lipari	3.70	5.03	1.56	73.90	0.09	0.01	0.76	0.05	12.58	0.00	97.68
	Lipari	3.99	4.99	1.59	74.20	0.13	0.01	0.75	0.05	12.79	0.01	98.51
	Lipari	4.17	5.05	1.62	73.66	0.06	0.04	0.75	0.04	12.47	0.02	97.90
	Lipari	4.08	5.07	1.64	74.50	0.08	0.01	0.72	0.04	12.49	0.02	98.65
	Lipari	4.86	4.03	1.64	73.32	0.07	0.05	0.96	0.02	12.66	0.03	97.64
	Lipari	3.88	5.12	1.49	74.51	0.09	0.00	0.65	0.07	12.66	0.03	98.50
	Lipari	4.09	5.07	1.60	73.93	0.09	0.05	0.62	0.10	12.56	0.00	98.12
	Lipari	3.76	5.05	1.59	74.17	0.10	0.01	0.71	0.13	13.28	0.00	98.81
	Lipari	4.04	5.06	1.56	74.27	0.08	0.06	0.74	0.13	13.15	0.00	99.08
	Lipari	3.83	4.98	1.67	73.65	0.09	0.03	0.78	0.08	12.92	0.02	98.05
	Lipari	3.76	5.10	1.62	73.55	0.07	0.00	0.73	0.00	12.93	0.01	97.77
	Lipari	3.89	5.11	1.61	73.28	0.07	0.00	0.79	0.02	12.93	0.03	97.73
	Lipari	3.89	5.07	1.55	74.38	0.08	0.02	0.76	0.07	13.27	0.00	99.10
27.08.2020	Lipari	3.83	5.06	1.53	73.23	0.07	0.02	0.75	0.08	12.94	0.00	97.50
	Lipari	3.84	5.03	1.58	73.21	0.07	0.08	0.74	0.02	12.94	0.00	97.50
	Lipari	3.78	4.93	1.65	73.14	0.09	0.06	0.74	0.11	12.83	0.00	97.33
	Lipari	4.23	4.99	1.60	73.64	0.09	0.03	0.78	0.00	12.89	0.02	98.27
	Lipari	3.80	5.02	1.48	73.41	0.08	0.02	0.75	0.10	12.97	0.02	97.65
	Lipari	3.84	5.05	1.70	72.89	0.07	0.06	0.77	0.05	12.94	0.00	97.37
	Lipari	3.95	4.95	1.63	71.01	0.07	0.04	0.73	0.02	12.88	0.02	95.30
	Lipari	3.91	4.98	1.56	72.28	0.09	0.01	0.77	0.08	12.72	0.01	96.41
	Lipari	3.90	5.04	1.67	73.63	0.07	0.04	0.72	0.09	12.97	0.01	98.14
	Lipari	3.79	5.05	1.59	72.92	0.06	0.02	0.76	0.07	13.00	0.01	97.26
	Lipari	3.90	5.03	1.41	73.11	0.10	0.03	0.79	0.11	12.73	0.00	97.21
	Lipari	3.99	5.03	1.44	72.78	0.09	0.00	0.76	0.05	12.85	0.00	97.00
	Lipari	3.88	5.04	1.68	72.98	0.10	0.02	0.80	0.09	12.77	0.00	97.35
	Lipari	3.86	4.96	1.43	72.97	0.09	0.03	0.74	0.04	12.93	0.00	97.06
	Lipari	4.02	4.99	1.48	72.78	0.09	0.03	0.75	0.02	12.94	0.00	97.11
	Lipari	3.84	4.98	1.56	72.99	0.09	0.06	0.76	0.08	12.77	0.00	97.13
27.08.2020	Lipari	3.97	4.94	1.66	73.28	0.08	0.05	0.76	0.10	12.88	0.03	97.75
	Lipari	4.10	4.97	1.61	73.02	0.04	0.06	0.71	0.07	12.97	0.00	97.55
	Lipari	4.00	5.01	1.90	73.10	0.09	0.04	0.70	0.05	12.82	0.00	97.72
	Lipari	4.07	4.98	1.64	73.76	0.08	0.03	0.77	0.06	12.65	0.00	98.04
	Lipari	4.00	4.93	1.55	73.32	0.09	0.02	0.75	0.11	12.97	0.00	97.73
	Lipari	4.07	4.98	1.56	72.94	0.08	0.04	0.78	0.06	12.88	0.05	97.43
	Lipari	4.07	5.03	1.55	73.15	0.09	0.06	0.73	0.06	12.73	0.00	97.46
27.08.2020	Lipari	3.95	5.04	1.56	72.98	0.10	0.02	0.73	0.07	12.71	0.01	97.17
	Lipari	3.85	5.04	1.71	73.17	0.07	0.01	0.75	0.01	12.79	0.00	97.40

Appendix A

Supplementary Table S4: EMP standard measurements on reference material Lipari Obsidian.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
31.08.2020	Lipari	3.92	5.02	1.90	73.43	0.12	0.04	0.75	0.01	12.75	0.02	97.97
	Lipari	3.84	4.96	1.56	74.47	0.06	0.03	0.72	0.06	12.72	0.00	98.42
	Lipari	4.08	5.00	1.44	73.50	0.09	0.06	0.74	0.05	12.97	0.00	97.93
	Lipari	3.88	5.05	1.38	74.60	0.08	0.02	0.75	0.04	12.96	0.02	98.78
	Lipari	4.03	5.01	1.62	74.94	0.09	0.00	0.72	0.05	12.48	0.00	98.94
	Lipari	3.87	5.10	1.69	74.41	0.03	0.00	0.72	0.09	12.98	0.00	98.89
	Lipari	3.89	5.02	1.67	74.10	0.08	0.02	0.70	0.06	12.94	0.00	98.47
	Lipari	3.97	4.96	1.44	74.71	0.10	0.04	0.70	0.07	12.84	0.01	98.84
	Lipari	5.64	3.29	1.19	73.57	0.06	0.06	1.18	0.01	14.20	0.03	99.23
	Lipari	5.66	2.16	0.96	76.08	0.07	0.06	1.11	0.03	12.42	0.03	98.58
	Lipari	3.85	5.09	1.57	74.41	0.08	0.01	0.54	0.00	12.79	0.01	98.35
	Lipari	3.82	5.11	1.53	74.27	0.07	0.00	0.73	0.05	12.92	0.06	98.56
	Lipari	3.94	4.99	1.63	74.41	0.05	0.02	0.75	0.09	12.89	0.00	98.77
	Lipari	3.90	5.07	1.75	74.64	0.08	0.00	0.73	0.02	12.91	0.03	99.14
	Lipari	4.01	4.93	1.47	74.41	0.07	0.05	0.77	0.13	12.85	0.02	98.70
	Lipari	3.79	4.97	1.66	74.34	0.06	0.04	0.73	0.04	13.00	0.00	98.63
	Lipari	3.92	5.05	1.61	74.33	0.06	0.02	0.76	0.02	12.83	0.02	98.63
	Lipari	3.78	5.03	1.81	74.14	0.08	0.02	0.73	0.06	13.05	0.00	98.70
	Lipari	3.74	5.08	1.49	73.97	0.06	0.06	0.72	0.05	12.78	0.06	98.01
	Lipari	3.67	5.03	1.52	74.16	0.06	0.03	0.73	0.13	12.92	0.02	98.27
	Lipari	3.63	5.04	1.60	74.03	0.07	0.07	0.77	0.06	12.65	0.00	97.92
	Lipari	3.92	5.05	1.43	74.33	0.08	0.00	0.76	0.04	12.89	0.00	98.51
	Lipari	3.71	4.94	1.57	74.51	0.06	0.04	0.72	0.06	12.85	0.02	98.48
	Lipari	4.00	4.98	1.70	74.35	0.08	0.03	0.73	0.04	12.76	0.01	98.67
	Lipari	3.87	4.98	1.56	74.52	0.06	0.03	0.77	0.13	12.79	0.00	98.70
	Lipari	3.98	4.99	1.49	74.21	0.07	0.04	0.76	0.15	12.95	0.05	98.68
	Lipari	3.80	5.04	1.62	73.84	0.06	0.03	0.73	0.09	12.83	0.02	98.07
	Lipari	4.15	5.02	1.51	74.11	0.08	0.00	0.76	0.12	12.94	0.00	98.70
	Lipari	3.88	5.05	1.63	73.49	0.10	0.02	0.76	0.07	13.01	0.01	98.02
	Lipari	4.03	5.01	1.48	74.00	0.09	0.01	0.75	0.07	13.01	0.02	98.47
	Lipari	4.02	4.94	1.58	74.90	0.07	0.05	0.76	0.05	12.99	0.02	99.39
	Lipari	3.99	5.04	1.60	73.78	0.10	0.05	0.75	0.05	12.57	0.03	97.96
12.10.2020	Lipari	4.18	5.04	1.43	74.07	0.08	0.01	0.76	0.02	12.81	0.02	98.42
	lipari	4.05	5.04	1.51	75.18	0.06	0.04	0.75	0.14	13.91	0.01	100.68
	lipari	4.10	5.02	1.45	75.53	0.09	0.06	0.75	0.05	14.01	0.00	101.05
	lipari	3.95	4.94	1.49	75.52	0.06	0.03	0.72	0.08	13.80	0.00	100.59
	lipari	3.62	5.02	1.55	75.31	0.07	0.05	0.71	0.08	13.44	0.00	99.85
	lipari	3.95	5.08	1.43	75.34	0.07	0.05	0.76	0.10	13.57	0.00	100.34
	lipari	3.79	5.00	1.73	74.77	0.08	0.04	0.81	0.06	13.34	0.00	99.62
	lipari	3.85	4.92	1.52	73.57	0.10	0.02	0.74	0.12	13.31	0.00	98.15
	lipari	3.73	5.06	1.44	73.52	0.08	0.03	0.73	0.04	13.35	0.01	97.99
	lipari	3.79	4.95	1.37	75.04	0.06	0.03	0.78	0.04	13.30	0.01	99.38
	lipari	3.90	4.96	1.71	75.39	0.09	0.04	0.78	0.01	13.24	0.01	100.14
	lipari	3.80	4.93	1.53	74.23	0.07	0.07	0.75	0.11	13.06	0.00	98.55
	lipari	3.65	4.95	1.51	74.97	0.05	0.03	0.75	0.09	13.37	0.04	99.42
	lipari	3.81	4.95	1.71	75.00	0.07	0.05	0.74	0.18	13.42	0.00	99.93
	lipari	3.60	5.00	1.60	74.85	0.05	0.06	0.75	0.01	13.29	0.01	99.22
12.10.2020	lipari	3.74	4.98	1.64	73.39	0.09	0.05	0.78	0.08	12.91	0.01	97.67
	lipari	3.77	5.00	1.56	74.05	0.07	0.05	0.75	0.05	13.14	0.01	98.44
	lipari	3.79	5.01	1.51	75.31	0.08	0.02	0.76	0.03	13.28	0.00	99.80
	lipari	3.79	4.89	1.43	75.35	0.05	0.04	0.71	0.13	13.43	0.01	99.82
	lipari	3.76	4.98	1.57	74.13	0.05	0.02	0.72	0.00	13.06	0.00	98.29
14.10.2020	lipari	4.12	5.06	1.59	74.80	0.07	0.03	0.72	0.05	13.18	0.00	99.62
	Lipari	4.13	5.12	1.52	74.29	0.08	0.03	0.62	0.00	13.05	0.03	98.88
	Lipari	3.96	5.01	1.50	74.02	0.09	0.03	0.70	0.14	13.08	0.00	98.54
	Lipari	5.02	1.86	1.15	77.67	0.07	0.02	1.15	0.07	12.02	0.00	99.03
	Lipari	3.77	5.08	1.53	73.98	0.09	0.02	0.61	0.06	12.91	0.01	98.05
	Lipari	4.18	5.04	1.43	74.28	0.08	0.00	0.67	0.04	13.07	0.02	98.82
	Lipari	3.98	5.01	1.66	74.23	0.10	0.04	0.72	0.04	13.08	0.03	98.88
	Lipari	3.96	5.02	1.56	73.72	0.10	0.03	0.75	0.03	12.96	0.00	98.12
	Lipari	4.01	5.05	1.55	73.93	0.09	0.02	0.78	0.06	12.92	0.02	98.43
	Lipari	3.72	4.95	1.71	74.15	0.09	0.06	0.77	0.13	12.87	0.01	98.45
	Lipari	3.94	4.99	1.59	74.22	0.07	0.03	0.75	0.08	13.20	0.00	98.87
	Lipari	3.70	4.99	1.79	73.99	0.08	0.02	0.73	0.03	12.72	0.02	98.07
	Lipari	3.85	4.97	1.71	74.13	0.06	0.00	0.75	0.07	13.02	0.00	98.56
	Lipari	3.66	4.50	3.82	71.77	0.10	0.19	2.56	0.14	12.04	0.01	98.78
	Lipari	3.94	5.08	1.57	74.29	0.08	0.04	0.78	0.06	12.77	0.00	98.61
	Lipari	3.99	4.97	1.50	74.31	0.05	0.04	0.72	0.05	12.98	0.03	98.64
	Lipari	3.51	5.07	1.55	73.78	0.07	0.01	0.72	0.02	12.92	0.01	97.66
	Lipari	3.71	4.95	1.69	74.31	0.12	0.04	0.76	0.09	12.89	0.03	98.59

Appendix A

Supplementary Table S4: EMP standard measurements on reference material Lipari Obsidian.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
16.10.2020	Lipari	3.81	4.93	1.65	73.84	0.07	0.05	0.75	0.00	12.67	0.01	97.78
	Lipari	3.95	5.00	1.58	74.05	0.08	0.03	0.75	0.13	12.83	0.00	98.40
	Lipari	3.86	5.04	1.72	73.83	0.05	0.04	0.75	0.04	12.74	0.00	98.07
	Lipari	3.81	5.03	1.40	74.37	0.11	0.05	0.75	0.00	12.95	0.00	98.48
	Lipari	3.82	4.94	2.87	73.14	0.09	0.02	0.74	0.09	12.66	0.02	98.39
	Lipari	3.93	4.96	1.64	73.11	0.08	0.04	0.79	0.03	13.26	0.06	97.90
	Lipari	3.83	4.99	1.63	72.46	0.10	0.03	0.76	0.05	13.09	0.02	96.97
	Lipari	3.95	4.97	1.57	74.05	0.09	0.04	0.74	0.08	13.19	0.01	98.68
	Lipari	3.91	4.96	1.55	74.47	0.05	0.04	0.75	0.04	13.05	0.05	98.88
	Lipari	3.76	5.00	1.50	74.07	0.06	0.02	0.75	0.07	12.96	0.04	98.23
	Lipari	3.98	5.04	1.53	74.20	0.07	0.01	0.76	0.08	13.01	0.00	98.68
	Lipari	3.85	4.99	1.31	72.59	0.10	0.00	0.74	0.03	13.18	0.00	96.79
	Lipari	3.73	4.98	1.67	74.53	0.08	0.03	0.81	0.04	13.01	0.03	98.91
	Lipari	3.62	5.08	1.40	74.32	0.08	0.00	0.74	0.06	12.97	0.02	98.28
	Lipari	3.61	5.04	1.58	74.44	0.05	0.03	0.79	0.07	12.91	0.00	98.52
	Lipari	3.96	5.06	1.68	74.37	0.10	0.05	0.78	0.08	13.30	0.00	99.37
	Lipari	3.81	5.03	1.55	74.36	0.09	0.03	0.75	0.03	12.94	0.00	98.60
	Lipari	3.80	5.02	1.56	74.29	0.06	0.04	0.75	0.11	13.13	0.02	98.79
	Lipari	3.77	5.05	1.50	74.15	0.06	0.01	0.79	0.07	13.19	0.00	98.58
	Lipari	3.97	5.01	1.55	74.44	0.04	0.03	0.75	0.07	13.14	0.03	99.03
30.10.2020	Lipari	3.76	4.98	1.62	74.28	0.08	0.03	0.76	0.10	13.20	0.00	98.81
	Lipari	3.80	5.00	1.50	73.88	0.08	0.00	0.77	0.06	12.94	0.01	98.04
	Lipari	3.82	5.01	1.53	74.60	0.06	0.02	0.72	0.12	13.10	0.03	99.00
	Lipari	3.97	4.93	2.72	72.91	0.09	0.00	0.70	0.00	12.98	0.01	98.31
	Lipari	4.05	4.81	4.47	71.36	0.12	0.03	0.69	0.16	12.99	0.03	98.70
	Lipari	4.06	5.01	1.48	74.03	0.07	0.00	0.75	0.06	12.89	0.01	98.36
	Lipari	3.78	5.03	1.68	73.74	0.08	0.01	0.77	0.09	12.91	0.02	98.10
	Lipari	3.87	5.10	1.52	74.19	0.05	0.08	0.72	0.09	13.00	0.04	98.66
	Lipari	3.91	4.96	1.51	73.79	0.05	0.01	0.76	0.06	12.94	0.02	98.01
	Lipari	3.76	4.98	1.57	73.69	0.08	0.04	0.72	0.08	13.07	0.01	98.00
30.10.2020	Lipari	3.86	5.00	1.57	73.74	0.08	0.04	0.72	0.01	12.94	0.00	97.95
	Lipari	3.95	5.03	1.46	73.93	0.08	0.00	0.74	0.14	12.99	0.03	98.35
	Lipari	3.96	5.04	1.47	73.53	0.07	0.00	0.77	0.04	12.94	0.01	97.84
	Lipari	3.74	5.00	1.61	73.85	0.09	0.05	0.80	0.04	12.90	0.00	98.09
	Lipari	3.93	5.04	1.63	73.12	0.07	0.06	0.75	0.10	12.84	0.02	97.56
26.01.2021	Lipari	4.06	5.06	1.47	75.35	0.06	0.03	0.74	0.11	13.95	0.00	100.83
	Lipari	3.85	5.15	1.59	75.00	0.09	0.05	0.77	0.04	13.41	0.00	99.95
	Lipari	4.04	5.14	1.59	74.25	0.06	0.02	0.73	0.05	13.70	0.00	99.57
	Lipari	3.83	5.18	1.59	74.57	0.07	0.05	0.76	0.06	13.44	0.01	99.56
	Lipari	3.91	5.05	1.48	74.42	0.09	0.06	0.80	0.09	13.40	0.00	99.31
	Lipari	3.78	5.17	1.29	74.75	0.10	0.03	0.77	0.01	13.72	0.00	99.62
	Lipari	3.66	5.13	1.39	74.41	0.07	0.03	0.71	0.00	13.46	0.01	98.87
	Lipari	3.48	5.14	1.53	74.39	0.08	0.05	0.72	0.06	13.27	0.00	98.73
	Lipari	3.62	5.10	1.59	74.63	0.06	0.07	0.72	0.04	13.63	0.01	99.47
	Lipari	3.47	5.06	1.68	72.70	0.07	0.04	0.74	0.06	13.34	0.01	97.17
31.01.2021	Lipari	3.72	5.19	1.45	73.53	0.06	0.03	0.73	0.09	12.97	0.03	97.81
	Lipari	2.69	5.14	1.69	74.54	0.06	0.03	0.71	0.03	12.92	0.00	97.81
	Lipari	3.88	5.11	1.61	74.95	0.08	0.07	0.80	0.02	12.53	0.02	99.08
	Lipari	3.73	5.21	1.51	74.37	0.07	0.01	0.73	0.00	12.86	0.00	98.50
	Lipari	3.79	5.14	1.53	74.41	0.06	0.03	0.76	0.00	13.11	0.00	98.84
01.02.2021	Lipari	3.77	5.08	1.58	73.82	0.06	0.05	0.72	0.03	12.55	0.00	97.66
	Lipari	3.73	5.21	1.53	73.64	0.07	0.02	0.78	0.10	13.15	0.03	98.26
	Lipari	3.68	5.10	1.56	74.84	0.07	0.03	0.77	0.04	12.85	0.00	98.95
	Lipari	3.81	5.04	1.47	74.42	0.05	0.02	0.73	0.09	12.92	0.03	98.58
	Lipari	3.97	5.13	1.57	72.63	0.05	0.02	0.72	0.04	13.10	0.03	97.26
	Lipari	3.45	5.10	1.53	73.27	0.07	0.04	0.76	0.06	13.64	0.01	97.93
	Lipari	3.55	5.07	1.80	72.51	0.08	0.02	0.74	0.00	13.39	0.01	97.17
	Lipari	3.37	5.13	1.57	73.56	0.09	0.01	0.72	0.08	13.15	0.05	97.74
	Lipari	3.52	5.15	1.58	74.53	0.08	0.02	0.78	0.01	13.22	0.03	98.91
	Lipari	3.54	5.14	1.53	74.90	0.07	0.03	0.76	0.00	13.41	0.00	99.38
01.02.2021	Lipari	3.52	5.08	1.47	74.35	0.10	0.01	0.75	0.12	13.51	0.00	98.92
	Lipari	3.00	5.14	1.58	74.67	0.09	0.04	0.72	0.08	13.27	0.00	98.59
	Lipari	3.70	5.09	1.42	74.65	0.08	0.05	0.72	0.05	12.80	0.05	98.61
	Lipari	3.52	5.10	1.98	74.55	0.07	0.02	0.77	0.07	13.19	0.00	99.27
	Lipari	3.51	5.06	1.60	74.22	0.08	0.06	0.76	0.06	12.92	0.02	98.30
	Lipari	3.63	5.04	1.59	74.15	0.06	0.03	0.77	0.04	12.90	0.00	98.22
	Lipari	3.80	5.06	1.62	73.79	0.08	0.04	0.73	0.10	12.97	0.03	98.21
	Lipari	3.68	5.07	1.53	72.98	0.09	0.08	0.76	0.09	12.99	0.00	97.26
	Lipari	3.79	5.00	1.60	72.60	0.03	0.01	0.80	0.04	13.30	0.02	97.18
	Lipari	3.84	5.03	1.70	72.22	0.11	0.02	0.77	0.00	13.04	0.04	96.76

Appendix A

Supplementary Table S4: EMP standard measurements on reference material Lipari Obsidian.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	Lipari	3.41	5.05	1.72	72.73	0.06	0.04	0.74	0.01	13.19	0.03	96.97
	Lipari	3.67	5.10	1.71	72.99	0.12	0.00	0.76	0.09	13.28	0.00	97.72
	Lipari	3.51	5.11	1.56	72.57	0.06	0.04	0.74	0.01	12.91	0.00	96.52
	Lipari	3.31	5.08	1.59	74.74	0.07	0.03	0.74	0.08	13.08	0.00	98.72
	Lipari	3.56	5.07	1.68	74.42	0.06	0.05	0.73	0.10	13.14	0.02	98.82
	Lipari	3.64	5.08	1.72	74.25	0.06	0.06	0.73	0.05	12.98	0.00	98.57
	Lipari	3.76	5.15	1.64	71.65	0.06	0.02	0.76	0.07	13.22	0.01	96.34
	Lipari	3.56	5.06	1.49	73.89	0.06	0.04	0.77	0.09	13.16	0.02	98.13
	Lipari	3.44	5.09	1.71	73.85	0.11	0.02	0.74	0.05	12.81	0.00	97.83
	Lipari	3.77	5.12	1.67	74.29	0.07	0.04	0.79	0.08	13.42	0.00	99.25
04.02.2021	Lipari	3.60	5.10	1.59	74.87	0.04	0.01	0.73	0.00	13.25	0.01	99.20
	Lipari	3.39	5.12	1.79	75.02	0.07	0.05	0.75	0.05	13.36	0.00	99.59
04.02.2021	Lipari	3.51	5.11	1.61	74.71	0.11	0.04	0.75	0.04	13.05	0.01	98.94
	Lipari	3.44	5.10	1.66	73.38	0.07	0.07	0.76	0.00	12.66	0.02	97.16
	Lipari	3.57	5.08	1.68	73.72	0.09	0.00	0.76	0.08	13.29	0.02	98.28
	Lipari	3.91	5.19	1.60	73.81	0.08	0.02	0.77	0.10	13.27	0.00	98.75
	Lipari	3.65	5.10	1.52	74.16	0.05	0.03	0.78	0.10	13.14	0.00	98.54
	Lipari	3.73	5.12	1.60	74.58	0.08	0.03	0.79	0.03	13.54	0.00	99.50
	Lipari	3.67	5.08	1.53	75.11	0.07	0.03	0.74	0.04	13.34	0.00	99.61
	Lipari	3.75	5.05	1.67	74.62	0.09	0.04	0.70	0.03	13.09	0.00	99.05
	Lipari	3.60	5.08	1.70	75.48	0.07	0.02	0.76	0.11	13.35	0.03	100.20
	Lipari	3.70	5.13	1.40	74.73	0.08	0.06	0.78	0.09	12.82	0.01	98.80
	Lipari	3.77	5.12	1.64	75.55	0.08	0.00	0.76	0.01	13.48	0.00	100.40
	Lipari	3.53	5.08	1.65	75.09	0.10	0.04	0.73	0.07	13.16	0.02	99.48
12.05.2021	Lipari	3.64	5.13	1.60	74.45	0.08	0.07	0.76	0.05	13.16	0.00	98.94
	Lipari	4.10	5.12	1.59	74.11	0.06	0.03	0.72	0.02	12.75	0.00	98.51
	Lipari	3.98	5.08	1.68	73.17	0.07	0.02	0.76	0.07	12.90	0.00	97.73
	Lipari	3.86	5.06	1.67	72.91	0.11	0.01	0.75	0.04	12.85	0.00	97.26
	Lipari	4.04	5.03	1.67	72.92	0.05	0.06	0.76	0.07	12.73	0.00	97.32
26.12.2021	Lipari	3.66	5.13	1.39	74.41	0.07	0.03	0.71	0.00	13.46	0.01	98.87
	Lipari	3.48	5.14	1.53	74.39	0.08	0.05	0.72	0.06	13.27	0.00	98.73
26.12.2021	Lipari	3.62	5.10	1.59	74.63	0.06	0.07	0.72	0.04	13.63	0.01	99.47
	Lipari	4.04	5.14	1.59	74.25	0.06	0.02	0.73	0.05	13.70	0.00	99.57
	Lipari	3.83	5.18	1.59	74.57	0.07	0.05	0.76	0.06	13.44	0.01	99.56
	Lipari	3.91	5.05	1.48	74.42	0.09	0.06	0.80	0.09	13.40	0.00	99.31
	Lipari	3.78	5.17	1.29	74.75	0.10	0.03	0.77	0.01	13.72	0.00	99.62
	Lipari	4.06	5.06	1.47	75.35	0.06	0.03	0.74	0.11	13.95	0.00	100.83
	Lipari	3.85	5.15	1.59	75.00	0.09	0.05	0.77	0.04	13.41	0.00	99.95
	Lipari	3.78	5.08	1.67	75.54	0.06	0.02	0.75	0.09	13.21	0.00	100.20
	Lipari	3.74	5.04	1.52	74.15	0.11	0.00	0.81	0.17	13.16	0.00	98.70
	Lipari	3.80	5.12	1.57	75.85	0.10	0.02	0.71	0.06	13.43	0.00	100.65
	Lipari	4.03	5.05	1.44	75.68	0.05	0.04	0.71	0.07	13.21	0.01	100.30
	Lipari	3.74	5.12	1.57	75.39	0.10	0.04	0.71	0.06	13.26	0.03	100.02
	Lipari	3.81	5.20	1.43	75.35	0.10	0.03	0.72	0.03	13.39	0.00	100.07
	Lipari	3.90	5.17	1.49	74.99	0.09	0.00	0.69	0.05	13.41	0.00	99.79
	Lipari	3.84	5.19	1.64	72.30	0.08	0.05	0.69	0.09	13.41	0.00	97.29

Appendix A

Supplementary Table S4: EMP standard measurements on reference material Lipari Obsidian.

		Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2 O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
average std measurements entire period		3.89	5.03	1.59	74.14	0.08	0.03	0.75	0.06	13.04	0.01	98.63
Hunt & Hill (2001) - Lipari	Cameca	3.93	5.12	1.51	74.35		0.05	0.74	0.08	12.87		98.65
	Mk V	4.07	5.17	1.49	74.27		0.05	0.74	0.07	13.00		98.86
	average	4.00	5.15	1.50	74.31		0.05	0.74	0.08	12.94		98.76
deviation (%) over measurement period		-2.70	-2.25	5.87	-0.23		-35.12	1.85	-14.40	0.82		-0.12
average std measurements 20.11.2019		3.97	5.11	1.50	74.29	0.08	0.03	0.75	0.08	13.21	0.01	99.03
deviation (%) for 20.11.2019		-0.87	-0.69	-0.24	-0.02		-34.89	0.92	1.49	2.15		0.27
average std measurements 21.11.2019		3.97	5.08	1.53	74.19	0.08	0.03	0.75	0.08	13.24	0.01	98.95
deviation (%) for 21.11.2019		-0.85	-1.26	2.28	-0.16		-46.50	1.76	1.87	2.32		0.20
average std measurements 22.11.2019		3.97	5.08	1.54	74.18	0.08	0.03	0.74	0.06	13.28	0.01	98.98
deviation (%) for 22.11.2019		-0.66	-1.20	2.72	-0.18		-42.18	0.30	-15.97	2.63		0.22
average std measurements 25.11.2019		3.97	5.10	1.53	75.14	0.09	0.03	0.75	0.08	13.29	0.01	99.97
deviation (%) for 25.11.2019		-0.87	-0.91	1.67	1.12		-33.24	1.04	2.04	2.76		1.23
average std measurements 16.12.2019		3.90	5.12	1.63	73.64	0.08	0.05	0.71	0.08	13.10	0.01	98.30
deviation (%) for 16.12.2019		-2.53	-0.58	8.58	-0.91		-6.63	-3.81	3.45	1.27		-0.46
average std measurements 17.12.2019		3.86	5.07	1.59	74.61	0.08	0.03	0.77	0.06	12.99	0.01	99.07
deviation (%) for 17.12.2019		-3.61	-1.39	5.97	0.41		-42.02	3.67	-14.12	0.45		0.32
average std measurements 19.12.2019		3.89	5.07	1.56	73.69	0.08	0.03	0.76	0.09	13.06	0.01	98.23
deviation (%) for 19.12.2019		-2.85	-1.38	3.78	-0.83		-49.05	2.70	16.83	0.97		-0.53
average std measurements 24.01.2020		3.82	5.06	1.61	73.81	0.08	0.03	0.76	0.05	12.78	0.01	98.01
deviation (%) for 24.01.2020		-4.62	-1.71	7.27	-0.68		-33.25	3.14	-30.55	-1.19		-0.76
average std measurements 14.02.2020		3.85	4.87	1.55	75.36	0.08	0.03	0.77	0.08	12.57	0.01	99.18
deviation (%) for 14.02.2020		-3.64	-5.36	3.66	1.42		-34.04	4.36	3.78	-2.86		0.43
average std measurements 25.02.2020		3.81	5.03	1.61	74.11	0.08	0.03	0.76	0.06	12.95	0.01	98.46
deviation (%) for 25.02.2020		-4.77	-2.19	7.47	-0.27		-32.01	2.46	-18.55	0.09		-0.30
average std measurements 27.04.2020		3.86	5.06	1.59	73.67	0.08	0.03	0.75	0.06	12.94	0.01	98.04
deviation (%) for 27.04.2020		-3.59	-1.68	5.92	-0.86		-33.82	1.97	-25.61	0.03		-0.72
average std measurements 11.05.2020		3.80	5.04	1.57	73.21	0.08	0.04	0.75	0.05	13.01	0.01	97.56
deviation (%) for 11.05.2020		-5.03	-1.99	4.77	-1.48		-21.34	1.91	-27.67	0.55		-1.21
average std measurements 15.05.2020		3.77	5.02	1.59	74.23	0.08	0.03	0.74	0.07	13.04	0.01	98.58
deviation (%) for 15.05.2020		-5.78	-2.51	5.82	-0.10		-39.01	0.60	-10.72	0.85		-0.18
average std measurements 12.06.2020		4.25	5.04	1.58	74.25	0.09	0.03	0.75	0.07	13.06	0.01	99.12
deviation (%) for 12.06.2020		6.26	-2.09	5.00	-0.08		-35.22	1.44	-12.47	0.97		0.37
average std measurements 16.06.2020		4.02	5.04	1.58	74.47	0.08	0.03	0.74	0.06	13.16	0.01	99.18
deviation (%) for 16.06.2020		0.48	-2.09	5.00	0.22		-33.35	-0.08	-21.33	1.74		0.43
average std measurements 18.06.2020		4.02	5.05	1.60	74.54	0.08	0.03	0.74	0.07	13.21	0.01	99.36
deviation (%) for 18.06.2020		0.59	-1.79	6.95	0.31		-32.14	-0.33	-7.60	2.09		0.61
average std measurements 22.06.2020		4.14	5.03	1.60	74.08	0.08	0.03	0.75	0.09	13.22	0.02	99.02
deviation (%) for 22.06.2020		3.41	-2.17	6.33	-0.31		-39.33	1.01	17.55	2.18		0.27
average std measurements 24.08.2020		3.97	4.99	1.60	74.03	0.08	0.03	0.75	0.06	12.65	0.02	98.17
deviation (%) for 24.08.2020		-0.78	-3.02	6.97	-0.38		-47.27	1.61	-18.89	-2.22		-0.59
average std measurements 27.08.2020		3.92	5.01	1.60	73.20	0.08	0.03	0.75	0.06	12.90	0.01	97.57
deviation (%) for 27.08.2020		-1.93	-2.55	6.73	-1.49		-34.77	1.53	-15.12	-0.29		-1.20
average std measurements 31.08.2020		4.01	4.88	1.54	74.30	0.07	0.03	0.76	0.06	12.89	0.02	98.56
deviation (%) for 31.08.2020		0.34	-5.24	2.48	-0.01		-43.34	2.70	-16.87	-0.34		-0.20
average std measurements 12.10.2020		3.83	4.99	1.54	74.76	0.07	0.04	0.75	0.07	13.37	0.01	99.43

Appendix A

Supplementary Table S4: EMP standard measurements on reference material Lipari Obsidian.

	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2 O3	P2O5	Total
	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
deviation (%) for 12.10.2020	-4.30	-3.07	2.83	0.61		-19.20	1.22	-4.75	3.37		0.68
average std measurements 14.10.2020	3.93	4.83	1.69	74.14	0.08	0.04	0.84	0.06	12.84	0.01	98.46
deviation (%) for 14.10.2020	-1.69	-6.09	12.61	-0.23		-27.17	13.39	-16.17	-0.76		-0.30
average std measurements 16.10.2020	3.82	5.01	1.61	74.01	0.08	0.03	0.76	0.06	13.06	0.02	98.45
deviation (%) for 16.10.2020	-4.39	-2.68	7.13	-0.41		-47.41	2.54	-14.08	0.96		-0.31
average std measurements 30.10.2020	3.90	4.99	1.89	73.49	0.08	0.03	0.74	0.07	12.95	0.02	98.16
deviation (%) for 30.10.2020	-2.42	-2.93	26.06	-1.10		-45.50	-0.09	-5.58	0.11		-0.60
average std measurements 26.01.2021	3.80	5.12	1.50	74.64	0.08	0.04	0.75	0.05	13.55	0.00	99.55
deviation (%) for 26.01.2021	-4.92	-0.40	0.15	0.45		-11.60	1.09	-32.90	4.78		0.80
average std measurements 31.01.2021	3.66	5.13	1.56	73.99	0.07	0.03	0.74	0.05	12.94	0.01	98.17
deviation (%) for 31.01.2021	-8.55	-0.33	4.12	-0.44		-35.51	0.62	-38.18	0.01		-0.59
average std measurements 01.02.2021	3.48	5.10	1.60	74.12	0.08	0.03	0.75	0.05	13.22	0.02	98.46
deviation (%) for 01.02.2021	-12.93	-0.87	6.97	-0.25		-39.09	1.35	-27.76	2.19		-0.30
average std measurements 02.02.2021	3.61	5.07	1.64	73.28	0.07	0.03	0.75	0.06	13.08	0.01	97.62
deviation (%) for 02.02.2021	-9.67	-1.40	9.08	-1.38		-31.17	1.53	-20.54	1.14		-1.15
average std measurements 04.02.2021	3.61	5.12	1.64	74.25	0.07	0.03	0.76	0.06	13.18	0.01	98.71
deviation (%) for 04.02.2021	-9.88	-0.58	9.33	-0.09		-33.25	2.46	-24.37	1.89		-0.04
average std measurements 05.02.2021	3.67	5.10	1.60	74.95	0.08	0.04	0.76	0.05	13.24	0.01	99.50
deviation (%) for 05.02.2021	-8.16	-0.90	6.58	0.86		-26.38	2.05	-28.67	2.38		0.75
average std measurements 12.05.2021	4.00	5.07	1.65	73.28	0.07	0.03	0.75	0.05	12.81	0.00	97.70
deviation (%) for 12.05.2021	-0.12	-1.41	10.17	-1.39		-38.20	0.86	-34.53	-0.99		-1.06
average std measurements 26.12.2021	3.80	5.12	1.50	74.64	0.08	0.04	0.75	0.05	13.55	0.00	99.55
deviation (%) for 26.12.2021	-4.92	-0.40	0.15	0.45		-11.60	1.09	-32.90	4.78		0.80
average std measurements 27.12.2021	3.83	5.12	1.54	74.91	0.09	0.03	0.72	0.08	13.31	0.01	99.63
deviation (%) for 27.12.2021	-4.25	-0.46	2.75	0.80		-48.03	-2.36	4.20	2.90		0.88

Appendix A

Supplementary Table S5: EMP standard measurements on reference material VGA-99.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
20.11.2019	VGA99	2.82	0.82	12.89	51.57	4.07	5.12	9.32	0.15	12.72	0.33	99.82
	VGA99	2.65	0.84	13.01	51.39	4.02	5.07	9.26	0.19	12.68	0.30	99.41
	VGA99	2.81	0.83	13.19	50.85	4.03	5.21	9.32	0.29	12.62	0.27	99.43
	VGA99	2.76	0.81	13.54	51.25	4.10	5.15	9.31	0.25	12.75	0.30	100.21
	VGA99	2.62	0.83	13.00	51.05	4.07	5.29	9.29	0.21	12.52	0.39	99.28
	VGA99	2.80	0.84	13.67	51.41	4.05	5.12	9.25	0.19	12.47	0.33	100.13
	VGA99	2.94	0.83	13.29	51.18	4.06	5.08	9.18	0.21	12.33	0.36	99.46
	VGA99	3.00	0.87	13.45	51.52	4.06	5.22	9.20	0.18	12.41	0.31	100.22
	VGA99	2.78	0.86	13.36	51.26	4.15	5.24	9.33	0.13	12.79	0.31	100.21
	VGA99	2.86	0.83	13.63	51.36	4.05	5.03	9.24	0.17	12.52	0.31	100.01
	VGA99	2.94	0.85	13.00	50.99	4.08	5.11	9.32	0.25	12.60	0.33	99.47
	VGA99	2.78	0.84	13.09	51.20	4.03	5.23	9.26	0.23	12.54	0.35	99.55
	VGA99	2.82	0.82	13.13	51.24	4.12	5.23	9.29	0.14	12.53	0.31	99.63
	VGA99	2.77	0.83	13.64	50.76	4.07	5.11	9.30	0.20	12.52	0.33	99.54
21.11.2019	VGA99	3.10	0.87	12.92	51.17	4.05	5.17	9.21	0.18	12.57	0.33	99.57
	VGA99	2.74	0.85	13.18	51.02	4.05	4.99	9.23	0.20	12.53	0.37	99.17
	VGA99	2.97	0.84	13.02	51.17	4.01	5.24	9.28	0.27	12.58	0.38	99.76
	VGA99	2.68	0.86	13.01	51.36	3.99	5.22	9.30	0.25	12.52	0.32	99.51
	VGA99	2.86	0.83	12.92	50.85	4.07	5.22	9.32	0.16	12.55	0.31	99.10
	VGA99	2.84	0.81	12.58	51.55	4.03	5.03	9.27	0.17	12.62	0.39	99.29
	VGA99	2.75	0.86	13.26	51.22	4.08	5.16	9.22	0.20	12.20	0.42	99.37
	VGA99	2.91	0.84	13.16	51.02	4.13	5.13	9.18	0.24	12.26	0.38	99.25
	VGA99	2.83	0.81	13.11	51.06	4.08	5.26	9.23	0.10	12.64	0.35	99.46
	VGA99	2.90	0.83	13.47	51.47	4.14	5.22	9.17	0.25	12.72	0.41	100.57
	VGA99	2.90	0.86	12.60	50.82	4.11	5.08	9.27	0.24	12.47	0.42	98.77
	VGA99	2.81	0.82	13.20	51.15	3.99	5.12	9.34	0.16	12.46	0.40	99.45
22.11.2019	VGA99	2.89	0.83	13.08	51.19	4.12	5.16	9.18	0.22	12.57	0.41	99.65
	VGA99	2.72	0.82	13.04	51.06	4.01	5.00	9.19	0.24	12.69	0.33	99.09
	VGA99	2.68	0.83	12.96	50.93	4.07	5.03	9.24	0.16	12.67	0.40	98.97
	VGA99	2.76	0.82	12.84	51.12	4.00	5.18	9.16	0.10	12.56	0.35	98.88
	VGA99	2.83	0.82	13.00	50.99	4.14	4.99	9.31	0.21	12.67	0.38	99.35
	VGA99	2.86	0.83	13.41	51.07	3.96	5.10	9.31	0.15	12.64	0.38	99.70
	VGA99	2.77	0.80	13.06	51.33	4.02	5.14	9.25	0.19	12.65	0.36	99.58
	VGA99	2.71	0.85	13.20	51.25	3.99	5.16	9.19	0.26	12.57	0.36	99.53
	VGA99	2.89	0.82	12.87	51.22	3.97	5.14	9.24	0.20	12.51	0.36	99.22
	VGA99	2.74	0.83	13.00	50.93	4.06	5.12	9.24	0.15	12.45	0.33	98.85
	VGA99	2.78	0.85	13.09	50.50	4.02	5.11	9.25	0.20	12.57	0.36	98.73
	VGA99	2.66	0.83	12.90	50.70	4.04	5.15	9.19	0.16	12.58	0.43	98.65
	VGA99	3.02	0.82	13.39	50.96	4.03	5.23	9.32	0.22	12.79	0.40	100.18
	VGA99	2.75	0.81	13.36	51.00	3.99	5.04	9.39	0.23	12.72	0.39	99.68
	VGA99	2.92	0.82	12.88	51.06	3.99	5.15	9.33	0.24	12.54	0.39	99.33
25.11.2019	VGA99	2.65	0.85	13.22	50.49	4.04	5.14	9.30	0.14	12.66	0.40	98.89
	VGA99	2.83	0.81	12.96	50.79	4.05	5.23	9.28	0.26	12.40	0.38	98.99
	VGA99	2.74	0.83	13.43	51.12	3.99	5.08	9.21	0.21	12.76	0.42	99.79
	VGA99	2.89	0.86	13.21	51.84	4.13	5.08	9.38	0.18	12.83	0.40	100.80
	VGA99	2.90	0.84	13.56	50.85	4.05	5.21	9.42	0.23	12.63	0.37	100.06
	VGA99	2.89	0.82	13.51	50.82	3.95	5.16	9.31	0.24	12.51	0.31	99.52
	VGA99	2.87	0.85	13.16	51.22	4.03	5.15	9.35	0.14	12.72	0.41	99.90
	VGA99	2.46	0.83	13.06	51.21	4.04	4.91	9.24	0.26	12.45	0.41	98.87
	VGA99	2.68	0.84	13.09	51.18	4.03	5.03	9.25	0.15	12.51	0.39	99.15
	VGA99	2.65	0.86	13.13	51.22	4.07	5.11	9.37	0.16	12.74	0.36	99.67
	VGA99	2.91	0.83	13.69	51.45	4.01	5.10	9.36	0.23	12.55	0.40	100.53
	VGA99	2.79	0.82	12.89	51.39	4.08	5.15	9.42	0.11	12.57	0.46	99.67
	VGA99	2.76	0.85	13.07	50.99	4.01	5.13	9.19	0.19	12.52	0.30	99.01
16.12.2019	VGA99	2.85	0.82	13.03	51.32	4.07	5.09	9.16	0.25	12.37	0.42	99.39
	VGA99	2.45	0.83	12.78	51.43	4.03	5.09	9.38	0.12	12.62	0.41	99.14
	VGA99	2.84	0.83	12.93	51.61	3.97	5.15	9.36	0.29	12.42	0.36	99.76
	VGA99	2.70	0.82	13.14	51.76	4.01	5.06	9.27	0.16	12.55	0.35	99.81
	VGA99	2.50	0.83	12.78	51.89	3.95	5.17	9.17	0.31	12.64	0.36	99.60
	VGA99	2.81	0.83	13.22	51.64	4.07	5.20	9.16	0.19	12.69	0.39	100.20
	VGA99	2.68	0.82	13.35	51.48	4.04	5.16	9.16	0.24	12.62	0.37	99.92
	VGA99	2.82	0.83	13.12	51.74	4.03	5.10	9.12	0.18	12.74	0.31	99.98
	VGA99	2.78	0.81	13.45	51.64	3.95	5.18	9.20	0.16	12.56	0.44	100.17
	VGA99	2.53	0.82	13.67	50.80	3.99	5.14	9.50	0.10	12.54	0.37	99.46
	VGA99	2.80	0.83	13.37	50.75	4.04	5.10	9.39	0.23	12.33	0.29	99.13
	VGA99	2.66	0.80	13.57	49.85	4.04	5.20	9.43	0.15	12.57	0.36	98.63
	VGA99	2.79	0.81	13.44	50.44	3.96	5.12	9.34	0.13	12.30	0.46	98.79
	VGA99	2.84	0.82	13.59	50.68	4.04	5.19	9.44	0.13	12.42	0.37	99.52
	VGA99	2.72	0.83	13.73	50.66	4.07	5.28	9.29	0.11	12.29	0.44	99.42
	VGA99	2.79	0.86	13.68	50.52	4.06	5.05	9.38	0.23	12.45	0.33	99.36

Appendix A

Supplementary Table S5: EMP standard measurements on reference material VGA-99.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
17.12.2019	VGA99	2.87	0.82	13.30	49.44	4.01	5.18	9.42	0.25	12.23	0.40	97.92
	VGA99	2.74	0.79	13.26	50.71	4.05	5.21	9.43	0.17	12.24	0.46	99.06
	VGA99	2.81	0.84	13.25	50.54	3.97	5.26	9.37	0.18	12.30	0.38	98.91
	VGA99	2.77	0.81	13.49	51.28	4.00	5.21	9.49	0.15	12.14	0.38	99.73
	VGA99	2.53	0.85	13.54	51.02	4.07	5.15	9.39	0.25	12.16	0.30	99.26
	VGA99	2.79	0.85	13.63	51.13	4.10	5.24	9.40	0.17	12.25	0.37	99.93
	VGA99	2.74	0.82	13.28	50.96	4.05	5.11	9.42	0.18	12.28	0.41	99.24
	VGA99	2.95	0.82	13.24	51.69	4.01	5.14	9.45	0.23	12.24	0.42	100.20
	VGA99	2.88	0.83	13.11	51.27	4.07	5.00	9.47	0.17	12.10	0.40	99.30
	VGA99	2.78	0.84	13.36	51.30	4.01	5.22	9.38	0.12	12.36	0.40	99.77
	VGA99	2.57	0.83	12.92	51.17	4.00	5.13	9.31	0.24	11.95	0.40	98.53
	VGA99	2.81	0.82	13.38	51.12	3.98	5.31	9.41	0.21	12.30	0.41	99.76
	VGA99	2.55	0.82	13.46	51.50	4.01	5.08	9.40	0.16	12.19	0.36	99.53
	VGA99	2.74	0.81	13.86	51.24	4.10	5.16	9.44	0.20	12.20	0.39	100.13
	VGA99	2.93	0.83	13.20	50.68	4.04	5.23	9.35	0.16	12.20	0.42	99.04
	VGA99	2.87	0.83	13.22	51.48	3.97	5.10	9.32	0.19	12.41	0.38	99.77
	VGA99	2.92	0.80	13.33	51.20	4.01	5.14	9.48	0.14	12.27	0.36	99.65
	VGA99	2.54	0.83	13.15	50.84	3.97	5.12	9.36	0.21	12.36	0.34	98.72
	VGA99	2.68	0.83	13.24	50.80	4.02	5.15	9.45	0.18	12.26	0.47	99.08
	VGA99	2.91	0.83	13.46	50.97	3.99	5.16	9.34	0.21	12.30	0.33	99.51
	VGA99	2.89	0.83	12.87	51.11	3.98	5.06	9.40	0.23	12.45	0.38	99.21
19.12.2019	VGA99	2.74	0.80	13.73	50.71	4.02	5.13	9.40	0.20	12.38	0.35	99.46
	VGA99	2.50	0.83	13.21	50.40	4.03	5.09	9.41	0.23	12.37	0.47	98.54
	VGA99	2.61	0.83	13.11	50.14	4.07	5.13	9.44	0.24	12.45	0.36	98.38
	VGA99	2.81	0.80	13.52	50.09	4.07	5.22	9.34	0.16	12.26	0.43	98.71
	VGA99	2.91	0.81	13.91	50.57	3.99	5.17	9.41	0.15	12.23	0.29	99.44
	VGA99	2.93	0.81	13.36	50.27	4.07	5.14	9.48	0.15	12.33	0.38	98.92
	VGA99	2.89	0.82	13.47	48.46	4.02	5.20	9.42	0.17	12.51	0.36	97.32
	VGA99	2.92	0.80	13.55	48.68	3.98	5.13	9.42	0.26	12.09	0.39	97.22
	VGA99	2.74	0.85	13.53	50.12	4.05	5.15	9.41	0.28	12.40	0.35	98.88
	VGA99	2.81	0.85	13.41	49.43	3.98	5.10	9.49	0.25	12.31	0.40	98.03
	VGA99	2.49	0.82	13.89	49.95	4.03	5.25	9.44	0.17	12.42	0.42	98.88
	VGA99	2.79	0.82	13.76	49.97	4.09	5.27	9.38	0.12	12.38	0.37	98.95
	VGA99	2.75	0.83	13.10	50.82	4.11	5.10	9.51	0.20	12.03	0.36	98.81
	VGA99	2.82	0.84	13.63	50.59	4.09	5.06	9.56	0.20	12.15	0.41	99.35
	VGA99	2.61	0.80	12.83	51.33	4.03	5.12	9.43	0.22	12.32	0.36	99.05
24.01.2020	VGA99	2.70	0.82	13.34	50.91	4.08	5.11	9.52	0.18	12.00	0.38	99.04
	VGA99	2.94	0.82	13.48	50.89	4.08	5.00	9.43	0.15	12.09	0.39	99.27
	VGA99	2.81	0.85	13.53	50.89	4.04	5.20	9.49	0.15	12.06	0.38	99.41
	VGA99	2.78	0.83	13.96	50.70	4.01	5.24	9.49	0.18	12.16	0.36	99.71
	VGA99	2.81	0.82	13.43	50.66	3.98	5.20	9.48	0.21	12.06	0.36	99.01
	VGA99	2.90	0.82	13.38	50.36	4.05	5.08	9.39	0.19	11.89	0.41	98.46
	VGA99	2.99	0.82	13.34	50.56	4.03	5.24	9.44	0.24	12.03	0.37	99.06
	VGA99	2.64	0.82	13.67	50.74	4.05	5.20	9.41	0.24	12.28	0.36	99.41
	VGA99	2.98	0.83	13.31	50.51	3.94	5.14	9.29	0.24	12.07	0.38	98.68
	VGA99	2.81	0.86	13.62	50.54	4.11	5.09	9.52	0.28	12.10	0.40	99.33
24.01.2020	VGA99	2.74	0.83	13.65	50.71	4.01	5.15	9.31	0.31	12.06	0.30	99.06
	VGA99	2.81	0.86	13.34	50.70	4.03	5.18	9.36	0.31	12.15	0.33	99.07
	VGA99	2.70	0.84	13.41	50.66	4.10	5.24	9.43	0.24	12.14	0.40	99.16
	VGA99	2.85	0.83	13.12	50.15	4.08	5.01	9.33	0.17	12.02	0.41	97.97
	VGA99	2.92	0.79	13.66	50.51	4.09	5.21	9.38	0.17	12.00	0.34	99.07
	VGA99	2.82	0.82	13.57	51.23	3.98	5.17	9.46	0.12	11.94	0.33	99.44
	VGA99	2.83	0.85	13.70	50.54	4.07	5.05	9.42	0.26	12.16	0.40	99.28
	VGA99	2.64	0.82	13.52	50.53	4.01	5.15	9.54	0.23	12.01	0.38	98.83
	VGA99	2.77	0.83	13.10	50.96	4.05	5.20	9.49	0.21	12.04	0.34	98.99
	VGA99	2.74	0.80	13.42	51.83	3.99	5.19	9.34	0.22	12.23	0.39	100.15
	VGA99	2.83	0.83	13.44	51.54	4.03	5.09	9.42	0.20	12.22	0.40	100.00
	VGA99	2.83	0.84	13.56	51.51	3.97	5.17	9.39	0.16	12.19	0.38	100.00
	VGA99	2.96	0.80	13.65	51.41	3.95	5.14	9.33	0.15	12.18	0.36	99.93
	VGA99	2.78	0.84	13.29	51.06	3.91	5.18	9.39	0.19	12.16	0.39	99.19
	VGA99	2.79	0.82	13.70	51.59	3.98	5.10	9.40	0.21	12.02	0.39	100.00
	VGA99	2.78	0.82	13.56	51.63	3.96	5.07	9.42	0.24	12.29	0.36	100.12
	VGA99	2.67	0.83	13.78	51.70	3.99	4.97	9.33	0.18	12.14	0.30	99.90
	VGA99	2.84	0.81	13.46	51.46	3.97	5.06	9.41	0.19	12.27	0.39	99.86
	VGA99	2.73	0.84	13.50	51.37	3.95	4.99	9.42	0.23	12.14	0.42	99.59
	VGA99	2.64	0.83	13.48	51.11	3.95	5.08	9.37	0.28	12.11	0.37	99.22
	VGA99	2.74	0.83	13.74	51.56	3.91	5.04	9.26	0.21	11.82	0.35	99.46
14.02.2020	VGA99	2.73	0.83	13.32	51.15	3.94	5.15	9.34	0.23	11.99	0.37	99.05
	VGA99	2.77	0.84	13.56	51.32	3.94	5.18	9.40	0.21	11.80	0.38	99.40
	VGA99	2.67	0.81	13.54	50.93	3.88	5.24	9.32	0.22	11.98	0.37	98.95

Appendix A

Supplementary Table S5: EMP standard measurements on reference material VGA-99.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
25.02.2020	VGA99	2.83	0.80	13.44	50.91	3.90	5.16	9.41	0.12	11.97	0.44	98.98
	VGA99	2.81	0.81	13.63	50.54	3.94	5.19	9.41	0.22	12.05	0.36	98.97
	VGA99	2.97	0.83	13.68	50.39	3.96	4.98	9.32	0.24	11.83	0.41	98.62
	VGA99	2.72	0.81	13.45	51.27	4.05	5.07	9.46	0.24	12.20	0.34	99.61
	VGA99	2.69	0.79	13.54	50.79	4.11	5.00	9.40	0.20	12.50	0.43	99.45
	VGA99	2.67	0.84	13.95	51.35	4.08	5.28	9.48	0.29	12.36	0.34	100.64
	VGA99	2.62	0.82	13.54	50.73	3.99	5.16	9.50	0.31	12.06	0.36	99.09
	VGA99	2.82	0.80	13.72	50.86	4.05	5.22	9.39	0.24	12.38	0.33	99.81
	VGA99	2.73	0.81	13.65	50.62	4.08	5.13	9.34	0.33	12.26	0.39	99.33
	VGA99	2.86	0.78	13.70	50.79	4.07	4.99	9.43	0.13	12.22	0.40	99.37
	VGA99	2.78	0.83	13.40	50.60	4.12	5.13	9.36	0.24	12.43	0.40	99.30
	VGA99	2.58	0.82	13.71	50.99	4.02	5.17	9.27	0.14	12.09	0.34	99.13
	VGA99	2.68	0.84	13.35	51.03	4.03	5.04	9.30	0.24	12.26	0.32	99.09
	VGA99	2.79	0.82	13.73	51.10	4.01	5.11	9.35	0.21	12.26	0.39	99.77
	VGA99	2.63	0.81	13.33	51.06	4.06	5.17	9.33	0.14	12.48	0.39	99.40
	VGA99	2.69	0.82	13.72	50.88	4.12	5.13	9.43	0.18	12.25	0.34	99.56
	VGA99	2.73	0.81	13.30	50.64	4.04	5.12	9.37	0.19	12.09	0.37	98.66
	VGA99	2.52	0.82	13.43	50.69	4.02	5.02	9.40	0.25	12.35	0.36	98.85
	VGA99	2.74	0.85	13.40	50.92	4.10	5.03	9.46	0.16	12.28	0.39	99.33
	VGA99	2.57	0.80	13.77	50.59	4.13	5.13	9.38	0.17	12.15	0.37	99.06
25.02.2020	VGA99	2.71	0.83	13.60	50.73	4.05	5.04	9.39	0.23	12.48	0.42	99.48
	VGA99	2.74	0.83	13.43	51.03	4.11	5.09	9.48	0.24	12.24	0.37	99.57
	VGA99	2.89	0.83	13.47	51.02	4.08	5.07	9.39	0.15	12.34	0.35	99.59
	VGA99	2.81	0.81	13.35	50.85	4.04	5.10	9.40	0.22	12.18	0.40	99.15
	VGA99	2.62	0.80	13.41	50.79	4.10	5.13	9.34	0.25	12.41	0.38	99.24
	VGA99	2.55	0.80	13.69	50.59	4.04	5.14	9.39	0.23	12.24	0.35	99.02
	VGA99	2.62	0.83	13.68	50.46	4.07	5.15	9.37	0.17	12.11	0.38	98.85
	VGA99	2.70	0.81	13.50	50.99	4.04	5.03	9.42	0.21	12.43	0.38	99.51
	VGA99	2.73	0.80	13.58	51.10	4.01	5.13	9.43	0.13	12.35	0.32	99.58
	VGA99	2.84	0.82	13.70	50.89	4.07	5.07	9.34	0.26	12.43	0.38	99.79
	VGA99	2.72	0.85	13.53	50.95	4.10	5.18	9.38	0.26	12.20	0.39	99.56
	VGA99	2.86	0.80	13.64	50.76	4.09	5.13	9.32	0.20	12.33	0.31	99.44
	VGA99	2.71	0.81	13.63	50.88	4.13	5.07	9.35	0.11	12.45	0.36	99.49
	VGA99	2.66	0.79	13.47	50.63	4.14	5.09	9.35	0.12	12.12	0.39	98.77
	VGA99	2.80	0.80	13.37	50.51	4.15	5.09	9.33	0.17	12.28	0.38	98.88
	VGA99	2.87	0.81	13.52	50.83	4.07	4.98	9.37	0.20	12.36	0.35	99.37
	VGA99	2.67	0.85	13.51	50.68	3.89	5.16	9.25	0.26	12.43	0.30	99.00
	VGA99	2.79	0.82	13.20	50.73	4.06	5.18	9.37	0.25	12.43	0.35	99.18
	VGA99	2.63	0.83	13.51	51.04	4.02	5.07	9.22	0.27	12.15	0.39	99.13
	VGA99	2.51	0.82	13.27	51.15	4.04	5.12	9.33	0.17	12.51	0.32	99.25
27.04.2020	VGA99	2.91	0.84	13.46	50.72	4.01	5.08	9.34	0.15	12.52	0.37	99.40
	VGA99	2.77	0.82	13.27	50.77	4.07	5.19	9.38	0.26	12.38	0.31	99.21
	VGA99	2.75	0.85	13.66	51.07	4.01	5.03	9.32	0.20	12.18	0.32	99.39
	VGA99	2.58	0.82	13.34	50.99	3.97	4.99	9.32	0.17	12.34	0.34	98.86
	VGA99	2.62	0.82	13.69	50.76	4.02	4.97	9.40	0.18	12.42	0.39	99.26
	VGA99	2.79	0.82	13.31	51.13	4.03	5.19	9.35	0.18	12.33	0.35	99.48
	VGA99	2.80	0.81	13.65	50.82	4.06	5.15	9.28	0.24	12.27	0.38	99.46
	VGA99	2.53	0.85	12.94	50.88	4.02	5.13	9.39	0.14	12.39	0.36	98.63
	VGA99	2.70	0.80	13.50	51.01	4.07	5.12	9.37	0.19	12.39	0.38	99.53
	VGA99	2.72	0.82	13.24	50.86	3.98	5.23	9.35	0.23	12.38	0.38	99.20
	VGA99	2.65	0.85	13.26	51.14	4.14	5.04	9.39	0.22	12.41	0.37	99.47
	VGA99	2.51	0.84	13.52	50.86	4.06	5.03	9.33	0.14	12.23	0.32	98.84
	VGA99	2.71	0.83	13.23	50.81	3.98	5.09	9.41	0.24	12.24	0.31	98.85
	VGA99	2.72	0.83	13.87	50.95	4.02	5.08	9.26	0.10	12.65	0.37	99.85
	VGA99	2.99	0.84	13.32	50.84	4.02	5.14	9.40	0.22	12.50	0.32	99.59
	VGA99	2.84	0.84	13.56	50.72	3.95	5.09	9.26	0.17	12.22	0.40	99.05
	VGA99	2.90	0.83	13.72	51.92	4.18	5.13	9.54	0.18	12.65	0.39	101.44
	VGA99	2.70	0.82	13.45	50.93	3.98	5.11	9.22	0.18	12.33	0.36	99.09
	VGA99	2.61	0.82	13.26	50.87	4.05	5.14	9.23	0.23	12.27	0.45	98.93
	VGA99	2.47	0.83	13.64	51.07	3.96	5.07	9.30	0.16	12.38	0.35	99.23
27.04.2020	VGA99	2.43	0.81	13.27	50.76	4.10	5.10	9.38	0.13	12.20	0.36	98.54
	VGA99	2.74	0.84	13.29	50.60	4.02	5.10	9.37	0.23	12.14	0.38	98.71
	VGA99	2.84	0.81	13.48	50.51	4.04	5.06	9.38	0.24	12.20	0.31	98.87
	VGA99	2.67	0.81	13.39	50.04	4.01	5.19	9.33	0.21	12.19	0.39	98.23
	VGA99	2.65	0.84	13.36	51.25	4.01	5.08	9.28	0.20	12.09	0.32	99.09
	VGA99	2.74	0.83	13.36	50.96	4.05	5.06	9.37	0.17	12.21	0.35	99.10
	VGA99	2.66	0.80	13.44	51.00	3.97	5.08	9.34	0.21	12.24	0.38	99.13
	VGA99	2.85	0.81	13.17	50.91	4.04	4.94	9.31	0.28	12.16	0.38	98.85
11.05.2020	VGA99	2.89	0.81	13.20	50.68	4.02	5.05	9.37	0.18	12.33	0.36	98.89
	VGA99	2.69	0.79	13.52	50.24	4.00	5.09	9.31	0.29	12.55	0.36	98.84

Appendix A

Supplementary Table S5: EMP standard measurements on reference material VGA-99.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
11.05.2020	VGA99	2.82	0.79	13.58	50.47	4.06	5.21	9.38	0.11	12.59	0.41	99.42
	VGA99	2.82	0.82	13.81	50.21	4.05	5.19	9.32	0.24	12.52	0.39	99.37
	VGA99	2.65	0.84	13.49	50.68	4.05	5.18	9.27	0.15	12.52	0.37	99.20
	VGA99	2.77	0.85	13.57	50.25	4.07	5.13	9.27	0.22	12.30	0.37	98.80
	VGA99	2.86	0.83	13.78	50.07	4.01	5.09	9.37	0.19	12.42	0.43	99.04
	VGA99	2.99	0.84	13.33	48.41	4.08	5.10	9.30	0.23	12.59	0.39	97.26
	VGA99	2.83	0.83	13.43	48.36	4.04	5.14	9.32	0.23	12.29	0.36	96.82
	VGA99	2.51	0.82	13.45	49.02	4.09	5.12	9.21	0.25	12.01	0.38	96.86
	VGA99	2.79	0.82	13.76	50.18	4.04	4.99	9.43	0.21	12.35	0.29	98.85
	VGA99	2.65	0.84	13.32	48.45	4.05	5.13	9.38	0.19	12.31	0.37	96.69
	VGA99	2.94	0.81	13.45	48.59	4.09	5.19	9.37	0.16	12.20	0.37	97.17
	VGA99	2.91	0.77	13.51	48.45	4.10	5.26	9.27	0.16	12.42	0.38	97.23
	VGA99	2.75	0.84	13.06	49.52	4.00	5.13	9.29	0.22	12.45	0.36	97.61
	VGA99	2.84	0.86	13.62	50.17	3.99	5.11	9.34	0.25	12.28	0.39	98.85
	VGA99	2.76	0.81	13.47	50.44	3.95	5.27	9.44	0.17	12.45	0.34	99.10
	VGA99	2.82	0.83	13.57	50.29	4.03	5.03	9.36	0.18	12.25	0.41	98.77
15.05.2020	VGA99	2.73	0.83	13.73	50.27	4.06	5.11	9.39	0.19	12.45	0.37	99.13
	VGA99	2.91	0.82	13.67	50.59	3.97	5.20	9.38	0.23	12.30	0.40	99.47
	VGA99	2.78	0.82	13.81	50.14	4.06	5.07	9.29	0.26	12.25	0.40	98.88
	VGA99	2.70	0.81	13.88	50.67	4.07	5.05	9.31	0.12	12.34	0.40	99.35
	VGA99	2.82	0.82	13.45	50.69	4.03	5.06	9.37	0.23	12.44	0.35	99.26
	VGA99	2.79	0.85	13.18	50.92	4.01	5.14	9.36	0.22	12.42	0.37	99.25
	VGA99	2.78	0.82	13.52	50.90	4.09	4.98	9.35	0.17	12.40	0.42	99.43
	VGA99	2.80	0.87	13.73	51.18	4.12	5.15	9.38	0.18	12.45	0.39	100.24
	VGA99	3.17	0.81	13.79	51.09	4.08	5.15	9.31	0.12	12.31	0.34	100.17
	VGA99	2.89	0.85	13.61	51.24	4.14	5.12	9.23	0.26	12.21	0.41	99.96
	VGA99	2.84	0.85	13.55	50.65	4.05	5.02	9.43	0.22	12.42	0.38	99.41
	VGA99	2.99	0.81	13.66	50.47	4.15	5.10	9.37	0.15	12.39	0.38	99.48
	VGA99	2.92	0.81	13.75	50.62	4.03	5.12	9.46	0.18	12.36	0.41	99.66
	VGA99	2.77	0.85	13.25	50.85	3.99	5.12	9.47	0.19	12.44	0.37	99.30
	VGA99	2.68	0.82	13.39	50.78	3.97	4.96	9.37	0.18	12.56	0.40	99.10
	VGA99	2.80	0.83	13.33	50.73	4.00	5.23	9.38	0.18	12.36	0.42	99.27
15.05.2020	VGA99	2.80	0.83	13.35	50.71	4.03	5.04	9.43	0.21	12.41	0.37	99.18
	VGA99	2.76	0.85	13.55	50.81	4.04	5.08	9.24	0.25	12.57	0.35	99.50
	VGA99	2.63	0.81	13.63	50.71	4.02	5.12	9.46	0.16	12.49	0.46	99.49
	VGA99	2.66	0.83	13.82	50.33	4.01	5.21	9.39	0.23	12.45	0.41	99.34
	VGA99	2.69	0.81	13.93	50.48	3.96	5.25	9.31	0.13	12.16	0.34	99.06
	VGA99	2.97	0.79	13.65	50.76	4.05	5.08	9.41	0.16	12.48	0.36	99.71
	VGA99	2.95	0.78	13.74	50.03	3.99	5.17	9.28	0.20	12.38	0.33	98.86
	VGA99	2.80	0.81	13.54	49.92	3.97	5.14	9.46	0.20	12.31	0.42	98.57
	VGA99	2.79	0.85	13.47	50.98	4.07	5.01	9.42	0.12	12.18	0.36	99.24
	VGA99	2.80	0.84	13.39	50.56	3.97	5.22	9.30	0.19	12.37	0.39	99.03
	VGA99	2.90	0.87	13.25	50.75	4.11	5.07	9.35	0.16	12.22	0.38	99.05
	VGA99	2.54	0.82	13.40	50.68	4.04	5.11	9.38	0.29	12.29	0.39	98.93
	VGA99	2.63	0.80	13.11	50.65	3.96	5.14	9.27	0.18	12.30	0.32	98.37
	VGA99	2.67	0.83	13.76	50.47	4.09	5.08	9.43	0.20	12.15	0.39	99.08
	VGA99	2.57	0.86	13.36	50.83	4.01	5.19	9.37	0.30	12.05	0.37	98.91
	VGA99	2.55	0.85	12.71	51.02	4.07	5.04	9.30	0.17	12.07	0.37	98.15
12.06.2020	VGA99	2.82	0.83	13.50	50.73	4.05	5.27	9.40	0.27	12.23	0.40	99.50
	VGA99	2.83	0.84	13.42	51.18	4.05	5.10	9.34	0.14	12.50	0.39	99.79
	VGA99	2.79	0.82	13.64	51.44	4.04	5.01	9.34	0.21	12.46	0.41	100.16
	VGA99	2.88	0.82	13.41	51.05	4.02	5.10	9.32	0.20	12.36	0.34	99.51
	VGA99	2.77	0.84	13.44	50.45	4.11	5.19	9.41	0.19	12.44	0.34	99.18
	VGA99	2.70	0.86	13.50	50.99	4.15	5.04	9.32	0.20	12.44	0.38	99.58
	VGA99	2.72	0.82	13.47	50.75	4.00	5.07	9.47	0.14	12.32	0.32	99.08
	VGA99	2.93	0.83	13.35	51.24	3.98	5.05	9.18	0.16	12.20	0.34	99.26
	VGA99	2.90	0.81	13.16	51.22	4.02	5.07	9.27	0.18	12.21	0.39	99.23
	VGA99	2.83	0.82	13.43	50.92	4.02	5.12	9.36	0.22	12.44	0.31	99.47
	VGA99	3.04	0.81	13.79	50.88	3.93	5.09	9.39	0.18	12.42	0.34	99.87
	VGA99	3.09	0.83	13.18	50.95	4.02	4.99	9.33	0.20	12.37	0.35	99.30
	VGA99	2.91	0.82	13.52	51.32	4.03	5.00	9.32	0.21	12.55	0.34	100.02
	VGA99	3.09	0.84	13.26	51.62	3.97	5.13	9.31	0.17	12.49	0.37	100.24
	VGA99	2.87	0.84	13.47	51.09	4.05	5.10	9.18	0.20	12.26	0.36	99.42
	VGA99	2.81	0.79	13.39	51.12	4.00	4.98	9.26	0.17	12.35	0.36	99.22
12.06.2020	VGA99	2.97	0.81	13.45	51.44	4.01	5.17	9.28	0.21	12.50	0.41	100.26
	VGA99	2.96	0.81	13.47	51.23	4.05	5.08	9.32	0.19	12.35	0.35	99.80
	VGA99	3.16	0.82	13.74	51.29	4.11	4.98	9.29	0.24	12.52	0.36	100.51
	VGA99	2.89	0.80	13.64	50.98	3.95	5.10	9.25	0.33	12.62	0.34	99.90
	VGA99	2.89	0.81	13.20	51.63	4.01	5.07	9.36	0.22	12.60	0.37	100.16
	VGA99	2.79	0.83	13.39	51.02	4.05	5.06	9.28	0.24	12.19	0.33	99.18

Appendix A

Supplementary Table S5: EMP standard measurements on reference material VGA-99.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
16.06.2020	VGA99	2.95	0.84	13.42	51.28	4.04	5.10	9.23	0.20	12.26	0.37	99.69
	VGA99	2.98	0.80	13.90	51.28	4.00	4.96	9.33	0.24	12.62	0.38	100.49
	VGA99	2.79	0.79	13.28	51.13	3.97	5.04	9.28	0.14	12.18	0.31	98.92
	VGA99	2.87	0.81	13.49	51.31	4.04	5.04	9.36	0.12	12.16	0.31	99.50
	VGA99	3.12	0.77	13.43	51.47	3.97	5.00	9.29	0.24	12.62	0.34	100.25
	VGA99	3.10	0.80	13.79	51.19	4.02	5.04	9.29	0.20	12.32	0.29	100.04
	VGA99	2.93	0.80	13.60	51.05	3.98	5.10	9.24	0.19	12.37	0.36	99.62
	VGA99	2.65	0.80	13.40	51.11	3.97	5.09	9.27	0.23	12.48	0.42	99.43
	VGA99	3.10	0.82	13.85	51.54	4.07	5.06	9.35	0.15	11.98	0.34	100.26
	VGA99	3.19	0.79	13.45	51.12	3.95	5.10	9.27	0.12	12.57	0.35	99.91
	VGA99	2.85	0.82	13.49	51.24	4.00	5.12	9.18	0.26	12.51	0.34	99.81
	VGA99	2.90	0.81	13.74	51.39	4.07	4.98	9.35	0.25	12.70	0.34	100.53
	VGA99	2.76	0.83	13.51	51.82	3.93	5.08	9.27	0.25	12.20	0.36	100.01
	VGA99	2.93	0.81	13.69	51.81	4.05	4.99	9.36	0.18	12.58	0.43	100.83
	VGA99	2.61	0.82	13.35	51.08	3.97	5.08	9.26	0.08	12.21	0.31	98.78
	VGA99	2.73	0.79	13.44	51.02	4.03	5.01	9.32	0.24	12.58	0.37	99.53
	VGA99	2.68	0.85	13.68	51.08	4.01	5.07	9.36	0.15	12.36	0.31	99.55
	VGA99	2.86	0.84	13.66	51.19	4.12	5.08	9.29	0.25	12.26	0.38	99.92
	VGA99	2.83	0.82	13.52	51.09	4.04	5.02	9.28	0.14	12.52	0.31	99.57
	VGA99	2.82	0.83	12.96	50.55	4.00	5.09	9.42	0.27	12.23	0.34	98.51
	VGA99	2.85	0.82	13.21	50.85	4.08	5.15	9.37	0.18	12.25	0.36	99.12
	VGA99	2.81	0.81	13.68	50.93	4.00	5.02	9.29	0.14	12.37	0.33	99.39
	VGA99	2.88	0.80	13.59	51.26	4.04	5.07	9.32	0.25	12.31	0.40	99.92
	VGA99	3.06	0.79	13.96	51.30	3.94	5.12	9.40	0.18	12.21	0.35	100.30
	VGA99	2.77	0.84	13.48	51.64	4.03	5.05	9.32	0.26	12.53	0.35	100.28
	VGA99	2.80	0.82	13.98	51.27	3.95	5.03	9.22	0.19	12.54	0.40	100.20
	VGA99	2.62	0.84	13.84	51.18	4.04	4.97	9.13	0.25	12.27	0.35	99.49
	VGA99	2.81	0.84	13.21	51.00	3.98	5.05	9.30	0.24	12.51	0.34	99.28
	VGA99	2.97	0.82	13.89	51.19	3.98	5.06	9.25	0.24	12.65	0.34	100.39
	VGA99	2.72	0.81	13.60	50.91	3.99	5.08	9.20	0.20	12.56	0.37	99.45
16.06.2020	VGA99	2.81	0.83	13.12	50.92	4.01	5.05	9.29	0.16	12.28	0.32	98.80
	VGA99	2.89	0.82	13.29	50.66	3.95	4.94	9.25	0.21	12.55	0.34	98.89
	VGA99	2.78	0.84	13.57	51.40	4.01	4.97	9.31	0.19	12.58	0.33	99.98
	VGA99	2.66	0.81	13.25	51.11	4.00	5.14	9.29	0.19	12.40	0.31	99.16
	VGA99	2.97	0.82	13.70	51.13	3.98	5.04	9.31	0.25	12.65	0.39	100.24
	VGA99	2.74	0.82	13.15	51.35	3.98	4.99	9.31	0.07	12.46	0.35	99.22
18.06.2020	VGA99	2.73	0.84	13.44	51.06	4.05	5.00	9.36	0.14	12.31	0.38	99.31
	VGA99	2.94	0.84	13.52	50.84	3.98	4.97	9.35	0.16	12.41	0.43	99.43
	VGA99	2.93	0.81	13.55	51.53	3.98	5.05	9.30	0.19	12.06	0.35	99.75
	VGA99	2.83	0.82	13.93	50.80	4.00	5.09	9.38	0.20	12.45	0.34	99.83
	VGA99	2.87	0.82	12.95	50.82	4.07	5.00	9.44	0.13	12.37	0.29	98.77
	VGA99	2.98	0.83	13.32	50.99	4.00	5.08	9.36	0.18	12.44	0.42	99.60
	VGA99	2.87	0.81	13.04	50.25	4.00	4.94	9.41	0.22	12.36	0.33	98.23
	VGA99	2.85	0.81	13.80	51.02	3.94	5.17	9.24	0.13	12.39	0.39	99.74
	VGA99	3.03	0.80	13.22	51.00	3.98	5.01	9.34	0.24	12.39	0.36	99.37
	VGA99	2.92	0.81	13.61	48.36	3.97	5.09	9.38	0.22	12.49	0.36	97.22
	VGA99	2.73	0.81	13.15	48.21	3.97	5.16	9.28	0.11	12.27	0.36	96.05
	VGA99	2.86	0.85	13.60	49.80	3.97	4.99	9.29	0.17	12.71	0.33	98.57
22.06.2020	VGA99	2.90	0.79	13.92	51.37	4.02	5.06	9.33	0.20	12.52	0.31	100.42
	VGA99	3.06	0.82	13.33	51.09	4.07	5.11	9.37	0.16	12.26	0.39	99.65
	VGA99	2.71	0.86	13.32	51.38	3.93	5.03	9.35	0.27	12.61	0.36	99.82
	VGA99	3.02	0.82	13.80	48.99	4.04	5.22	9.39	0.13	12.53	0.39	98.33
	VGA99	2.77	0.83	13.66	51.32	3.94	4.98	9.22	0.13	12.45	0.39	99.69
	VGA99	2.89	0.84	13.94	51.30	4.01	5.11	9.27	0.18	12.60	0.32	100.45
	VGA99	3.06	0.84	13.42	51.00	3.96	5.16	9.37	0.14	12.52	0.38	99.85
	VGA99	3.05	0.82	13.63	51.02	3.95	5.12	9.28	0.25	12.65	0.35	100.12
	VGA99	2.89	0.81	13.58	51.18	3.99	5.03	9.33	0.21	12.69	0.40	100.11
	VGA99	2.99	0.80	13.70	51.11	3.96	5.10	9.31	0.21	12.36	0.33	99.87
	VGA99	3.00	0.84	13.60	51.19	4.00	5.25	9.39	0.23	12.40	0.38	100.28
	VGA99	2.63	0.81	13.71	51.50	4.07	5.09	9.20	0.19	12.43	0.29	99.92
	VGA99	2.88	0.83	14.12	51.68	3.96	5.14	9.34	0.28	12.66	0.43	101.32
	VGA99	2.72	0.83	13.70	51.39	3.97	5.04	9.23	0.31	12.52	0.35	100.07
	VGA99	2.82	0.81	14.01	51.41	3.96	5.25	9.34	0.14	12.40	0.34	100.48
	VGA99	2.78	0.79	13.71	51.28	3.97	5.16	9.18	0.22	12.67	0.40	100.16
	VGA99	3.10	0.80	13.48	51.53	4.03	5.15	9.28	0.18	12.38	0.38	100.31
	VGA99	2.68	0.82	14.05	51.45	3.98	5.24	9.27	0.25	12.53	0.36	100.62
	VGA99	2.92	0.85	13.44	51.28	4.02	5.15	9.19	0.20	12.52	0.34	99.91
	VGA99	2.86	0.82	13.69	51.16	3.98	5.14	9.39	0.18	12.56	0.33	100.11
	VGA99	2.96	0.85	13.31	50.97	3.99	5.08	9.25	0.23	12.70	0.40	99.74
	VGA99	2.92	0.84	13.31	50.94	3.96	5.11	9.23	0.16	12.80	0.34	99.61

Appendix A

Supplementary Table S5: EMP standard measurements on reference material VGA-99.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
24.08.2020	VGA99	2.57	0.81	13.25	50.97	3.98	5.09	9.33	0.18	12.39	0.36	98.93
	VGA99	2.87	0.82	13.46	51.08	3.99	4.98	9.31	0.13	12.41	0.30	99.36
	VGA99	2.90	0.81	13.37	50.55	4.00	5.04	9.25	0.14	12.56	0.32	98.93
	VGA99	2.95	0.83	13.57	50.62	3.88	5.08	9.28	0.21	12.26	0.40	99.07
	VGA99	2.99	0.87	13.10	50.95	4.05	5.18	9.32	0.14	12.55	0.35	99.50
	VGA99	2.78	0.82	13.81	51.16	4.02	4.98	9.38	0.24	12.47	0.35	100.01
	VGA99	2.98	0.84	13.93	50.96	3.93	5.14	9.18	0.13	12.49	0.32	99.89
	VGA99	3.02	0.83	13.57	50.90	3.94	4.93	9.31	0.21	12.51	0.33	99.56
	VGA99	2.88	0.82	13.64	50.83	3.92	5.07	9.33	0.24	12.65	0.40	99.77
	VGA99	3.07	0.84	13.97	50.68	3.94	5.17	9.34	0.13	12.49	0.38	100.01
	VGA99	2.94	0.83	13.54	50.95	4.04	5.15	9.12	0.15	12.63	0.31	99.66
	VGA99	2.75	0.81	13.91	51.14	4.01	5.07	9.31	0.21	12.45	0.38	100.04
	VGA99	2.91	0.82	13.50	50.61	3.89	5.02	9.29	0.17	12.57	0.33	99.11
	VGA99	2.66	0.81	13.21	50.82	4.03	4.95	9.32	0.27	12.37	0.39	98.84
	VGA99	2.64	0.82	13.63	50.62	4.08	5.17	9.27	0.19	12.40	0.46	99.27
	VGA99	2.67	0.80	13.56	51.31	4.04	5.00	9.34	0.16	11.97	0.38	99.24
	VGA99	2.84	0.80	13.32	51.76	3.97	5.15	9.38	0.19	12.31	0.36	100.07
	VGA99	2.76	0.81	13.78	51.18	4.00	5.09	9.28	0.27	11.80	0.40	99.38
	VGA99	2.75	0.81	13.51	51.27	3.91	4.97	9.47	0.22	11.80	0.35	99.07
	VGA99	2.79	0.82	13.21	50.81	3.93	5.05	9.35	0.20	11.99	0.37	98.52
	VGA99	2.88	0.82	13.59	49.95	4.07	5.01	9.36	0.13	11.97	0.31	98.09
	VGA99	2.62	0.84	13.90	50.11	4.04	4.97	9.32	0.26	12.14	0.35	98.54
	VGA99	2.92	0.82	13.65	51.13	3.98	4.97	9.31	0.12	12.20	0.42	99.53
	VGA99	3.07	0.82	14.18	50.78	3.95	5.03	9.31	0.15	12.10	0.39	99.78
	VGA99	3.07	0.82	13.80	50.93	4.02	5.04	9.28	0.25	12.15	0.38	99.75
	VGA99	2.94	0.82	13.93	50.03	3.97	5.09	9.18	0.18	12.05	0.40	98.59
	VGA99	2.87	0.82	13.45	51.15	4.04	5.09	9.37	0.23	12.03	0.40	99.45
	VGA99	2.85	0.82	13.84	51.40	4.01	5.02	9.23	0.24	12.10	0.40	99.92
	VGA99	2.87	0.80	13.54	50.85	4.01	5.07	9.39	0.27	12.08	0.38	99.26
	VGA99	2.80	0.83	13.48	51.16	3.99	5.04	9.31	0.27	11.83	0.36	99.08
	VGA99	2.70	0.80	13.49	51.23	4.01	5.05	9.39	0.13	12.04	0.33	99.17
	VGA99	2.61	0.80	13.21	50.98	4.03	5.01	9.32	0.21	12.00	0.36	98.53
	VGA99	2.58	0.79	13.24	49.63	3.92	4.79	9.12	0.09	14.45	0.33	98.94
	VGA99	2.86	0.78	13.72	51.27	4.01	4.99	9.40	0.24	12.21	0.37	99.84
	VGA99	2.87	0.82	13.75	51.18	4.02	5.04	9.39	0.17	12.02	0.44	99.70
	VGA99	2.91	0.80	13.77	50.96	4.03	5.12	9.33	0.30	12.04	0.38	99.65
	VGA99	2.84	0.82	13.35	50.77	3.98	4.96	9.43	0.25	12.11	0.39	98.91
	VGA99	2.65	0.80	13.82	51.03	4.02	4.90	9.36	0.15	12.36	0.38	99.47
27.08.2020	VGA99	2.86	0.81	13.84	50.77	3.96	5.24	9.47	0.13	12.22	0.40	99.70
	VGA99	3.01	0.82	13.61	51.18	3.97	5.20	9.34	0.27	12.32	0.37	100.10
	VGA99	2.84	0.81	13.15	50.58	3.93	4.97	9.40	0.09	12.42	0.42	98.62
	VGA99	2.67	0.81	13.04	50.72	3.88	5.00	9.23	0.21	12.46	0.39	98.41
	VGA99	2.84	0.82	13.55	50.24	3.89	4.96	9.39	0.20	12.17	0.36	98.42
	VGA99	2.91	0.82	13.36	50.49	3.96	5.05	9.42	0.16	12.47	0.43	99.07
	VGA99	2.80	0.82	13.24	50.39	3.93	5.08	9.17	0.22	12.42	0.32	98.38
	VGA99	2.75	0.81	12.87	50.17	4.00	5.08	9.33	0.16	12.12	0.40	97.69
	VGA99	2.96	0.81	12.90	49.96	3.96	4.96	9.40	0.25	12.12	0.32	97.64
	VGA99	2.81	0.82	13.45	50.45	4.01	5.10	9.29	0.25	12.08	0.42	98.69
	VGA99	2.76	0.78	13.19	49.97	3.98	5.06	9.28	0.12	12.21	0.36	97.70
	VGA99	2.92	0.84	13.43	49.81	3.92	5.07	9.31	0.12	12.08	0.35	97.85
	VGA99	2.94	0.83	13.44	50.15	4.03	5.02	9.37	0.29	12.02	0.37	98.46
	VGA99	2.77	0.81	12.98	49.67	3.93	5.03	9.25	0.21	12.06	0.36	97.07
	VGA99	3.12	0.81	13.59	50.38	3.93	5.05	9.51	0.21	12.14	0.40	99.15
	VGA99	2.82	0.82	12.96	49.84	4.03	5.09	9.17	0.13	12.08	0.40	97.34
	VGA99	2.82	0.83	13.14	49.99	4.01	5.00	9.44	0.14	12.10	0.33	97.81
	VGA99	3.04	0.79	13.32	50.03	4.00	5.04	9.25	0.16	12.39	0.32	98.34
	VGA99	2.87	0.81	13.31	50.38	3.96	4.94	9.37	0.23	12.12	0.41	98.40
	VGA99	3.14	0.82	13.36	50.25	3.96	5.01	9.45	0.22	12.17	0.34	98.72
	VGA99	2.86	0.82	12.81	50.35	4.04	4.94	9.26	0.21	12.01	0.31	97.61
	VGA99	2.69	0.80	13.60	50.17	3.92	5.01	9.37	0.19	12.17	0.45	98.37
	VGA99	2.75	0.81	12.84	50.45	3.96	5.14	9.33	0.14	11.92	0.38	97.72
	VGA99	3.00	0.81	13.32	49.78	4.02	5.02	9.34	0.20	12.13	0.33	97.94
	VGA99	3.02	0.80	13.73	50.41	4.01	5.09	9.31	0.17	12.05	0.36	98.95
	VGA99	2.59	0.80	13.51	50.07	4.09	5.08	9.25	0.17	12.06	0.26	97.88
	VGA99	2.88	0.84	13.68	50.26	4.03	5.03	9.45	0.17	12.25	0.38	98.97
	VGA99	2.84	0.83	13.83	50.49	4.04	5.12	9.33	0.19	12.34	0.33	99.34
	VGA99	2.96	0.80	13.15	50.12	3.93	4.98	9.42	0.21	12.34	0.24	98.15
	VGA99	2.72	0.79	13.14	50.16	3.96	5.03	9.42	0.15	12.29	0.39	98.05
	VGA99	2.67	0.79	13.05	50.07	4.02	5.04	9.38	0.13	12.20	0.34	97.69
	VGA99	2.92	0.82	13.47	50.21	4.01	5.01	9.36	0.25	12.17	0.39	98.61

Appendix A

Supplementary Table S5: EMP standard measurements on reference material VGA-99.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
31.08.2020	VGA99	2.72	0.79	13.27	50.30	3.93	5.04	9.35	0.18	12.07	0.31	97.96
	VGA99	3.01	0.80	13.06	50.41	3.96	5.08	9.43	0.25	12.05	0.39	98.45
	VGA99	2.85	0.84	13.42	50.66	3.96	4.97	9.33	0.21	12.24	0.44	98.92
	VGA99	2.87	0.81	13.58	51.23	3.91	5.16	9.38	0.16	12.08	0.37	99.55
	VGA99	2.69	0.82	13.12	51.06	4.01	5.02	9.36	0.19	12.11	0.39	98.77
	VGA99	2.76	0.80	13.49	50.33	3.99	4.96	9.39	0.19	12.27	0.29	98.47
	VGA99	2.94	0.80	13.28	51.11	3.97	5.10	9.33	0.19	12.17	0.38	99.27
	VGA99	2.87	0.80	13.08	51.02	3.98	4.90	9.37	0.19	12.05	0.38	98.64
	VGA99	3.13	0.81	13.42	50.73	3.98	5.06	9.36	0.21	12.09	0.40	99.19
	VGA99	2.74	0.82	13.54	51.04	4.01	4.95	9.30	0.20	12.24	0.42	99.27
	VGA99	2.85	0.79	13.33	51.26	4.04	4.92	9.43	0.22	12.35	0.38	99.57
	VGA99	2.76	0.82	13.23	51.28	4.01	5.06	9.31	0.18	12.11	0.39	99.15
	VGA99	2.72	0.83	13.16	51.09	3.99	4.89	9.43	0.17	11.83	0.38	98.50
	VGA99	2.96	0.80	13.48	51.07	4.03	5.02	9.40	0.26	12.29	0.36	99.67
	VGA99	2.75	0.80	13.21	50.77	4.09	5.08	9.39	0.29	12.39	0.30	99.08
31.08.2020	VGA99	2.79	0.79	13.12	51.07	4.04	5.01	9.34	0.19	12.23	0.35	98.94
	VGA99	3.00	0.78	13.33	51.15	3.99	5.01	9.24	0.25	12.47	0.40	99.62
	VGA99	2.69	0.81	12.83	50.63	3.95	4.85	9.31	0.23	12.08	0.29	97.67
	VGA99	2.83	0.83	13.35	51.22	3.92	5.06	9.43	0.25	12.37	0.34	99.60
	VGA99	2.82	0.83	13.07	51.14	4.02	4.95	9.35	0.16	12.14	0.41	98.89
	VGA99	2.65	0.78	13.92	51.10	3.99	5.09	9.25	0.18	12.26	0.38	99.60
	VGA99	2.79	0.82	13.39	50.63	3.93	5.00	9.34	0.22	12.14	0.31	98.57
	VGA99	2.88	0.81	13.15	50.94	3.98	4.98	9.42	0.24	12.26	0.38	99.03
	VGA99	2.77	0.81	13.35	50.83	3.99	5.07	9.57	0.17	12.27	0.37	99.20
	VGA99	2.76	0.79	13.51	50.80	4.01	5.04	9.32	0.20	12.02	0.33	98.78
	VGA99	2.71	0.82	13.39	50.80	4.07	5.04	9.35	0.24	12.26	0.37	99.04
	VGA99	2.77	0.79	13.20	51.16	3.94	4.91	9.38	0.15	12.24	0.39	98.93
	VGA99	2.77	0.81	13.25	50.65	4.06	5.13	9.39	0.23	12.23	0.36	98.88
	VGA99	2.84	0.79	13.59	51.16	3.97	4.96	9.40	0.18	12.25	0.29	99.43
	VGA99	2.96	0.80	12.99	51.31	4.01	5.01	9.43	0.15	12.13	0.36	99.15
12.10.2020	VGA99	2.87	0.83	13.37	51.04	4.03	4.90	9.42	0.17	12.10	0.41	99.14
	VGA99	2.66	0.84	13.52	50.78	4.12	4.99	9.40	0.16	12.20	0.30	98.96
	VGA99	2.84	0.80	13.85	51.21	4.02	4.91	9.34	0.24	12.19	0.36	99.77
	VGA99	2.89	0.81	13.17	51.28	4.01	5.04	9.39	0.20	13.02	0.48	100.29
	VGA99	2.97	0.79	12.71	51.90	3.95	4.93	9.35	0.17	13.01	0.33	100.11
	VGA99	2.60	0.80	13.22	51.61	3.95	4.90	9.43	0.16	12.86	0.32	99.86
	VGA99	2.53	0.81	13.07	51.60	3.98	4.94	9.32	0.14	12.82	0.42	99.63
	VGA99	2.75	0.80	13.09	51.21	4.02	4.89	9.37	0.11	12.93	0.37	99.54
	VGA99	2.68	0.81	13.37	51.69	3.97	4.96	9.41	0.28	12.91	0.32	100.41
	VGA99	2.93	0.77	13.21	50.87	4.00	4.96	9.23	0.21	12.61	0.34	99.14
	VGA99	2.89	0.80	12.88	50.70	3.93	5.09	9.27	0.22	12.61	0.40	98.79
	VGA99	2.65	0.81	13.15	51.55	4.03	5.05	9.34	0.24	12.42	0.40	99.64
	VGA99	3.01	0.79	13.22	52.06	4.01	4.84	9.35	0.12	12.70	0.45	100.55
	VGA99	2.64	0.80	13.35	50.92	4.05	4.87	9.29	0.24	12.40	0.31	98.88
	VGA99	2.67	0.82	13.75	51.28	4.03	5.12	9.39	0.21	12.32	0.41	100.01
12.10.2020	VGA99	2.75	0.82	13.15	51.17	3.95	4.98	9.36	0.20	12.55	0.36	99.29
	VGA99	2.61	0.83	13.15	51.09	4.05	4.93	9.41	0.17	12.69	0.38	99.31
	VGA99	2.76	0.84	13.48	50.50	3.95	4.90	9.34	0.17	12.39	0.44	98.77
	VGA99	2.72	0.80	12.82	50.72	4.04	4.84	9.38	0.23	12.24	0.31	98.09
	VGA99	2.83	0.81	13.18	51.44	4.05	4.87	9.28	0.19	12.41	0.45	99.51
	VGA99	2.89	0.79	13.18	51.15	4.02	4.95	9.30	0.19	12.74	0.32	99.53
	VGA99	2.71	0.80	13.28	50.36	4.07	4.85	9.42	0.22	12.46	0.40	98.57
	VGA99	2.73	0.80	13.79	51.25	3.98	4.97	9.41	0.20	12.49	0.36	99.99
	VGA99	2.69	0.82	13.29	50.84	4.08	4.98	9.53	0.14	12.34	0.39	99.10
	VGA99	2.72	0.79	13.13	50.35	4.09	4.94	9.28	0.18	12.41	0.47	98.37
	VGA99	2.89	0.80	13.41	50.99	4.01	4.89	9.39	0.22	12.37	0.37	99.34
	VGA99	2.93	0.80	14.17	50.77	4.02	5.01	9.42	0.11	12.44	0.40	100.06
	VGA99	2.83	0.82	13.39	51.17	4.08	5.03	9.40	0.23	12.52	0.36	99.84
	VGA99	2.64	0.83	13.31	50.46	4.06	5.00	9.33	0.16	12.51	0.30	98.59
	VGA99	2.84	0.80	13.27	50.27	4.03	4.94	9.39	0.20	12.49	0.39	98.62
14.10.2020	VGA99	2.70	0.82	13.16	50.85	3.98	4.90	9.31	0.21	12.67	0.39	98.98
	VGA99	2.89	0.82	13.53	50.67	3.97	5.04	9.32	0.24	12.55	0.34	99.37
	VGA99	2.83	0.82	13.63	50.55	4.07	4.88	9.31	0.20	12.55	0.38	99.22
	VGA99	2.52	0.83	13.37	50.51	4.06	4.93	9.28	0.27	12.05	0.49	98.30
	VGA99	2.82	0.80	13.29	50.78	3.94	4.88	9.33	0.17	12.35	0.38	98.74
	VGA99	2.87	0.80	13.24	50.74	4.10	4.92	9.40	0.15	12.29	0.42	98.93
	VGA99	2.82	0.83	13.35	50.90	4.04	4.91	9.32	0.20	12.67	0.39	99.42
	VGA99	2.73	0.81	13.12	50.88	4.09	4.92	9.38	0.22	12.50	0.40	99.05
	VGA99	2.82	0.80	13.71	50.72	4.08	4.99	9.35	0.28	12.36	0.44	99.55
	VGA99	2.96	0.83	12.98	50.87	4.13	4.88	9.34	0.17	12.23	0.36	98.74

Appendix A

Supplementary Table S5: EMP standard measurements on reference material VGA-99.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
16.10.2020	VGA99	2.62	0.83	13.04	51.17	4.01	4.86	9.23	0.22	12.37	0.44	98.79
	VGA99	2.79	0.80	13.34	50.88	4.08	4.96	9.36	0.17	12.01	0.44	98.82
	VGA99	3.09	0.82	13.08	50.85	3.97	4.87	9.35	0.27	12.26	0.39	98.96
	VGA99	2.98	0.78	12.98	50.25	4.04	4.97	9.23	0.11	12.31	0.46	98.11
	VGA99	2.83	0.79	13.10	50.81	3.97	4.94	9.34	0.23	12.32	0.36	98.68
	VGA99	2.88	0.81	13.28	50.78	4.12	5.07	9.38	0.19	12.36	0.37	99.24
	VGA99	2.62	0.81	12.89	50.54	4.07	5.04	9.50	0.11	12.32	0.42	98.32
	VGA99	2.52	0.81	13.18	50.73	4.00	5.01	9.31	0.16	12.32	0.41	98.45
	VGA99	2.55	0.80	13.54	50.97	3.95	4.94	9.31	0.25	12.36	0.41	99.08
	VGA99	2.69	0.81	13.37	50.85	4.07	4.95	9.31	0.16	12.39	0.37	98.97
	VGA99	2.60	0.81	13.28	51.13	3.99	4.94	9.31	0.13	12.26	0.38	98.84
	VGA99	2.67	0.78	13.18	50.62	4.10	4.88	9.37	0.28	12.35	0.39	98.62
	VGA99	2.91	0.81	13.33	49.84	3.96	5.07	9.25	0.13	12.24	0.37	97.91
	VGA99	2.74	0.83	12.69	50.81	4.05	4.97	9.36	0.19	12.23	0.39	98.26
	VGA99	2.82	0.84	12.94	50.90	4.03	4.92	9.32	0.16	12.33	0.46	98.72
	VGA99	2.91	0.80	13.26	50.95	4.07	4.95	9.31	0.18	12.31	0.43	99.17
	VGA99	2.66	0.80	13.21	50.53	4.10	4.92	9.31	0.21	12.46	0.37	98.58
	VGA99	2.65	0.80	13.21	50.97	3.98	4.85	9.31	0.22	12.41	0.41	98.80
	VGA99	2.74	0.82	13.40	50.49	4.02	4.83	9.22	0.16	12.34	0.39	98.41
	VGA99	2.81	0.82	13.31	50.42	4.01	4.86	9.46	0.20	12.27	0.37	98.54
30.10.2020	VGA99	2.84	0.79	13.55	51.12	4.00	4.94	9.42	0.14	12.24	0.31	99.35
	VGA99	2.84	0.81	13.42	50.94	4.01	5.00	9.45	0.24	12.49	0.37	99.57
	VGA99	2.77	0.82	12.67	49.36	3.98	4.85	9.25	0.21	12.31	0.38	96.61
	VGA99	2.82	0.82	13.14	50.53	4.02	5.02	9.32	0.20	12.38	0.43	98.68
	VGA99	2.86	0.81	13.11	50.26	4.01	4.84	9.35	0.11	12.25	0.39	97.99
	VGA99	2.71	0.80	13.07	50.88	3.85	5.01	9.34	0.12	12.06	0.37	98.22
	VGA99	2.73	0.83	13.37	50.87	4.07	4.99	9.29	0.24	11.98	0.33	98.70
	VGA99	2.70	0.81	13.00	50.84	4.06	4.87	9.24	0.23	12.30	0.39	98.43
	VGA99	2.75	0.82	13.38	51.07	3.95	5.05	9.34	0.15	12.23	0.31	99.04
	VGA99	2.76	0.83	13.00	50.76	4.03	5.01	9.32	0.28	12.11	0.41	98.52
30.10.2020	VGA99	2.91	0.80	13.60	50.65	3.96	4.98	9.35	0.25	12.04	0.41	98.96
	VGA99	2.68	0.81	13.24	49.25	3.93	5.11	9.22	0.18	12.08	0.38	96.88
	VGA99	2.63	0.81	13.12	49.72	4.01	5.01	9.39	0.15	12.08	0.32	97.24
	VGA99	2.47	0.81	12.81	50.50	4.07	4.96	9.39	0.28	12.19	0.35	97.83
	VGA99	2.84	0.81	12.76	50.73	4.03	4.96	9.36	0.17	11.99	0.36	98.01
	VGA99	3.10	0.84	12.68	50.60	3.96	4.90	9.43	0.20	12.92	0.31	98.94
	VGA99	2.99	0.82	12.67	51.04	3.94	5.02	9.38	0.17	12.53	0.28	98.84
	VGA99	2.80	0.84	12.41	51.34	3.98	4.97	9.42	0.16	12.68	0.33	98.93
	VGA99	2.63	0.82	12.79	51.14	3.95	5.00	9.36	0.17	12.67	0.37	98.91
	VGA99	2.83	0.82	12.76	51.55	3.95	4.94	9.50	0.23	13.14	0.36	100.08
26.01.2021	VGA99	2.83	0.83	12.73	51.56	3.96	4.87	9.33	0.23	12.51	0.37	99.23
	VGA99	2.77	0.82	13.31	50.68	3.96	4.92	9.29	0.13	12.42	0.35	98.65
	VGA99	2.76	0.82	12.79	50.35	3.93	4.97	9.32	0.25	12.78	0.37	98.34
	VGA99	2.88	0.84	12.76	51.02	3.97	4.91	9.35	0.21	12.04	0.32	98.30
	VGA99	2.63	0.81	12.99	50.93	4.01	5.05	9.39	0.18	12.03	0.34	98.36
	VGA99	2.66	0.84	12.55	51.06	4.03	4.96	9.36	0.23	11.96	0.34	97.99
	VGA99	2.70	0.84	13.25	50.79	3.95	5.10	9.51	0.17	11.86	0.37	98.53
	VGA99	2.62	0.83	12.67	50.66	3.94	5.00	9.21	0.22	11.95	0.41	97.52
	VGA99	2.66	0.83	12.71	50.88	3.96	5.10	9.30	0.21	12.13	0.36	98.14
	VGA99	2.75	0.79	12.80	51.03	3.98	4.88	9.35	0.20	12.24	0.38	98.40
31.01.2021	VGA99	2.74	0.81	12.42	51.01	3.96	5.05	9.29	0.22	11.82	0.35	97.67
	VGA99	2.75	0.84	12.57	49.25	4.01	4.93	9.47	0.14	12.14	0.34	96.44
	VGA99	2.66	0.83	12.47	48.87	3.98	4.97	9.30	0.21	12.24	0.40	95.92
	VGA99	2.67	0.85	13.77	50.83	3.97	5.00	9.37	0.15	12.91	0.38	99.90
	VGA99	2.41	0.82	13.78	50.85	3.86	5.02	9.35	0.15	12.67	0.32	99.22
	VGA99	2.45	0.85	13.78	51.46	3.86	4.96	9.31	0.20	12.35	0.35	99.56
	VGA99	2.56	0.83	14.13	51.06	3.82	4.98	9.27	0.13	12.89	0.32	100.00
	VGA99	2.53	0.84	13.40	51.19	4.00	4.94	9.38	0.15	12.47	0.36	99.26
	VGA99	2.70	0.81	13.59	51.08	3.89	5.10	9.44	0.22	12.84	0.34	100.02
	VGA99	2.65	0.82	12.96	50.38	3.95	5.00	9.37	0.16	12.28	0.34	97.91
01.02.2021	VGA99	2.65	0.81	13.12	50.25	3.87	5.01	9.28	0.24	12.62	0.33	98.17
	VGA99	2.74	0.85	13.81	50.33	3.91	4.97	9.39	0.17	12.11	0.37	98.66
	VGA99	2.45	0.81	13.81	50.99	3.91	4.96	9.34	0.23	12.54	0.30	99.34
	VGA99	2.76	0.86	13.40	49.57	3.94	5.10	9.37	0.14	12.42	0.39	97.95
	VGA99	2.67	0.85	13.44	49.94	3.83	4.98	9.31	0.24	12.38	0.37	98.01
	VGA99	2.79	0.80	13.87	50.07	3.96	5.03	9.30	0.13	12.24	0.30	98.50
	VGA99	2.80	0.81	13.67	49.81	3.94	5.07	9.35	0.16	12.56	0.34	98.51
	VGA99	2.49	0.81	13.20	50.13	3.96	5.03	9.29	0.22	12.19	0.38	97.70
	VGA99	2.71	0.84	13.70	49.39	3.90	5.21	9.44	0.24	12.28	0.46	98.16
	VGA99	2.55	0.81	13.77	49.72	3.93	5.12	9.41	0.18	12.69	0.34	98.52

Appendix A

Supplementary Table S5: EMP standard measurements on reference material VGA-99.

date	Comment	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
04.02.2021	VGA99	2.75	0.82	13.38	49.53	3.85	5.09	9.32	0.17	12.72	0.36	97.99
	VGA99	2.80	0.81	14.00	50.32	3.89	4.96	9.38	0.17	12.12	0.30	98.74
	VGA99	2.53	0.85	13.75	49.82	3.88	5.06	9.42	0.21	12.28	0.34	98.14
	VGA99	2.54	0.81	13.11	50.33	4.01	5.11	9.37	0.23	12.64	0.41	98.56
	VGA99	2.54	0.81	13.54	50.96	4.11	4.96	9.32	0.22	12.43	0.32	99.22
	VGA99	2.95	0.86	13.75	50.84	3.92	5.02	9.31	0.13	12.56	0.37	99.70
	VGA99	2.46	0.81	13.34	51.19	3.93	4.99	9.32	0.21	12.64	0.36	99.25
	VGA99	2.52	0.85	13.61	51.39	3.99	4.94	9.24	0.20	12.44	0.33	99.50
	VGA99	2.39	0.81	13.73	51.34	4.06	5.05	9.33	0.22	12.28	0.40	99.61
	VGA99	2.58	0.82	13.17	51.02	3.95	4.92	9.44	0.19	12.33	0.31	98.73
04.02.2021	VGA99	2.38	0.84	13.22	51.30	3.93	5.13	9.40	0.17	12.06	0.36	98.79
	VGA99	2.76	0.84	13.28	50.94	3.99	4.91	9.37	0.19	12.67	0.38	99.33
	VGA99	2.61	0.84	13.28	50.64	3.99	4.99	9.34	0.19	12.43	0.37	98.68
05.02.2021	VGA99	2.89	0.81	13.33	51.05	4.00	4.89	9.45	0.16	12.57	0.41	99.56
	VGA99	2.69	0.81	13.24	51.10	4.00	5.15	9.50	0.22	12.61	0.39	99.71
	VGA99	2.49	0.82	13.22	51.18	4.05	4.92	9.37	0.20	12.88	0.34	99.47
12.05.2021	VGA99	2.76	0.84	13.68	51.26	3.99	4.93	9.51	0.22	13.00	0.38	100.57
	VGA99	2.60	0.81	13.16	51.90	3.99	5.06	9.41	0.27	12.85	0.36	100.41
	VGA99	2.81	0.81	13.42	51.00	3.95	5.03	9.32	0.20	12.43	0.35	99.32
	VGA99	2.48	0.81	13.12	51.51	3.92	5.04	9.43	0.13	12.32	0.37	99.12
	VGA99	2.61	0.80	13.59	51.42	3.99	5.18	9.34	0.16	12.49	0.32	99.90
	VGA99	2.79	0.83	13.72	51.50	3.87	5.07	9.33	0.19	12.32	0.37	99.99
	VGA99	2.72	0.80	14.32	49.99	3.95	5.16	9.28	0.26	12.11	0.35	98.95
	VGA99	2.93	0.86	14.07	50.73	3.85	5.03	9.39	0.17	12.11	0.38	99.52
	VGA99	2.97	0.86	13.76	50.08	3.87	5.09	9.49	0.20	12.38	0.38	99.08
	VGA99	2.59	0.86	13.29	51.90	4.02	5.08	8.93	0.13	12.60	0.34	99.75
26.12.2021	VGA99	2.70	0.87	13.48	51.68	3.99	5.11	9.00	0.29	12.88	0.22	100.21
	VGA99	2.54	0.84	13.70	52.03	3.97	5.01	8.94	0.22	12.82	0.37	100.44
	VGA99	2.44	0.85	13.70	52.30	3.97	5.07	8.89	0.15	12.78	0.26	100.41
	VGA99	2.73	0.81	13.47	51.85	3.90	5.13	8.99	0.05	12.51	0.31	99.75
	VGA99	2.89	0.81	13.67	51.89	4.01	5.18	8.90	0.20	12.70	0.34	100.60
	VGA99	2.52	0.84	13.07	51.52	4.02	5.15	9.11	0.24	12.52	0.25	99.23
	VGA99	2.62	0.82	13.58	49.37	3.97	5.21	9.05	0.17	12.53	0.27	97.59
	VGA99	2.77	0.82	13.31	50.68	3.96	4.92	9.29	0.13	12.42	0.35	98.65
	VGA99	2.76	0.82	12.79	50.35	3.93	4.97	9.32	0.25	12.78	0.37	98.34
	VGA99	2.83	0.82	12.76	51.55	3.95	4.94	9.50	0.23	13.14	0.36	100.08
27.12.2021	VGA99	2.83	0.83	12.73	51.56	3.96	4.87	9.33	0.23	12.51	0.37	99.23
	VGA99	2.80	0.84	12.41	51.34	3.98	4.97	9.42	0.16	12.68	0.33	98.93
	VGA99	2.63	0.82	12.79	51.14	3.95	5.00	9.36	0.17	12.67	0.37	98.91
	VGA99	3.10	0.84	12.68	50.60	3.96	4.90	9.43	0.20	12.92	0.31	98.94
	VGA99	2.99	0.82	12.67	51.04	3.94	5.02	9.38	0.17	12.53	0.28	98.84

Appendix A

Supplementary Table S5: EMP standard measurements on reference material VGA-99.

	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2 O3	P2O5	Total
	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
average std measurements entire period	2.79	0.82	13.39	50.84	4.01	5.07	9.34	0.20	12.36	0.37	99.17
VGA 99 - Jarosevich et al. (1980)	2.66	0.82	13.30	50.94	4.06	5.08	9.30	0.15	12.49	0.38	99.39
deviation (%) over measurement period	4.75	0.11	0.65	-0.20	-1.22	-0.27	0.42	31.03	-1.01	-3.37	-0.22
average std measurements 20.11.2019	2.81	0.84	13.28	51.22	4.07	5.16	9.28	0.20	12.57	0.32	99.74
deviation (%) for 20.11.2019	5.67	1.91	-0.17	0.54	0.21	1.53	-0.25	33.71	0.65	-14.53	0.35
average std measurements 21.11.2019	2.86	0.84	13.04	51.16	4.06	5.15	9.25	0.20	12.51	0.37	99.44
deviation (%) for 21.11.2019	7.42	2.39	-1.99	0.42	0.02	1.44	-0.52	33.96	0.16	-1.57	0.05
average std measurements 22.11.2019	2.79	0.83	13.15	51.07	4.03	5.11	9.28	0.19	12.61	0.38	99.45
deviation (%) for 22.11.2019	4.76	1.23	-1.14	0.26	-0.68	0.65	-0.17	29.40	0.97	0.93	0.06
average std measurements 25.11.2019	2.72	0.83	13.09	51.55	4.01	5.13	9.22	0.21	12.57	0.37	99.70
deviation (%) for 25.11.2019	2.22	0.81	-1.60	1.20	-1.16	1.04	-0.89	38.42	0.66	-2.21	0.31
average std measurements 16.12.2019	2.75	0.83	13.54	50.39	4.03	5.16	9.40	0.17	12.39	0.38	99.03
deviation (%) for 16.12.2019	3.38	0.71	1.83	-1.07	-0.83	1.53	1.06	11.35	-0.79	-0.94	-0.36
average std measurements 17.12.2019	2.77	0.83	13.31	51.10	4.02	5.16	9.40	0.19	12.25	0.39	99.42
deviation (%) for 17.12.2019	4.14	0.75	0.09	0.32	-0.99	1.56	1.11	26.08	-1.94	2.21	0.03
average std measurements 19.12.2019	2.76	0.82	13.54	49.90	4.03	5.17	9.42	0.20	12.34	0.38	98.56
deviation (%) for 19.12.2019	3.82	0.02	1.79	-2.04	-0.66	1.67	1.29	32.33	-1.17	0.12	-0.84
average std measurements 24.01.2020	2.80	0.83	13.44	50.70	4.05	5.14	9.44	0.21	12.08	0.37	99.07
deviation (%) for 24.01.2020	5.30	1.04	1.06	-0.46	-0.34	1.23	1.51	42.16	-3.28	-2.54	-0.33
average std measurements 14.02.2020	2.78	0.82	13.54	51.28	3.95	5.11	9.37	0.21	12.08	0.38	99.52
deviation (%) for 14.02.2020	4.66	0.30	1.82	0.66	-2.68	0.59	0.76	37.12	-3.30	-0.07	0.13
average std measurements 25.02.2020	2.72	0.82	13.56	50.83	4.07	5.10	9.38	0.21	12.29	0.37	99.35
deviation (%) for 25.02.2020	2.42	-0.46	1.96	-0.22	0.31	0.44	0.90	37.19	-1.61	-3.24	-0.04
average std measurements 27.04.2020	2.70	0.83	13.41	50.90	4.03	5.10	9.34	0.20	12.33	0.36	99.18
deviation (%) for 27.04.2020	1.56	0.74	0.83	-0.08	-0.84	0.36	0.39	33.34	-1.31	-5.67	-0.21
average std measurements 11.05.2020	2.80	0.82	13.52	49.77	4.04	5.14	9.34	0.20	12.38	0.37	98.37
deviation (%) for 11.05.2020	5.13	0.29	1.62	-2.30	-0.55	1.10	0.41	34.74	-0.89	-1.54	-1.03
average std measurements 15.05.2020	2.79	0.83	13.51	50.74	4.04	5.11	9.37	0.19	12.34	0.38	99.30
deviation (%) for 15.05.2020	4.77	1.00	1.56	-0.39	-0.41	0.54	0.71	29.62	-1.17	0.26	-0.09
average std measurements 12.06.2020	2.95	0.81	13.48	51.22	4.01	5.06	9.29	0.20	12.39	0.35	99.76
deviation (%) for 12.06.2020	10.84	-0.96	1.37	0.55	-1.28	-0.33	-0.14	33.00	-0.80	-7.74	0.37
average std measurements 16.06.2020	2.82	0.82	13.52	51.14	4.01	5.04	9.31	0.19	12.41	0.35	99.61
deviation (%) for 16.06.2020	5.96	0.29	1.62	0.39	-1.26	-0.76	0.11	29.62	-0.62	-7.34	0.23
average std measurements 18.06.2020	2.89	0.82	13.60	50.87	3.99	5.11	9.31	0.20	12.50	0.36	99.64
deviation (%) for 18.06.2020	8.66	0.14	2.27	-0.15	-1.80	0.57	0.07	33.18	0.08	-4.71	0.25
average std measurements 22.06.2020	2.90	0.83	13.57	50.88	3.97	5.07	9.28	0.17	12.52	0.35	99.53
deviation (%) for 22.06.2020	8.83	0.97	2.00	-0.11	-2.27	-0.15	-0.17	15.99	0.21	-8.55	0.14
average std measurements 24.08.2020	2.80	0.81	13.60	50.89	4.00	5.02	9.33	0.21	12.18	0.38	99.22
deviation (%) for 24.08.2020	5.29	-1.03	2.23	-0.09	-1.42	-1.13	0.31	37.76	-2.48	-0.14	-0.17
average std measurements 27.08.2020	2.86	0.81	13.31	50.25	3.98	5.04	9.35	0.19	12.19	0.36	98.33
deviation (%) for 27.08.2020	7.39	-0.92	0.05	-1.35	-2.07	-0.69	0.49	23.60	-2.43	-4.97	-1.07
average std measurements 31.08.2020	2.82	0.81	13.33	50.96	4.00	5.00	9.37	0.20	12.19	0.36	99.05
deviation (%) for 31.08.2020	6.09	-1.37	0.23	0.04	-1.50	-1.53	0.77	36.19	-2.39	-3.96	-0.34
average std measurements 12.10.2020	2.76	0.81	13.21	51.22	4.00	4.94	9.35	0.19	12.63	0.38	99.49
deviation (%) for 12.10.2020	3.78	-1.70	-0.67	0.54	-1.43	-2.68	0.56	28.93	1.11	-0.31	0.10

Appendix A

Supplementary Table S5: EMP standard measurements on reference material VGA-99.

	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2 O3	P2O5	Total
	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
average std measurements 14.10.2020	2.80	0.81	13.34	50.76	4.04	4.94	9.35	0.20	12.40	0.40	99.04
deviation (%) for 14.10.2020	5.26	-0.94	0.30	-0.35	-0.38	-2.82	0.55	33.07	-0.74	4.61	-0.35
average std measurements 16.10.2020	2.75	0.81	13.19	50.65	4.03	4.95	9.34	0.18	12.33	0.39	98.61
deviation (%) for 16.10.2020	3.44	-1.63	-0.83	-0.57	-0.84	-2.66	0.39	22.31	-1.27	2.80	-0.78
average std measurements 30.10.2020	2.74	0.81	13.13	50.51	4.00	4.98	9.33	0.20	12.14	0.37	98.21
deviation (%) for 30.10.2020	2.94	-0.75	-1.25	-0.85	-1.50	-1.89	0.28	31.24	-2.80	-2.59	-1.19
average std measurements 26.01.2021	2.84	0.83	12.77	51.03	3.95	4.95	9.38	0.19	12.71	0.35	98.99
deviation (%) for 26.01.2021	6.72	0.66	-4.00	0.18	-2.62	-2.58	0.85	28.50	1.73	-9.15	-0.40
average std measurements 31.01.2021	2.71	0.83	12.72	50.55	3.98	5.00	9.35	0.20	12.04	0.36	97.73
deviation (%) for 31.01.2021	1.69	0.61	-4.37	-0.77	-2.00	-1.67	0.57	32.63	-3.59	-5.18	-1.67
average std measurements 01.02.2021	2.58	0.83	13.62	50.84	3.90	4.99	9.35	0.18	12.57	0.34	99.20
deviation (%) for 01.02.2021	-2.97	1.08	2.37	-0.19	-3.84	-1.69	0.54	19.31	0.62	-9.92	-0.19
average std measurements 02.02.2021	2.66	0.82	13.57	49.97	3.93	5.06	9.36	0.19	12.41	0.36	98.33
deviation (%) for 02.02.2021	0.03	0.40	2.02	-1.91	-3.12	-0.39	0.61	27.23	-0.62	-5.25	-1.06
average std measurements 04.02.2021	2.58	0.83	13.42	51.08	3.97	4.99	9.34	0.19	12.43	0.36	99.20
deviation (%) for 04.02.2021	-2.96	1.59	0.92	0.28	-2.22	-1.70	0.47	24.54	-0.51	-5.28	-0.19
average std measurements 05.02.2021	2.67	0.81	13.35	51.30	3.99	5.03	9.42	0.19	12.64	0.36	99.76
deviation (%) for 05.02.2021	0.23	-0.76	0.34	0.71	-1.82	-1.08	1.25	29.64	1.23	-4.15	0.37
average std measurements 12.05.2021	2.85	0.84	13.97	50.58	3.89	5.09	9.37	0.21	12.23	0.37	99.39
deviation (%) for 12.05.2021	7.24	2.05	5.02	-0.72	-4.31	0.15	0.78	38.18	-2.08	-2.20	0.00
average std measurements 26.12.2021	2.63	0.84	13.50	51.57	3.98	5.12	8.98	0.18	12.67	0.29	99.75
deviation (%) for 26.12.2021	-1.17	2.08	1.47	1.23	-1.94	0.74	-3.48	21.13	1.42	-22.40	0.36
average std measurements 27.12.2021	2.84	0.83	12.77	51.03	3.95	4.95	9.38	0.19	12.71	0.35	98.99
deviation (%) for 27.12.2021	6.72	0.66	-4.00	0.18	-2.62	-2.58	0.85	28.50	1.73	-9.15	-0.40
average std measurements 27.12.2021	3.83	5.12	1.54	74.91	0.09	0.03	0.72	0.08	13.31	0.01	99.63
deviation (%) for 27.12.2021	-4.25	-0.46	2.75	0.80		-48.03	-2.36	4.20	2.90		0.88

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Ce45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.09.2020	N612-16	40.78	39.85	34.91	35.56	31.21	78.43	38.09	37.17	38.63	42.58	39.66	35.67	38.36	38.07	35.66
	N612-17	40.83	39.71	37.21	35.19	31.33	78.52	38.31	37.85	39.08	42.36	38.78	36.18	38.37	37.46	35.52
	N612-18	38.78	40.18	37.13	35.82	31.74	78.18	38.53	38.89	38.98	43.31	39.59	36.09	38.38	38.27	35.24
	N612-19	39.97	39.77	36.83	35.37	31.40	78.63	38.34	38.07	38.97	42.68	38.79	36.45	39.1	37.82	35.74
	N612-20	40.43	40.54	35.20	35.65	31.20	78.43	38.45	37.95	39.12	42.56	39.52	36.27	38.19	37.82	35.47
	N612-21	40.30	39.42	37.00	35.46	31.56	78.19	38.10	37.62	38.62	42.80	39.54	35.37	38.02	38.03	35.35
	N612-19	39.77	39.67	37.23	35.26	31.47	78.73	38.46	38.21	39.12	42.92	38.48	36.67	39.49	37.81	35.81
	N612-20	40.25	40.45	35.51	35.58	31.23	78.52	38.49	38.07	39.18	42.66	39.26	36.46	38.52	37.81	35.54
	N612-21	40.14	39.36	37.24	35.43	31.56	78.26	38.07	37.73	38.60	42.78	39.34	35.53	38.3	38.02	35.42
	N612-22	40.67	39.79	36.19	35.44	31.33	78.27	38.62	37.53	38.79	42.34	39.05	36.18	38.28	37.79	35.92
	N612-23	39.51	39.74	37.75	35.47	31.94	78.79	38.26	38.38	39.31	42.79	39.75	35.67	38.26	37.79	35.26
	N612-24	40.44	40.18	35.37	35.58	30.98	78.17	38.09	37.79	38.66	42.92	39.11	36.19	38.64	38.08	35.38
	N612-01	40.17	39.90	37.30	35.04	31.37	78.02	38.02	37.63	38.97	42.95	38.67	36.2	38.16	37.46	35.52
	N612-02	40.95	40.39	36.01	36.06	31.54	78.96	38.89	38.35	38.83	42.52	39.72	36.19	38.81	38.17	35.6
	N612-03	39.64	39.45	35.96	35.40	31.29	78.31	38.04	37.82	38.87	42.65	39.49	35.59	38.27	38.18	35.36
	N612-04	39.13	39.30	34.16	35.55	31.44	78.29	37.97	37.18	39.00	42.45	39.61	35.84	38.4	37.53	35.42
	N612-05	40.23	40.40	38.07	35.90	31.33	77.63	38.43	38.03	38.99	42.69	39.78	36.18	38.03	37.64	35.86
	N612-06	41.15	40.00	36.68	35.07	31.44	79.22	38.46	38.40	38.74	42.94	38.55	36.02	38.75	38.43	35.25
	N612-04	39.28	39.73	35.16	35.81	31.48	78.11	38.09	37.34	39.04	42.49	40.02	35.98	38.29	37.52	35.55
	N612-05	40.40	40.95	39.25	36.31	31.38	77.56	38.64	38.32	39.20	42.96	40.13	36.44	38.08	37.75	36.19
	N612-06	41.28	40.12	37.49	35.15	31.32	78.69	38.51	38.56	38.73	42.95	38.54	36.01	38.54	38.34	35.42
	N612-07	39.90	40.16	36.52	35.15	31.51	76.92	37.80	37.70	38.91	43.09	39.30	35.88	38.56	37.64	36.85
	N612-08	40.17	39.48	39.02	35.68	31.25	78.93	38.76	37.80	39.11	42.50	38.94	36.11	38.14	37.83	35.76
	N612-09	40.09	40.27	33.56	35.38	31.55	77.88	37.86	37.91	38.72	42.85	39.75	35.9	38.62	37.91	35.27
	N612-07	39.76	40.22	36.50	35.04	31.54	76.80	37.85	37.80	38.90	43.20	39.11	35.82	38.59	37.65	36.73
	N612-08	40.10	39.54	38.87	35.56	31.22	78.82	38.67	37.72	39.01	42.53	38.72	36.03	38.2	37.83	35.7
	N612-09	40.30	40.23	33.53	35.40	31.53	77.78	37.84	38.02	38.75	42.87	39.93	35.89	38.56	37.9	35.31
	N612-10	40.39	40.37	36.80	35.88	31.79	79.84	38.93	38.39	39.05	42.48	39.22		38.79	38.32	35.27
	N612-11	39.96	39.86	35.30	35.44	31.71	78.42	38.27	38.07	39.18	43.36	39.56	36.15	38.55	38.2	35.55
	N612-12	40.27	39.54	37.28	35.26	30.80	77.29	37.86	37.34	38.53	42.27	39.09	35.44	37.94	37.29	35.66
	N612-14	40.40	40.42	37.22	35.49	31.57	79.09	38.29	37.89	38.74	42.59	39.27	36.33	38.67	38.13	35.28
	N612-15	39.95	39.38	35.53	35.53	31.23	77.64	38.27	37.90	39.08	42.82	39.33	35.66	38.12	37.63	35.71
	N612-16	40.43	40.39	34.88	35.25	31.19	79.12	38.25	37.65	39.60	42.50	39.46	35.99	38.37	37.78	35.88
	N612-17	41.40	40.04	35.93	36.19	31.01	78.91	38.62	37.64	39.23	43.03	40.40	36.19	39.13	38.81	36.13
	N612-18	40.62	39.49	35.89	35.23	31.29	79.20	38.89	37.99	38.84	42.60	39.29	36.02	38.44	38.45	35.91
	N612-19	39.85	40.32	36.94	35.75	31.52	77.74	37.79	37.82	38.94	42.78	39.31	36	38.38	37.44	35.12
	N612-17	41.22	40.28	36.17	36.22	31.13	78.70	38.82	37.85	39.51	42.94	40.31	36.16	38.92	38.75	36.18
	N612-18	40.45	39.47	36.00	35.20	31.07	78.78	38.56	37.91	38.75	42.65	39.34	35.95	38.41	38.28	35.7
	N612-19	39.91	40.40	36.95	35.84	31.77	77.97	38.04	37.91	39.07	42.75	39.27	36.07	38.37	37.48	35.27
	N612-20	41.50	39.83	35.24	36.08	32.67	80.67	38.34	37.43	38.72	42.98	41.49	36.88	39.3	38.95	35.83
	N612-21	40.59	39.68	34.78	35.39	31.38	78.69	38.01	37.62	38.77	42.78	39.17	35.71	38.73	38.08	35.75
	N612-22	39.82	40.11	38.02	35.59	31.39	78.12	38.64	38.20	39.03	42.61	39.44	36.32	38.05	37.74	35.25
	N612-20	41.20	40.54	35.67	36.34	32.85	80.62	38.98	37.95	39.00	43.10	41.69	37.04	39.12	38.72	35.74
	N612-21	40.29	40.13	35.02	35.51	31.35	78.68	38.37	37.98	39.08	43.06	39.44	35.84	38.57	37.96	35.62
	N612-22	40.14	39.64	37.86	35.51	31.44	78.12	38.22	37.79	38.70	42.34	39.13	36.18	38.23	37.85	35.35
	N612-23	39.70	40.20	35.45	35.32	31.47	78.22	38.46	38.26	39.05	42.42	39.58	35.88	38.32	37.62	35.94
	N612-24	40.65	39.67	37.15	35.66	31.34	78.58	38.17	37.60	38.79	42.97	39.07	36.09	38.48	38.15	35.15
01.10.2020	N612-01	38.34	38.72	35.03	34.33	30.92	74.68	37.27	37.40	38.07	41.59	38.16	34.75	36.97	36.49	34.04
	N612-02	40.46	40.04	37.49	35.18	31.54	78.06	38.19	37.72	39.13	42.94	39.09	36.1	38.36	37.87	35.57
	N612-03	40.47	39.72	33.87	35.59	31.38	78.78	38.14	38.25	38.89	42.60	39.96	36.11	38.5	37.94	36.03
	N612-04	39.66	40.05	38.04	35.83	31.25	78.41	38.69	37.75	38.68	42.57	38.77	35.82	38.41	37.94	34.86
	N612-05	39.87	39.34	36.26	35.03	31.74	78.39	37.82	37.76	38.69	42.65	39.63	35.46	37.89	37.6	35.59
	N612-06	39.96	39.57	34.62	35.53	30.86	77.75	38.28	37.73	38.67	42.44	39.31	36.26	38.29	37.71	34.93
	N612-07	40.77	40.71	38.09	35.84	31.64	78.99	38.71	38.18	39.33	43.01	39.03	36.25	38.95	38.34	36.01
	N612-05	39.94	39.43	36.30	35.13	31.65	78.31	37.91	37.73	38.68	42.62	39.51	35.46	37.93	37.58	35.57
	N612-06	39.99	39.63	34.68	35.60	30.85	77.77	38.33	37.75	38.69	42.44	39.26	36.29	38.35	37.73	34.94
	N612-07	40.76	40.74	38.20	35.88	31.70	79.11	38.73	38.24	39.36	43.05	39.05	36.31	39.03	38.41	36.05
	N612-08	40.41	39.80	36.87	35.22	31.32	78.90	38.16	37.90	39.05	42.85	39.59	36.17	38.14	38.22	35.39
	N612-09	39.29	40.05	36.89	35.34	31.66	78.47	38.39	38.21	38.93	42.64	39.50	36.01	38.55	37.99	35.61
N612-10	40.84	39.76	35.43	35.84	31.23	77.87	38.29	37.59	38.70	42.60	38.91	35.79	38.41	37.5	35.46	
N612-08	40.50	39.98	36.95	35.35	31.38	79.12	38.25	37.98	39.07	42.90	39.67	36.26	38.27	38.27	35.52	
N612-09	39.34	40.11	36.88	35.41	31.66	78.48	38.45	38.24	38.95	42.65	39.53	36.04	38.61	37.99	35.65	
N612-10	40.84	39.70	35.32	35.85	31.17	77.67	38.33	37.56	38.71	42.58	38.88	35.77	38.41	37.45	35.39	
N612-11	40.30	39.20	35.96	34.88	31.08	77.40	37.33	37.15	38.26	42.20	38.15	35.27	37.8	37.45	35.02	
N612-12	39.68	39.90	36.93	35.56	31.92	78.38	38.33	38.08	39.32	42.90	38.34	36	38.47	38.24	35.44	
N612-13	40.57	40.53	36.44	35.95	31.23											

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Hol65	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.09.2020	N612-16	37.48	35.63	36.51	37.26	35.30	37.85	37.30	36.53	38.72	36.78	36.03	37.45	37.86	37.54	37.37
	N612-17	38.02	35.54	37.14	37.64	35.48	38.64	38.07	36.62	38.97	36.85	37.02	37.70	38.80	37.77	37.45
	N612-18	37.54	35.64	38.51	37.99	35.77	38.42	38.64	37.35	40.12	37.51	37.16	37.65	39.25	38.09	37.32
	N612-19	37.67	35.51	37.18	37.44	35.29	38.49	39.03	36.96	39.33	36.71	36.46	37.55	38.27	38.08	37.26
	N612-20	38.19	35.71	37.81	37.88	36.06	38.20	37.95	36.75	38.97	37.18	37.18	37.74	38.54	37.59	37.42
	N612-21	37.27	35.57	36.83	37.44	35.15	38.20	37.15	36.67	39.24	37.04	36.41	37.50	38.77	37.70	37.45
	N612-19	37.79	35.55	37.14	37.41	35.10	38.65	39.70	37.16	39.48	36.60	36.37	37.56	38.13	38.30	37.19
	N612-20	38.19	35.69	37.78	37.83	35.92	38.32	38.48	36.87	39.08	37.05	37.09	37.72	38.44	37.76	37.35
	N612-21	37.15	35.49	36.81	37.36	35.07	38.27	37.56	36.73	39.31	36.88	36.33	37.46	38.72	37.83	37.37
	N612-22	38.11	35.72	37.40	37.51	35.26	38.30	37.37	36.50	39.22	37.48	36.61	37.84	38.44	37.79	37.67
	N612-23	37.71	35.58	36.94	37.79	35.84	38.30	38.39	37.30	39.35	37.15	36.50	37.43	38.59	37.66	37.42
	N612-24	37.40	35.53	37.58	37.51	35.42	38.30	38.22	36.62	39.04	36.50	36.98	37.57	38.65	37.91	37.11
	N612-01	37.18	35.52	37.67	38.06	35.78	38.06	38.08	36.53	38.75	36.97	36.49	37.66	38.82	37.93	37.26
	N612-02	38.27	35.93	37.30	37.69	35.61	38.84	38.54	37.30	39.88	37.32	37.63	37.56	38.68	37.68	37.68
	N612-03	37.81	35.36	36.96	37.08	35.13	38.04	37.43	36.68	39.05	36.74	36.00	37.56	38.16	37.80	37.24
	N612-04	36.89	35.49	37.02	37.07	35.03	38.25	37.66	36.22	38.81	36.72	36.81	37.70	38.78	37.64	37.37
	N612-05	37.57	35.62	36.94	37.96	35.68	38.09	37.80	36.64	39.19	37.04	36.56	37.71	38.47	37.51	36.98
	N612-06	38.51	35.69	37.93	37.80	35.78	38.54	38.53	37.47	39.53	37.22	36.78	37.43	38.53	38.20	37.77
	N612-04	36.98	35.47	36.85	37.30	35.14	38.19	37.60	36.21	38.88	36.73	36.70	37.78	38.69	37.55	37.22
	N612-05	37.74	35.78	37.00	38.43	36.25	38.27	37.89	36.86	39.36	37.33	36.54	38.02	38.60	37.60	36.85
	N612-06	38.55	35.74	37.82	37.94	35.93	38.43	38.44	37.48	39.55	37.30	36.68	37.38	38.43	38.04	37.58
	N612-07	37.14	35.88	37.68	37.46	35.89	39.05	38.12	36.70	39.30	37.21	37.07	37.53	38.83	38.09	37.01
	N612-08	37.67	35.67	37.37	37.64	35.35	38.36	38.33	36.99	39.43	37.07	37.03	37.79	38.68	38.20	37.24
	N612-09	37.62	35.52	37.17	37.52	35.59	38.23	37.64	36.54	38.94	36.89	36.40	37.46	38.48	37.38	37.49
	N612-07	37.15	35.82	37.72	37.45	36.01	39.17	38.15	36.76	39.46	37.29	37.05	37.54	38.74	38.09	36.86
	N612-08	37.67	35.69	37.43	37.67	35.39	38.38	38.28	36.97	39.39	37.11	37.01	37.77	38.62	38.10	37.22
	N612-09	37.81	35.46	37.19	37.47	35.58	38.12	37.62	36.52	38.95	36.88	36.32	37.42	38.49	37.38	37.44
	N612-10	37.23	35.86	36.60	37.87	35.73	38.84	38.69	37.48	39.40	36.99	36.90	37.53	38.75	38.30	38.06
	N612-11	37.49	35.78	38.27	37.95	35.64	38.65	38.12	37.03	39.48	37.07	37.04	37.75	38.59	38.11	37.76
	N612-12	38.30	35.24	37.01	37.07	35.18	37.57	37.37	36.07	38.79	36.95	36.25	37.53	38.41	37.12	36.50
	N612-14	37.47	35.37	37.16	37.55	35.73	38.32	38.17	36.76	39.91	36.73	36.90	37.67	38.33	38.13	37.23
	N612-15	37.93	35.86	37.45	37.66	35.24	38.26	37.82	36.83	38.45	37.28	36.49	37.54	38.86	37.45	37.53
	N612-16	38.08	35.35	37.91	37.76	35.61	38.24	38.49	36.87	39.03	37.16	36.69	38.26	38.55	37.82	37.48
	N612-17	37.98	35.96	37.78	37.16	36.27	39.24	39.10	37.29	40.14	36.99	36.78	37.75	39.12	38.24	37.95
	N612-18	37.86	35.52	37.38	37.47	35.76	38.59	37.94	37.07	39.75	37.07	36.68	37.36	37.97	37.57	37.55
	N612-19	37.54	35.66	37.22	37.71	35.29	38.04	38.06	36.55	38.77	36.92	36.73	37.83	39.12	38.02	37.22
	N612-17	38.04	36.00	37.84	37.21	36.42	39.42	39.21	37.44	40.21	37.09	36.80	37.76	38.72	38.29	37.78
	N612-18	37.70	35.47	37.27	37.36	35.47	38.33	37.69	36.80	39.46	36.96	36.57	37.30	38.27	37.41	37.48
	N612-19	37.74	35.74	37.38	37.89	35.54	38.26	38.35	36.81	38.97	37.08	36.87	37.95	38.93	38.24	37.28
	N612-20	38.56	35.73	37.41	37.84	36.12	39.05	38.33	37.29	39.61	37.17	36.42	37.82	39.31	38.62	38.37
	N612-21	37.05	35.62	36.61	37.17	35.37	38.38	37.88	36.64	38.43	36.41	36.37	37.36	38.25	37.39	37.28
	N612-22	38.42	35.57	38.06	38.06	35.64	38.22	38.10	36.98	40.09	37.66	37.05	37.84	38.90	38.20	37.50
	N612-20	38.94	35.73	37.80	38.05	36.11	39.30	38.57	37.56	40.00	37.55	36.73	38.01	39.22	38.80	38.03
	N612-21	37.26	35.77	36.95	37.52	35.57	38.60	38.09	36.88	38.71	36.78	36.72	37.66	38.42	37.54	37.22
	N612-22	38.18	35.45	37.67	37.69	35.41	37.97	37.92	36.71	39.71	37.24	36.66	37.54	38.76	38.06	37.57
	N612-23	37.65	35.21	37.38	37.55	35.65	38.55	37.78	36.90	39.52	36.96	37.11	37.55	38.19	37.71	37.05
	N612-24	37.72	35.95	37.21	37.64	35.38	38.11	38.20	36.72	38.90	37.02	36.37	37.65	38.89	37.84	37.65
01.10.2020	N612-01	36.77	34.43	36.92	37.00	34.88	37.71	37.21	36.04	38.39	35.98	35.50	36.78	37.41	37.18	36.06
	N612-02	37.87	35.89	37.84	37.81	36.11	38.53	37.88	36.99	38.67	37.09	36.85	37.39	38.56	37.95	37.24
	N612-03	38.26	35.74	36.97	37.44	35.64	38.22	38.44	36.85	39.56	36.77	36.84	37.71	38.78	38.00	37.59
	N612-04	36.86	35.16	37.13	37.61	34.77	38.21	37.74	36.60	39.53	37.24	36.44	37.76	38.33	37.42	37.33
	N612-05	38.10	35.28	37.26	37.27	35.05	37.67	37.59	36.29	38.46	36.54	36.06	37.41	38.43	37.33	37.13
	N612-06	37.27	35.49	36.45	37.46	34.80	38.41	37.59	36.73	39.19	36.87	37.02	37.44	39.12	37.99	37.55
	N612-07	37.83	36.04	38.20	38.04	36.68	38.78	38.76	37.35	39.81	37.52	37.00	37.89	38.21	38.05	37.44
	N612-05	38.01	35.27	37.23	37.23	35.06	37.68	37.61	36.28	38.55	36.57	36.10	37.43	38.33	37.31	37.10
	N612-06	37.20	35.52	36.46	37.51	34.85	38.46	37.65	36.76	39.28	36.90	37.05	37.46	39.09	38.01	37.57
	N612-07	37.78	36.10	38.27	38.17	36.75	38.88	38.87	37.43	39.90	37.55	37.01	37.91	38.27	38.11	37.50
	N612-08	38.54	35.40	37.49	37.29	35.22	38.13	37.73	37.04	39.20	37.44	36.86	37.77	38.60	37.78	37.46
	N612-09	37.72	35.61	37.61	37.82	36.01	38.45	38.16	36.78	38.86	37.03	36.67	37.78	39.05	37.91	37.18
N612-10	37.01	35.71	36.79	37.60	35.17	38.23	38.00	36.54	39.42	36.55	36.53	37.26	38.12	37.64	37.46	
N612-08	38.51	35.50	37.50	37.42	35.34	38.23	37.86	37.13	39.31	37.46	36.89	37.77	38.63	37.86	37.53	
N612-09	37.65	35.66	37.62	37.88	36.07	38.50	38.23	36.80	38.93	37.05	36.71	37.79	39.02	37.94	37.22	
N612-10	36.91	35.70	36.81	37.61	35.16	38.25	38.00	36.51	39.46	36.56	36.59	37.27	38.04	37.62	37.47	
N612-11	37.53	35.28	36.93	36.82	35.08	37.61	37.31	36.34	38.19	36.17	35.91	36.86	38.15	37.19	36.54	
N612-12	37.60	35.57	37.22	37.76	35.46	38.43	38.22	36.62	39.80	37.06	36.75	38.26	39.43	38.10	37.61	
N612-13	38.04	35														

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	N612-15	40.72	40.09	36.00	35.88	32.28	80.02	38.84	38.46	39.63	43.18	38.46	36.76	39.22	39.05	36.7
	N612-16	40.66	39.63	36.18	35.13	31.07	78.05	38.11	37.83	38.69	42.33	38.69	35.69	38.13	37.71	35.48
	N612-17	40.55	40.33	35.58	35.43	31.42	77.62	38.08	37.87	38.94	42.54	39.93	36.09	38.13	37.77	35.1
	N612-18	39.94	39.74	36.66	35.15	31.44	78.15	38.42	37.78	38.50	42.35	38.67	35.65	38.24	37.79	35.39
	N612-19	39.96	39.64	37.19	35.98	31.34	79.67	38.50	38.13	39.39	43.32	39.35	36.36	38.96	38.19	36.2
	N612-20	41.02	39.42	36.31	35.16	31.23	78.10	37.51	37.25	38.05	42.27	38.13	35.44	37.98	37.73	34.55
	N612-21	40.62	40.09	34.44	35.95	31.64	78.28	38.71	38.23	39.35	43.22	40.51	36.01	38.46	37.92	35.96
	N612-22	39.20	40.19	38.02	35.36	31.34	78.65	38.60	38.15	39.22	42.57	39.30	36.46	38.65	38.01	35.87
	N612-20	41.06	39.45	35.33	35.42	31.44	78.50	37.81	37.42	38.32	42.60	38.80	35.56	38.19	37.97	35.12
	N612-21	40.67	40.10	33.73	36.24	31.84	78.75	38.98	38.39	39.66	43.61	41.27	36.13	38.75	38.17	36.52
	N612-22	39.22	40.45	37.54	35.60	31.35	78.28	38.91	38.50	39.61	42.82	39.91	36.54	38.65	37.82	35.96
	N612-23	40.29	39.85	36.28	35.49	31.40	78.41	38.24	37.85	38.84	42.69	39.24	35.95	38.38	37.91	35.46
	N612-24	40.98	40.18	35.11	36.19	32.56	80.28	38.86	39.04	39.73	43.60	40.59	36.45	39.97	38.68	36.44
	N612-25	41.41	40.06	36.67	35.53	31.56	80.35	38.56	37.72	39.46	43.60	39.62	35.91	39.15	38.06	36.6
	N612-23	39.86	39.70	36.89	35.23	30.89	77.66	38.02	37.35	38.54	42.34	38.77	35.79	37.74	37.61	35.1
	N612-24	40.59	40.12	35.86	35.80	31.99	79.20	38.62	38.51	39.31	43.10	39.94	36.21	39.16	38.22	35.97
	N612-25	40.82	40.18	37.29	35.20	31.05	79.06	38.52	37.37	38.97	42.85	38.92	35.73	38.24	37.56	36.28
	N612-29	40.08	39.83	36.93	35.52	31.36	78.99	38.24	38.11	38.88	42.84	38.91	36.28	38.33	38.03	35.27
	N612-30	40.28	39.95	35.98	35.46	31.39	77.82	38.33	37.67	38.88	42.54	39.61	35.74	38.41	37.76	35.68
	N612-31	39.60	41.55	38.20	34.30	30.51	78.08	39.27	37.61	38.11	42.00	39.25	36.11	38.27	37.43	36.05
	N612-01	40.83	39.76	36.19	35.26	31.30	77.88	37.56	38.19	39.20	42.75	39.53	35.86	38.24	37.79	36.27
	N612-02	40.38	40.01	34.83	35.54	31.57	78.83	38.25	38.01	38.85	42.56	38.90	36.23	38.35	38.03	35.54
	N612-03	39.96	39.83	37.91	35.45	31.22	77.97	38.40	37.81	38.95	42.86	39.74	35.76	38.42	37.73	35.44
	N612-04	40.57	39.54	37.24	35.55	31.38	78.18	38.00	37.67	38.90	42.59	39.37	35.9	38.61	38.12	35.64
	N612-05	40.85	40.12	39.12	35.08	31.79	77.94	38.30	37.27	39.07	42.90	38.64	35.47	38.45	37.57	35.73
	N612-06	39.87	40.27	35.50	35.46	31.43	78.64	38.59	38.13	38.89	42.80	39.20	36.11	38.2	37.71	35.37
	N612-04	40.35	39.76	37.28	35.56	31.43	78.28	38.24	37.77	38.91	42.63	39.18	35.85	38.59	38.07	35.53
	N612-05	40.78	40.36	39.26	35.19	31.81	77.96	38.40	37.56	39.15	43.20	38.74	35.63	38.16	37.51	35.94
	N612-06	40.03	40.05	35.42	35.44	31.36	78.53	38.37	38.05	38.89	42.78	39.44	36.17	38.19	37.71	35.46
	N612-07	41.42	40.36	35.95	35.79	31.54	78.26	38.21	37.14	39.67	43.17	40.91	36.59	38.98	38.3	35.97
	N612-08	41.36	39.80	35.38	36.00	31.15	79.03	37.88	37.28	39.75	42.82	40.07	36.83	39.04	38.21	36.01
	N612-09	40.22	39.88	36.50	35.51	31.40	78.38	38.29	37.88	38.90	42.69	39.28	35.98	38.43	37.92	35.5
	N612-07	41.15	40.43	35.72	35.40	31.55	78.17	38.45	37.51	39.42	43.25	40.45	36.06	38.56	38.07	35.59
	N612-08	40.82	39.89	35.53	35.59	31.19	78.47	38.05	37.66	39.34	42.77	39.43	36.18	38.49	37.84	35.4
	N612-09	39.55	39.91	37.23	35.41	31.63	78.32	38.57	38.16	38.44	42.62	39.16	35.81	38.3	37.96	35.61
	N612-10	40.25	39.90	36.34	35.51	31.38	78.41	38.28	37.88	38.93	42.71	39.31	36.01	38.41	37.9	35.49
	N612-11	39.60	40.70	37.98	36.19	32.29	80.62	38.87	38.89	38.98	42.71	40.41	36.56	39.02	39.26	36.59
	N612-12	40.31	40.53	33.12	36.45	32.16	81.06	38.86	38.26	39.09	42.82	40.11	36.7	39.62	39.25	36.64
	N612-10	40.64	39.45	35.44	35.31	31.18	77.70	38.18	37.67	38.95	42.79	39.10	35.74	38.25	37.64	35.39
	N612-11	39.68	40.44	37.51	35.73	31.66	79.25	38.44	38.17	38.84	42.60	39.53	36.31	38.58	38.22	35.63
	N612-12	40.90	40.30	32.96	36.65	32.27	80.47	39.05	38.26	39.59	43.85	40.00	36.91	39.91	38.86	36.55
	N612-13	40.05	39.91	35.50	35.97	31.32	79.89	38.51	37.66	39.44	43.05	39.67	36.18	38.87	38.7	36.74
	N612-14	39.44	40.31	35.51	35.72	31.65	78.87	38.24	38.86	39.11	42.97	38.75	35.7	38.36	38.45	36.36
	N612-15	40.23	39.87	36.34	35.49	31.39	78.36	38.29	37.89	38.90	42.70	39.29	35.99	38.39	37.89	35.49
01.10.2020	N612-16	39.79	39.59	36.37	35.18	31.29	78.18	38.50	38.07	38.79	42.28	39.41	36.19	38.58	37.96	35.62
	N612-17	41.32	40.02	36.84	35.39	32.19	78.63	38.46	37.18	38.59	43.00	39.22	36.65	38.4	38.19	35.76
	N612-18	40.64	40.26	36.42	35.87	31.55	78.66	38.07	37.70	39.02	43.18	39.17	35.78	38.18	37.81	35.36
	N612-20	40.14	39.12	36.13	35.25	31.05	77.07	37.93	37.31	39.61	43.03	39.88	35.69	38.13	37.61	36.08
	N612-21	40.97	40.03	36.53	35.53	31.11	78.36	38.34	38.02	39.11	43.16	39.42	35.99	38.65	38.34	35.66
	N612-22	39.46	39.75	36.28	35.43	31.65	78.41	38.29	37.81	38.71	42.25	39.21	36.03	38.21	37.52	35.38
	N612-20	40.13	39.18	36.85	35.32	31.32	77.03	38.10	37.30	39.55	43.04	39.76	35.71	37.99	37.52	36.02
	N612-21	40.86	40.08	36.29	35.63	31.17	78.48	38.31	38.02	39.09	43.20	39.47	35.99	38.65	38.32	35.71
	N612-22	39.41	39.74	36.47	35.29	31.65	78.24	38.25	37.72	38.67	42.18	39.06	35.98	38.05	37.41	35.24
	N612-23	40.78	39.80	36.34	36.08	31.50	79.76	38.60	38.27	39.11	42.69	40.17	36.49	39.08	38.32	35.85
	N612-24	40.28	39.65	37.17	35.39	31.17	76.80	38.31	37.89	38.84	42.64	38.48	35.51	38.29	37.83	35.24
	N612-25	39.69	40.23	35.73	35.13	31.52	78.79	38.03	37.61	38.79	42.80	39.35	36.04	37.96	37.64	35.46
	N612-23	40.79	39.88	36.19	36.35	31.71	80.54	38.67	38.54	39.28	42.73	40.71	36.78	39.53	38.67	36.03
	N612-24	40.35	39.82	37.20	35.68	31.38	77.57	38.46	38.13	38.96	42.77	38.95	35.74	38.62	38.06	35.41
	N612-25	40.03	39.99	35.55	35.29	31.42	79.39	38.12	37.64	38.83	42.62	39.71	36.3	38.15	37.72	35.6
	N612-26	41.11	39.96	33.88	35.18	31.67	78.28	38.69	38.16	39.18	43.13	39.07	35.96	38.61	37.6	35.96
	N612-27	40.21	39.89	36.45	35.51	31.40	78.34	38.31	37.92	38.90	42.70	39.28	35.98	38.42	37.91	35.49
	N612-28	40.46	39.79	34.35	34.50	31.41	77.36	39.04	38.17	38.75	42.44	38.41	35.41	38.52	37.31	36.5
	N612-26	40.65	39.93	35.14	35.31	31.52	78.33	38.58	38.05	39.07	42.92	39.13	35.96	38.47	37.78	35.72
	N612-27	39.76	39.89	37.98	35.68	31.24	78.45	38.05	37.77	38.74	42.47	39.51	36.03	38.33	38.08	35.27
	N612-28	39.98	39.75	35.71	34.63	31.20	77.47	38.73	37.96	38.53	42.18	38.68	35.45	38.45	37.53	36.27
	N612-29	39.54	39.65	34.18	35.65	31.67	78.54	38.02	37.58	38.58	42.58	38.91	36.07	38.1	37.36	35.49
	N612-30	41.09	40.02	38.23	35.62	31.56	78.61	38.27	38.08	39.33	42.92	39.79	36.08	38.88	38.18	35.56
	N612-31	40.02	40.04	36.63	35.21	30.99	78.04	38.65	38.06	38.81	42.62	39.18	35.85	38.23	38.16	35.46
	N612-01	39.61	39.87	33.32	35.46	31.27	77.59	38.02	38.13	39.27	42.59	39.25	35.79	38.07	37.87	35.2
	N612-02	40.61	40.62	38.35	35.42	31.52	79.56	38.55	38.19	39.18	42.69	39.81	36.14	38.96	38.74	36.19

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.10.2020	N612-15	37.81	36.87	38.55	38.27	35.31	38.74	38.64	37.43	40.10	37.70	37.74	39.01	40.53	38.66	38.62
	N612-16	37.21	35.52	37.39	37.20	35.34	38.34	38.14	36.79	39.06	36.67	36.49	37.19	38.16	37.54	37.01
	N612-17	38.50	35.53	37.26	37.56	35.50	38.28	38.43	36.71	39.43	37.09	36.42	37.43	38.41	37.60	36.68
	N612-18	37.75	35.17	37.31	37.51	35.25	38.26	37.57	36.87	38.61	36.54	36.88	37.32	38.36	37.84	37.34
	N612-19	36.82	36.18	37.36	37.79	35.80	38.39	38.03	36.88	39.59	37.48	36.86	38.17	39.02	38.01	38.28
	N612-20	37.14	35.42	37.27	37.18	35.16	37.92	37.70	36.44	39.12	36.24	36.39	37.00	38.26	37.48	37.29
	N612-21	37.74	35.68	37.05	37.59	35.84	38.51	37.86	36.83	39.33	37.31	36.86	37.85	38.79	37.70	37.66
	N612-22	38.25	35.65	37.55	37.96	35.47	38.43	38.42	37.07	39.14	37.37	36.80	37.86	38.60	38.12	37.11
	N612-20	37.38	35.57	37.08	37.14	35.34	38.08	37.61	36.58	39.24	36.53	36.50	37.17	38.58	37.53	37.72
	N612-21	37.94	35.88	36.85	37.57	36.05	38.69	37.73	36.92	39.43	37.57	36.94	38.03	39.14	37.78	38.14
	N612-22	38.09	35.63	37.56	38.17	35.69	38.57	38.48	37.07	39.15	37.59	36.94	38.13	38.55	38.11	36.99
	N612-23	37.66	35.60	37.28	37.55	35.48	38.28	37.96	36.78	39.20	36.95	36.68	37.55	38.57	37.76	37.42
	N612-24	37.24	35.86	36.80	38.29	36.73	39.47	38.51	37.50	39.78	37.69	37.59	38.35	39.79	38.39	37.92
	N612-25	36.52	35.68	37.73	38.06	36.26	38.99	37.97	37.22	39.03	37.44	37.19	38.03	38.16	38.70	37.67
	N612-23	37.82	35.49	37.60	37.31	34.91	37.78	37.81	36.52	38.89	36.63	36.26	37.28	38.05	37.53	37.18
	N612-24	37.55	35.70	37.02	37.92	36.17	38.91	38.22	37.13	39.59	37.42	37.19	37.96	39.15	38.08	37.57
	N612-25	36.86	35.35	38.02	37.66	35.81	38.54	37.82	37.02	38.90	37.12	36.85	37.46	37.43	38.29	37.06
	N612-29	38.08	35.93	36.71	37.59	35.67	38.05	38.00	36.63	38.69	36.97	36.79	37.64	38.74	37.94	37.97
	N612-30	37.38	35.30	37.87	37.59	35.30	38.48	37.98	36.93	39.65	37.00	36.59	37.54	38.38	37.63	36.85
	N612-31	37.23	34.89	37.10	37.51	35.69	38.53	37.94	36.65	39.30	36.82	36.51	36.93	37.53	37.36	36.61
	N612-01	37.11	35.47	37.27	37.33	36.20	38.32	37.54	37.18	39.42	37.35	36.78	37.51	38.53	37.84	37.58
	N612-02	37.28	35.55	36.77	37.46	35.57	38.15	38.01	36.46	39.01	36.98	36.53	37.58	38.57	37.85	37.78
	N612-03	38.23	35.66	37.89	37.83	35.48	38.53	38.03	37.22	39.46	37.05	36.95	37.65	38.54	37.74	36.90
	N612-04	37.32	35.54	37.37	37.07	35.07	37.80	37.74	36.53	38.88	36.82	36.19	37.37	38.80	37.64	37.83
	N612-05	37.78	35.82	37.35	37.25	34.79	37.97	38.15	36.87	38.66	36.82	36.13	37.38	38.57	37.54	37.78
	N612-06	38.04	35.65	37.19	38.13	35.94	38.79	38.26	37.04	39.50	37.18	37.19	37.82	38.35	37.94	36.99
	N612-04	37.25	35.70	37.46	37.22	35.18	37.93	37.94	36.65	38.94	36.88	36.31	37.45	38.62	37.81	37.78
	N612-05	38.16	35.88	37.66	37.41	35.06	38.32	38.54	37.22	39.13	37.01	36.56	37.55	38.50	37.59	37.47
	N612-06	38.22	35.49	37.12	38.04	35.87	38.73	38.07	36.97	39.50	37.14	37.15	37.77	38.51	37.77	36.95
	N612-07	38.58	35.64	37.10	38.09	35.63	38.28	38.31	37.14	39.14	37.39	37.28	38.40	39.28	37.92	37.46
	N612-08	38.20	35.37	37.45	38.27	35.52	38.18	39.11	36.73	38.74	37.57	37.09	38.15	39.63	37.63	37.54
	N612-09	37.64	35.61	37.32	37.55	35.46	38.25	37.99	36.78	39.16	36.98	36.64	37.58	38.58	37.79	37.43
	N612-07	38.45	35.75	36.90	37.78	35.38	38.31	37.74	37.37	39.33	37.26	37.13	38.08	38.54	37.81	37.39
	N612-08	37.93	35.40	37.28	37.81	35.33	38.14	38.39	36.71	38.90	37.28	36.87	37.78	38.82	37.55	37.26
	N612-09	37.45	35.82	37.32	37.38	35.68	38.48	37.60	36.90	39.53	36.70	36.52	37.41	38.31	38.05	37.51
	N612-10	37.72	35.58	37.30	37.62	35.49	38.29	38.03	36.79	39.18	37.02	36.71	37.61	38.59	37.77	37.37
	N612-11	38.74	36.17	37.50	37.76	36.31	39.09	39.65	37.51	39.21	37.23	36.27	38.17	39.86	38.60	37.59
	N612-12	39.31	35.84	38.27	37.64	35.84	38.95	39.00	37.12	39.72	37.18	36.57	37.72	40.12	38.67	38.23
	N612-10	37.47	35.49	37.28	37.47	35.00	38.04	37.44	36.80	39.38	36.93	36.80	37.38	38.11	37.70	37.67
	N612-11	37.98	35.73	37.32	37.76	36.11	38.61	38.68	36.80	38.99	37.08	36.58	37.87	39.13	37.89	37.04
	N612-12	39.18	35.88	38.38	38.12	36.18	39.26	38.72	37.54	40.09	37.43	37.37	38.09	40.31	38.80	38.45
	N612-13	38.02	35.67	38.05	38.13	36.37	39.28	38.82	37.30	40.07	37.48	37.33	38.11	40.70	38.24	38.26
	N612-14	38.70	35.57	37.12	37.60	35.53	38.69	38.25	36.88	39.73	36.91	36.79	37.26	39.29	37.79	38.08
	N612-15	37.69	35.59	37.30	37.59	35.47	38.29	37.97	36.80	39.21	37.00	36.71	37.59	38.54	37.79	37.40
	N612-16	37.29	35.42	37.40	37.69	35.73	38.62	38.21	36.92	39.38	37.01	36.88	37.84	38.26	37.95	37.28
	N612-17	37.33	35.22	37.94	37.48	35.46	38.31	38.36	36.83	38.81	36.92	36.72	37.37	38.64	38.48	37.95
	N612-18	38.22	35.80	37.18	37.49	35.23	37.93	37.76	36.65	38.99	36.98	36.50	37.32	38.93	37.61	37.48
	N612-20	37.36	35.52	36.33	36.69	34.38	37.16	37.46	36.00	38.73	36.36	35.45	36.89	38.08	37.10	36.73
N612-21	37.12	35.77	37.41	37.60	35.53	38.45	38.02	36.87	39.28	37.17	36.69	37.75	38.63	37.85	37.56	
N612-22	38.19	35.43	37.22	37.61	35.50	38.20	38.01	36.75	39.15	36.85	36.73	37.49	38.48	37.76	37.21	
N612-20	37.19	35.48	36.29	36.62	34.46	37.16	37.45	36.01	38.62	36.30	35.55	36.92	38.15	37.11	36.59	
N612-21	37.23	35.84	37.37	37.61	35.47	38.49	38.05	36.86	39.26	37.17	36.72	37.77	38.76	37.91	37.63	
N612-22	38.21	35.36	37.17	37.55	35.48	38.07	37.91	36.69	39.11	36.80	36.74	37.37	38.33	37.62	37.06	
N612-23	37.88	35.48	37.80	38.17	36.07	38.60	38.54	37.12	39.55	37.22	36.31	38.18	39.10	38.26	37.81	
N612-24	37.45	35.61	37.08	37.10	35.29	38.06	37.41	36.80	38.85	36.80	36.61	37.09	38.04	37.49	37.41	
N612-25	37.74	35.71	37.08	37.59	35.22	38.28	38.10	36.53	39.23	37.01	37.13	37.61	38.63	37.68	37.01	
N612-23	38.11	35.42	38.01	38.49	36.36	38.78	38.88	37.29	39.61	37.38	36.19	38.38	39.59	38.59	38.17	
N612-24	37.53	35.59	37.26	37.40	35.58	38.30	37.74	36.96	38.99	36.98	36.56	37.40	38.45	37.78	37.63	
N612-25	37.90	35.61	37.35	37.83	35.41	38.30	38.30	36.62	39.45	37.02	36.86	37.83	38.71	37.81	37.10	
N612-26	37.59	35.42	37.58	37.79	35.48	38.38	38.07	37.16	39.39	37.04	36.72	37.49	38.69	37.90	37.57	
N612-27	37.69	35.60	37.30	37.59	35.51	38.30	37.98	36.81	39.19	37.00	36.69	37.59	38.56	37.79	37.40	
N612-28	37.16	35.47	36.55	37.52	35.62	37.89	37.43	36.99	39.18	36.97	36.25	37.45	38.46	37.31	36.97	
N612-26	37.67	35.53	37.40	37.70	35.46	38.37	38.06	37.03	39.30	37.05	36.67	37.56	38.64	37.85	37.45	
N612-27	37.71	35.69	37.19	37.50	35.54	38.24	37.96	36.61	39.13	37.00	36.68	37.64	38.48	37.77	37.34	
N612-28	37.22	35.50	36.43	37.37	35.61	37.79	37.39	36.74	39.05	36.94	36.22	37.48	38.34	37.30	36.97	
N612-29	37.50	35.35	37.06	37.42	35.23	38.08	37.69									

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	N612-03	40.64	39.90	38.96	35.55	31.54	79.12	38.59	37.70	38.66	42.82	39.22	36.19	38.69	37.94	35.81
	N612-04	41.00	39.94	37.12	35.12	31.24	78.08	37.74	37.89	38.18	42.47	40.35	35.88	38.3	37.82	35.2
	N612-05	39.89	40.22	38.32	35.94	31.22	78.62	38.64	38.14	39.33	42.75	39.38	36.02	38.5	37.73	35.12
	N612-06	39.78	39.58	34.01	35.43	31.69	78.39	38.45	37.71	39.16	42.83	38.40	36.06	38.36	38.12	36.08
	N612-04	40.93	40.01	37.35	35.08	31.27	78.10	37.79	37.94	38.22	42.47	40.18	35.95	38.3	37.85	35.25
	N612-05	39.87	40.20	38.32	35.93	31.23	78.66	38.68	38.12	39.36	42.74	39.27	36.03	38.51	37.74	35.17
	N612-06	39.80	39.47	33.80	35.45	31.68	78.45	38.46	37.61	39.17	42.82	38.35	36.02	38.38	38.11	36.13
	N612-07	40.41	40.00	35.15	36.09	31.63	78.48	38.60	38.24	39.03	43.31	39.84	36.24	38.82	38.05	35.71
	N612-08	39.59	39.99	37.70	35.62	31.54	78.27	38.03	37.76	38.87	42.80	39.58	35.71	37.89	37.77	34.86
	N612-09	40.64	39.78	36.42	34.92	31.08	78.43	38.27	37.77	38.77	42.13	38.74	36.05	38.51	37.88	35.85
	N612-07	40.53	40.10	35.21	36.09	31.58	78.33	38.56	38.13	39.02	43.24	39.71	36.19	38.65	37.93	35.71
	N612-08	39.55	39.94	37.64	35.58	31.54	78.36	38.05	37.76	38.91	42.78	39.51	35.73	37.95	37.82	34.93
	N612-09	40.55	39.65	36.27	34.82	31.08	78.52	38.30	37.82	38.80	42.05	38.58	36.06	38.56	37.91	35.87
	N612-10	40.04	39.92	37.71	35.74	31.51	78.57	38.19	38.13	38.70	42.79	40.27	36.17	38.86	38.26	35.24
	N612-11	40.15	39.94	35.10	35.16	31.24	78.17	38.26	37.27	38.71	43.01	38.99	35.84	38.13	37.72	35.84
	N612-12	40.39	39.88	36.52	35.72	31.50	78.47	38.45	38.35	39.29	42.41	38.86	36.02	38.28	37.76	35.39
	N612-10	40.93	40.85	38.84	36.22	32.81	79.94	39.60	40.72	39.58	43.97	40.10	36.44	39.43	39.32	35.95
	N612-11	40.10	39.70	34.57	35.48	31.44	79.37	38.01	37.39	38.69	42.55	39.76	36.15	38.76	38.07	35.59
	N612-12	40.95	40.38	41.91	35.09	30.86	75.38	38.82	39.24	39.21	42.48	38.16	35.56	37.11	37.03	35.39
	N612-13	39.44	40.16	37.43	35.99	31.90	79.03	38.59	38.23	39.29	43.61	39.43	36.02	38.81	38.41	35.52
	N612-14	40.62	39.66	36.51	35.62	31.41	78.24	38.50	37.75	38.82	42.45	38.76	35.98	38.35	37.87	35.15
	N612-15	40.45	39.90	35.44	35.00	31.00	78.06	37.88	37.76	38.65	42.21	39.71	36	38.13	37.52	35.81
	N612-16	39.81	40.10	35.69	35.34	31.52	77.86	38.48	38.21	39.10	42.61	38.95	35.85	37.9	37.77	35.26
	N612-17	40.72	40.06	33.41	35.53	31.83	79.94	38.80	38.92	39.34	43.48	39.82	36.02	38.53	37.98	37.09
	N612-18	40.78	39.62	37.38	35.75	31.25	79.39	38.00	37.47	38.60	42.85	39.92	36.26	39.29	38.1	35.88
	N612-19	40.44	39.66	36.09	35.63	31.06	77.79	38.32	37.35	38.76	42.75	39.11	35.92	38.42	37.91	35.87
	N612-20	40.43	39.82	36.71	35.44	31.53	78.90	38.27	38.25	38.87	42.58	39.46	36.16	38.18	38.08	34.96
	N612-21	39.73	40.22	36.31	35.43	31.61	78.43	38.33	38.11	39.07	42.77	39.28	35.91	38.55	37.72	35.68
	N612-19	40.53	39.84	36.09	35.66	31.11	77.78	38.57	37.72	38.80	42.71	39.11	36.06	38.39	37.81	35.87
	N612-20	40.50	39.71	36.71	35.47	31.53	78.89	38.07	37.91	38.80	42.57	39.40	36.07	38.19	38.16	34.77
	N612-21	39.60	40.17	36.18	35.39	31.61	78.53	38.19	38.08	39.12	42.83	39.31	35.85	38.61	37.72	35.73
01.10.2020	N612-22	39.88	39.96	37.13	35.85	31.49	79.36	38.95	37.89	39.07	42.96	39.91	36.4	38.5	38.1	36.31
	N612-23	40.56	39.47	38.07	34.42	31.02	77.64	37.73	38.00	38.31	42.03	39.44	35.57	38.21	37.95	35.27
	N612-24	40.20	40.25	34.04	36.32	31.66	78.28	38.33	37.78	39.32	43.14	38.64	36.09	38.48	37.69	35.05
	N612-22	40.00	39.77	36.37	35.59	31.27	78.94	38.74	37.63	38.93	42.62	39.12	36.08	38.34	37.81	35.92
	N612-23	40.55	39.53	38.40	34.50	31.09	77.90	37.76	38.06	38.36	42.31	39.86	35.68	38.12	37.94	35.33
	N612-24	39.93	40.44	33.67	36.57	31.94	78.52	38.55	37.96	39.39	43.10	38.81	36.3	38.76	37.95	35.29
	N612-25	40.42	39.68	38.40	35.58	31.05	78.28	38.05	37.85	39.27	43.32	39.35	35.8	38.41	37.77	35.56
	N612-26	40.58	40.35	36.43	35.39	31.25	78.10	38.52	38.10	39.25	42.82	39.84	36.16	38.42	38.05	35.62
	N612-27	39.70	39.65	34.86	35.49	31.80	78.79	38.31	37.75	38.27	42.07	38.80	36.01	38.35	37.86	35.38
	N612-25	40.63	39.79	38.51	35.63	31.21	78.65	38.12	37.93	39.35	43.30	39.35	35.98	38.56	37.94	35.61
	N612-26	40.47	40.33	36.21	35.37	31.24	77.97	38.49	38.06	39.17	42.73	39.75	36.08	38.36	37.96	35.54
	N612-27	39.44	39.57	34.59	35.47	31.80	78.60	38.26	37.69	38.14	42.05	38.82	35.91	38.29	37.77	35.31
	N612-28	40.73	40.15	34.22	35.73	31.46	78.82	38.53	38.05	38.87	42.66	39.40	36.38	38.35	38.25	35.82
	N612-29	39.69	39.61	36.31	35.29	31.11	77.29	38.46	37.77	39.10	42.46	38.76	35.78	38.18	37.64	35.28
	N612-30	40.32	39.97	38.43	35.51	31.59	79.11	37.95	37.92	38.82	43.05	39.77	35.9	38.67	37.86	35.45
	N612-01	40.78	39.51	37.91	34.98	30.87	78.15	38.04	37.24	38.54	42.62	39.10	35.81	38.18	38.32	36.18
	N612-02	39.90	39.74	35.99	35.43	31.39	77.35	37.90	37.96	38.92	42.98	39.29	36.04	38.35	37.7	35.03
	N612-03	40.54	40.12	36.75	35.60	31.46	79.66	38.78	37.84	38.90	42.42	39.36	35.99	38.49	38.18	36.05
	N612-04	40.11	39.66	37.21	35.20	30.87	77.77	37.98	37.71	38.74	42.56	38.77	35.83	38.16	37.42	35.3
	N612-05	40.35	39.79	36.16	35.79	31.72	78.53	38.44	38.17	38.93	42.77	39.70	35.97	38.48	38.01	35.55
	N612-06	40.12	40.20	35.90	35.50	31.58	78.75	38.43	37.83	39.01	42.78	39.41	36.17	38.53	38.21	35.6
	N612-04	39.88	39.77	36.62	35.01	30.59	77.47	37.82	37.61	38.61	42.24	38.52	35.71	37.97	37.2	35.02
	N612-05	40.40	39.82	36.27	35.90	31.86	78.74	38.57	38.23	39.03	42.92	39.81	36.08	38.58	38.15	35.73
	N612-06	40.25	40.12	36.21	35.56	31.71	78.98	38.48	37.84	39.06	42.91	39.52	36.2	38.62	38.37	35.78
	N612-07	41.07	39.93	35.55	35.55	31.84	78.21	38.37	38.18	38.98	42.76	39.36	35.9	38.66	37.81	35.17
	N612-08	39.53	39.75	39.23	35.64	31.24	78.96	38.59	37.58	38.64	42.85	39.87	36.34	38.22	37.91	35.61
	N612-09	40.10	39.99	34.48	35.30	31.12	77.95	37.94	37.95	39.05	42.48	38.67	35.75	38.32	37.89	35.64
	N612-07	41.34	40.33	35.57	35.64	31.79	78.23	38.38	38.41	38.98	42.51	39.27	35.96	38.58	37.84	35.1
	N612-08	39.32	39.53	39.10	35.64	31.25	79.01	38.53	37.35	38.56	43.04	40.23	36.34	38.32	37.93	35.66
	N612-09	40.02	39.89	34.34	35.33	31.24	78.02	38.02	37.95	39.17	42.64	38.57	35.77	38.32	37.97	35.79
	N612-10	39.82	39.58	38.15	34.99	31.09	78.51	38.29	37.96	39.02	42.48	38.57	35.89	38.37	37.73	35.35
	N612-11	39.98	39.63	35.42	35.07	30.95	77.96	38.05	37.41	38.35	42.20	39.40	35.59	38.22	37.67	35.25
	N612-12	40.95	40.60	35.93	36.61	32.35	78.83	38.65	38.47	39.43	43.54	40.01	36.64	38.67	38.34	35.91
	N612-10	40.66	40.10	39.32	35.58	31.56	78.46	38.81	38.83	39.48	43.41	38.77	36.13	38.34	37.86	35.15
	N612-11	39.96	39.57	34.93	35.06	31.10	78.30	38.18	37.65	38.49	42.40	39.20	35.56	38.19	37.78	35.61
	N612-12	40.22	40.26	35.77	36.40	31.85	78.68	38.01	37.39	39.14	42.49	40.10	36.79	38.98	38.23	35.74
	N612-13	40.02	40.46	36.31	35.04	31.27	78.34	38.14	38.06	38.68	42.67	39.30	35.92	38.1	38.05	35.31
	N612-14	39.90	39.16	36.52	35.45	31.23	77.30	38.24	37.45	38.60	42.74	39.44	35.62	38.15	37.26	35.4
	N612-15	40.66	40.12	36.50	35.92	31.67	79.51	38.53	38.24	39.39	42.72	39.13	36.41	38.88	38.38	35.73

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	N612-03	37.57	35.78	37.04	37.71	35.80	38.35	38.46	37.17	39.34	37.27	37.12	37.78	38.83	37.91	37.80
	N612-04	37.54	35.21	37.47	37.30	35.41	37.99	38.00	36.39	39.04	36.38	36.10	37.26	37.93	37.52	37.18
	N612-05	37.96	35.78	37.31	37.82	35.66	38.70	37.98	36.98	39.29	37.34	37.12	37.79	38.94	38.14	37.31
	N612-06	37.61	35.75	37.18	37.65	35.40	38.20	37.97	36.95	39.24	37.21	36.80	37.70	38.76	37.70	37.57
	N612-04	37.45	35.24	37.56	37.38	35.51	38.02	38.07	36.44	39.11	36.46	36.22	37.33	37.95	37.56	37.18
	N612-05	37.93	35.81	37.28	37.83	35.66	38.70	37.98	37.00	39.28	37.37	37.14	37.80	38.95	38.12	37.32
	N612-06	37.64	35.77	37.03	37.59	35.31	38.16	37.91	36.95	39.14	37.19	36.71	37.64	38.75	37.63	37.57
	N612-07	38.71	35.88	37.47	37.93	35.77	38.75	38.49	37.14	39.96	37.20	37.54	38.07	39.60	38.68	38.15
	N612-08	37.25	35.30	37.14	37.12	35.36	38.11	37.57	36.67	38.90	37.17	36.20	37.54	38.53	37.36	37.18
	N612-09	37.30	35.61	37.33	37.75	35.41	38.11	38.00	36.62	38.87	36.65	36.45	37.27	37.78	37.47	36.94
	N612-07	38.68	35.86	37.26	37.82	35.57	38.65	38.27	37.02	39.73	37.05	37.32	37.86	39.40	38.45	37.87
	N612-08	37.23	35.33	37.18	37.18	35.37	38.15	37.60	36.70	38.93	37.22	36.23	37.59	38.58	37.39	37.23
	N612-09	37.16	35.56	37.46	37.81	35.47	38.11	38.08	36.66	38.94	36.70	36.49	37.30	37.76	37.50	36.98
	N612-10	37.75	36.12	37.40	37.68	36.39	38.15	38.35	37.08	39.23	37.40	37.12	38.05	38.70	38.14	37.92
	N612-11	38.05	35.25	37.00	37.25	35.17	38.38	37.90	36.51	38.91	36.63	36.70	37.23	38.02	37.47	37.10
	N612-12	37.42	35.52	37.50	37.88	35.07	38.40	37.80	36.87	39.52	37.04	36.39	37.61	39.13	37.86	37.25
	N612-10	38.44	36.21	37.68	38.97	37.98	39.02	39.71	38.57	40.09	38.92	38.43	38.90	39.31	39.31	38.80
	N612-11	37.51	35.38	36.82	37.52	35.41	38.28	38.09	36.66	38.87	36.69	36.63	37.24	38.46	37.79	37.77
	N612-12	38.34	36.25	38.40	37.66	35.65	38.07	37.59	37.03	40.22	37.67	36.79	38.23	38.17	37.60	35.86
	N612-13	37.92	35.59	37.68	37.81	35.65	38.71	38.03	36.95	39.16	37.41	36.91	38.21	39.38	38.08	38.06
	N612-14	37.11	35.61	37.31	37.61	35.47	38.15	38.32	36.94	39.18	36.78	36.55	37.40	38.64	37.67	37.24
	N612-15	38.07	35.60	36.97	37.42	35.40	38.11	37.69	36.55	39.24	36.87	36.67	37.29	37.86	37.67	36.98
	N612-16	37.53	35.43	37.48	37.56	35.36	38.36	38.11	36.88	39.41	37.16	36.94	37.45	38.26	37.65	36.92
	N612-17	37.32	36.39	38.25	38.53	35.67	39.29	39.41	37.39	40.24	37.96	36.79	38.35	38.45	38.53	38.13
	N612-18	37.94	35.93	37.00	37.72	35.75	38.24	37.79	36.69	38.90	36.77	36.28	37.85	39.13	38.07	38.21
	N612-19	38.17	35.37	37.50	37.38	35.53	38.01	38.37	36.73	38.97	36.81	36.99	37.46	38.45	37.49	37.19
	N612-20	37.26	35.52	36.93	37.39	35.37	38.38	37.63	36.75	39.21	36.93	36.44	37.87	38.50	37.84	37.38
	N612-21	37.69	35.87	37.50	38.00	35.58	38.50	38.04	36.92	39.42	37.26	36.71	37.46	38.73	38.00	37.51
	N612-19	38.19	35.41	37.71	37.56	35.69	38.13	38.49	36.85	38.97	36.98	37.26	37.67	38.66	37.73	37.15
	N612-20	37.12	35.45	36.73	37.31	35.35	38.28	37.39	36.63	39.27	36.82	36.17	37.69	38.22	37.65	37.32
	N612-21	37.67	35.92	37.39	37.86	35.46	38.43	38.02	36.89	39.30	37.14	36.57	37.39	38.80	37.93	37.58
01.10.2020	N612-22	38.20	35.80	37.53	37.98	35.39	38.97	38.59	36.98	39.79	37.43	37.24	38.24	38.94	38.37	38.06
	N612-23	37.81	35.59	37.19	37.74	35.56	37.87	37.77	36.79	39.08	36.83	36.41	37.00	38.16	37.37	37.46
	N612-24	37.21	35.40	37.23	37.13	35.55	38.13	37.74	36.65	38.79	36.79	36.56	37.67	38.65	37.69	36.71
	N612-22	37.90	35.53	37.33	37.48	34.85	38.50	38.18	36.38	39.31	37.18	36.54	37.52	38.16	37.69	37.82
	N612-23	37.58	35.57	36.97	37.75	35.78	37.90	37.68	36.92	39.32	36.74	36.61	37.13	38.53	37.47	37.33
	N612-24	37.63	35.65	37.58	37.55	35.78	38.57	38.15	37.07	39.02	37.12	37.01	38.17	38.88	38.27	37.07
	N612-25	37.64	35.69	37.53	37.33	35.52	38.14	38.22	36.54	38.79	36.77	36.07	37.74	39.01	37.41	37.04
	N612-26	38.15	35.90	37.55	38.09	35.62	38.54	38.07	37.17	39.51	37.63	37.12	37.80	38.97	38.21	37.82
	N612-27	37.36	35.25	36.88	37.39	35.34	38.21	37.76	36.66	39.28	36.64	36.83	37.28	37.84	37.70	37.31
	N612-25	37.75	35.78	37.61	37.43	35.65	38.22	38.36	36.65	38.85	36.85	36.24	37.83	39.20	37.57	37.22
	N612-26	38.05	35.83	37.45	38.04	35.53	38.47	37.96	37.13	39.46	37.56	37.11	37.71	38.77	38.15	37.73
	N612-27	37.24	35.19	36.82	37.37	35.27	38.16	37.63	36.62	39.26	36.62	36.80	37.20	37.62	37.65	37.21
	N612-28	38.08	35.58	37.12	37.50	36.06	38.77	38.23	36.99	39.69	37.02	36.67	37.94	39.09	37.97	37.35
	N612-29	37.60	35.36	37.51	37.41	34.95	38.17	37.77	36.62	39.16	36.72	36.55	37.56	38.82	37.62	37.31
	N612-30	37.51	35.89	37.32	37.88	35.58	38.03	38.07	36.81	38.80	37.27	36.82	37.39	38.02	37.79	37.47
	N612-01	37.98	35.46	37.78	37.65	35.97	38.47	38.40	36.68	40.06	36.99	36.76	37.67	38.73	37.39	37.32
	N612-02	37.45	35.61	36.88	37.42	35.39	37.99	37.56	36.35	39.26	36.74	36.56	37.40	38.45	37.18	37.07
	N612-03	37.95	35.61	37.74	37.83	35.66	38.68	38.53	37.33	39.11	37.33	36.88	37.84	38.76	38.53	37.82
	N612-04	37.66	35.52	37.25	37.34	35.09	37.96	37.72	36.58	39.45	36.71	36.42	37.40	38.05	37.47	36.67
	N612-05	38.07	35.55	37.64	37.65	35.66	38.42	37.92	36.80	39.04	36.96	36.90	37.79	38.85	37.76	37.60
	N612-06	37.39	35.71	37.01	37.77	35.71	38.46	38.28	36.96	39.14	37.27	36.75	37.58	38.77	38.05	37.79
	N612-04	37.50	35.42	37.24	37.30	34.97	37.80	37.63	36.41	39.24	36.68	36.25	37.32	37.67	37.35	36.45
	N612-05	38.18	35.62	37.66	37.71	35.73	38.55	38.00	36.91	39.17	37.03	37.03	37.88	39.09	37.87	37.79
	N612-06	37.39	35.73	36.93	37.75	35.75	38.52	38.31	37.02	39.19	37.27	36.76	37.55	38.91	38.08	37.91
	N612-07	37.73	35.74	37.66	37.85	35.91	38.51	38.40	37.18	39.10	37.30	36.96	37.92	38.92	38.30	37.42
	N612-08	37.97	35.82	37.56	37.60	35.32	38.41	37.96	36.82	39.42	36.74	36.72	37.56	38.47	37.82	37.49
	N612-09	37.44	35.27	36.80	37.37	35.28	37.98	37.66	36.44	39.08	36.95	36.43	37.36	38.29	37.31	37.15
	N612-07	37.75	35.67	37.66	37.79	35.91	38.58	38.42	37.11	39.09	37.32	36.85	37.87	38.47	38.16	37.22
	N612-08	37.88	35.87	37.52	37.65	35.36	38.35	37.76	36.73	39.24	36.70	36.82	37.55	38.76	37.79	37.53
	N612-09	37.51	35.34	36.84	37.37	35.31	38.04	37.84	36.60	39.32	37.02	36.49	37.42	38.55	37.48	37.44
	N612-10	37.40	35.31	36.64	37.65	35.16	38.12	38.01	36.73	39.10	36.85	36.26	37.50	38.70	37.72	37.36
	N612-11	37.93	35.31	37.14	37.42	35.15	37.84	37.59	36.36	38.74	36.55	36.77	37.17	37.54	37.33	36.90
	N612-12	37.76	36.29	38.28	37.80	36.34	39.11	38.53	37.46	39.85	37.73	37.10	38.27	39.73	38.48	37.97
	N612-10	38.08	35.49	37.03	38.16	35.52	38.63	38.61	37.42	39.68	37.50	36.75	37.89	39.09	38.31	37.64
	N612-11	37.93	35.23	36.88	37.21	35.11	38.05	37.61	36.62	38.87	36.49	36.80	37.27	37.84	37.43	37.08
	N612-12	36.89	36.45	38.50	37.69	36.24	38.48	38.08	36.50	39.41	37.44	36.50	37.93	39.39	37.95	37.73
	N612-13	37.61	35.60	36.89	37.85	35.68	38.12	38.30	36.79	39.05	36.85	36.58	37.69	38.76	37.83	37.14
	N612-14	37.57	35.64	37.68	37.49	35.23	37.96	37.38	36.55	38.58	37.19	36.58	37.28	38.52	37.36	37.28
	N612-15	37.94	35.53	37.25	37.51	35.57	38.78	38.35	37.08	39.95	36.96	36.92	37.82	38.44	38.18	37.67

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.10.2020	N612-16	40.34	39.90	36.30	35.71	31.68	78.45	38.32	38.16	38.81	42.62	39.56	35.7	38.35	37.85	35.77
	N612-17	40.59	39.83	35.29	35.41	31.34	78.46	38.16	37.98	38.81	43.14	39.51	36.18	38.34	37.57	35.58
	N612-18	39.65	39.95	37.80	35.36	31.16	78.26	38.52	37.59	39.14	42.37	38.77	36.14	38.52	38.33	35.09
	N612-19	40.17	40.15	36.11	35.41	31.34	78.32	37.72	37.32	38.73	42.51	40.08	36.14	38.37	37.77	35.66
	N612-20	39.85	39.65	36.45	35.79	31.36	78.85	38.36	38.15	38.83	42.47	38.01	35.93	38.44	38.11	35.58
	N612-21	40.66	39.92	36.51	35.31	31.53	78.01	38.82	38.27	39.12	43.16	40.04	35.9	38.38	37.77	35.3
	N612-19	40.31	40.33	36.23	35.47	31.44	78.36	37.86	37.37	38.80	42.66	40.13	36.22	38.31	37.75	35.49
	N612-20	39.93	39.67	36.30	35.74	31.33	78.53	38.37	38.16	38.78	42.52	37.86	35.88	38.33	37.97	35.43
	N612-21	40.46	39.63	36.73	35.23	31.41	78.26	38.76	38.21	39.15	42.92	39.96	35.88	38.55	37.96	35.61
	N612-22	39.59	40.15	36.26	35.79	31.62	78.66	38.15	38.08	38.92	42.91	39.74	36.02	38.64	38.15	35.27
	N612-23	41.03	40.28	35.95	35.66	31.42	77.66	38.56	38.52	39.62	43.21	39.83	36.62	38.59	37.95	36.1
	N612-24	40.70	39.73	36.48	35.27	31.22	78.19	38.37	37.70	38.86	42.51	38.95	36	38.18	37.68	35.69
	N612-22	39.37	40.06	36.54	35.72	31.60	78.86	38.11	37.96	38.76	42.76	39.58	35.85	38.57	38.09	35.1
	N612-23	40.83	40.10	36.10	35.57	31.38	77.83	38.49	38.31	39.39	43.03	39.62	36.41	38.5	37.91	35.95
	N612-24	40.54	39.48	36.52	35.16	31.15	78.35	38.27	37.40	38.58	42.30	38.69	35.75	38.08	37.66	35.47
	N612-25	39.71	40.29	36.65	35.73	31.44	78.78	38.48	38.03	38.80	42.80	39.44	36.1	38.35	37.8	35.67
	N612-26	41.01	39.80	36.00	35.50	32.06	79.14	38.87	38.42	39.39	42.83	39.02	36.24	39.06	38.54	35.77
	N612-27	39.83	39.70	36.54	35.34	30.82	77.46	37.64	37.37	38.55	42.52	39.50	35.71	37.89	37.45	35.09
	N612-25	40.13	39.95	36.40	35.44	31.48	78.60	38.51	38.06	38.93	42.69	39.04	36.01	38.48	37.95	35.72
	N612-26	41.52	39.82	35.85	35.65	32.53	79.76	39.32	38.78	39.68	42.99	39.05	36.47	39.46	38.96	35.95
	N612-27	40.28	39.81	36.42	35.56	31.28	78.14	38.04	37.70	38.86	42.69	39.63	35.96	38.27	37.85	35.23
	N612-28	40.27	40.19	36.18	35.66	31.66	78.60	38.37	37.90	38.95	43.00	39.31	36.29	38.75	37.71	35.58
	N612-29	40.12	39.64	36.61	35.34	31.16	78.25	38.27	37.92	38.86	42.41	39.24	35.73	38.09	38.09	35.46
	N612-01	41.28	39.86	36.61	35.00	31.46	78.31	38.58	38.35	38.79	42.31	39.61	35.89	38.25	38.18	35.67
	N612-02	39.28	40.26	37.82	35.76	31.44	79.14	38.35	38.00	39.17	43.31	39.50	36.25	38.44	37.83	35.85
	N612-03	40.09	39.62	34.86	35.75	31.30	77.81	38.00	37.38	38.76	42.49	38.77	35.88	38.51	37.71	35.01
	N612-04	40.27	39.63	34.67	35.38	31.62	77.84	38.08	37.99	38.73	42.96	40.08	35.87	38.45	37.75	35.28
	N612-05	40.22	40.18	38.13	35.55	31.20	79.01	38.57	37.89	39.08	42.44	38.63	36.13	38.33	38.09	35.78
	N612-06	39.83	40.16	37.39	35.71	31.79	78.32	38.83	38.79	39.56	42.54	38.65	36.06	38.23	37.63	36.57
	N612-04	40.35	39.86	35.02	35.40	31.75	78.20	38.24	38.06	38.95	43.13	39.95	35.99	38.53	37.88	35.49
	N612-05	40.01	39.95	38.04	35.63	30.88	78.69	38.40	37.65	38.80	42.06	38.33	36.02	38.17	37.91	35.51
	N612-06	40.22	40.22	37.20	35.78	31.92	78.63	39.14	38.95	39.81	42.81	38.66	36.27	38.36	37.9	36.8
	N612-07	39.86	39.96	37.25	35.85	31.46	78.59	38.29	37.91	39.15	42.70	39.42	36	38.69	38.08	35.46
	N612-08	40.51	39.84	35.58	35.19	31.37	78.22	38.31	37.90	38.68	42.73	39.23	36	38.16	37.75	35.54
	N612-09	40.59	39.90	35.97	35.28	32.14	80.19	39.26	38.56	39.26	42.32	39.31	36.35	38.98	38.63	36.46
	N612-07	39.92	39.95	37.05	35.68	31.29	78.19	38.24	37.92	39.20	42.63	39.32	35.91	38.55	37.95	35.4
	N612-08	40.52	39.90	35.99	35.27	31.51	78.43	38.35	37.90	38.59	42.81	39.31	36.08	38.19	37.79	35.54
	N612-09	40.59	39.73	36.15	35.04	31.99	79.79	38.99	38.37	39.23	42.35	39.26	36.21	38.79	38.41	36.42
	N612-10	39.94	39.52	33.63	35.83	31.40	79.41	38.19	37.63	38.87	42.48	38.70	36.02	38.56	37.92	35.78
	N612-11	40.25	39.86	37.38	35.46	31.60	79.41	38.64	38.10	38.91	42.65	40.11	36.23	38.89	38.67	36.06
	N612-12	40.38	40.32	38.06	35.24	31.19	76.43	38.05	37.96	38.94	42.96	39.06	35.73	37.76	37.12	34.66
	N612-10	39.95	39.77	34.03	36.04	31.53	79.49	38.22	37.63	39.05	42.91	39.02	36.25	38.56	38	35.75
	N612-11	40.31	39.83	37.64	35.27	31.45	78.50	38.63	38.04	38.80	42.53	39.77	35.96	38.31	38.18	35.75
	N612-12	40.38	40.12	37.80	35.13	31.20	77.13	38.09	38.07	38.83	42.62	39.18	35.76	38.3	37.53	34.99
	N612-13	40.17	39.87	36.09	35.57	31.43	78.59	38.31	37.87	38.92	42.72	39.29	36.04	38.42	37.94	35.56
	N612-14	39.30	39.07	37.39	34.95	30.82	78.33	38.31	37.87	38.27	41.40	39.13	36.03	38.22	37.9	36.25
	N612-15	40.09	39.87	36.44	35.65	31.77	79.14	38.07	37.80	38.59	42.88	39.58	36.36	38.76	38.36	35.47
	N612-16	40.34	39.93	36.32	35.34	31.02	77.64	38.55	38.04	39.27	42.53	38.95	35.61	38.04	37.43	35.55
N612-17	41.79	40.05	35.76	35.73	31.40	79.52	38.58	38.18	39.37	42.56	39.36	36.22	38.68	37.95	35.76	
N612-18	40.22	39.66	36.89	35.43	31.07	78.25	38.44	37.81	38.56	42.51	39.50	36.02	38.17	37.62	35.24	
N612-19	39.79	40.42	36.38	35.77	31.71	78.35	38.18	37.53	39.13	42.64	39.86	36.25	38.45	38.21	35.68	
N612-20	40.60	39.60	35.97	35.30	31.42	78.64	38.28	38.38	38.99	42.96	38.57	35.75	38.59	37.88	35.57	
N612-26	40.47	40.29	37.65	35.29	31.17	78.61	38.54	37.95	39.28	42.89	39.42	36.42	38.58	38.07	35.42	
N612-27	39.82	39.45	35.30	35.63	31.69	77.89	38.14	37.56	38.47	42.47	39.38	35.71	38.2	37.75	35.63	
N612-28	40.18	39.89	36.03	35.64	31.33	78.64	38.14	38.18	38.91	42.70	39.02	35.77	38.36	37.8	35.38	
N612-29	41.53	40.45	36.32	35.17	31.89	78.83	38.88	38.56	39.13	42.78	39.89	36.61	38.82	38.12	35.9	
N612-30	39.60	39.70	37.52	35.72	30.92	78.72	38.09	37.33	38.84	42.97	39.05	35.95	38.35	38.34	35.71	
N612-31	39.74	39.67	35.44	35.54	31.46	77.73	38.06	37.91	38.79	42.39	39.08	35.59	38.12	37.32	34.97	
N612-01	41.06	40.90	35.25	35.22	31.18	77.42	39.37	38.81	39.26	42.67	39.07	36.35	37.51	38.14	36.03	
N612-02	39.57	39.89	34.63	35.33	31.13	77.43	38.53	38.07	38.90	42.28	39.46	36.12	38.2	37.61	35.77	
N612-03	40.86	39.92	38.41	35.67	31.70	79.52	38.05	37.73	38.92	43.17	39.14	35.87	38.63	38.22	35.21	
N612-04	39.92	40.57	37.26	35.89	31.66	78.05	38.47	37.91	39.00	42.77	39.35	35.95	38.1	37.85	36.09	
N612-05	40.92	39.83	35.62	35.69	31.43	78.21	38.34	37.77	38.64	42.70	39.08	36.01	38.22	37.98	35.56	
N612-06	39.52	39.96	36.95	35.32	31.35	78.51	38.28	38.04	39.15	42.67	39.52	36	38.55	37.81	35.47	
N612-04	39.71	40.72	37.52	36.21	31.87	78.30	38.43	37.88	39.08	42.93	39.56	36.19	38.27	37.97	35.99	
N612-05	40.87	39.93	35.84	35.72	31.45	78.18	38.31	37.72	38.65	42.81	39.11	35.94	38.17	37.9	35.5	
N612-06																

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Hol65	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.10.2020	N612-16	37.92	36.01	36.93	37.41	34.59	38.07	37.86	36.77	39.12	36.90	36.66	37.48	38.19	37.53	37.17
	N612-17	37.70	35.46	37.51	37.65	36.30	38.48	38.19	36.91	39.44	37.02	36.58	37.66	38.90	37.89	37.39
	N612-18	37.50	35.28	37.51	37.80	35.74	38.39	38.00	36.74	38.98	37.13	36.95	37.72	38.63	37.97	37.65
	N612-19	37.42	35.49	37.46	37.55	35.36	38.15	37.73	36.78	39.49	36.98	36.42	37.36	38.66	37.87	37.08
	N612-20	37.67	35.90	36.74	37.34	35.70	38.35	37.94	36.55	39.34	36.70	36.45	37.43	38.83	38.00	37.63
	N612-21	38.05	35.45	37.72	37.91	35.34	38.37	38.32	37.09	38.78	37.34	37.24	38.01	38.18	37.45	37.39
	N612-19	37.49	35.44	37.56	37.72	35.58	38.28	37.91	36.83	39.55	37.14	36.69	37.57	38.83	37.94	37.10
	N612-20	37.69	35.79	36.78	37.34	35.79	38.31	37.91	36.52	39.32	36.73	36.45	37.47	38.82	38.00	37.46
	N612-21	37.97	35.53	37.65	37.74	35.11	38.29	38.21	37.06	38.61	37.13	36.99	37.76	37.97	37.33	37.58
	N612-22	37.58	35.89	36.89	37.67	35.45	38.47	37.91	36.94	39.76	37.05	36.70	37.78	38.85	38.29	37.60
	N612-23	38.16	36.04	38.70	38.26	36.85	38.99	37.83	37.19	39.91	37.78	36.91	38.33	39.11	38.35	37.24
	N612-24	37.77	35.35	37.65	37.54	35.58	38.16	38.06	36.67	38.80	36.96	36.68	37.44	38.40	37.42	37.16
	N612-22	37.46	35.76	36.57	37.48	35.14	38.26	37.97	36.82	39.46	36.86	36.58	37.54	38.59	38.07	37.59
	N612-23	38.02	35.87	38.26	38.02	36.42	38.74	37.87	37.06	39.61	37.53	36.82	38.07	38.91	38.09	37.27
	N612-24	37.62	35.16	37.12	37.26	35.05	37.88	38.09	36.53	38.51	36.66	36.63	37.18	38.25	37.13	37.24
	N612-25	37.48	35.58	37.85	37.97	35.22	38.46	38.26	36.57	39.23	36.78	37.38	37.68	38.17	38.11	37.22
	N612-26	38.59	35.81	37.91	37.98	35.98	38.66	38.55	37.40	39.52	37.41	36.63	38.09	39.03	38.24	38.07
	N612-27	37.08	35.47	36.28	36.97	35.31	37.87	37.29	36.48	38.94	36.83	36.20	37.13	38.52	37.19	36.93
	N612-25	37.85	35.70	37.86	37.91	35.27	38.37	38.23	36.75	39.27	36.91	37.10	37.62	38.30	38.00	37.47
	N612-26	39.06	35.84	38.26	38.22	36.42	38.97	39.02	37.84	39.70	37.68	36.65	38.52	39.44	38.58	38.52
	N612-27	37.53	35.48	36.58	37.21	35.79	38.18	37.74	36.88	39.10	37.10	36.22	37.56	38.89	37.53	37.27
	N612-28	37.53	35.63	37.98	37.82	35.50	38.65	37.85	36.59	39.40	37.15	36.77	37.67	38.81	37.89	37.34
	N612-29	37.90	35.59	36.77	37.44	35.46	37.98	38.19	37.00	39.02	36.84	36.71	37.53	38.29	37.74	37.44
	N612-01	37.70	35.58	37.59	37.40	35.56	38.56	38.37	37.34	39.62	37.17	36.74	37.72	38.30	37.91	37.28
	N612-02	37.93	35.96	37.35	38.02	35.23	38.66	37.88	36.86	38.97	37.24	36.93	37.86	38.69	37.91	37.53
	N612-03	37.46	35.29	36.95	37.39	35.70	37.72	37.78	36.25	39.02	36.59	36.41	37.22	38.72	37.56	37.33
	N612-04	37.87	35.42	37.63	37.67	35.77	38.18	37.79	36.73	39.21	37.22	37.09	37.94	38.66	37.83	37.37
	N612-05	37.56	35.80	37.04	37.54	35.23	38.49	38.25	36.97	39.24	36.84	36.36	37.32	38.45	37.78	37.39
	N612-06	37.52	35.02	37.47	38.07	35.99	38.42	38.02	37.04	38.91	37.07	37.08	37.42	38.46	37.77	37.40
	N612-04	37.95	35.57	37.75	37.66	35.66	38.30	37.88	36.78	39.26	37.21	36.99	37.90	38.72	37.89	37.47
	N612-05	37.33	35.65	36.66	37.52	35.23	38.28	38.17	36.87	39.10	36.70	36.24	37.14	38.33	37.65	37.25
	N612-06	37.82	35.29	37.74	38.10	35.94	38.69	38.36	37.25	39.06	37.29	37.28	37.61	38.78	38.10	37.69
	N612-07	37.62	35.62	36.83	37.48	35.88	38.57	38.18	36.41	39.29	36.84	37.00	37.79	38.76	37.68	37.28
	N612-08	37.79	35.58	37.76	37.71	35.18	38.07	37.83	37.16	39.12	37.15	36.46	37.45	38.41	37.89	37.48
	N612-09	37.90	35.33	37.81	37.67	35.30	38.75	39.14	37.99	39.85	37.11	36.94	38.14	38.18	37.89	38.00
	N612-07	37.79	35.68	36.84	37.34	35.71	38.39	38.06	36.46	39.43	36.86	36.85	37.68	38.65	37.51	37.10
	N612-08	37.63	35.48	37.76	37.88	35.26	38.18	37.90	37.18	38.96	37.17	36.58	37.49	38.45	38.08	37.61
	N612-09	38.01	35.34	37.59	37.50	35.10	38.44	38.75	37.88	39.91	37.01	36.58	37.81	38.07	37.61	37.85
	N612-10	37.29	35.81	37.63	37.37	35.31	38.15	37.98	36.58	39.02	36.75	36.27	37.63	38.75	37.64	37.76
	N612-11	38.10	35.61	37.28	38.19	36.15	39.02	38.61	37.16	39.58	37.28	36.95	37.94	38.72	38.40	37.83
	N612-12	37.69	35.39	36.97	37.22	35.04	37.72	37.40	36.63	39.00	36.94	36.89	37.23	38.25	37.29	36.55
	N612-10	37.42	35.91	37.69	37.74	35.59	38.31	37.99	36.58	39.04	36.89	36.66	37.84	38.93	37.72	37.70
	N612-11	37.83	35.33	37.02	37.64	35.80	38.46	38.37	37.05	39.33	37.32	36.80	37.59	38.48	37.97	37.45
	N612-12	37.89	35.51	37.13	37.41	35.12	38.14	37.67	36.82	39.26	36.83	36.65	37.34	38.26	37.70	36.97
	N612-13	37.66	35.63	37.34	37.63	35.54	38.31	38.03	36.78	39.18	37.00	36.70	37.64	38.62	37.79	37.44
	N612-14	36.98	35.61	37.79	36.97	35.28	37.74	38.33	36.90	39.57	36.96	36.47	37.06	38.30	37.68	37.48
	N612-15	37.46	35.76	37.79	37.73	35.51	38.53	38.05	36.71	39.38	36.94	36.84	37.85	38.76	37.89	37.52
	N612-16	38.04	35.47	36.79	37.48	35.54	38.07	37.99	36.93	39.00	37.10	36.57	37.33	38.38	37.71	37.22
N612-17	38.34	35.52	38.20	37.61	37.01	38.48	38.48	37.08	39.34	37.46	37.67	38.36	38.72	38.27	37.60	
N612-18	36.72	35.15	37.22	37.33	35.22	38.13	37.44	36.53	39.16	36.69	36.65	37.62	38.47	37.52	37.30	
N612-19	38.14	35.69	37.09	37.65	35.19	38.43	38.23	36.82	39.45	37.03	36.40	37.59	38.58	37.88	37.62	
N612-20	38.22	35.96	37.63	37.81	36.10	38.35	38.32	37.04	38.99	37.27	37.07	37.60	38.67	37.96	37.22	
N612-26	37.97	35.73	37.46	37.66	35.87	38.67	38.32	36.83	39.45	37.46	37.47	37.92	38.97	38.33	37.51	
N612-27	37.59	35.69	37.24	37.66	35.68	38.05	37.82	36.79	38.90	36.36	35.73	37.07	38.05	37.50	37.22	
N612-28	37.44	35.28	37.17	37.39	34.82	38.06	37.77	36.70	39.16	37.11	36.81	37.75	38.66	37.40	37.35	
N612-29	38.31	36.03	37.44	38.25	35.76	38.93	38.42	37.25	39.92	37.62	37.42	38.00	38.70	38.41	37.64	
N612-30	37.58	35.86	37.37	37.55	35.98	38.42	38.11	37.02	39.08	37.03	36.76	37.85	38.62	37.85	37.70	
N612-31	37.35	35.03	37.14	37.14	34.91	37.71	37.58	36.23	38.75	36.49	36.10	37.04	38.43	37.29	36.87	
N612-01	39.73	35.98	37.00	37.50	36.03	38.53	39.09	37.08	40.14	38.08	36.67	38.12	37.60	37.31	37.02	
N612-02	37.85	35.18	37.74	37.68	35.76	38.35	38.24	37.11	40.03	37.14	36.93	37.93	38.24	37.78	37.22	
N612-03	37.57	36.06	36.84	37.51	35.22	38.24	37.74	36.48	38.32	36.85	36.48	37.24	38.92	37.81	37.56	
N612-04	37.89	35.67	36.99	38.25	35.89	38.49	37.62	37.00	39.65	37.61	37.07	38.19	38.61	38.12	37.41	
N612-05	37.21	35.83	37.10	37.62	35.51	38.32	38.12	36.62	39.36	37.04	36.34	37.73	38.84	37.75	37.26	
N612-06	38.18	35.36	37.52	37.59	35.51	38.28	37.91	36.99	39.12	36.97	37.06	37.51	38.30	37.83	37.48	
N612-04	37.73	35.73	37.31	38.47	36.08	38.59	37.54	37.02	39.65	37.63	37.14	38.28	38.87	38.23	37.35	
N612-05	37.18	35.85	37.13	37.65	35.52	38.29	38.05									

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.10.2020	N612-07	40.49	39.88	37.04	35.69	31.28	78.29	38.17	38.12	38.86	42.58	39.57	35.79	38.33	38.04	35.54
	N612-08	39.86	39.90	35.69	35.32	31.52	78.53	38.43	37.67	38.94	42.80	39.01	36.23	38.48	37.75	35.47
	N612-09	40.31	40.37	36.80	35.84	31.90	79.05	38.73	38.24	38.95	42.92	39.05	36.33	38.62	38.09	36.56
	N612-10	41.40	40.05	35.55	35.67	31.55	77.76	38.17	37.82	39.46	42.25	39.26	36.09	38.2	37.95	36.24
	N612-11	40.61	40.12	36.37	35.26	31.65	78.31	38.38	38.01	38.96	43.04	39.29	35.93	38.27	37.89	35.38
	N612-12	39.84	39.70	36.47	35.73	31.17	78.48	38.22	37.81	38.84	42.40	39.32	36.05	38.52	37.92	35.61
	N612-10	39.83	40.43	35.04	35.89	31.30	77.99	38.91	38.60	39.20	43.21	39.12	36.09	38.67	38.14	35.76
	N612-11	40.47	41.03	36.27	36.56	31.99	79.16	39.19	38.74	39.56	43.64	39.32	36.8	38.96	38.25	36.65
	N612-13	40.52	39.36	36.94	35.22	31.44	78.71	37.92	37.39	38.34	42.28	39.88	35.81	38.12	37.98	35.53
	N612-14	40.21	39.99	37.12	35.45	31.45	78.45	38.16	37.81	39.21	42.69	38.88	36.11	38.45	37.61	35.24
	N612-16	41.24	41.12	34.84	36.69	31.95	80.01	39.57	38.35	38.80	42.68	39.79	36.5	38.81	38.95	36.04
	N612-17	40.43	40.04	36.18	35.73	31.99	79.18	38.66	37.87	39.33	42.99	39.91	36.34	38.74	38.05	35.37
	N612-18	39.96	39.76	36.68	35.26	30.83	77.62	37.93	37.89	38.47	42.43	38.68	35.68	38.07	37.76	35.67
	N612-19	40.30	39.90	35.45	35.53	31.12	78.33	38.41	38.44	38.80	42.42	39.40	35.64	38.25	37.75	35.04
	N612-20	40.12	39.91	37.28	35.48	31.73	78.53	38.22	37.39	39.03	43.00	39.25	36.38	38.58	38.06	35.95
	N612-21	38.97	39.84	38.07	35.36	31.62	78.98	38.29	38.04	38.72	43.08	38.94	35.96	38.79	37.31	36.35
	N612-19	40.40	40.02	35.87	35.73	31.47	78.70	38.61	38.40	38.83	42.63	39.58	35.94	38.57	37.96	35.4
	N612-20	40.01	39.73	37.01	35.20	31.31	78.03	37.90	37.26	39.00	42.78	38.93	36.08	38.21	37.85	35.62
	N612-21	39.88	40.46	38.25	36.06	32.10	78.64	38.44	38.21	39.23	43.56	39.37	36.36	39.13	37.53	36.56
	N612-22	39.44	40.19	36.40	35.60	31.43	78.25	38.39	38.20	38.86	42.74	39.45	35.98	38.02	37.47	35.6
	N612-23	40.93	39.64	36.36	35.42	31.38	78.56	38.24	37.66	38.93	42.65	39.18	36.02	38.77	38.32	35.4
	N612-24	41.60	40.51	38.71	35.80	31.26	77.70	38.31	38.08	39.20	43.32	38.35	35.68	37.66	38	36.23
	N612-22	39.43	40.47	36.15	35.98	31.64	78.43	38.60	38.32	38.96	42.99	39.70	36.26	38.33	37.54	35.63
	N612-23	40.79	39.88	36.17	35.75	31.62	78.86	38.43	37.74	39.02	42.86	39.48	36.35	39.14	38.37	35.39
N612-24	40.83	39.03	37.26	34.31	30.67	77.76	37.60	37.46	38.58	41.89	38.37	35.01	37.43	37.84	35.51	
N612-25	39.28	39.85	37.07	35.77	31.37	77.97	38.40	37.77	39.10	43.32	38.87	36.28	38.29	37.79	35.31	
N612-26	40.35	39.54	33.56	35.04	31.22	78.07	37.99	37.88	38.71	42.00	39.99	35.48	38.22	37.73	35.49	
N612-27	40.76	40.37	38.20	35.80	31.65	79.11	38.56	38.09	38.92	42.89	39.15	36.32	38.7	38.13	35.69	
N612-25	39.59	39.91	37.92	36.14	31.83	79.26	38.69	37.97	38.91	42.64	38.65	36.57	38.7	38.15	35.35	
N612-26	40.87	39.89	34.69	34.86	30.97	77.52	37.90	37.83	38.89	42.76	40.01	35.43	38.09	37.64	35.66	
N612-27	40.93	40.33	39.31	35.87	31.54	79.45	38.45	38.14	38.84	42.71	38.70	36.22	38.69	38.18	35.94	
N612-28	38.92	39.30	36.52	35.02	31.03	78.37	38.22	38.14	38.84	42.06	40.66	35.85	38.38	38.01	36.29	
N612-29	40.16	39.90	36.50	35.54	31.43	78.45	38.32	37.90	38.90	42.70	39.26	36.04	38.42	37.92	35.49	
N612-27	40.47	40.07	35.82	35.51	31.28	77.88	38.29	37.79	38.76	43.23	39.09	35.65	38.17	38.12	35.61	
01.11.2020	N612-01	40.31	39.30	34.51	35.70	31.33	78.76	38.25	37.52	38.55	42.58	39.18	36.1	38.53	37.83	35.61
	N612-02	40.53	40.30	36.20	35.33	31.56	78.64	38.30	38.29	39.03	42.94	39.82	35.96	38.38	38	35.41
	N612-03	39.65	40.14	38.75	35.46	31.28	77.67	38.36	37.87	39.17	42.58	38.82	35.89	38.24	37.85	35.5
	N612-04	39.90	39.73	37.40	35.50	31.35	79.40	38.39	37.97	39.01	42.48	39.43	35.67	38.62	38.22	35.95
	N612-05	40.52	39.74	36.39	35.73	31.46	78.65	38.49	37.91	38.63	42.38	39.24	36.44	38.7	38.08	35.33
	N612-06	39.95	40.00	36.12	35.31	31.35	78.24	38.12	37.87	39.11	43.00	39.38	35.62	38.15	37.73	35.66
	N612-04	40.11	40.01	37.20	35.48	31.55	79.44	38.63	38.09	39.09	42.63	39.64	35.49	38.61	38.26	36.01
	N612-05	40.50	39.81	36.42	35.70	31.46	78.58	38.46	37.90	38.67	42.40	39.25	36.37	38.69	38.09	35.33
	N612-06	39.84	40.02	36.24	35.29	31.34	78.17	38.13	37.89	39.15	43.05	39.34	35.6	38.1	37.71	35.7
	N612-07	40.68	39.61	38.37	35.51	31.37	78.91	38.30	38.05	38.93	42.38	39.54	36.13	38.34	37.77	35.22
	N612-08	39.79	40.16	34.76	35.51	31.44	77.96	38.31	37.77	38.85	42.98	39.08	35.91	38.48	38.04	35.75
	N612-09	39.42	40.81	37.50	35.65	30.99	77.70	38.48	38.37	38.77	42.82	39.90	36.29	37.97	37.59	36.31
	N612-07	40.80	39.43	38.40	35.58	31.51	79.20	38.22	37.86	38.94	42.43	39.43	36.1	38.49	37.88	35.08
	N612-08	40.04	39.94	34.53	35.54	31.62	78.25	38.23	37.60	38.89	43.04	38.98	35.87	38.64	38.17	35.54
	N612-09	39.78	40.47	36.39	35.34	30.99	77.42	38.44	38.32	38.76	42.63	39.62	36.02	37.94	37.51	36.04
	N612-10	39.35	40.10	36.24	35.55	31.35	79.19	38.52	38.16	39.56	42.57	39.09	36.15	38.77	38.3	35.42
	N612-11	39.79	39.97	36.25	35.38	31.28	78.01	38.53	37.75	38.77	43.02	38.84	35.9	38.06	37.86	35.71
	N612-12	41.43	39.61	36.79	35.57	31.58	78.17	37.91	37.78	38.47	42.53	39.88	35.97	38.42	37.62	35.33
	N612-10	39.94	40.24	36.11	35.73	31.56	79.00	38.71	38.32	39.56	43.05	38.96	36.18	38.68	38.31	35.48
	N612-11	39.91	39.81	35.77	35.11	31.01	77.81	38.44	37.44	38.53	43.09	38.79	35.77	37.93	37.94	35.99
	N612-12	40.50	39.52	36.79	35.25	31.23	77.79	37.90	37.50	38.24	42.34	39.60	35.82	38.14	37.48	35.54
	N612-13	40.05	40.24	35.38	35.60	31.44	78.41	38.09	37.61	38.99	42.76	40.00	35.92	38.05	37.91	35.32
	N612-14	40.31	39.63	37.31	35.44	31.38	78.47	38.56	38.24	38.90	42.69	38.60	36.1	38.78	37.95	35.67
	N612-15	40.99	40.79	40.03	35.60	31.44	77.86	39.69	38.96	39.28	42.79	39.44	36.35	38.54	38.13	36.92
N612-13	40.05	40.31	35.67	35.64	31.38	78.20	38.14	37.61	38.86	42.71	39.93	35.93	37.95	37.73	35.3	
N612-14	40.35	39.45	37.22	35.32	31.38	78.56	38.44	38.19	38.92	42.66	38.66	36.04	38.86	38.05	35.71	
N612-15	41.17	40.59	39.64	35.47	31.43	78.06	39.56	38.91	39.27	42.83	39.59	36.3	38.66	38.3	36.91	
N612-16	40.41	40.32	35.42	36.01	32.00	79.19	38.69	38.28	39.30	43.14	39.27	36.45	38.74	38.25	35.65	
01.11.2020	N612-17	40.00	39.55	37.21	35.05	30.87	77.68	37.94	37.53	38.54	42.31	39.37	35.59	38.06	37.57	35.35
	N612-18	40.50	39.83	35.04	35.89	31.80	79.32	38.48	38.00	39.40	42.55	39.30	36.25	38.69	38.33	35.59
	N612-19	39.51	39.93	38.34	35.55	31.15	78.05	38.48	37.93	38.36	42.49	39.94	35.82	38.24	37.73	35.26
	N612-20	40.58	39.95	36.06	35.03	31.27	77.75	37.94	37.77	38.90	43.13	38.63	35.			

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.10.2020	N612-07	37.42	35.27	37.28	37.50	35.24	38.29	37.95	36.77	39.10	37.08	36.49	37.53	38.26	37.49	37.51
	N612-08	38.02	35.96	37.31	37.71	35.82	38.34	38.05	36.84	39.27	36.91	37.66	38.95	38.13	37.25	
	N612-09	37.32	35.53	37.08	37.85	35.47	38.63	38.39	36.96	39.10	37.16	36.60	38.07	38.74	38.64	37.91
	N612-10	37.60	35.92	36.42	37.62	35.28	38.38	38.16	37.38	39.57	37.24	36.62	37.82	37.71	37.62	37.42
	N612-11	37.36	35.69	37.34	37.54	35.02	37.85	38.00	36.66	39.71	37.10	36.98	37.70	37.96	37.55	37.42
	N612-12	37.99	35.50	37.27	37.65	35.93	38.71	38.00	36.92	38.75	36.92	36.44	37.50	39.12	37.99	37.35
	N612-10	37.94	35.58	36.98	38.38	35.77	38.80	38.82	37.61	39.44	37.85	37.23	38.23	38.82	38.18	37.69
	N612-11	39.18	36.00	38.43	39.15	37.06	40.04	39.66	37.80	39.94	38.14	37.64	38.99	38.88	39.36	37.43
	N612-13	37.78	35.34	36.90	37.08	35.56	37.81	37.68	36.43	38.82	36.21	36.01	37.18	37.98	37.34	37.18
	N612-14	37.40	35.88	38.02	37.47	35.20	38.37	37.62	36.49	39.39	37.10	36.96	37.48	38.97	37.91	37.31
	N612-16	38.25	35.88	37.66	38.50	36.17	39.55	39.07	37.67	40.24	37.23	37.37	38.37	38.94	38.25	37.92
	N612-17	37.86	35.71	37.59	37.81	35.87	38.56	38.19	37.12	39.20	37.49	37.03	37.92	38.95	38.07	37.68
	N612-18	37.53	35.51	37.00	37.42	35.16	38.05	37.82	36.48	39.23	36.52	36.39	37.30	38.22	37.51	37.07
	N612-19	37.71	35.30	37.34	37.12	35.05	38.05	37.76	36.72	38.83	36.91	36.35	37.24	38.13	37.66	37.38
	N612-20	37.70	35.91	37.29	38.10	35.98	38.57	38.26	36.90	39.57	37.13	37.07	37.98	39.04	37.94	37.41
	N612-21	37.49	35.34	37.56	37.86	36.62	38.01	38.07	37.23	39.69	36.80	35.81	37.29	37.98	37.91	37.26
	N612-19	37.82	35.34	37.44	37.31	35.40	38.39	37.95	36.90	38.89	36.99	36.40	37.49	38.63	37.92	37.54
	N612-20	37.58	35.94	37.12	37.99	35.62	38.19	38.07	36.69	39.57	37.01	37.12	37.76	38.50	37.63	37.19
	N612-21	37.77	35.76	38.50	38.45	37.49	38.78	38.75	37.56	40.28	37.31	36.70	38.05	38.68	38.61	37.31
	N612-22	37.29	35.59	37.29	37.62	35.56	38.20	37.93	36.59	39.68	37.09	36.50	37.40	38.47	37.72	37.20
	N612-23	38.10	35.59	37.32	37.56	35.43	38.40	38.06	37.01	38.74	36.92	36.86	37.78	38.67	37.87	37.56
	N612-24	38.03	35.86	38.33	38.00	36.19	38.26	38.38	37.61	39.37	37.59	37.04	38.24	39.23	38.06	37.75
	N612-22	37.43	35.69	37.30	37.85	35.66	38.55	38.19	36.72	39.79	37.19	36.75	37.63	38.67	38.04	37.19
	N612-23	38.18	35.69	37.26	37.82	35.60	38.76	38.24	37.07	38.90	37.00	37.10	38.04	38.88	38.17	37.54
	N612-24	37.49	35.34	37.41	36.86	35.08	37.18	37.38	36.60	38.76	36.67	36.00	36.84	37.89	36.82	37.48
	N612-25	37.43	35.38	37.31	37.69	35.46	38.20	37.87	36.59	38.96	37.02	36.59	37.82	38.97	37.79	37.59
	N612-26	37.60	35.72	37.06	37.24	35.40	38.36	37.59	36.57	39.05	37.01	36.80	37.22	38.03	37.51	36.81
	N612-27	38.01	35.71	37.51	37.91	35.66	38.41	38.54	37.20	39.61	37.01	36.74	37.80	38.77	38.12	37.71
N612-25	37.38	35.30	37.39	37.83	35.65	38.49	38.36	36.93	39.10	36.96	36.51	37.95	39.10	38.23	38.00	
N612-26	38.04	35.92	37.21	37.36	35.34	38.10	37.63	36.66	39.31	37.04	36.90	37.24	38.03	37.34	36.75	
N612-27	38.55	35.81	37.57	37.80	35.74	38.58	39.15	37.75	39.88	36.74	36.45	37.61	39.04	38.31	37.95	
N612-28	37.83	35.25	37.60	37.28	35.43	38.03	37.59	36.56	39.59	37.00	36.48	37.23	37.70	37.35	37.54	
N612-29	37.68	35.58	37.31	37.61	35.51	38.31	38.02	36.81	39.19	37.00	36.69	37.62	38.60	37.82	37.42	
N612-27	37.16	35.47	37.88	37.67	35.35	38.12	37.48	36.67	38.97	36.80	36.60	37.80	38.75	37.82	37.41	
01.11.2020	N612-01	37.22	35.62	37.38	37.03	35.15	38.05	38.19	36.59	39.36	36.66	36.31	37.55	38.47	37.65	37.45
	N612-02	38.27	35.71	37.53	37.95	35.77	38.43	38.21	37.02	38.89	37.35	36.84	37.65	38.97	37.72	37.52
	N612-03	37.60	35.42	36.96	37.85	35.56	38.43	37.54	36.78	39.40	36.99	36.98	37.59	38.16	38.01	37.12
	N612-04	38.11	35.67	37.04	37.23	35.03	38.14	37.34	36.21	38.59	36.36	35.79	37.14	37.94	37.77	37.47
	N612-05	37.42	35.80	36.84	37.65	35.76	38.57	37.85	36.93	39.23	36.94	36.89	37.68	39.18	38.21	37.57
	N612-06	37.94	35.43	37.76	37.50	35.23	38.03	38.18	36.67	39.17	37.03	36.48	37.53	38.05	37.39	37.23
	N612-04	38.46	35.74	37.13	37.32	35.00	38.44	37.62	36.54	38.92	36.53	35.80	37.25	37.90	37.89	37.67
	N612-05	37.45	35.80	36.84	37.66	35.73	38.54	37.82	36.90	39.25	36.95	36.88	37.66	39.14	38.20	37.56
	N612-06	37.99	35.39	37.82	37.53	35.25	38.03	38.19	36.68	39.17	37.06	36.52	37.52	37.98	37.37	37.19
	N612-07	37.47	35.63	37.11	37.60	35.67	38.53	38.11	36.92	38.90	37.01	36.60	37.70	38.59	37.72	37.31
	N612-08	37.89	35.59	37.44	37.60	35.36	38.11	37.89	36.70	39.48	36.99	36.80	37.51	38.60	37.89	37.46
	N612-09	37.92	35.50	37.83	37.98	35.99	38.64	38.60	37.05	39.09	37.55	36.87	38.16	39.27	37.99	37.40
	N612-07	37.45	35.60	37.02	37.57	35.55	38.46	37.95	36.83	38.88	36.86	36.63	37.62	38.45	37.64	37.33
	N612-08	37.89	35.60	37.34	37.56	35.24	38.03	37.74	36.61	39.50	36.85	36.80	37.42	38.49	37.84	37.51
	N612-09	37.83	35.58	37.62	37.64	35.71	38.39	38.40	36.98	39.23	37.35	36.64	37.79	38.88	37.84	37.24
	N612-10	37.57	35.81	37.60	38.05	35.92	38.71	38.01	36.92	39.36	37.20	36.93	37.64	38.49	38.26	37.65
	N612-11	37.57	35.54	36.77	37.20	35.39	37.97	38.28	36.95	39.21	37.09	36.50	37.70	38.23	37.90	37.39
	N612-12	37.90	35.47	37.47	37.56	35.23	38.24	37.74	36.56	39.03	36.73	36.67	37.47	38.91	37.29	37.15
	N612-10	37.72	35.72	37.45	37.89	35.92	38.60	38.36	37.07	39.35	37.34	36.91	37.75	38.69	38.40	37.82
	N612-11	37.57	35.58	36.43	36.84	35.04	37.68	38.17	36.92	39.01	36.96	36.23	37.51	38.06	37.87	37.45
	N612-12	37.64	35.47	37.14	37.32	35.08	38.00	37.63	36.54	39.04	36.66	36.48	37.43	38.43	37.18	36.94
	N612-13	38.12	35.67	37.31	37.37	35.47	38.28	38.09	36.53	39.28	36.92	36.72	37.78	38.67	37.81	37.35
	N612-14	37.31	35.55	37.31	37.86	35.59	38.36	37.97	37.11	39.14	37.13	36.71	37.45	38.49	37.85	37.47
	N612-15	38.03	35.66	37.70	38.54	35.63	39.33	38.25	37.80	40.28	37.40	37.55	38.42	38.37	38.27	37.22
	N612-13	37.94	35.59	37.25	37.41	35.47	38.20	38.05	36.50	39.22	36.82	36.80	37.81	38.43	37.63	37.06
	N612-14	37.43	35.59	37.31	37.79	35.50	38.38	37.94	37.09	39.17	37.15	36.57	37.37	38.72	37.94	37.71
	N612-15	38.24	35.73	37.72	38.46	35.58	39.38	38.33	37.81	40.35	37.49	37.36	38.32	38.68	38.47	37.58
	N612-16	37.97	35.81	37.82	37.74	35.99	38.65	38.10	37.16	39.30	37.56	36.93	37.78	38.65	38.04	37.60
01.11.2020	N612-17	37.47	35.41	36.83	37.46	35.06	37.98	37.91	36.46	39.11	36.49	36.50	37.45	38.49	37.55	37.16
	N612-18	37.35	35.43	37.70	37.70	35.87	38.88	38.56	36.92	39.63	36.90	36.69	38.21	38.95	38.39	37.51
	N612-19	37.92	35.88	37.42	37.62	34.88	38.11	37.78	36.88	39.20	37.43	36.96	37.65	38.57	37.86	37.44
	N612-20	37.90	35.55	36.80												

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	N612-22	39.67	40.24	36.07	35.30	31.92	78.01	38.73	38.13	38.89	42.80	39.57	36.24	38.55	38.06	36.47
	N612-23	40.25	39.86	36.63	35.65	31.86	78.60	38.68	38.16	38.99	43.04	38.87	36.32	38.86	38.3	35.48
	N612-24	40.19	39.91	36.37	35.48	31.33	78.37	38.24	37.86	38.89	42.65	39.37	35.95	38.33	37.84	35.5
	N612-25	40.25	38.44	34.78	35.40	31.07	78.27	37.82	37.46	38.97	42.55	38.95	36.64	38.98	37.64	36.44
	N612-26	40.75	39.61	36.48	35.05	31.16	78.69	37.75	38.10	39.45	42.91	39.66	36.77	38.67	38.29	36.47
	N612-04	39.86	39.91	35.37	35.74	31.18	78.31	37.91	37.75	38.58	42.99	39.62	35.88	38.22	37.83	35.65
	N612-05	40.39	39.70	36.97	35.45	31.57	78.34	38.36	37.75	38.91	42.35	39.06	35.87	38.58	37.7	35.26
	N612-06	40.47	40.21	36.94	35.19	31.49	78.62	38.79	38.35	39.40	42.82	39.20	36.36	38.44	38.3	35.67
	N612-07	40.02	39.53	36.20	35.54	31.32	78.48	38.22	37.88	38.92	42.68	39.07	36.02	38.41	38.07	35.34
	N612-08	40.21	40.27	38.08	35.69	31.52	78.25	38.58	37.95	38.66	42.53	39.67	36.12	38.13	37.53	35.44
	N612-09	40.32	39.88	34.94	35.33	31.35	78.45	38.07	37.85	39.06	42.89	39.19	35.85	38.62	38.06	35.69
	N612-07	39.95	39.62	36.19	35.52	31.35	78.44	38.21	37.90	38.97	42.63	39.11	35.98	38.39	38.06	35.35
	N612-08	40.22	40.28	38.00	35.62	31.50	78.23	38.57	37.94	38.68	42.51	39.63	36.11	38.12	37.52	35.46
	N612-09	40.42	39.85	34.90	35.33	31.34	78.50	38.10	37.86	39.04	42.96	39.16	35.89	38.68	38.1	35.71
	N612-10	39.69	39.93	34.33	36.09	31.41	79.80	37.83	38.14	39.44	43.30	39.56	36.05	38.88	38.14	36.21
	N612-11	41.03	39.80	37.41	35.92	31.77	78.91	38.89	37.69	39.16	43.09	39.71	36.37	38.77	38.14	35.37
	N612-12	39.47	39.97	35.62	35.16	31.09	77.96	37.81	38.09	38.67	42.35	38.95	35.69	38.07	37.7	35.58
	N612-10	39.62	40.18	34.33	36.15	31.38	79.53	37.91	38.29	39.57	43.36	39.32	36.21	38.93	38.15	36.41
	N612-11	40.82	39.65	37.04	35.84	31.69	78.93	38.63	37.52	39.04	43.06	39.68	36.26	38.79	38.11	35.34
	N612-12	39.56	40.15	35.77	35.17	31.09	77.76	37.90	38.28	38.78	42.30	38.92	35.74	38.08	37.68	35.65
	N612-13	40.18	39.91	36.34	35.29	31.36	79.08	38.57	38.37	38.70	42.87	39.34	35.95	37.92	37.96	35.59
	N612-14	39.89	40.30	35.45	35.32	31.43	77.96	38.40	37.76	38.92	42.62	38.78	35.81	37.96	37.69	35.67
	N612-15	40.52	39.55	37.34	35.85	31.43	78.26	38.02	37.62	39.06	42.65	39.74	36.22	39.21	38.04	35.28
	N612-13	40.47	39.61	36.80	35.00	31.26	79.54	38.31	38.25	38.53	42.81	38.86	35.93	37.95	37.92	35.37
	N612-14	39.85	40.33	35.46	35.46	31.44	77.84	38.42	37.75	38.98	42.63	39.02	35.78	37.96	37.73	35.7
	N612-15	40.33	39.72	37.11	35.95	31.48	78.11	38.16	37.80	39.12	42.68	39.88	36.26	39.21	38.04	35.41
	N612-16	40.35	39.94	35.10	35.34	31.30	78.11	38.56	37.73	38.78	42.64	39.92	36.28	38.3	38.2	35.44
	N612-17	40.07	39.86	37.53	35.60	31.48	78.75	38.07	38.08	38.98	42.76	38.68	35.72	38.42	37.61	35.56
	N612-18	40.54	39.68	37.21	35.48	31.78	78.23	37.99	37.46	38.78	42.39	39.73	35.98	38.35	37.81	35.22
	N612-19	39.03	39.76	35.25	35.53	31.15	78.53	38.26	37.83	38.65	42.52	38.91	35.83	38.31	37.6	35.68
	N612-20	41.09	40.39	36.66	35.48	31.21	78.38	38.74	38.54	39.30	43.30	39.19	36.19	38.49	38.3	35.65
	N612-21	39.71	39.62	36.92	35.73	31.62	79.53	38.36	38.17	39.03	42.90	39.71	36.16	38.75	38.29	35.8
	N612-22	41.22	39.68	35.78	35.11	31.00	77.26	38.13	37.35	39.03	42.33	38.74	35.92	38.53	37.67	35.04
	N612-23	39.66	40.33	36.59	35.67	31.63	78.49	38.36	38.12	38.62	42.82	39.51	35.91	37.95	37.74	35.65
	N612-21	39.66	39.62	37.14	35.96	31.77	80.11	38.50	38.49	39.18	43.08	39.88	36.32	38.93	38.54	36.06
	N612-22	41.07	39.63	35.99	35.29	31.11	77.81	38.24	37.61	39.14	42.49	38.93	36.02	38.69	37.88	35.27
	N612-23	39.36	40.24	36.59	35.78	31.72	79.05	38.40	38.30	38.68	42.96	39.71	35.98	38.1	37.92	35.81
	N612-24	39.44	39.61	38.40	35.17	31.53	78.52	38.04	37.30	38.55	42.50	39.36	35.97	38.21	37.94	35.12
	N612-25	39.86	39.61	37.59	35.09	30.85	78.95	38.85	37.89	39.24	42.79	39.27	36.43	38.71	37.95	35.96
	N612-26	40.95	40.12	34.60	35.76	31.27	78.26	38.51	38.38	39.22	42.85	39.22	36.02	38.58	37.87	35.8
	N612-24	39.96	39.94	37.50	35.31	31.68	78.57	38.24	37.50	38.60	42.55	39.35	35.94	38.17	38	35.2
	N612-25	39.67	39.70	36.63	35.36	31.07	78.51	38.53	37.91	39.15	42.78	39.20	36.2	38.55	37.85	35.74
	N612-26	41.13	40.09	34.69	35.87	31.48	78.00	38.13	38.30	39.01	42.75	39.35	35.87	38.49	37.83	35.61
	N612-27	40.01	39.76	37.36	35.54	31.08	79.04	38.24	38.39	38.72	43.01	39.33	35.99	38.58	37.98	35.37
	N612-28	39.44	40.26	35.62	35.90	31.79	78.71	38.22	38.18	39.20	42.70	40.38	36.54	38.43	38.36	35.89
	N612-29	40.29	40.01	35.75	35.43	31.69	77.89	38.36	37.44	39.04	42.42	39.28	36.01	38.23	37.84	35.59
	N612-27	40.57	39.56	37.36	35.50	31.01	79.05	38.18	38.23	38.72	43.24	39.26	35.91	38.73	37.98	35.44
	N612-28	39.62	40.26	35.85	35.75	31.64	78.51	38.34	38.19	39.05	42.54	39.78	36.28	38.26	38.07	35.63
	N612-29	40.42	39.89	35.90	35.23	31.58	77.58	38.39	37.25	38.93	42.29	38.84	35.8	38.19	37.63	35.43
01.11.2020	N612-30	40.21	39.88	36.51	35.52	31.36	78.51	38.28	37.98	38.88	42.77	39.33	36.01	38.44	37.93	35.5
	N612-31	40.93	40.29	38.40	35.05	31.19	79.37	38.59	38.41	39.06	42.93	39.19	35.99	38.63	37.77	36.2
	N612-01	39.84	39.69	35.95	35.40	31.44	78.44	38.37	37.81	39.10	42.82	39.54	36.21	38.67	38.06	35.7
	N612-02	40.24	40.08	35.93	35.74	31.60	78.53	38.51	38.22	38.70	42.88	39.71	36.06	38.31	37.82	35.57
	N612-03	40.53	39.88	37.36	35.37	31.14	78.17	37.96	37.63	38.88	42.39	38.59	35.72	38.18	37.78	35.2
	N612-04	40.41	40.26	36.66	35.33	31.63	79.11	38.68	38.30	39.06	42.57	39.68	36.11	38.81	38.32	35.66
	N612-05	39.75	40.03	36.58	35.36	31.29	78.03	38.63	37.68	39.10	42.94	39.52	35.96	38.41	37.82	35.76
	N612-06	40.40	39.47	35.95	35.78	31.32	78.14	37.71	37.76	38.60	42.62	38.83	35.97	38.07	37.62	35.16
	N612-04	40.39	40.33	36.71	35.38	31.59	78.92	38.63	38.24	38.99	42.64	39.46	36.04	38.69	38.21	35.54
	N612-05	39.74	39.99	36.57	35.38	31.27	78.03	38.55	37.69	39.10	43.04	39.55	35.99	38.48	37.89	35.86
	N612-06	40.50	39.34	35.82	35.73	31.34	78.19	37.65	37.77	38.56	42.44	38.80	35.96	38.02	37.55	35.08
	N612-07	39.96	39.92	37.41	35.52	31.55	78.65	38.61	37.87	39.28	42.85	40.06	35.89	38.29	38.11	35.69
	N612-08	40.34	40.08	35.28	35.78	31.05	78.23	38.33	37.76	38.60	42.25	38.78	36.15	38.25	37.88	35.32
	N612-09	40.26	39.77	36.67	35.20	31.63	78.40	38.07	38.10	38.91	43.04	39.22	35.95	38.69	37.78	35.55
	N612-07	39.97	39.89	37.26	35.83	31.48	78.27	38.54	37.92	39.25	42.74	39.93	35.78	38.15	38	35.7
	N612-08	40.36	40.13	35.03	35.09	31.06	78.28	38.32	37.78	38.49	42.30	38.80	36.2	38.26	37.83	35.1
	N612-09	40.18	39.61	36.99	35.53	31.67	78.57	37.97	37.99	38.91	43.07	39.22	35.98	38.8	37.82	35.65
	N612-10	40.75	40.27	36.18	35.61	31.59	79.37	38.80	38.25	39.29	42.93	39.23	36.54	38.94	38.47	36.2
	N612-11	40.57	40.01	36.17	36.22	31.33	78.04	38.18	37.54	39.03	42.67	38.87	35.57	37.89	37.51	35.22
	N612-12	39.44	39.53	36.77	34.84	31.29	77.92	38.04	37.92	38.50	42.52	39.78	35.94	38.37	37.8	35.19
	N612-10	40.56	40.26	36.27	35.46	31.55	79.28	38.71	38.34	39.20	42.79	39.23	36.51	38.92	38.47	36.13

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	N612-22	37.73	36.46	38.18	38.11	36.18	38.46	38.05	36.53	39.55	37.30	36.86	38.56	39.17	38.51	38.07
	N612-23	38.00	35.86	37.90	37.82	36.22	38.79	38.58	36.99	39.47	37.12	37.12	38.07	39.41	38.39	37.68
	N612-24	37.65	35.56	37.21	37.57	35.39	38.23	37.91	36.77	39.16	36.98	36.64	37.53	38.44	37.70	37.33
	N612-25	37.68	35.80	37.16	37.53	35.26	38.50	37.97	35.85	39.13	36.87	37.79	37.61	38.72	37.58	37.90
	N612-26	38.61	36.22	37.63	37.77	35.66	38.53	38.41	36.64	38.99	37.21	38.33	37.76	39.00	37.82	38.13
	N612-04	37.68	35.47	37.82	37.44	35.69	38.63	37.93	36.65	38.74	37.01	36.93	37.40	38.81	37.62	37.00
	N612-05	37.24	35.76	37.00	37.58	35.06	37.70	37.65	36.53	38.92	36.79	36.16	37.44	38.34	37.70	37.45
	N612-06	38.49	35.60	36.98	37.88	35.79	38.74	38.64	37.41	40.32	37.32	37.20	38.13	38.56	38.17	37.80
	N612-07	37.31	35.52	37.05	37.40	35.64	38.25	38.07	36.99	39.23	37.02	36.68	37.60	38.60	37.79	37.85
	N612-08	37.90	35.40	37.80	37.82	35.93	38.22	37.76	36.77	39.34	36.67	36.44	37.81	38.50	37.81	37.00
	N612-09	37.83	35.85	37.13	37.56	35.00	38.41	38.12	36.63	38.97	37.28	36.95	37.38	38.63	37.75	37.28
	N612-07	37.37	35.57	36.98	37.41	35.61	38.25	38.08	36.99	39.24	37.06	36.63	37.61	38.58	37.79	37.81
	N612-08	37.92	35.40	37.77	37.82	35.87	38.21	37.76	36.74	39.35	36.68	36.42	37.79	38.45	37.79	36.97
	N612-09	37.86	35.82	37.19	37.60	34.98	38.44	38.15	36.63	39.02	37.26	37.05	37.40	38.64	37.77	37.31
	N612-10	37.40	35.52	37.04	37.36	35.22	38.08	38.00	36.57	38.93	36.71	36.34	37.35	38.71	37.58	37.80
	N612-11	37.85	35.92	37.51	37.56	35.98	38.42	38.18	37.11	38.89	37.07	37.13	37.68	39.26	38.09	37.68
	N612-12	37.54	35.31	37.10	37.62	35.15	38.18	37.84	36.57	39.49	36.93	36.30	37.55	37.99	37.54	37.16
	N612-10	37.41	35.49	37.37	37.68	35.36	38.38	38.27	36.79	39.24	36.97	36.64	37.57	38.60	37.74	37.66
	N612-11	37.74	35.84	37.38	37.42	35.72	38.24	37.88	36.83	38.73	36.83	36.85	37.48	39.20	37.83	37.68
	N612-12	37.66	35.31	37.23	37.83	35.28	38.37	38.02	36.78	39.72	37.19	36.53	37.74	37.95	37.73	37.10
	N612-13	37.37	35.78	37.39	37.41	35.37	38.13	38.82	36.70	39.35	36.91	36.69	37.65	38.17	37.89	37.03
	N612-14	38.35	35.64	36.80	37.59	35.40	38.56	37.89	36.88	39.07	37.22	36.79	37.35	38.85	37.81	37.49
	N612-15	37.45	35.44	37.66	37.75	35.70	38.22	37.45	36.81	39.16	36.88	36.65	37.76	38.71	37.70	37.60
	N612-13	37.32	35.74	37.06	37.15	35.33	37.95	38.53	36.42	39.29	36.72	36.49	37.53	37.81	37.77	37.13
	N612-14	38.28	35.61	36.94	37.68	35.42	38.61	37.94	36.98	39.14	37.25	36.80	37.42	38.99	37.85	37.45
	N612-15	37.46	35.47	37.82	37.87	35.70	38.27	37.62	36.92	39.21	36.97	36.77	37.83	38.72	37.75	37.49
	N612-16	37.58	35.85	37.73	37.79	35.59	38.30	38.58	36.96	38.97	37.06	36.71	37.75	39.15	37.74	37.64
	N612-17	37.82	35.38	36.85	37.38	35.39	38.29	37.52	36.62	39.43	36.93	36.68	37.44	37.99	37.84	37.12
	N612-18	37.59	35.51	36.68	37.29	35.19	37.92	37.33	36.63	38.95	36.88	36.77	37.45	38.34	37.42	37.20
	N612-19	37.47	35.31	37.31	37.50	35.57	38.22	38.11	36.65	39.26	36.95	36.35	37.41	38.70	37.76	37.35
	N612-20	38.11	36.01	37.99	38.07	35.81	38.89	38.71	37.19	39.38	37.22	37.04	37.99	38.68	38.31	37.62
	N612-21	37.58	35.85	38.12	37.92	35.72	38.36	38.20	36.71	39.79	36.97	36.46	37.80	38.86	37.73	37.46
	N612-22	37.72	35.43	36.91	37.39	35.02	38.08	37.86	36.95	38.87	36.76	36.65	37.23	38.38	37.71	37.54
	N612-23	37.76	35.50	36.86	37.46	35.73	38.40	37.85	36.71	38.96	37.24	36.95	37.75	38.47	37.86	37.13
	N612-21	37.59	35.93	38.63	38.12	35.90	38.48	38.45	36.69	39.97	37.00	36.40	37.98	39.10	37.76	37.55
	N612-22	37.72	35.58	37.37	37.59	35.20	38.20	38.06	36.94	39.16	36.82	36.57	37.40	38.59	37.75	37.61
	N612-23	37.74	35.69	37.32	37.64	35.87	38.49	37.98	36.70	39.31	37.26	36.88	37.86	38.64	37.85	37.14
	N612-24	37.20	35.12	36.52	37.41	35.26	37.71	37.66	36.39	38.72	36.55	36.44	37.35	37.85	37.64	37.26
	N612-25	38.16	35.77	37.75	38.08	35.38	38.29	37.83	37.28	39.15	37.27	37.12	37.66	39.37	38.29	37.95
	N612-26	38.12	36.00	37.97	37.75	35.67	38.79	38.29	37.15	39.59	37.37	36.91	37.79	39.19	37.91	37.49
	N612-24	37.27	35.28	36.77	37.44	35.57	38.05	37.89	36.63	39.04	36.71	36.68	37.57	37.86	37.76	37.25
	N612-25	37.88	35.63	37.52	37.86	35.30	38.28	37.84	36.96	39.04	37.07	36.87	37.58	39.15	37.92	37.60
	N612-26	37.98	35.96	37.68	37.50	35.56	38.60	38.21	36.81	39.46	37.25	36.52	37.69	38.84	37.68	37.30
	N612-27	38.01	35.55	37.43	37.75	36.02	38.40	38.60	36.91	40.04	37.15	36.85	37.34	38.39	37.81	37.43
	N612-28	39.25	35.92	37.66	38.06	36.03	38.41	38.87	36.67	39.26	36.95	36.69	37.74	39.49	38.01	37.87
	N612-29	37.40	35.60	37.13	37.46	35.06	38.18	37.48	36.69	38.48	36.84	36.58	37.83	38.67	37.78	37.33
	N612-27	37.69	35.70	37.31	37.75	35.89	38.30	38.22	36.85	39.99	37.15	36.77	37.44	38.26	37.83	37.49
	N612-28	38.56	35.74	37.54	37.86	35.82	38.46	38.61	36.80	39.13	37.00	36.80	37.73	39.12	37.94	37.57
	N612-29	36.83	35.34	37.04	37.16	34.76	38.13	37.14	36.74	38.43	36.84	36.52	37.64	38.34	37.59	37.06
01.11.2020	N612-30	37.77	35.63	37.32	37.65	35.59	38.31	38.09	36.81	39.32	37.02	36.72	37.58	38.57	37.81	37.41
	N612-31	38.49	35.78	36.50	38.34	35.91	39.24	38.93	37.61	39.49	37.50	38.01	37.62	39.07	38.15	37.24
	N612-01	37.93	35.63	37.73	37.62	35.81	38.63	38.35	36.86	38.47	37.10	36.59	37.69	38.05	38.06	37.62
	N612-02	37.66	35.63	36.94	37.73	35.29	38.23	38.11	36.92	39.78	37.02	36.83	37.47	39.28	37.84	37.41
	N612-03	37.50	35.48	37.20	37.43	35.39	38.05	37.56	36.61	39.35	36.87	36.66	37.64	38.36	37.47	37.10
	N612-04	38.03	36.08	37.79	37.69	35.64	38.17	37.74	36.69	39.28	36.89	36.43	37.64	38.69	37.59	37.47
	N612-05	37.19	35.84	37.22	37.60	35.54	38.46	38.11	36.97	39.13	37.40	37.67	37.74	38.64	38.10	37.27
	N612-06	37.91	34.99	36.98	37.52	35.37	38.30	38.17	36.75	39.15	36.75	36.10	37.44	38.39	37.72	37.42
	N612-04	38.01	35.98	37.67	37.61	35.50	38.13	37.75	36.62	39.20	36.79	36.32	37.52	38.41	37.50	37.31
	N612-05	37.25	35.87	37.27	37.67	35.58	38.53	38.24	37.06	39.26	37.49	37.73	37.85	38.81	38.22	37.42
	N612-06	37.80	34.92	36.99	37.54	35.43	38.25	38.07	36.74	39.14	36.77	36.09	37.41	38.46	37.68	37.43
	N612-07	38.12	35.60	36.74	37.62	35.71	38.45	37.98	36.79	39.52	36.67	36.65	38.04	39.11	37.86	37.43
	N612-08	37.31	35.71	37.55	37.33	34.98	38.15	37.57	36.74	38.58	37.08	36.94	37.05	38.15	37.67	37.02
	N612-09	37.75	35.57	37.58	37.86	35.85	38.32	38.42	36.86	39.55	37.21	36.53	37.79	38.53	37.83	37.69
	N612-07	37.95	35.58	36.58	37.51	35.57	38.33	37.82	36.70	39.31	36.68	36.63	37.95	39.17	37.75	37.32
	N612-08	37.35	35.60	37.65	37.40	35.08	38.17	37.68	36.76	38.66	37.17	36.96	37.04	37.90	37.67	37.04
	N612-09	37.74	35.61	37.66	37.89	35.77	38									

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146	
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	
	N612-11	40.72	39.88	36.22	36.26	31.38	77.95	38.10	37.44	38.99	42.85	39.05	35.54	37.94	37.46	35.2	
	N612-12	39.29	39.48	36.75	34.73	31.27	77.92	38.00	37.91	38.45	42.43	39.73	35.93	38.32	37.74	35.16	
	N612-13	40.60	40.44	35.83	36.11	31.28	78.39	38.94	37.88	39.19	42.77	38.60	36.08	38.31	37.95	35.24	
	N612-14	39.86	39.71	36.64	35.54	31.38	78.51	38.09	37.89	38.96	42.99	39.42	35.96	38.53	37.81	35.55	
	N612-15	40.28	39.70	36.59	35.05	31.54	78.41	38.04	37.95	38.67	42.42	39.73	36.01	38.4	37.99	35.73	
	N612-13	40.50	40.23	35.91	35.91	31.30	78.33	38.75	37.73	39.08	42.77	38.55	36.05	38.28	37.87	35.19	
	N612-14	39.74	39.95	36.82	35.65	31.33	78.63	38.31	38.10	39.07	42.87	39.65	36.03	38.61	37.84	35.69	
	N612-15	40.40	39.52	36.58	34.93	31.60	78.33	37.84	37.89	38.55	42.50	39.77	35.97	38.38	37.98	35.63	
	N612-16	39.57	39.86	35.26	35.51	31.08	77.72	38.23	37.69	38.77	42.31	39.30	35.71	37.86	37.87	35.64	
	N612-17	40.73	39.82	37.21	35.57	31.72	78.62	38.27	38.13	39.12	42.93	39.29	35.91	38.76	38.03	35.35	
	N612-18	40.30	40.05	36.59	35.49	31.37	78.79	38.45	37.86	38.85	42.84	39.23	36.33	38.54	37.8	35.49	
	N612-19	40.73	39.97	37.90	35.59	31.45	78.67	38.30	37.65	39.04	42.87	39.81	36.29	38.59	38.22	35.43	
	N612-20	40.10	40.39	36.39	35.71	31.32	78.02	38.29	38.19	39.03	43.11	40.08	36.26	38.67	38.23	37.04	
	N612-21	39.61	39.80	34.72	35.45	31.36	78.02	38.33	38.18	38.75	42.53	38.76	35.64	38.17	37.53	35.58	
	N612-22	39.81	40.15	34.83	35.13	31.40	78.90	38.27	37.88	38.85	42.26	38.98	36.08	38.31	37.68	35.47	
	N612-23	40.46	39.64	37.46	35.52	31.16	78.08	38.03	38.32	38.76	43.22	39.31	36.03	38.64	38.19	35.67	
	N612-24	40.36	39.94	36.91	35.80	31.63	78.31	38.58	37.51	39.09	42.63	39.63	35.94	38.29	37.86	35.36	
	N612-22	39.78	40.25	34.79	35.24	31.52	78.86	38.38	37.94	38.91	42.35	39.04	36.11	38.39	37.74	35.59	
	N612-23	40.58	39.61	37.63	35.57	31.18	78.24	38.06	38.34	38.82	43.30	39.33	36.02	38.64	38.25	35.72	
	N612-24	40.37	39.83	36.93	35.72	31.51	77.98	38.46	37.39	38.95	42.53	39.51	35.81	38.1	37.74	35.21	
	N612-25	39.17	39.92	35.20	35.60	31.23	78.87	38.37	38.03	39.14	42.52	40.04	36.29	38.87	37.77	34.94	
	N612-26	40.90	39.73	38.12	35.35	31.70	78.59	38.24	37.94	38.82	42.30	38.80	36.13	38.24	37.8	35.97	
01.03.2021	N612-01	40.41	40.02	37.01	35.43	31.27	78.02	38.13	37.81	39.61	43.10	38.88	35.87	38.31	37.73	36.02	
	N612-02	40.28	39.71	35.84	35.24	31.53	78.79	38.18	37.98	38.57	42.46	39.43	36.32	38.48	38.17	35.63	
	N612-03	39.83	39.97	36.37	35.86	31.42	78.43	38.60	37.96	38.47	42.62	39.75	35.84	38.48	37.85	34.89	
	N612-04	40.64	39.93	35.55	35.44	31.41	78.01	38.44	37.64	39.02	41.86	38.11	35.59	37.67	37.35	34.63	
	N612-05	40.22	39.92	37.54	35.62	31.19	78.95	38.30	37.72	38.97	43.04	40.08	36.19	38.92	38.2	35.96	
	N612-06	39.85	39.87	36.18	35.41	31.58	78.21	38.14	38.28	38.81	43.17	39.59	36.19	38.56	38.1	35.94	
	N612-04	40.53	40.26	35.71	35.48	31.44	78.05	38.48	37.66	39.00	41.95	38.21	35.67	37.78	37.46	34.93	
	N612-05	40.19	39.90	37.49	35.63	31.19	78.93	38.29	37.73	38.93	43.08	40.15	36.21	38.95	38.23	35.75	
	N612-06	39.89	39.51	35.93	35.40	31.55	78.13	38.07	38.28	38.75	43.17	39.63	36.14	38.52	38.06	35.93	
	N612-07	39.91	39.93	38.23	35.72	31.65	79.14	38.65	38.51	39.01	42.93	39.74	36.31	38.74	37.89	35.4	
	N612-08	40.19	39.73	35.19	34.91	31.39	78.47	38.19	37.73	38.63	42.44	39.23	35.61	38.16	37.84	35.19	
	N612-09	40.50	40.09	36.10	35.91	31.19	77.71	38.14	37.52	39.09	42.67	38.91	36.09	38.3	37.92	35.83	
	N612-07	39.88	40.02	38.05	35.92	31.73	79.15	38.62	38.47	39.04	42.98	39.89	36.36	38.77	37.95	35.52	
	N612-08	40.20	39.70	35.18	34.80	31.26	78.35	38.12	37.69	38.58	42.44	39.05	35.54	38.09	37.79	35.14	
	01.03.2021	N612-09	40.52	39.98	36.04	35.87	31.20	77.67	38.13	37.50	39.08	42.68	38.91	36.13	38.32	37.94	35.86
		N612-10	40.73	39.96	36.11	35.08	31.26	78.07	38.47	38.11	39.25	42.58	39.53	35.96	38.59	38.16	35.76
N612-11		39.68	39.85	36.81	35.89	31.57	78.81	38.17	37.77	38.58	42.83	39.16	36.05	38.25	37.67	35.24	
N612-12		40.26	39.76	35.92	35.40	31.14	78.63	38.59	38.27	39.16	42.41	39.79	36.15	38.08	37.94	34.91	
N612-13		40.07	39.78	36.30	36.37	32.04	77.85	37.83	37.66	38.65	42.96	38.84	35.65	38.53	38.14	35.89	
N612-14		40.25	40.22	37.17	34.73	31.07	78.74	38.49	37.78	38.89	42.77	39.34	36.23	38.66	37.65	35.83	
N612-15		40.04	39.87	35.98	35.17	31.37	78.39	38.27	37.74	38.92	42.53	38.54	35.91	38.08	37.71	35.24	
N612-16		40.93	39.65	35.69	36.18	30.92	78.28	38.03	37.71	38.64	42.75	39.47	35.77	38.64	37.48	35.26	
N612-17		39.67	40.13	37.38	35.21	31.91	78.51	38.59	38.26	39.15	42.78	39.85	36.3	38.42	38.5	35.89	
N612-15		39.85	39.80	35.85	35.14	31.42	78.47	38.22	37.67	38.84	42.83	38.79	36.1	38.4	38	35.7	
N612-16		41.02	39.78	35.96	36.15	30.90	78.38	38.08	37.78	38.70	42.81	39.57	35.83	38.62	37.52	35.39	
N612-17		39.79	40.15	37.61	35.20	32.00	78.39	38.62	38.33	39.17	42.44	39.62	36.03	38.1	38.17	35.4	
N612-18		40.24	39.84	36.86	35.94	31.15	78.04	38.41	37.90	38.96	42.67	39.07	36.21	38.88	38.09	35.52	
N612-19		39.63	39.91	34.70	35.25	31.14	78.49	38.33	37.61	39.00	42.72	39.61	36.1	38.37	37.95	35.36	
N612-20		40.73	39.92	37.47	35.36	31.85	78.64	38.15	38.14	38.73	42.73	39.16	35.73	38.03	37.67	35.64	
N612-18		40.47	39.87	37.31	36.25	31.19	77.95	38.49	37.93	39.04	42.50	38.80	36.14	38.86	38.01	35.41	
N612-19		39.73	39.92	35.09	35.47	31.11	78.36	38.42	37.65	39.06	42.66	39.42	36.14	38.51	38	35.35	
N612-20		40.70	39.92	37.86	35.50	31.76	78.48	38.24	38.19	38.78	42.77	39.04	35.89	38.32	37.83	35.72	
N612-21		40.41	39.58	35.80	35.71	31.17	78.14	37.83	37.80	38.58	42.52	40.21	35.71	38.13	37.69	35.1	
N612-22		40.09	39.66	36.04	35.47	30.69	77.76	38.08	37.48	38.25	42.79	39.06	35.38	37.89	37.47	35.29	
N612-23		39.96	40.23	36.90	35.29	31.61	78.65	38.79	37.98	39.23	42.87	38.45	36.31	38.68	38.12	35.9	
N612-21		40.58	39.75	36.26	35.81	31.49	78.43	38.00	38.04	38.85	42.70	40.30	36.03	38.42	37.96	35.27	
N612-22		40.03	39.87	36.27	35.37	30.96	78.10	38.25	37.73	38.45	42.49	39.18	35.65	38.05	37.64	35.49	
N612-23		39.96	40.15	36.76	35.30	31.78	78.69	38.75	37.93	39.49	42.94	38.31	36.39	38.79	38.12	35.82	
N612-24		40.01	39.48	35.78	35.20	31.55	78.47	37.93	37.88	38.71	42.47	39.38	35.63	38.04	37.79	35.14	
N612-25		40.43	40.27	36.95	35.82	31.24	78.32	38.60	37.93	39.04	42.90	39.37	36.33	38.72	37.99	35.8	
N612-01		39.93	39.67	37.07	35.06	31.13	77.91	37.76	37.63	38.52	42.46	39.06	35.61	38.24	37.31	35.41	
N612-02		41.48	39.77	37.70	35.96	31.38	78.03	38.77	37.92	39.25	43.41	40.94	36.21	39.24	38.64	36.3	
N612-03		40.49	40.20	35.61	36.08	31.3											

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.03.2021	N612-11	37.48	35.31	37.11	37.37	34.95	37.87	37.73	36.73	38.55	36.55	36.49	37.05	38.46	37.37	37.46
	N612-12	37.21	35.69	36.90	37.43	34.93	38.17	37.38	36.48	38.88	37.38	36.74	37.36	38.07	37.21	37.26
	N612-13	38.05	35.48	37.49	37.67	35.95	38.77	37.96	36.61	39.31	37.30	36.91	37.70	39.09	38.11	37.41
	N612-14	37.19	35.42	37.35	37.69	34.95	38.07	38.23	36.86	38.93	37.14	36.83	37.57	38.73	37.78	37.60
	N612-15	37.97	35.87	37.18	37.50	35.76	38.19	37.92	36.95	39.44	36.62	36.42	37.61	38.09	37.65	37.17
	N612-13	37.92	35.45	37.28	37.54	35.80	38.61	37.77	36.46	39.17	37.17	36.79	37.54	39.18	37.90	37.34
	N612-14	37.26	35.53	37.60	37.82	35.09	38.24	38.49	37.09	39.06	37.24	36.96	37.72	38.22	37.93	37.66
	N612-15	37.89	35.82	37.08	37.46	35.64	38.06	37.82	36.89	39.45	36.58	36.37	37.52	38.26	37.58	37.24
	N612-16	37.95	35.59	36.84	37.56	35.09	38.02	37.74	36.79	38.93	37.20	36.46	37.48	38.76	37.36	36.66
	N612-17	37.56	35.65	37.54	37.59	35.69	38.56	37.83	36.59	38.66	36.93	37.09	38.12	38.69	38.05	37.46
	N612-18	37.62	35.54	37.49	37.65	35.69	38.34	38.38	36.97	39.92	36.93	36.59	37.25	38.36	37.95	37.95
	N612-19	37.65	35.83	37.24	37.82	35.61	38.26	37.85	36.81	39.20	37.03	36.47	37.60	39.02	37.62	37.42
	N612-20	39.28	35.65	37.84	38.41	36.26	38.96	38.58	37.04	39.98	37.54	36.48	38.36	39.79	38.77	37.74
	N612-21	37.76	35.36	37.36	37.32	35.38	38.33	38.17	36.77	39.20	36.95	37.01	37.62	38.71	38.02	37.35
	N612-22	37.63	35.43	37.50	37.60	35.30	38.37	38.24	36.95	39.08	36.99	36.59	37.68	36.03	37.69	37.41
	N612-23	37.78	35.57	37.11	37.80	35.70	38.36	37.76	36.77	39.42	37.18	36.65	37.19	35.91	37.75	37.17
	N612-24	37.68	35.81	37.31	37.45	35.50	38.19	38.00	36.70	39.10	36.85	36.81	37.92	44.61	37.89	37.56
	N612-22	37.70	35.47	37.56	37.69	35.47	38.47	38.37	37.01	39.14	37.06	36.76	37.86	36.31	37.82	37.53
	N612-23	37.76	35.58	37.18	37.79	35.71	38.38	37.71	36.77	39.42	37.22	36.66	37.25	36.38	37.81	37.25
	N612-24	37.58	35.72	37.19	37.28	35.28	37.99	37.83	36.57	38.98	36.66	36.63	37.68	45.09	37.73	37.33
	N612-25	37.78	36.09	37.12	37.87	35.89	38.65	38.51	37.00	39.76	37.37	37.16	37.82	37.83	37.98	37.75
	N612-26	38.24	35.27	36.89	37.30	35.31	38.19	38.14	36.79	38.93	36.90	36.37	37.19	38.50	37.58	37.01
	N612-01	37.71	35.77	37.42	37.51	35.34	38.21	38.16	36.62	38.83	37.10	36.69	37.44	39.20	37.62	37.57
	N612-02	37.66	35.73	37.15	37.60	35.30	38.51	38.25	37.03	39.35	36.99	37.74	37.61	38.56	38.02	37.03
	N612-03	37.86	35.29	37.39	37.75	35.98	38.19	37.58	36.78	39.50	36.97	35.68	37.83	37.88	37.83	37.54
	N612-04	36.84	35.38	36.86	37.19	34.85	38.03	37.51	36.50	38.96	36.31	36.57	36.91	38.65	36.99	37.34
	N612-05	37.36	35.70	37.18	37.81	35.66	38.61	38.73	37.02	39.22	37.48	36.60	38.21	38.84	38.16	37.54
	N612-06	38.80	35.73	37.81	37.75	35.88	38.26	37.80	36.85	39.35	37.18	36.98	37.62	38.34	38.15	37.27
	N612-04	36.92	35.40	36.88	37.28	34.95	38.08	37.53	36.55	39.06	36.34	36.58	36.97	38.56	37.09	37.34
	N612-05	37.41	35.69	37.19	37.85	35.70	38.62	38.70	37.03	39.25	37.51	36.58	38.24	38.80	38.21	37.53
	N612-06	38.81	35.70	37.81	37.72	35.88	38.23	37.73	36.81	39.29	37.20	36.94	37.63	38.36	38.14	37.25
	N612-07	38.97	36.09	38.33	37.73	36.07	38.36	38.50	37.05	39.37	37.39	37.30	37.94	38.64	38.09	37.55
	N612-08	37.42	35.21	36.85	37.24	35.22	37.92	38.27	36.81	39.17	36.77	35.97	37.41	38.15	37.74	37.40
	N612-09	36.82	35.55	36.83	37.81	35.24	38.62	37.32	36.56	39.07	36.84	36.90	37.45	38.94	37.52	37.22
	N612-07	38.95	36.16	38.36	37.79	36.20	38.44	38.49	37.07	39.40	37.44	37.37	37.97	38.67	38.13	37.57
	N612-08	37.32	35.16	36.75	37.19	35.07	37.88	38.20	36.76	39.14	36.71	35.94	37.35	38.07	37.64	37.30
01.03.2021	N612-09	36.78	35.49	36.80	37.83	35.22	38.62	37.27	36.55	39.07	36.82	36.89	37.48	39.02	37.56	37.27
	N612-10	37.88	35.52	37.00	37.76	35.50	38.26	37.74	36.73	38.91	37.09	36.04	37.41	38.58	38.15	37.34
	N612-11	37.68	35.72	37.69	37.45	35.56	38.33	38.33	36.90	39.49	36.96	37.37	37.80	38.54	37.51	37.43
	N612-12	37.67	35.45	36.77	37.52	35.48	38.34	38.07	36.61	39.58	37.15	36.77	37.62	38.32	38.23	36.82
	N612-13	37.85	35.54	36.98	37.48	34.79	37.64	37.40	36.61	38.79	36.46	35.98	37.16	38.71	36.98	37.57
	N612-14	37.63	35.83	38.30	37.82	36.34	38.96	38.60	37.26	39.18	37.45	37.37	38.09	38.73	38.20	37.85
	N612-15	37.79	35.80	37.37	37.73	35.83	38.48	38.03	36.98	39.44	36.95	37.28	37.40	38.43	37.71	37.23
	N612-16	36.60	35.39	37.19	37.39	34.52	38.19	37.58	35.98	39.11	36.71	36.40	37.51	38.53	37.69	37.67
	N612-17	38.72	35.61	37.24	37.67	36.12	38.21	38.34	37.40	39.11	37.30	36.45	37.83	38.70	37.96	37.17
	N612-15	38.14	36.11	37.70	37.90	36.07	38.74	38.41	37.25	39.78	37.30	37.42	37.66	38.53	37.64	37.27
	N612-16	36.73	35.42	37.31	37.43	34.53	38.17	37.62	36.07	39.07	36.75	36.43	37.52	38.52	37.69	37.71
	N612-17	38.26	35.19	36.82	37.44	35.95	37.89	37.94	37.07	38.62	36.91	36.12	37.56	38.62	38.09	37.11
	N612-18	37.61	35.75	37.48	37.53	35.39	38.59	38.11	37.10	39.49	37.12	37.20	37.96	39.00	37.61	37.56
	N612-19	38.13	35.56	37.08	37.62	35.47	38.32	37.85	36.48	39.48	36.98	36.41	37.62	38.37	38.00	37.67
	N612-20	37.37	35.57	37.41	37.67	35.64	38.08	38.08	36.86	38.76	36.93	36.63	37.27	38.38	37.71	36.97
	N612-18	37.28	35.55	37.26	37.38	35.18	38.50	37.88	36.99	39.27	36.87	37.25	37.89	39.31	37.57	37.66
	N612-19	38.01	35.52	37.06	37.56	35.38	38.37	37.83	36.55	39.49	36.95	36.56	37.71	38.62	37.96	37.74
	N612-20	37.47	35.70	37.57	37.70	35.68	38.29	38.26	37.11	38.98	37.12	36.89	37.50	38.57	37.67	37.01
	N612-21	36.97	35.51	37.30	37.23	35.18	37.83	37.52	36.63	38.53	36.58	36.45	37.49	38.17	37.39	37.30
	N612-22	37.63	35.18	36.49	36.52	34.70	37.91	38.07	36.74	38.21	36.75	37.17	37.18	37.79	36.97	37.36
	N612-23	38.48	35.69	37.28	37.97	35.82	38.78	38.47	36.95	39.91	37.42	36.94	37.72	38.98	38.22	37.48
	N612-21	37.22	35.83	37.76	37.72	35.51	38.11	37.65	36.82	38.98	36.87	36.38	37.78	38.56	37.86	37.51
	N612-22	37.78	35.37	36.95	36.94	35.01	38.17	38.13	36.79	38.65	36.92	37.12	37.35	38.05	37.33	37.33
	N612-23	38.24	35.58	37.22	38.25	36.04	38.69	38.30	36.81	40.08	37.26	36.66	37.70	39.19	38.23	37.31
	N612-24	37.23	35.67	36.47	37.18	35.38	38.06	37.70	36.57	39.50	36.68	36.31	37.23	38.39	37.70	37.09
	N612-25	38.07	35.55	38.15	37.96	35.58	38.49	38.24	37.02	38.84	37.28	37.06	37.96	38.70	37.85	37.67
	N612-01	37.12	35.03	36.33	37.23	34.86	37.96	37.22	36.32	38.50	36.45	35.99	36.69	38.00	37.31	36.93
	N612-02	36.55	35.77	36.96	37.81	35.84	38.67	38.34	36.85	39.24	36.41	36.29	37.54	39.62	38.36	38.85
	N612-03	38.32	36.29	38.40	38.04	36.29	38.73	39.02	37.40	40.04	37.72	37.61	38.78	39.23	38.41	37.95
	N612-04	38.19	35.65	38.27	37.59	3										

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.03.2021	N612-06	39.81	40.06	36.21	35.53	31.22	78.68	38.59	37.51	38.79	42.17	39.55	36.24	38.39	38	35.95
	N612-07	40.02	39.58	35.73	35.29	31.62	78.10	38.00	37.49	38.56	43.77	39.63	36.26	39.4	37.95	36.24
	N612-08	39.82	40.30	36.39	35.84	31.66	79.38	38.19	38.14	39.06	42.78	39.43	36.59	38.62	38.67	35.48
	N612-09	40.78	39.80	36.98	35.36	31.00	77.74	38.65	38.07	39.06	41.75	38.89	35.22	37.34	37.13	34.78
	N612-07	39.86	39.75	35.68	35.24	31.49	78.08	38.12	37.60	38.60	43.71	39.80	36.41	39.4	38.04	36.45
	N612-08	39.83	40.29	36.44	35.84	31.62	79.37	38.21	38.14	39.07	42.69	39.41	36.53	38.51	38.63	35.47
	N612-09	40.96	39.62	37.16	35.42	31.05	77.73	38.57	37.95	39.05	41.62	38.68	34.96	37.13	36.97	34.55
	N612-10	40.68	40.30	37.22	35.80	31.64	78.87	38.75	37.96	39.17	42.33	39.06	36.38	38.89	37.93	35.01
	N612-11	40.26	39.93	35.65	35.33	31.26	78.12	37.97	38.34	38.78	43.11	38.90	36.19	38.58	38.28	35.38
	N612-12	39.68	39.54	36.32	35.39	31.36	78.28	38.20	37.43	38.75	42.79	39.97	35.61	37.98	37.6	36.17
	N612-10	40.76	40.24	37.31	35.80	31.61	78.80	38.69	37.86	39.13	42.01	38.67	35.98	38.48	37.6	34.73
	N612-11	40.22	39.88	35.61	35.32	31.23	78.09	37.96	38.32	38.79	43.11	38.94	36.16	38.54	38.28	35.46
	N612-12	39.52	39.50	36.15	35.36	31.33	78.30	38.24	37.50	38.80	43.12	40.45	35.94	38.31	37.93	36.62
	N612-13	40.64	40.17	37.16	35.32	31.55	78.36	38.33	38.08	38.47	42.35	39.19	35.4	37.33	37.44	34.34
	N612-14	40.21	40.02	36.35	35.88	31.41	78.26	38.30	37.76	39.22	42.63	39.16	35.92	38.63	37.61	35.6
	N612-15	39.91	39.61	35.89	35.34	31.29	78.59	38.30	37.90	39.01	42.99	39.40	36.62	39.17	38.56	36.33
	N612-16	40.36	39.45	35.78	35.46	31.02	78.11	37.86	37.35	38.36	41.71	38.93	35.17	37.49	37.18	34.71
	N612-17	40.37	39.90	36.85	35.34	31.57	78.91	38.49	37.91	39.03	43.60	39.54	36.21	38.58	38.42	35.73
	N612-18	39.71	40.48	36.70	35.71	31.58	78.17	38.65	38.56	39.39	42.80	39.51	36.82	39.31	38.19	36.27
	N612-19	40.95	39.31	36.49	35.60	32.37	78.73	38.05	37.65	38.94	43.94	39.36	35.5	38.37	38.04	34.67
	N612-20	40.79	40.32	35.49	35.52	30.82	77.82	38.27	38.19	38.76	41.85	38.56	36.3	38.42	37.74	35.92
	N612-21	39.13	39.97	37.07	35.38	31.11	78.65	38.50	37.78	38.93	42.41	39.91	36.06	38.3	37.87	35.75
	N612-19	41.50	39.06	35.26	35.56	32.29	79.84	38.53	39.00	38.68	41.87	38.00	35.41	37.59	36.58	35.41
	N612-20	40.16	40.08	36.67	35.59	31.69	79.16	38.91	38.26	39.02	42.51	39.21	35.83	38.32	37.73	35.25
	N612-21	40.20	39.66	36.07	35.39	31.13	77.62	37.69	37.50	38.79	43.00	39.49	36.29	38.56	38.11	35.77
	N612-22	40.88	40.37	36.97	35.67	31.35	78.42	38.51	38.45	38.81	42.08	38.33	35.02	38.06	37.9	35.14
	N612-23	39.50	39.99	36.40	35.49	31.37	78.85	38.25	37.58	38.88	42.34	39.70	36.23	37.9	37.28	36.04
	N612-24	40.28	39.46	35.96	35.38	31.48	78.04	38.21	37.77	39.00	43.54	39.76	36.62	39.13	38.45	35.31
	N612-01	39.96	40.10	37.35	35.20	31.28	78.46	38.12	38.30	39.15	43.35	39.85	36.23	39.09	38.08	36.2
	N612-02	40.34	39.84	37.16	35.83	31.47	78.46	38.77	38.09	38.93	43.06	38.91	36.41	38.96	38.55	36.09
	N612-03	40.37	39.74	34.65	35.51	31.46	78.23	38.05	37.26	38.62	41.72	39.12	35.41	37.14	37.15	34.17
	N612-04	39.90	39.74	35.72	35.34	31.36	78.55	38.15	37.81	38.43	41.63	38.80	35.32	37.71	37.04	35.35
	N612-05	40.27	40.16	36.30	35.88	31.51	78.64	38.12	37.85	39.14	43.23	39.62	36	38.88	38.07	35.14
	N612-06	40.36	39.83	37.27	35.27	31.32	78.06	38.61	38.10	39.14	43.30	39.49	36.69	38.72	38.6	36.12
	N612-04	39.82	39.88	35.77	35.48	31.41	78.62	38.22	37.85	38.53	41.98	39.17	35.68	38.05	37.41	35.69
	N612-05	40.31	40.14	36.31	35.87	31.51	78.61	38.13	37.81	39.15	43.22	39.59	36	38.84	38.08	35.1
	N612-06	40.53	39.65	37.22	35.11	31.27	77.93	38.56	37.97	39.04	42.91	39.05	36.31	38.29	38.22	35.69
	N612-07	40.39	39.99	37.37	35.38	31.38	78.15	38.18	38.44	38.84	43.06	39.86	36.36	38.65	38.29	35.62
	N612-08	39.82	40.06	34.44	36.03	31.63	78.81	38.69	38.07	39.43	43.21	39.51	36.4	38.67	38.1	35.63
	N612-09	40.35	39.69	37.22	35.15	31.22	78.29	38.03	37.29	38.44	41.88	38.65	35.3	37.93	37.34	35.28
	N612-07	40.75	39.88	38.07	35.12	31.30	77.74	37.90	38.53	38.64	43.54	40.41	36.65	38.99	38.77	36.06
	N612-08	40.02	39.99	35.10	35.85	31.59	78.50	38.52	38.15	39.28	43.47	39.71	36.58	38.77	38.35	35.72
	N612-09	40.40	39.78	37.79	35.13	31.19	78.28	38.06	37.66	38.49	41.93	38.84	35.43	38.02	37.46	35.28
	N612-10	40.18	40.24	35.80	35.68	31.52	78.61	38.40	37.71	39.05	42.61	39.79	35.82	38.33	37.68	35.4
	N612-11	40.20	39.59	36.86	35.36	31.30	78.21	38.23	38.10	38.79	42.84	38.88	36.22	38.49	38.15	35.61
	N612-13	40.52	40.11	35.72	35.33	31.72	78.82	38.68	37.90	39.28	42.17	38.59	35.78	38.2	37.94	35.26
	N612-14	39.76	39.95	37.24	34.86	31.12	78.38	38.39	38.22	38.86	42.80	40.21	36.31	38.68	38.05	35.97
	N612-15	40.30	39.60	36.22	36.39	31.42	77.98	37.82	37.56	38.59	43.29	39.10	35.91	38.34	37.75	35.31
N612-16	39.94	39.96	36.68	35.22	30.73	78.09	38.10	37.95	38.35	41.60	39.56	36.04	38.08	37.25	35.24	
N612-17	40.97	40.39	37.25	35.49	31.32	78.96	38.68	38.02	39.18	42.85	40.13	36.13	38.97	38.4	35.67	
N612-18	39.73	39.41	35.29	35.72	32.13	78.19	38.17	37.75	39.18	43.57	38.29	35.84	38.15	38.04	35.58	
N612-07	39.95	39.69	35.85	35.33	31.10	78.17	38.51	38.28	38.71	42.25	39.81	35.76	38.35	38.3	35.43	
N612-08	40.51	39.77	35.89	35.23	31.23	78.81	38.31	37.52	39.20	42.51	39.11	36.13	38.18	37.49	35.29	
N612-09	40.21	40.31	37.58	36.01	31.98	78.24	38.00	37.91	38.82	43.50	39.03	36.17	38.74	37.94	35.83	
N612-10	39.98	39.76	37.08	35.66	31.14	78.31	38.77	38.00	38.81	42.29	37.87	35.89	38.33	37.64	35.39	
N612-11	39.91	39.94	35.86	35.01	31.49	78.41	38.04	37.33	38.74	43.00	40.88	35.84	38.2	37.62	35.59	
N612-12	40.65	39.94	36.22	35.78	31.48	78.47	38.19	38.38	39.12	42.69	39.23	36.22	38.61	38.42	35.48	
N612-10	39.94	39.84	37.02	35.65	31.16	78.26	38.69	38.06	38.79	42.44	37.89	35.96	38.39	37.77	35.51	
N612-11	39.92	39.98	35.90	34.99	31.49	78.39	37.97	37.34	38.73	42.95	40.80	35.82	38.1	37.55	35.52	
N612-12	40.74	39.89	36.34	35.84	31.54	78.60	38.21	38.35	39.19	42.72	39.39	36.2	38.65	38.36	35.33	
N612-13	40.43	40.11	36.27	35.62	31.54	78.46	38.44	37.89	39.19	43.26	40.50	36.39	39.22	38.63	36.66	
N612-14	40.45	39.47	35.38	35.76	31.62	77.83	38.17	37.61	38.50	41.85	37.54	35.83	38.06	37.45	35.24	
N612-15	39.73	40.12	37.51	35.15	31.05	78.87	38.34	38.17	39.02	43.04	39.96	35.82	38.04	37.69	34.83	
N612-16	40.04	40.10	37.43	35.77	31.44	78.37	38.33	37.86	39.02	42.60	38.74	35.86	38.07	37.77	35.21	
N612-17	40.39	39.62	35.81	35.38	30.99	78.69	38.20	37.80	39.18	42.44	39.67	36.16	38.21	37.83	35.13	
N612-18	40.21	39.96	35.81	35.36	31.82	78.19	38.40	38.10	38.51	43.13	39.57	35.98	39.03	38.16	36.36	
N612-																

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.03.2021	N612-06	37.04	35.43	36.84	37.61	35.62	38.69	38.11	37.07	39.14	37.17	36.74	37.82	38.40	38.29	37.53
	N612-07	38.28	36.78	37.29	37.94	35.31	38.44	37.99	36.99	39.38	37.13	36.55	37.59	38.84	37.53	36.78
	N612-08	37.64	35.98	37.82	37.86	36.29	38.43	38.59	37.33	39.97	37.75	36.38	38.09	38.75	37.94	38.03
	N612-09	37.31	34.30	36.90	37.05	34.94	38.01	37.41	36.11	38.35	36.17	37.09	37.11	38.19	37.82	37.31
	N612-07	38.44	36.86	37.57	38.19	35.47	38.73	38.26	37.26	39.62	37.32	36.85	37.86	38.86	37.73	36.75
	N612-08	37.58	35.86	37.74	37.81	36.25	38.39	38.57	37.31	39.88	37.70	36.39	38.05	38.72	37.95	38.08
	N612-09	37.02	33.99	36.48	36.71	34.72	37.65	37.11	35.80	37.95	35.89	36.82	36.78	38.11	37.64	37.45
	N612-10	37.34	35.55	37.97	37.61	35.89	38.84	37.90	36.46	39.76	37.35	36.96	38.02	38.17	38.04	36.94
	N612-11	38.09	35.68	36.94	37.73	35.53	38.33	38.56	37.07	39.53	37.09	36.91	37.73	39.04	38.13	37.45
	N612-12	37.74	35.76	37.14	37.56	35.20	37.89	37.65	36.94	38.55	36.72	36.29	37.20	38.55	37.29	37.65
	N612-10	37.04	35.19	37.57	37.25	35.64	38.40	37.50	36.16	39.30	36.99	36.63	37.65	38.00	37.84	36.91
	N612-11	38.13	35.67	36.94	37.75	35.53	38.30	38.56	37.10	39.49	37.06	36.91	37.70	39.06	38.12	37.50
	N612-12	38.12	36.12	37.53	37.97	35.46	38.26	38.05	37.31	38.92	37.02	36.63	37.52	38.76	37.47	37.78
	N612-13	36.54	34.88	36.19	36.83	34.61	37.74	37.56	36.20	38.39	36.46	36.14	36.96	38.40	37.19	37.35
	N612-14	38.61	35.37	37.62	37.36	35.30	38.57	38.05	36.83	38.89	37.13	36.80	37.78	38.41	37.93	37.55
	N612-15	37.84	36.41	38.00	38.48	36.51	38.55	38.30	37.22	40.25	37.35	37.11	38.01	38.81	38.21	37.20
	N612-16	37.41	34.83	35.67	36.33	34.51	37.77	37.49	36.24	38.39	36.36	36.59	37.05	37.96	37.14	36.82
	N612-17	38.04	35.72	38.55	38.24	36.02	38.32	37.97	36.95	39.89	37.16	36.59	37.90	39.22	38.24	37.88
	N612-18	37.80	36.41	38.10	38.51	36.16	38.98	38.64	37.40	39.50	37.65	37.08	38.02	38.58	38.09	37.55
	N612-19	36.43	35.51	36.50	37.31	35.36	37.72	38.19	35.90	38.32	36.24	35.65	36.88	38.69	37.45	37.26
	N612-20	38.35	35.51	36.98	37.53	35.32	38.44	37.63	37.21	39.80	37.58	36.85	37.57	38.48	38.16	36.85
	N612-21	38.21	35.66	38.15	37.78	35.68	38.60	38.10	37.15	39.35	37.06	37.46	38.20	38.51	37.69	37.94
	N612-19	36.68	34.60	36.93	36.51	33.47	37.48	36.56	35.69	36.88	35.48	35.13	36.26	38.03	37.37	37.24
	N612-20	37.65	35.62	37.54	37.20	35.23	38.23	37.98	36.66	39.02	36.86	36.80	37.29	38.50	37.55	37.31
	N612-21	37.79	35.68	37.23	38.09	35.74	38.43	38.04	37.05	39.50	37.22	36.62	37.94	38.66	38.08	37.45
	N612-22	37.67	34.92	36.14	37.20	35.68	37.93	37.75	36.12	38.34	36.38	36.57	37.55	38.19	37.55	37.35
	N612-23	37.11	35.29	36.89	37.23	35.64	38.10	38.23	36.54	39.13	37.14	36.70	37.39	39.05	37.64	37.53
	N612-24	38.26	36.47	38.71	38.24	35.22	38.78	38.00	37.60	39.98	37.38	36.81	37.81	38.45	38.11	37.27
	N612-01	38.40	36.02	36.98	37.98	36.34	38.45	38.04	37.02	38.74	37.40	36.76	37.88	39.15	37.59	37.40
	N612-02	37.98	36.53	38.70	37.80	35.66	38.91	38.51	37.27	40.11	37.75	37.34	38.11	38.50	38.11	37.56
	N612-03	36.74	34.34	36.46	37.09	34.52	37.62	37.56	36.24	38.93	35.92	36.08	36.81	37.99	37.73	37.22
	N612-04	36.62	34.60	35.89	36.90	34.61	37.47	37.09	35.59	38.13	36.12	36.07	37.14	38.56	37.38	37.02
	N612-05	38.16	35.69	37.47	37.25	35.51	38.37	37.99	36.84	39.49	37.17	36.39	37.74	38.49	37.88	37.36
	N612-06	38.39	36.58	38.51	38.66	36.45	39.05	38.88	37.95	39.90	37.76	37.63	37.97	38.74	38.06	37.74
	N612-04	37.00	35.06	36.34	37.26	34.99	37.89	37.51	36.07	38.62	36.63	36.41	37.49	38.74	37.49	37.10
	N612-05	38.16	35.69	37.49	37.26	35.49	38.38	38.02	36.89	39.51	37.14	36.39	37.69	38.45	37.90	37.39
	N612-06	37.98	36.09	38.07	38.31	36.02	38.63	38.51	37.54	39.43	37.17	37.28	37.52	38.49	37.99	37.73
	N612-07	38.20	35.85	38.19	38.22	36.37	38.71	38.11	37.01	39.90	37.79	37.26	38.49	38.43	37.91	37.09
	N612-08	37.49	35.87	38.26	37.51	35.43	38.49	38.39	37.19	39.66	37.10	37.36	37.41	39.17	38.05	37.36
	N612-09	37.40	35.07	35.64	37.09	34.77	37.74	37.48	36.17	38.16	36.22	35.60	37.04	38.17	37.42	37.62
	N612-07	38.73	36.17	38.63	38.66	36.75	39.11	38.37	37.34	40.45	38.41	37.70	39.07	38.47	38.07	37.13
	N612-08	37.81	35.94	38.63	37.80	35.77	38.66	38.48	37.30	39.93	37.43	37.55	37.78	39.00	38.08	37.30
	N612-09	37.63	35.24	36.01	37.39	35.23	37.91	37.55	36.29	38.49	36.56	35.87	37.43	38.12	37.47	37.41
	N612-10	37.15	35.67	37.07	37.62	35.34	38.44	37.54	36.71	38.75	36.91	36.33	37.30	38.75	38.07	38.13
	N612-11	38.24	35.56	37.62	37.60	35.68	38.20	38.48	36.93	39.69	37.12	37.12	37.90	38.43	37.55	36.70
	N612-13	37.10	35.85	37.11	37.58	35.79	38.33	37.86	37.18	39.86	37.01	36.88	37.42	38.68	37.89	37.75
	N612-14	38.23	35.80	38.31	37.72	35.49	38.83	38.66	36.88	39.44	37.26	36.86	38.07	37.64	37.89	37.17
	N612-15	37.75	35.13	36.53	37.49	35.25	37.70	37.49	36.29	38.29	36.72	36.32	37.29	39.50	37.56	37.28
N612-16	38.28	35.20	37.04	37.42	35.11	38.35	38.06	36.72	39.04	36.87	36.83	37.69	37.92	38.01	36.64	
N612-17	37.71	36.48	37.64	38.12	35.64	38.97	38.11	37.62	39.43	37.42	37.03	38.02	38.92	37.86	37.50	
N612-18	37.14	35.19	37.25	37.28	35.76	37.67	37.86	36.16	39.21	36.74	36.30	37.12	38.80	37.55	37.99	
N612-07	37.45	35.63	37.14	37.74	35.34	38.40	38.16	37.09	39.70	37.26	36.21	37.59	38.72	37.83	37.27	
N612-08	37.83	35.53	37.39	37.44	35.12	37.67	38.03	36.54	39.13	36.71	37.02	37.58	38.63	37.65	37.14	
N612-09	37.86	35.65	37.45	37.58	36.12	38.93	37.82	36.74	38.71	37.06	36.89	37.62	38.44	37.93	37.83	
N612-10	37.58	35.65	37.11	37.99	35.22	38.34	37.57	36.93	39.17	36.68	37.03	37.94	37.79	37.75	36.86	
N612-11	37.85	35.42	36.93	37.21	36.10	37.92	38.49	36.77	39.22	36.97	36.72	37.21	38.77	37.40	37.64	
N612-12	37.64	35.72	37.80	37.65	35.15	38.59	37.95	36.75	39.27	37.32	36.36	37.67	39.10	38.19	37.55	
N612-10	37.81	35.68	37.23	38.07	35.30	38.59	37.80	36.99	39.19	36.81	37.05	37.97	37.72	37.73	36.77	
N612-11	37.79	35.35	36.87	37.12	36.04	37.86	38.41	36.67	39.15	36.90	36.62	37.13	38.65	37.32	37.58	
N612-12	37.44	35.77	37.74	37.56	35.06	38.36	37.74	36.68	39.35	37.27	36.44	37.70	39.36	38.32	37.87	
N612-13	38.18	35.99	38.24	38.03	36.29	39.19	38.73	37.25	38.81	37.47	36.58	37.85	39.58	38.44	37.62	
N612-14	37.42	34.98	36.83	37.27	35.45	37.78	37.43	36.60	38.87	36.79	36.23	37.03	38.41	37.23	36.89	
N612-15	37.59	35.87	36.94	37.59	34.93	38.08	37.94	36.63	39.86	36.79	37.30	37.96	37.81	37.75	37.57	
N612-16	37.12	35.65	37.57	37.48	35.44	37.99	37.44	36.76	39.33	36.59	36.37	37.26	37.98	37.74	36.90	
N612-17	37.85	35.30	37.84	37.74	35.95	38.66	37.97	36.63	38.81	37.20	36.92	37.64	39.00	37.83	37.66	
N612-18	38.24	35.86	36.46	37.65	35.12	38.28	38.73									

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.03.2021	N612-20	40.19	39.60	35.02	35.49	31.15	78.18	38.15	37.71	39.02	42.53	38.81	35.61	38.14	37.93	34.99
	N612-21	40.57	39.91	36.92	35.70	31.71	78.73	38.56	38.24	39.04	42.74	39.15	35.92	38.5	37.79	36.11
	N612-22	40.19	40.48	34.89	34.68	31.72	78.57	38.55	38.32	39.17	42.08	38.41	36.18	37.94	37.75	36.44
	N612-23	40.15	39.92	36.42	35.47	31.38	78.37	38.28	37.87	38.87	42.71	39.35	36.04	38.4	37.91	35.46
	N612-24	40.10	39.94	37.20	34.19	31.44	77.87	38.13	38.41	38.56	42.47	38.29	35.94	38.12	37.33	35.74
	N612-22	40.24	40.20	35.40	35.36	31.64	78.82	38.51	38.02	39.17	42.37	38.80	36.1	38.15	37.93	35.97
	N612-23	40.25	39.67	36.55	36.22	31.19	78.30	38.27	37.60	38.93	42.99	40.13	35.89	38.69	38.11	35.04
	N612-24	40.09	39.80	37.50	34.89	31.32	78.05	38.12	38.10	38.58	42.76	39.05	36	38.37	37.62	35.5
	N612-25	40.42	39.94	35.40	35.88	31.69	78.29	38.11	37.77	38.70	42.80	38.87	35.99	38.52	38.16	35.13
	N612-26	40.01	39.89	37.20	35.19	31.16	78.55	38.50	38.02	39.13	42.58	39.69	36.02	38.28	37.69	35.88
	N612-01	41.35	40.19	37.48	36.63	31.80	78.97	37.90	37.58	38.58	43.37	39.72	35.92	39.39	38.04	35.41
	N612-02	39.62	39.69	35.44	34.87	31.22	78.46	38.57	38.02	39.31	42.39	39.03	36.23	38.04	37.88	35.38
	N612-04	40.59	39.64	36.23	35.52	31.32	78.83	38.49	38.09	38.92	42.00	38.91	35.57	37.92	37.7	35.19
	N612-05	40.27	40.03	37.01	35.54	31.73	77.54	37.90	37.67	38.67	42.94	38.91	35.9	38.26	37.47	35.43
	N612-06	39.93	40.03	36.06	35.57	31.21	78.97	38.48	37.92	39.10	43.18	40.09	36.49	39.11	38.53	35.83
	N612-04	40.40	39.78	35.88	35.62	31.51	79.01	38.60	38.08	39.06	42.69	39.79	36.14	38.39	38.2	35.81
	N612-05	39.81	40.03	36.96	35.29	31.12	77.43	37.84	37.59	38.62	42.48	38.51	35.72	38.26	37.33	34.99
	N612-06	40.04	40.30	35.49	35.58	31.28	78.72	38.45	37.84	39.27	42.88	39.92	36.34	38.7	37.99	35.24
	N612-07	40.75	40.12	37.30	35.91	31.99	79.16	38.47	38.02	39.19	44.27	40.15	36.24	39.43	38.86	35.63
	N612-08	40.53	39.96	35.84	35.33	31.76	78.66	38.62	38.36	39.10	42.70	39.08	36.54	38.37	37.98	36.31
	N612-09	39.46	39.64	36.11	35.32	30.60	77.57	37.89	37.40	38.48	41.43	38.82	35.33	37.57	37.05	34.69
	N612-07	40.67	40.31	37.08	35.94	31.84	79.05	38.48	38.00	39.08	43.82	39.71	36.01	39.15	38.49	35.19
	N612-08	40.47	39.97	35.72	35.35	31.69	78.62	38.59	38.36	39.05	42.55	39.03	36.5	38.29	37.85	36.14
	N612-09	39.46	39.34	36.25	35.20	30.68	77.53	37.77	37.36	38.55	41.70	39.15	35.5	37.74	37.34	35.28
	N612-10	39.83	39.94	37.23	35.41	31.07	78.04	38.30	37.59	38.92	42.42	39.29	35.78	37.75	37.63	34.93
	N612-11	40.06	40.28	36.16	35.14	31.31	77.97	38.73	37.95	38.64	42.55	38.91	36.19	39.05	37.87	35.52
	N612-12	40.72	39.63	35.96	35.92	31.85	79.17	38.01	38.17	39.13	43.21	39.67	36.06	38.54	38.23	35.98
	N612-10	39.63	39.94	37.25	35.57	31.18	78.04	38.39	37.69	39.00	42.43	39.03	35.79	37.79	37.65	34.96
	N612-11	40.55	40.10	36.20	35.00	31.25	78.14	38.37	37.84	38.58	42.59	39.67	36.06	38.94	37.75	35.37
	N612-12	40.52	39.66	35.66	36.03	31.79	79.16	38.15	38.25	39.17	43.11	39.26	36.2	38.58	38.4	36.3
	N612-13	39.97	39.70	37.43	35.28	31.80	77.98	38.04	37.70	38.62	43.32	39.28	35.73	38.13	37.78	35.33
	N612-14	40.04	40.10	34.95	35.25	31.04	78.29	38.37	37.77	39.01	41.91	38.73	36.17	38.31	37.6	35.52
	N612-15	40.49	39.91	37.12	35.91	31.36	78.81	38.47	38.16	39.03	42.89	39.86	36.05	38.68	38.25	35.53
	N612-16	39.38	40.28	37.72	35.88	31.09	78.95	38.71	38.12	38.93	42.55	38.80	36.05	38.3	38	35.63
	N612-17	40.01	39.88	36.22	35.02	31.43	78.16	38.36	38.20	38.95	42.24	39.72	36.14	38.48	37.98	35.34
	N612-18	41.34	39.58	35.12	35.64	31.75	78.06	37.86	37.45	38.83	43.52	39.49	35.89	38.47	37.83	35.64
	N612-19	40.23	39.40	36.75	35.65	31.22	78.30	37.78	37.36	38.69	41.86	39.10	35.52	38.29	37.03	34.79
	N612-20	39.98	40.13	37.38	34.81	31.18	78.75	38.70	37.80	38.99	42.43	38.56	35.84	37.92	38.03	35.52
	N612-21	40.27	40.19	35.28	36.10	31.74	78.21	38.44	38.56	39.00	43.72	40.21	36.63	38.99	38.6	36.15
	N612-19	40.28	39.52	36.84	35.72	31.24	78.68	37.92	37.52	38.85	42.33	39.71	35.89	38.76	37.43	35.16
N612-20	39.99	40.08	37.18	34.84	31.30	78.61	38.67	37.76	38.95	42.48	38.52	35.82	37.9	38.06	35.53	
N612-21	40.34	40.13	35.07	36.08	31.76	77.85	38.36	38.51	38.89	43.38	39.68	36.33	38.54	38.23	35.8	
N612-22	40.27	39.98	35.96	34.99	30.93	78.35	38.22	37.94	38.99	42.79	39.94	36.13	38.48	38.42	36.08	
N612-23	40.13	40.04	36.01	35.83	31.68	78.36	38.23	38.04	39.00	42.97	38.75	35.86	38.58	37.57	35.4	
N612-24	40.21	39.66	37.21	35.61	31.51	78.53	38.40	37.68	38.73	42.33	39.29	35.99	38.19	37.72	35.08	
N612-22	40.41	39.92	35.93	34.99	30.93	78.10	38.18	37.91	38.82	42.57	39.52	35.98	38.08	38.12	35.96	
N612-23	40.24	40.07	36.33	35.90	31.79	78.49	38.30	38.15	39.18	43.15	39.06	35.96	38.86	37.72	35.55	
N612-24	39.96	39.68	37.14	35.65	31.58	78.58	38.43	37.63	38.67	42.38	39.31	36.12	38.33	37.86	35.09	
N612-25	39.82	39.95	35.68	35.70	31.26	79.15	38.31	38.01	39.13	42.83	39.70	35.82	38.08	38.05	34.5	
N612-26	40.57	40.08	35.54	35.13	30.93	77.55	38.28	37.66	38.66	42.58	38.66	35.69	38.29	37.52	35.52	
N612-27	40.23	39.71	37.76	35.63	31.94	78.52	38.29	38.04	38.93	42.72	39.57	36.45	38.78	38.15	36.47	
N612-01	40.27	40.28	37.84	35.82	31.56	78.08	38.13	37.89	38.92	42.89	39.47	36.12	38.44	37.63	34.68	
N612-02	40.03	40.01	35.68	35.27	31.32	78.03	38.04	37.34	38.35	42.06	38.90	35.56	37.78	37.42	35.54	
N612-03	40.33	39.45	35.60	35.46	31.31	79.19	38.77	38.55	39.53	43.18	39.62	36.34	39.06	38.7	36.36	
N612-04	40.22	39.54	37.24	35.08	31.46	78.21	38.25	37.69	38.52	42.81	38.89	36.26	38.43	38.35	35.38	
N612-05	39.87	39.75	36.79	35.96	31.37	78.21	38.37	38.15	39.23	43.07	39.23	35.75	38.27	37.49	35.65	
N612-06	40.45	40.40	35.48	35.52	31.39	78.64	38.24	37.83	38.92	42.29	39.71	35.97	38.43	37.78	35.36	
N612-04	40.14	39.73	36.98	35.27	31.53	78.43	38.35	37.81	38.57	42.73	38.90	36.18	38.41	38.25	35.23	
N612-05	39.85	39.79	36.66	35.85	31.33	78.42	38.45	38.16	39.30	43.00	39.19	35.75	38.22	37.53	35.68	
N612-06	40.63	40.20	35.53	35.45	31.39	78.45	38.13	37.82	38.94	42.50	39.89	36.09	38.67	37.97	35.69	
N612-07	40.04	39.93	36.01	35.34	30.82	77.72	38.15	37.46	38.63	42.08	39.02	35.78	37.45	37.34	34.94	
N612-08	40.11	39.69	36.81	35.30	31.59	78.25	38.22	37.79	38.65	42.33	39.09	35.66	38.72	37.66	35.49	
N612-09	40.39	40.04	36.46	35.82	31.74	79.13	38.52	38.39	39.34	43.62	39.67	36.52	38.92	38.64	35.97	
N612-07	40.15	40.06	36.12	35.53	30.90	77.82	38.17	37.52	38.76	42.56	39.41	36.07	37.88	37.76	35.31	
N612-08	40.19	39.69	36.84	35.35	31.62	78.38	38.21	37.83	38.74	42.46	39.14	35.72	38.88	37.74	35.52	
N612-09	40.40	39.95	36.27	35.68	31.69	79.07	38.49	38.40	39.30	43.23	39.32	36.18	38.53	38.23	35.57	

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.03.2021	N612-20	37.42	35.52	37.46	37.57	35.33	38.38	37.89	36.57	39.27	37.23	36.56	37.56	38.64	37.79	37.36
	N612-21	37.44	35.35	36.95	37.60	35.50	37.81	37.83	36.77	39.27	36.62	37.27	37.74	38.89	37.97	37.97
	N612-22	38.01	35.44	37.66	37.87	36.43	38.86	38.60	37.05	38.95	37.50	36.92	37.81	37.36	37.92	36.81
	N612-23	37.75	35.64	37.33	37.60	35.51	38.36	38.03	36.82	39.19	37.03	36.64	37.59	38.52	37.77	37.31
	N612-24	37.20	35.37	37.00	37.48	35.52	38.31	38.08	36.59	40.26	37.10	37.33	37.31	37.88	37.68	36.56
	N612-22	37.86	35.46	37.54	37.73	36.04	38.51	38.37	36.94	38.56	37.16	36.57	37.77	37.95	37.90	37.26
	N612-23	37.86	35.78	37.20	37.48	35.14	38.10	37.66	36.80	39.02	36.80	36.44	37.57	39.17	37.71	37.80
	N612-24	37.35	35.57	37.11	37.56	35.26	38.30	37.96	36.67	40.17	37.03	37.15	37.46	38.67	37.79	37.06
	N612-25	37.69	35.55	37.55	37.80	35.76	37.97	37.91	36.56	38.98	36.95	36.46	37.41	38.37	37.41	37.58
	N612-26	37.74	35.64	37.10	37.43	35.31	38.62	38.11	37.04	39.30	37.05	36.88	37.80	38.70	38.15	37.21
	N612-01	37.49	35.45	37.35	37.02	34.89	37.82	37.20	36.41	38.70	36.57	36.45	37.67	39.68	37.36	38.23
	N612-02	37.84	35.56	36.90	38.09	35.94	38.66	38.64	37.19	39.51	37.14	37.10	37.59	37.94	38.09	36.96
	N612-04	37.65	35.42	37.40	37.27	35.19	38.19	37.39	37.11	39.47	36.60	36.23	37.16	38.39	37.64	36.97
	N612-05	37.42	35.46	36.52	37.50	35.72	37.77	37.80	36.28	38.84	36.62	36.34	37.56	38.91	37.62	37.52
	N612-06	38.00	35.87	37.97	37.94	35.50	38.87	38.67	37.01	39.26	37.68	37.48	38.05	38.53	38.04	37.71
	N612-04	37.99	35.66	37.97	37.67	35.50	38.75	38.01	37.39	39.77	37.25	36.97	37.74	38.77	37.95	37.24
	N612-05	37.15	35.49	36.32	37.38	35.42	37.59	37.87	35.92	38.40	36.53	36.23	37.29	38.17	37.48	37.47
	N612-06	37.20	35.56	37.57	37.49	35.00	38.42	38.33	36.76	38.97	37.38	37.70	38.16	38.75	38.19	37.63
	N612-07	38.41	35.72	37.65	38.28	35.84	38.73	38.83	37.21	39.33	37.59	37.36	38.11	39.14	38.21	37.96
	N612-08	38.12	35.67	37.68	37.80	35.91	38.65	37.89	37.20	39.27	37.45	36.59	37.99	38.87	38.08	37.68
	N612-09	36.75	35.43	36.71	36.85	34.85	37.65	37.40	36.14	39.07	36.13	36.26	36.84	37.83	37.18	36.61
	N612-07	38.00	35.53	37.42	37.99	35.63	38.41	38.41	36.98	39.15	37.24	37.12	37.82	38.84	37.99	37.71
	N612-08	38.01	35.64	37.57	37.71	35.85	38.59	37.76	37.10	39.20	37.34	36.49	37.89	38.68	37.97	37.57
	N612-09	37.01	35.65	36.98	37.05	35.02	37.91	37.76	36.30	39.29	36.43	36.44	37.11	38.29	37.41	36.92
	N612-10	37.94	35.62	36.72	37.43	35.49	38.17	38.47	36.70	39.15	36.69	36.63	37.11	37.59	37.71	36.60
	N612-11	37.96	35.28	37.03	37.88	35.14	38.03	37.48	36.89	38.76	37.11	36.81	37.85	38.75	37.66	37.54
	N612-12	37.36	35.84	38.07	37.59	35.84	38.67	38.07	36.86	39.60	37.23	36.72	37.87	39.33	38.01	38.00
	N612-10	37.97	35.67	36.67	37.37	35.41	38.21	38.57	36.74	39.25	36.67	36.70	37.20	38.00	37.93	36.75
	N612-11	37.57	35.31	37.07	37.79	35.16	37.88	37.38	36.72	38.58	37.03	36.66	37.72	38.56	37.44	37.57
	N612-12	37.52	35.86	38.37	37.63	35.96	38.93	38.20	36.99	39.85	37.35	36.83	38.02	39.26	38.04	37.91
	N612-13	37.81	35.71	36.43	37.76	35.45	37.74	36.96	36.49	38.79	36.95	36.12	36.65	38.62	37.64	37.60
	N612-14	37.76	35.00	38.25	37.60	35.81	38.72	38.07	37.05	39.77	37.02	36.83	38.22	38.24	37.80	37.05
	N612-15	37.57	36.08	37.09	37.45	35.22	38.36	38.92	36.82	38.99	36.98	37.09	37.83	38.76	37.90	37.43
	N612-16	37.78	35.25	37.18	37.50	36.16	38.22	37.27	36.83	38.90	37.02	36.91	37.53	38.60	38.04	36.47
	N612-17	37.78	36.05	37.89	37.49	35.51	38.20	38.31	36.77	39.18	37.06	36.94	37.59	38.69	37.80	37.19
	N612-18	37.69	35.58	36.91	37.93	34.90	38.64	38.61	36.89	39.70	37.00	36.27	37.75	38.49	37.53	38.67
	N612-19	36.42	34.92	36.77	36.81	35.06	37.35	36.94	36.03	37.98	36.30	36.25	37.34	38.32	37.48	37.36
	N612-20	38.22	35.98	37.07	37.77	35.12	38.29	38.24	37.13	39.66	37.11	37.02	37.32	38.02	38.24	37.00
	N612-21	38.42	35.84	38.05	38.15	36.39	39.19	38.67	37.19	39.85	37.55	36.84	38.11	39.38	37.67	37.64
	N612-19	36.90	35.16	37.30	37.26	35.35	37.87	37.50	36.34	38.47	36.72	36.47	37.65	38.44	37.57	37.53
N612-20	38.26	36.05	37.07	37.77	35.12	38.36	38.31	37.15	39.73	37.10	37.01	37.35	38.09	38.24	37.06	
N612-21	38.07	35.64	37.56	37.81	36.10	38.77	38.23	36.95	39.53	37.19	36.67	37.87	39.29	37.61	37.57	
N612-22	37.73	35.31	37.12	37.63	35.91	38.19	38.05	36.75	38.77	37.23	36.11	37.40	38.57	37.31	37.35	
N612-23	37.30	35.84	37.75	37.52	35.14	38.33	38.26	36.94	39.45	36.92	37.16	37.52	38.72	37.75	37.46	
N612-24	37.96	35.59	37.04	37.61	35.45	38.30	37.68	36.67	39.26	36.85	36.77	37.83	38.38	38.24	37.33	
N612-22	37.61	35.20	36.83	37.42	35.76	37.93	37.78	36.62	38.60	37.02	36.03	37.25	38.44	37.23	37.32	
N612-23	37.47	35.94	37.92	37.66	35.31	38.51	38.32	37.08	39.68	37.06	37.32	37.69	39.00	37.97	37.61	
N612-24	38.10	35.73	37.23	37.75	35.53	38.53	37.92	36.77	39.44	36.97	36.81	37.92	38.33	38.27	37.24	
N612-25	37.41	35.26	36.79	37.46	34.81	38.24	37.77	36.51	38.82	36.64	36.82	37.50	38.04	37.46	37.37	
N612-26	37.41	35.74	37.56	37.62	35.25	37.71	38.16	36.45	38.96	37.03	36.36	37.41	38.78	37.74	37.08	
N612-27	38.20	35.73	37.48	37.68	36.39	38.87	38.04	37.39	39.70	37.29	36.86	37.82	38.86	38.06	37.68	
N612-01	37.43	35.35	37.88	37.86	35.29	38.30	37.84	36.70	39.08	37.05	36.73	37.59	38.86	37.54	37.45	
N612-02	37.99	35.35	36.86	36.91	35.02	37.88	37.64	36.11	38.60	36.52	36.16	37.21	38.10	37.93	37.24	
N612-03	37.66	36.20	37.11	38.15	36.28	38.82	38.61	37.72	40.01	37.49	37.22	38.04	38.72	37.91	37.48	
N612-04	37.86	35.15	38.10	37.32	35.54	37.94	37.56	36.76	38.69	36.94	36.99	37.62	39.12	37.70	37.46	
N612-05	37.48	35.74	36.92	37.66	35.23	38.25	38.32	36.46	40.34	37.09	36.86	37.54	38.55	37.84	37.00	
N612-06	37.73	35.82	36.99	37.77	35.62	38.62	38.07	37.04	38.68	36.95	36.29	37.60	38.14	37.80	37.63	
N612-04	37.84	35.12	37.85	37.29	35.56	37.98	37.56	36.78	38.69	36.91	37.02	37.62	39.01	37.77	37.43	
N612-05	37.46	35.86	36.96	37.68	35.23	38.26	38.41	36.57	40.36	37.07	36.70	37.48	38.48	37.82	36.99	
N612-06	37.82	35.98	37.07	37.95	35.77	38.74	38.18	37.12	38.83	37.08	36.37	37.75	38.25	37.83	37.73	
N612-07	36.99	34.94	37.10	37.04	35.16	38.30	37.45	36.36	38.48	36.74	36.91	37.32	38.48	37.38	37.17	
N612-08	38.47	35.45	37.29	37.34	35.23	37.58	37.77	36.64	38.73	36.64	36.23	37.30	38.15	37.85	37.34	
N612-09	37.61	36.26	37.54	38.30	36.04	38.95	38.65	37.32	40.29	37.56	37.01	38.12	39.10	38.08	37.58	
N612-07	37.33	35.27	37.46	37.44	35.48	38.73	37.90	36.66	38.85	37.12	37.15	37.63	38.70	37.47	37.33	
N612-08	38.46	35.58	37.31	37.44	35.27	37.64	37.86	36.72	38.85	36.70	36.27	37.39	38.28	37.96	37.47	
N612-09	37.21	36.02	37.12	37.97	35.73	38.50										

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	N612-11	40.26	39.90	36.07	35.58	31.14	78.29	38.54	38.12	39.16	42.90	39.43	35.95	38.66	37.88	35.32
	N612-12	41.18	39.92	36.71	35.92	31.19	78.38	37.89	37.80	39.21	43.54	39.36	35.89	38.71	38.02	35.05
	N612-13	40.50	39.84	35.60	35.73	31.56	78.76	38.21	38.18	39.11	42.79	39.53	35.85	38.43	38.12	35.88
	N612-14	40.32	40.06	37.72	35.28	31.70	78.30	38.49	37.78	39.04	42.98	39.66	36.1	38.47	37.54	34.73
	N612-15	39.73	39.80	35.90	35.46	31.04	78.20	38.24	37.78	38.54	42.26	38.78	36.05	38.25	38.04	35.99
	N612-16	40.26	39.82	36.56	35.75	31.60	79.13	38.29	37.68	39.18	43.34	39.32	35.77	38.77	37.96	35.18
	N612-17	40.32	39.96	38.27	35.18	31.10	77.81	37.95	37.68	38.40	41.79	39.63	35.94	37.98	37.75	36.08
	N612-18	40.01	39.87	34.08	35.54	31.51	78.34	38.73	38.39	39.11	42.99	38.78	36.31	38.47	38	35.29
	N612-19	40.01	40.37	35.66	35.33	31.28	77.86	38.30	38.22	39.12	42.79	40.56	36.13	38.4	38.03	35.33
	N612-20	40.48	39.85	38.41	36.38	31.75	78.05	38.10	37.76	39.02	42.95	38.67	36.15	38.34	37.72	35.19
	N612-21	40.12	39.54	35.44	34.89	31.19	79.26	38.46	37.71	38.61	42.42	38.86	35.72	38.47	37.95	35.93
	N612-19	40.02	40.29	35.52	35.35	31.23	78.19	38.33	38.13	39.09	42.89	40.47	36.14	38.55	38.16	35.4
	N612-20	40.50	39.75	38.33	36.35	31.76	78.30	38.09	37.71	38.99	42.98	38.64	36.16	38.48	37.79	35.21
	N612-21	40.13	39.64	35.46	34.82	31.20	78.83	38.47	37.82	38.60	42.24	38.73	35.72	38.15	37.72	35.93
	N612-22	40.20	39.97	35.79	35.38	31.46	78.06	38.45	38.14	38.80	42.28	39.23	35.71	38.4	37.88	35.56
	N612-23	39.76	39.30	37.56	35.43	31.45	78.13	38.32	37.73	38.88	42.93	39.04	35.89	38.37	37.87	35.39
	N612-24	40.62	40.46	35.93	35.71	31.30	78.94	38.14	37.87	39.05	42.92	39.74	36.4	38.45	37.98	35.52
	N612-22	40.24	39.83	35.79	35.41	31.57	77.96	38.34	38.08	38.74	42.35	39.36	35.72	38.46	37.87	35.61
	N612-23	39.90	39.44	37.53	35.37	31.28	78.29	38.41	37.76	38.92	42.91	39.02	35.93	38.33	37.81	35.18
	N612-24	40.54	40.43	35.94	35.78	31.37	78.94	38.12	37.81	39.08	42.95	39.52	36.41	38.45	38.03	35.66
	N612-25	39.45	40.28	37.14	35.90	31.31	79.35	38.34	38.12	39.11	42.68	39.33	36.17	38.14	37.91	36.01
	N612-26	40.94	39.91	35.82	34.39	30.99	77.95	38.41	37.75	38.38	42.03	39.45	35.92	38.21	37.88	35.27
	N612-27	40.14	39.54	36.35	36.25	31.88	77.99	38.18	37.88	39.20	43.34	39.12	35.89	38.81	37.9	35.3
	N612-01	40.17	40.18	35.71	35.34	31.31	78.41	38.09	38.09	38.89	42.54	38.56	35.81	38.03	37.91	35.05
	N612-02	40.21	39.79	36.44	35.29	31.21	78.38	38.36	37.96	38.95	42.78	40.06	36.1	38.51	37.71	36.01
	N612-03	40.22	39.71	37.20	36.02	31.71	78.35	38.49	37.58	38.82	42.78	39.22	36.04	38.74	38.06	35.57
	N612-04	40.29	39.65	36.37	35.28	31.50	78.70	38.36	37.95	39.13	42.79	39.84	36.62	38.3	38.2	35.31
	N612-05	40.07	40.05	36.75	34.98	31.47	78.57	38.33	38.03	39.03	42.87	40.63	35.92	38.63	37.82	34.92
	N612-06	40.24	40.01	35.99	36.16	31.22	77.99	38.20	37.77	38.58	42.45	37.64	35.54	38.21	37.71	36.21
	N612-04	40.15	39.84	36.57	35.43	31.52	78.67	38.24	37.80	39.07	42.70	39.79	36.61	38.33	38.09	35.28
	N612-05	40.16	40.07	36.75	35.00	31.52	78.70	38.42	38.24	39.00	42.93	40.39	35.76	38.58	37.49	34.98
	N612-06	40.36	39.86	35.91	36.16	31.18	77.83	38.26	37.65	38.61	42.54	37.70	35.67	38.42	37.78	36.47
	N612-07	39.82	39.51	36.04	35.05	31.23	77.95	38.17	38.10	39.04	42.15	39.67	35	37.56	37.25	34.25
	N612-08	40.24	39.90	36.08	35.86	31.07	78.65	38.36	37.83	38.52	42.92	38.89	36.48	38.43	38.04	36.12
	N612-09	40.49	40.24	37.06	35.52	31.89	78.62	38.35	37.80	39.17	43.00	39.51	36.54	39.14	38.38	36
	N612-07	39.79	39.53	35.97	35.01	31.21	77.83	38.17	38.05	39.05	42.32	39.82	35.13	37.78	37.48	34.55
	N612-08	40.27	39.93	36.09	35.90	31.10	78.65	38.35	37.81	38.51	42.93	38.82	36.51	38.49	38.06	36.18
	N612-09	40.57	40.26	37.16	35.63	31.99	78.73	38.34	37.80	39.15	42.84	39.23	36.46	39.03	38.17	35.82
	N612-10	40.45	39.95	37.22	35.63	31.49	78.88	38.43	37.97	38.84	43.16	39.04	36.45	38.4	38.31	36.22
	N612-11	40.16	40.37	35.87	35.62	30.93	78.45	38.79	38.01	39.07	42.53	39.74	35.79	38.71	37.75	35.62
	N612-12	39.97	39.39	36.07	35.24	31.72	77.89	37.75	37.76	38.79	42.44	39.16	35.73	38.04	37.65	34.71
	N612-10	40.61	39.99	37.27	35.68	31.53	78.88	38.35	37.91	38.79	43.03	38.84	36.33	38.27	38.13	35.97
	N612-11	40.16	40.36	35.85	35.61	30.96	78.43	38.76	37.99	39.08	42.51	39.73	35.79	38.72	37.74	35.6
	N612-12	39.80	39.33	35.97	35.19	31.74	77.83	37.77	37.79	38.84	42.54	39.34	35.86	38.19	37.81	34.9
	N612-13	40.08	39.78	36.06	35.45	31.34	78.51	38.37	38.00	38.91	42.61	39.84	35.85	38.86	38.01	35.15
	N612-14	40.38	40.07	36.84	35.58	31.44	78.37	38.28	37.81	38.88	42.82	38.75	36.19	37.98	37.82	35.93
	N612-15	40.03	40.00	36.59	35.73	31.61	78.99	38.06	37.85	39.26	42.51	40.07	36.15	38.55	37.97	35.6
	N612-16	40.10	39.80	36.77	35.35	31.25	77.89	38.29	37.65	38.39	42.36	38.77	35.6	37.9	37.32	35.27
	N612-17	40.60	39.91	35.84	35.35	31.29	78.14	38.57	38.19	39.00	43.23	38.80	36.18	38.68	38.35	35.58
	N612-18	39.88	39.93	35.93	35.70	31.54	79.50	38.39	38.42	39.19	43.88	40.66	36.79	39.67	39.04	36.05
	N612-19	40.16	39.69	36.04	35.55	31.30	78.01	38.80	37.77	39.17	41.91	39.00	35.88	37.63	37.84	35.22
	N612-20	40.48	40.08	37.21	35.31	31.39	77.90	37.75	37.56	38.43	42.43	38.56	35.47	38.08	37.02	35.3
	N612-18	39.36	39.82	35.48	35.86	31.60	80.28	38.49	38.77	39.32	45.01	42.12	37.49	40.8	40.19	37
	N612-19	39.79	39.83	36.08	35.71	31.52	78.67	38.91	38.16	39.49	42.64	39.78	36.37	38.43	38.56	35.63
01.03.2021	N612-20	40.55	39.95	36.76	35.29	31.27	78.17	37.73	37.67	38.32	42.74	38.79	35.64	38.41	37.25	35.37
	N612-21	41.14	40.17	36.04	35.51	31.48	77.92	38.09	37.55	39.03	43.01	39.77	35.98	37.98	38.1	35.5
	N612-22	39.34	39.64	36.70	35.51	31.33	78.88	38.54	38.25	38.82	42.41	38.90	36.04	38.81	37.76	35.51
	N612-01	39.88	40.33	37.14	35.25	31.48	78.54	38.32	37.80	38.84	42.32	39.73	36.17	38.54	37.98	35.11
	N612-02	40.25	39.79	35.75	35.61	31.18	78.66	38.51	38.30	39.31	42.95	38.84	36.05	38.44	38.11	35.47
	N612-03	40.51	39.56	36.29	35.64	31.55	77.91	38.00	37.59	38.49	42.87	39.34	35.77	38.16	37.55	35.93
	N612-04	40.30	39.74	35.80	35.60	31.32	78.54	38.69	37.97	39.14	42.55	38.75	35.98	38.85	38.18	36.14
	N612-05	40.11	39.96	37.74	35.75	31.77	78.69	38.05	37.64	38.86	42.89	40.11	35.87	38.1	37.81	35.35
	N612-06	40.16	40.03	35.68	35.15	31.11	78.04	38.24	38.11	38.76	42.61	39.04	36.17	38.34	37.78	35.05
	N612-04	40.44	39.88	36.04	35.61	31.17	78.19	38.39	37.81	39.03	42.28	38.61	35.8	38.67	37.91	35.73
	N612-05	40.32	40.16	37.88	35.91	32.02	79.28	38.35	37.92	38.97	43.22	40.07	36.09	38.34	38.01	35.54
	N612-06	39.85	39.69	35.42	35.04	31.10	77.80	38.15	38.04	38.76	42.77	39.42	36.17	38.17	37.82	35.23
	N612-07	39.30	39.51	34.83	34.26	30.59	77.62	38.14	37.25	37.81	41.55	38.52	35.67	37.88	37.25	34.93
	N612-08	41.26	40.35	38.22	36.99	32.34	79.29	38.49	38.61	40.17	43.98	40.10	36.34	39.01	38.63	36.18
	N612-07	39.44	39.74	35.89	34.73	31.03	78.84	38.40	37.76	38.48	42.66	39.73	36.14	38.39	37.9	36.02
	N612-08	41.64	40.30	39.35	37.67	32.86	80.31	38.43	38.80	40.74	44.81	40.71	36.62	39.36	39.09	36.8

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	N612-11	38.63	36.04	38.14	37.75	35.30	38.13	37.78	36.68	39.50	37.16	36.87	37.68	38.56	37.98	37.46
	N612-12	36.62	35.68	37.27	37.79	35.36	38.24	38.32	36.63	38.71	36.79	36.69	37.52	38.95	37.40	37.73
	N612-13	37.68	35.52	36.97	37.56	35.99	38.50	38.04	36.87	38.92	37.05	37.01	37.50	38.25	38.04	37.64
	N612-14	38.03	35.77	37.27	37.64	35.84	38.29	37.89	36.65	39.24	37.13	36.22	37.63	39.24	37.50	37.19
	N612-15	37.49	35.48	37.57	37.57	34.82	38.16	38.05	36.91	39.45	36.85	36.88	37.66	38.20	37.88	37.29
	N612-16	38.06	35.50	37.19	37.53	35.35	37.83	37.70	36.74	39.35	36.75	36.32	37.43	38.96	37.46	37.69
	N612-17	37.21	35.35	37.09	37.23	35.17	38.42	38.02	36.68	38.90	36.98	37.10	37.59	38.30	37.82	37.02
	N612-18	37.84	35.98	37.78	38.14	36.03	38.73	38.37	37.05	39.41	37.33	36.82	37.80	38.46	38.14	37.48
	N612-19	37.35	35.88	36.81	37.53	35.49	38.47	37.77	36.61	38.97	36.98	35.81	37.80	38.55	37.73	37.17
	N612-20	38.45	35.28	36.85	37.46	36.07	38.10	37.95	36.60	39.03	36.93	37.04	37.28	38.10	38.00	37.29
	N612-21	37.35	35.63	38.13	37.75	34.96	38.28	38.20	37.13	39.57	37.05	37.15	37.70	39.06	37.61	37.67
	N612-19	37.33	35.93	36.91	37.56	35.56	38.52	37.76	36.70	38.99	36.99	35.91	37.86	38.64	37.76	37.22
	N612-20	38.41	35.35	36.88	37.48	36.07	38.11	38.00	36.65	39.05	36.96	37.12	37.31	38.15	38.03	37.33
	N612-21	37.38	35.56	38.11	37.79	34.85	38.26	38.25	37.12	39.52	37.09	37.19	37.62	38.93	37.54	37.63
	N612-22	37.97	35.09	38.00	37.54	35.52	38.18	38.09	36.53	40.06	36.59	36.48	37.56	38.77	37.86	37.26
	N612-23	37.38	35.76	37.55	37.60	35.36	38.34	38.11	36.77	38.75	37.26	37.27	37.67	38.48	37.93	37.57
	N612-24	37.76	35.95	36.39	37.64	35.66	38.39	37.79	37.04	38.84	37.12	36.29	37.59	38.45	37.61	37.29
	N612-22	37.95	35.13	37.87	37.50	35.45	38.10	38.07	36.52	39.97	36.62	36.44	37.55	38.89	37.78	37.33
	N612-23	37.29	35.78	37.53	37.56	35.29	38.35	38.18	36.81	38.65	37.24	37.28	37.55	38.25	37.91	37.53
	N612-24	37.82	35.97	36.40	37.71	35.74	38.46	37.74	37.12	38.88	37.20	36.42	37.75	38.60	37.67	37.36
	N612-25	37.89	35.67	37.29	37.87	36.05	38.57	38.26	37.09	39.72	37.15	36.66	37.47	38.88	37.94	37.51
	N612-26	37.72	35.59	37.51	37.79	35.14	38.16	37.45	36.49	38.50	36.68	36.59	37.20	37.16	37.58	36.22
	N612-27	37.53	35.49	37.21	37.20	35.37	38.19	38.33	36.82	39.51	37.14	36.84	38.08	39.76	37.88	38.44
	N612-01	37.69	35.24	37.12	37.50	35.20	38.16	37.65	36.45	38.72	36.34	36.41	37.14	38.36	37.90	37.02
	N612-02	37.92	35.61	37.31	37.78	35.53	38.37	38.07	36.79	39.23	37.31	37.11	37.86	38.65	37.65	37.64
	N612-03	37.52	36.09	37.59	37.54	35.86	38.40	38.38	37.22	39.76	37.52	36.62	37.85	38.71	37.84	37.56
	N612-04	37.48	35.31	36.94	37.33	35.29	38.13	37.80	37.02	39.18	36.76	36.63	37.72	38.50	37.62	37.07
	N612-05	37.42	35.60	37.01	37.86	35.56	38.60	38.14	36.91	39.42	37.20	36.66	37.84	39.07	37.86	37.58
	N612-06	38.18	35.80	37.88	37.59	35.58	38.15	37.99	36.46	38.94	36.94	36.79	37.22	38.14	37.88	37.42
	N612-04	37.48	35.34	36.80	37.29	35.27	37.97	37.71	36.88	39.11	36.68	36.52	37.72	38.59	37.61	37.09
	N612-05	37.34	35.60	37.07	37.92	35.61	38.73	38.25	36.97	39.45	37.23	36.67	37.73	38.90	37.85	37.59
	N612-06	38.38	35.98	38.24	37.73	35.81	38.32	38.22	36.59	39.15	37.21	36.96	37.40	38.30	37.94	37.54
	N612-07	36.94	35.08	36.82	36.82	34.42	37.83	36.87	36.38	38.61	36.54	36.19	37.06	37.96	37.82	36.99
	N612-08	38.66	35.68	37.10	37.98	35.66	38.45	38.47	36.95	38.92	37.02	37.42	37.74	38.65	37.76	37.77
	N612-09	37.45	35.95	37.83	37.92	36.31	38.56	38.55	37.05	40.01	37.36	36.46	37.97	39.07	37.77	37.34
	N612-07	37.23	35.21	37.18	37.07	34.68	38.15	37.14	36.54	38.84	36.82	36.37	37.25	37.94	37.81	36.92
	N612-08	38.70	35.73	37.16	38.03	35.74	38.46	38.56	36.96	38.98	37.05	37.41	37.77	38.70	37.77	37.80
	N612-09	37.25	35.92	37.58	37.77	36.18	38.28	38.44	36.91	39.90	37.15	36.26	37.83	39.20	37.80	37.48
	N612-10	37.43	35.41	37.28	37.48	35.71	38.42	37.83	36.81	38.93	37.06	36.92	37.69	38.59	37.76	37.51
	N612-11	37.72	35.82	37.50	37.90	35.74	38.37	38.32	37.05	39.31	37.04	37.48	37.53	38.49	37.62	37.15
	N612-12	37.92	35.51	37.11	37.39	35.01	38.12	37.76	36.54	39.26	36.89	35.84	37.55	38.55	37.98	37.45
	N612-10	37.29	35.35	37.11	37.33	35.54	38.19	37.75	36.68	38.84	36.88	36.70	37.58	38.64	37.75	37.53
	N612-11	37.76	35.86	37.51	37.91	35.76	38.37	38.35	37.04	39.37	37.05	37.43	37.54	38.51	37.63	37.15
	N612-12	38.13	35.63	37.29	37.57	35.21	38.35	37.91	36.66	39.48	37.08	35.96	37.69	38.53	38.01	37.43
	N612-13	37.43	35.35	37.33	37.71	35.18	38.21	38.07	36.99	38.74	37.10	36.67	37.59	38.88	37.73	37.58
	N612-14	37.90	35.83	37.25	37.47	35.84	38.38	37.92	36.62	39.61	36.88	36.78	37.60	38.29	37.83	37.20
	N612-15	37.47	35.92	37.20	37.25	35.30	37.81	37.95	36.61	38.88	36.53	36.30	37.44	38.57	37.73	37.80
	N612-16	37.26	35.16	37.04	37.73	35.17	38.29	37.69	36.45	38.96	37.07	37.31	37.34	38.73	37.69	36.69
	N612-17	38.33	35.61	37.64	37.80	36.05	38.80	38.33	37.39	39.82	37.38	36.37	38.03	38.40	37.93	37.64
	N612-18	39.19	36.28	38.01	38.44	36.30	39.27	38.74	37.41	39.85	38.16	37.67	38.18	38.52	38.24	37.75
	N612-19	37.33	35.65	37.15	37.23	35.20	38.28	37.76	36.74	39.00	36.66	36.72	37.56	38.57	37.65	37.09
	N612-20	36.79	35.01	36.82	37.22	35.07	37.48	37.58	36.30	38.79	36.32	35.88	37.12	38.62	37.53	37.35
	N612-18	40.56	36.94	38.95	39.25	37.17	40.35	39.65	38.01	40.38	39.24	38.27	38.81	38.62	38.54	38.07
	N612-19	38.23	36.09	37.77	37.85	35.89	38.92	38.25	37.15	39.48	37.42	37.35	38.02	38.69	37.97	37.36
01.03.2021	N612-20	37.23	35.12	36.80	37.35	35.10	37.68	37.76	36.47	38.93	36.58	36.10	37.19	38.46	37.61	37.41
	N612-21	37.08	35.50	37.69	37.70	35.67	38.59	37.89	36.68	39.02	37.06	36.32	37.54	38.49	37.82	37.38
	N612-22	38.34	35.73	36.97	37.53	35.37	38.08	38.12	36.94	39.39	36.98	37.11	37.68	38.66	37.77	37.38
	N612-01	36.87	35.75	37.94	37.31	35.62	38.25	38.30	36.66	39.26	36.81	36.56	37.50	38.83	37.91	36.98
	N612-02	37.89	35.86	37.25	37.90	35.53	38.44	38.26	37.14	39.19	37.49	36.97	37.70	38.56	37.76	37.73
	N612-03	38.47	35.11	36.65	37.56	35.36	38.18	37.38	36.55	39.11	36.71	36.56	37.64	38.24	37.65	37.49
	N612-04	38.03	35.65	37.48	37.77	35.15	38.29	37.76	37.06	39.43	36.79	36.87	37.24	38.78	38.02	37.21
	N612-05	37.34	35.97	36.83	37.82	35.73	38.72	38.33	36.87	39.17	37.16	36.49	37.79	38.85	37.90	37.30
	N612-06	37.66	35.26	37.70	37.23	35.60	37.92	37.95	36.52	39.05	37.03	36.76	37.72	38.17	37.51	37.57
	N612-04	37.57	35.52	37.19	37.49	34.88	37.87	37.29	36.70	39.16	36.47	36.62	37.03	38.61	37.82	37.11
	N612-05	37.64	36.00	36.89	37.91	35.96	39.05	38.66	37.12	39.24	37.42	36.91	38.12	38.94	38.16	37.63
	N612-06	37.98	35.28	37.91	37.44	35.82	38.07	38.17	36.59	39.26	37.28	36.60	37.78	38.19	37.42	37.56
	N612-07	37.10	35.49	37.11	37.23	35.20	38.00	38.38	36.72	38.57	36.40	36.30	37.46	37.77	37.10	36.26
	N612-08	38.33	35.74	37.45	38.00	35.74	38.61	37.53	36.90	39.89	37.60	37.14	37.69	39.50	38.60	38.64
	N612-07	37.75	35.80	37.82	37.80	36.05	39.06	38.76	37.22	39.39	37.49	37.07	38.01	38.38	37.45	36.80
	N612-08	38.71	35.95	37.86	38.38	36.29	39.32	37.51	36.96	40.31	38.35	37.75	37.89	40		

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	N612-09	41.11	40.10	37.20	36.43	31.86	77.91	38.19	38.08	39.40	42.78	38.81	35.88	38.44	37.91	34.93
	N612-10	40.21	39.75	34.25	35.62	31.24	78.33	38.23	37.68	38.82	42.35	39.35	35.61	37.97	37.7	35.37
	N612-11	40.06	40.02	38.24	35.25	31.50	78.54	38.38	38.10	38.92	43.05	39.32	36.42	38.83	38.1	35.72
	N612-10	40.28	39.76	34.52	35.69	31.30	78.24	38.19	37.65	38.78	42.56	39.45	35.45	37.97	37.73	35.5
	N612-11	40.05	40.02	38.54	35.33	31.63	78.59	38.41	38.11	38.92	43.18	39.42	36.25	38.79	38.06	35.8
	N612-12	40.19	39.99	36.11	35.42	31.28	78.35	38.35	38.01	39.10	42.37	39.02	36.43	38.51	37.93	35.13
	N612-13	40.59	39.45	36.07	35.50	31.44	78.38	37.99	37.82	38.27	42.60	39.46	35.57	38.37	37.74	35.91
	N612-14	40.40	40.09	38.02	35.93	31.36	79.04	38.56	37.77	39.17	43.02	38.74	36.68	38.59	38.33	35.49
	N612-15	39.70	40.12	35.23	35.13	31.41	77.83	38.32	38.07	39.19	42.51	39.71	35.72	38.22	37.65	35.19
	N612-13	40.57	39.41	35.90	35.37	31.45	78.33	37.94	37.74	38.23	42.34	39.35	35.55	38.23	37.55	35.67
	N612-14	40.28	40.12	38.28	35.89	31.34	79.05	38.63	37.84	39.29	43.10	38.74	36.65	38.59	38.42	35.55
	N612-15	39.69	40.28	35.29	35.24	31.43	77.83	38.39	38.16	39.33	42.73	39.86	35.85	38.4	37.77	35.2
	N612-16	40.32	39.58	34.95	35.59	31.07	78.18	38.26	37.84	38.81	42.66	39.02	36.31	38.46	38.02	36.07
	N612-17	40.15	40.13	37.80	35.43	31.71	78.64	38.30	37.93	38.91	42.71	39.53	35.7	38.33	37.77	35.03
	N612-18	41.07	39.58	36.86	35.74	31.31	79.36	38.07	38.20	38.94	42.69	39.77	35.94	38.59	38.21	35.55
	N612-19	39.58	40.15	34.85	35.75	31.70	78.16	38.33	37.67	39.00	42.70	38.72	36.24	38.33	37.28	35.27
	N612-20	39.86	40.02	37.55	34.96	31.15	77.46	38.54	37.78	38.71	42.66	39.33	35.8	38.18	38.16	35.64
	N612-21	40.27	39.92	36.67	35.69	32.02	79.73	38.33	38.13	39.39	43.36	39.86	36.32	39.37	38.36	36.03
	N612-22	40.22	39.85	36.09	35.38	30.86	77.33	38.24	37.72	38.47	42.10	38.82	35.72	37.57	37.49	35.01
	N612-21	40.33	40.04	37.09	35.95	32.23	80.52	38.19	38.00	39.65	44.11	40.50	36.61	40.21	39	36.61
	N612-22	40.39	39.93	36.75	35.68	31.07	78.06	37.99	37.52	38.71	42.80	39.40	35.94	38.37	38.11	35.55
	N612-23	39.99	39.86	36.01	35.30	31.77	78.78	38.66	38.33	39.11	42.59	39.19	36.07	38.43	37.67	35.45
	N612-24	40.22	39.90	36.43	35.52	31.37	78.37	38.27	37.86	38.88	42.71	39.31	35.99	38.4	37.92	35.5
	N612-24	39.77	39.87	35.57	35.38	31.22	77.98	38.28	38.06	38.98	43.02	39.46	35.82	38.08	37.7	35.75
	N612-25	40.80	39.84	36.50	35.51	31.95	78.91	38.24	38.01	38.68	43.02	38.85	36.17	38.79	38.32	36.11
	N612-26	40.07	40.00	37.26	35.63	31.05	78.36	38.38	37.61	39.04	42.02	39.60	36.03	38.37	37.69	34.61
	N612-27	40.50	39.69	37.30	34.92	31.73	78.93	38.62	37.85	39.07	42.85	39.45	36.07	38.24	38.59	36.65
	N612-28	40.18	39.89	36.28	35.48	31.41	78.37	38.29	37.93	38.90	42.77	39.29	35.98	38.38	37.9	35.58
	N612-01	40.38	40.50	35.30	35.48	31.48	78.32	38.53	37.64	38.86	43.26	40.80	36.07	38.45	38.47	35.19
	N612-02	39.53	39.85	36.84	35.18	31.12	78.28	38.54	38.11	39.08	42.32	38.63	36.04	37.91	37.14	35.99
	N612-03	40.77	39.33	37.32	35.89	31.63	78.61	37.75	37.92	38.75	42.50	38.25	35.85	38.84	37.95	35.43
	N612-04	39.65	39.54	36.82	34.96	31.06	78.44	38.64	38.35	38.97	42.53	40.42	36.22	38.56	38.36	35.13
	N612-05	40.30	39.95	34.26	36.18	31.66	78.63	38.46	37.93	38.94	42.30	38.40	36	38.27	38.13	35.32
	N612-06	40.58	40.26	37.89	35.33	31.45	78.13	37.92	37.47	38.81	43.30	39.39	35.82	38.36	37.33	35.99
	N612-04	39.72	40.06	37.04	35.04	30.95	78.12	38.50	38.20	38.87	42.61	40.31	36.2	38.56	38.24	35.16
	N612-05	40.45	39.91	34.30	36.11	31.76	78.63	38.39	37.92	38.95	42.56	38.30	36.02	38.33	38.09	35.39
	N612-06	40.57	39.74	37.89	35.45	31.56	78.52	37.98	37.52	38.91	43.01	39.26	35.74	38.3	37.3	35.99
	N612-07	39.88	39.60	36.52	35.01	31.25	78.19	38.18	37.95	38.47	42.21	39.44	36.06	38.2	37.83	35.62
	N612-08	39.83	39.89	36.43	35.63	31.48	78.19	38.47	37.99	39.27	43.10	39.22	36.05	38.75	38.41	35.78
	N612-09	40.80	40.21	36.20	35.81	31.42	78.76	38.28	37.82	38.95	42.76	39.32	35.93	38.28	37.56	35.07
	N612-07	40.05	39.80	36.43	35.09	31.27	78.20	38.13	37.83	38.45	42.28	39.38	35.97	38.2	37.79	35.63
01.03.2021	N612-08	39.87	39.90	36.42	35.68	31.49	78.24	38.46	37.97	39.29	43.13	39.18	36.03	38.73	38.37	35.79
	N612-09	40.70	40.03	36.29	35.84	31.41	78.84	38.30	37.91	39.03	42.74	39.32	35.98	38.25	37.51	35.08
	N612-10	40.39	39.71	37.45	35.33	31.77	78.53	38.49	37.83	39.03	42.70	39.59	36.18	38.77	38.18	35.94
	N612-11	40.41	40.27	34.97	35.50	31.29	77.87	38.44	38.12	38.79	43.05	38.99	35.96	38.27	37.76	34.21
	N612-12	39.82	39.71	36.79	35.59	31.19	78.73	38.01	37.76	38.85	42.37	39.34	35.89	38.21	37.82	36.4
	N612-10	40.34	39.72	37.64	35.50	31.80	78.61	38.45	37.88	39.06	42.79	39.56	36.17	38.78	38.14	35.96
	N612-11	40.43	40.28	34.93	35.54	31.25	77.91	38.44	38.14	38.81	43.06	38.98	35.97	38.26	37.75	34.25
	N612-12	39.89	39.73	36.52	35.52	31.08	78.74	38.04	37.74	38.86	42.31	39.35	35.91	38.17	37.82	36.47
	N612-13	39.70	39.95	36.29	35.23	31.77	78.11	37.95	37.51	38.49	42.42	39.03	35.65	38.15	37.87	34.62
	N612-14	40.27	39.69	36.76	35.17	31.28	78.30	38.46	37.94	39.09	42.41	39.98	35.93	38.41	37.58	35.77
	N612-15	40.62	40.06	36.22	36.07	31.23	78.75	38.50	38.24	39.11	43.27	38.93	36.4	38.66	38.25	36.02
	N612-13	39.70	40.00	36.04	35.23	31.69	78.14	38.02	37.57	38.54	42.38	39.04	35.74	38.15	37.92	34.71
	N612-14	40.27	39.68	36.74	35.21	31.24	78.30	38.46	37.98	39.11	42.45	39.91	35.97	38.43	37.59	35.84
	N612-15	40.65	39.98	36.43	36.15	31.23	78.73	38.43	38.25	39.11	43.39	38.81	36.39	38.7	38.23	36.08
	N612-16	40.59	40.67	36.49	35.47	31.44	79.21	38.70	37.79	39.13	42.46	40.74	35.65	38.23	37.82	35.74
	N612-17	40.59	39.01	36.37	35.64	31.43	78.05	37.95	37.58	38.50	42.79	38.84	36.12	38.26	37.94	35.2
	N612-18	39.47	40.11	36.33	35.34	31.37	78.02	38.26	38.25	39.04	42.75	38.59	36.15	38.64	37.91	35.48
	N612-19	39.40	40.23	36.72	35.51	31.24	78.49	38.63	37.89	38.82	41.99	38.95	35.64	38.17	37.74	34.97
	N612-20	40.58	39.82	36.88	35.41	31.59	78.63	38.20	38.39	38.98	43.37	39.01	35.99	38.46	37.98	36.13
	N612-21	40.66	39.66	35.62	35.56	31.38	77.99	38.01	37.36	38.87	42.82	40.00	36.4	38.57	37.98	35.42
	N612-22	40.43	39.78	35.03	35.81	31.55	79.02	38.58	38.44	39.22	42.77	39.25	36.27	38.73	38.24	35.51
	N612-23	40.88	39.48	37.90	35.33	31.26	78.13	38.13	37.57	38.72	42.56	39.80	35.86	38.21	37.49	35.88
	N612-24	39.32	40.44	36.23	35.39	31.39	78.15	38.26	37.78	38.79	42.72	38.83	35.85	38.27	37.98	35.12
	N612-01	40.36	40.13	37.25	35.77	31.49	79.36	38.53	38.28	39.07	43.01	39.54	36.14	38.64	37.82	34.94
	N612-02	39.78	39.64	36.42	35.34	31.33	77.37	38.25	37.73	38.57	42.58	39.06	35.68	38.04	37.71	35.72
	N612-03	40.46	39.96	35.35	35.37	31.40	78.50	38.15	37.72	39.11	42.49	39.26	36.15	38.5	38.18	35.79
	N612-04	40.18	39.64	36.70	35.62	31.16	78.12	37.84	37.53	38.69	42.70	39.46	36.31	38.58	38.05	36.03
	N612-05	40.53	39.96	37.06	35.42	31.53	78.82	38.63	37.98	38.71	42.73	39.36	35.9	38.38	37.73	35.84
	N612-06	39.91	40.08	35.65	35.50	31.50	78.31	38.42	38.19	39.26	42.71	39.12	35.83	38.27	37.91	34.69

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Hol65	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	N612-09	37.63	35.40	36.75	37.38	34.93	37.49	37.17	36.35	38.96	36.47	36.31	37.16	38.80	38.23	38.07
	N612-10	37.81	35.28	36.80	37.48	35.04	37.92	37.83	36.53	39.46	36.82	36.42	37.42	38.53	37.33	37.46
	N612-11	37.60	35.96	37.90	37.75	36.06	38.81	38.29	37.15	38.97	37.26	37.05	37.85	38.58	38.21	37.20
	N612-10	37.83	35.31	36.74	37.52	35.18	37.89	37.71	36.55	39.16	36.90	36.52	37.42	38.45	37.14	37.52
	N612-11	37.54	35.96	37.72	37.71	36.09	38.70	37.99	37.14	38.59	37.26	37.12	37.83	38.55	38.06	37.31
	N612-12	37.62	35.58	37.53	37.58	35.23	38.40	38.35	36.78	39.86	36.86	36.49	37.59	38.81	38.34	37.25
	N612-13	37.89	35.40	37.49	37.57	35.59	37.92	37.74	36.48	39.11	36.81	36.69	37.26	37.97	37.51	37.61
	N612-14	38.62	35.96	37.22	37.64	36.13	38.78	38.68	37.11	39.87	37.24	36.62	38.03	38.93	38.00	37.39
	N612-15	36.77	35.44	37.15	37.58	34.88	38.17	37.59	36.79	38.65	36.95	36.78	37.50	38.75	37.77	37.19
	N612-13	37.63	35.29	37.28	37.41	35.47	37.84	37.57	36.37	39.04	36.66	36.52	37.18	37.95	37.50	37.48
	N612-14	38.74	36.02	37.19	37.64	36.09	38.86	38.73	37.19	39.91	37.26	36.65	38.09	38.96	38.07	37.44
	N612-15	36.76	35.53	37.43	37.78	34.90	38.29	37.77	36.92	38.64	37.15	37.00	37.59	38.92	37.87	37.20
	N612-16	37.66	35.63	37.46	37.68	36.00	38.16	37.96	36.71	39.59	36.82	36.38	37.73	38.61	37.48	37.38
	N612-17	37.80	35.56	37.14	37.50	35.10	38.39	38.02	36.84	38.88	37.13	36.96	37.46	38.47	38.06	37.40
	N612-18	37.19	35.53	37.04	37.32	35.20	38.02	37.75	36.92	38.89	36.61	36.21	37.33	38.76	37.91	37.73
	N612-19	38.03	35.56	37.13	37.80	35.64	38.28	38.14	36.65	38.60	36.93	36.58	37.82	38.47	37.89	37.27
	N612-20	37.93	35.69	37.78	37.72	35.66	38.62	38.12	36.80	40.20	37.51	37.41	37.68	38.43	37.50	37.06
	N612-21	38.12	35.95	37.37	37.79	36.10	38.69	38.35	37.13	39.42	37.39	36.72	37.73	38.89	38.29	37.67
	N612-22	37.26	35.26	37.18	37.39	34.93	37.90	37.65	36.50	38.91	36.58	36.60	37.45	38.30	37.36	37.16
	N612-21	39.11	36.41	37.76	38.20	36.88	39.04	38.76	37.27	39.04	37.83	37.12	38.01	39.20	38.65	37.74
	N612-22	38.12	35.67	37.55	37.76	35.65	38.15	38.06	36.57	38.41	36.90	36.91	37.68	38.57	37.61	37.17
	N612-23	37.24	35.52	37.02	37.42	35.33	38.47	37.93	37.06	40.12	37.12	36.46	37.51	38.58	37.99	37.62
	N612-24	37.74	35.61	37.32	37.61	35.51	38.29	38.01	36.78	39.13	36.99	36.72	37.61	38.57	37.77	37.36
	N612-24	38.26	35.54	37.24	37.77	35.60	38.14	37.74	36.78	39.32	37.30	36.80	37.52	38.73	37.83	37.47
	N612-25	36.94	35.84	37.52	37.62	34.88	38.51	38.41	36.87	39.60	36.83	36.73	37.76	38.30	37.90	37.53
	N612-26	37.88	35.43	37.14	37.40	36.06	38.26	37.88	36.75	38.66	36.84	36.56	37.53	38.68	37.62	37.12
	N612-27	38.63	35.89	35.96	37.52	35.89	38.81	37.94	37.16	38.69	37.35	37.03	37.76	38.11	38.07	37.54
	N612-28	37.73	35.61	37.31	37.63	35.47	38.29	37.99	36.80	39.25	37.03	36.72	37.60	38.57	37.80	37.40
	N612-01	38.35	35.85	37.26	37.67	35.72	38.42	38.33	36.95	39.16	36.95	37.26	37.93	38.72	37.96	38.04
	N612-02	37.37	35.51	38.00	37.68	35.48	38.18	37.97	36.57	38.96	37.12	36.56	37.43	38.67	37.54	36.89
	N612-03	37.31	35.45	36.75	37.48	35.37	38.29	37.61	36.82	39.45	36.93	36.24	37.40	38.32	37.83	37.13
	N612-04	37.79	35.22	36.55	37.37	34.60	38.05	38.27	36.87	39.47	36.90	36.79	37.62	38.34	37.99	37.42
	N612-05	37.29	35.86	37.47	37.62	35.81	38.65	38.15	37.22	39.30	37.42	36.14	37.57	38.60	37.74	37.39
	N612-06	38.09	35.73	37.86	37.80	36.05	38.20	37.68	36.37	38.85	36.70	37.25	37.65	38.78	37.67	37.40
	N612-04	37.86	35.21	36.66	37.41	34.69	38.15	38.43	36.86	39.38	36.98	36.86	37.61	38.26	37.85	37.15
	N612-05	37.30	35.90	37.43	37.69	35.91	38.71	38.08	37.23	39.34	37.45	36.16	37.60	38.68	37.79	37.22
	N612-06	37.99	35.76	37.92	37.70	36.05	38.05	37.35	36.29	38.85	36.55	37.15	37.59	38.79	37.71	37.84
	N612-07	37.47	35.24	37.33	37.95	35.28	37.99	38.50	36.79	39.24	36.86	36.51	37.53	38.82	37.87	37.18
	N612-08	37.64	36.02	37.34	37.37	35.61	38.68	38.26	36.71	39.17	37.30	36.75	37.73	38.34	37.84	37.59
	N612-09	37.96	35.51	37.15	37.47	35.50	38.24	37.39	36.93	39.23	36.88	36.82	37.55	38.52	37.68	37.32
	N612-07	37.46	35.26	37.28	37.83	35.27	37.89	38.29	36.70	39.15	36.75	36.41	37.46	38.81	37.80	37.25
01.03.2021	N612-08	37.66	36.02	37.36	37.36	35.65	38.69	38.19	36.72	39.14	37.29	36.77	37.73	38.33	37.83	37.59
	N612-09	38.02	35.51	37.25	37.58	35.61	38.37	37.45	37.03	39.26	36.98	36.97	37.62	38.52	37.73	37.26
	N612-10	38.27	36.13	37.49	37.66	35.46	38.47	38.06	36.64	39.56	37.14	37.02	37.74	38.84	37.77	37.67
	N612-11	36.97	35.46	37.19	37.61	35.72	38.24	38.06	36.69	39.51	36.99	36.23	37.66	38.33	38.03	37.52
	N612-12	37.87	35.29	37.24	37.56	35.32	38.19	37.96	37.02	38.63	36.88	36.82	37.42	38.59	37.59	37.02
	N612-10	38.18	36.09	37.47	37.69	35.44	38.47	38.01	36.67	39.48	37.13	37.03	37.71	38.92	37.75	37.66
	N612-11	36.95	35.45	37.19	37.62	35.75	38.25	38.06	36.74	39.47	37.00	36.27	37.67	38.32	38.04	37.51
	N612-12	37.91	35.31	37.25	37.56	35.39	38.22	38.00	37.09	38.63	36.91	36.88	37.47	38.49	37.64	37.00
	N612-13	38.05	35.14	37.08	37.18	35.17	38.01	37.23	36.19	39.18	36.58	36.12	37.23	38.43	37.44	37.28
	N612-14	37.86	35.48	37.58	37.47	35.15	38.15	38.56	36.80	39.20	37.07	36.76	37.40	38.31	37.76	36.96
	N612-15	37.26	36.19	37.25	38.13	36.15	38.73	38.19	37.33	39.27	37.33	37.18	38.15	38.98	38.15	37.92
	N612-13	38.10	35.16	37.15	37.21	35.25	38.04	37.32	36.31	39.27	36.66	36.22	37.32	38.43	37.51	37.29
	N612-14	37.82	35.50	37.58	37.50	35.18	38.15	38.59	36.86	39.19	37.09	36.77	37.43	38.33	37.77	36.96
	N612-15	37.12	36.22	37.18	38.16	36.14	38.70	38.15	37.33	39.16	37.29	37.10	38.13	39.02	38.11	37.92
	N612-16	37.57	35.62	37.76	37.69	35.64	38.91	38.50	36.79	39.21	37.17	37.35	37.57	38.53	38.04	37.57
	N612-17	37.96	35.83	36.53	37.57	35.46	38.04	37.61	36.74	38.74	37.06	36.75	37.60	38.48	37.82	37.54
	N612-18	37.64	35.31	37.65	37.49	35.36	37.99	37.89	36.80	39.63	36.76	36.06	37.57	38.65	37.52	37.03
	N612-19	38.06	35.17	36.81	37.48	35.40	37.90	37.63	36.78	39.10	36.70	37.17	37.43	38.57	37.61	37.22
	N612-20	37.47	35.73	38.29	37.58	35.46	38.58	38.32	37.20	39.42	37.35	36.46	37.66	39.03	37.85	37.57
	N612-21	37.48	35.94	36.86	37.73	35.70	38.47	38.09	36.40	39.11	37.00	36.51	37.76	38.15	37.90	37.36
	N612-22	37.99	35.95	37.52	37.93	35.45	38.48	38.01	36.82	39.17	36.94	36.27	37.44	38.42	38.23	37.56
	N612-23	38.07	35.24	36.52	37.30	35.02	38.02	37.87	36.82	38.90	36.72	36.46	37.38	37.97	37.40	36.99
	N612-24	37.15	35.59	37.86	37.58	35.99	38.38	38.09	36.78	39.51	37.30	37.36	37.93	39.31	37.76	37.58
	N612-01	37.10	35.75	37.17	37.36	34.98	38.30	38.07	36.99	39.13	36.66	36.24	37.57	38.68	38.13	37.48
	N612-02	37.65	35.58	37.59	37.47	35.53	37.80	37.35	36.73	38.97	37.09	36.94	37.57	38.35	37.59	37.22
	N612-03	38.30	35.39	37.13	38.01	36.06	38.81	38.59	36.65	39.50	37.23	36.92	37.64	38.57	37.63	37.42
	N612-04	38.90	36.11	37.43	37.68	35.59	38.70	38.45	36.86	39.21	37.35	37.04	37.84	39.49	37.86	37.41
	N612-05	37.03	35.44	37.23	37.51	35.16	38.06	37.69	36.99	39.36	36.88	36.62	37.52	38.47	37.80	37.58
	N612-06	37.25	35.34	37.26	37.57	35.67	38.15	37.87	36.59	39.03	36.78	36.44	37.47	37.91	37.75	37.17

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.03.2021	N612-04	40.03	39.81	36.78	35.74	31.36	78.28	37.90	37.61	38.79	42.95	39.63	36.41	38.73	38.22	36.14
	N612-05	40.54	39.98	36.99	35.41	31.57	78.84	38.66	37.99	38.74	42.75	39.39	35.88	38.37	37.73	35.82
	N612-06	40.08	39.94	35.44	35.38	31.40	78.18	38.42	38.14	39.22	42.50	38.99	35.67	38.11	37.75	34.55
	N612-07	39.89	39.63	35.39	35.06	30.52	77.58	38.24	37.78	38.64	41.84	38.20	35.93	38.06	37.62	34.87
	N612-08	40.12	40.10	37.55	35.63	31.39	78.74	38.09	38.09	39.18	42.57	39.29	36.12	38.36	38.02	35.64
	N612-09	40.54	39.94	36.35	35.79	32.21	78.81	38.52	37.80	38.84	43.63	40.35	36	38.78	38.06	36.02
	N612-07	40.08	39.76	35.35	35.04	30.47	77.46	38.21	37.69	38.57	41.72	38.19	35.75	37.9	37.44	34.72
	N612-08	40.14	40.11	37.57	35.67	31.48	78.80	38.10	38.10	39.19	42.68	39.41	36.11	38.4	38.05	35.66
	N612-09	40.39	39.84	36.42	35.89	32.47	79.05	38.59	37.90	38.94	43.98	40.60	36.17	39.02	38.3	36.21
	N612-10	40.47	39.93	35.83	35.25	31.32	78.56	38.76	37.97	39.23	42.39	38.77	35.95	38.22	37.83	35.79
	N612-11	39.80	39.85	37.59	35.48	31.13	78.21	37.80	38.12	38.76	42.30	39.14	36.12	38.32	37.72	35.29
	N612-12	40.33	39.92	35.64	35.67	31.59	78.33	38.36	37.62	38.73	43.21	39.75	35.91	38.55	38.07	35.35
	N612-10	40.41	39.94	35.68	35.31	31.42	78.62	38.74	38.01	39.25	42.64	38.98	36.13	38.41	38.05	35.99
	N612-11	39.83	39.85	37.55	35.53	31.21	78.24	37.78	38.13	38.75	42.40	39.22	36.12	38.35	37.74	35.3
	N612-12	40.43	39.91	35.70	35.71	31.63	78.34	38.33	37.58	38.70	43.14	39.70	35.72	38.42	37.89	35.17
	N612-13	39.86	39.71	37.75	35.39	31.00	78.04	38.43	37.55	38.76	42.76	39.78	36.11	38.62	37.84	35.34
	N612-14	40.05	40.19	36.50	35.42	31.49	78.89	38.54	38.00	38.89	42.04	38.99	35.98	38.33	38.21	35.73
	N612-15	40.65	39.79	35.14	35.65	31.66	78.28	37.98	38.15	39.08	43.26	39.14	35.95	38.27	37.68	35.47
	N612-16	39.70	40.11	36.74	35.15	31.54	78.38	38.41	37.91	39.07	42.32	38.67	36.08	38.22	37.75	35.63
	N612-17	40.54	39.85	36.36	35.22	31.16	78.64	38.32	38.05	39.03	42.54	39.24	35.9	38.11	38	35.36
	N612-18	40.44	39.73	36.10	36.21	31.53	78.10	38.07	37.63	38.50	43.28	40.20	36	38.9	37.93	35.42
	N612-19	39.87	39.79	36.25	35.64	31.29	79.17	38.90	38.91	39.48	42.99	38.18	36.22	38.68	38.35	36.36
	N612-20	40.34	39.95	36.19	35.42	31.53	77.85	38.28	37.26	38.81	42.63	40.33	35.77	38.22	37.49	35.05
	N612-21	40.30	39.97	36.74	35.40	31.38	78.29	37.87	37.70	38.56	42.47	39.26	36.03	38.29	37.9	35.23
	N612-19	39.74	39.83	36.27	35.68	31.33	79.21	38.90	38.88	39.47	43.20	38.36	36.37	38.81	38.5	36.39
	N612-20	40.38	39.94	36.19	35.44	31.53	77.82	38.22	37.18	38.75	42.64	40.41	35.77	38.21	37.46	35
	N612-21	40.52	39.91	36.72	35.40	31.34	78.17	37.76	37.59	38.44	42.29	39.25	35.88	38.15	37.68	35.09
	N612-22	40.43	40.10	36.11	35.50	31.44	78.05	38.22	38.11	39.08	42.15	39.00	35.64	38.26	38.17	35.54
	N612-23	39.70	39.86	37.43	35.20	31.34	78.60	38.56	38.11	38.96	43.11	39.88	36.19	38.88	38.04	35.49
	N612-24	40.44	39.76	35.68	35.81	31.42	78.58	38.20	37.61	38.76	42.86	38.96	36.16	38.12	37.6	35.56
	N612-22	40.57	40.12	36.18	35.50	31.45	77.98	38.13	38.07	38.97	41.90	38.84	35.49	38.08	37.92	35.41
	N612-23	39.74	39.88	37.44	35.19	31.36	78.58	38.52	38.06	38.88	42.99	39.85	36.19	38.83	37.98	35.43
N612-24	40.37	39.72	35.59	35.91	31.47	78.77	38.26	37.57	38.92	43.39	39.30	36.4	38.33	37.82	35.73	
N612-25	39.43	39.78	36.73	35.31	30.96	77.57	38.31	37.98	38.34	42.24	39.05	35.92	38.45	37.79	35.14	
N612-26	40.76	39.53	35.45	34.90	31.09	78.77	38.18	37.43	39.08	42.56	38.92	35.78	37.91	37.72	35.4	
N612-27	40.39	40.37	37.04	36.22	32.09	78.75	38.39	38.30	39.24	43.13	39.85	36.21	38.8	38.18	35.89	
N612-01	40.23	39.64	35.36	35.41	31.20	77.73	38.16	37.41	38.74	42.82	39.59	36.01	38.11	37.6	35.58	
N612-02	40.11	39.95	37.26	35.39	31.81	78.78	38.59	38.05	39.02	42.74	39.47	36.1	38.61	38.2	35.27	
N612-03	40.29	40.17	36.61	35.75	31.24	78.74	38.15	38.36	38.96	42.63	38.80	35.86	38.53	37.9	35.58	
N612-04	40.03	39.87	37.57	35.27	31.38	79.05	38.44	37.86	38.99	42.30	39.64	36.21	38.21	38.18	35.82	
N612-05	40.16	39.65	35.15	35.46	30.80	77.56	38.10	37.39	38.61	42.08	38.57	35.86	38.44	37.65	35.98	
N612-06	40.38	40.14	36.51	35.71	32.01	78.59	38.37	38.37	39.08	43.69	39.78	35.97	38.5	37.88	34.79	
N612-04	40.02	40.02	37.46	35.18	31.30	78.85	38.39	37.91	38.90	42.14	39.42	36.06	38.04	38.03	35.7	
N612-05	40.22	39.65	35.13	35.50	30.84	77.56	38.07	37.40	38.64	42.16	38.60	35.86	38.49	37.65	35.92	
N612-06	40.39	40.04	36.67	35.85	32.19	78.85	38.45	38.45	39.18	44.02	39.98	36.12	38.76	38.04	34.84	
N612-18	40.15	39.80	35.24	34.54	31.22	78.21	38.35	37.87	38.67	42.23	39.33	36.05	38.27	37.91	35.17	
N612-19	40.24	39.99	37.52	36.59	31.62	78.66	38.26	37.97	39.15	43.23	39.25	35.97	38.57	37.91	35.91	
N612-20	39.67	40.23	37.27	34.91	31.58	78.29	38.39	38.57	39.28	42.74	39.77	36.21	38.57	37.6	35.5	
N612-21	40.43	40.16	37.64	35.64	31.17	77.65	38.13	37.35	38.89	42.52	39.58	35.62	37.93	37.57	34.9	
N612-22	39.96	39.63	35.15	35.28	31.63	79.18	38.48	38.48	38.89	42.85	39.01	36.41	38.89	38.25	36.12	
N612-24	40.21	39.92	36.79	35.59	31.31	78.64	38.43	38.00	39.17	42.49	39.24	35.69	38.34	37.71	35.54	
N612-25	40.27	39.90	36.69	35.29	31.56	78.16	38.31	38.07	38.82	42.60	39.59	36.27	38.58	37.95	35.59	
N612-26	40.11	39.89	35.61	35.63	31.33	78.38	38.13	37.59	38.66	43.06	39.06	36.06	38.29	38.07	35.34	
N612-27	40.23	39.83	36.45	35.43	31.41	78.49	38.40	38.12	39.17	42.60	39.20	36.2	38.29	37.98	35.65	
N612-28	40.18	39.97	36.45	35.57	31.39	78.34	38.23	37.73	38.69	42.75	39.40	35.79	38.5	37.8	35.38	
N612-01	39.79	40.18	36.45	35.67	31.28	78.53	38.25	37.97	38.67	43.11	39.57	36.25	38.77	38.19	35.74	
N612-02	40.39	39.84	36.37	35.38	31.45	78.46	38.41	37.89	39.08	42.70	39.44	36.05	38.58	38.03	35.93	
N612-03	40.50	39.66	36.45	35.45	31.50	78.22	38.23	37.85	39.00	42.28	38.87	35.68	37.82	37.44	34.81	
N612-04	39.86	39.79	35.55	35.37	31.26	77.95	38.32	37.59	38.57	42.10	38.76	35.57	37.9	37.7	34.86	
N612-05	40.46	40.04	37.21	35.63	31.51	78.84	38.29	38.19	39.18	43.33	39.87	36.45	38.95	38.15	36.18	
N612-04	39.92	39.92	35.45	35.56	31.24	78.63	38.49	37.61	38.56	42.17	38.73	35.81	38.04	37.82	35	
N612-05	40.67	39.95	37.28	35.82	31.45	78.86	38.22	38.13	39.13	43.20	39.78	36.52	38.65	37.9	35.82	
N612-06	40.00	39.82	36.53	35.08	31.54	77.61	38.15	37.95	39.07	42.85	39.43	35.68	38.49	37.95	35.74	
N612-07	40.60	39.98	36.30	35.69	31.36	78.98	38.58	38.13	38.83	42.45	39.78	36.09	38.63	38.17	35.48	
N612-08	39.93	39.68	37.16	35.43	31.33	77.98	38.12	38.00	38.69	42.49	38.87	35.89	38.65	37.86	35.5	
N612-09	40.10	40.06	35.66	35.43	31.50	78.36	38.24	37.56	39.16	43.12	39.25	36.04	37.88	37.68	35.47	
N612-07																

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.03.2021	N612-04	39.01	36.14	37.52	37.82	35.74	38.85	38.57	36.91	39.27	37.46	37.15	37.91	39.54	37.85	37.43
	N612-05	37.01	35.40	37.21	37.51	35.19	38.05	37.69	36.98	39.36	36.87	36.62	37.52	38.43	37.80	37.61
	N612-06	37.10	35.25	37.14	37.44	35.58	37.99	37.75	36.52	38.97	36.66	36.32	37.40	37.79	37.76	37.21
	N612-07	37.34	35.38	37.41	37.47	35.31	38.02	37.37	36.69	39.20	36.89	36.53	37.16	37.69	37.69	36.50
	N612-08	37.24	35.53	37.21	37.86	35.61	38.27	38.36	36.56	39.00	36.75	36.42	37.54	38.46	37.41	37.33
	N612-09	38.58	35.92	37.32	37.50	35.57	38.63	38.28	37.15	39.40	37.38	37.17	38.08	39.59	38.24	38.23
	N612-07	37.20	35.31	37.29	37.31	35.15	37.83	37.17	36.60	39.09	36.73	36.35	37.09	37.74	37.68	36.61
	N612-08	37.30	35.54	37.25	37.86	35.62	38.29	38.39	36.57	39.02	36.76	36.42	37.58	38.53	37.42	37.43
	N612-09	38.84	36.01	37.52	37.66	35.73	38.87	38.53	37.26	39.55	37.56	37.35	38.23	39.69	38.27	38.32
	N612-10	37.07	35.40	36.43	37.66	35.91	38.36	38.51	37.19	39.25	37.16	37.29	37.57	38.06	38.23	37.03
	N612-11	37.52	35.90	36.92	37.41	35.26	38.01	37.46	36.46	38.61	36.89	36.46	37.50	38.42	37.53	37.06
	N612-12	38.32	35.45	38.45	37.70	35.35	38.45	38.00	36.75	39.70	36.91	36.36	37.64	39.03	37.63	37.88
	N612-10	37.35	35.50	36.68	37.81	36.03	38.61	38.79	37.27	39.40	37.34	37.45	37.69	38.16	38.22	37.04
	N612-11	37.62	35.91	37.01	37.42	35.22	38.04	37.46	36.44	38.63	36.89	36.42	37.52	38.52	37.51	37.16
	N612-12	38.24	35.38	38.38	37.58	35.16	38.25	37.73	36.62	39.58	36.73	36.13	37.56	39.14	37.62	38.09
	N612-13	37.45	35.51	37.15	37.28	35.80	38.12	37.99	37.12	39.30	37.16	36.87	37.81	38.48	37.53	37.18
	N612-14	37.52	35.84	37.27	37.81	35.73	38.54	37.91	36.87	39.38	36.94	37.10	37.56	38.28	38.30	36.85
	N612-15	38.04	35.46	37.35	37.71	35.08	38.26	38.17	36.50	38.93	36.95	36.27	37.46	38.87	37.59	38.02
	N612-16	37.46	35.64	37.42	38.03	36.01	38.32	37.94	36.63	39.52	37.21	37.24	37.67	37.76	38.06	37.20
	N612-17	38.10	35.50	37.07	37.49	34.98	38.33	38.31	36.88	39.11	37.13	36.41	37.42	38.36	37.81	37.85
	N612-18	37.43	35.63	37.33	37.23	35.52	38.17	37.60	36.81	38.92	36.60	36.39	37.69	39.69	37.44	37.05
	N612-19	38.48	35.93	37.91	37.82	35.51	38.87	39.30	37.46	39.66	37.31	37.00	37.68	39.57	38.06	37.65
	N612-20	37.70	35.44	37.34	37.48	35.50	38.16	37.45	36.71	38.60	36.84	36.57	38.01	37.68	37.78	37.40
	N612-21	37.09	35.48	36.79	37.57	35.52	37.99	37.51	36.35	39.41	36.93	36.63	37.18	38.47	37.62	37.16
	N612-19	38.55	36.01	38.04	37.94	35.70	39.04	39.49	37.56	39.73	37.46	37.06	37.82	39.57	38.05	37.61
	N612-20	37.64	35.42	37.29	37.45	35.51	38.10	37.38	36.66	38.58	36.81	36.52	37.98	37.65	37.74	37.37
	N612-21	36.90	35.37	36.58	37.38	35.35	37.70	37.19	36.15	39.30	36.72	36.46	36.98	38.41	37.55	37.14
	N612-22	37.38	35.40	37.14	37.55	34.91	38.35	37.46	36.87	39.13	36.90	36.87	37.63	39.27	37.55	37.23
N612-23	38.22	35.85	37.09	37.91	35.54	38.72	38.14	36.99	38.98	37.06	36.92	37.90	38.41	38.38	37.68	
N612-24	37.60	35.58	37.73	37.39	36.00	37.96	38.49	36.66	39.50	37.08	36.39	37.36	38.21	37.49	37.26	
N612-22	37.24	35.29	36.93	37.39	34.73	38.08	37.23	36.63	39.01	36.70	36.70	37.45	39.14	37.43	37.16	
N612-23	38.17	35.80	37.06	37.87	35.53	38.63	38.10	36.89	38.95	36.99	36.84	37.82	38.25	38.31	37.61	
N612-24	37.74	35.78	38.00	37.62	36.35	38.21	38.84	36.91	39.74	37.40	36.63	37.58	38.38	37.69	37.47	
N612-25	37.85	35.51	37.65	37.29	35.61	38.31	37.55	36.68	38.88	36.76	36.28	37.43	38.03	37.54	36.78	
N612-26	37.04	35.06	36.42	37.25	35.37	38.21	38.04	36.82	39.12	36.79	36.38	37.21	38.39	37.69	37.22	
N612-27	38.16	36.16	37.76	38.19	35.42	38.37	38.26	36.87	39.51	37.36	37.38	38.11	39.28	38.08	38.05	
N612-01	37.51	35.62	37.54	37.41	35.32	38.14	37.70	36.60	38.58	36.98	36.47	37.48	38.52	37.63	37.30	
N612-02	37.83	35.20	36.91	37.51	35.35	38.62	37.98	36.95	39.32	36.76	36.70	37.49	38.73	37.74	37.62	
N612-03	37.81	36.06	37.47	37.92	35.87	38.09	38.35	36.85	39.87	37.26	36.96	37.85	38.55	38.00	37.33	
N612-04	37.56	35.37	37.64	37.69	35.79	38.87	38.45	37.18	38.90	37.22	37.05	37.69	37.99	38.14	36.63	
N612-05	37.56	35.48	36.54	37.46	35.07	37.88	37.55	36.28	38.86	36.90	36.18	37.53	38.40	37.55	37.23	
N612-06	37.94	35.89	37.76	37.62	35.63	38.23	38.01	36.96	39.71	36.90	36.87	37.56	39.25	37.70	38.20	
N612-04	37.42	35.29	37.49	37.58	35.69	38.69	38.25	37.06	38.86	37.06	36.93	37.53	37.97	38.09	36.55	
N612-05	37.63	35.53	36.54	37.49	35.08	37.86	37.55	36.28	38.94	36.89	36.17	37.56	38.46	37.53	37.32	
N612-06	38.09	36.05	37.98	37.76	35.74	38.38	38.24	37.09	39.90	37.06	37.01	37.74	39.43	37.75	38.49	
N612-18	37.61	35.19	36.94	37.39	35.53	38.38	37.83	36.39	38.62	36.92	36.67	37.60	38.00	37.96	37.19	
N612-19	37.80	36.04	37.69	37.84	35.51	38.22	38.20	37.26	39.85	37.11	36.77	37.61	39.19	37.61	37.60	
N612-20	38.06	35.96	37.63	37.69	35.56	38.34	38.29	36.63	38.59	37.09	37.48	37.56	38.52	37.61	37.21	
N612-21	37.65	35.68	37.41	37.50	34.97	38.19	37.75	36.73	39.08	36.70	36.16	37.42	38.65	37.69	37.13	
N612-22	37.75	35.48	37.16	37.68	36.06	38.42	38.25	36.84	39.28	37.31	37.28	37.79	38.44	37.91	37.63	
N612-24	37.49	35.30	37.67	37.62	35.62	38.18	37.76	36.72	38.91	37.08	36.69	37.65	39.18	37.90	37.65	
N612-25	37.29	35.74	36.86	37.39	35.37	38.35	38.62	36.86	39.10	37.12	36.41	37.46	38.24	37.83	37.12	
N612-26	38.41	35.81	37.34	37.82	35.49	38.39	37.61	36.82	39.63	36.77	37.01	37.71	38.20	37.62	37.35	
N612-27	37.59	35.58	37.62	37.63	35.71	38.18	38.23	36.87	39.50	37.11	37.04	37.46	39.11	37.72	37.32	
N612-28	37.73	35.58	37.04	37.56	35.32	38.39	37.80	36.73	38.88	36.92	36.37	37.72	38.16	37.88	37.46	
N612-01	38.05	35.70	37.51	37.94	35.43	38.54	37.67	36.94	39.68	37.16	36.57	37.82	38.91	37.72	37.72	
N612-02	37.18	35.66	37.26	37.49	35.36	38.35	38.26	36.74	39.22	37.20	36.81	37.75	38.74	37.93	37.48	
N612-03	37.88	35.45	37.14	37.34	35.77	37.99	38.12	36.72	38.66	36.64	36.77	37.21	38.00	37.74	36.90	
N612-04	37.76	35.18	36.90	37.40	35.15	38.04	37.86	36.52	38.85	36.51	36.17	37.29	38.51	37.55	37.13	
N612-05	37.66	36.02	37.70	37.83	35.80	38.59	38.09	37.08	39.60	37.50	37.19	37.94	38.70	38.01	37.68	
N612-04	37.60	35.34	36.85	37.37	35.58	38.21	38.24	36.80	38.78	36.61	36.53	37.31	38.64	37.80	37.13	
N612-05	37.71	35.91	37.58	37.88	35.84	38.50	37.87	36.98	39.39	37.44	37.13	37.79	38.78	37.92	37.50	
N612-06	37.80	35.55	37.48	37.59	35.05	38.16	37.79	36.57	39.45	36.98	36.50	37.70	38.24	37.63	37.53	
N612-07	37.64	35.71	37.58	37.38	35.32	38.39	38.53	36.98	39.75	37.07	36.24	37.78	38.78	37.85	37.33	
N612-08	37.93	35.64	37.35	37.84	35.81	38.42	37.89	36.97	38.54	37.08	36.87	37.60	38.58	37.94	37.56	
N612-09	37.50	35.44	36.94	37.55	35.38	38.09										

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	N612-11	40.36	39.88	36.41	35.32	31.45	78.97	38.38	38.07	38.60	42.45	39.35	36.17	38.24	37.78	35.15
	N612-10	39.99	39.84	36.24	35.65	31.42	78.14	38.33	37.70	39.11	42.61	39.30	35.74	38.8	38.08	36.1
	N612-11	40.28	39.85	36.34	35.00	31.53	78.32	38.09	37.87	38.57	42.46	39.31	36.04	38.04	37.61	35.25
	N612-12	40.33	40.04	36.54	35.93	31.24	78.80	38.54	38.20	39.10	43.13	39.33	36.26	38.31	37.99	35.09
	N612-13	40.34	39.78	36.71	35.39	31.29	78.30	38.22	37.62	38.65	42.41	38.75	35.85	38.63	38.01	35.67
	N612-14	40.19	39.85	37.34	35.49	31.59	78.53	38.14	38.01	38.54	42.55	39.82	36.28	38.62	38.17	35.38
	N612-15	40.07	40.03	35.32	35.59	31.34	78.33	38.51	38.02	39.47	43.07	39.31	35.84	38.04	37.56	35.53
	N612-13	40.40	39.82	36.65	35.34	31.31	78.33	38.25	37.66	38.73	42.48	38.77	35.91	38.62	37.94	35.68
	N612-14	40.20	39.90	37.29	35.53	31.58	78.57	38.16	38.06	38.60	42.63	39.83	36.31	38.57	38.12	35.34
	N612-15	39.97	40.01	35.23	35.66	31.31	78.28	38.49	37.96	39.44	43.02	39.43	35.79	37.98	37.63	35.44
	N612-16	40.24	39.73	36.77	35.42	31.47	78.72	38.48	38.52	38.78	42.82	38.48	35.96	38.3	37.91	35.82
	N612-17	40.20	40.04	36.21	35.55	31.34	78.12	38.12	37.33	38.95	42.55	40.02	36.05	38.54	37.91	35.23
	N612-19	39.91	39.82	35.03	35.54	31.38	78.31	38.18	38.05	38.94	41.84	38.91	36.07	38.43	37.46	35.33
	N612-20	40.44	39.85	36.99	35.64	31.38	78.91	38.24	37.71	38.79	42.91	39.57	36	38.47	38.34	35.16
	N612-21	40.27	40.04	37.30	35.31	31.44	78.00	38.50	37.94	38.98	43.47	39.43	35.93	38.33	37.93	36.07
01.02.2022	N612-22	40.29	39.85	35.91	35.66	31.46	78.22	38.14	37.74	38.78	42.16	39.49	35.89	37.87	37.95	35.05
	N612-23	40.10	39.93	36.73	35.37	31.35	78.59	38.43	38.06	39.01	43.12	39.09	36.11	38.91	37.83	35.88
	N612-22	40.44	40.04	36.10	35.69	31.32	78.30	38.19	37.69	38.92	42.24	39.34	35.99	38.03	38.03	35.36
	N612-23	40.22	39.97	36.80	35.45	31.54	78.65	38.41	37.99	39.11	43.29	38.84	36.03	38.97	37.75	36.13
	N612-24	39.94	39.69	36.28	35.36	31.35	78.23	38.30	38.04	38.65	42.58	39.77	35.97	38.22	37.9	34.98
	N612-25	40.08	39.76	36.83	35.36	31.20	78.60	38.33	37.83	39.03	42.78	39.09	36.16	38.34	38.29	35.99
	N612-26	40.34	40.05	36.00	35.65	31.59	78.22	38.27	37.95	38.80	42.60	39.47	35.86	38.44	37.56	35.08
	N612-25	40.25	39.94	36.87	35.48	31.32	78.65	38.42	37.84	38.93	42.73	39.20	36.07	38.36	38.2	36.3
	N612-26	40.39	40.10	35.91	35.57	31.57	78.26	38.29	37.90	38.66	42.53	39.49	35.78	38.48	37.53	35.32
	N612-27	39.98	39.66	36.48	35.45	31.30	78.31	38.19	37.95	39.12	42.86	39.26	36.2	38.4	37.98	34.84
	N612-28	39.73	39.64	35.54	35.35	31.48	77.84	38.21	38.10	38.91	42.62	38.59	35.59	37.93	37.92	35.55
	N612-29	40.67	40.16	37.26	35.65	31.33	78.96	38.40	37.71	38.88	42.77	39.99	36.39	38.85	37.89	35.56
	N612-01	40.38	40.43	36.13	35.69	31.31	78.35	38.10	37.71	38.79	42.39	38.67	35.81	38.17	37.92	34.79
	N612-02	40.15	39.66	36.58	35.51	31.26	78.37	38.56	37.90	38.75	42.92	39.62	36	38.5	38.04	35.84
	N612-03	40.05	39.60	36.58	35.26	31.63	78.45	38.27	38.13	39.19	42.80	39.63	36.21	38.5	37.71	35.99
	N612-04	40.21	39.56	35.59	36.02	31.58	78.99	38.01	37.62	38.70	42.83	39.90	35.94	39.05	38.25	35.01
	N612-05	40.21	40.30	37.22	35.03	31.20	77.82	38.58	38.15	39.07	42.54	38.66	36.04	37.76	37.57	35.92

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.02.2022	N612-11	37.60	35.37	36.66	37.11	34.93	38.08	37.55	36.38	39.13	36.64	36.26	37.21	38.11	37.77	37.33
	N612-10	37.61	35.70	37.87	37.83	35.90	38.53	38.70	37.23	39.23	37.33	36.78	37.87	38.58	37.83	37.20
	N612-11	37.65	35.38	37.02	37.09	34.66	38.00	37.15	35.99	39.20	36.65	36.17	37.17	37.96	37.77	37.02
	N612-12	37.93	35.77	36.92	37.91	35.94	38.37	38.17	37.28	39.17	37.06	37.16	37.80	39.27	37.77	38.03
	N612-13	37.25	35.23	37.60	37.74	35.94	38.23	38.03	36.71	39.08	36.82	36.91	37.41	38.32	37.87	37.22
	N612-14	37.80	35.88	37.36	37.65	35.59	38.51	38.15	36.66	39.47	36.88	37.09	37.73	38.87	37.65	37.33
	N612-15	37.99	35.67	37.05	37.43	35.04	38.18	37.87	37.00	39.06	37.29	36.15	37.65	38.47	37.85	37.52
	N612-13	37.28	35.27	37.63	37.76	35.91	38.18	37.95	36.73	39.12	36.87	36.89	37.42	38.31	37.87	37.26
	N612-14	37.86	35.91	37.35	37.64	35.58	38.51	38.15	36.67	39.45	36.91	37.02	37.74	38.83	37.65	37.35
	N612-15	38.04	35.67	36.92	37.38	34.97	38.22	37.88	37.02	39.03	37.27	36.15	37.67	38.59	37.82	37.54
	N612-16	37.62	35.38	36.82	37.65	35.42	38.33	38.24	36.69	39.23	36.74	36.90	37.54	38.73	38.19	37.48
	N612-17	37.71	35.77	37.81	37.59	35.65	38.27	37.79	36.88	39.18	37.21	36.58	37.63	38.41	37.44	37.27
	N612-19	37.32	35.54	37.35	37.37	35.32	38.01	37.50	36.72	38.41	36.33	36.37	37.56	37.88	37.65	37.38
	N612-20	37.48	35.61	36.55	37.83	35.55	38.33	38.60	36.84	39.69	37.70	37.15	37.40	38.94	37.79	37.26
	N612-21	38.32	35.67	38.06	37.63	35.66	38.60	37.95	36.85	39.58	37.05	36.58	37.85	38.95	37.95	37.52
	N612-22	38.13	35.50	37.16	37.36	35.23	38.14	37.81	36.85	39.04	36.86	37.01	37.57	38.42	37.58	37.21
	N612-23	37.25	35.69	37.39	37.81	35.73	38.42	38.15	36.75	39.28	37.09	36.41	37.61	38.65	37.97	37.53
	N612-22	38.09	35.65	37.31	37.43	35.39	38.11	37.78	36.90	39.18	36.99	37.17	37.81	38.37	37.64	37.26
	N612-23	37.12	35.65	37.33	37.68	35.65	38.20	37.96	36.66	39.20	37.06	36.35	37.73	38.74	37.99	37.73
	N612-24	37.88	35.50	37.25	37.70	35.46	38.60	38.29	36.83	39.21	36.94	36.56	37.23	38.60	37.74	37.11
	N612-25	38.11	35.63	37.40	37.59	35.52	38.50	38.05	37.01	39.35	37.14	36.93	37.81	38.64	37.85	37.77
	N612-26	37.34	35.58	37.21	37.59	35.47	38.08	37.92	36.62	39.06	36.87	36.53	37.44	38.49	37.73	37.04
	N612-25	38.17	35.50	37.30	37.46	35.37	38.62	38.27	36.95	39.28	37.11	36.72	37.75	38.50	37.73	37.83
	N612-26	37.49	35.44	37.28	37.51	35.30	38.27	38.08	36.55	38.98	36.87	36.43	37.44	38.42	37.65	37.14
	N612-27	37.44	35.90	37.35	37.86	35.87	37.98	37.62	36.92	39.36	37.03	37.01	37.61	38.82	38.02	37.16
	N612-28	37.45	35.56	36.86	37.46	35.52	38.27	37.99	36.74	39.05	36.85	36.18	37.58	38.47	37.65	37.20
	N612-29	37.99	35.61	37.72	37.70	35.44	38.37	38.05	36.85	39.33	37.15	37.19	37.63	38.64	37.91	37.59
	N612-01	37.28	35.49	37.03	37.16	35.05	38.04	37.54	36.69	39.06	36.78	36.63	37.32	38.96	38.08	37.13
	N612-02	38.19	35.67	37.10	38.09	36.20	38.54	38.17	36.75	39.10	37.09	36.67	37.54	38.10	37.51	37.50
	N612-03	37.67	35.64	37.82	37.60	35.30	38.35	38.34	36.98	39.47	37.19	36.83	38.00	38.60	37.79	37.50
	N612-04	37.59	35.75	37.21	37.49	35.29	38.22	37.98	36.71	39.18	36.63	36.43	37.36	39.23	37.48	37.77
	N612-05	37.79	35.44	37.34	37.68	35.70	38.36	37.97	36.87	39.19	37.35	36.96	37.80	37.96	38.12	36.98

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
average all analyses	40.23	39.92	36.42	35.51	31.42	78.44	38.33	37.93	38.93	42.73	39.33	36.023	38.43	37.927	35.577
Norman et al. (1996)		38.90		32.50	32.70	79.10	41.30	42.30	42.30	42.60	38.40	36.1	39.2	38.9	36.6
Jochum et al. (2005)				35.3±2.4	31.8±0.3	78.4±0.8	38.3±2.1	38.4±1.1	40±3.0	41.6±2.6	39.7±0.4	35.8±0.4	38.7±0.4	37.2±0.9	35.9±0.4
				35.30	31.80	78.40	38.30	38.40	40.00	41.60	39.70	35.8	38.7	37.2	35.9
deviation (%) over deviation (%) over measurement period (Jochum et al., 2005)		2.63		9.27	-3.91	-0.83	-7.19	-10.33	-7.97	0.30	2.43	-0.213	-1.9631	-2.501	-2.795
				0.60	-1.19	0.05	0.08	-1.22	-2.68	2.71	-0.92	0.6235	-0.6964	1.9545	-0.899
average std measurements Sept' 2020	40.28	39.97	36.38	35.55	31.45	78.46	38.33	37.89	38.95	42.75	39.45	36.069	38.485	37.961	35.625
deviation (%) for Sept' 2020 (Norman et al., 1996)		2.75		9.39	-3.83	-0.81	-7.20	-10.42	-7.93	0.36	2.73	-0.085	-1.8237	-2.413	-2.663
deviation (%) for Sept' 2020 (Jochum et al., 2005)				0.72	-1.10	0.07	0.07	-1.32	-2.63	2.77	-0.64	0.7518	-0.5553	2.0464	-0.765
average std measurements Oct' 2020	40.27	39.95	36.41	35.52	31.45	78.47	38.37	37.95	38.96	42.74	39.34	36.031	38.444	37.943	35.64
deviation (%) for Oct' 2020 (Norman et al., 1996)		2.71		9.30	-3.83	-0.79	-7.10	-10.27	-7.90	0.33	2.44	-0.19	-1.9291	-2.46	-2.623
deviation (%) for Oct' 2020 (Jochum et al., 2005)				0.63	-1.11	0.10	0.17	-1.16	-2.61	2.74	-0.91	0.6459	-0.6621	1.9974	-0.724
average std measurements Nov' 2020	40.19	39.92	36.45	35.50	31.40	78.45	38.33	37.94	38.93	42.72	39.33	36.029	38.428	37.927	35.614
deviation (%) for Nov' 2020 (Norman et al., 1996)		2.62		9.23	-3.98	-0.82	-7.20	-10.30	-7.97	0.28	2.42	-0.197	-1.9697	-2.501	-2.693
deviation (%) for Nov' 2020 (Jochum et al., 2005)				0.57	-1.27	0.06	0.07	-1.19	-2.67	2.69	-0.93	0.6398	-0.7031	1.955	-0.796
average std measurements March' 2021	40.21	39.90	36.42	35.51	31.41	78.42	38.31	37.91	38.91	42.72	39.32	36.012	38.419	37.916	35.524
deviation (%) for March' 2021 (Norman et al., 1996)		2.58		9.26	-3.94	-0.86	-7.25	-10.37	-8.01	0.29	2.40	-0.243	-1.9926	-2.53	-2.939
deviation (%) for March' 2021 (Jochum et al., 2005)				0.59	-1.22	0.02	0.02	-1.26	-2.72	2.70	-0.96	0.5929	-0.7263	1.9245	-1.046
average std measurements Feb' 2022	40.19	39.91	36.42	35.49	31.40	78.40	38.30	37.91	38.91	42.70	39.31		38.405	37.897	35.506
deviation (%) for Feb' 2022 (Norman et al., 1996)		2.59		9.21	-3.96	-0.88	-7.26	-10.37	-8.02	0.24	2.37	-0.259	-2.0283	-2.578	-2.99
deviation (%) for Feb' 2022 (Jochum et al., 2005)				0.55	-1.24	0.00	0.01	-1.27	-2.73	2.65	-0.98	0.5768	-0.7625	1.8737	-1.098

Appendix A

Supplementary Table S6: LA-ICP-MS standard measurements on reference material NIST 612.

	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
average all analyses	37.73	35.61	37.33	37.62	35.54	38.33	38.04	36.83	39.23	37.03	36.72	37.629	38.597	37.821	37.408
Norman et al. (1996)	38.20	36.00	37.70		37.00	40.40	39.10		40.80	39.00	38.90	40.8		40.2	39.4
Jochum et al. (2005)	38.1± 0.4	35.3± 1.1	36.7± 0.4	35.9± 2.7	36± 0.4	37.9±1. 1	38± 0.9	37.6± 1.3	39.2± 0.4	36.9± 0.4	34.8±3. 7	39.8±2. 2	42.2±0. 8	37.2±0. 7	37.2±1. 2
	38.10	35.30	36.70	35.90	36.00	37.90	38.00	37.60	39.20	36.90	34.80	39.8	42.2	37.2	37.2
deviation (%) over	-1.22	-1.07	-0.98		-3.95	-5.11	-2.71		-3.85	-5.05	-5.60	-7.773		-5.919	-5.055
deviation (%) over measurement period (Jochum et al., 2005)	-0.96	0.89	1.72	4.80	-1.29	1.15	0.10	-2.04	0.08	0.35	5.52	-5.455	-8.539	1.6687	0.56
average std measurements Sept' 2020	37.75	35.63	37.36	37.61	35.59	38.42	38.12	36.86	39.29	37.03	36.71	37.641	38.617	37.874	37.406
deviation (%) for Sept' 2020 (Norman et al., 1996)	-1.18	-1.03	-0.90		-3.80	-4.89	-2.49		-3.70	-5.04	-5.63	-7.742		-5.786	-5.061
deviation (%) for Sept' 2020 (Jochum et al., 2005)	-0.92	0.94	1.81	4.77	-1.13	1.38	0.33	-1.96	0.23	0.36	5.49	-5.424	-8.489	1.8114	0.5536
average std measurements Oct' 2020	37.74	35.61	37.36	37.65	35.57	38.35	38.07	36.88	39.26	37.06	36.72	37.658	38.611	37.845	37.429
deviation (%) for Oct' 2020 (Norman et al., 1996)	-1.20	-1.07	-0.91		-3.86	-5.08	-2.63		-3.78	-4.98	-5.60	-7.701		-5.859	-5.002
deviation (%) for Oct' 2020 (Jochum et al., 2005)	-0.94	0.89	1.79	4.87	-1.18	1.18	0.19	-1.93	0.15	0.43	5.52	-5.382	-8.506	1.7326	0.6158
average std measurements Nov' 2020	37.76	35.63	37.32	37.63	35.52	38.33	38.04	36.81	39.23	37.02	36.73	37.63	38.629	37.827	37.423
deviation (%) for Nov' 2020 (Norman et al., 1996)	-1.15	-1.03	-1.00		-4.01	-5.11	-2.71		-3.85	-5.09	-5.59	-7.769		-5.903	-5.019
deviation (%) for Nov' 2020 (Jochum et al., 2005)	-0.89	0.93	1.70	4.83	-1.34	1.15	0.10	-2.10	0.08	0.31	5.53	-5.452	-8.463	1.6854	0.5985
average std measurements March' 2021	37.72	35.61	37.31	37.61	35.51	38.32	38.01	36.81	39.21	37.02	36.72	37.61	38.577	37.8	37.393
deviation (%) for March' 2021 (Norman et al., 1996)	-1.26	-1.09	-1.03		-4.01	-5.15	-2.78		-3.91	-5.08	-5.61	-7.818		-5.97	-5.093
deviation (%) for March' 2021 (Jochum et al., 2005)	-1.00	0.87	1.67	4.76	-1.35	1.10	0.03	-2.11	0.02	0.32	5.52	-5.502	-8.585	1.613	0.52
average std measurements Feb' 2022	37.71	35.61	37.31	37.60	35.50	38.30	38.01	36.80	39.19	37.00	36.72	37.601	38.571	37.788	37.378
deviation (%) for Feb' 2022 (Norman et al., 1996)	-1.28	-1.09	-1.04		-4.04	-5.19	-2.79		-3.94	-5.12	-5.60	-7.84		-6.001	-5.131
deviation (%) for Feb' 2022 (Jochum et al., 2005)	-1.03	0.87	1.66	4.75	-1.38	1.06	0.02	-2.13	-0.02	0.28	5.52	-5.525	-8.599	1.5799	0.4796

Appendix A

Supplementary Table S7: LA-ICP-MS standard measurements on reference material BCR-2G.

date	Comment	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.09.2020	BCR-05	10.71	33.65	15.32	44.92	55.69	345.07	33.17	177.51	12.27	1.25	685.93	25.54	53.47	6.61	28.11
	BCR-06	8.94	33.71	13.87	41.80	51.56	343.53	33.43	175.83	12.01	1.28	673.33	24.52	53.42	6.56	27.15
01.10.2020	BCR-01	9.69	33.31	14.84	39.55	48.60	342.05	33.01	173.97	11.51	1.17	671.72	24.42	52.12	6.53	27.68
	BCR-02	10.12	34.14	15.19	40.14	50.46	336.98	33.24	177.30	12.32	1.17	689.12	24.72	52.05	6.55	27.81
	BCR-03	9.98	32.29	19.96	39.30	49.15	330.55	31.92	171.82	11.88	1.23	671.62	23.6	50.91	6.22	28.06
	BCR-04	9.93	34.14	18.84	40.29	49.39	331.58	32.99	175.70	12.05	1.25	665.72	24.37	50.44	6.21	27.61
	BCR-05	10.66	33.14	14.83	41.11	51.50	327.27	32.47	172.06	11.93	1.24	663.07	24.07	50.82	6.36	27.38
	BCR-06	9.94	33.77	15.92	41.11	52.48	338.34	32.90	175.43	12.09	1.24	673.60	24.99	49.97	6.43	27.49
	BCR-01	9.74	32.39	15.98	38.81	49.97	335.28	32.05	170.16	12.06	1.18	671.19	24.34	51.77	6.58	27.55
	BCR-02	10.40	32.84	16.44	40.13	47.88	327.83	31.87	168.15	12.21	1.14	663.01	23.98	50.9	6.33	27.42
	BCR-03	10.55	32.57	16.10	39.45	49.67	340.11	32.18	171.30	11.74	1.24	666.06	23.81	51.29	6.44	28.47
	BCR-05	10.30	32.86	18.04	41.24	52.89	337.59	31.89	171.25	12.31	1.25	681.45	24.51	51.89	6.38	27.29
	BCR-06	9.94	33.11	16.38	39.24	49.27	327.84	32.11	172.53	11.79	1.15	671.39	23.93	51.4	6.42	28.09
	BCR-07	10.12	32.94	12.38	39.70	49.59	335.90	32.39	173.73	12.03	1.25	674.41	24.51	52.1	6.54	27.86
	BCR-08	10.05	32.57	13.54	39.49	50.53	341.02	30.86	164.19	12.18	1.24	685.13	24.59	53.63	6.59	27.68
	BCR-01	9.48	33.35	11.42	41.36	51.81	334.97	31.86	173.19	11.98	1.25	662.94	23.75	50.07	6.38	27.3
	BCR-02	9.03	32.48	13.55	38.37	49.37	325.93	30.69	168.37	11.85	1.13	637.31	22.88	47.96	6.25	27.41
	BCR-03	8.86	33.33	16.72	40.15	50.64	335.20	33.21	173.92	12.16	1.13	655.40	23.92	50.74	6.33	27.02
	BCR-04	9.62	32.32	17.31	40.56	49.46	330.48	31.84	167.75	12.15	1.18	652.88	23.03	50	6.13	25.74
	BCR-05	8.80	33.25	17.54	40.68	51.18	339.45	32.26	167.23	12.00	1.18	653.82	23.1	50.94	6.44	27.51
	BCR-06	9.36	32.71	16.41	41.15	51.79	333.30	32.66	173.33	11.85	1.25	637.77	23.95	50.51	6.15	26.39
	BCR-07	9.85	32.67	9.58	42.88	52.85	339.90	31.91	173.61	11.94	1.24	654.13	23.44	50.48	6.26	27.59
	BCR-08	8.05	33.47	12.65	41.41	50.43	329.37	31.68	169.82	12.24	1.15	654.84	24.42	50.59	6.5	27.13
	BCR-09	9.13	33.58	18.53	42.00	51.44	342.74	33.65	177.81	12.00	1.20	651.59	23.56	51.23	6.86	27.92
	BCR-10	8.41	33.05	14.94	40.25	50.03	334.99	31.86	174.94	11.94	1.25	635.62	24.27	50.61	6.05	27.21
	BCR-11	10.21	34.56	16.44	41.40	49.80	343.42	32.91	175.90	11.59	1.12	674.32	23.77	51.95	6.55	27.36
	BCR-12	9.08	33.92	19.37	41.12	52.28	333.04	32.03	170.43	12.22	1.20	650.54	24.76	50.91	6.52	27.36
	BCR-01	9.05	34.24	14.82	41.75	51.84	332.30	32.47	176.10	12.14	1.25	659.66		49.99	6.45	26.78
	BCR-03	9.25	33.36	16.57	41.86	52.61	335.59	32.30	174.64	11.67	1.26	662.88	23.6	49.99	6.34	28.1
	BCR-04	9.03	33.67	15.15	41.20	51.02	338.07	32.41	173.78	12.08	1.28	666.87	23.87	51.19	6.35	27.94
	BCR-05	8.41	33.98	17.18	40.46	50.47	335.92	32.63	179.45	12.02	1.24	645.05	23.5	50.31	6.46	27.01
	BCR-06	9.70	33.06	17.69	39.61	50.41	326.29	31.92	172.22	12.46	1.16	647.31	23.28	49.28	6.17	27.04
	BCR-07	8.60	33.36	17.74	39.33	48.43	330.30	31.21	171.26	12.13	1.23	660.50	23.97	49.76	6.26	26.96
	BCR-08	8.25	33.84	15.64	42.25	51.85	331.34	32.71	178.33	11.98	1.18	665.73	24.42	50.08	6.28	27.03
	BCR-09	9.11	34.10	19.45	41.43	50.69	336.87	32.06	175.61	12.33	1.22	658.68	24.08	51.37	6.3	27.47
	BCR-01	9.23	33.18	18.17	42.23	53.50	336.64	32.21	172.91	12.26	1.22	665.77	24.41	51.76	6.55	27.31
	BCR-02	8.85	32.63	15.53	41.26	50.71	337.41	31.74	169.30	12.56	1.23	645.64	23.86	50.23	6.38	27.09
	BCR-03	9.11	33.06	14.02	41.37	49.96	329.77	31.92	172.94	12.18	1.22	654.76	23.52	50.42	6.42	26.93
BCR-04	9.27	32.13	12.19	43.83	53.59	352.40	33.96	174.25	11.49	1.30	662.77	25.36	55.6	7.06	27.61	
BCR-05	8.95	31.48	16.30	45.00	54.81	353.98	31.62	170.70	12.52	0.93	699.63	26.54	54.12	6.35	27.21	
BCR-06	8.99	33.99	16.40	41.58	51.37	336.33	31.89	171.25	12.46	1.27	669.51	23.98	50.78	6.39	27.74	
BCR-07	8.44	33.26	15.83	41.29	50.01	332.96	32.44	173.91	12.60	1.21	687.25	24.05	50.51	6.32	27.79	
BCR-08	7.80	32.82	17.56	40.40	49.38	332.14	32.31	176.14	12.58	1.17	650.64	24.06	49.98	6.25	28.18	
BCR-09	8.49	32.57	13.52	39.45	48.43	329.94	32.19	174.83	12.03	1.23	649.59	23.63	50.34	6.44	27.36	
BCR-01	9.33	32.93	12.83	41.92	51.49	331.17	32.39	173.24	12.19	1.22	656.26	23.51	50.47	6.22	27.36	
BCR-02	8.52	34.08	16.91	42.44	53.39	338.24	32.89	175.55	12.06	1.26	660.62	24.57	50.66	6.34	27.3	
BCR-03	8.26	34.17	14.58	41.34	51.15	331.72	32.89	176.64	12.51	1.23	649.78	23.97	50.48	6.38	27.52	
BCR-04	7.66	34.11	18.34	42.93	51.40	330.84	32.58	176.01	12.31	1.29	666.20	23.7	49.28	6.58	27.49	
BCR-05	8.14	32.41	16.95	41.50	51.38	341.64	32.19	170.05	12.56	1.24	677.03	24.48	52.19	6.63	27.38	
BCR-08	8.35	34.05	15.08	39.70	49.91	332.16	32.60	179.22	12.09	1.13	654.35	23.92	50.97	6.43	27.16	
BCR-01	8.18	33.28	14.76	40.22	49.70	334.31	33.15	176.80	12.05	1.16	655.76	24	50.95	6.45	27.36	
BCR-02	8.63	33.16	17.21	41.31	51.71	338.86	32.16	172.28	12.09	1.25	662.13	24.18	51.51	6.6	27.66	
BCR-03	9.07	32.60	16.09	39.09	48.49	327.78	31.75	173.25	12.16	1.18	635.54	23.21	50.01	6.39	27.6	
BCR-04	8.46	33.21	15.30	40.06	49.72	336.19	32.65	172.84	12.02	1.21	642.52	23.71	51.65	6.38	27.4	
BCR-05	9.14	33.09	14.66	40.42	49.42	332.12	31.76	169.34	12.06	1.28	663.36	23.88	50.83	6.5	27.3	
BCR-06	8.41	34.16	18.65	42.59	54.27	340.17	33.16	178.18	12.39	1.30	677.51	24.41	51.51	6.38	27.38	
BCR-07	8.39	34.87	17.48	41.79	52.87	334.39	33.16	177.86	12.06	1.26	656.44	24.07	51.09	6.42	27.39	
01.10.2020	BCR-08	8.35	33.73	16.94	40.29	50.39	333.25	32.38	176.10	12.41	1.24	639.78	23.85	50.67	6.4	27.36
	BCR-05	9.55	31.77	15.38	38.79	49.86	327.33	30.22	163.35	11.94	1.16	678.00	23.72	51.82	6.62	27.36
BCR-06	9.55	32.95	15.78	40.57	51.70	337.07	30.75	166.59	12.18	1.22	665.01	24.18	52.03	6.64	27.33	
BCR-07	9.19	32.63	14.34	39.38	49.87	333.74	31.42	167.38	11.98	1.23	699.52	24.56	52.13	6.7	28.44	
01.11.2020	BCR-01	9.97	32.46	16.53	41.47	53.11	338.28	31.95	171.68	12.66	1.31	693.16	24.34	52.78	6.25	27.41
	BCR-02	9.48	32.80	13.47	39.15	49.11	334.90	32.91	175.91	12.25	1.26	684.03	24.65	51.65	6.53	27.64
	BCR-01	9.40	33.49	15.20	42.36	53.76	337.26	33.65	178.26	12.48	1.37	648.92	24.16	49.86	6.41	27.62
	BCR-02	9.19	32.20	15.53	41.46	51.73	336.69	32.83	172.26	12.19	1.19	660.77	22.95	51.19	6.46	27.7
	BCR-03	9.44	32.50	19.09	42.51	53.82	340.24	32.92								

Appendix A

Supplementary Table S7: LA-ICP-MS standard measurements on reference material BCR-2G.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Hol65	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.09.2020	BCR-05	6.98	1.91	6.30	0.89	6.58	1.24	4.00	0.49	3.32	0.45	4.51	0.82	11.43	5.77	1.53
	BCR-06	6.43	1.83	6.22	0.95	5.97	1.29	3.67	0.49	3.28	0.46	4.47	0.69	10.86	5.64	1.65
01.10.2020	BCR-01	6.60	1.99	6.56	0.98	6.15	1.30	3.47	0.49	3.37	0.45	4.38	0.76	8.63	5.88	1.93
	BCR-02	6.48	1.93	6.51	0.97	6.19	1.35	3.53	0.51	3.41	0.52	4.92	0.76	8.75	5.93	1.98
	BCR-03	6.24	1.85	6.02	0.92	6.21	1.21	3.47	0.43	3.50	0.47	4.53	0.66	8.59	5.78	1.95
	BCR-04	6.84	1.94	6.20	0.99	6.19	1.28	3.54	0.52	3.37	0.47	4.92	0.66	8.70	5.65	1.95
	BCR-05	6.20	1.78	6.39	0.97	6.36	1.19	3.64	0.46	3.29	0.46	4.74	0.74	8.76	5.65	1.97
	BCR-06	6.43	1.90	6.14	1.03	6.03	1.35	3.64	0.49	3.46	0.48	5.07	0.75	8.95	5.69	1.85
	BCR-01	6.42	1.91	6.69	0.94	5.90	1.21	3.59	0.48	3.27	0.46	4.61	0.69	8.96	5.83	2.05
	BCR-02	6.21	1.82	5.96	0.94	6.09	1.15	3.46	0.47	3.22	0.48	4.77	0.71	8.92	5.80	2.02
	BCR-03	6.35	2.02	6.09	1.00	5.85	1.23	3.41	0.47	3.11	0.45	4.47	0.73	8.72	5.62	1.97
	BCR-05	6.48	1.87	6.49	0.95	6.05	1.28	3.28	0.50	3.17	0.44	4.84	0.70	9.41	5.85	1.90
	BCR-06	6.58	1.96	5.99	0.99	6.22	1.13	3.47	0.47	3.26	0.46	4.90	0.69	8.63	5.69	2.01
	BCR-07	6.45	1.93	6.60	0.99	6.16	1.23	3.41	0.51	3.38	0.47	4.80	0.67	8.65	5.76	2.03
	BCR-08	6.07	1.92	5.93	0.94	5.98	1.24	3.61	0.49	3.28	0.47	4.64	0.66	9.43	5.84	1.98
	BCR-01	6.21	1.75	6.19	0.95	6.15	1.23	3.50	0.44	3.19	0.49	4.63	0.69	8.07	5.64	1.94
	BCR-02	5.41	1.79	5.66	0.88	6.04	1.10	3.17	0.47	3.13	0.42	4.38	0.73	7.64	5.19	1.83
	BCR-03	5.76	1.75	6.28	0.90	5.80	1.21	3.56	0.48	3.25	0.44	4.58	0.67	7.79	5.39	1.81
	BCR-04	6.03	1.94	6.06	0.94	5.49	1.15	3.18	0.44	3.07	0.43	4.48	0.64	7.75	5.18	1.85
	BCR-05	5.90	1.87	5.81	0.95	6.06	1.13	3.29	0.42	2.94	0.47	4.43	0.69	10.30	5.28	1.55
	BCR-06	6.28	1.91	6.02	0.90	5.98	1.18	3.44	0.47	3.29	0.45	4.31	0.70	10.16	5.53	1.64
	BCR-07	5.91	1.94	5.57	1.00	5.91	1.38	3.50	0.46	3.06	0.46	4.38	0.65	9.00	5.62	1.68
	BCR-08	5.91	2.00	6.89	1.07	5.68	1.31	3.14	0.42	3.06	0.49	4.15	0.68	10.18	5.35	1.47
	BCR-09	6.08	1.75	6.33	0.89	5.47	1.25	3.61	0.42	3.25	0.54	4.01	0.67	9.87	5.33	1.66
	BCR-10	6.07	1.82	5.96	0.88	5.31	1.08	3.43	0.45	3.29	0.42	4.28	0.70	9.85	5.43	1.49
	BCR-11	6.35	1.85	5.98	0.93	5.98	1.15	3.32	0.52	2.87	0.44	4.34	0.69	10.11	5.30	1.51
	BCR-12	6.09	1.80	6.12	0.95	5.75	1.08	3.28	0.52	3.36	0.51	4.34	0.70	10.85	5.26	1.61
	BCR-01	6.47	1.86	6.10	0.94	5.77	1.22	3.27	0.44	3.08	0.45	4.32	0.66	9.89	5.26	1.56
	BCR-03	6.04	1.82	6.02	0.90	6.10	1.20	3.49	0.46	3.15	0.44	4.59	0.69	10.31	5.45	1.58
	BCR-04	6.32	1.85	6.06	0.95	6.12	1.23	3.41	0.44	3.05	0.47	4.53	0.70	10.27	5.33	1.59
	BCR-05	6.05	1.81	6.13	0.93	6.28	1.19	3.32	0.45	3.43	0.44	4.48	0.70	9.77	5.46	1.63
	BCR-06	6.25	1.82	6.12	0.91	5.45	1.16	3.35	0.45	2.97	0.45	4.57	0.65	9.42	5.30	1.53
	BCR-07	6.23	1.94	6.13	0.88	5.56	1.17	3.36	0.45	3.12	0.46	4.54	0.64	9.92	5.25	1.64
	BCR-08	6.16	1.86	6.43	0.97	6.34	1.25	3.61	0.49	3.27	0.50	4.32	0.70	10.31	5.57	1.60
	BCR-09	6.20	1.94	5.64	0.93	5.61	1.17	3.35	0.47	2.89	0.47	4.53	0.72	10.02	5.49	1.63
	BCR-01	6.25	1.89	6.29	0.91	6.02	1.22	3.46	0.44	3.21	0.46	4.50	0.73	10.13	5.45	1.59
	BCR-02	5.84	1.96	6.09	0.96	5.35	1.17	3.29	0.44	3.20	0.42	4.26	0.70	10.47	5.25	1.62
	BCR-03	6.21	1.90	5.99	0.91	5.55	1.18	3.14	0.46	3.17	0.42	4.29	0.64	10.01	5.31	1.62
	BCR-04	6.63	1.91	6.15	1.08	6.42	1.29	3.40	0.46	3.09	0.47	3.82	0.66	10.32	5.69	1.58
	BCR-05	6.34	1.71	4.86	0.99	6.51	1.25	3.80	0.46	3.23	0.45	4.95	0.66	11.58	5.91	1.71
	BCR-06	6.16	1.96	5.87	1.00	6.13	1.19	3.39	0.45	3.15	0.45	4.46	0.67	10.24	5.46	1.65
	BCR-07	6.48	1.91	6.38	0.94	5.86	1.22	3.36	0.46	3.05	0.47	4.31	0.67	10.09	5.30	1.55
	BCR-08	6.17	1.86	6.88	0.93	5.86	1.12	3.36	0.48	3.27	0.42	4.58	0.68	9.69	5.19	1.62
	BCR-09	5.80	1.87	6.48	1.00	5.67	1.14	3.30	0.46	3.28	0.46	4.52	0.68	9.94	5.28	1.56
	BCR-01	6.38	1.92	5.88	0.93	5.53	1.20	3.50	0.47	3.03	0.46	4.15	0.67	10.28	5.41	1.60
	BCR-02	6.22	1.81	5.58	0.98	5.56	1.15	3.17	0.50	2.93	0.42	4.60	0.69	9.12	5.18	1.47
	BCR-03	6.51	1.87	6.46	0.97	5.74	1.14	3.47	0.41	3.09	0.47	4.49	0.65	9.51	5.28	1.52
	BCR-04	6.18	1.88	6.14	0.98	5.56	1.21	3.30	0.44	3.01	0.51	4.49	0.70	9.91	5.16	1.55
	BCR-05	6.39	1.90	6.11	0.90	5.78	1.18	3.47	0.45	3.11	0.44	4.40	0.70	10.63	5.42	1.74
	BCR-08	6.43	1.89	6.24	0.92	5.58	1.21	3.25	0.45	3.01	0.42	4.60	0.68	10.20	5.24	1.53
	BCR-01	6.66	1.84	6.15	0.99	5.95	1.16	3.21	0.45	3.19	0.46	4.52	0.67	9.84	5.23	1.62
	BCR-02	6.14	1.85	5.94	0.95	5.70	1.18	3.45	0.47	3.07	0.45	4.51	0.70	10.12	5.52	1.71
	BCR-03	6.13	1.82	5.88	0.96	5.58	1.18	3.32	0.45	3.23	0.48	4.35	0.69	9.53	5.24	1.61
	BCR-04	6.43	1.78	5.98	0.96	5.87	1.17	3.22	0.46	3.02	0.43	4.37	0.67	10.05	5.22	1.58
	BCR-05	6.12	1.89	5.99	0.94	5.67	1.16	3.33	0.48	3.26	0.47	4.45	0.70	9.95	5.38	1.62
	BCR-06	6.56	1.91	5.99	0.91	6.07	1.18	3.62	0.49	3.05	0.47	4.64	0.71	10.68	5.52	1.63
	BCR-07	6.31	1.87	5.87	1.02	6.01	1.20	3.63	0.44	3.46	0.46	4.41	0.62	9.83	5.54	1.63
01.10.2020	BCR-08	5.76	1.85	6.26	0.93	5.56	1.19	3.49	0.48	3.14	0.48	4.56	0.66	9.61	5.40	1.53
	BCR-05	6.36	1.99	6.20	0.95	5.83	1.17	3.29	0.46	3.11	0.41	4.40	0.73	10.60	5.40	1.75
	BCR-06	5.95	1.86	5.94	0.95	5.68	1.17	3.72	0.43	2.96	0.49	4.43	0.66	11.26	5.60	1.73
	BCR-07	6.26	1.87	6.13	0.97	6.10	1.23	3.36	0.46	3.41	0.47	4.52	0.67	10.93	5.52	1.72
01.11.2020	BCR-01	6.35	1.98	6.43	1.04	5.81	1.18	3.30	0.44	3.11	0.48	4.66	0.74	11.36	5.75	1.81
	BCR-02	6.93	1.99	6.60	0.99	6.17	1.23	3.43	0.49	3.24	0.45	5.02	0.71	10.56	5.66	1.67
	BCR-01	6.42	1.93	6.72	0.97	5.91	1.18	3.63	0.46	3.33	0.45	4.43	0.65	8.57	5.35	1.94
	BCR-02	6.26	1.83	6.01	0.91	5.79	1.14	3.22	0.47	3.17	0.43	4.31	0.68	8.70	5.28	1.83
	BCR-03	6.11	1.83	6.17	0.94	6.01	1.22	3.46	0.46	3.20	0.47	4.28	0.64	8.67	5.31	1.75
	BCR-04	6.14	1.86	6.10	0.95	5.94	1.20	3.34	0.46	3.40	0.43	4.30	0.63	8.90	5.42	1.80
	BCR-05	5.87	1.90	6.19	0.99	6.09	1.20	3.58	0.50	3.00	0.44	4.62	0.69	9.23	5.62	1.78
	BCR-06	6.68	1.98	5.93	1.00	5.90	1.22	3.67	0.47	3.21	0.48	4.57	0.69	9.45	5.56	1.74
	BCR-07	6.33	1.91	6.19	0.97	5.83	1.17	3.37	0.48	3.08	0.46	4.62	0.71	8.73	5.59	1.92

Appendix A

Supplementary Table S7: LA-ICP-MS standard measurements on reference material BCR-2G.

date	Comment	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.03.2021	BCR-02	9.56	32.80	14.27	41.64	52.47	348.34	34.42	180.27	12.38	1.20	648.89	24.4	51.22	6.65	27.71
	BCR-03	9.28	34.23	16.36	44.00	54.69	349.40	33.85	179.49	12.07	1.27	667.73	24.39	52.39	6.49	27.41
	BCR-04	9.21	33.34	15.05	41.99	51.66	332.78	32.20	172.52	12.03	1.24	647.86	24.26	50.14	6.3	27.25
	BCR-05	9.56	32.42	16.31	39.06	48.54	334.33	32.27	168.82	11.87	1.13	642.45	23.13	48.71	6.18	26.91
	BCR-06	9.57	33.40	12.59	42.93	53.64	337.53	32.28	174.73	12.39	1.26	669.21	23.51	49.09	6.12	26.87
	BCR-07	9.68	33.78	16.36	41.38	53.77	341.67	32.16	173.66	12.31	1.33	663.32	24.09	51.14	6.27	27.21
	BCR-08	9.46	33.35	15.11	41.32	53.79	340.85	32.18	174.28	12.33	1.34	673.14	23.7	50.72	6.3	26.98
	BCR-09	9.40	32.35	15.37	42.15	52.44	340.78	32.03	171.59	11.95	1.27	659.95	23.57	50.78	6.26	26.32
	BCR-10	10.66	33.72	17.36	43.13	53.37	332.01	32.89	179.98	12.77	1.28	645.96	23.78	49.8	6.32	27.27
	BCR-11	9.41	34.84	17.51	43.21	54.56	341.36	34.17	181.75	12.75	1.30	665.33	24.26	50.98	6.58	27.2
	BCR-01	10.17	32.77	16.30	42.76	53.09	337.32	32.93	178.32	12.51	1.15	640.50	24.26	51.07	6.3	27.31
	BCR-02	9.62	32.99	15.59	42.88	52.12	340.70	32.96	174.95	12.11	1.28	669.11	24.52	51.47	6.39	27.14
	BCR-03	9.43	33.16	14.52	40.70	51.38	342.22	33.23	175.55	12.29	1.16	660.10	24.03	50.85	6.54	27.07
	BCR-04	10.01	33.12	20.26	42.52	53.41	332.48	32.80	178.05	12.59	1.26	665.11	24.07	51.21	6.36	27.32
	BCR-05	8.40	33.63	15.43	41.66	52.48	342.49	32.15	172.26	12.20	1.29	681.95	24.5	51.68	6.29	27.62
	BCR-06	9.73	33.42	17.41	41.27	51.71	337.45	32.25	172.67	11.87	1.23	668.09	24.44	50.76	6.28	27.87
	BCR-07	9.42	33.54	12.63	42.08	53.69	335.01	32.68	175.02	12.69	1.22	689.45	24.13	50.87	6.55	27.27
	BCR-06	10.01	32.59	17.90	40.36	50.72	334.23	31.27	166.94	11.94	1.15	682.72	24.19	52.25	6.65	27.82
	BCR-07	9.61	32.77	15.89	39.50	50.11	332.21	31.02	165.14	12.02	1.21	684.46	23.83	51.23	6.51	26.68
	BCR-08	10.25	32.59	15.83	40.42	49.56	336.60	30.48	166.06	12.24	1.36	696.73	24.18	51.99	6.73	27.21
	BCR-01	9.80	32.55	15.81	39.45	50.81	336.42	32.51	172.67	11.58	1.19	690.50	24.51	52.45	6.59	27.67
	BCR-02	9.58	33.08	17.85	40.95	51.69	337.96	32.44	174.75	12.05	1.28	681.14	24.55	51.56	6.62	27.66
	BCR-03	8.83	33.25	17.20	38.21	48.71	333.81	33.23	173.61	11.74	1.28	683.56	24.51	51.22	6.63	28.21
	BCR-04	9.34	33.30	15.02	38.72	49.17	335.84	32.69	174.02	11.97	1.22	671.56	24.56	51.98	6.49	27.62
	BCR-08	9.74	32.19	15.35	40.90	49.54	336.20	30.91	166.72	12.10	1.23	708.33	24.58	53.13	6.78	27.78
	BCR-01	9.67	31.38	15.55	39.17	49.15	331.06	30.87	163.41	11.99	1.22	673.79	23.8	51.36	6.38	27.85
	BCR-02	9.20	31.45	14.74	37.76	46.63	335.14	30.84	164.52	11.73	1.13	674.41	23.99	51.93	6.49	26.47
	BCR-03	9.33	32.75	14.09	38.45	48.18	335.28	32.30	172.15	12.09	1.20	685.78	25.18	52.01	6.6	27.92
	BCR-04	10.00	33.77	15.83	39.56	50.21	336.69	32.65	171.75	12.00	1.28	687.00	24.44	52.56	6.75	27.53
	BCR-05	9.48	32.43	15.63	39.97	49.94	334.80	31.97	171.63	11.84	1.19	682.50	24.39	51.47	6.62	27.85
	BCR-02	9.53	32.40	13.84	39.89	51.36	332.10	32.17	172.36	11.90	1.31	689.74	24.83	52.16	6.7	27.52
	BCR-03	9.94	33.41	15.90	41.43	52.52	339.39	33.16	178.52	12.39	1.26	687.98	25.16	52.46	6.65	28.21
	BCR-04	9.55	32.61	16.34	40.45	48.56	336.77	32.76	175.78	12.13	1.17	683.19	24.8	51.8	6.58	28.14
	BCR-05	9.35	32.70	15.35	40.08	50.38	339.27	31.82	171.58	12.09	1.22	704.36	24.47	52.85	6.62	27.56
	BCR-06	9.54	32.49	13.67	40.16	50.71	336.13	31.54	166.84	12.26	1.29	703.07	24.36	53.17	6.68	27.97
	BCR-07	9.64	31.13	16.32	40.39	49.46	331.61	29.70	160.92	12.31	1.16	682.57	23.57	52	6.34	27.37
	BCR-04	9.25	33.60	14.24	38.28	49.21	332.49	31.71	173.55	12.13	1.22	673.72	24.81	52.25	6.53	27.92
	BCR-05	9.17	33.51	15.24	38.44	49.41	335.95	32.51	176.96	12.14	1.13	674.87	24.96	50.96	6.53	27.91
	BCR-06	9.06	32.31	14.71	38.98	47.40	328.19	31.32	167.99	11.60	1.21	677.02	23.91	51.77	6.61	26.98
	BCR-07	9.43	31.70	17.18	39.50	49.18	333.14	30.52	164.45	11.96	1.23	708.49	23.99	52.97	6.67	28.57
	BCR-01	9.83	32.70	15.05	40.63	51.32	334.77	31.95	173.33	12.47	1.33	687.06	24.47	52.62	6.7	28.57
	BCR-02	10.16	32.07	16.35	40.24	50.27	331.75	30.13	163.50	12.07	1.26	693.20	24.02	52.73	6.42	28.45
	BCR-03	10.30	32.88	16.77	39.29	50.40	338.85	31.76	168.46	12.48	1.25	694.31	24.73	54.22	7.13	28.96
	BCR-04	9.35	32.67	16.35	41.46	48.71	335.77	30.20	163.63	12.51	1.22	703.93	24.57	53.34	6.57	28
01.03.2021	BCR-05	9.23	32.39	15.79	38.27	47.45	331.31	29.79	160.66	11.86	1.24	666.94	23.72	52.71	6.58	27.53
	BCR-06	9.25	31.44	13.83	39.55	48.98	333.70	29.76	160.85	11.93	1.07	666.91	22.91	51.27	6.48	27.03
	BCR-01	9.96	31.91	17.81	39.81	52.36	335.97	31.88	171.26	11.93	1.25	687.36	24.31	51.99	6.68	28.17
	BCR-05	9.70	32.01	15.81	40.02	51.75	335.04	30.72	164.56	12.41	1.38	686.57	24.45	52.71	6.74	28.12
	BCR-06	9.53	32.15	16.33	40.17	49.58	340.32	30.74	166.64	12.26	1.17	690.20	24.31	52.89	6.45	27.39
	BCR-07	9.86	30.21	15.18	40.88	50.12	327.19	29.33	160.39	12.52	1.26	692.64	23.74	52.25	6.62	27.37
	BCR-01	10.14	31.46	16.47	40.18	50.97	335.40	29.34	159.51	12.73	1.31	695.83	23.73	53.81	6.55	28.17
	BCR-02	9.67	30.97	15.12	40.29	50.77	339.53	29.30	157.28	12.28	1.33	707.90	23.8	53.41	6.55	26.84
	BCR-03	9.73	32.78	15.68	40.35	49.49	331.16	30.63	163.69	12.00	1.21	660.77	24.11	52.02	6.35	27.3
	BCR-04	8.97	32.46	16.50	40.17	49.00	338.57	30.65	167.28	12.10	1.24	688.02	24.67	53.59	6.53	28.78
	BCR-05	9.35	32.15	14.54	38.46	47.73	329.58	29.96	162.19	11.90	1.29	695.83	24.36	53.85	6.47	27.37
	BCR-06	9.21	31.41	14.50	39.60	48.55	334.08	30.31	161.24	12.05	1.22	704.20	24.75	53.64	6.66	28.7
	BCR-07	9.97	31.42	15.10	39.62	49.49	333.69	29.21	159.61	12.17	1.19	684.19	24.12	52.08	6.65	27.49
	BCR-01	9.86	32.96	15.04	39.86	53.00	336.27	32.56	172.78	12.02	1.27	683.63	24.59	52.55	6.69	28.75
	BCR-02	9.52	32.45	16.30	39.83	50.41	337.36	32.39	172.45	11.91	1.29	681.68	24.28	52.82	6.42	28.32
	BCR-03	9.62	33.00	16.11	39.80	50.19	336.85	32.31	172.95	12.09	1.30	686.55	24.96	52.62	6.98	28.16
	BCR-03	10.00	32.44	15.42	38.82	49.03	334.40	31.19	167.50	11.88	1.10	659.68	23.16	49.16	6.31	26.8
	BCR-04	9.84	32.32	15.38	39.11	48.85	329.89	31.24	166.43	11.90	1.13	664.65	23.21	50.17	6.41	27.69
	BCR-05	10.17	31.55	15.02	39.26	51.72	334.95	30.71	165.22	12.26	1.30	707.18	24.47	54.76	6.63	29.32
	BCR-06	10.05	31.23	13.46	37.33	49.81	321.33	28.68	156.71	11.45	1.22	668.50	23.3	50.78	6.41	26.43
	BCR-07	9.84	32.19	14.73	39.41	50.31	331.72	30.30	164.73	12.62	1.22	694.94	24.55	53.84	6.37	27.99
	BCR-08	9.32	32.63	14.27	36.47	47.08	336.30	32.57	174.79	11.50	1.06					

Appendix A

Supplementary Table S7: LA-ICP-MS standard measurements on reference material BCR-2G.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Hol65	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	BCR-02	6.37	1.85	6.27	0.99	5.98	1.24	3.34	0.46	3.24	0.45	4.48	0.64	9.04	5.54	1.71
	BCR-03	6.16	1.93	5.92	0.99	5.66	1.25	3.26	0.45	3.23	0.48	4.61	0.72	9.01	5.54	1.70
	BCR-04	6.10	1.88	6.41	0.97	5.81	1.12	3.30	0.44	3.02	0.44	4.26	0.71	8.65	5.23	1.75
	BCR-05	5.84	1.79	6.67	0.92	5.83	1.13	3.21	0.46	2.48	0.40	4.25	0.63	9.30	5.46	1.84
	BCR-06	5.28	1.75	6.08	1.00	5.37	1.27	3.62	0.43	2.87	0.41	4.67	0.73	8.96	5.38	1.68
	BCR-07	6.24	1.85	6.31	0.88	5.71	1.14	3.45	0.46	3.17	0.49	4.43	0.70	9.39	5.26	1.63
	BCR-08	6.02	2.01	6.02	0.92	5.95	1.08	3.29	0.46	3.13	0.45	3.94	0.60	9.61	5.32	1.64
	BCR-09	6.10	1.82	5.97	0.87	5.89	1.17	3.14	0.45	2.92	0.43	4.30	0.73	9.05	5.24	1.59
	BCR-10	6.14	1.83	6.19	1.02	5.84	1.23	3.40	0.43	3.04	0.49	4.54	0.66	8.05	5.44	1.77
	BCR-11	6.18	1.84	6.52	1.00	5.81	1.21	3.46	0.44	3.10	0.36	4.75	0.75	8.47	5.48	1.86
	BCR-01	6.27	1.90	6.19	0.92	6.01	1.23	3.39	0.49	2.97	0.47	4.63	0.71	8.24	5.54	1.96
	BCR-02	6.40	1.87	6.45	1.00	6.36	1.20	3.67	0.51	2.99	0.44	4.72	0.69	8.15	5.60	1.91
	BCR-03	6.45	1.83	6.46	0.94	6.05	1.19	3.38	0.48	3.12	0.46	4.60	0.65	8.09	5.38	1.86
	BCR-04	6.03	1.82	6.63	1.00	5.98	1.23	3.37	0.44	3.13	0.47	4.13	0.72	8.19	5.43	1.84
	BCR-05	5.58	1.85	6.48	0.96	5.72	1.21	3.39	0.44	3.14	0.48	4.38	0.74	8.08	5.51	1.91
	BCR-06	6.00	1.84	5.79	0.95	5.92	1.25	3.25	0.44	3.18	0.47	4.49	0.66	8.18	5.50	1.95
	BCR-07	5.03	1.90	5.56	0.98	5.81	1.09	3.09	0.47	2.89	0.45	4.42	0.66	8.18	5.12	1.75
01.03.2021	BCR-06	6.43	1.97	6.36	0.95	6.00	1.22	3.38	0.45	2.99	0.48	4.44	0.79	10.77	5.72	1.73
	BCR-07	5.99	1.95	6.32	0.99	5.88	1.12	3.37	0.55	3.04	0.46	4.25	0.64	10.71	5.53	1.70
	BCR-08	6.10	1.91	6.26	0.97	5.72	1.16	3.40	0.48	3.04	0.44	4.66	0.71	10.84	5.63	1.68
	BCR-01	6.74	2.01	6.95	0.93	5.98	1.26	3.48	0.53	3.59	0.46	4.78	0.61	10.90	5.80	1.83
	BCR-02	6.42	1.91	6.56	1.01	5.95	1.23	3.46	0.51	3.21	0.44	4.70	0.65	11.38	5.60	1.73
	BCR-03	6.01	2.00	6.56	0.97	6.29	1.30	3.55	0.53	3.48	0.47	4.48	0.69	10.98	5.71	1.76
	BCR-04	6.03	1.91	6.55	1.01	6.23	1.25	3.52	0.47	3.12	0.48	5.04	0.65	10.67	5.75	1.65
	BCR-08	6.24	1.84	6.51	0.98	6.13	1.20	3.40	0.46	3.15	0.46	4.38	0.73	10.30	5.58	1.81
	BCR-01	6.07	2.04	6.32	0.94	5.54	1.15	3.27	0.48	3.07	0.42	4.53	0.69	11.22	5.57	1.76
	BCR-02	6.57	2.00	6.31	0.94	5.69	1.14	3.49	0.44	2.98	0.47	4.33	0.68	10.21	5.57	1.67
	BCR-03	6.46	2.04	6.37	1.04	6.04	1.25	3.67	0.51	3.32	0.46	4.71	0.77	10.14	5.72	1.72
	BCR-04	5.82	2.01	6.33	1.01	6.11	1.30	3.45	0.46	3.41	0.53	4.70	0.71	10.65	5.76	1.74
	BCR-05	6.43	1.89	6.23	0.94	5.87	1.34	3.46	0.56	3.14	0.45	4.44	0.70	10.55	5.61	1.73
	BCR-02	6.54	1.99	6.53	1.04	6.28	1.16	3.47	0.44	3.02	0.45	4.63	0.78	10.80	5.68	1.64
	BCR-03	6.66	1.81	6.39	1.04	5.99	1.21	3.60	0.44	3.11	0.41	4.67	0.69	10.73	5.98	1.70
	BCR-04	6.44	2.07	6.33	0.92	6.08	1.22	3.53	0.45	3.58	0.47	4.70	0.65	10.44	5.84	1.72
	BCR-05	6.36	1.92	6.11	1.01	6.49	1.23	3.29	0.49	3.30	0.49	4.73	0.71	10.59	5.57	1.71
	BCR-06	6.39	1.88	6.36	1.01	6.20	1.29	3.28	0.45	3.30	0.48	4.55	0.73	10.83	5.64	1.75
	BCR-07	6.02	1.82	5.84	0.94	5.74	1.13	3.14	0.46	2.92	0.43	4.50	0.67	10.24	5.40	1.65
	BCR-04	6.47	1.95	6.27	0.99	6.27	1.29	3.74	0.50	3.41	0.47	4.67	0.71	10.66	5.98	1.67
	BCR-05	6.14	1.96	6.24	1.06	6.37	1.29	3.44	0.47	3.32	0.51	4.70	0.68	10.57	6.02	1.57
	BCR-06	6.67	1.81	6.09	0.95	5.87	1.11	3.47	0.47	3.20	0.46	4.51	0.69	10.10	5.69	1.67
	BCR-07	6.16	1.88	6.48	0.96	5.85	1.13	3.06	0.43	3.30	0.47	4.42	0.68	10.93	5.48	1.77
	BCR-01	6.67	2.01	6.35	0.94	5.98	1.25	3.39	0.49	3.02	0.50	4.63	0.69	11.56	5.72	1.77
	BCR-02	6.84	1.85	6.04	0.89	5.69	1.18	3.32	0.45	3.06	0.48	4.52	0.77	10.97	5.43	1.78
	BCR-03	7.06	1.98	6.42	1.03	5.99	1.18	3.64	0.46	3.32	0.54	4.53	0.69	11.19	5.89	1.60
01.03.2021	BCR-04	6.36	2.01	6.31	0.97	5.72	1.13	3.30	0.45	3.06	0.47	4.36	0.68	11.09	5.59	1.79
	BCR-05	6.49	1.93	6.18	0.94	5.49	1.17	3.09	0.47	3.16	0.45	4.47	0.67	10.90	5.55	1.68
	BCR-06	5.84	1.86	5.50	1.01	5.37	1.16	3.10	0.46	2.89	0.42	4.80	0.64	10.49	5.50	1.76
	BCR-01	6.32	2.02	6.54	0.96	6.12	1.21	3.41	0.45	3.27	0.45	4.99	0.69	11.15	5.63	1.68
	BCR-05	6.38	1.83	5.66	0.90	5.85	1.21	3.43	0.47	3.05	0.45	4.60	0.70	11.08	5.58	1.75
	BCR-06	6.21	1.88	6.13	0.92	6.15	1.18	3.16	0.43	2.91	0.44	4.21	0.70	10.86	5.67	1.72
	BCR-07	6.24	1.91	6.31	0.97	5.13	1.13	3.20	0.46	2.87	0.43	4.22	0.64	11.27	5.29	1.75
	BCR-01	6.42	2.09	6.44	0.90	5.52	1.11	3.36	0.48	2.84	0.43	4.60	0.71	11.08	5.48	1.88
	BCR-02	5.75	1.96	5.42	0.89	5.35	1.12	3.11	0.40	2.81	0.39	4.15	0.76	11.33	5.32	1.75
	BCR-03	6.60	1.88	6.15	0.97	5.70	1.18	3.14	0.47	2.95	0.42	4.48	0.69	10.66	5.38	1.55
	BCR-04	6.39	1.86	6.37	0.98	5.81	1.23	3.41	0.42	3.01	0.47	4.41	0.77	10.37	5.40	1.62
	BCR-05	6.11	1.89	5.69	0.92	5.32	1.19	3.35	0.43	3.35	0.48	4.55	0.65	10.57	5.54	1.65
	BCR-06	7.18	1.96	6.35	0.97	5.81	1.18	3.36	0.46	3.24	0.46	4.37	0.75	10.62	5.50	1.72
	BCR-07	6.15	1.93	6.02	0.89	5.57	1.15	3.19	0.45	3.06	0.46	4.33	0.65	10.74	5.35	1.72
	BCR-01	5.91	1.86	6.79	0.99	5.86	1.24	3.34	0.46	3.29	0.48	4.49	0.72	10.99	5.65	1.76
	BCR-02	6.29	2.11	6.60	0.93	6.08	1.31	3.43	0.45	3.31	0.46	4.90	0.77	11.08	5.72	1.66
	BCR-03	6.64	1.94	6.53	1.07	6.65	1.33	3.70	0.50	3.40	0.54	5.02	0.68	10.70	5.89	1.70
	BCR-03	5.39	1.86	5.89	0.95	5.69	1.17	3.26	0.44	3.18	0.48	4.31	0.78	7.76	5.39	2.00
	BCR-04	5.61	1.77	5.76	0.91	5.50	1.23	3.26	0.42	3.11	0.46	4.38	0.69	8.48	5.51	1.96
	BCR-05	6.56	1.85	5.75	0.89	5.71	1.27	3.16	0.49	3.26	0.48	4.53	0.71	8.45	5.56	1.87
	BCR-06	6.22	1.79	5.60	0.94	5.35	1.07	3.00	0.42	2.96	0.42	4.45	0.77	8.29	5.28	2.23
	BCR-07	6.73	2.04	6.32	0.96	5.92	1.22	3.56	0.48	3.33	0.47	4.57	0.65	8.84	5.77	2.16
	BCR-08	6.32	1.88	6.11	0.98	6.18	1.25	3.75	0.51	3.69	0.49	4.79	0.57	7.53	6.01	1.91
	BCR-01	6.61	1.97	6.48	0.97	6.35	1.32	3.64	0.48	3.39	0.50	4.67	0.71	11.35	5.94	1.80
	BCR-02	6.71	2.14	6.02	1.00	6.15	1.21	3.48	0.53	3.39	0.48	4.60	0.71	10.78	5.78	1.78
	BCR-03	6.42	1.85	5.39	0.95	5.21	1.26	3.33	0.42	2.95	0.45	4.71	0.56	10.20	5.82	1.72
	BCR-04	6.59	1.99	6.11	1.03	5.84	1.23	3.26	0.43	3.25	0.48	4.71	0.68	10.72	5.64	1.73

Appendix A

Supplementary Table S7: LA-ICP-MS standard measurements on reference material BCR-2G.

date	Comment	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.02.2022	BCR-03	9.92	32.81	13.86	39.40	50.71	335.52	31.86	172.09	11.96	1.19	673.75	24.67	52.55	6.55	27.93
	BCR-04	9.20	32.70	15.97	39.61	48.96	337.53	30.66	166.70	12.34	1.22	699.38	24.77	53.98	6.76	28.46
	BCR-01	10.34	31.96	16.98	40.16	51.76	332.52	31.92	168.64	11.65	1.19	674.32	24.18	51.08	6.56	27.8
	BCR-02	10.78	32.81	16.30	39.22	50.41	337.17	32.41	171.45	11.50	1.18	691.79	24.54	53.17	6.87	29.52
	BCR-03	10.22	32.71	13.58	38.89	50.09	336.45	31.90	171.76	11.89	1.14	689.33	24.75	51.77	6.58	27.63
	BCR-04	10.08	32.92	14.15	38.55	50.31	333.43	31.79	170.84	11.93	1.13	683.32	24.66	51.32	6.54	27.93
	BCR-05	10.42	32.71	15.39	39.88	51.45	338.69	31.44	168.09	12.40	1.30	688.03	24.18	53.01	6.75	28.27
	BCR-06	10.57	31.52	15.00	41.27	52.64	335.51	30.06	164.53	11.77	1.20	688.53	24.27	52.64	6.59	27.07
	BCR-07	10.17	32.71	14.25	40.62	50.47	336.56	31.24	167.82	12.18	1.21	706.04	24.82	53.36	6.73	27.52
	BCR-01	10.59	31.74	16.50	39.57	51.46	335.48	30.61	163.06	12.16	1.12	688.74	22.49	51	6.45	27.56
	BCR-02	9.94	31.95	14.29	40.49	52.37	336.69	31.11	167.19	12.13	1.23	721.79	25.66	54.92	7.04	27.95
	BCR-07	9.78	32.11	16.24	40.76	51.53	329.86	30.20	161.14	11.96	1.32	694.90	24.54	54.09	6.63	28.06
	BCR-09	9.82	32.76	15.26	40.78	53.01	336.32	31.30	168.17	11.77	1.35	708.21	24.55	53.13	6.7	28.98
	BCR-01	9.43	32.11	16.96	39.94	51.38	335.50	31.45	166.47	11.90	1.30	670.61	24.31	51.29	6.6	28.67
	BCR-02	9.56	32.32	14.91	39.62	51.01	339.26	31.90	168.64	11.76	1.39	683.00	24.91	52.71	6.74	28.05
	BCR-03	9.26	32.17	15.56	39.60	49.92	331.89	31.50	167.65	11.76	1.29	678.01	24.21	52.5	6.51	27.68
	BCR-04	9.24	32.63	14.19	39.78	49.89	333.94	31.77	170.57	11.87	1.28	694.12	25.28	53.53	6.55	28.46
	BCR-05	9.40	32.74	13.12	39.48	50.27	334.71	32.00	169.48	11.92	1.21	697.44	25.32	54.41	6.85	28.34
	BCR-06	9.13	32.84	15.13	39.07	49.05	336.75	31.71	170.19	11.85	1.20	671.61	23.84	51.25	6.44	27.39
	BCR-07	8.89	32.27	16.09	39.54	49.98	337.24	31.83	171.44	11.91	1.23	677.32	24.79	52.53	6.68	27.92
	BCR-08	9.81	31.91	17.22	41.40	51.41	337.75	30.56	165.88	12.19	1.23	692.08	24.51	53.45	6.45	27.33
	BCR-01	9.45	31.23	15.94	39.19	49.46	333.82	30.57	164.14	11.72	1.19	671.24	23.47	50.98	6.4	27.49

Appendix A

Supplementary Table S7: LA-ICP-MS standard measurements on reference material BCR-2G.

date	Comment	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
01.02.2022	BCR-03	6.63	2.01	6.29	1.00	5.83	1.23	3.38	0.44	3.08	0.45	4.58	0.73	11.11	5.83	1.73
	BCR-04	6.74	2.09	6.14	0.94	5.91	1.32	3.50	0.46	3.11	0.50	4.32	0.68	10.69	5.63	1.73
	BCR-01	5.65	1.98	6.70	0.97	6.00	1.20	3.55	0.44	3.27	0.49	4.62	0.67	8.84	5.51	2.06
	BCR-02	6.57	1.94	6.34	1.12	5.70	1.23	3.71	0.48	3.24	0.54	4.75	0.68	8.90	5.54	1.94
	BCR-03	6.72	2.08	6.08	0.97	6.11	1.18	3.61	0.45	3.04	0.47	4.83	0.63	8.61	5.81	2.10
	BCR-04	6.02	1.86	6.64	0.95	6.33	1.21	3.59	0.46	3.13	0.51	4.44	0.73	8.47	5.77	1.94
	BCR-05	6.42	1.87	6.23	0.99	5.69	1.26	3.34	0.48	2.95	0.42	4.63	0.70	8.62	5.42	2.13
	BCR-06	6.45	1.79	5.82	0.86	5.46	1.17	3.08	0.43	2.96	0.44	4.34	0.67	8.51	5.60	2.08
	BCR-07	6.40	2.12	5.92	0.90	5.82	1.16	3.44	0.41	3.48	0.40	4.38	0.65	9.00	5.57	1.98
	BCR-01	6.27	1.96	6.20	0.93	5.81	1.14	3.61	0.47	3.28	0.41	4.32	0.69	8.29	5.48	2.05
	BCR-02	6.65	2.05	6.33	1.04	5.92	1.29	3.35	0.51	3.04	0.46	4.76	0.74	8.47	5.59	2.16
	BCR-07	6.57	1.91	5.98	0.96	5.64	1.12	3.31	0.48	3.37	0.48	4.37	0.76	11.94	5.31	1.62
	BCR-09	6.47	1.93	6.55	0.96	5.93	1.21	3.52	0.45	3.29	0.43	4.85	0.69	10.99	5.70	1.68
	BCR-01	6.43	2.09	6.37	0.95	5.71	1.26	3.36	0.46	3.19	0.45	4.65	0.67	10.66	5.55	1.70
	BCR-02	6.69	1.92	6.18	1.01	6.05	1.30	3.37	0.53	3.26	0.50	4.87	0.73	10.93	5.66	1.73
	BCR-03	6.42	2.03	6.29	0.99	6.31	1.26	3.41	0.46	3.00	0.53	4.62	0.71	10.72	5.63	1.62
	BCR-04	6.24	1.98	7.12	1.09	5.88	1.25	3.68	0.47	3.32	0.52	4.55	0.73	10.75	5.86	1.74
	BCR-05	6.44	1.96	6.70	1.05	6.08	1.23	3.28	0.45	3.31	0.49	4.65	0.78	10.79	5.93	1.71
	BCR-06	6.22	1.91	5.96	0.99	5.99	1.24	3.44	0.45	3.18	0.42	4.83	0.72	11.25	5.70	1.63
	BCR-07	6.10	2.01	5.93	1.02	6.27	1.20	3.61	0.52	3.13	0.45	4.49	0.70	10.81	5.69	1.72
	BCR-08	6.09	1.89	6.46	0.95	5.81	1.12	3.38	0.47	3.16	0.41	4.65	0.72	10.47	5.48	1.69
	BCR-01	6.40	2.08	6.39	0.95	5.88	1.21	3.38	0.46	3.03	0.49	4.45	0.64	10.79	5.48	1.72

Appendix A

Supplementary Table S7: LA-ICP-MS standard measurements on reference material BCR-2G.

	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
average all analyses	9.46	32.82	15.73	40.52	50.83	335.69	31.90	170.96	12.10	1.23	674.05	24.21	51.702	6.4986	27.626
BCR-2G - Jochum et al. (2005)				35.50	47.02	342.00	36.10	188.00	12.30	1.18	683.00	24.73	53.3	6.77	28.87
BCR recommended values (used by analysts)	9.00	33.00	17.00	38.00	47.00	342.00	35.00	184.00	12.50	1.16	683.00	24.7	53.3	6.7	28.9
deviation (%) over measurement period (Jochum et al., 2005)				14.14	8.10	-1.85	-11.64	-9.07	-1.64	3.88	-1.31	-2.104	-2.9986	-4.009	-4.308
deviation (%) over measurement period (used by analysts)	5.16	-0.56	-7.47	6.63	8.15	-1.85	-8.87	-7.09	-3.21	5.67	-1.31	-1.985	-2.9986	-3.006	-4.407
average std measurements Sept' 2020	9.83	33.68	14.60	43.36	53.63	344.30	33.30	176.67	12.14	1.27	679.63	25.03	53.445	6.585	27.63
deviation (%) for Sept' 2020 (Jochum et al., 2005)				22.14	14.05	0.67	-7.76	-6.03	-1.30	7.25	-0.49	1.2131	0.272	-2.733	-4.295
deviation (%) for Sept' 2020 (used by analysts)	9.17	2.06	-14.15	14.11	14.10	0.67	-4.86	-3.98	-2.88	9.09	-0.49	1.336	0.272	-1.716	-4.394
average std measurements Oct' 2020	9.16	33.21	15.87	40.82	50.83	335.04	32.25	173.01	12.12	1.21	662.92	24.055	51.044	6.4198	27.442
deviation (%) for Oct' 2020 (Jochum et al., 2005)				14.99	8.10	-2.03	-10.66	-7.97	-1.44	2.81	-2.94	-2.731	-4.2331	-5.172	-4.948
deviation (%) for Oct' 2020 (used by analysts)	1.72	0.64	-6.66	7.43	8.14	-2.03	-7.85	-5.97	-3.02	4.59	-2.94	-2.613	-4.2331	-4.182	-5.046
average std measurements Nov' 2020	9.52	33.20	15.99	42.08	52.80	339.37	32.88	175.07	12.27	1.23	662.52	24.095	50.921	6.3979	27.331
deviation (%) for Nov' 2020 (Jochum et al., 2005)				18.55	12.29	-0.77	-8.92	-6.88	-0.26	4.63	-3.00	-2.569	-4.4629	-5.496	-5.33
deviation (%) for Nov' 2020 (used by analysts)	5.81	0.60	-5.94	10.75	12.34	-0.77	-6.05	-4.85	-1.86	6.43	-3.00	-2.451	-4.4629	-4.509	-5.428
average std measurements March 2021	9.73	32.36	15.57	39.66	50.04	334.73	31.24	167.84	12.05	1.23	686.88	24.322	52.393	6.592	27.843
deviation (%) for March 2021 (Jochum et al., 2005)				11.71	6.42	-2.12	-13.46	-10.72	-2.04	3.86	0.57	-1.652	-1.702	-2.629	-3.559
deviation (%) for March 2021 (used by analysts)	8.12	-1.93	-8.39	4.36	6.47	-2.12	-10.74	-8.78	-3.61	5.65	0.57	-1.532	-1.702	-1.611	-3.659
average std measurements Feb' 2022	9.43	32.28	15.51	39.92	50.63	335.19	31.34	167.62	11.87	1.27	685.32	24.521	52.715	6.5955	28.034
deviation (%) for Feb' 2022 (Jochum et al., 2005)				12.46	7.67	-1.99	-13.17	-10.84	-3.47	7.67	0.34	-0.845	-1.0967	-2.578	-2.897
deviation (%) for Feb' 2022 (used by analysts)	4.82	-2.18	-8.76	5.06	7.72	-1.99	-10.44	-8.90	-5.01	9.53	0.34		-1.0967	-1.56	-2.998

Appendix A

Supplementary Table S7: LA-ICP-MS standard measurements on reference material BCR-2G.

	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
average all analyses	6.28	1.91	6.20	0.96	5.89	1.20	3.41	0.46	3.16	0.46	4.53	0.6919	9.8773	5.5429	1.749
BCR-2G - Jochum et al. (2005)	6.59	1.97	6.71	1.10	6.44	1.28	3.70		3.39	0.50	4.71	0.7444	10.9	5.58	1.63
BCR recommended values (used by analysts)	6.59	1.97	6.71	1.02	6.44	1.27	3.70	0.51	3.39	0.50	4.84	0.78	11	5.9	1.69
deviation (%) over measurement period (Jochum et al., 2005)	-4.69	-2.92	-7.69	-12.56	-8.44	-5.87	-7.83		-6.67	-8.52	-3.86	-7.051	-9.383	-0.665	7.3014
deviation (%) over measurement period (used by analysts)	-4.72	-3.16	-7.66	-5.70	-8.48	-5.13	-7.90	-8.91	-6.64	-8.52	-6.44	-11.29	-10.21	-6.053	3.4919
average std measurements Sept' 2020	6.71	1.87	6.26	0.92	6.28	1.27	3.84	0.49	3.30	0.46	4.49	0.7545	11.145	5.705	1.586
deviation (%) for Sept' 2020 (Jochum et al., 2005)	1.78	-4.89	-6.73	-16.64	-2.52	-1.17	3.73		-2.68	-9.34	-4.67	1.3568	2.2477	2.2401	-2.699
deviation (%) for Sept' 2020 (used by analysts)	1.75	-5.13	-6.71	-10.10	-2.56	-0.39	3.65	-3.63	-2.65	-9.34	-7.23	-3.269	1.3182	-3.305	-6.154
average std measurements Oct' 2020	6.25	1.88	6.13	0.95	5.89	1.20	3.41	0.46	3.18	0.46	4.51	0.6878	9.7216	5.4769	1.7026
deviation (%) for Oct' 2020 (Jochum et al., 2005)	-5.19	-4.38	-8.70	-13.30	-8.48	-6.21	-7.71		-6.27	-8.67	-4.27	-7.599	-10.81	-1.848	4.4524
deviation (%) for Oct' 2020 (used by analysts)	-5.22	-4.62	-8.67	-6.50	-8.53	-5.47	-7.78	-9.13	-6.24	-8.67	-6.84	-11.82	-11.62	-7.171	0.744
average std measurements Nov' 2020	6.08	1.87	6.22	0.96	5.88	1.19	3.39	0.46	3.08	0.45	4.45	0.6829	8.7038	5.4208	1.7954
deviation (%) for Nov' 2020 (Jochum et al., 2005)	-7.66	-5.02	-7.36	-12.85	-8.62	-6.90	-8.39		-9.06	-10.57	-5.58	-8.259	-20.15	-2.852	10.146
deviation (%) for Nov' 2020 (used by analysts)	-7.69	-5.26	-7.33	-6.02	-8.66	-6.17	-8.47	-9.74	-9.03	-10.57	-8.12	-12.45	-20.88	-8.121	6.2352
average std measurements March 2021	6.35	1.94	6.22	0.97	5.88	1.21	3.39	0.47	3.17	0.46	4.56	0.6935	10.247	5.6306	1.7917
deviation (%) for March 2021 (Jochum et al., 2005)	-3.54	-1.25	-7.30	-12.10	-8.68	-5.48	-8.20		-6.48	-7.90	-3.18	-6.84	-5.989	0.9073	9.9185
deviation (%) for March 2021 (used by analysts)	-3.57	-1.50	-7.28	-5.21	-8.72	-4.73	-8.27	-8.80	-6.45	-7.90	-5.79	-11.09	-6.844	-4.566	6.0161
average std measurements Feb' 2022	6.37	1.97	6.36	0.99	5.96	1.22	3.43	0.47	3.20	0.47	4.63	0.7136	10.918	5.6355	1.6868
deviation (%) for Feb' 2022 (Jochum et al., 2005)	-3.31	0.44	-5.28	-9.73	-7.42	-4.95	-7.20		-5.53	-6.67	-1.60	-4.133	0.1668	0.9938	3.4858
deviation (%) for Feb' 2022 (used by analysts)	-3.34	0.19	-5.26	-2.65	-7.47	-4.20	-7.27	-7.43	-5.50	-6.67	-4.24	-8.508	-0.744	-4.484	-0.188

Appendix A

Supplementary Table S8: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 372 - Site U1517.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1517C_36F-1_49-50_1	3.95	3.41	1.02	73.80	0.10	0.10	0.80	0.03	11.42	0.01	94.63
	1517C_36F-1_49-50_2	3.87	3.56	1.15	74.70	0.17	0.08	0.99	0.06	11.89	0.03	96.51
	1517C_36F-1_49-50_3	3.90	3.41	1.17	74.22	0.12	0.06	0.81	0.03	11.52	0.00	95.25
	1517C_36F-1_49-50_4	3.70	3.74	1.15	74.98	0.09	0.03	0.73	0.01	11.61	0.02	96.06
	1517C_36F-1_49-50_5	3.76	3.59	1.09	75.22	0.10	0.10	0.76	0.12	11.74	0.02	96.50
	1517C_36F-1_49-50_6	3.70	3.78	1.05	73.93	0.06	0.08	0.69	0.05	11.57	0.00	94.91
	1517C_36F-1_49-50_7	3.76	3.29	1.58	73.29	0.19	0.17	1.16	0.06	12.48	0.02	95.99
	1517C_36F-1_49-50_8	3.66	3.23	1.15	72.83	0.17	0.14	1.02	0.01	11.90	0.04	94.15
	1517C_36F-1_49-50_9	3.80	3.60	1.10	73.92	0.11	0.08	0.76	0.04	11.76	0.00	95.16
	1517C_36F-1_49-50_10	3.71	3.73	0.89	73.93	0.08	0.08	0.74	0.06	11.44	0.00	94.66
	1517C_36F-1_49-50_11	3.78	3.68	1.21	72.96	0.08	0.05	0.74	0.05	11.50	0.00	94.04
	1517C_36F-1_49-50_12	3.64	3.50	1.26	72.68	0.20	0.14	1.05	0.02	12.00	0.01	94.50
	1517C_36F-1_49-50_13	3.74	3.71	1.20	73.14	0.16	0.08	0.82	0.10	11.95	0.04	94.94
	1517C_36F-1_49-50_14	3.86	3.40	1.09	73.36	0.09	0.10	0.78	0.01	11.50	0.00	94.19
	1517C_36F-1_49-50_15	4.12	3.28	1.43	71.32	0.18	0.22	1.26	0.00	12.11	0.05	93.97
	1517C_36F-1_49-50_16	3.87	3.63	1.33	73.95	0.17	0.12	0.99	0.04	11.88	0.04	96.02
	1517C_36F-1_49-50_17	3.75	3.85	1.08	74.11	0.11	0.05	0.66	0.04	11.55	0.04	95.24
	1517C_36F-1_49-50_18	3.71	3.57	0.94	73.84	0.11	0.04	0.75	0.02	11.41	0.00	94.38
	1517C_36F-1_49-50_19	3.95	3.31	1.15	73.84	0.16	0.17	1.06	0.09	11.90	0.00	95.64
	1517C_36F-1_49-50_20	3.75	3.78	0.95	75.04	0.09	0.04	0.65	0.07	12.01	0.00	96.39
	1517C_36F-1_38-39_1	3.79	3.69	1.06	74.28	0.06	0.06	0.67	0.00	11.77	0.03	95.41
	1517C_36F-1_38-39_2	3.87	3.29	1.35	73.18	0.15	0.15	1.00	0.07	11.84	0.03	94.94
	1517C_36F-1_38-39_3	3.66	3.71	1.03	74.24	0.08	0.07	0.67	0.04	11.45	0.00	94.95
	1517C_36F-1_38-39_4	3.86	3.54	1.25	73.05	0.15	0.11	0.85	0.01	11.40	0.04	94.27
	1517C_36F-1_38-39_5	3.65	3.54	1.39	72.94	0.13	0.18	1.08	0.04	11.69	0.03	94.68
	1517C_36F-1_38-39_6	3.94	3.39	1.20	73.33	0.13	0.07	0.90	0.04	11.71	0.00	94.72
	1517C_36F-1_38-39_7	3.88	3.61	1.05	73.43	0.07	0.06	0.72	0.00	11.29	0.04	94.14
	1517C_36F-1_38-39_8	3.67	3.37	1.31	72.78	0.14	0.15	1.06	0.09	12.16	0.03	94.77
	1517C_36F-1_38-39_9	3.81	3.86	0.96	74.34	0.10	0.02	0.69	0.04	11.61	0.03	95.47
	1517C_36F-1_38-39_10	3.85	3.33	1.16	72.75	0.12	0.14	1.01	0.05	11.79	0.02	94.22
	1517C_36F-1_38-39_11	3.80	3.10	1.09	72.18	0.21	0.18	1.07	0.09	12.05	0.02	93.78
	1517C_36F-1_38-39_12	4.02	3.27	1.98	71.84	0.17	0.11	1.15	0.05	12.28	0.02	94.90
	1517C_36F-1_38-39_13	4.43	3.03	1.67	70.60	0.24	0.21	1.27	0.12	12.19	0.04	93.79
	1517C_36F-1_38-39_14	3.76	3.20	1.31	71.53	0.10	0.07	1.00	0.11	11.63	0.02	92.72
	1517C_36F-1_38-39_15	3.67	3.50	1.29	73.34	0.13	0.09	0.80	0.14	11.69	0.02	94.67
	1517C_36F-1_38-39_16	3.86	3.51	1.62	71.75	0.11	0.01	1.04	0.05	11.49	0.03	93.47
	1517C_36F-1_38-39_17	3.74	3.85	0.81	74.29	0.07	0.02	0.61	0.02	11.33	0.02	94.75
	1517C_36F-1_38-39_18	3.77	3.38	0.96	75.14	0.17	0.13	0.96	0.00	11.69	0.00	96.20
	1517C_36F-1_38-39_19	3.93	3.42	1.33	74.42	0.17	0.13	1.11	0.05	12.29	0.00	96.85
	1517C_36F-1_38-39_20	3.77	3.56	1.01	73.55	0.08	0.03	0.78	0.05	11.35	0.00	94.19
s27	1517C_36F-2_3-5_1	3.69	3.63	1.12	72.80	0.09	0.06	0.67	0.02	11.18	0.01	93.28
	1517C_36F-2_3-5_2	3.82	3.45	1.25	71.61	0.12	0.11	0.89	0.05	11.42	0.00	92.71
	1517C_36F-2_3-5_3	3.80	3.66	1.08	74.59	0.11	0.05	0.76	0.03	11.59	0.00	95.67
	1517C_36F-2_3-5_4	3.50	3.79	1.00	73.72	0.08	0.05	0.69	0.02	11.56	0.00	94.42
	1517C_36F-2_3-5_5	3.73	3.76	1.15	73.15	0.09	0.08	0.64	0.02	11.29	0.00	93.90
	1517C_36F-2_3-5_6	3.64	3.75	0.96	72.74	0.09	0.03	0.68	0.02	11.38	0.00	93.30
	1517C_36F-2_3-5_7	3.73	3.46	1.18	72.79	0.11	0.12	0.83	0.05	11.38	0.00	93.65
	1517C_36F-2_3-5_8	3.65	3.41	1.20	72.32	0.14	0.11	0.84	0.10	11.57	0.03	93.37
	1517C_36F-2_3-5_9	3.99	3.51	1.21	72.77	0.11	0.09	0.83	0.02	11.57	0.00	94.10
	1517C_36F-2_3-5_10	3.55	3.45	1.32	70.05	0.18	0.16	1.22	0.00	12.29	0.03	92.25
	1517C_36F-2_3-5_11	4.22	3.21	1.49	71.34	0.18	0.20	1.20	0.04	12.15	0.03	94.06
	1517C_36F-2_3-5_12	4.23	3.24	1.44	69.44	0.22	0.23	1.29	0.10	12.40	0.01	92.59
	1517C_36F-2_3-5_13	3.90	3.42	1.09	72.24	0.09	0.09	0.74	0.00	11.18	0.00	92.74
	1517C_36F-2_3-5_14	3.59	3.66	0.97	72.41	0.10	0.04	0.66	0.02	11.51	0.01	92.97
	1517C_36F-2_3-5_16	3.87	3.55	1.24	71.57	0.12	0.07	0.88	0.09	11.51	0.03	92.91
	1517C_36F-2_3-5_17	3.66	3.53	1.13	73.36	0.13	0.03	0.73	0.03	11.52	0.02	94.15
	1517C_36F-2_3-5_18	3.57	3.71	1.05	72.48	0.10	0.06	0.71	0.02	11.34	0.01	93.05
	1517C_36F-2_3-5_19	4.08	3.24	1.51	70.26	0.17	0.18	1.24	0.05	12.16	0.00	92.89
	1517C_36F-2_3-5_20	3.67	3.40	1.47	71.10	0.15	0.12	1.01	0.05	11.70	0.00	92.67
	1517C_36F-2_3-5cm_1	3.47	3.75	0.96	75.12	0.08	0.04	0.65	0.02	11.75	0.03	95.87
s30	1517C_36F-2_3-5cm_2	3.41	3.79	0.95	73.34	0.09	0.07	0.62	0.05	11.88	0.00	94.20
	1517C_36F-2_3-5cm_3	3.56	3.79	1.14	74.76	0.10	0.09	0.67	0.01	11.88	0.00	95.99
	1517C_36F-2_3-5cm_4	3.47	3.39	1.32	75.11	0.14	0.09	0.84	0.06	11.91	0.02	96.35
	1517C_36F-2_3-5cm_7	3.45	3.37	1.28	74.45	0.09	0.07	0.79	0.06	11.75	0.01	95.31
	1517C_36F-2_3-5cm_5	3.81	3.50	1.12	75.35	0.09	0.07	0.74	0.00	11.61	0.00	96.29
	1517C_36F-2_3-5cm_6	3.81	3.36	1.27	74.73	0.15	0.10	0.82	0.02	12.14	0.02	96.43
	1517C_36F-2_3-5cm_8	3.74	3.62	0.92	74.64	0.11	0.05	0.65	0.08	11.53	0.00	95.34
	1517C_36F-2_3-5cm_9	3.82	3.49	1.09	75.03	0.13	0.02	0.75	0.08	11.77	0.01	96.18
	1517C_36F-2_3-5cm_10	3.75	3.71	0.90	75.14	0.10	0.08	0.63	0.08	11.82	0.03	96.23
	1517C_36F-2_100-101_1	4.04	3.25	1.37	72.04	0.08	0.03	0.69	0.05	11.24	0.00	92.79

Appendix A

Supplementary Table S8: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 372 - Site U1517.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s21*	1517C_36F-2_100-101_2	4.06	3.15	1.64	70.22	0.22	0.19	1.35	0.05	12.21	0.02	93.10
	1517C_36F-2_100-101_3	3.53	3.57	1.48	69.77	0.13	0.09	1.02	0.05	11.12	0.01	90.77
	1517C_36F-2_100-101_4	3.70	3.27	1.10	71.46	0.08	0.12	0.94	0.04	11.49	0.02	92.23
	1517C_36F-2_100-101_5	3.54	3.78	1.06	71.40	0.08	0.11	0.86	0.04	11.35	0.01	92.22
	1517C_36F-2_100-101_6	4.06	3.42	1.39	71.71	0.10	0.09	0.92	0.02	11.54	0.02	93.28
	1517C_36F-2_100-101_7	3.06	4.32	0.96	73.26	0.13	0.09	0.82	0.06	11.75	0.01	94.46
	1517C_36F-2_100-101_8	3.86	3.33	1.21	71.23	0.12	0.09	0.90	0.00	11.60	0.00	92.35
	1517C_36F-2_100-101_9	3.87	3.41	1.18	73.15	0.12	0.11	0.83	0.00	11.55	0.02	94.24
	1517C_36F-2_100-101_10	3.67	3.54	1.42	72.57	0.14	0.09	0.95	0.02	11.70	0.02	94.12
	1517C_36F-2_100-101_11	3.64	3.87	0.85	71.79	0.09	0.00	0.67	0.03	10.92	0.01	91.87
	1517C_36F-2_100-101_12	3.68	3.75	0.93	72.68	0.09	0.06	0.68	0.03	11.15	0.00	93.05
	1517C_36F-2_100-101_13	3.94	3.42	1.31	70.62	0.13	0.07	0.96	0.10	11.59	0.01	92.14
	1517C_36F-2_100-101_14	3.64	3.54	0.90	72.12	0.07	0.08	0.70	0.06	11.45	0.00	92.56
	1517C_36F-2_100-101_15	3.79	3.58	1.23	72.50	0.10	0.13	0.90	0.05	11.97	0.03	94.27
	1517C_36F-2_100-101_16	3.90	3.65	1.15	72.99	0.09	0.06	0.79	0.05	11.36	0.03	94.07
	1517C_36F-2_100-101_17	3.70	3.51	1.17	72.80	0.12	0.04	0.83	0.06	11.57	0.03	93.83
	1517C_36F-2_100-101_18	3.55	3.69	1.17	72.13	0.06	0.05	0.67	0.04	11.03	0.02	92.40
	1517C_36F-2_100-101_19	3.60	3.63	1.19	72.73	0.10	0.01	0.68	0.07	11.34	0.00	93.36
	1517C_36F-2_100-101_20	4.11	3.11	1.67	71.41	0.19	0.19	1.27	0.01	12.35	0.02	94.33
s21*	1517C_35F-3_12-14_1	3.94	3.46	1.10	73.50	0.07	0.08	0.77	0.07	11.37	0.01	94.36
	1517C_35F-3_12-14_2	3.81	3.55	1.08	72.52	0.08	0.07	0.75	0.01	11.35	0.00	93.22
	1517C_35F-3_12-14_3	3.27	4.17	0.94	72.30	0.06	0.06	0.68	0.01	11.29	0.02	92.79
	1517C_35F-3_12-14_4	3.96	3.61	1.51	71.92	0.16	0.08	1.02	0.05	12.06	0.03	94.40
	1517C_35F-3_12-14_5	3.61	3.58	1.16	73.63	0.07	0.07	0.75	0.03	11.54	0.00	94.45
	1517C_35F-3_12-14_6	3.60	3.70	0.93	72.54	0.09	0.06	0.67	0.06	11.42	0.00	93.07
	1517C_35F-3_12-14_7	3.77	3.56	1.06	72.80	0.09	0.08	0.75	0.00	11.42	0.00	93.53
	1517C_35F-3_12-14_8	3.93	3.65	1.08	73.10	0.07	0.05	0.76	0.01	11.35	0.00	94.00
	1517C_35F-3_12-14_9	3.66	3.64	1.06	72.95	0.07	0.06	0.65	0.02	11.35	0.00	93.47
	1517C_35F-3_12-14_10	3.62	3.52	1.10	71.47	0.07	0.09	0.74	0.10	11.53	0.00	92.24
	1517C_35F-3_12-14_11	3.72	3.55	1.18	72.02	0.11	0.10	0.75	0.09	11.04	0.00	92.56
	1517C_35F-3_12-14_12	3.81	3.64	1.09	73.39	0.11	0.05	0.76	0.00	11.58	0.00	94.44
	1517C_35F-3_12-14_13	4.15	3.31	1.03	71.58	0.07	0.02	0.93	0.10	12.01	0.04	93.23
	1517C_35F-3_12-14_14	3.96	3.64	1.02	72.87	0.09	0.08	0.72	0.01	11.29	0.00	93.69
	1517C_35F-3_12-14_15	3.58	3.64	0.90	74.84	0.06	0.02	0.68	0.00	11.62	0.01	95.35
	1517C_35F-3_12-14_16	3.58	3.67	0.83	75.70	0.12	0.06	0.64	0.01	11.55	0.02	96.18
	1517C_35F-3_12-14_17	3.49	3.71	0.89	75.23	0.10	0.06	0.66	0.00	11.52	0.04	95.69
	1517C_35F-3_12-14_18	3.42	3.66	1.21	74.27	0.07	0.02	0.65	0.05	11.20	0.00	94.56
	1517C_35F-3_12-14_19	3.83	3.55	1.11	75.35	0.09	0.02	0.72	0.00	11.28	0.02	95.97
	1517C_35F-3_12-14_20	3.81	3.37	1.07	74.59	0.16	0.10	0.88	0.09	11.89	0.00	95.96
u22	1517C 35F-3 12-14cm_1	3.67	3.46	1.10	75.01	0.08	0.07	0.70	0.03	11.66	0.00	95.79
	1517C 35F-3 12-14cm_2	3.65	3.47	1.13	75.14	0.10	0.03	0.72	0.00	11.72	0.02	95.98
	1517C 35F-3 12-14cm_4	3.61	3.41	1.10	74.32	0.12	0.04	0.70	0.05	11.72	0.05	95.12
	1517C 35F-3 12-14cm_6	3.68	3.48	1.28	75.18	0.10	0.03	0.70	0.02	11.95	0.00	96.41
	1517C 35F-3 12-14cm_8	3.62	3.55	1.02	74.66	0.10	0.00	0.69	0.03	11.53	0.00	95.20
	1517C 35F-3 12-14cm_3	3.87	3.51	1.16	74.88	0.10	0.06	0.69	0.05	11.90	0.02	96.25
	1517C 35F-3 12-14cm_5	3.56	3.77	0.85	75.00	0.09	0.05	0.53	0.08	11.71	0.01	95.65
	1517C 35F-3 12-14cm_7	3.68	3.55	1.08	73.65	0.08	0.07	0.59	0.04	11.64	0.00	94.39
	1517C 35F-3 12-14cm_9	3.48	3.61	0.85	74.99	0.08	0.02	0.64	0.04	11.70	0.02	95.43
	1517C 35F-3 12-14cm_10	3.60	3.51	1.16	75.07	0.10	0.03	0.71	0.06	11.58	0.00	95.82
	1517C_35F-4_61-63_1	3.82	3.56	1.40	75.13	0.08	0.07	0.86	0.00	11.67	0.00	96.59
	1517C_35F-4_61-63_2	3.56	3.65	1.27	75.51	0.14	0.08	0.79	0.00	11.76	0.00	96.75
	1517C_35F-4_61-63_3	3.63	3.28	1.58	72.02	0.26	0.22	1.00	0.05	11.85	0.01	93.90
	1517C_35F-4_61-63_4	3.77	3.55	1.40	75.56	0.13	0.05	0.87	0.01	11.55	0.00	96.89
	1517C_35F-4_61-63_5	3.65	3.47	1.39	75.10	0.08	0.09	0.84	0.09	11.51	0.00	96.23
	1517C_35F-4_61-63_6	3.90	3.48	1.20	74.57	0.11	0.05	0.83	0.01	11.62	0.02	95.79
	1517C_35F-4_61-63_7	3.77	3.58	1.24	75.23	0.10	0.05	0.87	0.01	11.68	0.00	96.54
	1517C_35F-4_61-63_8	3.89	3.53	1.34	75.07	0.10	0.07	0.83	0.01	11.50	0.01	96.35
	1517C_35F-4_61-63_9	3.76	3.43	1.10	74.81	0.10	0.10	0.83	0.00	11.34	0.00	95.46
	1517C_35F-4_61-63_10	3.78	3.60	1.36	75.38	0.13	0.06	0.84	0.10	11.73	0.03	97.00
	1517C_35F-4_61-63_11	3.68	3.34	1.15	74.11	0.18	0.15	0.98	0.05	11.35	0.00	94.99
	1517C_35F-4_61-63_12	3.64	3.50	1.34	74.63	0.12	0.06	0.83	0.07	11.66	0.00	95.86
	1517C_35F-4_61-63_13	3.97	3.52	1.33	76.13	0.13	0.06	0.81	0.08	11.72	0.02	97.75
	1517C_35F-4_61-63_14	4.09	3.60	1.30	76.30	0.12	0.07	0.85	0.03	11.89	0.03	98.28
	1517C_35F-4_61-63_15	3.68	3.52	1.18	76.08	0.13	0.08	0.83	0.11	11.69	0.01	97.30
	1517C_35F-4_61-63_16	3.88	3.48	1.33	75.67	0.12	0.11	0.81	0.06	11.62	0.04	97.12
	1517C_35F-4_61-63_17	3.88	3.54	1.23	74.83	0.11	0.08	0.87	0.09	11.52	0.00	96.16
	1517C_35F-4_61-63_18	3.69	3.51	1.28	75.62	0.14	0.04	0.84	0.06	11.63	0.00	96.81
	1517C_35F-4_61-63_19	4.03	3.55	1.26	74.45	0.13	0.06	0.84	0.00	11.66	0.06	96.04
	1517C_35F-4_61-63_20	3.94	3.54	1.01	73.04	0.12	0.08	0.83	0.07	11.56	0.00	94.19
	1517C 35F-4 61-63cm_1	3.84	3.36	1.27	74.89	0.10	0.02	0.78	0.03	11.99	0.00	96.28

Appendix A

Supplementary Table S8: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 372 - Site U1517.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s22	1517C_35F-4_61-63cm_5	4.04	3.42	1.17	73.99	0.16	0.06	0.80	0.07	11.85	0.04	95.60
	1517C_35F-4_61-63cm_6	3.68	3.46	1.14	75.18	0.08	0.05	0.72	0.08	11.82	0.01	96.23
	1517C_35F-4_61-63cm_10	3.62	3.41	1.20	74.86	0.13	0.07	0.83	0.00	11.91	0.05	96.07
	1517C_35F-4_61-63cm_11	3.61	3.48	1.43	74.92	0.12	0.08	0.84	0.03	12.25	0.04	96.79
	1517C_35F-4_61-63cm_2	3.77	3.50	1.33	75.87	0.11	0.08	0.75	0.02	11.98	0.01	97.42
	1517C_35F-4_61-63cm_3	4.11	3.38	1.21	73.96	0.13	0.06	0.79	0.02	11.98	0.00	95.64
	1517C_35F-4_61-63cm_4	3.68	3.46	1.32	75.45	0.11	0.10	0.82	0.10	12.07	0.05	97.16
	1517C_35F-4_61-63cm_7	3.79	3.51	1.11	74.53	0.11	0.08	0.77	0.01	11.85	0.06	95.82
	1517C_35F-4_61-63cm_8	3.73	3.48	1.15	75.41	0.15	0.11	0.80	0.00	12.16	0.00	97.00
	1517C_35F-4_61-63cm_9	3.71	3.69	1.14	75.12	0.06	0.07	0.64	0.00	11.98	0.00	96.41
	1517C_35F-4_125-127_1	4.02	3.07	1.59	73.11	0.13	0.10	1.03	0.07	11.97	0.02	95.11
	1517C_35F-4_125-127_2	3.78	3.48	1.26	73.95	0.10	0.06	0.77	0.04	11.43	0.01	94.87
	1517C_35F-4_125-127_3	3.92	3.37	1.41	73.25	0.09	0.09	0.87	0.06	11.46	0.02	94.54
	1517C_35F-4_125-127_4	3.80	3.61	1.16	73.53	0.11	0.07	0.85	0.06	11.06	0.01	94.26
	1517C_35F-4_125-127_5	3.63	3.49	1.14	74.06	0.10	0.06	0.78	0.08	11.49	0.01	94.86
	1517C_35F-4_125-127_6	3.97	3.06	1.70	72.77	0.13	0.10	1.06	0.03	11.69	0.00	94.51
	1517C_35F-4_125-127_7	3.76	3.40	1.11	73.52	0.08	0.04	0.80	0.04	11.36	0.00	94.11
	1517C_35F-4_125-127_8	4.12	3.27	1.66	73.55	0.13	0.12	1.01	0.08	12.18	0.03	96.15
	1517C_35F-4_125-127_9	4.20	3.09	1.55	72.87	0.15	0.09	0.99	0.01	11.99	0.01	94.95
	1517C_35F-4_125-127_10	3.82	3.45	1.33	75.22	0.09	0.08	0.77	0.01	11.45	0.01	96.23
	1517C_35F-4_125-127_11	3.86	3.38	1.27	74.24	0.11	0.06	0.86	0.02	11.46	0.00	95.26
	1517C_35F-4_125-127_12	4.09	3.11	1.21	73.53	0.15	0.07	0.98	0.07	11.88	0.00	95.09
	1517C_35F-4_125-127_13	3.94	3.47	1.22	73.89	0.12	0.08	0.77	0.06	11.68	0.00	95.23
	1517C_35F-4_125-127_14	4.06	3.50	1.31	73.68	0.11	0.10	0.83	0.03	11.61	0.00	95.23
	1517C_35F-4_125-127_15	3.84	3.51	1.15	73.93	0.08	0.04	0.81	0.09	11.68	0.01	95.13
	1517C_35F-4_125-127_16	4.02	3.56	1.34	74.11	0.11	0.09	0.84	0.04	11.89	0.01	96.01
	1517C_35F-4_125-127_17	3.66	1.96	1.11	74.52	0.12	0.11	0.49	0.09	11.51	0.02	93.58
	1517C_35F-4_125-127_20	3.72	3.49	1.16	74.30	0.10	0.07	0.76	0.01	11.81	0.01	95.44

Appendix A

Supplementary Table S8: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 372 - Site U1517.

Sample name	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1517C 36F-2 3-5cm_1	41.70	10.12	2.00	0.36	136.25	45.80	26.89	86.26	7.61	5.77	801.13	26.21	55.04	6.25	22.29
1517C 36F-2 3-5cm_2	46.65	9.76	2.25	0.39	139.61	47.69	26.68	91.50	7.97	5.62	818.42	26.52	55.31	6.21	23.13
1517C 36F-2 3-5cm_3	40.61	9.77	1.95	0.39	134.08	44.75	26.13	88.42	7.31	5.26	789.71	26.11	54.53	5.75	23.34
1517C 36F-2 3-5cm_4	33.97	10.39	2.87	0.46	127.02	65.05	28.34	119.70	8.38	4.97	786.50	26.09	56.07	6.29	23.5
1517C 36F-2 3-5cm_7	36.40	9.79	1.77	0.51	119.38	61.72	25.92	117.06	7.92	4.71	746.05	25.18	52.38	6.02	23.04
1517C 35F-3 12-14cm_1	41.65	7.84	1.91	0.30	129.76	54.38	25.04	101.49	7.98	5.30	747.32	25.47	53.96	5.86	22.57
1517C 35F-3 12-14cm_2	44.74	8.34	2.30	0.43	141.54	56.81	26.94	108.92	8.56	5.74	782.70	26.34	56.71	6.2	24.26
1517C 35F-3 12-14cm_4	39.13	8.04	2.62	0.33	135.89	54.81	26.30	103.89	7.89	5.55	759.41	25.71	54.06	6.09	22.73
1517C 35F-3 12-14cm_6	39.35	8.62	2.21	0.31	139.90	55.98	25.93	106.38	8.13	5.74	766.99	26.28	55.68	6.29	22.58
1517C 35F-3 12-14cm_8	32.33	8.21	4.84	0.30	134.59	52.62	25.75	99.65	7.54	5.45	750.30	25.27	52.47	5.86	22.34
1517C 35F-4 61-63cm_1	40.65	8.55	2.13	0.41	127.32	61.59	24.55	119.50	7.95	5.47	716.05	24.87	52.81	5.97	21.85
1517C 35F-4 61-63cm_5	41.74	9.10	2.17	0.37	127.28	65.07	26.68	124.74	8.77	5.50	750.93	27.19	57.55	6.55	24.76
1517C 35F-4 61-63cm_6	39.96	8.84	2.40	0.36	136.11	56.87	26.85	99.93	8.04	5.58	763.28	26.98	55.33	6.4	23.54
1517C 35F-4 61-63cm_10	38.83	8.78	2.16	0.30	128.19	69.11	27.35	122.42	8.03	5.21	749.24	26.16	53.97	6.41	22.27
1517C 35F-4 61-63cm_11	39.02	8.84	2.45	0.44	133.49	67.25	25.56	124.93	8.22	5.73	740.21	25.99	53.72	6.12	22.87
	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1517C 36F-2 3-5cm_1	4.80	0.63	5.03	0.71	4.53	0.96	2.79	0.42	3.00	0.51	2.91	0.598	22.02	11.91	2.92
1517C 36F-2 3-5cm_2	4.80	0.56	4.85	0.72	4.43	0.98	2.91	0.43	2.86	0.40	3.62	0.647	20.23	12.3	3.1
1517C 36F-2 3-5cm_3	4.56	0.52	4.77	0.73	4.77	1.04	2.77	0.38	3.07	0.50	3.61	0.64	18.85	11.58	2.9
1517C 36F-2 3-5cm_4	4.87	0.66	4.68	0.75	5.07	1.17	3.03	0.40	2.72	0.42	3.66	0.687	20.14	12.32	2.89
1517C 36F-2 3-5cm_7	4.93	0.79	4.36	0.60	4.84	0.89	2.69	0.41	2.97	0.44	3.86	0.653	18.09	11.19	2.86
1517C 35F-3 12-14cm_1	4.74	0.64	3.92	0.59	4.11	0.98	2.87	0.42	3.10	0.44	3.34	0.601	20.52	11.79	3.1
1517C 35F-3 12-14cm_2	4.95	0.63	4.53	0.72	4.35	0.97	2.90	0.38	3.04	0.46	3.61	0.706	20.71	12.48	3.16
1517C 35F-3 12-14cm_4	4.88	0.65	4.47	0.71	4.21	0.91	2.66	0.36	2.85	0.44	3.46	0.643	19.97	11.49	2.84
1517C 35F-3 12-14cm_6	4.68	0.65	4.32	0.70	4.13	0.94	2.86	0.42	2.83	0.44	3.64	0.694	21.28	11.76	3.02
1517C 35F-3 12-14cm_8	4.66	0.60	3.42	0.69	3.86	0.90	2.80	0.40	2.93	0.40	3.55	0.6	19.93	11.68	2.73
1517C 35F-4 61-63cm_1	4.76	0.71	3.72	0.67	4.25	0.88	2.78	0.40	2.98	0.43	3.76	0.7		11.23	2.83
1517C 35F-4 61-63cm_5	5.32	0.76	4.12	0.75	4.16	0.98	3.36	0.36	3.25	0.50	4.44	0.594	21.83	12.01	3.12
1517C 35F-4 61-63cm_6	5.46	0.70	4.46	0.74	4.69	0.94	2.64	0.42	3.21	0.43	3.37	0.653	19.32	11.96	2.86
1517C 35F-4 61-63cm_10	5.14	0.74	4.56	0.74	4.62	0.97	2.97	0.39	3.25	0.50	3.71	0.736	20.57	11.71	2.89
1517C 35F-4 61-63cm_11	4.97	0.78	4.33	0.70	4.34	0.96	2.82	0.43	2.95	0.47	4.01	0.653	20.17	11.68	2.92

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s20	U1518E-1H-2_122-124-1	3.46	4.11	0.86	71.81	0.08	0.07	0.67	0.06	11.81	0.04	92.97
	U1518E-1H-2_122-124-2	3.32	3.98	0.94	71.94	0.11	0.09	0.76	0.05	12.00	0.00	93.19
	U1518E-1H-2_122-124-3	3.59	3.55	0.89	72.29	0.14	0.13	0.92	0.00	11.89	0.01	93.40
	U1518E-1H-2_122-124-4	3.43	3.80	0.90	72.58	0.12	0.06	0.78	0.00	11.96	0.00	93.63
	U1518E-1H-2_122-124-5	3.61	3.88	0.84	73.81	0.10	0.11	0.80	0.00	11.87	0.01	95.03
	U1518E-1H-2_122-124-6	3.43	3.76	0.90	73.47	0.10	0.09	0.76	0.03	12.15	0.03	94.72
	U1518E-1H-2_122-124-7	3.53	3.49	1.07	73.80	0.16	0.15	1.00	0.01	11.89	0.02	95.13
	U1518E-1H-2_122-124-8	3.39	3.65	1.13	73.80	0.14	0.12	0.95	0.09	11.79	0.00	95.05
	U1518E-1H-2_122-124-9	3.27	3.85	0.72	73.13	0.10	0.07	0.72	0.00	11.80	0.01	93.67
	U1518E-1H-2_122-124-10	3.36	3.73	1.00	72.64	0.12	0.13	0.87	0.03	11.61	0.01	93.50
	U1518E-1H-2_122-124-12	3.63	3.58	0.90	72.79	0.12	0.12	0.93	0.03	11.98	0.02	94.09
	U1518E-1H-2_122-124-13	3.68	3.91	0.86	71.35	0.09	0.09	0.70	0.03	11.82	0.02	92.55
	U1518E-1H-2_122-124-14	3.50	3.57	1.09	74.25	0.19	0.17	1.03	0.02	12.02	0.03	95.87
	U1518E-1H-2_122-124-15	3.40	3.84	1.05	73.29	0.08	0.08	0.73	0.06	11.97	0.02	94.52
	U1518E-1H-4_16-18-1	3.31	4.04	0.93	72.43	0.09	0.07	0.79	0.06	11.66	0.00	93.39
	U1518E-1H-4_16-18-2	3.16	3.81	0.92	71.14	0.07	0.13	0.74	0.00	11.72	0.04	91.73
	U1518E-1H-4_16-18-3	3.37	3.80	0.93	72.93	0.10	0.06	0.76	0.00	12.05	0.02	94.03
	U1518E-1H-4_16-18-4	3.31	3.78	0.99	71.48	0.11	0.11	0.83	0.04	11.75	0.01	92.42
	U1518E-1H-4_16-18-5	3.52	3.89	0.72	72.22	0.09	0.11	0.81	0.05	12.01	0.01	93.42
	U1518E-1H-4_16-18-6	3.45	3.85	0.86	72.81	0.09	0.08	0.76	0.09	12.07	0.02	94.08
u23	U1518E-1H-4_16-18-7	3.58	3.89	0.89	72.42	0.09	0.09	0.78	0.08	12.12	0.04	93.97
	U1518E-1H-4_16-18-8	3.34	3.83	0.96	72.11	0.09	0.06	0.78	0.08	12.00	0.02	93.27
	U1518E-1H-4_16-18-9	3.20	3.80	1.43	72.08	0.10	0.10	0.81	0.02	11.80	0.01	93.35
	U1518E-1H-4_16-18-11	3.45	3.82	0.96	71.79	0.10	0.11	0.77	0.00	12.14	0.03	93.17
	U1518E-1H-4_16-18-13	3.48	3.75	0.95	73.16	0.10	0.11	0.79	0.08	11.87	0.02	94.29
	U1518E-1H-4_16-18-14	3.36	3.77	0.99	72.14	0.10	0.07	0.78	0.05	12.07	0.00	93.34
	U1518E-1H-4_16-18-15	3.29	3.91	0.86	72.38	0.08	0.07	0.79	0.02	11.91	0.01	93.34
	1518E 1H-4 16-18_1	3.43	3.75	0.98	71.26	0.09	0.09	0.77	0.02	11.72	0.01	92.11
	1518E 1H-4 16-18_3	3.71	3.82	0.96	74.66	0.10	0.06	0.74	0.05	11.67	0.00	95.77
	1518E 1H-4 16-18_4	3.51	3.80	1.15	72.56	0.16	0.15	0.88	0.12	12.04	0.01	94.38
	1518E 1H-4 16-18_6	3.47	3.80	1.03	74.34	0.09	0.10	0.75	0.06	11.43	0.01	95.09
	1518E 1H-4 16-18_2	3.71	3.74	0.89	72.23	0.10	0.10	0.79	0.04	11.52	0.00	93.12
	1518E 1H-4 16-18_7	3.29	3.88	0.89	74.43	0.09	0.10	0.77	0.07	11.83	0.01	95.36
	1518E 1H-4 16-18_8	3.59	3.95	0.88	74.33	0.11	0.11	0.75	0.04	12.01	0.03	95.81
	1518E-1H-4_118-120-1	3.38	3.84	0.96	74.82	0.08	0.09	0.75	0.07	11.81	0.04	95.85
	1518E-1H-4_118-120-2	3.37	3.60	1.19	74.53	0.15	0.16	0.97	0.04	11.91	0.03	95.95
	1518E-1H-4_118-120-3	3.25	3.78	0.90	74.74	0.10	0.09	0.82	0.05	11.95	0.01	95.68
	1518E-1H-4_118-120-4	3.47	3.63	1.01	75.24	0.12	0.09	0.86	0.05	11.92	0.02	96.41
	1518E-1H-4_118-120-5	3.45	3.78	0.95	74.74	0.13	0.09	0.83	0.07	11.85	0.00	95.89
	1518E-1H-4_118-120-6	3.37	3.88	0.87	74.72	0.11	0.12	0.77	0.07	11.81	0.00	95.73
s23*	1518E-1H-4_118-120-7	3.27	3.69	0.89	74.73	0.13	0.10	0.76	0.03	11.80	0.03	95.42
	1518E-1H-4_118-120-8	3.40	3.84	0.86	74.54	0.10	0.06	0.80	0.08	11.75	0.03	95.46
	1518E-1H-4_118-120-9	3.44	3.70	0.93	74.66	0.15	0.15	0.84	0.00	11.79	0.03	95.69
	1518E-1H-4_118-120-10	3.43	3.90	0.80	74.89	0.13	0.11	0.79	0.07	11.97	0.03	96.12
	1518E-1H-4_118-120-11	3.37	3.85	0.83	74.97	0.11	0.09	0.80	0.07	11.90	0.01	95.99
	1518E-1H-4_118-120-12	3.37	3.79	1.10	74.61	0.09	0.07	0.82	0.02	12.10	0.01	95.98
	1518E-1H-4_118-120-13	3.21	3.71	1.04	72.21	0.15	0.11	0.93	0.00	11.19	0.07	92.62
	1518E-1H-4_118-120-14	3.11	4.13	1.00	75.24	0.12	0.07	0.80	0.09	12.01	0.03	96.60
	1518E-1H-4_118-120-15	3.52	3.88	0.95	75.02	0.07	0.11	0.79	0.03	11.78	0.01	96.16
	1518E-1H-4_118-120-16	3.38	3.84	1.01	74.83	0.10	0.10	0.77	0.01	11.91	0.00	95.95
	1518E-1H-4_118-120-17	3.40	3.86	0.84	74.69	0.11	0.07	0.77	0.02	11.76	0.00	95.53
	1518E-1H-4_118-120-18	3.48	3.73	0.98	74.53	0.11	0.09	0.86	0.04	11.74	0.00	95.57
	1518E-1H-4_118-120-19	3.38	3.85	0.90	74.81	0.09	0.08	0.78	0.08	11.91	0.04	95.93
	1518E-1H-4_118-120-20	3.49	3.86	1.09	74.93	0.09	0.09	0.82	0.01	12.09	0.00	96.46
	1518E_2H-1_136-138_1	4.26	2.93	2.26	69.67	0.35	0.49	2.21	0.11	14.48	0.09	96.85
	1518E_2H-1_136-138_2	3.26	3.67	0.85	74.15	0.10	0.11	0.87	0.03	12.03	0.01	95.09
	1518E_2H-1_136-138_3	3.48	3.51	1.23	73.97	0.15	0.12	1.06	0.02	12.43	0.02	96.00
	1518E_2H-1_136-138_4	3.68	3.54	0.86	74.48	0.10	0.10	0.83	0.04	11.95	0.02	95.59
	1518E_2H-1_136-138_5	4.00	3.27	1.53	72.04	0.18	0.21	1.31	0.10	12.81	0.05	95.50
	1518E_2H-1_136-138_6	3.74	3.22	1.72	71.40	0.19	0.17	1.39	0.01	13.14	0.03	95.00
	1518E_2H-1_136-138_7	3.68	3.76	0.93	75.19	0.06	0.11	0.84	0.03	12.12	0.02	96.74
	1518E_2H-1_136-138_8	3.99	2.77	2.74	68.80	0.37	0.56	2.42	0.08	14.32	0.03	96.07
	1518E_2H-1_136-138_9	3.69	3.31	1.46	72.26	0.14	0.17	1.35	0.04	12.69	0.03	95.13
	1518E_2H-1_136-138_10	4.08	3.04	2.01	68.97	0.32	0.29	1.94	0.05	14.24	0.06	95.00
	1518E_2H-1_136-138_11	4.34	2.85	2.64	69.52	0.39	0.54	2.27	0.06	14.30	0.05	96.96
	1518E_2H-1_136-138_12	3.76	3.27	1.62	72.08	0.17	0.15	1.37	0.08	13.03	0.01	95.53
	1518E_2H-1_136-138_13	3.99	3.10	2.03	70.21	0.29	0.37	1.87	0.09	13.66	0.06	95.67
	1518E_2H-1_136-138_14	4.02	3.10	2.09	67.38	0.27	0.33	1.86	0.10	13.63	0.05	92.83
	1518E_2H-1_136-138_15	3.33	3.65	0.83	74.58	0.11	0.10	0.81	0.06	12.24	0.00	95.71
	1518E_2H-1_136-138_16	3.60	3.35	1.45	70.67	0.16	0.15	1.27	0.08	12.73	0.02	93.48

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1518E_2H-1_136-138_17	3.80	3.27	1.58	71.45	0.17	0.22	1.43	0.12	13.29	0.00	95.33
	1518E_2H-1_136-138_18	3.47	3.71	0.88	74.98	0.09	0.11	0.81	0.11	12.14	0.00	96.31
	1518E_2H-1_136-138_19	3.79	3.24	1.49	71.48	0.20	0.18	1.34	0.06	12.82	0.00	94.60
	1518E_2H-1_136-138_20	3.58	2.98	2.08	67.20	0.30	0.30	1.89	0.05	13.18	0.04	91.60
	1518E_2H-2_67-69_1	4.23	3.18	2.33	69.89	0.29	0.27	1.54	0.06	13.67	0.02	95.48
	1518E_2H-2_67-69_2	3.30	3.52	1.36	74.23	0.14	0.10	0.95	0.11	11.87	0.02	95.60
	1518E_2H-2_67-69_3	3.26	3.07	1.17	74.76	0.16	0.19	1.29	0.09	12.03	0.00	96.03
	1518E_2H-2_67-69_4	3.16	3.35	1.16	73.17	0.10	0.11	1.20	0.09	12.02	0.01	94.37
	1518E_2H-2_67-69_6	3.51	2.99	1.28	74.69	0.14	0.13	1.19	0.09	12.10	0.01	96.13
	1518E_2H-2_67-69_7	3.64	3.85	0.95	74.59	0.08	0.10	0.78	0.05	12.22	0.00	96.25
	1518E_2H-2_67-69_8	3.87	3.49	1.26	74.03	0.12	0.12	0.90	0.06	12.16	0.01	96.02
	1518E_2H-2_67-69_9	3.56	3.35	1.43	73.73	0.17	0.10	1.03	0.07	12.11	0.01	95.56
	1518E_2H-2_67-69_10	3.83	3.27	1.61	72.20	0.19	0.19	1.46	0.08	12.74	0.02	95.58
	1518E_2H-2_67-69_11	4.01	3.25	1.66	71.89	0.21	0.17	0.96	0.11	12.04	0.03	94.34
	1518E_2H-2_67-69_13	3.14	3.71	1.11	75.81	0.12	0.08	0.85	0.06	11.91	0.01	96.79
	1518E_2H-2_67-69_14	3.91	2.42	2.80	68.33	0.38	0.65	2.67	0.04	14.34	0.01	95.56
	1518E_2H-2_67-69_15	3.56	3.95	0.84	74.29	0.12	0.08	0.76	0.05	11.94	0.00	95.60
	1518E_2H-2_67-69_16	3.96	3.31	1.57	73.46	0.21	0.16	0.97	0.00	12.18	0.01	95.84
	1518E_2H-2_67-69_17	3.68	3.38	1.48	72.41	0.20	0.19	1.49	0.01	12.86	0.02	95.71
	1518E_2H-2_67-69_18	3.86	3.44	1.49	72.91	0.09	0.12	1.13	0.07	12.58	0.01	95.69
	1518E_2H-2_67-69_19	3.39	3.36	1.15	75.33	0.09	0.13	1.05	0.00	12.17	0.00	96.68
	1518E_2H-2_67-69_20	2.92	4.86	0.86	73.78	0.00	0.03	0.71	0.04	12.23	0.00	95.43
	1518E_2H-3_23-24_1	3.82	3.39	1.42	72.83	0.20	0.20	1.33	0.00	12.61	0.02	95.82
	1518E_2H-3_23-24_2	3.22	3.42	1.21	74.36	0.17	0.11	1.10	0.02	12.39	0.00	95.99
	1518E_2H-3_23-24_3	3.06	3.50	1.00	70.68	0.09	0.08	0.72	0.10	11.16	0.02	90.40
	1518E_2H-3_23-24_4	3.63	3.34	1.37	73.16	0.18	0.17	1.23	0.06	12.63	0.04	95.80
	1518E_2H-3_23-24_5	3.44	4.03	0.83	74.18	0.07	0.06	0.79	0.00	11.98	0.03	95.42
	1518E_2H-3_23-24_6	3.40	3.47	1.09	74.45	0.12	0.07	0.94	0.05	11.75	0.03	95.37
	1518E_2H-3_23-24_7	3.86	3.36	1.53	72.76	0.16	0.20	1.28	0.00	12.48	0.00	95.63
	1518E_2H-3_23-24_8	3.29	3.88	1.00	72.39	0.13	0.09	0.99	0.02	12.13	0.07	93.99
	1518E_2H-3_23-24_9	3.56	3.24	1.41	71.90	0.17	0.18	1.44	0.00	13.02	0.02	94.94
	1518E_2H-3_23-24_10	3.76	3.22	1.69	72.67	0.19	0.19	1.40	0.06	12.74	0.01	95.93
	1518E_2H-3_23-24_11	3.79	3.34	1.66	72.16	0.21	0.24	1.60	0.09	13.27	0.00	96.36
	1518E_2H-3_23-24_12	4.02	3.35	1.89	72.99	0.17	0.10	1.00	0.04	12.72	0.04	96.32
	1518E_2H-3_23-24_13	3.76	3.39	1.76	72.40	0.21	0.25	1.56	0.06	13.30	0.05	96.74
	1518E_2H-3_23-24_15	3.60	3.29	1.47	72.04	0.19	0.21	1.41	0.04	12.82	0.05	95.12
	1518E_2H-3_23-24_16	3.38	3.27	1.45	68.62	0.18	0.22	1.32	0.09	12.19	0.03	90.74
	1518E_2H-3_23-24_18	3.64	3.69	0.99	74.48	0.10	0.06	0.79	0.04	11.91	0.00	95.70
	1518E_2H-3_23-24_19	3.53	3.35	1.44	73.50	0.18	0.17	1.25	0.09	12.68	0.02	96.21
	1518E_2H-3_23-24_20	3.85	3.26	1.51	71.82	0.19	0.21	1.41	0.08	12.98	0.00	95.32
	1518E_2H-3_33-34_2	0.31	3.79	0.04	74.49	0.10	0.01	0.95	0.00	12.22	0.00	91.91
	1518E_2H-3_33-34_3	0.09	3.38	0.02	72.82	0.12	0.01	1.26	0.01	12.35	0.00	90.06
	1518E_2H-3_33-34_4	3.62	3.42	0.00	72.78	0.20	0.19	1.30	0.00	12.42	0.02	93.96
	1518E_2H-3_33-34_5	3.59	3.41	0.00	72.52	0.18	0.20	1.29	0.02	12.55	0.03	93.79
	1518E_2H-3_33-34_6	3.41	3.47	0.87	72.71	0.18	0.17	1.24	0.01	12.54	0.02	94.64
	1518E_2H-3_33-34_7	3.40	3.84	0.99	75.16	0.10	0.14	0.84	0.02	12.12	0.02	96.63
	1518E_2H-3_33-34_8	3.82	3.35	1.54	72.13	0.23	0.20	1.44	0.08	12.80	0.02	95.61
	1518E_2H-3_33-34_9	3.89	3.31	1.55	72.66	0.19	0.20	1.41	0.06	13.17	0.02	96.46
	1518E_2H-3_33-34_10	3.67	3.30	1.46	72.60	0.18	0.16	1.36	0.03	12.83	0.00	95.58
	1518E_2H-3_33-34_11	3.52	3.38	1.41	73.00	0.19	0.18	1.28	0.02	12.20	0.03	95.21
	1518E_2H-3_33-34_12	3.15	4.56	0.86	76.22	0.10	0.06	0.50	0.04	11.17	0.00	96.65
	1518E_2H-3_33-34_13	3.46	3.88	0.96	74.29	0.12	0.07	0.74	0.04	12.04	0.03	95.63
	1518E_2H-3_33-34_14	3.80	3.33	1.44	72.95	0.20	0.16	1.32	0.11	12.83	0.02	96.17
	1518E_2H-3_33-34_15	3.93	3.36	1.42	72.80	0.18	0.24	1.38	0.11	12.86	0.00	96.29
	1518E_2H-3_33-34_16	3.64	3.44	1.60	72.59	0.19	0.27	1.50	0.07	12.97	0.01	96.28
	1518E_2H-3_33-34_17	3.22	4.25	0.98	73.49	0.07	0.04	0.55	0.04	11.74	0.01	94.38
	1518E_2H-3_33-34_18	3.77	3.29	1.56	72.82	0.20	0.24	1.38	0.08	12.79	0.02	96.14
	1518E_2H-3_33-34_19	3.71	3.41	1.52	73.27	0.21	0.18	1.31	0.01	12.54	0.01	96.17
	1518E_2H-3_69-70_1	3.88	3.39	1.66	72.75	0.10	0.04	0.98	0.08	12.32	0.02	95.23
	1518E_2H-3_69-70_2	3.51	3.80	1.02	74.88	0.07	0.07	0.77	0.03	12.16	0.00	96.32
	1518E_2H-3_69-70_4	3.65	3.86	0.93	74.27	0.08	0.10	0.78	0.00	11.87	0.02	95.57
	1518E_2H-3_69-70_5	3.35	3.12	1.04	75.78	0.12	0.15	1.26	0.04	12.24	0.00	97.10
	1518E_2H-3_69-70_6	3.39	3.83	0.97	74.59	0.09	0.09	0.78	0.06	11.99	0.03	95.83
	1518E_2H-3_69-70_7	3.32	3.06	1.02	74.95	0.14	0.16	1.23	0.05	11.87	0.05	95.85
	1518E_2H-3_69-70_8	3.45	3.83	0.91	74.95	0.07	0.06	0.74	0.06	12.03	0.01	96.11
	1518E_2H-3_69-70_9	3.52	3.89	0.83	75.02	0.08	0.09	0.77	0.00	12.00	0.00	96.20
	1518E_2H-3_69-70_10	3.44	3.90	1.00	75.11	0.09	0.07	0.78	0.00	12.08	0.01	96.47
	1518E_2H-3_69-70_11	3.35	3.90	0.81	74.47	0.11	0.06	0.82	0.03	11.98	0.03	95.56
	1518E_2H-3_69-70_12	3.44	4.24	1.08	74.62	0.12	0.10	0.75	0.06	12.12	0.00	96.54
	1518E_2H-3_69-70_13	3.49	3.64	1.12	74.87	0.10	0.09	0.90	0.05	12.10	0.01	96.37

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s23*	1518E_2H-3_69-70_14	3.28	3.94	0.89	74.84	0.10	0.08	0.79	0.04	12.15	0.00	96.11
	1518E_2H-3_69-70_15	3.47	3.84	0.89	74.49	0.07	0.06	0.76	0.06	12.08	0.04	95.75
	1518E_2H-3_69-70_16	4.29	3.57	1.79	71.98	0.10	0.07	0.89	0.03	12.83	0.03	95.59
	1518E_2H-3_69-70_17	3.40	3.29	0.90	75.05	0.11	0.14	0.96	0.05	12.07	0.01	95.98
	1518E_2H-3_69-70_18	3.33	4.03	0.99	74.08	0.08	0.07	0.74	0.01	11.88	0.00	95.21
	1518E_2H-3_69-70_19	3.23	3.90	0.86	74.38	0.05	0.03	0.75	0.06	11.91	0.04	95.21
	1518E_2H-3_69-70_20	3.45	3.95	0.94	74.64	0.09	0.11	0.77	0.09	11.83	0.01	95.86
	U1518E-2H-4_26-28-1	3.30	3.92	0.95	74.61	0.09	0.11	0.95	0.04	12.03	0.01	96.01
	U1518E-2H-4_26-28-2	3.22	3.60	0.95	73.44	0.12	0.09	0.85	0.00	11.96	0.00	94.24
	U1518E-2H-4_26-28-3	3.46	3.65	1.06	72.97	0.09	0.09	0.92	0.02	12.10	0.01	94.38
	U1518E-2H-4_26-28-4	3.42	3.64	1.04	74.58	0.11	0.14	0.92	0.04	12.10	0.01	95.99
	U1518E-2H-4_26-28-5	3.30	3.62	0.85	72.69	0.08	0.05	0.87	0.00	11.97	0.00	93.43
	U1518E-2H-4_26-28-6	3.66	3.66	1.03	72.58	0.08	0.09	0.95	0.11	11.93	0.03	94.12
	U1518E-2H-4_26-28-7	3.45	3.51	1.06	73.89	0.09	0.11	0.92	0.08	12.08	0.00	95.18
	U1518E-2H-4_26-28-8	3.47	3.58	1.02	73.77	0.12	0.12	0.95	0.05	12.10	0.02	95.20
	U1518E-2H-4_26-28-9	3.37	3.82	1.03	71.42	0.07	0.07	0.88	0.10	11.89	0.04	92.69
	U1518E-2H-4_26-28-10	3.42	3.59	1.09	72.32	0.09	0.08	0.92	0.02	11.82	0.00	93.35
	U1518E-2H-4_26-28-11	3.47	3.63	0.98	74.12	0.12	0.07	0.93	0.01	12.03	0.00	95.36
	U1518E-2H-4_26-28-12	3.57	3.63	1.08	74.01	0.11	0.11	0.83	0.15	11.98	0.02	95.49
	U1518E-2H-4_26-28-13	3.40	3.72	0.94	74.27	0.09	0.12	0.90	0.05	11.94	0.02	95.46
	U1518E-2H-4_26-28-14	3.34	3.12	1.10	73.90	0.13	0.13	1.15	0.02	12.07	0.00	94.96
	U1518E-2H-4_26-28-15	3.35	3.60	0.96	72.71	0.09	0.08	0.69	0.08	11.45	0.02	93.02
	1518E 2H-4 26-28_2	3.61	3.47	1.05	73.47	0.10	0.11	0.89	0.00	11.49	0.00	94.19
	1518E 2H-4 26-28_7	3.66	3.66	1.04	74.68	0.10	0.05	0.94	0.04	11.71	0.02	95.91
	1518E 2H-4 26-28_9	4.00	3.27	0.70	74.88	0.08	0.11	1.05	0.04	12.21	0.02	96.37
	1518E 2H-4 26-28_10	3.44	3.63	1.04	75.03	0.09	0.10	0.92	0.02	11.92	0.02	96.22
	1518E 2H-4 26-28_3	3.66	3.65	0.95	74.41	0.12	0.08	0.90	0.00	11.69	0.00	95.46
	1518E 2H-4 26-28_4	3.60	3.56	1.07	73.89	0.13	0.10	0.97	0.10	11.68	0.00	95.10
	1518E 2H-4 26-28_5	3.17	3.61	0.92	71.07	0.11	0.08	0.89	0.10	10.97	0.00	90.91
	1518E 2H-4 26-28_6	3.57	3.59	0.85	74.27	0.09	0.08	0.91	0.01	11.62	0.03	95.02
	1518E 2H-4 26-28_8	3.64	3.66	1.07	75.04	0.10	0.09	0.95	0.08	11.73	0.00	96.37
u25	U1518E-2H-6_109-111-1	3.65	2.77	1.88	68.83	0.26	0.30	2.03	0.05	13.35	0.04	93.16
	U1518E-2H-6_109-111-2	3.72	2.66	1.96	68.28	0.24	0.31	1.98	0.05	13.27	0.03	92.50
	U1518E-2H-6_109-111-3	3.88	2.66	1.81	69.86	0.26	0.31	1.97	0.00	13.27	0.04	94.06
	U1518E-2H-6_109-111-5	3.79	2.57	1.82	68.88	0.24	0.33	1.96	0.07	13.60	0.02	93.29
	U1518E-2H-6_109-111-7	3.92	2.65	1.82	68.74	0.25	0.32	1.97	0.09	13.28	0.02	93.06
	U1518E-2H-6_109-111-8	3.98	2.66	1.93	68.76	0.26	0.32	2.04	0.05	13.35	0.05	93.40
	U1518E-2H-6_109-111-10	4.13	2.63	1.71	69.23	0.25	0.31	2.05	0.09	13.24	0.03	93.68
	U1518E-2H-6_109-111-11	3.73	2.70	1.87	69.14	0.26	0.30	1.92	0.09	13.27	0.02	93.28
	U1518E-2H-6_109-111-13	3.78	2.62	1.87	68.55	0.23	0.34	1.97	0.06	13.51	0.01	92.94
	U1518E-2H-6_109-111-14	3.68	2.70	1.71	69.42	0.27	0.36	2.02	0.07	13.42	0.00	93.65
	U1518E-2H-6_109-111-15	3.64	2.71	1.74	70.19	0.24	0.20	1.83	0.02	13.27	0.03	93.87
	U1518E-3H-1_73-75-1	3.61	3.11	1.39	69.77	0.25	0.27	1.53	0.05	12.97	0.07	93.02
	U1518E-3H-1_73-75-2	3.77	3.05	1.62	69.47	0.25	0.27	1.61	0.04	12.93	0.02	93.04
	U1518E-3H-1_73-75-3	3.51	2.84	1.67	68.68	0.30	0.40	1.94	0.07	13.48	0.04	92.93
	U1518E-3H-1_73-75-4	3.56	2.99	1.41	69.79	0.26	0.23	1.53	0.01	13.00	0.04	92.83
s24*	U1518E-3H-1_73-75-6	3.71	3.05	1.52	70.01	0.27	0.28	1.61	0.08	12.92	0.01	93.47
	U1518E-3H-1_73-75-10	3.72	2.97	1.48	69.07	0.30	0.26	1.73	0.00	12.92	0.00	92.44
	U1518E-3H-1_73-75-11	3.71	3.01	1.41	69.51	0.26	0.19	1.60	0.07	13.05	0.00	92.82
	U1518E-3H-1_73-75-12	3.40	3.17	1.44	69.98	0.25	0.27	1.55	0.04	12.78	0.03	92.90
	U1518E-3H-1_73-75-13	3.65	2.94	1.59	70.41	0.25	0.30	1.77	0.06	13.06	0.03	94.05
	U1518E-3H-1_73-75-14	3.56	3.04	1.46	70.77	0.23	0.29	1.61	0.03	12.89	0.04	93.93
	U1518E-3H-1_73-75-15	3.81	3.00	1.27	70.57	0.25	0.35	1.59	0.11	12.79	0.00	93.73
	U1518E-3H-1_92-93-1	3.60	3.12	1.25	71.33	0.11	0.13	1.24	0.07	12.06	0.01	92.91
	U1518E-3H-1_92-93-2	3.65	2.83	1.33	71.15	0.17	0.13	1.54	0.07	12.79	0.01	93.66
	U1518E-3H-1_92-93-3	3.55	2.88	1.56	70.18	0.19	0.19	1.58	0.10	12.31	0.03	92.57
	U1518E-3H-1_92-93-4	3.48	2.87	1.64	70.48	0.20	0.24	1.67	0.00	12.46	0.01	93.05
	U1518E-3H-1_92-93-5	3.55	2.94	1.35	70.17	0.16	0.23	1.45	0.08	12.28	0.01	92.23
	U1518E-3H-1_92-93-6	3.78	2.87	1.54	70.04	0.19	0.25	1.65	0.02	12.52	0.02	92.88
	U1518E-3H-1_92-93-7	3.55	3.02	1.48	71.23	0.14	0.18	1.36	0.01	12.40	0.01	93.38
	U1518E-3H-1_92-93-8	3.15	3.00	1.83	70.02	0.34	0.32	1.27	0.08	11.71	0.07	91.80
	U1518E-3H-1_92-93-10	3.61	2.98	1.47	70.48	0.22	0.20	1.42	0.01	12.30	0.00	92.69
	U1518E-3H-1_92-93-11	3.67	3.01	1.32	72.00	0.16	0.18	1.34	0.10	12.31	0.00	94.08
	U1518E-3H-1_92-93-12	3.56	3.00	1.39	72.02	0.16	0.16	1.33	0.03	12.37	0.01	94.02
	U1518E-3H-1_92-93-14	3.36	3.00	1.50	71.11	0.15	0.15	1.43	0.03	12.34	0.02	93.09
	U1518E-3H-1_92-93-15	3.63	2.94	1.55	71.13	0.21	0.22	1.56	0.02	12.71	0.03	93.99
	1518E 3H-1 92-93_3	3.82	3.01	1.49	73.66	0.20	0.17	1.49	0.07	12.41	0.00	96.32
	1518E 3H-1 92-93_4	3.73	2.97	1.75	71.84	0.21	0.19	1.55	0.08	12.27	0.01	94.60
	1518E 3H-1 92-93_7	3.45	3.00	1.62	72.59	0.13	0.17	1.45	0.08	11.91	0.03	94.44
	1518E 3H-1 92-93_9	3.78	2.97	1.47	71.03	0.18	0.16	1.53	0.08	12.10	0.05	93.34

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s30	1518E-3H-1 92-93_8	3.64	2.93	1.50	71.91	0.18	0.17	1.54	0.03	12.51	0.01	94.43
	1518E-3H-1 92-93_2	3.52	2.97	1.40	72.23	0.14	0.10	1.31	0.04	12.24	0.01	93.96
	1518E-3H-1_130-134-1	3.36	3.82	0.91	74.67	0.09	0.10	0.82	0.03	11.93	0.00	95.71
	1518E-3H-1_130-134-2	3.81	3.08	1.60	71.59	0.26	0.24	1.72	0.04	12.84	0.03	95.21
	1518E-3H-1_130-134-3	3.52	3.84	0.88	73.93	0.10	0.11	0.84	0.08	12.18	0.00	95.47
	1518E-3H-1_130-134-4	3.65	3.17	1.83	68.34	0.29	0.34	1.34	0.08	12.40	0.01	91.45
	1518E-3H-1_130-134-5	4.18	3.02	1.84	72.16	0.26	0.29	1.34	0.09	12.58	0.00	95.76
	1518E-3H-1_130-134-6	3.50	3.88	0.93	74.76	0.09	0.09	0.79	0.06	12.05	0.00	96.15
	1518E-3H-1_130-134-7	3.53	3.69	0.93	74.84	0.09	0.14	0.86	0.03	12.08	0.00	96.19
	1518E-3H-1_130-134-8	3.53	3.70	1.59	71.73	0.22	0.14	1.05	0.03	12.39	0.02	94.40
	1518E-3H-1_130-134-9	3.29	3.47	0.95	74.35	0.12	0.15	1.05	0.03	11.87	0.03	95.30
	1518E-3H-1_130-134-10	3.79	3.63	0.93	74.13	0.14	0.11	0.83	0.00	12.03	0.01	95.60
	1518E-3H-1_130-134-11	3.25	4.16	0.90	74.17	0.07	0.07	0.85	0.03	12.00	0.01	95.51
	1518E-3H-1_130-134-12	3.50	3.57	0.98	73.81	0.08	0.13	0.83	0.07	11.77	0.02	94.76
	1518E-3H-1_130-134-13	3.47	3.67	1.22	73.40	0.14	0.21	0.98	0.00	12.10	0.02	95.20
	1518E-3H-1_130-134-14	3.52	3.43	1.68	71.75	0.20	0.13	1.17	0.07	12.60	0.00	94.55
	1518E-3H-1_130-134-16	3.56	3.70	0.88	74.77	0.10	0.13	0.83	0.04	11.99	0.00	96.00
	1518E-3H-1_130-134-17	4.12	3.37	1.19	73.41	0.14	0.08	0.87	0.02	12.34	0.00	95.55
	1518E-3H-1_130-134-18	3.04	3.40	0.93	68.96	0.10	0.10	0.74	0.01	10.90	0.01	88.20
	1518E-3H-1_130-134-19	3.70	3.76	0.93	74.70	0.11	0.08	0.84	0.00	11.93	0.00	96.04
	1518E-3H-1_130-134-20	3.62	3.63	1.14	74.53	0.11	0.09	0.74	0.01	11.79	0.01	95.67
	U1518E-3H-3_36-40-1	3.54	3.66	1.07	72.13	0.08	0.10	0.87	0.09	12.01	0.01	93.55
	U1518E-3H-3_36-40-2	3.30	3.83	1.01	72.92	0.11	0.11	0.88	0.08	11.90	0.00	94.15
	U1518E-3H-3_36-40-4	3.29	3.66	0.95	72.55	0.08	0.10	0.84	0.00	11.98	0.04	93.49
	U1518E-3H-3_36-40-5	3.59	3.67	0.88	72.24	0.10	0.06	0.87	0.02	12.07	0.02	93.52
	U1518E-3H-3_36-40-6	3.43	3.65	0.98	73.82	0.08	0.10	0.84	0.06	12.18	0.03	95.18
	U1518E-3H-3_36-40-7	3.53	3.87	0.93	74.39	0.12	0.11	0.85	0.08	12.11	0.03	96.02
	U1518E-3H-3_36-40-8	3.37	3.79	0.80	72.75	0.10	0.09	0.85	0.02	12.10	0.01	93.87
	U1518E-3H-3_36-40-9	3.64	3.61	0.97	72.73	0.11	0.11	0.86	0.05	12.02	0.03	94.12
	U1518E-3H-3_36-40-10	3.47	3.56	0.88	71.45	0.10	0.08	0.87	0.07	11.84	0.04	92.36
	U1518E-3H-3_36-40-11	3.63	3.59	0.98	70.92	0.08	0.12	0.84	0.05	12.08	0.01	92.32
	U1518E-3H-3_36-40-12	3.68	3.45	0.88	73.23	0.13	0.09	0.85	0.04	12.18	0.02	94.54
	U1518E-3H-3_36-40-13	3.70	3.75	0.88	73.11	0.13	0.10	0.81	0.04	12.07	0.05	94.63
	U1518E-3H-3_36-40-14	3.47	3.79	0.93	74.09	0.09	0.10	0.84	0.08	12.00	0.01	95.40
	U1518E-3H-3_36-40-15	3.54	3.65	0.97	72.72	0.09	0.09	0.83	0.00	12.36	0.00	94.26
	1518E-3H-3 36-40_1	3.89	3.52	1.15	73.31	0.07	0.11	0.88	0.03	11.72	0.00	94.68
	1518E-3H-3 36-40_2	3.57	3.73	0.93	74.67	0.11	0.11	0.84	0.04	11.80	0.00	95.79
	1518E-3H-3 36-40_3	3.52	3.61	0.98	74.71	0.13	0.12	0.84	0.05	11.55	0.01	95.51
	1518E-3H-3 36-40_4	3.64	3.59	0.89	72.93	0.08	0.10	0.87	0.08	11.88	0.00	94.06
	1518E-3H-3 36-40_6	3.52	3.85	0.97	73.86	0.08	0.08	0.83	0.04	11.83	0.00	95.06
	1518E-3H-3 36-40_7	3.53	3.73	0.93	72.77	0.10	0.13	0.83	0.06	12.38	0.00	94.46
	1518E-3H-3 36-40_8	3.60	3.73	0.73	74.03	0.10	0.10	0.83	0.03	11.85	0.00	95.01
	1518E-3H-3 36-40_9	3.78	3.63	0.91	73.60	0.08	0.10	0.88	0.04	11.69	0.00	94.72
	1518E-3H-3 36-40_10	3.62	3.58	1.05	73.44	0.08	0.09	0.81	0.05	11.95	0.01	94.68
	1518E-3H-3 36-40_11	3.64	3.76	0.97	74.43	0.11	0.10	0.81	0.10	12.21	0.01	96.15
	1518E-3H-3 36-40_12	3.52	3.63	0.99	74.10	0.08	0.12	0.82	0.07	11.82	0.02	95.17
	1518E-3H-3 36-40_13	3.48	3.66	0.97	74.27	0.08	0.10	0.84	0.00	11.82	0.03	95.25
	1518E-3H-3 36-40_15	3.29	3.73	0.99	73.37	0.10	0.07	0.87	0.00	11.91	0.01	94.33
	1518E-3H-3 36-40_5	3.56	3.73	0.85	73.57	0.08	0.07	0.82	0.06	11.51	0.03	94.29
	U1518E-3H-4_93-95-1	3.32	3.81	1.04	74.30	0.09	0.13	1.01	0.00	12.11	0.01	95.82
	U1518E-3H-4_93-95-2	3.45	3.85	0.86	73.14	0.05	0.03	0.73	0.00	12.14	0.00	94.25
	U1518E-3H-4_93-95-3	3.31	3.71	0.81	73.86	0.08	0.09	0.82	0.04	12.03	0.00	94.76
	U1518E-3H-4_93-95-4	3.26	3.79	0.91	72.91	0.09	0.08	0.81	0.03	12.08	0.00	93.96
	U1518E-3H-4_93-95-5	3.24	3.95	0.90	72.65	0.06	0.05	0.82	0.02	12.02	0.02	93.74
	U1518E-3H-4_93-95-6	3.56	3.93	0.94	72.75	0.11	0.09	0.81	0.00	12.15	0.00	94.34
	U1518E-3H-4_93-95-7	3.39	3.64	1.00	71.03	0.09	0.06	0.75	0.04	11.90	0.05	91.95
	U1518E-3H-4_93-95-8	3.20	3.61	1.06	73.23	0.11	0.12	1.06	0.01	11.94	0.00	94.34
	U1518E-3H-4_93-95-9	3.35	3.92	0.89	74.25	0.09	0.08	0.85	0.08	12.19	0.00	95.69
	U1518E-3H-4_93-95-10	3.49	3.89	0.87	72.74	0.11	0.09	0.95	0.02	12.09	0.04	94.30
	U1518E-3H-4_93-95-11	3.33	3.79	1.00	71.41	0.06	0.07	0.79	0.05	11.99	0.01	92.51
	U1518E-3H-4_93-95-12	3.37	3.82	0.93	72.77	0.11	0.09	0.84	0.04	12.11	0.02	94.10
	U1518E-3H-4_93-95-13	3.05	3.89	1.00	72.16	0.06	0.08	0.85	0.08	12.02	0.04	93.23
	U1518E-3H-4_93-95-14	3.19	3.97	0.89	71.81	0.09	0.10	0.81	0.04	11.88	0.00	92.78
	U1518E-3H-4_93-95-15	3.29	3.89	0.99	72.07	0.09	0.06	0.81	0.03	11.97	0.02	93.22
s33	U1518E-3H-6_16-18-1	3.60	2.70	1.57	69.73	0.21	0.25	1.81	0.12	12.96	0.04	92.99
	U1518E-3H-6_16-18-2	3.53	2.62	1.71	69.91	0.17	0.28	1.92	0.10	12.87	0.00	93.10
	U1518E-3H-6_16-18-3	3.84	2.63	1.81	69.52	0.19	0.30	1.85	0.00	13.00	0.02	93.16
	U1518E-3H-6_16-18-4	3.82	2.61	1.63	68.62	0.22	0.33	1.89	0.08	12.97	0.00	92.17
	U1518E-3H-6_16-18-6	3.76	2.58	1.72	69.04	0.21	0.30	1.93	0.02	13.15	0.04	92.75
	U1518E-3H-6_16-18-7	3.75	2.67	1.73	69.19	0.20	0.31	1.84	0.08	13.04	0.01	92.83

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	U1518E-3H-6_16-18-8	3.55	2.62	1.78	68.47	0.24	0.25	1.90	0.10	12.84	0.01	91.76
	U1518E-3H-6_16-18-9	3.87	2.65	1.87	69.91	0.19	0.27	1.92	0.06	12.98	0.01	93.74
	U1518E-3H-6_16-18-10	3.72	2.62	1.75	69.04	0.26	0.27	1.96	0.08	13.11	0.03	92.84
	U1518E-3H-6_16-18-12	3.41	2.62	1.89	68.74	0.22	0.36	2.01	0.06	13.27	0.04	92.62
	U1518E-3H-6_16-18-13	3.61	2.62	1.79	69.42	0.20	0.24	1.87	0.00	13.04	0.01	92.81
	U1518E-3H-6_16-18-14	4.46	3.95	1.24	72.75	0.08	0.01	0.77	0.08	13.75	0.01	97.10
	1518E_3H-6 16-18cm_3	3.71	2.65	1.62	72.30	0.18	0.25	1.73	0.09	12.82	0.04	95.39
	1518E_3H-6 16-18cm_4	3.88	2.64	1.66	72.62	0.21	0.25	1.76	0.00	12.74	0.04	95.80
	1518E_3H-6 16-18cm_5	3.40	2.65	1.89	72.24	0.21	0.26	1.81	0.02	13.07	0.05	95.60
	1518E_3H-6 16-18cm_6	3.72	2.73	1.77	72.73	0.23	0.27	1.80	0.12	12.96	0.04	96.37
	1518E_5H-1_34-36_2	3.35	3.31	0.48	74.46	0.00	0.12	0.99	0.02	11.93	0.01	94.68
	1518E_5H-1_34-36_3	3.46	3.53	0.89	74.08	0.00	0.06	0.91	0.02	12.14	0.00	95.09
	1518E_5H-1_34-36_6	3.61	3.66	1.02	74.70	0.09	0.10	0.84	0.08	12.14	0.00	96.24
	1518E_5H-1_34-36_7	3.16	3.42	0.99	70.55	0.11	0.08	0.94	0.01	11.30	0.02	90.60
	1518E_5H-1_34-36_8	3.38	3.75	1.16	74.08	0.08	0.12	0.83	0.03	12.09	0.02	95.54
	1518E_5H-1_34-36_9	3.61	3.84	0.94	74.68	0.09	0.08	0.88	0.02	12.18	0.00	96.32
	1518E_5H-1_34-36_10	3.39	3.69	1.02	74.03	0.10	0.12	0.87	0.00	12.03	0.00	95.24
	1518E_5H-1_34-36_11	3.38	3.70	0.82	74.08	0.11	0.11	0.84	0.02	11.93	0.02	95.01
	1518E_5H-1_34-36_12	3.19	3.84	0.89	74.20	0.11	0.07	0.86	0.00	11.97	0.00	95.13
	1518E_5H-1_34-36_13	3.37	3.77	0.91	74.54	0.11	0.14	0.86	0.05	12.37	0.01	96.13
	1518E_5H-1_34-36_14	3.50	3.82	0.99	74.15	0.10	0.07	0.85	0.02	12.11	0.03	95.62
	1518E_5H-1_34-36_15	3.39	3.53	1.11	73.48	0.14	0.16	0.98	0.02	12.15	0.05	94.99
	1518E_5H-1_34-36_16	3.29	3.06	1.12	73.94	0.13	0.18	1.30	0.13	11.78	0.00	94.92
	1518E_5H-1_34-36_17	3.56	3.75	0.99	73.93	0.08	0.09	0.82	0.03	12.09	0.02	95.37
	1518E_5H-1_34-36_18	3.41	3.38	0.96	74.36	0.10	0.11	0.99	0.00	11.90	0.03	95.25
	1518E_5H-1_34-36_19	3.55	3.69	0.91	74.11	0.09	0.14	0.84	0.06	12.17	0.02	95.58
	1518E_5H-1_34-36_20	3.31	3.04	1.24	74.13	0.17	0.21	1.28	0.09	11.86	0.00	95.34
	1518E-5H-2_18-20-1	3.32	3.12	1.11	74.07	0.11	0.16	1.21	0.00	12.13	0.05	95.29
	1518E-5H-2_18-20-2	3.43	3.39	0.97	74.51	0.11	0.13	1.01	0.03	11.78	0.00	95.35
	1518E-5H-2_18-20-3	3.51	3.76	0.89	73.72	0.11	0.14	0.84	0.04	11.93	0.01	94.94
	1518E-5H-2_18-20-4	3.38	3.08	1.13	74.54	0.16	0.17	1.26	0.00	12.00	0.01	95.73
	1518E-5H-2_18-20-5	3.30	3.09	1.04	74.34	0.15	0.17	1.27	0.02	11.91	0.02	95.32
	1518E-5H-2_18-20-6	3.11	3.12	1.08	73.50	0.14	0.17	1.23	0.08	11.40	0.02	93.87
	1518E-5H-2_18-20-8	3.59	3.33	1.08	74.78	0.12	0.12	1.04	0.04	11.86	0.00	95.95
	1518E-5H-2_18-20-9	3.45	3.63	0.96	74.45	0.13	0.09	0.85	0.04	12.01	0.00	95.61
	1518E-5H-2_18-20-10	3.49	3.31	0.84	73.82	0.14	0.10	1.02	0.02	11.85	0.00	94.58
	1518E-5H-2_18-20-11	3.40	3.37	0.98	74.39	0.07	0.13	1.03	0.02	11.90	0.02	95.32
	1518E-5H-2_18-20-12	3.58	3.28	0.99	74.22	0.12	0.09	1.00	0.00	11.83	0.03	95.14
	1518E-5H-2_18-20-13	3.52	3.44	1.10	73.03	0.14	0.10	0.98	0.04	11.72	0.07	94.13
	1518E-5H-2_18-20-14	3.47	3.35	1.07	74.92	0.13	0.14	0.99	0.04	12.04	0.05	96.20
	1518E-5H-2_18-20-15	3.64	3.55	1.09	74.06	0.09	0.12	0.85	0.10	12.10	0.00	95.60
	1518E-5H-2_18-20-16	3.56	3.66	0.90	75.14	0.11	0.08	0.87	0.04	11.93	0.00	96.29
	1518E-5H-2_18-20-17	3.72	3.32	1.01	74.86	0.15	0.10	0.95	0.05	11.98	0.00	96.13
	1518E-5H-2_18-20-19	3.69	3.62	0.93	74.25	0.09	0.10	0.85	0.01	12.17	0.00	95.71
	1518E-5H-2_18-20-20	3.23	2.99	1.23	74.08	0.17	0.21	1.27	0.05	11.76	0.00	94.98
s36	U1518E-5H-2_66-70-1	3.46	3.63	0.94	72.25	0.07	0.11	0.86	0.02	12.29	0.00	93.64
	U1518E-5H-2_66-70-2	3.54	3.49	0.99	71.39	0.08	0.11	0.95	0.05	12.05	0.00	92.65
	U1518E-5H-2_66-70-3	3.37	3.54	0.89	71.83	0.11	0.06	0.93	0.05	11.98	0.02	92.77
	U1518E-5H-2_66-70-4	3.45	3.31	1.07	71.71	0.09	0.13	1.04	0.04	11.96	0.02	92.81
	U1518E-5H-2_66-70-5	3.42	3.10	1.06	72.17	0.14	0.18	1.23	0.10	12.08	0.02	93.50
	U1518E-5H-2_66-70-6	3.28	3.92	0.81	71.53	0.05	0.04	0.86	0.02	11.86	0.02	92.38
	U1518E-5H-2_66-70-7	3.44	3.66	0.96	71.37	0.08	0.08	0.84	0.06	12.11	0.00	92.60
	U1518E-5H-2_66-70-8	3.36	3.11	1.20	71.35	0.12	0.17	1.34	0.02	12.00	0.02	92.70
	U1518E-5H-2_66-70-9	3.44	3.58	1.07	72.22	0.09	0.11	1.00	0.04	12.08	0.00	93.63
	U1518E-5H-2_66-70-10	3.19	3.14	1.05	71.52	0.14	0.18	1.24	0.07	11.84	0.00	92.37
	U1518E-5H-2_66-70-11	3.33	3.49	1.05	70.87	0.11	0.12	0.94	0.05	11.93	0.00	91.88
	U1518E-5H-2_66-70-12	3.39	3.29	1.03	71.33	0.10	0.09	1.02	0.00	12.04	0.00	92.29
	U1518E-5H-2_66-70-13	3.47	3.26	1.02	71.77	0.11	0.12	1.04	0.10	11.75	0.04	92.67
	U1518E-5H-2_66-70-14	3.50	3.73	0.99	72.44	0.10	0.10	0.83	0.03	12.17	0.00	93.90
	U1518E-5H-2_66-70-15	3.14	3.98	0.91	70.42	0.08	0.07	0.72	0.05	11.87	0.00	91.24
	1518E 5H-2 66-70_4	3.24	3.27	1.05	73.80	0.15	0.15	1.06	0.03	11.57	0.00	94.32
	1518E 5H-2 66-70_5	3.72	3.57	0.96	73.64	0.07	0.10	0.84	0.05	11.86	0.04	94.85
	1518E 5H-2 66-70_6	3.59	3.71	0.97	74.20	0.07	0.04	0.84	0.00	11.99	0.01	95.42
	1518E 5H-2 66-70_7	3.36	3.30	1.08	73.84	0.14	0.13	0.97	0.01	11.93	0.00	94.76
	1518E 5H-2 66-70_8	3.33	3.46	1.08	73.83	0.11	0.09	0.96	0.02	11.81	0.00	94.69
	1518E 5H-2 66-70_3	3.43	3.45	1.00	73.93	0.12	0.11	0.96	0.03	11.82	0.01	94.86
	1518E 5H-2 66-70_9	3.27	3.51	0.97	73.81	0.10	0.14	1.01	0.02	11.50	0.03	94.37
	1518E 5H-2 66-70_10	3.59	3.31	0.95	74.69	0.13	0.17	1.02	0.12	11.75	0.00	95.72
	1518E-5H-3_108-110_1	3.46	3.87	0.93	74.08	0.09	0.10	0.87	0.12	11.73	0.00	95.24
	1518E-5H-3_108-110_2	3.31	4.16	1.12	75.27	0.08	0.08	0.79	0.00	12.18	0.02	97.01

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1518E-5H-3_108-110_3	4.19	2.96	1.73	71.03	0.20	0.19	1.15	0.00	12.88	0.02	94.35
	1518E-5H-3_108-110_4	3.49	3.64	0.98	74.00	0.07	0.08	0.87	0.06	12.12	0.00	95.31
	1518E-5H-3_108-110_6	3.41	3.64	1.02	74.06	0.11	0.09	0.89	0.08	12.04	0.01	95.35
	1518E-5H-3_108-110_7	0.00	3.75	1.10	73.61	0.11	0.01	0.89	0.08	11.74	0.01	91.30
	1518E-5H-3_108-110_9	3.26	3.08	1.23	74.40	0.17	0.14	1.27	0.01	11.96	0.03	95.54
	1518E-5H-3_108-110_10	3.70	3.60	1.65	71.73	0.10	0.05	1.06	0.09	12.07	0.02	94.06
	1518E_6H-2_103-105_1	3.47	3.65	1.25	75.57	0.11	0.09	1.03	0.02	12.11	0.01	97.32
	1518E_6H-2_103-105_2	3.62	2.86	1.29	72.51	0.18	0.17	1.24	0.06	12.26	0.05	94.25
	1518E_6H-2_103-105_3	4.02	3.85	1.72	72.50	0.13	0.07	0.86	0.04	12.85	0.03	96.07
	1518E_6H-2_103-105_4	3.56	3.87	1.69	73.96	0.10	0.09	0.92	0.06	11.64	0.00	95.89
	1518E_6H-2_103-105_5	3.32	4.06	0.93	74.52	0.10	0.09	0.76	0.00	11.71	0.01	95.51
	1518E_6H-2_103-105_6	3.57	2.93	1.19	70.44	0.16	0.35	1.74	0.10	13.42	0.04	93.93
	1518E_6H-2_103-105_9	0.00	4.10	0.85	74.63	0.13	0.00	0.95	0.01	12.04	0.02	92.74
	1518E_6H-2_103-105_10	3.57	2.87	1.38	73.93	0.12	0.09	1.22	0.07	12.03	0.00	95.27
	1518E_6H-2_103-105_11	0.00	3.34	1.45	73.99	0.18	0.00	0.86	0.09	11.46	0.02	91.39
	1518E_6H-2_103-105_12	0.00	3.67	0.00	74.53	0.13	0.00	1.01	0.00	12.13	0.01	91.49
	1518E_6H-2_103-105_13	0.00	3.70	0.03	74.64	0.10	0.00	0.95	0.00	11.74	0.03	91.19
	1518E_6H-2_103-105_15	3.39	3.72	1.06	75.04	0.09	0.15	1.00	0.05	12.03	0.00	96.54
	1518E_6H-2_103-105_16	3.55	3.74	1.13	75.59	0.09	0.07	0.88	0.02	12.15	0.01	97.22
	1518E_6H-2_103-105_17	3.92	3.10	1.74	72.86	0.10	0.04	0.97	0.04	11.99	0.01	94.76
	1518E_6H-2_103-105_18	3.90	3.28	1.46	72.57	0.17	0.12	1.09	0.05	12.34	0.03	95.01
	1518E_6H-2_103-105_19	3.51	3.80	1.14	75.75	0.11	0.09	0.81	0.04	12.08	0.00	97.32
	1518E_6H-2_103-105_20	4.19	3.21	1.92	72.93	0.18	0.09	1.05	0.09	12.88	0.02	96.55
	1518E-7H-2_13-14-1	3.90	3.62	1.50	71.48	0.17	0.15	0.98	0.09	12.47	0.00	94.36
	1518E-7H-2_13-14-2	3.27	3.67	1.13	73.76	0.11	0.11	1.03	0.02	11.85	0.00	94.95
	1518E_7H-3_8-9_1	3.25	3.40	1.44	72.43	0.11	0.13	1.34	0.04	12.18	0.00	94.32
	1518E_7H-3_8-9_3	4.16	3.48	1.89	71.41	0.14	0.11	1.00	0.08	12.36	0.01	94.63
	1518E_7H-3_8-9_4	3.69	3.71	1.49	71.32	0.10	0.02	0.59	0.09	11.56	0.00	92.57
	1518E_7H-3_8-9_6	3.42	3.88	1.44	72.09	0.13	0.08	0.97	0.01	12.32	0.03	94.37
	1518E_7H-3_8-9_7	3.33	3.41	1.15	74.26	0.12	0.13	1.01	0.10	12.18	0.01	95.69
	1518E_7H-3_8-9_8	3.74	3.36	1.01	73.77	0.14	0.12	0.80	0.11	12.00	0.01	95.05
	1518E_7H-3_8-9_9	3.23	3.77	1.03	74.29	0.14	0.16	0.98	0.00	11.69	0.02	95.30
	1518E_7H-3_8-9_11	4.65	3.09	2.51	69.49	0.23	0.18	1.45	0.10	13.89	0.08	95.68
	1518E_7H-3_8-9_12	4.01	3.31	1.44	72.22	0.11	0.11	0.96	0.11	12.52	0.03	94.81
	1518E_7H-3_8-9_13	3.84	3.17	1.41	73.44	0.19	0.14	0.92	0.13	12.56	0.02	95.82
	1518E_7H-3_8-9_14	3.79	3.40	1.61	72.99	0.15	0.12	0.95	0.04	12.35	0.02	95.42
	1518E_7H-3_8-9_15	3.89	3.26	1.49	73.29	0.21	0.16	0.93	0.10	12.30	0.04	95.67
	1518E_7H-3_8-9_16	3.60	3.23	1.57	70.96	0.19	0.16	1.24	0.03	12.77	0.04	93.78
	1518E_7H-3_8-9_17	3.63	3.12	1.30	72.34	0.18	0.23	1.42	0.00	12.88	0.05	95.14
	1518E_7H-3_8-9_18	3.40	3.72	1.11	73.21	0.09	0.08	0.94	0.07	11.86	0.00	94.48
	1518E_7H-3_8-9_19	4.17	3.44	2.14	69.70	0.23	0.29	1.73	0.07	13.99	0.02	95.78
	1518E_7H-3_8-9_20	3.46	3.81	0.90	74.12	0.05	0.06	1.09	0.00	12.24	0.00	95.72
s37	1518E-9H-2_0-1-1	3.37	4.08	1.06	73.57	0.11	0.06	0.72	0.00	11.86	0.02	94.85
	1518E-9H-2_0-1-2	3.23	4.16	1.06	73.57	0.15	0.11	0.73	0.03	11.64	0.00	94.68
	1518E-9H-2_0-1-3	3.51	4.23	1.07	75.25	0.13	0.06	0.69	0.04	12.05	0.00	97.05
	1518E-9H-2_0-1-4	3.29	4.18	0.93	73.49	0.14	0.09	0.70	0.06	11.74	0.00	94.63
	1518E-9H-2_0-1-5	3.41	4.16	1.04	74.50	0.12	0.12	0.70	0.00	11.72	0.00	95.77
	1518E-9H-2_0-1-6	3.49	4.10	1.00	74.13	0.13	0.11	0.74	0.01	11.65	0.05	95.41
	1518E-9H-2_0-1-7	3.12	4.28	0.89	74.65	0.10	0.08	0.65	0.09	11.91	0.00	95.78
	1518E-9H-2_0-1-8	3.45	4.08	0.94	74.63	0.13	0.11	0.76	0.02	11.91	0.02	96.05
	1518E-9H-2_0-1-9	3.07	3.90	2.11	71.98	0.17	0.89	2.29	0.07	11.20	0.00	95.68
	1518E-9H-2_0-1-10	2.82	4.77	0.81	74.01	0.09	0.03	0.61	0.01	12.10	0.02	95.27
	1518E-9H-2_0-1-11	3.42	3.67	1.45	73.50	0.16	0.08	0.85	0.10	11.86	0.03	95.10
	1518E-9H-2_0-1-12	3.45	4.27	0.92	75.35	0.11	0.14	0.71	0.04	12.00	0.01	97.01
	1518E-9H-2_0-1-14	3.42	3.81	1.02	75.44	0.10	0.10	0.77	0.00	12.17	0.01	96.83
	1518E-9H-2_0-1-15	3.18	4.23	0.96	74.07	0.11	0.10	0.71	0.00	11.76	0.01	95.12
	1518E-9H-2_0-1-16	3.24	4.24	0.99	73.60	0.11	0.07	0.69	0.03	11.58	0.00	94.56
	1518E-9H-2_0-1-17	2.47	3.12	0.90	62.02	0.07	0.09	0.86	0.00	10.09	0.03	79.66
	1518E-9H-2_0-1-18	3.50	4.27	0.83	74.14	0.14	0.11	0.73	0.09	11.89	0.03	95.74
	1518E-9H-2_0-1-19	3.57	4.20	0.99	74.81	0.09	0.11	0.72	0.01	12.02	0.00	96.51
	1518E-9H-2_0-1-20	3.28	4.16	0.94	74.42	0.13	0.11	0.79	0.02	11.95	0.00	95.81
	1518E 9H-2 8-9_1	3.24	3.83	1.18	75.66	0.10	0.08	0.89	0.02	12.22	0.03	97.24
	1518E 9H-2 8-9_10	3.75	3.59	1.43	73.54	0.13	0.03	0.80	0.00	12.07	0.03	95.38
	1518E_9H-2_8-9_4	4.45	1.97	5.00	62.33	1.03	1.03	4.72	0.03	15.90	0.17	96.62
	1518E_9H-2_8-9_6	3.89	3.48	1.56	72.89	0.07	0.02	0.80	0.09	12.28	0.01	95.10
	1518E_9H-2_8-9_7	3.86	3.61	1.52	72.41	0.09	0.04	0.83	0.02	12.09	0.00	94.46
	1518E_9H-2_8-9_8	3.82	3.34	1.47	70.34	0.18	0.13	1.25	0.12	12.37	0.03	93.05
	1518E_9H-2_8-9_9	4.33	1.58	4.52	60.71	0.76	1.22	5.68	0.03	17.56	0.19	96.57
	1518E_9H-2_8-9_10	4.60	1.53	4.69	62.54	0.89	0.80	5.03	0.04	16.46	0.15	96.74
	1518E_9H-2_8-9_11	4.80	2.02	5.42	63.83	0.92	1.71	4.58	0.10	15.60	0.17	99.15

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s51	1518E_9H-2_8-9_13	4.88	1.61	5.39	61.48	0.80	1.88	5.50	0.11	17.55	0.10	99.30
	1518E_9H-2_8-9_14	4.46	1.73	3.73	62.26	0.83	0.75	4.91	0.06	16.62	0.11	95.45
	1518E_9H-2_8-9_15	4.32	2.09	5.46	62.82	1.00	1.37	4.35	0.03	14.88	0.21	96.53
	1518E_9H-2_8-9_16	4.00	2.10	5.28	61.75	1.05	1.19	4.02	0.08	14.87	0.19	94.54
	1518E_9H-2_8-9_17	3.59	3.87	1.07	73.72	0.14	0.10	0.76	0.03	11.74	0.02	95.04
	1518E_9H-2_8-9_18	4.30	1.74	6.35	62.28	0.93	2.37	5.20	0.15	15.99	0.14	99.45
	1518E_9H-2_8-9_19	2.95	2.85	1.96	73.84	0.20	0.14	1.14	0.00	10.37	0.03	93.49
	1518E_9H-3_26-27_3	3.94	3.19	2.83	68.97	0.27	0.22	1.29	0.09	13.15	0.01	93.96
	1518E_9H-3_26-27_5	3.68	3.65	0.96	75.61	0.10	0.10	0.92	0.08	12.28	0.02	97.40
	1518E_9H-3_26-27_6	3.79	3.18	1.45	72.92	0.17	0.12	0.90	0.03	12.36	0.08	95.00
	1518E_9H-3_26-27_7	2.70	4.40	0.99	72.74	0.12	0.15	0.99	0.05	12.09	0.04	94.25
	1518E_9H-3_26-27_8	3.71	3.45	1.48	74.03	0.20	0.13	0.87	0.00	11.78	0.01	95.65
	1518E_9H-3_26-27_11	3.53	3.80	1.00	75.00	0.09	0.05	0.79	0.00	12.19	0.00	96.45
	1518E_9H-3_26-27_12	3.55	3.76	1.23	74.04	0.12	0.08	0.60	0.01	11.74	0.00	95.12
	1518E_9H-3_26-27_13	3.35	3.61	1.18	74.87	0.10	0.12	0.93	0.04	11.90	0.00	96.10
	1518E_9H-3_26-27_14	3.32	3.70	1.01	73.76	0.15	0.12	0.95	0.00	12.03	0.03	95.06
	1518E_9H-3_26-27_16	3.50	3.80	1.10	73.68	0.08	0.07	0.87	0.03	12.03	0.01	95.18
	1518E_9H-3_26-27_18	3.09	4.12	0.87	72.39	0.13	0.08	0.73	0.10	11.58	0.01	93.09
	1518E-9H-CC_14-16-1	4.42	3.48	2.13	71.03	0.16	0.12	1.07	0.08	13.05	0.06	95.60
	1518E-9H-CC_14-16-2	3.85	3.30	1.45	72.08	0.24	0.21	1.00	0.03	12.15	0.02	94.32
	1518E-9H-CC_14-16-3	3.44	4.03	0.99	74.47	0.14	0.06	0.70	0.07	11.71	0.01	95.61
	1518E-9H-CC_14-16-5	3.61	3.68	1.07	74.46	0.05	0.02	0.79	0.00	12.37	0.00	96.05
	1518E-9H-CC_14-16-6	3.33	4.20	0.99	74.87	0.15	0.09	0.76	0.01	11.73	0.00	96.15
	1518E-9H-CC_14-16-7	3.62	3.48	1.25	73.50	0.11	0.13	1.05	0.04	12.03	0.00	95.20
	1518E-9H-CC_14-16-8	3.80	2.04	1.26	73.99	0.12	0.10	0.47	0.04	12.22	0.01	94.05
	1518E-9H-CC_14-16-9	4.40	2.81	2.25	70.66	0.33	0.33	1.72	0.03	13.41	0.03	95.96
	1518E-9H-CC_14-16-10	3.41	4.02	0.96	74.98	0.13	0.10	0.73	0.05	11.87	0.01	96.27
	1518E-9H-CC_14-16-11	3.63	3.30	1.10	73.34	0.13	0.10	0.79	0.00	11.86	0.01	94.27
	1518E-9H-CC_14-16-12	3.78	3.73	1.23	75.59	0.09	0.06	0.67	0.00	11.85	0.00	96.99
	1518E-9H-CC_14-16-13	3.20	4.21	0.86	74.56	0.10	0.11	0.74	0.00	11.63	0.02	95.43
	1518E-9H-CC_14-16-14	2.69	3.80	1.28	73.30	0.23	0.20	1.32	0.03	11.58	0.02	94.44
	1518E-9H-CC_14-16-17	3.25	4.34	0.92	73.74	0.15	0.07	0.71	0.12	11.78	0.00	95.07
	1518E-9H-CC_14-16-18	4.00	3.06	1.95	71.08	0.16	0.19	1.29	0.07	12.97	0.00	94.77
	1518E-9H-CC_14-16-19	3.87	3.43	1.42	73.76	0.11	0.06	0.63	0.00	11.67	0.04	94.98
	1518E-9H-CC_14-16-20	3.34	3.65	1.15	74.64	0.10	0.08	0.97	0.03	11.86	0.01	95.83
	1518E_10H-1_50-51_1	3.65	3.62	1.24	74.67	0.11	0.07	0.96	0.04	12.06	0.02	96.46
	1518E_10H-1_50-51_4	3.62	3.97	0.98	75.33	0.11	0.13	0.81	0.04	12.07	0.00	97.06
	1518E_10H-1_50-51_5	4.29	3.12	2.16	72.72	0.21	0.21	1.28	0.10	12.74	0.04	96.86
	1518E_10H-1_50-51_6	3.37	3.70	1.17	74.04	0.08	0.14	0.95	0.00	12.02	0.01	95.48
	1518E_10H-1_50-51_7	3.17	3.53	1.40	73.72	0.28	0.17	0.96	0.09	11.64	0.04	95.00
	1518E_10H-1_50-51_8	3.69	3.66	1.60	72.84	0.09	0.05	1.05	0.05	12.44	0.04	95.51
	1518E_10H-1_50-51_10	3.09	4.17	0.95	73.84	0.12	0.11	0.69	0.04	11.61	0.03	94.65
	1518E_10H-1_50-51_11	3.28	3.47	1.34	73.04	0.06	0.02	0.90	0.07	11.86	0.01	94.06
	1518E_10H-1_50-51_12	3.20	3.97	1.38	73.87	0.08	0.02	0.99	0.08	11.85	0.02	95.46
	1518E_10H-1_50-51_14	3.22	3.86	1.05	74.23	0.14	0.13	0.82	0.00	11.74	0.00	95.20
	1518E_10H-1_50-51_15	3.58	3.63	1.15	75.60	0.13	0.09	0.86	0.00	11.96	0.01	97.01
	1518E_10H-1_50-51_16	4.07	3.27	1.69	73.20	0.23	0.14	0.99	0.16	12.65	0.01	96.42
	1518E_10H-1_50-51_17	4.29	3.04	2.18	71.04	0.18	0.14	1.22	0.11	12.65	0.02	94.88
	1518E_10H-1_50-51_18	3.69	3.86	1.91	71.98	0.26	0.19	1.25	0.03	12.25	0.01	95.42
	1518E_10H-1_50-51_19	3.30	4.22	1.12	74.38	0.09	0.02	0.81	0.00	12.26	0.03	96.23
	1518E_13F-3_20-22_1	3.75	2.88	2.02	72.08	0.15	0.10	1.25	0.05	12.72	0.03	95.03
	1518E_13F-3_20-22_2	3.72	3.63	1.23	74.64	0.11	0.10	1.00	0.04	12.07	0.04	96.56
	1518E_13F-3_20-22_3	3.56	3.25	1.46	70.37	0.14	0.12	1.22	0.03	12.61	0.02	92.79
	1518E_13F-3_20-22_4	3.46	3.69	1.26	75.27	0.12	0.11	0.98	0.00	12.09	0.03	97.00
	1518E_13F-3_20-22_6	3.43	3.51	1.32	74.39	0.10	0.08	1.04	0.03	12.18	0.02	96.11
	1518E_13F-3_20-22_7	3.55	3.56	1.18	74.54	0.10	0.12	0.94	0.01	11.98	0.02	96.00
	1518E_13F-3_20-22_9	3.58	3.44	1.29	74.04	0.13	0.09	0.94	0.06	11.93	0.00	95.50
	1518E_13F-3_20-22_10	3.44	3.83	1.00	75.63	0.06	0.06	0.91	0.07	12.19	0.01	97.21
	1518E_13F-3_20-22_11	3.44	3.63	1.37	75.36	0.09	0.09	0.96	0.02	12.42	0.00	97.38
	1518E_13F-3_20-22_13	3.28	4.05	1.18	73.64	0.06	0.00	0.82	0.04	12.10	0.03	95.19
	1518E_13F-3_20-22_14	3.08	4.18	0.93	72.93	0.12	0.11	0.84	0.03	11.72	0.02	93.96
	1518E_13F-3_20-22_15	3.46	3.61	1.70	71.22	0.14	0.06	1.15	0.09	12.60	0.00	94.03
	1518E-23F-2_80-84-2	3.76	3.41	1.49	72.62	0.18	0.12	1.28	0.00	12.49	0.00	95.35
	1518E-23F-2_80-84-3	3.24	3.80	1.06	74.93	0.13	0.15	0.96	0.05	12.09	0.04	96.44
	1518E-23F-2_80-84-4	4.54	3.36	2.31	70.28	0.19	0.15	1.28	0.08	13.41	0.04	95.64
	1518E-23F-2_80-84-5	4.02	3.22	1.70	72.21	0.17	0.16	1.00	0.08	12.53	0.02	95.11
	1518E-23F-2_80-84-6	3.57	3.49	1.17	74.49	0.12	0.11	0.95	0.04	11.84	0.01	95.79
	1518E-23F-2_80-84-7	4.37	3.11	1.83	70.10	0.20	0.11	1.19	0.13	12.59	0.02	93.66
	1518E-23F-2_80-84-8	3.33	3.70	1.17	74.16	0.13	0.10	0.96	0.09	11.77	0.05	95.45
	1518E-23F-2_80-84-9	3.43	3.84	1.10	73.99	0.10	0.08	0.81	0.01	11.71	0.00	95.07

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u48	1518E-23F-2_80-84-12	3.53	3.05	1.87	71.54	0.16	0.19	1.12	0.05	12.59	0.02	94.12
	1518E-23F-2_80-84-13	3.30	3.48	1.44	71.98	0.13	0.16	1.14	0.05	12.20	0.02	93.91
	1518E-23F-2_80-84-14	2.92	3.93	1.00	73.45	0.05	0.00	0.77	0.09	12.19	0.00	94.40
	1518E-23F-2_80-84-15	3.97	3.05	1.47	72.80	0.19	0.11	0.99	0.08	12.75	0.00	95.41
	1518E-23F-2_80-84-16	3.37	2.52	1.26	67.96	0.23	0.28	1.64	0.06	11.33	0.03	88.68
	1518E-23F-2_80-84-18	3.22	3.70	1.20	75.00	0.12	0.10	1.09	0.11	12.05	0.02	96.60
	1518E-23F-2_80-84-20	3.38	4.17	0.96	74.51	0.03	0.04	0.88	0.05	12.25	0.01	96.27
	1518E-24F-1_1-3-1	2.97	3.97	1.37	70.77	0.13	0.12	1.12	0.03	12.31	0.02	92.81
	1518E-24F-1_1-3-2	3.66	3.81	1.64	72.50	0.11	0.05	1.29	0.04	12.71	0.02	95.83
	1518E-24F-1_1-3-3	3.27	3.89	0.80	73.53	0.04	0.05	0.83	0.06	12.09	0.00	94.56
	1518E-24F-1_1-3-4	3.80	2.91	1.55	72.82	0.09	0.07	1.17	0.12	12.54	0.03	95.11
	1518E-24F-1_1-3-5	4.04	3.18	1.53	71.39	0.22	0.10	0.98	0.04	12.62	0.03	94.14
	1518E-24F-1_1-3-7	4.13	2.94	2.14	70.53	0.42	0.37	1.65	0.04	12.99	0.05	95.26
	1518E-24F-1_1-3-8	3.75	3.63	1.01	75.34	0.13	0.14	0.99	0.04	12.07	0.03	97.12
	1518E-24F-1_1-3-9	3.84	2.95	1.59	72.14	0.06	0.09	1.18	0.02	12.33	0.00	94.20
	1518E-24F-1_1-3-11	4.04	3.39	1.60	72.06	0.16	0.10	1.02	0.02	12.64	0.03	95.06
	1518E-24F-1_1-3-12	3.12	4.29	0.99	73.12	0.03	0.02	0.81	0.00	11.87	0.00	94.25
	1518E-24F-1_1-3-13	4.19	3.91	2.04	70.05	0.19	0.07	0.82	0.02	12.05	0.00	93.34
	1518E-24F-1_1-3-14	3.51	3.79	1.01	74.00	0.11	0.06	0.78	0.03	11.93	0.00	95.22
	1518E-24F-1_1-3-16	2.99	4.30	0.75	72.56	0.11	0.15	0.94	0.06	11.68	0.02	93.56
	1518E-24F-1_1-3-17	3.60	3.59	1.18	74.71	0.13	0.10	0.92	0.05	11.93	0.05	96.27
	1518E-24F-1_1-3-18	4.35	2.60	3.11	67.11	0.35	0.49	2.38	0.05	14.30	0.09	94.83
	1518E-24F-1_1-3-19	3.39	3.97	1.31	73.33	0.09	0.09	0.96	0.05	12.00	0.01	95.21
	1518E-24F-1_1-3-20	3.49	3.64	1.14	74.67	0.11	0.12	0.92	0.00	11.91	0.03	96.03
	1518E_24F-3_71-73_1	3.55	3.60	1.07	73.61	0.07	0.09	0.96	0.00	12.12	0.00	95.07
	1518E_24F-3_71-73_2	3.60	3.72	1.56	70.50	0.14	0.10	0.96	0.05	12.43	0.04	93.11
	1518E_24F-3_71-73_3	3.53	3.64	1.13	72.47	0.22	0.16	0.95	0.03	12.45	0.01	94.59
	1518E_24F-3_71-73_4	4.20	3.19	1.73	73.01	0.24	0.18	1.01	0.04	12.21	0.02	95.82
	1518E_24F-3_71-73_6	3.63	3.60	1.34	74.66	0.10	0.12	1.00	0.06	12.36	0.02	96.90
	1518E_24F-3_71-73_7	3.85	3.17	1.32	71.50	0.25	0.23	1.15	0.04	12.85	0.02	94.38
	1518E_24F-3_71-73_8	4.15	2.34	1.91	68.97	0.37	0.42	1.77	0.07	13.21	0.05	93.27
	1518E_24F-3_71-73_10	3.56	3.49	1.23	71.26	0.07	0.02	0.78	0.02	12.62	0.00	93.05
	1518E_24F-3_71-73_11	3.59	3.65	1.42	74.57	0.11	0.08	0.90	0.00	12.26	0.00	96.57
	1518E_24F-3_71-73_12	3.90	3.19	1.45	73.37	0.19	0.12	0.85	0.04	11.84	0.04	94.99
	1518E_24F-3_71-73_13	4.02	3.09	2.71	67.70	0.46	0.64	2.38	0.15	13.76	0.09	95.00
	1518E_24F-3_71-73_15	3.43	3.07	1.84	70.24	0.20	0.13	0.99	0.02	12.42	0.01	92.34
	1518E_24F-3_71-73_16	3.32	4.31	0.84	73.44	0.07	0.03	0.62	0.00	11.91	0.02	94.57
	1518E_24F-3_71-73_2	3.48	3.59	1.14	75.00	0.11	0.09	0.96	0.02	11.80	0.02	96.20
	1518E_24F-3_71-73_4	3.67	3.29	1.26	72.59	0.12	0.06	0.90	0.06	11.95	0.02	93.92
	1518E_24F-3_71-73_6	3.43	3.61	1.36	74.95	0.13	0.12	0.97	0.03	11.96	0.02	96.59
	1518E_24F-3_71-73_10	3.89	2.95	1.61	71.00	0.17	0.09	1.04	0.07	12.13	0.00	92.94
	1518E_24F-3_71-73_3	4.40	3.18	2.18	70.95	0.17	0.04	1.02	0.08	12.52	0.00	94.54
s71*	1518E-25F-2_30-32-1	3.40	3.81	1.10	74.36	0.07	0.06	0.94	0.00	11.84	0.01	95.60
	1518E-25F-2_30-32-2	3.01	3.60	0.88	72.74	0.04	0.00	0.49	0.05	11.72	0.01	92.54
	1518E-25F-2_30-32-3	2.80	3.52	1.47	74.89	0.46	0.17	0.76	0.01	10.76	0.00	94.84
	1518E-25F-2_30-32-5	3.22	3.70	0.84	72.99	0.12	0.17	1.01	0.04	12.02	0.03	94.13
	1518E-25F-2_30-32-6	2.91	3.56	1.26	74.08	0.21	0.15	1.20	0.00	11.41	0.00	94.78
	1518E-25F-2_30-32-7	3.52	3.78	1.74	72.35	0.25	0.19	1.14	0.07	12.04	0.03	95.10
	1518E-25F-2_30-32-9	3.04	3.58	1.02	75.08	0.11	0.11	0.93	0.05	12.00	0.01	95.94
	1518E-25F-2_30-32-10	3.92	2.86	1.59	71.24	0.18	0.15	1.17	0.02	12.46	0.00	93.58
	1518E-25F-2_30-32-11	4.68	2.48	2.60	70.43	0.21	0.15	1.20	0.10	12.96	0.05	94.85
	1518E-25F-2_30-32-12	3.43	3.48	1.48	74.33	0.21	0.14	0.88	0.03	11.80	0.01	95.79
	1518E-25F-2_30-32-13	3.06	4.16	1.04	73.38	0.07	0.07	1.04	0.01	12.36	0.00	95.19
	1518E-25F-2_30-32-14	4.02	3.56	1.34	75.40	0.13	0.07	0.77	0.02	11.87	0.00	97.19
	1518E-25F-2_30-32-17	4.01	3.10	1.86	71.94	0.12	0.08	1.04	0.12	12.51	0.01	94.80
	1518E-25F-2_30-32-18	4.34	3.16	1.77	72.50	0.22	0.17	1.14	0.09	12.99	0.00	96.38
	1518E-25F-2_30-32-19	3.78	3.52	1.58	72.19	0.11	0.08	1.08	0.07	12.44	0.05	94.90
	1518E_25F-2_30-32_4	4.47	2.90	2.43	70.39	0.16	0.03	1.05	0.09	12.25	0.04	93.81
	1518E_25F-2_30-32_10	3.92	3.19	1.99	70.81	0.28	0.26	1.30	0.05	12.86	0.04	94.69
	1518E_25F-2_30-32_3	3.31	4.04	0.93	73.58	0.08	0.08	0.78	0.05	11.83	0.02	94.70
	1518E_25F-2_30-32_6	3.74	3.84	0.73	73.25	0.04	0.07	0.47	0.04	12.32	0.02	94.52
	1518E_25F-2_30-32_1	3.60	3.25	1.25	73.08	0.12	0.17	1.03	0.09	11.85	0.01	94.44
s73	1518E_25F-2_30-32_2	3.72	3.78	1.17	75.23	0.11	0.08	0.64	0.09	12.21	0.03	97.06
	1518E-28X-7_47-48-4	3.45	3.17	1.36	72.98	0.14	0.15	1.29	0.10	11.94	0.00	94.59
	1518E-28X-7_47-48-9	3.54	3.50	1.23	74.64	0.13	0.11	0.83	0.03	11.59	0.01	95.62
	1518E-28X-7_47-48-10	3.23	3.54	1.24	75.18	0.12	0.13	1.12	0.06	12.31	0.03	96.96
	1518E-28X-7_47-48-19	2.45	3.48	1.18	58.56	0.09	0.13	1.21	0.07	9.81	0.00	76.98
	1518E_29X-2_66-68_1	3.66	3.60	1.07	74.89	0.10	0.11	0.92	0.08	12.04	0.00	96.48
	1518E_29X-2_66-68_2	3.21	3.94	2.05	70.81	0.20	0.03	0.77	0.01	12.93	0.00	93.95
	1518E_29X-2_66-68_3	3.83	4.10	1.24	73.47	0.12	0.02	0.64	0.00	12.36	0.01	95.80

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u54	1518E_29X-2_66-68_4	2.64	3.80	1.22	71.10	0.12	0.08	0.58	0.04	10.95	0.04	90.57
	1518E_29X-2_66-68_6	3.67	3.12	1.94	70.56	0.20	0.24	2.05	0.05	13.07	0.03	94.94
	1518E_29X-2_66-68_8	3.22	4.25	0.97	73.48	0.05	0.06	0.65	0.02	11.94	0.02	94.66
	1518E_29X-2_66-68_9	3.62	3.75	1.53	74.30	0.11	0.07	1.08	0.03	12.29	0.03	96.81
	1518E_29X-2_66-68_10	3.62	0.00	1.43	73.30	0.13	0.01	0.00	0.02	12.16	0.00	90.67
	1518E_29X-2_66-68_11	3.46	0.00	1.14	74.72	0.13	0.11	0.00	0.04	11.77	0.01	91.38
	1518E_29X-2_66-68_13	3.72	3.67	1.02	75.57	0.12	0.10	1.05	0.00	12.25	0.01	97.52
	1518E_29X-2_66-68_14	3.47	3.45	1.28	73.05	0.11	0.08	0.98	0.02	12.05	0.03	94.51
	1518E_29X-2_66-68_15	3.52	4.22	0.91	74.02	0.08	0.03	0.55	0.01	11.59	0.00	94.94
	1518E_29X-2_66-68_16	3.85	1.60	3.35	64.83	0.73	1.02	2.94	0.13	14.29	0.18	92.93
	1518E_29X-2_66-68_17	3.08	3.20	0.90	72.83	0.15	0.13	0.81	0.10	11.90	0.01	93.12
	1518E-29X-6_7-9-1	3.76	3.76	0.45	77.02	0.14	0.01	0.64	0.02	11.88	0.00	97.68
	1518E-29X-6_7-9-5	3.45	3.95	0.75	72.46	0.07	0.04	0.65	0.07	11.93	0.00	93.38
	1518E-29X-6_7-9-6	3.11	3.58	1.29	72.16	0.05	0.00	1.04	0.03	11.85	0.00	93.11
	1518E-29X-6_7-9-7	3.71	3.74	1.60	72.12	0.10	0.06	0.76	0.01	11.98	0.02	94.09
	1518E-29X-6_7-9-8	4.37	3.32	1.93	71.94	0.14	0.06	1.04	0.09	12.76	0.01	95.67
	1518E-29X-6_7-9-9	4.32	2.92	2.04	71.11	0.19	0.11	1.12	0.09	12.55	0.01	94.46
	1518E-29X-6_7-9-11	3.45	3.71	1.80	71.24	0.10	0.06	1.15	0.04	12.02	0.02	93.59
	1518E-29X-6_7-9-12	3.15	4.01	1.28	73.47	0.05	0.04	0.79	0.07	11.79	0.00	94.65
	1518E-29X-6_7-9-14	3.62	3.42	1.84	71.30	0.12	0.06	1.24	0.04	12.18	0.02	93.84
	1518E-29X-6_7-9-16	3.63	1.83	1.91	70.46	0.18	0.13	1.27	0.05	12.15	0.00	91.62
	1518E-29X-6_7-9-17	3.95	2.97	1.66	72.48	0.23	0.21	1.14	0.10	12.44	0.04	95.23
	1518E-29X-6_7-9-18	3.58	3.48	1.16	74.18	0.12	0.09	0.75	0.05	11.89	0.01	95.31
	1518E-29X-6_7-9-19	3.80	3.50	1.35	73.52	0.12	0.14	0.93	0.08	12.11	0.02	95.58
	1518E-29X-6_7-9-20	3.00	3.03	2.52	69.65	0.18	0.14	1.31	0.13	12.55	0.04	92.55
	1518E_29X-6_7-9_1	3.53	3.23	1.24	73.87	0.12	0.04	0.93	0.07	12.01	0.01	95.06
	1518E_29X-6_7-9_6	3.39	3.30	1.09	73.05	0.11	0.11	0.98	0.09	11.62	0.00	93.74
	1518E_29X-6_7-9_11	3.28	3.48	1.10	73.96	0.14	0.04	0.96	0.04	11.93	0.02	94.94
	1518E_29X-6_7-9_2	3.59	3.47	1.36	75.42	0.09	0.05	0.93	0.00	11.97	0.03	96.91
	1518E_29X-6_7-9_3	4.25	3.33	1.91	70.57	0.16	0.10	0.99	0.09	12.57	0.05	94.02
	1518E_29X-6_7-9_4	2.37	3.80	1.14	72.16	0.11	0.14	1.04	0.00	12.57	0.07	93.40
	1518E_29X-6_7-9_5	3.51	3.69	1.14	75.10	0.12	0.08	0.93	0.05	12.23	0.04	96.88
	1518E_29X-6_7-9_7	3.50	3.57	1.14	73.14	0.06	0.02	0.88	0.01	12.07	0.00	94.40
	1518E_29X-6_7-9_8	3.73	3.11	1.60	71.18	0.08	0.04	0.99	0.00	11.99	0.01	92.73
	1518E_29X-6_7-9_9	4.11	3.15	1.61	72.39	0.09	0.04	0.92	0.05	13.05	0.00	95.41
	1518E_29X-6_7-9_10	3.75	3.21	1.51	72.13	0.24	0.19	1.10	0.02	11.92	0.02	94.08
	1518E_29X-6_7-9_12	3.27	4.05	1.15	74.06	0.11	0.07	0.84	0.03	12.17	0.00	95.74
	1518E_31X-3_11-13_1	3.43	3.71	1.30	73.74	0.08	0.06	0.90	0.06	12.32	0.00	95.59
	1518E_31X-3_11-13_2	3.37	4.32	0.58	73.93	0.05	0.02	0.65	0.00	12.11	0.00	95.04
	1518E_31X-3_11-13_3	3.69	3.57	1.18	75.43	0.12	0.08	0.98	0.00	12.10	0.04	97.20
	1518E_31X-3_11-13_5	3.67	3.41	1.35	74.23	0.19	0.13	0.90	0.01	11.87	0.04	95.81
	1518E_31X-3_11-13_6	4.18	3.56	2.02	71.57	0.15	0.11	0.99	0.00	13.03	0.05	95.66
	1518E_31X-3_11-13_7	3.48	3.31	1.54	69.82	0.21	0.21	1.18	0.11	12.67	0.00	92.54
	1518E_31X-3_11-13_8	2.80	4.12	1.64	69.25	0.21	0.19	1.19	0.03	12.43	0.01	91.87
	1518E_31X-3_11-13_9	3.46	3.37	1.44	73.08	0.16	0.11	1.40	0.02	12.65	0.00	95.70
	1518E_31X-3_11-13_10	3.51	3.81	0.97	73.59	0.06	0.08	0.75	0.03	12.04	0.00	94.83
	1518E_31X-3_11-13_11	4.17	3.55	1.97	71.59	0.19	0.11	1.02	0.05	12.74	0.01	95.41
	1518E_31X-3_11-13_12	3.37	3.44	1.29	72.65	0.10	0.05	1.03	0.11	12.11	0.05	94.20
	1518E_31X-3_11-13_13	3.56	3.89	0.93	72.79	0.13	0.05	0.73	0.03	11.92	0.03	94.07
	1518E_31X-3_11-13_15	3.29	3.70	1.03	73.53	0.07	0.06	1.02	0.09	12.19	0.06	95.04
s75*	1518E-32X-1_20-24-1	3.93	2.70	2.59	69.51	0.37	0.39	2.02	0.06	14.02	0.04	95.63
	1518E-32X-1_20-24-4	3.12	4.03	0.93	72.94	0.14	0.09	0.75	0.07	10.88	0.00	92.95
	1518E-32X-1_20-24-5	4.07	3.01	2.01	71.60	0.17	0.16	1.31	0.05	13.02	0.05	95.45
	1518E-32X-1_20-24-7	3.44	3.69	1.31	75.97	0.14	0.10	0.93	0.00	12.20	0.00	97.78
	1518E-32X-1_20-24-9	4.00	3.29	1.51	72.05	0.12	0.08	0.87	0.05	12.25	0.00	94.22
	1518E-32X-1_20-24-10	3.43	3.52	1.28	74.59	0.11	0.11	0.87	0.07	11.81	0.00	95.79
	1518E-32X-1_20-24-11	3.22	3.43	1.56	70.64	0.19	0.21	1.41	0.07	12.59	0.01	93.32
	1518E-32X-1_20-24-12	3.26	3.83	1.11	74.66	0.13	0.11	0.83	0.03	11.93	0.02	95.92
	1518E-32X-1_20-24-13	3.77	3.62	1.02	74.68	0.06	0.04	0.66	0.06	11.94	0.00	95.85
	1518E-32X-1_20-24-14	4.30	3.29	1.64	73.13	0.16	0.16	1.06	0.00	12.72	0.00	96.47
	1518E-32X-1_20-24-15	4.26	3.19	1.57	72.80	0.17	0.15	1.00	0.06	12.51	0.00	95.71
	1518E-32X-1_20-24-16	3.21	4.16	1.66	70.18	0.14	0.08	1.00	0.05	12.36	0.00	92.84
	1518E-32X-1_20-24-18	2.91	4.39	0.98	73.36	0.11	0.09	0.88	0.01	12.03	0.00	94.77
	1518E-32X-1_20-24-19	3.36	3.88	1.19	73.81	0.15	0.10	0.82	0.00	11.93	0.00	95.25
	1518E-32X-1_20-24-20	3.11	4.16	1.21	72.61	0.06	0.04	0.82	0.00	11.78	0.00	93.79
	1518F-5R-3_60-62-1	4.08	3.28	1.52	71.85	0.19	0.16	1.08	0.00	12.53	0.02	94.71
	1518F-5R-3_60-62-2	3.91	3.23	1.34	74.00	0.13	0.11	0.85	0.04	11.98	0.01	95.60
	1518F-5R-3_60-62-3	3.63	3.48	1.26	74.48	0.13	0.13	0.99	0.02	11.91	0.06	96.08
	1518F-5R-3_60-62-4	3.09	4.05	1.27	73.67	0.11	0.07	0.94	0.04	11.84	0.00	95.08
	1518F-5R-3_60-62-5	4.03	3.42	2.06	72.64	0.15	0.08	1.14	0.07	12.62	0.00	96.21

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s18	1518F-5R-3_60-62-6	3.95	3.35	2.03	72.80	0.18	0.08	1.03	0.09	12.47	0.01	96.00
	1518F-5R-3_60-62-7	3.68	3.73	1.17	75.12	0.08	0.04	0.85	0.03	11.77	0.02	96.48
	1518F-5R-3_60-62-8	4.07	3.27	1.51	72.29	0.10	0.11	0.98	0.00	12.55	0.00	94.88
	1518F-5R-3_60-62-11	3.48	3.76	1.02	75.22	0.09	0.07	0.89	0.03	12.22	0.05	96.82
	1518F-5R-3_60-62-12	3.90	3.32	1.25	74.36	0.13	0.09	1.09	0.01	12.07	0.03	96.25
	1518F-5R-3_60-62-13	2.90	3.70	1.28	72.99	0.24	0.15	1.39	0.03	11.72	0.04	94.43
	1518F-5R-3_60-62-15	3.11	3.65	2.21	72.55	0.17	0.09	1.41	0.06	12.90	0.00	96.15
	1518F-5R-3_60-62-16	4.83	2.29	3.06	68.23	0.69	0.68	2.14	0.15	13.67	0.10	95.83
	1518F-5R-3_60-62-18	3.72	3.60	1.49	73.26	0.11	0.07	0.82	0.03	12.06	0.00	95.16
	1518F-13R-1_113-115-1	3.37	3.54	1.23	73.69	0.17	0.14	0.92	0.08	11.86	0.04	95.04
	1518F-13R-1_113-115-2	3.72	3.33	1.12	73.45	0.15	0.13	0.94	0.06	11.90	0.03	94.82
	1518F-13R-1_113-115-3	3.61	3.47	1.05	74.43	0.12	0.10	0.92	0.04	12.06	0.03	95.82
	1518F-13R-1_113-115-4	3.64	3.45	1.23	73.96	0.15	0.15	0.92	0.00	11.99	0.02	95.51
	1518F-13R-1_113-115-5	3.52	3.74	1.15	74.22	0.14	0.07	0.94	0.04	12.12	0.02	95.97
	1518F-13R-1_113-115-6	3.66	3.45	1.28	74.89	0.18	0.14	0.94	0.03	12.25	0.02	96.83
	1518F-13R-1_113-115-7	3.73	3.33	1.09	73.28	0.19	0.13	0.90	0.03	11.99	0.02	94.70
	1518F-13R-1_113-115-8	3.45	3.45	1.24	72.54	0.16	0.09	0.92	0.05	11.61	0.00	93.51
	1518F-13R-1_113-115-9	3.35	3.90	1.14	73.49	0.16	0.11	0.90	0.02	12.16	0.00	95.23
	1518F-13R-1_113-115-10	3.44	3.52	1.37	74.63	0.18	0.14	0.95	0.02	12.14	0.02	96.41
	1518F-13R-1_113-115-11	3.73	3.27	1.20	73.30	0.12	0.11	0.91	0.12	12.00	0.00	94.76
	1518F-13R-1_113-115-12	3.50	3.49	1.22	73.80	0.16	0.16	0.93	0.08	11.98	0.00	95.32
	1518F-13R-1_113-115-13	3.78	3.32	1.30	73.91	0.14	0.12	0.94	0.09	12.12	0.00	95.72
	1518F-13R-1_113-115-14	3.38	3.40	1.18	74.37	0.10	0.15	0.94	0.07	12.07	0.01	95.68
	1518F-13R-1_113-115-15	3.58	3.42	1.42	74.30	0.18	0.13	0.92	0.08	12.01	0.04	96.07
	1518F-13R-1_113-115-16	3.77	3.50	1.16	74.22	0.14	0.12	0.90	0.01	12.05	0.00	95.86
	1518F-13R-1_113-115-17	3.84	3.40	1.06	73.62	0.15	0.10	0.91	0.04	11.86	0.02	95.01
	1518F-13R-1_113-115-18	3.72	3.41	1.24	73.95	0.15	0.11	0.91	0.06	11.91	0.02	95.47
	1518F-13R-1_113-115-19	3.61	3.43	1.16	73.74	0.12	0.09	0.98	0.06	11.79	0.02	95.00
	1518F-13R-1_113-115-20	3.60	3.39	1.10	74.19	0.15	0.14	0.90	0.04	11.93	0.00	95.44
	1518F 13R-1 113-115_1	3.55	3.30	1.11	72.01	0.15	0.12	0.90	0.08	12.18	0.03	93.41
	1518F 13R-1 113-115_2	3.69	3.30	1.22	74.07	0.13	0.14	0.92	0.09	11.82	0.03	95.42
	1518F 13R-1 113-115_3	3.54	3.53	1.15	74.04	0.14	0.11	0.98	0.00	12.57	0.00	96.06
	1518F 13R-1 113-115_5	3.59	3.35	1.18	72.87	0.14	0.14	0.92	0.03	12.17	0.00	94.39
	1518F 13R-1 113-115_6	3.62	3.39	1.31	73.02	0.15	0.11	0.87	0.09	12.03	0.00	94.59
	1518F 13R-1 113-115_4	3.79	3.39	1.28	73.92	0.14	0.08	0.98	0.00	12.08	0.03	95.69
	1518F 13R-1 113-115_7	3.52	3.36	1.29	72.76	0.14	0.08	0.97	0.08	11.91	0.03	94.13
	1518F 13R-1 113-115_8	3.85	3.35	1.34	73.53	0.12	0.08	0.94	0.01	12.20	0.00	95.42
	1518F 13R-1 113-115_9	3.92	3.33	1.21	74.06	0.12	0.10	0.94	0.05	11.93	0.03	95.69
	1518E-27R-2_13-15-1	4.46	3.14	2.17	71.01	0.17	0.01	0.99	0.15	11.98	0.03	94.11
	1518E-27R-2_13-15-2	3.45	3.03	1.09	74.06	0.10	0.16	1.31	0.04	11.89	0.02	95.14
	1518E-27R-2_13-15-3	3.57	3.20	1.14	74.50	0.10	0.06	0.93	0.02	11.68	0.00	95.21
	1518E-27R-2_13-15-4	3.19	3.59	1.11	74.48	0.12	0.09	1.16	0.04	11.97	0.00	95.75
	1518E-27R-2_13-15-5	3.69	3.42	1.48	74.22	0.16	0.12	0.84	0.02	11.59	0.01	95.56
	1518E-27R-2_13-15-6	3.50	3.61	0.99	73.12	0.07	0.08	0.88	0.05	11.81	0.00	94.11
	1518E-27R-2_13-15-7	3.22	3.18	0.97	73.99	0.16	0.15	1.28	0.05	12.06	0.01	95.06
	1518E-27R-2_13-15-8	3.37	3.34	1.25	71.48	0.11	0.19	1.23	0.00	12.31	0.03	93.30
	1518E-27R-2_13-15-9	3.96	2.55	1.43	71.44	0.26	0.25	1.32	0.10	12.26	0.05	93.62
	1518E-27R-2_13-15-10	3.58	3.67	1.02	74.46	0.09	0.12	0.86	0.07	12.03	0.01	95.92
	1518E-27R-2_13-15-11	3.29	3.05	1.24	73.59	0.16	0.16	1.26	0.04	11.95	0.02	94.77
	1518E-27R-2_13-15-12	3.58	3.84	1.02	74.57	0.11	0.09	0.85	0.00	12.09	0.02	96.17
	1518E-27R-2_13-15-13	2.71	3.56	0.88	73.26	0.05	0.00	0.48	0.03	12.08	0.00	93.05
	1518E-27R-2_13-15-15	3.62	3.79	0.98	74.38	0.09	0.08	0.85	0.04	12.03	0.05	95.90
	1518E-27R-2_13-15-16	3.71	3.68	0.83	72.64	0.02	0.01	0.44	0.01	12.09	0.00	93.44
	1518E-27R-2_13-15-17	3.83	3.86	1.83	72.50	0.14	0.12	1.10	0.02	12.94	0.00	96.34
	1518E-27R-2_13-15-18	3.27	4.08	1.06	73.38	0.08	0.03	0.97	0.06	12.09	0.03	95.06
	1518E-27R-2_13-15-19	4.10	3.29	1.61	71.90	0.14	0.12	1.06	0.06	12.40	0.00	94.68
	1518E-27R-2_13-15-20	3.32	4.70	0.79	74.98	0.03	0.03	0.57	0.06	12.25	0.01	96.74
	1518F-28R-3_52-54-1	3.53	3.62	1.22	75.62	0.11	0.10	0.96	0.04	11.88	0.00	97.09
	1518F-28R-3_52-54-2	3.98	3.20	1.77	72.06	0.20	0.18	1.12	0.02	12.48	0.02	95.03
	1518F-28R-3_52-54-4	3.33	3.76	1.11	74.51	0.12	0.08	0.95	0.07	12.11	0.02	96.05
	1518F-28R-3_52-54-5	4.18	3.43	1.75	72.57	0.13	0.12	1.00	0.07	12.38	0.02	95.65
	1518F-28R-3_52-54-9	3.61	3.62	1.31	73.23	0.14	0.13	1.14	0.08	12.56	0.00	95.82
	1518F-28R-3_52-54-10	4.25	2.02	3.38	66.83	0.40	0.52	2.73	0.15	14.03	0.09	94.40
	1518F-28R-3_52-54-11	3.41	3.16	1.60	72.78	0.15	0.20	1.47	0.05	12.71	0.00	95.54
	1518F-28R-3_52-54-12	3.36	3.88	1.11	74.76	0.11	0.08	0.82	0.04	12.21	0.01	96.37
	1518F-28R-3_52-54-13	3.51	3.41	1.14	74.21	0.13	0.17	0.95	0.08	11.65	0.00	95.25
	1518F-28R-3_52-54-14	3.83	3.49	1.38	73.31	0.13	0.07	0.82	0.09	11.97	0.03	95.12
	1518F-28R-3_52-54-15	4.23	3.22	1.60	71.62	0.18	0.10	0.98	0.09	12.56	0.02	94.61
	1518F-28R-3_52-54-16	3.50	3.94	0.84	73.17	0.05	0.00	0.57	0.04	11.89	0.00	94.00
	1518F-28R-3_52-54-17	3.60	3.65	1.18	74.47	0.14	0.11	0.93	0.00	11.97	0.02	96.08

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1518F-28R-3_52-54-18	3.41	4.00	1.33	73.06	0.07	0.00	0.67	0.03	11.87	0.00	94.44
	1518F-28R-3_52-54-19	3.16	3.82	1.08	73.91	0.11	0.07	1.01	0.02	12.07	0.00	95.25
	1518F-28R-3_52-54-20	4.28	3.04	1.84	72.17	0.27	0.21	1.40	0.07	12.85	0.01	96.14
	1518F-28R-3_59-61-4	3.38	3.63	1.12	74.88	0.10	0.10	0.93	0.02	11.95	0.01	96.11
	1518F-28R-3_59-61-5	3.87	2.73	1.92	69.21	0.32	0.37	2.29	0.19	13.76	0.03	94.69
	1518F-28R-3_59-61-7	4.27	2.09	1.50	68.57	0.25	0.32	3.34	0.16	16.03	0.05	96.59
	1518F-28R-3_59-61-8	4.50	2.37	1.41	69.41	0.24	0.26	2.64	0.15	14.75	0.03	95.75
	1518F-28R-3_59-61-9	4.67	2.20	1.51	68.86	0.26	0.18	3.16	0.04	15.91	0.05	96.84
	1518F-28R-3_59-61-14	2.19	1.84	0.92	40.65	0.15	0.19	1.10	0.12	7.67	0.04	54.87
	1518F-28R-3_59-61-15	4.17	2.41	1.81	69.53	0.26	0.38	2.82	0.19	14.17	0.02	95.76
	1518F-28R-3_59-61-17	3.83	2.63	1.19	69.97	0.30	0.13	2.97	0.00	15.32	0.11	96.44
	1518F-28R-3_59-61-20	3.58	2.83	1.27	71.34	0.25	0.30	1.88	0.12	13.31	0.01	94.90
	1518F-28R-3_59-61_2	3.42	3.84	1.11	74.18	0.08	0.08	0.82	0.08	11.97	0.00	95.58
	1518F-28R-3_59-61_5	3.52	3.76	0.99	75.54	0.06	0.04	0.74	0.07	12.03	0.02	96.78
	1518F-28R-3_59-61_7	3.74	3.41	1.38	73.28	0.16	0.11	0.89	0.04	11.94	0.02	94.98
	1518F-28R-3_60-64-2	3.94	3.29	1.35	74.03	0.17	0.15	1.08	0.01	12.43	0.00	96.45
	1518F-28R-3_60-64-4	3.08	3.89	0.55	74.67	0.35	0.01	0.79	0.04	11.91	0.07	95.34
	1518F-28R-3_60-64-6	3.30	3.83	0.92	73.51	0.11	0.09	0.78	0.06	11.82	0.02	94.45
	1518F-28R-3_60-64-8	3.30	4.24	1.16	74.69	0.11	0.10	0.87	0.04	12.28	0.01	96.79
	1518F-28R-3_60-64-9	4.10	3.18	1.76	71.25	0.21	0.18	1.40	0.09	12.88	0.02	95.07
	1518F-28R-3_60-64-11	3.44	4.43	1.16	73.84	0.06	0.03	0.51	0.00	11.69	0.00	95.15
	1518F-28R-3_60-64-12	3.80	2.89	1.66	72.98	0.18	0.20	1.45	0.00	12.81	0.02	95.99
	1518F-28R-3_60-64-13	3.47	3.62	1.15	75.95	0.13	0.11	0.97	0.01	12.04	0.02	97.47
	1518F-28R-3_60-64-15	3.89	3.27	1.49	73.83	0.18	0.15	1.08	0.05	12.29	0.03	96.26
	1518F-28R-3_60-64-16	2.70	3.98	1.19	75.03	0.35	0.24	0.59	0.05	11.25	0.00	95.37
	1518F-28R-3_60-64-17	3.46	3.43	1.80	71.88	0.14	0.08	0.99	0.06	12.30	0.01	94.15
	1518F-28R-3_60-64-20	3.30	4.04	1.10	74.80	0.11	0.11	0.96	0.04	11.96	0.03	96.45

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

Sample name	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1518E 1H-4 16-18_1	47.43	7.00	2.33	0.54	143.85	55.94	14.44	75.74	6.31	6.79	764.96	20.57	39.89	3.99	13.94
1518E 1H-4 16-18_3	26.81	4.76	1.80	1.83	105.91	49.55	10.33	52.73	4.15	4.98	539.02	14.49	27.63	2.75	9.3
1518E 1H-4 16-18_4	44.14	7.61	2.42	0.92	155.36	61.54	15.53	78.29	6.40	7.08	779.24	21.22	40.5	3.99	13.61
1518E 1H-4 16-18_6	39.36	5.85	1.78	0.44	126.90	52.31	13.33	69.55	5.39	5.86	684.91	18.52	35.08	3.65	12.28
1518E 2H-4 26-28_2	40.54	3.88	3.86	0.54	122.11	66.03	14.48	78.00	5.47	5.62	705.35	19.32	37.68	3.9	14.33
1518E 2H-4 26-28_7	33.70	4.25	1.91	2.29	125.11	73.47	14.95	85.11	5.92	5.77	731.19	19.68	37.85	4.02	14.04
1518E 2H-4 26-28_9	46.50	4.91	2.58	0.57	158.70	84.06	17.77	94.75	7.20	7.12	876.55	23.62	46.25	4.93	17.46
1518E 2H-4 26-28_10	30.82	3.31	1.61	0.80	97.85	60.50	11.42	59.55	4.54	4.46	547.06	14.94	28.35	2.98	10.71
1518E 3H-1 92-93_3	44.57	10.66	2.45	0.93	113.17	125.15	22.80	176.17	6.60	5.15	818.28	22.28	45.65	5.09	19.45
1518E 3H-1 92-93_4	43.31	11.24	1.87	0.86	108.24	129.13	23.75	185.00	6.71	5.31	851.39	23.12	47.83	5.45	22.47
1518E 3H-1 92-93_7	45.44	10.38	2.48	1.04	113.10	127.60	24.41	174.83	6.53	5.37	892.53	22.99	48.85	5.35	20.53
1518E 3H-1 92-93_9	34.37	9.62	8.64	0.96	101.52	118.16	20.62	154.53	5.78	4.63	736.12	19.87	39.6	4.42	17.09
1518E 3H-3 36-40_1	50.12	5.79	3.61	0.53	142.41	70.70	13.93	78.84	5.88	6.84	773.73	21.45	39.47	4.03	12.93
1518E 3H-3 36-40_2	39.77	6.51	2.85	0.63	163.74	68.72	13.73	79.40	6.00	7.40	799.30	21.62	39.75	3.91	13.43
1518E 3H-3 36-40_3	52.16	5.83	1.97	0.51	141.55	67.94	13.55	77.16	6.23	6.44	768.24	21.12	39.96	4.16	13.06
1518E 3H-3 36-40_4	50.16	5.75	2.46	0.51	144.88	69.73	13.96	79.27	6.04	6.78	788.98	21.83	41.23	4.13	13.71
1518E 3H-3 36-40_6	38.29	4.72	2.05	0.57	130.30	64.58	12.96	72.03	5.82	5.57	703.80	19.72	36.81	3.48	13.3
1518E 3H-6 16-18cm_3	39.52	7.89	2.22	0.89	84.84	143.49	18.36	173.12	6.10	3.75	697.45	17.88	36.96	4.01	15.82
1518E 3H-6 16-18cm_4	40.56	8.19	2.17	1.04	86.66	152.35	19.34	175.25	6.04	3.65	727.42	18.77	38.17	4.21	15.61
1518E 3H-6 16-18cm_5	38.54	8.31	2.01	1.16	86.57	150.14	20.48	180.64	5.94	3.38	735.37	18.97	39.04	4.33	15.75
1518E 3H-6 16-18cm_6	41.76	8.97	2.96	1.22	106.91	154.64	19.25	183.77	6.75	4.62	759.53	19.63	40.26	4.51	16.21
1518E 5H-2 66-70_3	36.22	5.16	2.69	0.71	117.93	78.89	13.46	80.33	5.43	5.51	781.23	19.33	36.4	3.63	12.85
1518E 5H-2 66-70_9	25.66	5.67	3.08	0.65	133.76	78.64	14.90	79.60	5.40	6.42	796.82	19.63	36.89	3.89	14.4
1518E 5H-2 66-70_10	45.34	6.24	2.88	0.61	140.24	81.97	16.36	93.11	6.61	6.54	874.10	22.24	44.11	4.58	16.33
1518E 9H-2 8-9_1	44.24	5.14	2.26	1.13	131.78	61.82	21.83	99.83	6.94	6.72	744.61	24.18	47.2	4.95	19.52
1518E 9H-2 8-9_10	23.72	8.95	2.17	0.48	131.14	60.95	31.12	172.41	8.87	5.92	774.94	26.72	56.04	6.78	24.01
1518E 24F-3 71-73_2	42.70	5.85	2.47	0.53	137.52	68.70	23.71	112.92	8.09	7.25	851.08	26.6	52.96	5.73	22.14
1518E 24F-3 71-73_4	45.56	5.50	2.24	0.76	125.66	64.22	21.18	99.52	6.94	6.59	755.83	23.1		5.05	18.92
1518E 24F-3 71-73_6	34.43	3.90	3.07	1.10	109.82	49.30	17.40	62.37	5.57	5.75	654.77	20.49	40.34	4.29	15.81
1518E 24F-3 71-73_10	47.80	10.07	2.54	1.28	144.52	97.60	27.59	154.05	7.51	7.33	904.23	26.21	53.29	6.02	23.36
1518E 25F-2 30-32_4	4.09	5.31	1.79	0.35	157.70	49.86	22.28	79.09	6.27	8.56	788.32	25.23	52.36	5.47	19.53
1518E 25F-2 30-32_10	2.64	9.31	2.13	0.24	108.62	54.14	56.91	375.01	12.22	5.39	609.86	29.68	67.3	8.85	36.79
1518E 25F-2 30-32_3	13.95	7.96	3.10	1.84	94.25	73.18	26.97	145.51	5.68	3.99	665.99	19.38	40.36	4.67	19.15
1518E 25F-2 30-32_6	26.50	10.47	4.19	1.25	113.50	98.83	30.48	269.96	9.31	5.00	651.92	24.06	50.41	6.1	24.7
1518E 29X-6 7-9_1	45.39	5.36	2.45	0.65	133.76	67.98	22.72	107.20	7.49	7.27	804.56	25	49.71	5.49	21.29
1518E 29X-6 7-9_6	47.11	5.45	2.68	0.65	129.04	73.83	22.18	111.43	7.33	6.75	816.93	25.31	49.95	5.68	20.28
1518E 29X-6 7-9_11	42.97	5.56	1.96	0.73	125.62	76.15	24.13	115.48	7.44	6.87	838.16	25.94	51.07	5.64	21.81
1518F 13R-1 113-115_1	41.24	7.99	2.03	0.45	125.28	74.96	23.49	136.05	7.08	5.26	706.87	24.02	47.06	5.48	18.65
1518F 13R-1 113-115_2	40.91	7.91	1.82	0.48	124.32	77.98	24.35	139.86	6.88	5.28	726.85	23.69	48.78	5.24	19.28
1518F 13R-1 113-115_3	37.92	7.47	1.81	0.55	121.32	81.13	22.57	127.41	6.45	5.31	690.88	22.49	46.47	5.1	19.76
1518F 13R-1 113-115_5	43.29	7.54	1.86	0.46	122.55	76.93	24.73	140.31	7.34	5.41	731.75	23.98	49.53	5.52	20.9
1518F 13R-1 113-115_6	40.08	7.41	2.12	0.49	123.76	71.44	22.14	129.11	6.92	5.44	670.55	22.19	45.07	5.02	19.16
1518F 28R-3 59-61_2	27.81	3.98	7.97	2.59	103.35	55.47	16.99	59.09	5.51	5.34	590.32	19.36	36.43	4.12	13.88
1518F 28R-3 59-61_5	32.63	5.08	2.47	0.48	158.80	50.67	24.46	83.22	8.25	9.00	839.44	29.6	57.2	6.14	21.77
1518F 28R-3 59-61_7	30.04	5.85	7.16	1.95	90.60	56.21	17.94	94.34	5.68	4.44	468.84	17.24	35.68	4.05	15.58

Appendix A

Supplementary Table S9: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1518.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1518E 1H-4 16-18_1	2.38	0.33	2.32	0.37	2.26	0.51	1.44	0.24	1.82	0.26	2.60	0.597	14.63	13.14	3.14
1518E 1H-4 16-18_3	1.88	0.27	1.52	0.25	1.47	0.35	1.03	0.16	1.37	0.19	1.73	0.391	26.57	8.88	2.17
1518E 1H-4 16-18_4	2.63	0.38	2.29	0.35	1.99	0.51	1.60	0.26	1.87	0.25	2.43	0.616	15.87	12.35	3.1
1518E 1H-4 16-18_6	2.19	0.41	1.93	0.32	2.13	0.46	1.37	0.19	1.45	0.28	2.09	0.571	13.88	11.94	2.89
1518E 2H-4 26-28_2	2.59	0.44	2.36	0.35	2.40	0.46	1.59	0.25	1.82	0.27	2.80	0.533	14.59	11.19	2.56
1518E 2H-4 26-28_7	2.76	0.41	2.10	0.37	2.45	0.53	1.59	0.23	1.66	0.28	3.00	0.648	20.47	10.76	2.74
1518E 2H-4 26-28_9	2.90	0.50	2.61	0.46	2.87	0.61	1.88	0.29	2.24	0.38	3.11	0.703	16.98	13.5	3.46
1518E 2H-4 26-28_10	1.98	0.27	1.66	0.25	1.93	0.42	1.26	0.15	1.43	0.18	1.81	0.476	10.23	8.56	2.01
1518E 3H-1 92-93_3	3.78	0.80	4.02	0.61	3.97	0.82	2.60	0.40	2.82	0.41	5.08	0.557	15.81	10.16	2.32
1518E 3H-1 92-93_4	4.38	0.92	3.80	0.71	4.16	0.85	2.61	0.43	3.03	0.49	5.40	0.464	15.94	10.67	2.31
1518E 3H-1 92-93_7	3.78	0.95	4.08	0.64	4.86	0.76	2.63	0.31	2.69	0.39	4.90	0.511	15.98	10.89	2.51
1518E 3H-1 92-93_9	3.54	0.69	2.80	0.54	3.64	0.73	1.95	0.38	2.06	0.41	4.41	0.537	18.14	8.88	2.13
1518E 3H-3 36-40_1	2.03	0.32	1.93	0.35	1.95	0.50	1.54	0.20	1.80	0.23	2.54	0.659	15.66	13.65	3.42
1518E 3H-3 36-40_2	2.43	0.34	2.07	0.29	2.05	0.45	1.25	0.19	1.41	0.32	2.44	0.539	16.68	13.16	3.25
1518E 3H-3 36-40_3	2.41	0.39	1.99	0.32	1.90	0.42	1.23	0.23	1.91	0.21	2.51	0.664	16.03	13.48	3.26
1518E 3H-3 36-40_4	2.67	0.35	2.21	0.36	2.05	0.49	1.57	0.24	1.81	0.25	2.65	0.589	16.47	14.01	3.27
1518E 3H-3 36-40_6	1.79	0.24	2.24	0.30	1.72	0.44	1.32	0.23	1.32	0.32	2.45	0.557	13.04	12.5	2.9
1518E 3H-6 16-18cm_3	2.93	0.70	3.22	0.54	3.06	0.70	1.86	0.31	2.36	0.33	4.52	0.496	11.8	7.96	1.75
1518E 3H-6 16-18cm_4	3.58	0.74	2.79	0.50	3.00	0.68	2.02	0.27	2.62	0.35	4.67	0.385	12.83	8.35	1.89
1518E 3H-6 16-18cm_5	3.77	0.87	3.00	0.46	3.16	0.72	1.91	0.29	2.60	0.57	4.47	0.688	12.23	8.22	1.78
1518E 3H-6 16-18cm_6	3.36	0.72	2.84	0.49	2.92	0.70	2.01	0.30	2.29	0.36	4.64	0.517	18.77	8.37	1.997
1518E 5H-2 66-70_3	2.59	0.52	2.30	0.32	2.18	0.52	1.53	0.22	1.63	0.27	2.33	0.47	12.63	10.45	2.45
1518E 5H-2 66-70_9	2.55	0.40	2.15	0.35	2.44	0.45	1.60	0.24	1.66	0.35	2.74	0.507	14.82	10.28	2.27
1518E 5H-2 66-70_10	2.95	0.52	2.92	0.37	2.67	0.53	1.86	0.26	1.89	0.34	2.88	0.568	16	11.81	2.92
1518E 9H-2 8-9_1	3.95	0.45	3.26	0.55	3.40	0.76	2.15	0.32	2.43	0.39	3.28	0.651	17.3	12.03	2.67
1518E 9H-2 8-9_10	5.72	0.84	4.65	0.81	5.67	1.20	3.62	0.56	3.85	0.51	5.03	0.693	19.64	13.04	2.96
1518E 24F-3 71-73_2	3.87	0.53	3.94	0.58	3.97	0.76	2.70	0.38	2.85	0.45	3.83	0.643	18.51	13.42	3.12
1518E 24F-3 71-73_4	3.44	0.56	3.17	0.56	3.76	0.68	2.16	0.34	2.57	0.42	3.28	0.598	17.3	11.83	2.69
1518E 24F-3 71-73_6	3.41	0.32	2.51	0.39	2.82	0.58	1.77	0.34	2.01	0.34	2.48	0.606	15.45	10.96	2.45
1518E 24F-3 71-73_10	4.66	0.72	5.05	0.78	4.66	1.00	3.16	0.43	3.21	0.52	5.37	0.659	22.62	12.53	3
1518E 25F-2 30-32_4	3.41	0.45	3.21	0.60	3.63	0.74	2.27	0.35	2.77	0.36	3.13	0.689	19.07	14.45	3.15
1518E 25F-2 30-32_10	8.12	1.61	8.47	1.45	10.07	2.01	6.54	0.94	6.37	0.91	8.55	0.863	17.12	10.29	2.54
1518E 25F-2 30-32_3	3.57	0.72	3.83	0.64	4.24	0.98	2.91	0.45	3.24	0.52	4.29	0.436	13.09	8.85	2.02
1518E 25F-2 30-32_6	5.16	0.96	5.18	0.82	5.31	1.13	3.29	0.47	3.63	0.54	6.52	0.581	18.58	10.12	2.38
1518E 29X-6 7-9_1	3.63	0.65	3.33	0.61	3.71	0.74	2.48	0.32	2.54	0.45	3.78	0.65	19.09	12.41	2.85
1518E 29X-6 7-9_6	3.95	0.53	3.35	0.60	3.84	0.76	2.43	0.34	2.64	0.39	3.44	0.684	17.53	12.61	2.79
1518E 29X-6 7-9_11	3.84	0.55	3.99	0.57	3.78	0.78	2.52	0.35	3.02	0.37	4.14	0.716	18.18	12.39	2.3
1518F 13R-1 113-115_1	4.61	0.66	3.87	0.67	4.32	0.84	2.64	0.38	2.78	0.46	4.20	0.576	16.46	11.64	2.99
1518F 13R-1 113-115_2	4.68	0.68	3.23	0.53	3.84	1.05	2.19	0.32	3.14	0.40	4.68	0.71	16.82	12.17	2.72
1518F 13R-1 113-115_3	3.67	0.65	3.93	0.59	3.59	0.88	2.33	0.35	2.73	0.35	3.92	0.579	14.98	11.6	2.61
1518F 13R-1 113-115_5	4.60	0.77	4.34	0.72	3.90	0.98	2.79	0.36	2.74	0.42	4.82	0.645	17.13	12.22	2.93
1518F 13R-1 113-115_6	3.86	0.67	3.13	0.59	3.79	0.76	2.21	0.37	2.34	0.42	3.82	0.554	17.96	11.04	2.83
1518F 28R-3 59-61_2	3.03	0.39	2.16	0.41	2.67	0.58	1.83	0.27	1.87	0.27	2.28	0.431	16.49	10.14	2.33
1518F 28R-3 59-61_5	3.85	0.43	3.39	0.65	3.66	0.93	2.50	0.36	2.31	0.46	2.79	0.719	19.31	15.28	3.59
1518F 28R-3 59-61_7	3.50	0.48	2.89	0.48	3.14	0.58	1.90	0.28	2.02	0.36	2.84	0.401	15.95	7.53	1.726

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s20	U1518E-1H-2_122-124-1	3.46	4.11	0.86	71.81	0.08	0.07	0.67	0.06	11.81	0.04	92.97
	U1518E-1H-2_122-124-2	3.32	3.98	0.94	71.94	0.11	0.09	0.76	0.05	12.00	0.00	93.19
	U1518E-1H-2_122-124-3	3.59	3.55	0.89	72.29	0.14	0.13	0.92	0.00	11.89	0.01	93.40
	U1518E-1H-2_122-124-4	3.43	3.80	0.90	72.58	0.12	0.06	0.78	0.00	11.96	0.00	93.63
	U1518E-1H-2_122-124-5	3.61	3.88	0.84	73.81	0.10	0.11	0.80	0.00	11.87	0.01	95.03
	U1518E-1H-2_122-124-6	3.43	3.76	0.90	73.47	0.10	0.09	0.76	0.03	12.15	0.03	94.72
	U1518E-1H-2_122-124-7	3.53	3.49	1.07	73.80	0.16	0.15	1.00	0.01	11.89	0.02	95.13
	U1518E-1H-2_122-124-8	3.39	3.65	1.13	73.80	0.14	0.12	0.95	0.09	11.79	0.00	95.05
	U1518E-1H-2_122-124-9	3.27	3.85	0.72	73.13	0.10	0.07	0.72	0.00	11.80	0.01	93.67
	U1518E-1H-2_122-124-10	3.36	3.73	1.00	72.64	0.12	0.13	0.87	0.03	11.61	0.01	93.50
	U1518E-1H-2_122-124-12	3.63	3.58	0.90	72.79	0.12	0.12	0.93	0.03	11.98	0.02	94.09
	U1518E-1H-2_122-124-13	3.68	3.91	0.86	71.35	0.09	0.09	0.70	0.03	11.82	0.02	92.55
	U1518E-1H-2_122-124-14	3.50	3.57	1.09	74.25	0.19	0.17	1.03	0.02	12.02	0.03	95.87
	U1518E-1H-2_122-124-15	3.40	3.84	1.05	73.29	0.08	0.08	0.73	0.06	11.97	0.02	94.52
	U1518E-1H-4_16-18-1	3.31	4.04	0.93	72.43	0.09	0.07	0.79	0.06	11.66	0.00	93.39
	U1518E-1H-4_16-18-2	3.16	3.81	0.92	71.14	0.07	0.13	0.74	0.00	11.72	0.04	91.73
	U1518E-1H-4_16-18-3	3.37	3.80	0.93	72.93	0.10	0.06	0.76	0.00	12.05	0.02	94.03
	U1518E-1H-4_16-18-4	3.31	3.78	0.99	71.48	0.11	0.11	0.83	0.04	11.75	0.01	92.42
	U1518E-1H-4_16-18-5	3.52	3.89	0.72	72.22	0.09	0.11	0.81	0.05	12.01	0.01	93.42
	U1518E-1H-4_16-18-6	3.45	3.85	0.86	72.81	0.09	0.08	0.76	0.09	12.07	0.02	94.08
u23	U1518E-1H-4_16-18-7	3.58	3.89	0.89	72.42	0.09	0.09	0.78	0.08	12.12	0.04	93.97
	U1518E-1H-4_16-18-8	3.34	3.83	0.96	72.11	0.09	0.06	0.78	0.08	12.00	0.02	93.27
	U1518E-1H-4_16-18-9	3.20	3.80	1.43	72.08	0.10	0.10	0.81	0.02	11.80	0.01	93.35
	U1518E-1H-4_16-18-11	3.45	3.82	0.96	71.79	0.10	0.11	0.77	0.00	12.14	0.03	93.17
	U1518E-1H-4_16-18-13	3.48	3.75	0.95	73.16	0.10	0.11	0.79	0.08	11.87	0.02	94.29
	U1518E-1H-4_16-18-14	3.36	3.77	0.99	72.14	0.10	0.07	0.78	0.05	12.07	0.00	93.34
	U1518E-1H-4_16-18-15	3.29	3.91	0.86	72.38	0.08	0.07	0.79	0.02	11.91	0.01	93.34
	1518E 1H-4 16-18_1	3.43	3.75	0.98	71.26	0.09	0.09	0.77	0.02	11.72	0.01	92.11
	1518E 1H-4 16-18_3	3.71	3.82	0.96	74.66	0.10	0.06	0.74	0.05	11.67	0.00	95.77
	1518E 1H-4 16-18_4	3.51	3.80	1.15	72.56	0.16	0.15	0.88	0.12	12.04	0.01	94.38
	1518E 1H-4 16-18_6	3.47	3.80	1.03	74.34	0.09	0.10	0.75	0.06	11.43	0.01	95.09
	1518E 1H-4 16-18_2	3.71	3.74	0.89	72.23	0.10	0.10	0.79	0.04	11.52	0.00	93.12
	1518E 1H-4 16-18_7	3.29	3.88	0.89	74.43	0.09	0.10	0.77	0.07	11.83	0.01	95.36
	1518E 1H-4 16-18_8	3.59	3.95	0.88	74.33	0.11	0.11	0.75	0.04	12.01	0.03	95.81
	1518E-1H-4_118-120-1	3.38	3.84	0.96	74.82	0.08	0.09	0.75	0.07	11.81	0.04	95.85
	1518E-1H-4_118-120-2	3.37	3.60	1.19	74.53	0.15	0.16	0.97	0.04	11.91	0.03	95.95
	1518E-1H-4_118-120-3	3.25	3.78	0.90	74.74	0.10	0.09	0.82	0.05	11.95	0.01	95.68
	1518E-1H-4_118-120-4	3.47	3.63	1.01	75.24	0.12	0.09	0.86	0.05	11.92	0.02	96.41
	1518E-1H-4_118-120-5	3.45	3.78	0.95	74.74	0.13	0.09	0.83	0.07	11.85	0.00	95.89
	1518E-1H-4_118-120-6	3.37	3.88	0.87	74.72	0.11	0.12	0.77	0.07	11.81	0.00	95.73
s23*	1518E-1H-4_118-120-7	3.27	3.69	0.89	74.73	0.13	0.10	0.76	0.03	11.80	0.03	95.42
	1518E-1H-4_118-120-8	3.40	3.84	0.86	74.54	0.10	0.06	0.80	0.08	11.75	0.03	95.46
	1518E-1H-4_118-120-9	3.44	3.70	0.93	74.66	0.15	0.15	0.84	0.00	11.79	0.03	95.69
	1518E-1H-4_118-120-10	3.43	3.90	0.80	74.89	0.13	0.11	0.79	0.07	11.97	0.03	96.12
	1518E-1H-4_118-120-11	3.37	3.85	0.83	74.97	0.11	0.09	0.80	0.07	11.90	0.01	95.99
	1518E-1H-4_118-120-12	3.37	3.79	1.10	74.61	0.09	0.07	0.82	0.02	12.10	0.01	95.98
	1518E-1H-4_118-120-13	3.21	3.71	1.04	72.21	0.15	0.11	0.93	0.00	11.19	0.07	92.62
	1518E-1H-4_118-120-14	3.11	4.13	1.00	75.24	0.12	0.07	0.80	0.09	12.01	0.03	96.60
	1518E-1H-4_118-120-15	3.52	3.88	0.95	75.02	0.07	0.11	0.79	0.03	11.78	0.01	96.16
	1518E-1H-4_118-120-16	3.38	3.84	1.01	74.83	0.10	0.10	0.77	0.01	11.91	0.00	95.95
	1518E-1H-4_118-120-17	3.40	3.86	0.84	74.69	0.11	0.07	0.77	0.02	11.76	0.00	95.53
	1518E-1H-4_118-120-18	3.48	3.73	0.98	74.53	0.11	0.09	0.86	0.04	11.74	0.00	95.57
	1518E-1H-4_118-120-19	3.38	3.85	0.90	74.81	0.09	0.08	0.78	0.08	11.91	0.04	95.93
	1518E-1H-4_118-120-20	3.49	3.86	1.09	74.93	0.09	0.09	0.82	0.01	12.09	0.00	96.46
	1518E_2H-1_136-138_1	4.26	2.93	2.26	69.67	0.35	0.49	2.21	0.11	14.48	0.09	96.85
	1518E_2H-1_136-138_2	3.26	3.67	0.85	74.15	0.10	0.11	0.87	0.03	12.03	0.01	95.09
	1518E_2H-1_136-138_3	3.48	3.51	1.23	73.97	0.15	0.12	1.06	0.02	12.43	0.02	96.00
	1518E_2H-1_136-138_4	3.68	3.54	0.86	74.48	0.10	0.10	0.83	0.04	11.95	0.02	95.59
	1518E_2H-1_136-138_5	4.00	3.27	1.53	72.04	0.18	0.21	1.31	0.10	12.81	0.05	95.50
	1518E_2H-1_136-138_6	3.74	3.22	1.72	71.40	0.19	0.17	1.39	0.01	13.14	0.03	95.00
	1518E_2H-1_136-138_7	3.68	3.76	0.93	75.19	0.06	0.11	0.84	0.03	12.12	0.02	96.74
	1518E_2H-1_136-138_8	3.99	2.77	2.74	68.80	0.37	0.56	2.42	0.08	14.32	0.03	96.07
	1518E_2H-1_136-138_9	3.69	3.31	1.46	72.26	0.14	0.17	1.35	0.04	12.69	0.03	95.13
	1518E_2H-1_136-138_10	4.08	3.04	2.01	68.97	0.32	0.29	1.94	0.05	14.24	0.06	95.00
	1518E_2H-1_136-138_11	4.34	2.85	2.64	69.52	0.39	0.54	2.27	0.06	14.30	0.05	96.96
	1518E_2H-1_136-138_12	3.76	3.27	1.62	72.08	0.17	0.15	1.37	0.08	13.03	0.01	95.53
	1518E_2H-1_136-138_13	3.99	3.10	2.03	70.21	0.29	0.37	1.87	0.09	13.66	0.06	95.67
	1518E_2H-1_136-138_14	4.02	3.10	2.09	67.38	0.27	0.33	1.86	0.10	13.63	0.05	92.83
	1518E_2H-1_136-138_15	3.33	3.65	0.83	74.58	0.11	0.10	0.81	0.06	12.24	0.00	95.71
	1518E_2H-1_136-138_16	3.60	3.35	1.45	70.67	0.16	0.15	1.27	0.08	12.73	0.02	93.48

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1518E_2H-1_136-138_17	3.80	3.27	1.58	71.45	0.17	0.22	1.43	0.12	13.29	0.00	95.33
	1518E_2H-1_136-138_18	3.47	3.71	0.88	74.98	0.09	0.11	0.81	0.11	12.14	0.00	96.31
	1518E_2H-1_136-138_19	3.79	3.24	1.49	71.48	0.20	0.18	1.34	0.06	12.82	0.00	94.60
	1518E_2H-1_136-138_20	3.58	2.98	2.08	67.20	0.30	0.30	1.89	0.05	13.18	0.04	91.60
	1518E_2H-2_67-69_1	4.23	3.18	2.33	69.89	0.29	0.27	1.54	0.06	13.67	0.02	95.48
	1518E_2H-2_67-69_2	3.30	3.52	1.36	74.23	0.14	0.10	0.95	0.11	11.87	0.02	95.60
	1518E_2H-2_67-69_3	3.26	3.07	1.17	74.76	0.16	0.19	1.29	0.09	12.03	0.00	96.03
	1518E_2H-2_67-69_4	3.16	3.35	1.16	73.17	0.10	0.11	1.20	0.09	12.02	0.01	94.37
	1518E_2H-2_67-69_6	3.51	2.99	1.28	74.69	0.14	0.13	1.19	0.09	12.10	0.01	96.13
	1518E_2H-2_67-69_7	3.64	3.85	0.95	74.59	0.08	0.10	0.78	0.05	12.22	0.00	96.25
	1518E_2H-2_67-69_8	3.87	3.49	1.26	74.03	0.12	0.12	0.90	0.06	12.16	0.01	96.02
	1518E_2H-2_67-69_9	3.56	3.35	1.43	73.73	0.17	0.10	1.03	0.07	12.11	0.01	95.56
	1518E_2H-2_67-69_10	3.83	3.27	1.61	72.20	0.19	0.19	1.46	0.08	12.74	0.02	95.58
	1518E_2H-2_67-69_11	4.01	3.25	1.66	71.89	0.21	0.17	0.96	0.11	12.04	0.03	94.34
	1518E_2H-2_67-69_13	3.14	3.71	1.11	75.81	0.12	0.08	0.85	0.06	11.91	0.01	96.79
	1518E_2H-2_67-69_14	3.91	2.42	2.80	68.33	0.38	0.65	2.67	0.04	14.34	0.01	95.56
	1518E_2H-2_67-69_15	3.56	3.95	0.84	74.29	0.12	0.08	0.76	0.05	11.94	0.00	95.60
	1518E_2H-2_67-69_16	3.96	3.31	1.57	73.46	0.21	0.16	0.97	0.00	12.18	0.01	95.84
	1518E_2H-2_67-69_17	3.68	3.38	1.48	72.41	0.20	0.19	1.49	0.01	12.86	0.02	95.71
	1518E_2H-2_67-69_18	3.86	3.44	1.49	72.91	0.09	0.12	1.13	0.07	12.58	0.01	95.69
	1518E_2H-2_67-69_19	3.39	3.36	1.15	75.33	0.09	0.13	1.05	0.00	12.17	0.00	96.68
	1518E_2H-2_67-69_20	2.92	4.86	0.86	73.78	0.00	0.03	0.71	0.04	12.23	0.00	95.43
	1518E_2H-3_23-24_1	3.82	3.39	1.42	72.83	0.20	0.20	1.33	0.00	12.61	0.02	95.82
	1518E_2H-3_23-24_2	3.22	3.42	1.21	74.36	0.17	0.11	1.10	0.02	12.39	0.00	95.99
	1518E_2H-3_23-24_3	3.06	3.50	1.00	70.68	0.09	0.08	0.72	0.10	11.16	0.02	90.40
	1518E_2H-3_23-24_4	3.63	3.34	1.37	73.16	0.18	0.17	1.23	0.06	12.63	0.04	95.80
	1518E_2H-3_23-24_5	3.44	4.03	0.83	74.18	0.07	0.06	0.79	0.00	11.98	0.03	95.42
	1518E_2H-3_23-24_6	3.40	3.47	1.09	74.45	0.12	0.07	0.94	0.05	11.75	0.03	95.37
	1518E_2H-3_23-24_7	3.86	3.36	1.53	72.76	0.16	0.20	1.28	0.00	12.48	0.00	95.63
	1518E_2H-3_23-24_8	3.29	3.88	1.00	72.39	0.13	0.09	0.99	0.02	12.13	0.07	93.99
	1518E_2H-3_23-24_9	3.56	3.24	1.41	71.90	0.17	0.18	1.44	0.00	13.02	0.02	94.94
	1518E_2H-3_23-24_10	3.76	3.22	1.69	72.67	0.19	0.19	1.40	0.06	12.74	0.01	95.93
	1518E_2H-3_23-24_11	3.79	3.34	1.66	72.16	0.21	0.24	1.60	0.09	13.27	0.00	96.36
	1518E_2H-3_23-24_12	4.02	3.35	1.89	72.99	0.17	0.10	1.00	0.04	12.72	0.04	96.32
	1518E_2H-3_23-24_13	3.76	3.39	1.76	72.40	0.21	0.25	1.56	0.06	13.30	0.05	96.74
	1518E_2H-3_23-24_15	3.60	3.29	1.47	72.04	0.19	0.21	1.41	0.04	12.82	0.05	95.12
	1518E_2H-3_23-24_16	3.38	3.27	1.45	68.62	0.18	0.22	1.32	0.09	12.19	0.03	90.74
	1518E_2H-3_23-24_18	3.64	3.69	0.99	74.48	0.10	0.06	0.79	0.04	11.91	0.00	95.70
	1518E_2H-3_23-24_19	3.53	3.35	1.44	73.50	0.18	0.17	1.25	0.09	12.68	0.02	96.21
	1518E_2H-3_23-24_20	3.85	3.26	1.51	71.82	0.19	0.21	1.41	0.08	12.98	0.00	95.32
	1518E_2H-3_33-34_2	0.31	3.79	0.04	74.49	0.10	0.01	0.95	0.00	12.22	0.00	91.91
	1518E_2H-3_33-34_3	0.09	3.38	0.02	72.82	0.12	0.01	1.26	0.01	12.35	0.00	90.06
	1518E_2H-3_33-34_4	3.62	3.42	0.00	72.78	0.20	0.19	1.30	0.00	12.42	0.02	93.96
	1518E_2H-3_33-34_5	3.59	3.41	0.00	72.52	0.18	0.20	1.29	0.02	12.55	0.03	93.79
	1518E_2H-3_33-34_6	3.41	3.47	0.87	72.71	0.18	0.17	1.24	0.01	12.54	0.02	94.64
	1518E_2H-3_33-34_7	3.40	3.84	0.99	75.16	0.10	0.14	0.84	0.02	12.12	0.02	96.63
	1518E_2H-3_33-34_8	3.82	3.35	1.54	72.13	0.23	0.20	1.44	0.08	12.80	0.02	95.61
	1518E_2H-3_33-34_9	3.89	3.31	1.55	72.66	0.19	0.20	1.41	0.06	13.17	0.02	96.46
	1518E_2H-3_33-34_10	3.67	3.30	1.46	72.60	0.18	0.16	1.36	0.03	12.83	0.00	95.58
	1518E_2H-3_33-34_11	3.52	3.38	1.41	73.00	0.19	0.18	1.28	0.02	12.20	0.03	95.21
	1518E_2H-3_33-34_12	3.15	4.56	0.86	76.22	0.10	0.06	0.50	0.04	11.17	0.00	96.65
	1518E_2H-3_33-34_13	3.46	3.88	0.96	74.29	0.12	0.07	0.74	0.04	12.04	0.03	95.63
	1518E_2H-3_33-34_14	3.80	3.33	1.44	72.95	0.20	0.16	1.32	0.11	12.83	0.02	96.17
	1518E_2H-3_33-34_15	3.93	3.36	1.42	72.80	0.18	0.24	1.38	0.11	12.86	0.00	96.29
	1518E_2H-3_33-34_16	3.64	3.44	1.60	72.59	0.19	0.27	1.50	0.07	12.97	0.01	96.28
	1518E_2H-3_33-34_17	3.22	4.25	0.98	73.49	0.07	0.04	0.55	0.04	11.74	0.01	94.38
	1518E_2H-3_33-34_18	3.77	3.29	1.56	72.82	0.20	0.24	1.38	0.08	12.79	0.02	96.14
	1518E_2H-3_33-34_19	3.71	3.41	1.52	73.27	0.21	0.18	1.31	0.01	12.54	0.01	96.17
	1518E_2H-3_69-70_1	3.88	3.39	1.66	72.75	0.10	0.04	0.98	0.08	12.32	0.02	95.23
	1518E_2H-3_69-70_2	3.51	3.80	1.02	74.88	0.07	0.07	0.77	0.03	12.16	0.00	96.32
	1518E_2H-3_69-70_4	3.65	3.86	0.93	74.27	0.08	0.10	0.78	0.00	11.87	0.02	95.57
	1518E_2H-3_69-70_5	3.35	3.12	1.04	75.78	0.12	0.15	1.26	0.04	12.24	0.00	97.10
	1518E_2H-3_69-70_6	3.39	3.83	0.97	74.59	0.09	0.09	0.78	0.06	11.99	0.03	95.83
	1518E_2H-3_69-70_7	3.32	3.06	1.02	74.95	0.14	0.16	1.23	0.05	11.87	0.05	95.85
	1518E_2H-3_69-70_8	3.45	3.83	0.91	74.95	0.07	0.06	0.74	0.06	12.03	0.01	96.11
	1518E_2H-3_69-70_9	3.52	3.89	0.83	75.02	0.08	0.09	0.77	0.00	12.00	0.00	96.20
	1518E_2H-3_69-70_10	3.44	3.90	1.00	75.11	0.09	0.07	0.78	0.00	12.08	0.01	96.47
	1518E_2H-3_69-70_11	3.35	3.90	0.81	74.47	0.11	0.06	0.82	0.03	11.98	0.03	95.56
	1518E_2H-3_69-70_12	3.44	4.24	1.08	74.62	0.12	0.10	0.75	0.06	12.12	0.00	96.54
	1518E_2H-3_69-70_13	3.49	3.64	1.12	74.87	0.10	0.09	0.90	0.05	12.10	0.01	96.37

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1518E_2H-3_69-70_14	3.28	3.94	0.89	74.84	0.10	0.08	0.79	0.04	12.15	0.00	96.11
	1518E_2H-3_69-70_15	3.47	3.84	0.89	74.49	0.07	0.06	0.76	0.06	12.08	0.04	95.75
	1518E_2H-3_69-70_16	4.29	3.57	1.79	71.98	0.10	0.07	0.89	0.03	12.83	0.03	95.59
	1518E_2H-3_69-70_17	3.40	3.29	0.90	75.05	0.11	0.14	0.96	0.05	12.07	0.01	95.98
	1518E_2H-3_69-70_18	3.33	4.03	0.99	74.08	0.08	0.07	0.74	0.01	11.88	0.00	95.21
	1518E_2H-3_69-70_19	3.23	3.90	0.86	74.38	0.05	0.03	0.75	0.06	11.91	0.04	95.21
	1518E_2H-3_69-70_20	3.45	3.95	0.94	74.64	0.09	0.11	0.77	0.09	11.83	0.01	95.86
s23*	U1518E-2H-4_26-28-1	3.30	3.92	0.95	74.61	0.09	0.11	0.95	0.04	12.03	0.01	96.01
	U1518E-2H-4_26-28-2	3.22	3.60	0.95	73.44	0.12	0.09	0.85	0.00	11.96	0.00	94.24
	U1518E-2H-4_26-28-3	3.46	3.65	1.06	72.97	0.09	0.09	0.92	0.02	12.10	0.01	94.38
	U1518E-2H-4_26-28-4	3.42	3.64	1.04	74.58	0.11	0.14	0.92	0.04	12.10	0.01	95.99
	U1518E-2H-4_26-28-5	3.30	3.62	0.85	72.69	0.08	0.05	0.87	0.00	11.97	0.00	93.43
	U1518E-2H-4_26-28-6	3.66	3.66	1.03	72.58	0.08	0.09	0.95	0.11	11.93	0.03	94.12
	U1518E-2H-4_26-28-7	3.45	3.51	1.06	73.89	0.09	0.11	0.92	0.08	12.08	0.00	95.18
	U1518E-2H-4_26-28-8	3.47	3.58	1.02	73.77	0.12	0.12	0.95	0.05	12.10	0.02	95.20
	U1518E-2H-4_26-28-9	3.37	3.82	1.03	71.42	0.07	0.07	0.88	0.10	11.89	0.04	92.69
	U1518E-2H-4_26-28-10	3.42	3.59	1.09	72.32	0.09	0.08	0.92	0.02	11.82	0.00	93.35
	U1518E-2H-4_26-28-11	3.47	3.63	0.98	74.12	0.12	0.07	0.93	0.01	12.03	0.00	95.36
	U1518E-2H-4_26-28-12	3.57	3.63	1.08	74.01	0.11	0.11	0.83	0.15	11.98	0.02	95.49
	U1518E-2H-4_26-28-13	3.40	3.72	0.94	74.27	0.09	0.12	0.90	0.05	11.94	0.02	95.46
	U1518E-2H-4_26-28-14	3.34	3.12	1.10	73.90	0.13	0.13	1.15	0.02	12.07	0.00	94.96
	U1518E-2H-4_26-28-15	3.35	3.60	0.96	72.71	0.09	0.08	0.69	0.08	11.45	0.02	93.02
	1518E 2H-4 26-28_2	3.61	3.47	1.05	73.47	0.10	0.11	0.89	0.00	11.49	0.00	94.19
	1518E 2H-4 26-28_7	3.66	3.66	1.04	74.68	0.10	0.05	0.94	0.04	11.71	0.02	95.91
	1518E 2H-4 26-28_9	4.00	3.27	0.70	74.88	0.08	0.11	1.05	0.04	12.21	0.02	96.37
	1518E 2H-4 26-28_10	3.44	3.63	1.04	75.03	0.09	0.10	0.92	0.02	11.92	0.02	96.22
	1518E 2H-4 26-28_3	3.66	3.65	0.95	74.41	0.12	0.08	0.90	0.00	11.69	0.00	95.46
	1518E 2H-4 26-28_4	3.60	3.56	1.07	73.89	0.13	0.10	0.97	0.10	11.68	0.00	95.10
	1518E 2H-4 26-28_5	3.17	3.61	0.92	71.07	0.11	0.08	0.89	0.10	10.97	0.00	90.91
	1518E 2H-4 26-28_6	3.57	3.59	0.85	74.27	0.09	0.08	0.91	0.01	11.62	0.03	95.02
	1518E 2H-4 26-28_8	3.64	3.66	1.07	75.04	0.10	0.09	0.95	0.08	11.73	0.00	96.37
u25	U1518E-2H-6_109-111-1	3.65	2.77	1.88	68.83	0.26	0.30	2.03	0.05	13.35	0.04	93.16
	U1518E-2H-6_109-111-2	3.72	2.66	1.96	68.28	0.24	0.31	1.98	0.05	13.27	0.03	92.50
	U1518E-2H-6_109-111-3	3.88	2.66	1.81	69.86	0.26	0.31	1.97	0.00	13.27	0.04	94.06
	U1518E-2H-6_109-111-5	3.79	2.57	1.82	68.88	0.24	0.33	1.96	0.07	13.60	0.02	93.29
	U1518E-2H-6_109-111-7	3.92	2.65	1.82	68.74	0.25	0.32	1.97	0.09	13.28	0.02	93.06
	U1518E-2H-6_109-111-8	3.98	2.66	1.93	68.76	0.26	0.32	2.04	0.05	13.35	0.05	93.40
	U1518E-2H-6_109-111-10	4.13	2.63	1.71	69.23	0.25	0.31	2.05	0.09	13.24	0.03	93.68
	U1518E-2H-6_109-111-11	3.73	2.70	1.87	69.14	0.26	0.30	1.92	0.09	13.27	0.02	93.28
	U1518E-2H-6_109-111-13	3.78	2.62	1.87	68.55	0.23	0.34	1.97	0.06	13.51	0.01	92.94
	U1518E-2H-6_109-111-14	3.68	2.70	1.71	69.42	0.27	0.36	2.02	0.07	13.42	0.00	93.65
	U1518E-2H-6_109-111-15	3.64	2.71	1.74	70.19	0.24	0.20	1.83	0.02	13.27	0.03	93.87
u26	U1518E-3H-1_73-75-1	3.61	3.11	1.39	69.77	0.25	0.27	1.53	0.05	12.97	0.07	93.02
	U1518E-3H-1_73-75-2	3.77	3.05	1.62	69.47	0.25	0.27	1.61	0.04	12.93	0.02	93.04
	U1518E-3H-1_73-75-3	3.51	2.84	1.67	68.68	0.30	0.40	1.94	0.07	13.48	0.04	92.93
	U1518E-3H-1_73-75-4	3.56	2.99	1.41	69.79	0.26	0.23	1.53	0.01	13.00	0.04	92.83
	U1518E-3H-1_73-75-6	3.71	3.05	1.52	70.01	0.27	0.28	1.61	0.08	12.92	0.01	93.47
	U1518E-3H-1_73-75-10	3.72	2.97	1.48	69.07	0.30	0.26	1.73	0.00	12.92	0.00	92.44
	U1518E-3H-1_73-75-11	3.71	3.01	1.41	69.51	0.26	0.19	1.60	0.07	13.05	0.00	92.82
	U1518E-3H-1_73-75-12	3.40	3.17	1.44	69.98	0.25	0.27	1.55	0.04	12.78	0.03	92.90
	U1518E-3H-1_73-75-13	3.65	2.94	1.59	70.41	0.25	0.30	1.77	0.06	13.06	0.03	94.05
	U1518E-3H-1_73-75-14	3.56	3.04	1.46	70.77	0.23	0.29	1.61	0.03	12.89	0.04	93.93
	U1518E-3H-1_73-75-15	3.81	3.00	1.27	70.57	0.25	0.35	1.59	0.11	12.79	0.00	93.73
s24*	U1518E-3H-1_92-93-1	3.60	3.12	1.25	71.33	0.11	0.13	1.24	0.07	12.06	0.01	92.91
	U1518E-3H-1_92-93-2	3.65	2.83	1.33	71.15	0.17	0.13	1.54	0.07	12.79	0.01	93.66
	U1518E-3H-1_92-93-3	3.55	2.88	1.56	70.18	0.19	0.19	1.58	0.10	12.31	0.03	92.57
	U1518E-3H-1_92-93-4	3.48	2.87	1.64	70.48	0.20	0.24	1.67	0.00	12.46	0.01	93.05
	U1518E-3H-1_92-93-5	3.55	2.94	1.35	70.17	0.16	0.23	1.45	0.08	12.28	0.01	92.23
	U1518E-3H-1_92-93-6	3.78	2.87	1.54	70.04	0.19	0.25	1.65	0.02	12.52	0.02	92.88
	U1518E-3H-1_92-93-7	3.55	3.02	1.48	71.23	0.14	0.18	1.36	0.01	12.40	0.01	93.38
	U1518E-3H-1_92-93-8	3.15	3.00	1.83	70.02	0.34	0.32	1.27	0.08	11.71	0.07	91.80
	U1518E-3H-1_92-93-10	3.61	2.98	1.47	70.48	0.22	0.20	1.42	0.01	12.30	0.00	92.69
	U1518E-3H-1_92-93-11	3.67	3.01	1.32	72.00	0.16	0.18	1.34	0.10	12.31	0.00	94.08
	U1518E-3H-1_92-93-12	3.56	3.00	1.39	72.02	0.16	0.16	1.33	0.03	12.37	0.01	94.02
	U1518E-3H-1_92-93-14	3.36	3.00	1.50	71.11	0.15	0.15	1.43	0.03	12.34	0.02	93.09
	U1518E-3H-1_92-93-15	3.63	2.94	1.55	71.13	0.21	0.22	1.56	0.02	12.71	0.03	93.99
	1518E 3H-1 92-93_3	3.82	3.01	1.49	73.66	0.20	0.17	1.49	0.07	12.41	0.00	96.32
	1518E 3H-1 92-93_4	3.73	2.97	1.75	71.84	0.21	0.19	1.55	0.08	12.27	0.01	94.60
	1518E 3H-1 92-93_7	3.45	3.00	1.62	72.59	0.13	0.17	1.45	0.08	11.91	0.03	94.44
	1518E 3H-1 92-93_9	3.78	2.97	1.47	71.03	0.18	0.16	1.53	0.08	12.10	0.05	93.34

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s30	1518E-3H-1 92-93_8	3.64	2.93	1.50	71.91	0.18	0.17	1.54	0.03	12.51	0.01	94.43
	1518E-3H-1 92-93_2	3.52	2.97	1.40	72.23	0.14	0.10	1.31	0.04	12.24	0.01	93.96
	1518E-3H-1_130-134-1	3.36	3.82	0.91	74.67	0.09	0.10	0.82	0.03	11.93	0.00	95.71
	1518E-3H-1_130-134-2	3.81	3.08	1.60	71.59	0.26	0.24	1.72	0.04	12.84	0.03	95.21
	1518E-3H-1_130-134-3	3.52	3.84	0.88	73.93	0.10	0.11	0.84	0.08	12.18	0.00	95.47
	1518E-3H-1_130-134-4	3.65	3.17	1.83	68.34	0.29	0.34	1.34	0.08	12.40	0.01	91.45
	1518E-3H-1_130-134-5	4.18	3.02	1.84	72.16	0.26	0.29	1.34	0.09	12.58	0.00	95.76
	1518E-3H-1_130-134-6	3.50	3.88	0.93	74.76	0.09	0.09	0.79	0.06	12.05	0.00	96.15
	1518E-3H-1_130-134-7	3.53	3.69	0.93	74.84	0.09	0.14	0.86	0.03	12.08	0.00	96.19
	1518E-3H-1_130-134-8	3.53	3.70	1.59	71.73	0.22	0.14	1.05	0.03	12.39	0.02	94.40
	1518E-3H-1_130-134-9	3.29	3.47	0.95	74.35	0.12	0.15	1.05	0.03	11.87	0.03	95.30
	1518E-3H-1_130-134-10	3.79	3.63	0.93	74.13	0.14	0.11	0.83	0.00	12.03	0.01	95.60
	1518E-3H-1_130-134-11	3.25	4.16	0.90	74.17	0.07	0.07	0.85	0.03	12.00	0.01	95.51
	1518E-3H-1_130-134-12	3.50	3.57	0.98	73.81	0.08	0.13	0.83	0.07	11.77	0.02	94.76
	1518E-3H-1_130-134-13	3.47	3.67	1.22	73.40	0.14	0.21	0.98	0.00	12.10	0.02	95.20
	1518E-3H-1_130-134-14	3.52	3.43	1.68	71.75	0.20	0.13	1.17	0.07	12.60	0.00	94.55
	1518E-3H-1_130-134-16	3.56	3.70	0.88	74.77	0.10	0.13	0.83	0.04	11.99	0.00	96.00
	1518E-3H-1_130-134-17	4.12	3.37	1.19	73.41	0.14	0.08	0.87	0.02	12.34	0.00	95.55
	1518E-3H-1_130-134-18	3.04	3.40	0.93	68.96	0.10	0.10	0.74	0.01	10.90	0.01	88.20
	1518E-3H-1_130-134-19	3.70	3.76	0.93	74.70	0.11	0.08	0.84	0.00	11.93	0.00	96.04
	1518E-3H-1_130-134-20	3.62	3.63	1.14	74.53	0.11	0.09	0.74	0.01	11.79	0.01	95.67
	U1518E-3H-3_36-40-1	3.54	3.66	1.07	72.13	0.08	0.10	0.87	0.09	12.01	0.01	93.55
	U1518E-3H-3_36-40-2	3.30	3.83	1.01	72.92	0.11	0.11	0.88	0.08	11.90	0.00	94.15
	U1518E-3H-3_36-40-4	3.29	3.66	0.95	72.55	0.08	0.10	0.84	0.00	11.98	0.04	93.49
	U1518E-3H-3_36-40-5	3.59	3.67	0.88	72.24	0.10	0.06	0.87	0.02	12.07	0.02	93.52
	U1518E-3H-3_36-40-6	3.43	3.65	0.98	73.82	0.08	0.10	0.84	0.06	12.18	0.03	95.18
	U1518E-3H-3_36-40-7	3.53	3.87	0.93	74.39	0.12	0.11	0.85	0.08	12.11	0.03	96.02
	U1518E-3H-3_36-40-8	3.37	3.79	0.80	72.75	0.10	0.09	0.85	0.02	12.10	0.01	93.87
	U1518E-3H-3_36-40-9	3.64	3.61	0.97	72.73	0.11	0.11	0.86	0.05	12.02	0.03	94.12
	U1518E-3H-3_36-40-10	3.47	3.56	0.88	71.45	0.10	0.08	0.87	0.07	11.84	0.04	92.36
	U1518E-3H-3_36-40-11	3.63	3.59	0.98	70.92	0.08	0.12	0.84	0.05	12.08	0.01	92.32
	U1518E-3H-3_36-40-12	3.68	3.45	0.88	73.23	0.13	0.09	0.85	0.04	12.18	0.02	94.54
	U1518E-3H-3_36-40-13	3.70	3.75	0.88	73.11	0.13	0.10	0.81	0.04	12.07	0.05	94.63
	U1518E-3H-3_36-40-14	3.47	3.79	0.93	74.09	0.09	0.10	0.84	0.08	12.00	0.01	95.40
	U1518E-3H-3_36-40-15	3.54	3.65	0.97	72.72	0.09	0.09	0.83	0.00	12.36	0.00	94.26
s33	1518E-3H-3 36-40_1	3.89	3.52	1.15	73.31	0.07	0.11	0.88	0.03	11.72	0.00	94.68
	1518E-3H-3 36-40_2	3.57	3.73	0.93	74.67	0.11	0.11	0.84	0.04	11.80	0.00	95.79
	1518E-3H-3 36-40_3	3.52	3.61	0.98	74.71	0.13	0.12	0.84	0.05	11.55	0.01	95.51
	1518E-3H-3 36-40_4	3.64	3.59	0.89	72.93	0.08	0.10	0.87	0.08	11.88	0.00	94.06
	1518E-3H-3 36-40_6	3.52	3.85	0.97	73.86	0.08	0.08	0.83	0.04	11.83	0.00	95.06
	1518E-3H-3 36-40_7	3.53	3.73	0.93	72.77	0.10	0.13	0.83	0.06	12.38	0.00	94.46
	1518E-3H-3 36-40_8	3.60	3.73	0.73	74.03	0.10	0.10	0.83	0.03	11.85	0.00	95.01
	1518E-3H-3 36-40_9	3.78	3.63	0.91	73.60	0.08	0.10	0.88	0.04	11.69	0.00	94.72
	1518E-3H-3 36-40_10	3.62	3.58	1.05	73.44	0.08	0.09	0.81	0.05	11.95	0.01	94.68
	1518E-3H-3 36-40_11	3.64	3.76	0.97	74.43	0.11	0.10	0.81	0.10	12.21	0.01	96.15
	1518E-3H-3 36-40_12	3.52	3.63	0.99	74.10	0.08	0.12	0.82	0.07	11.82	0.02	95.17
	1518E-3H-3 36-40_13	3.48	3.66	0.97	74.27	0.08	0.10	0.84	0.00	11.82	0.03	95.25
	1518E-3H-3 36-40_15	3.29	3.73	0.99	73.37	0.10	0.07	0.87	0.00	11.91	0.01	94.33
	1518E-3H-3 36-40_5	3.56	3.73	0.85	73.57	0.08	0.07	0.82	0.06	11.51	0.03	94.29
	U1518E-3H-4_93-95-1	3.32	3.81	1.04	74.30	0.09	0.13	1.01	0.00	12.11	0.01	95.82
	U1518E-3H-4_93-95-2	3.45	3.85	0.86	73.14	0.05	0.03	0.73	0.00	12.14	0.00	94.25
	U1518E-3H-4_93-95-3	3.31	3.71	0.81	73.86	0.08	0.09	0.82	0.04	12.03	0.00	94.76
	U1518E-3H-4_93-95-4	3.26	3.79	0.91	72.91	0.09	0.08	0.81	0.03	12.08	0.00	93.96
	U1518E-3H-4_93-95-5	3.24	3.95	0.90	72.65	0.06	0.05	0.82	0.02	12.02	0.02	93.74
	U1518E-3H-4_93-95-6	3.56	3.93	0.94	72.75	0.11	0.09	0.81	0.00	12.15	0.00	94.34
	U1518E-3H-4_93-95-7	3.39	3.64	1.00	71.03	0.09	0.06	0.75	0.04	11.90	0.05	91.95
	U1518E-3H-4_93-95-8	3.20	3.61	1.06	73.23	0.11	0.12	1.06	0.01	11.94	0.00	94.34
	U1518E-3H-4_93-95-9	3.35	3.92	0.89	74.25	0.09	0.08	0.85	0.08	12.19	0.00	95.69
	U1518E-3H-4_93-95-10	3.49	3.89	0.87	72.74	0.11	0.09	0.95	0.02	12.09	0.04	94.30
	U1518E-3H-4_93-95-11	3.33	3.79	1.00	71.41	0.06	0.07	0.79	0.05	11.99	0.01	92.51
	U1518E-3H-4_93-95-12	3.37	3.82	0.93	72.77	0.11	0.09	0.84	0.04	12.11	0.02	94.10
	U1518E-3H-4_93-95-13	3.05	3.89	1.00	72.16	0.06	0.08	0.85	0.08	12.02	0.04	93.23
	U1518E-3H-4_93-95-14	3.19	3.97	0.89	71.81	0.09	0.10	0.81	0.04	11.88	0.00	92.78
	U1518E-3H-4_93-95-15	3.29	3.89	0.99	72.07	0.09	0.06	0.81	0.03	11.97	0.02	93.22
	U1518E-3H-6_16-18-1	3.60	2.70	1.57	69.73	0.21	0.25	1.81	0.12	12.96	0.04	92.99
	U1518E-3H-6_16-18-2	3.53	2.62	1.71	69.91	0.17	0.28	1.92	0.10	12.87	0.00	93.10
	U1518E-3H-6_16-18-3	3.84	2.63	1.81	69.52	0.19	0.30	1.85	0.00	13.00	0.02	93.16
	U1518E-3H-6_16-18-4	3.82	2.61	1.63	68.62	0.22	0.33	1.89	0.08	12.97	0.00	92.17
	U1518E-3H-6_16-18-6	3.76	2.58	1.72	69.04	0.21	0.30	1.93	0.02	13.15	0.04	92.75
	U1518E-3H-6_16-18-7	3.75	2.67	1.73	69.19	0.20	0.31	1.84	0.08	13.04	0.01	92.83

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	U1518E-3H-6_16-18-8	3.55	2.62	1.78	68.47	0.24	0.25	1.90	0.10	12.84	0.01	91.76
	U1518E-3H-6_16-18-9	3.87	2.65	1.87	69.91	0.19	0.27	1.92	0.06	12.98	0.01	93.74
	U1518E-3H-6_16-18-10	3.72	2.62	1.75	69.04	0.26	0.27	1.96	0.08	13.11	0.03	92.84
	U1518E-3H-6_16-18-12	3.41	2.62	1.89	68.74	0.22	0.36	2.01	0.06	13.27	0.04	92.62
	U1518E-3H-6_16-18-13	3.61	2.62	1.79	69.42	0.20	0.24	1.87	0.00	13.04	0.01	92.81
	U1518E-3H-6_16-18-14	4.46	3.95	1.24	72.75	0.08	0.01	0.77	0.08	13.75	0.01	97.10
	1518E_3H-6 16-18cm_3	3.71	2.65	1.62	72.30	0.18	0.25	1.73	0.09	12.82	0.04	95.39
	1518E_3H-6 16-18cm_4	3.88	2.64	1.66	72.62	0.21	0.25	1.76	0.00	12.74	0.04	95.80
	1518E_3H-6 16-18cm_5	3.40	2.65	1.89	72.24	0.21	0.26	1.81	0.02	13.07	0.05	95.60
	1518E_3H-6 16-18cm_6	3.72	2.73	1.77	72.73	0.23	0.27	1.80	0.12	12.96	0.04	96.37
	1518E_5H-1_34-36_2	3.35	3.31	0.48	74.46	0.00	0.12	0.99	0.02	11.93	0.01	94.68
	1518E_5H-1_34-36_3	3.46	3.53	0.89	74.08	0.00	0.06	0.91	0.02	12.14	0.00	95.09
	1518E_5H-1_34-36_6	3.61	3.66	1.02	74.70	0.09	0.10	0.84	0.08	12.14	0.00	96.24
	1518E_5H-1_34-36_7	3.16	3.42	0.99	70.55	0.11	0.08	0.94	0.01	11.30	0.02	90.60
	1518E_5H-1_34-36_8	3.38	3.75	1.16	74.08	0.08	0.12	0.83	0.03	12.09	0.02	95.54
	1518E_5H-1_34-36_9	3.61	3.84	0.94	74.68	0.09	0.08	0.88	0.02	12.18	0.00	96.32
	1518E_5H-1_34-36_10	3.39	3.69	1.02	74.03	0.10	0.12	0.87	0.00	12.03	0.00	95.24
	1518E_5H-1_34-36_11	3.38	3.70	0.82	74.08	0.11	0.11	0.84	0.02	11.93	0.02	95.01
	1518E_5H-1_34-36_12	3.19	3.84	0.89	74.20	0.11	0.07	0.86	0.00	11.97	0.00	95.13
	1518E_5H-1_34-36_13	3.37	3.77	0.91	74.54	0.11	0.14	0.86	0.05	12.37	0.01	96.13
	1518E_5H-1_34-36_14	3.50	3.82	0.99	74.15	0.10	0.07	0.85	0.02	12.11	0.03	95.62
	1518E_5H-1_34-36_15	3.39	3.53	1.11	73.48	0.14	0.16	0.98	0.02	12.15	0.05	94.99
	1518E_5H-1_34-36_16	3.29	3.06	1.12	73.94	0.13	0.18	1.30	0.13	11.78	0.00	94.92
	1518E_5H-1_34-36_17	3.56	3.75	0.99	73.93	0.08	0.09	0.82	0.03	12.09	0.02	95.37
	1518E_5H-1_34-36_18	3.41	3.38	0.96	74.36	0.10	0.11	0.99	0.00	11.90	0.03	95.25
	1518E_5H-1_34-36_19	3.55	3.69	0.91	74.11	0.09	0.14	0.84	0.06	12.17	0.02	95.58
	1518E_5H-1_34-36_20	3.31	3.04	1.24	74.13	0.17	0.21	1.28	0.09	11.86	0.00	95.34
	1518E-5H-2_18-20-1	3.32	3.12	1.11	74.07	0.11	0.16	1.21	0.00	12.13	0.05	95.29
	1518E-5H-2_18-20-2	3.43	3.39	0.97	74.51	0.11	0.13	1.01	0.03	11.78	0.00	95.35
	1518E-5H-2_18-20-3	3.51	3.76	0.89	73.72	0.11	0.14	0.84	0.04	11.93	0.01	94.94
	1518E-5H-2_18-20-4	3.38	3.08	1.13	74.54	0.16	0.17	1.26	0.00	12.00	0.01	95.73
	1518E-5H-2_18-20-5	3.30	3.09	1.04	74.34	0.15	0.17	1.27	0.02	11.91	0.02	95.32
	1518E-5H-2_18-20-6	3.11	3.12	1.08	73.50	0.14	0.17	1.23	0.08	11.40	0.02	93.87
	1518E-5H-2_18-20-8	3.59	3.33	1.08	74.78	0.12	0.12	1.04	0.04	11.86	0.00	95.95
	1518E-5H-2_18-20-9	3.45	3.63	0.96	74.45	0.13	0.09	0.85	0.04	12.01	0.00	95.61
	1518E-5H-2_18-20-10	3.49	3.31	0.84	73.82	0.14	0.10	1.02	0.02	11.85	0.00	94.58
	1518E-5H-2_18-20-11	3.40	3.37	0.98	74.39	0.07	0.13	1.03	0.02	11.90	0.02	95.32
	1518E-5H-2_18-20-12	3.58	3.28	0.99	74.22	0.12	0.09	1.00	0.00	11.83	0.03	95.14
	1518E-5H-2_18-20-13	3.52	3.44	1.10	73.03	0.14	0.10	0.98	0.04	11.72	0.07	94.13
	1518E-5H-2_18-20-14	3.47	3.35	1.07	74.92	0.13	0.14	0.99	0.04	12.04	0.05	96.20
	1518E-5H-2_18-20-15	3.64	3.55	1.09	74.06	0.09	0.12	0.85	0.10	12.10	0.00	95.60
	1518E-5H-2_18-20-16	3.56	3.66	0.90	75.14	0.11	0.08	0.87	0.04	11.93	0.00	96.29
	1518E-5H-2_18-20-17	3.72	3.32	1.01	74.86	0.15	0.10	0.95	0.05	11.98	0.00	96.13
	1518E-5H-2_18-20-19	3.69	3.62	0.93	74.25	0.09	0.10	0.85	0.01	12.17	0.00	95.71
	1518E-5H-2_18-20-20	3.23	2.99	1.23	74.08	0.17	0.21	1.27	0.05	11.76	0.00	94.98
s36	U1518E-5H-2_66-70-1	3.46	3.63	0.94	72.25	0.07	0.11	0.86	0.02	12.29	0.00	93.64
	U1518E-5H-2_66-70-2	3.54	3.49	0.99	71.39	0.08	0.11	0.95	0.05	12.05	0.00	92.65
	U1518E-5H-2_66-70-3	3.37	3.54	0.89	71.83	0.11	0.06	0.93	0.05	11.98	0.02	92.77
	U1518E-5H-2_66-70-4	3.45	3.31	1.07	71.71	0.09	0.13	1.04	0.04	11.96	0.02	92.81
	U1518E-5H-2_66-70-5	3.42	3.10	1.06	72.17	0.14	0.18	1.23	0.10	12.08	0.02	93.50
	U1518E-5H-2_66-70-6	3.28	3.92	0.81	71.53	0.05	0.04	0.86	0.02	11.86	0.02	92.38
	U1518E-5H-2_66-70-7	3.44	3.66	0.96	71.37	0.08	0.08	0.84	0.06	12.11	0.00	92.60
	U1518E-5H-2_66-70-8	3.36	3.11	1.20	71.35	0.12	0.17	1.34	0.02	12.00	0.02	92.70
	U1518E-5H-2_66-70-9	3.44	3.58	1.07	72.22	0.09	0.11	1.00	0.04	12.08	0.00	93.63
	U1518E-5H-2_66-70-10	3.19	3.14	1.05	71.52	0.14	0.18	1.24	0.07	11.84	0.00	92.37
	U1518E-5H-2_66-70-11	3.33	3.49	1.05	70.87	0.11	0.12	0.94	0.05	11.93	0.00	91.88
	U1518E-5H-2_66-70-12	3.39	3.29	1.03	71.33	0.10	0.09	1.02	0.00	12.04	0.00	92.29
	U1518E-5H-2_66-70-13	3.47	3.26	1.02	71.77	0.11	0.12	1.04	0.10	11.75	0.04	92.67
	U1518E-5H-2_66-70-14	3.50	3.73	0.99	72.44	0.10	0.10	0.83	0.03	12.17	0.00	93.90
	U1518E-5H-2_66-70-15	3.14	3.98	0.91	70.42	0.08	0.07	0.72	0.05	11.87	0.00	91.24
	1518E 5H-2 66-70_4	3.24	3.27	1.05	73.80	0.15	0.15	1.06	0.03	11.57	0.00	94.32
	1518E 5H-2 66-70_5	3.72	3.57	0.96	73.64	0.07	0.10	0.84	0.05	11.86	0.04	94.85
	1518E 5H-2 66-70_6	3.59	3.71	0.97	74.20	0.07	0.04	0.84	0.00	11.99	0.01	95.42
	1518E 5H-2 66-70_7	3.36	3.30	1.08	73.84	0.14	0.13	0.97	0.01	11.93	0.00	94.76
	1518E 5H-2 66-70_8	3.33	3.46	1.08	73.83	0.11	0.09	0.96	0.02	11.81	0.00	94.69
	1518E 5H-2 66-70_3	3.43	3.45	1.00	73.93	0.12	0.11	0.96	0.03	11.82	0.01	94.86
	1518E 5H-2 66-70_9	3.27	3.51	0.97	73.81	0.10	0.14	1.01	0.02	11.50	0.03	94.37
	1518E 5H-2 66-70_10	3.59	3.31	0.95	74.69	0.13	0.17	1.02	0.12	11.75	0.00	95.72
	1518E-5H-3_108-110_1	3.46	3.87	0.93	74.08	0.09	0.10	0.87	0.12	11.73	0.00	95.24
	1518E-5H-3_108-110_2	3.31	4.16	1.12	75.27	0.08	0.08	0.79	0.00	12.18	0.02	97.01

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1518E-5H-3_108-110_3	4.19	2.96	1.73	71.03	0.20	0.19	1.15	0.00	12.88	0.02	94.35
	1518E-5H-3_108-110_4	3.49	3.64	0.98	74.00	0.07	0.08	0.87	0.06	12.12	0.00	95.31
	1518E-5H-3_108-110_6	3.41	3.64	1.02	74.06	0.11	0.09	0.89	0.08	12.04	0.01	95.35
	1518E-5H-3_108-110_7	0.00	3.75	1.10	73.61	0.11	0.01	0.89	0.08	11.74	0.01	91.30
	1518E-5H-3_108-110_9	3.26	3.08	1.23	74.40	0.17	0.14	1.27	0.01	11.96	0.03	95.54
	1518E-5H-3_108-110_10	3.70	3.60	1.65	71.73	0.10	0.05	1.06	0.09	12.07	0.02	94.06
	1518E_6H-2_103-105_1	3.47	3.65	1.25	75.57	0.11	0.09	1.03	0.02	12.11	0.01	97.32
	1518E_6H-2_103-105_2	3.62	2.86	1.29	72.51	0.18	0.17	1.24	0.06	12.26	0.05	94.25
	1518E_6H-2_103-105_3	4.02	3.85	1.72	72.50	0.13	0.07	0.86	0.04	12.85	0.03	96.07
	1518E_6H-2_103-105_4	3.56	3.87	1.69	73.96	0.10	0.09	0.92	0.06	11.64	0.00	95.89
	1518E_6H-2_103-105_5	3.32	4.06	0.93	74.52	0.10	0.09	0.76	0.00	11.71	0.01	95.51
	1518E_6H-2_103-105_6	3.57	2.93	1.19	70.44	0.16	0.35	1.74	0.10	13.42	0.04	93.93
	1518E_6H-2_103-105_9	0.00	4.10	0.85	74.63	0.13	0.00	0.95	0.01	12.04	0.02	92.74
	1518E_6H-2_103-105_10	3.57	2.87	1.38	73.93	0.12	0.09	1.22	0.07	12.03	0.00	95.27
	1518E_6H-2_103-105_11	0.00	3.34	1.45	73.99	0.18	0.00	0.86	0.09	11.46	0.02	91.39
	1518E_6H-2_103-105_12	0.00	3.67	0.00	74.53	0.13	0.00	1.01	0.00	12.13	0.01	91.49
	1518E_6H-2_103-105_13	0.00	3.70	0.03	74.64	0.10	0.00	0.95	0.00	11.74	0.03	91.19
	1518E_6H-2_103-105_15	3.39	3.72	1.06	75.04	0.09	0.15	1.00	0.05	12.03	0.00	96.54
	1518E_6H-2_103-105_16	3.55	3.74	1.13	75.59	0.09	0.07	0.88	0.02	12.15	0.01	97.22
	1518E_6H-2_103-105_17	3.92	3.10	1.74	72.86	0.10	0.04	0.97	0.04	11.99	0.01	94.76
	1518E_6H-2_103-105_18	3.90	3.28	1.46	72.57	0.17	0.12	1.09	0.05	12.34	0.03	95.01
	1518E_6H-2_103-105_19	3.51	3.80	1.14	75.75	0.11	0.09	0.81	0.04	12.08	0.00	97.32
	1518E_6H-2_103-105_20	4.19	3.21	1.92	72.93	0.18	0.09	1.05	0.09	12.88	0.02	96.55
	1518E-7H-2_13-14-1	3.90	3.62	1.50	71.48	0.17	0.15	0.98	0.09	12.47	0.00	94.36
	1518E-7H-2_13-14-2	3.27	3.67	1.13	73.76	0.11	0.11	1.03	0.02	11.85	0.00	94.95
	1518E_7H-3_8-9_1	3.25	3.40	1.44	72.43	0.11	0.13	1.34	0.04	12.18	0.00	94.32
	1518E_7H-3_8-9_3	4.16	3.48	1.89	71.41	0.14	0.11	1.00	0.08	12.36	0.01	94.63
	1518E_7H-3_8-9_4	3.69	3.71	1.49	71.32	0.10	0.02	0.59	0.09	11.56	0.00	92.57
	1518E_7H-3_8-9_6	3.42	3.88	1.44	72.09	0.13	0.08	0.97	0.01	12.32	0.03	94.37
	1518E_7H-3_8-9_7	3.33	3.41	1.15	74.26	0.12	0.13	1.01	0.10	12.18	0.01	95.69
	1518E_7H-3_8-9_8	3.74	3.36	1.01	73.77	0.14	0.12	0.80	0.11	12.00	0.01	95.05
	1518E_7H-3_8-9_9	3.23	3.77	1.03	74.29	0.14	0.16	0.98	0.00	11.69	0.02	95.30
	1518E_7H-3_8-9_11	4.65	3.09	2.51	69.49	0.23	0.18	1.45	0.10	13.89	0.08	95.68
	1518E_7H-3_8-9_12	4.01	3.31	1.44	72.22	0.11	0.11	0.96	0.11	12.52	0.03	94.81
	1518E_7H-3_8-9_13	3.84	3.17	1.41	73.44	0.19	0.14	0.92	0.13	12.56	0.02	95.82
	1518E_7H-3_8-9_14	3.79	3.40	1.61	72.99	0.15	0.12	0.95	0.04	12.35	0.02	95.42
	1518E_7H-3_8-9_15	3.89	3.26	1.49	73.29	0.21	0.16	0.93	0.10	12.30	0.04	95.67
	1518E_7H-3_8-9_16	3.60	3.23	1.57	70.96	0.19	0.16	1.24	0.03	12.77	0.04	93.78
	1518E_7H-3_8-9_17	3.63	3.12	1.30	72.34	0.18	0.23	1.42	0.00	12.88	0.05	95.14
	1518E_7H-3_8-9_18	3.40	3.72	1.11	73.21	0.09	0.08	0.94	0.07	11.86	0.00	94.48
	1518E_7H-3_8-9_19	4.17	3.44	2.14	69.70	0.23	0.29	1.73	0.07	13.99	0.02	95.78
	1518E_7H-3_8-9_20	3.46	3.81	0.90	74.12	0.05	0.06	1.09	0.00	12.24	0.00	95.72
s37	1518E-9H-2_0-1-1	3.37	4.08	1.06	73.57	0.11	0.06	0.72	0.00	11.86	0.02	94.85
	1518E-9H-2_0-1-2	3.23	4.16	1.06	73.57	0.15	0.11	0.73	0.03	11.64	0.00	94.68
	1518E-9H-2_0-1-3	3.51	4.23	1.07	75.25	0.13	0.06	0.69	0.04	12.05	0.00	97.05
	1518E-9H-2_0-1-4	3.29	4.18	0.93	73.49	0.14	0.09	0.70	0.06	11.74	0.00	94.63
	1518E-9H-2_0-1-5	3.41	4.16	1.04	74.50	0.12	0.12	0.70	0.00	11.72	0.00	95.77
	1518E-9H-2_0-1-6	3.49	4.10	1.00	74.13	0.13	0.11	0.74	0.01	11.65	0.05	95.41
	1518E-9H-2_0-1-7	3.12	4.28	0.89	74.65	0.10	0.08	0.65	0.09	11.91	0.00	95.78
	1518E-9H-2_0-1-8	3.45	4.08	0.94	74.63	0.13	0.11	0.76	0.02	11.91	0.02	96.05
	1518E-9H-2_0-1-9	3.07	3.90	2.11	71.98	0.17	0.89	2.29	0.07	11.20	0.00	95.68
	1518E-9H-2_0-1-10	2.82	4.77	0.81	74.01	0.09	0.03	0.61	0.01	12.10	0.02	95.27
	1518E-9H-2_0-1-11	3.42	3.67	1.45	73.50	0.16	0.08	0.85	0.10	11.86	0.03	95.10
	1518E-9H-2_0-1-12	3.45	4.27	0.92	75.35	0.11	0.14	0.71	0.04	12.00	0.01	97.01
	1518E-9H-2_0-1-14	3.42	3.81	1.02	75.44	0.10	0.10	0.77	0.00	12.17	0.01	96.83
	1518E-9H-2_0-1-15	3.18	4.23	0.96	74.07	0.11	0.10	0.71	0.00	11.76	0.01	95.12
	1518E-9H-2_0-1-16	3.24	4.24	0.99	73.60	0.11	0.07	0.69	0.03	11.58	0.00	94.56
	1518E-9H-2_0-1-17	2.47	3.12	0.90	62.02	0.07	0.09	0.86	0.00	10.09	0.03	79.66
	1518E-9H-2_0-1-18	3.50	4.27	0.83	74.14	0.14	0.11	0.73	0.09	11.89	0.03	95.74
	1518E-9H-2_0-1-19	3.57	4.20	0.99	74.81	0.09	0.11	0.72	0.01	12.02	0.00	96.51
	1518E-9H-2_0-1-20	3.28	4.16	0.94	74.42	0.13	0.11	0.79	0.02	11.95	0.00	95.81
	1518E 9H-2 8-9_1	3.24	3.83	1.18	75.66	0.10	0.08	0.89	0.02	12.22	0.03	97.24
	1518E 9H-2 8-9_10	3.75	3.59	1.43	73.54	0.13	0.03	0.80	0.00	12.07	0.03	95.38
	1518E_9H-2_8-9_4	4.45	1.97	5.00	62.33	1.03	1.03	4.72	0.03	15.90	0.17	96.62
	1518E_9H-2_8-9_6	3.89	3.48	1.56	72.89	0.07	0.02	0.80	0.09	12.28	0.01	95.10
	1518E_9H-2_8-9_7	3.86	3.61	1.52	72.41	0.09	0.04	0.83	0.02	12.09	0.00	94.46
	1518E_9H-2_8-9_8	3.82	3.34	1.47	70.34	0.18	0.13	1.25	0.12	12.37	0.03	93.05
	1518E_9H-2_8-9_9	4.33	1.58	4.52	60.71	0.76	1.22	5.68	0.03	17.56	0.19	96.57
	1518E_9H-2_8-9_10	4.60	1.53	4.69	62.54	0.89	0.80	5.03	0.04	16.46	0.15	96.74
	1518E_9H-2_8-9_11	4.80	2.02	5.42	63.83	0.92	1.71	4.58	0.10	15.60	0.17	99.15

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s51	1518E_9H-2_8-9_13	4.88	1.61	5.39	61.48	0.80	1.88	5.50	0.11	17.55	0.10	99.30
	1518E_9H-2_8-9_14	4.46	1.73	3.73	62.26	0.83	0.75	4.91	0.06	16.62	0.11	95.45
	1518E_9H-2_8-9_15	4.32	2.09	5.46	62.82	1.00	1.37	4.35	0.03	14.88	0.21	96.53
	1518E_9H-2_8-9_16	4.00	2.10	5.28	61.75	1.05	1.19	4.02	0.08	14.87	0.19	94.54
	1518E_9H-2_8-9_17	3.59	3.87	1.07	73.72	0.14	0.10	0.76	0.03	11.74	0.02	95.04
	1518E_9H-2_8-9_18	4.30	1.74	6.35	62.28	0.93	2.37	5.20	0.15	15.99	0.14	99.45
	1518E_9H-2_8-9_19	2.95	2.85	1.96	73.84	0.20	0.14	1.14	0.00	10.37	0.03	93.49
	1518E_9H-3_26-27_3	3.94	3.19	2.83	68.97	0.27	0.22	1.29	0.09	13.15	0.01	93.96
	1518E_9H-3_26-27_5	3.68	3.65	0.96	75.61	0.10	0.10	0.92	0.08	12.28	0.02	97.40
	1518E_9H-3_26-27_6	3.79	3.18	1.45	72.92	0.17	0.12	0.90	0.03	12.36	0.08	95.00
	1518E_9H-3_26-27_7	2.70	4.40	0.99	72.74	0.12	0.15	0.99	0.05	12.09	0.04	94.25
	1518E_9H-3_26-27_8	3.71	3.45	1.48	74.03	0.20	0.13	0.87	0.00	11.78	0.01	95.65
	1518E_9H-3_26-27_11	3.53	3.80	1.00	75.00	0.09	0.05	0.79	0.00	12.19	0.00	96.45
	1518E_9H-3_26-27_12	3.55	3.76	1.23	74.04	0.12	0.08	0.60	0.01	11.74	0.00	95.12
	1518E_9H-3_26-27_13	3.35	3.61	1.18	74.87	0.10	0.12	0.93	0.04	11.90	0.00	96.10
	1518E_9H-3_26-27_14	3.32	3.70	1.01	73.76	0.15	0.12	0.95	0.00	12.03	0.03	95.06
	1518E_9H-3_26-27_16	3.50	3.80	1.10	73.68	0.08	0.07	0.87	0.03	12.03	0.01	95.18
	1518E_9H-3_26-27_18	3.09	4.12	0.87	72.39	0.13	0.08	0.73	0.10	11.58	0.01	93.09
	1518E-9H-CC_14-16-1	4.42	3.48	2.13	71.03	0.16	0.12	1.07	0.08	13.05	0.06	95.60
	1518E-9H-CC_14-16-2	3.85	3.30	1.45	72.08	0.24	0.21	1.00	0.03	12.15	0.02	94.32
	1518E-9H-CC_14-16-3	3.44	4.03	0.99	74.47	0.14	0.06	0.70	0.07	11.71	0.01	95.61
	1518E-9H-CC_14-16-5	3.61	3.68	1.07	74.46	0.05	0.02	0.79	0.00	12.37	0.00	96.05
	1518E-9H-CC_14-16-6	3.33	4.20	0.99	74.87	0.15	0.09	0.76	0.01	11.73	0.00	96.15
	1518E-9H-CC_14-16-7	3.62	3.48	1.25	73.50	0.11	0.13	1.05	0.04	12.03	0.00	95.20
	1518E-9H-CC_14-16-8	3.80	2.04	1.26	73.99	0.12	0.10	0.47	0.04	12.22	0.01	94.05
	1518E-9H-CC_14-16-9	4.40	2.81	2.25	70.66	0.33	0.33	1.72	0.03	13.41	0.03	95.96
	1518E-9H-CC_14-16-10	3.41	4.02	0.96	74.98	0.13	0.10	0.73	0.05	11.87	0.01	96.27
	1518E-9H-CC_14-16-11	3.63	3.30	1.10	73.34	0.13	0.10	0.79	0.00	11.86	0.01	94.27
	1518E-9H-CC_14-16-12	3.78	3.73	1.23	75.59	0.09	0.06	0.67	0.00	11.85	0.00	96.99
	1518E-9H-CC_14-16-13	3.20	4.21	0.86	74.56	0.10	0.11	0.74	0.00	11.63	0.02	95.43
	1518E-9H-CC_14-16-14	2.69	3.80	1.28	73.30	0.23	0.20	1.32	0.03	11.58	0.02	94.44
	1518E-9H-CC_14-16-17	3.25	4.34	0.92	73.74	0.15	0.07	0.71	0.12	11.78	0.00	95.07
	1518E-9H-CC_14-16-18	4.00	3.06	1.95	71.08	0.16	0.19	1.29	0.07	12.97	0.00	94.77
	1518E-9H-CC_14-16-19	3.87	3.43	1.42	73.76	0.11	0.06	0.63	0.00	11.67	0.04	94.98
	1518E-9H-CC_14-16-20	3.34	3.65	1.15	74.64	0.10	0.08	0.97	0.03	11.86	0.01	95.83
	1518E_10H-1_50-51_1	3.65	3.62	1.24	74.67	0.11	0.07	0.96	0.04	12.06	0.02	96.46
	1518E_10H-1_50-51_4	3.62	3.97	0.98	75.33	0.11	0.13	0.81	0.04	12.07	0.00	97.06
	1518E_10H-1_50-51_5	4.29	3.12	2.16	72.72	0.21	0.21	1.28	0.10	12.74	0.04	96.86
	1518E_10H-1_50-51_6	3.37	3.70	1.17	74.04	0.08	0.14	0.95	0.00	12.02	0.01	95.48
	1518E_10H-1_50-51_7	3.17	3.53	1.40	73.72	0.28	0.17	0.96	0.09	11.64	0.04	95.00
	1518E_10H-1_50-51_8	3.69	3.66	1.60	72.84	0.09	0.05	1.05	0.05	12.44	0.04	95.51
	1518E_10H-1_50-51_10	3.09	4.17	0.95	73.84	0.12	0.11	0.69	0.04	11.61	0.03	94.65
	1518E_10H-1_50-51_11	3.28	3.47	1.34	73.04	0.06	0.02	0.90	0.07	11.86	0.01	94.06
	1518E_10H-1_50-51_12	3.20	3.97	1.38	73.87	0.08	0.02	0.99	0.08	11.85	0.02	95.46
	1518E_10H-1_50-51_14	3.22	3.86	1.05	74.23	0.14	0.13	0.82	0.00	11.74	0.00	95.20
	1518E_10H-1_50-51_15	3.58	3.63	1.15	75.60	0.13	0.09	0.86	0.00	11.96	0.01	97.01
	1518E_10H-1_50-51_16	4.07	3.27	1.69	73.20	0.23	0.14	0.99	0.16	12.65	0.01	96.42
	1518E_10H-1_50-51_17	4.29	3.04	2.18	71.04	0.18	0.14	1.22	0.11	12.65	0.02	94.88
	1518E_10H-1_50-51_18	3.69	3.86	1.91	71.98	0.26	0.19	1.25	0.03	12.25	0.01	95.42
	1518E_10H-1_50-51_19	3.30	4.22	1.12	74.38	0.09	0.02	0.81	0.00	12.26	0.03	96.23
	1518E_13F-3_20-22_1	3.75	2.88	2.02	72.08	0.15	0.10	1.25	0.05	12.72	0.03	95.03
	1518E_13F-3_20-22_2	3.72	3.63	1.23	74.64	0.11	0.10	1.00	0.04	12.07	0.04	96.56
	1518E_13F-3_20-22_3	3.56	3.25	1.46	70.37	0.14	0.12	1.22	0.03	12.61	0.02	92.79
	1518E_13F-3_20-22_4	3.46	3.69	1.26	75.27	0.12	0.11	0.98	0.00	12.09	0.03	97.00
	1518E_13F-3_20-22_6	3.43	3.51	1.32	74.39	0.10	0.08	1.04	0.03	12.18	0.02	96.11
	1518E_13F-3_20-22_7	3.55	3.56	1.18	74.54	0.10	0.12	0.94	0.01	11.98	0.02	96.00
	1518E_13F-3_20-22_9	3.58	3.44	1.29	74.04	0.13	0.09	0.94	0.06	11.93	0.00	95.50
	1518E_13F-3_20-22_10	3.44	3.83	1.00	75.63	0.06	0.06	0.91	0.07	12.19	0.01	97.21
	1518E_13F-3_20-22_11	3.44	3.63	1.37	75.36	0.09	0.09	0.96	0.02	12.42	0.00	97.38
	1518E_13F-3_20-22_13	3.28	4.05	1.18	73.64	0.06	0.00	0.82	0.04	12.10	0.03	95.19
	1518E_13F-3_20-22_14	3.08	4.18	0.93	72.93	0.12	0.11	0.84	0.03	11.72	0.02	93.96
	1518E_13F-3_20-22_15	3.46	3.61	1.70	71.22	0.14	0.06	1.15	0.09	12.60	0.00	94.03
	1518E-23F-2_80-84-2	3.76	3.41	1.49	72.62	0.18	0.12	1.28	0.00	12.49	0.00	95.35
	1518E-23F-2_80-84-3	3.24	3.80	1.06	74.93	0.13	0.15	0.96	0.05	12.09	0.04	96.44
	1518E-23F-2_80-84-4	4.54	3.36	2.31	70.28	0.19	0.15	1.28	0.08	13.41	0.04	95.64
	1518E-23F-2_80-84-5	4.02	3.22	1.70	72.21	0.17	0.16	1.00	0.08	12.53	0.02	95.11
	1518E-23F-2_80-84-6	3.57	3.49	1.17	74.49	0.12	0.11	0.95	0.04	11.84	0.01	95.79
	1518E-23F-2_80-84-7	4.37	3.11	1.83	70.10	0.20	0.11	1.19	0.13	12.59	0.02	93.66
	1518E-23F-2_80-84-8	3.33	3.70	1.17	74.16	0.13	0.10	0.96	0.09	11.77	0.05	95.45
	1518E-23F-2_80-84-9	3.43	3.84	1.10	73.99	0.10	0.08	0.81	0.01	11.71	0.00	95.07

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u48	1518E-23F-2_80-84-12	3.53	3.05	1.87	71.54	0.16	0.19	1.12	0.05	12.59	0.02	94.12
	1518E-23F-2_80-84-13	3.30	3.48	1.44	71.98	0.13	0.16	1.14	0.05	12.20	0.02	93.91
	1518E-23F-2_80-84-14	2.92	3.93	1.00	73.45	0.05	0.00	0.77	0.09	12.19	0.00	94.40
	1518E-23F-2_80-84-15	3.97	3.05	1.47	72.80	0.19	0.11	0.99	0.08	12.75	0.00	95.41
	1518E-23F-2_80-84-16	3.37	2.52	1.26	67.96	0.23	0.28	1.64	0.06	11.33	0.03	88.68
	1518E-23F-2_80-84-18	3.22	3.70	1.20	75.00	0.12	0.10	1.09	0.11	12.05	0.02	96.60
	1518E-23F-2_80-84-20	3.38	4.17	0.96	74.51	0.03	0.04	0.88	0.05	12.25	0.01	96.27
	1518E-24F-1_1-3-1	2.97	3.97	1.37	70.77	0.13	0.12	1.12	0.03	12.31	0.02	92.81
	1518E-24F-1_1-3-2	3.66	3.81	1.64	72.50	0.11	0.05	1.29	0.04	12.71	0.02	95.83
	1518E-24F-1_1-3-3	3.27	3.89	0.80	73.53	0.04	0.05	0.83	0.06	12.09	0.00	94.56
	1518E-24F-1_1-3-4	3.80	2.91	1.55	72.82	0.09	0.07	1.17	0.12	12.54	0.03	95.11
	1518E-24F-1_1-3-5	4.04	3.18	1.53	71.39	0.22	0.10	0.98	0.04	12.62	0.03	94.14
	1518E-24F-1_1-3-7	4.13	2.94	2.14	70.53	0.42	0.37	1.65	0.04	12.99	0.05	95.26
	1518E-24F-1_1-3-8	3.75	3.63	1.01	75.34	0.13	0.14	0.99	0.04	12.07	0.03	97.12
	1518E-24F-1_1-3-9	3.84	2.95	1.59	72.14	0.06	0.09	1.18	0.02	12.33	0.00	94.20
	1518E-24F-1_1-3-11	4.04	3.39	1.60	72.06	0.16	0.10	1.02	0.02	12.64	0.03	95.06
	1518E-24F-1_1-3-12	3.12	4.29	0.99	73.12	0.03	0.02	0.81	0.00	11.87	0.00	94.25
	1518E-24F-1_1-3-13	4.19	3.91	2.04	70.05	0.19	0.07	0.82	0.02	12.05	0.00	93.34
	1518E-24F-1_1-3-14	3.51	3.79	1.01	74.00	0.11	0.06	0.78	0.03	11.93	0.00	95.22
	1518E-24F-1_1-3-16	2.99	4.30	0.75	72.56	0.11	0.15	0.94	0.06	11.68	0.02	93.56
	1518E-24F-1_1-3-17	3.60	3.59	1.18	74.71	0.13	0.10	0.92	0.05	11.93	0.05	96.27
	1518E-24F-1_1-3-18	4.35	2.60	3.11	67.11	0.35	0.49	2.38	0.05	14.30	0.09	94.83
	1518E-24F-1_1-3-19	3.39	3.97	1.31	73.33	0.09	0.09	0.96	0.05	12.00	0.01	95.21
	1518E-24F-1_1-3-20	3.49	3.64	1.14	74.67	0.11	0.12	0.92	0.00	11.91	0.03	96.03
	1518E_24F-3_71-73_1	3.55	3.60	1.07	73.61	0.07	0.09	0.96	0.00	12.12	0.00	95.07
	1518E_24F-3_71-73_2	3.60	3.72	1.56	70.50	0.14	0.10	0.96	0.05	12.43	0.04	93.11
	1518E_24F-3_71-73_3	3.53	3.64	1.13	72.47	0.22	0.16	0.95	0.03	12.45	0.01	94.59
	1518E_24F-3_71-73_4	4.20	3.19	1.73	73.01	0.24	0.18	1.01	0.04	12.21	0.02	95.82
	1518E_24F-3_71-73_6	3.63	3.60	1.34	74.66	0.10	0.12	1.00	0.06	12.36	0.02	96.90
	1518E_24F-3_71-73_7	3.85	3.17	1.32	71.50	0.25	0.23	1.15	0.04	12.85	0.02	94.38
	1518E_24F-3_71-73_8	4.15	2.34	1.91	68.97	0.37	0.42	1.77	0.07	13.21	0.05	93.27
	1518E_24F-3_71-73_10	3.56	3.49	1.23	71.26	0.07	0.02	0.78	0.02	12.62	0.00	93.05
	1518E_24F-3_71-73_11	3.59	3.65	1.42	74.57	0.11	0.08	0.90	0.00	12.26	0.00	96.57
	1518E_24F-3_71-73_12	3.90	3.19	1.45	73.37	0.19	0.12	0.85	0.04	11.84	0.04	94.99
	1518E_24F-3_71-73_13	4.02	3.09	2.71	67.70	0.46	0.64	2.38	0.15	13.76	0.09	95.00
	1518E_24F-3_71-73_15	3.43	3.07	1.84	70.24	0.20	0.13	0.99	0.02	12.42	0.01	92.34
	1518E_24F-3_71-73_16	3.32	4.31	0.84	73.44	0.07	0.03	0.62	0.00	11.91	0.02	94.57
	1518E_24F-3_71-73_2	3.48	3.59	1.14	75.00	0.11	0.09	0.96	0.02	11.80	0.02	96.20
	1518E_24F-3_71-73_4	3.67	3.29	1.26	72.59	0.12	0.06	0.90	0.06	11.95	0.02	93.92
	1518E_24F-3_71-73_6	3.43	3.61	1.36	74.95	0.13	0.12	0.97	0.03	11.96	0.02	96.59
	1518E_24F-3_71-73_10	3.89	2.95	1.61	71.00	0.17	0.09	1.04	0.07	12.13	0.00	92.94
	1518E_24F-3_71-73_3	4.40	3.18	2.18	70.95	0.17	0.04	1.02	0.08	12.52	0.00	94.54
s71*	1518E-25F-2_30-32-1	3.40	3.81	1.10	74.36	0.07	0.06	0.94	0.00	11.84	0.01	95.60
	1518E-25F-2_30-32-2	3.01	3.60	0.88	72.74	0.04	0.00	0.49	0.05	11.72	0.01	92.54
	1518E-25F-2_30-32-3	2.80	3.52	1.47	74.89	0.46	0.17	0.76	0.01	10.76	0.00	94.84
	1518E-25F-2_30-32-5	3.22	3.70	0.84	72.99	0.12	0.17	1.01	0.04	12.02	0.03	94.13
	1518E-25F-2_30-32-6	2.91	3.56	1.26	74.08	0.21	0.15	1.20	0.00	11.41	0.00	94.78
	1518E-25F-2_30-32-7	3.52	3.78	1.74	72.35	0.25	0.19	1.14	0.07	12.04	0.03	95.10
	1518E-25F-2_30-32-9	3.04	3.58	1.02	75.08	0.11	0.11	0.93	0.05	12.00	0.01	95.94
	1518E-25F-2_30-32-10	3.92	2.86	1.59	71.24	0.18	0.15	1.17	0.02	12.46	0.00	93.58
	1518E-25F-2_30-32-11	4.68	2.48	2.60	70.43	0.21	0.15	1.20	0.10	12.96	0.05	94.85
	1518E-25F-2_30-32-12	3.43	3.48	1.48	74.33	0.21	0.14	0.88	0.03	11.80	0.01	95.79
	1518E-25F-2_30-32-13	3.06	4.16	1.04	73.38	0.07	0.07	1.04	0.01	12.36	0.00	95.19
	1518E-25F-2_30-32-14	4.02	3.56	1.34	75.40	0.13	0.07	0.77	0.02	11.87	0.00	97.19
	1518E-25F-2_30-32-17	4.01	3.10	1.86	71.94	0.12	0.08	1.04	0.12	12.51	0.01	94.80
	1518E-25F-2_30-32-18	4.34	3.16	1.77	72.50	0.22	0.17	1.14	0.09	12.99	0.00	96.38
	1518E-25F-2_30-32-19	3.78	3.52	1.58	72.19	0.11	0.08	1.08	0.07	12.44	0.05	94.90
	1518E_25F-2_30-32_4	4.47	2.90	2.43	70.39	0.16	0.03	1.05	0.09	12.25	0.04	93.81
	1518E_25F-2_30-32_10	3.92	3.19	1.99	70.81	0.28	0.26	1.30	0.05	12.86	0.04	94.69
	1518E_25F-2_30-32_3	3.31	4.04	0.93	73.58	0.08	0.08	0.78	0.05	11.83	0.02	94.70
	1518E_25F-2_30-32_6	3.74	3.84	0.73	73.25	0.04	0.07	0.47	0.04	12.32	0.02	94.52
	1518E_25F-2_30-32_1	3.60	3.25	1.25	73.08	0.12	0.17	1.03	0.09	11.85	0.01	94.44
s73	1518E_25F-2_30-32_2	3.72	3.78	1.17	75.23	0.11	0.08	0.64	0.09	12.21	0.03	97.06
	1518E-28X-7_47-48-4	3.45	3.17	1.36	72.98	0.14	0.15	1.29	0.10	11.94	0.00	94.59
	1518E-28X-7_47-48-9	3.54	3.50	1.23	74.64	0.13	0.11	0.83	0.03	11.59	0.01	95.62
	1518E-28X-7_47-48-10	3.23	3.54	1.24	75.18	0.12	0.13	1.12	0.06	12.31	0.03	96.96
	1518E-28X-7_47-48-19	2.45	3.48	1.18	58.56	0.09	0.13	1.21	0.07	9.81	0.00	76.98
	1518E_29X-2_66-68_1	3.66	3.60	1.07	74.89	0.10	0.11	0.92	0.08	12.04	0.00	96.48
	1518E_29X-2_66-68_2	3.21	3.94	2.05	70.81	0.20	0.03	0.77	0.01	12.93	0.00	93.95
	1518E_29X-2_66-68_3	3.83	4.10	1.24	73.47	0.12	0.02	0.64	0.00	12.36	0.01	95.80

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u54	1518E_29X-2_66-68_4	2.64	3.80	1.22	71.10	0.12	0.08	0.58	0.04	10.95	0.04	90.57
	1518E_29X-2_66-68_6	3.67	3.12	1.94	70.56	0.20	0.24	2.05	0.05	13.07	0.03	94.94
	1518E_29X-2_66-68_8	3.22	4.25	0.97	73.48	0.05	0.06	0.65	0.02	11.94	0.02	94.66
	1518E_29X-2_66-68_9	3.62	3.75	1.53	74.30	0.11	0.07	1.08	0.03	12.29	0.03	96.81
	1518E_29X-2_66-68_10	3.62	0.00	1.43	73.30	0.13	0.01	0.00	0.02	12.16	0.00	90.67
	1518E_29X-2_66-68_11	3.46	0.00	1.14	74.72	0.13	0.11	0.00	0.04	11.77	0.01	91.38
	1518E_29X-2_66-68_13	3.72	3.67	1.02	75.57	0.12	0.10	1.05	0.00	12.25	0.01	97.52
	1518E_29X-2_66-68_14	3.47	3.45	1.28	73.05	0.11	0.08	0.98	0.02	12.05	0.03	94.51
	1518E_29X-2_66-68_15	3.52	4.22	0.91	74.02	0.08	0.03	0.55	0.01	11.59	0.00	94.94
	1518E_29X-2_66-68_16	3.85	1.60	3.35	64.83	0.73	1.02	2.94	0.13	14.29	0.18	92.93
	1518E_29X-2_66-68_17	3.08	3.20	0.90	72.83	0.15	0.13	0.81	0.10	11.90	0.01	93.12
	1518E-29X-6_7-9-1	3.76	3.76	0.45	77.02	0.14	0.01	0.64	0.02	11.88	0.00	97.68
	1518E-29X-6_7-9-5	3.45	3.95	0.75	72.46	0.07	0.04	0.65	0.07	11.93	0.00	93.38
	1518E-29X-6_7-9-6	3.11	3.58	1.29	72.16	0.05	0.00	1.04	0.03	11.85	0.00	93.11
	1518E-29X-6_7-9-7	3.71	3.74	1.60	72.12	0.10	0.06	0.76	0.01	11.98	0.02	94.09
	1518E-29X-6_7-9-8	4.37	3.32	1.93	71.94	0.14	0.06	1.04	0.09	12.76	0.01	95.67
	1518E-29X-6_7-9-9	4.32	2.92	2.04	71.11	0.19	0.11	1.12	0.09	12.55	0.01	94.46
	1518E-29X-6_7-9-11	3.45	3.71	1.80	71.24	0.10	0.06	1.15	0.04	12.02	0.02	93.59
	1518E-29X-6_7-9-12	3.15	4.01	1.28	73.47	0.05	0.04	0.79	0.07	11.79	0.00	94.65
	1518E-29X-6_7-9-14	3.62	3.42	1.84	71.30	0.12	0.06	1.24	0.04	12.18	0.02	93.84
	1518E-29X-6_7-9-16	3.63	1.83	1.91	70.46	0.18	0.13	1.27	0.05	12.15	0.00	91.62
	1518E-29X-6_7-9-17	3.95	2.97	1.66	72.48	0.23	0.21	1.14	0.10	12.44	0.04	95.23
	1518E-29X-6_7-9-18	3.58	3.48	1.16	74.18	0.12	0.09	0.75	0.05	11.89	0.01	95.31
	1518E-29X-6_7-9-19	3.80	3.50	1.35	73.52	0.12	0.14	0.93	0.08	12.11	0.02	95.58
	1518E-29X-6_7-9-20	3.00	3.03	2.52	69.65	0.18	0.14	1.31	0.13	12.55	0.04	92.55
	1518E_29X-6_7-9_1	3.53	3.23	1.24	73.87	0.12	0.04	0.93	0.07	12.01	0.01	95.06
	1518E_29X-6_7-9_6	3.39	3.30	1.09	73.05	0.11	0.11	0.98	0.09	11.62	0.00	93.74
	1518E_29X-6_7-9_11	3.28	3.48	1.10	73.96	0.14	0.04	0.96	0.04	11.93	0.02	94.94
	1518E_29X-6_7-9_2	3.59	3.47	1.36	75.42	0.09	0.05	0.93	0.00	11.97	0.03	96.91
	1518E_29X-6_7-9_3	4.25	3.33	1.91	70.57	0.16	0.10	0.99	0.09	12.57	0.05	94.02
	1518E_29X-6_7-9_4	2.37	3.80	1.14	72.16	0.11	0.14	1.04	0.00	12.57	0.07	93.40
	1518E_29X-6_7-9_5	3.51	3.69	1.14	75.10	0.12	0.08	0.93	0.05	12.23	0.04	96.88
	1518E_29X-6_7-9_7	3.50	3.57	1.14	73.14	0.06	0.02	0.88	0.01	12.07	0.00	94.40
	1518E_29X-6_7-9_8	3.73	3.11	1.60	71.18	0.08	0.04	0.99	0.00	11.99	0.01	92.73
	1518E_29X-6_7-9_9	4.11	3.15	1.61	72.39	0.09	0.04	0.92	0.05	13.05	0.00	95.41
	1518E_29X-6_7-9_10	3.75	3.21	1.51	72.13	0.24	0.19	1.10	0.02	11.92	0.02	94.08
	1518E_29X-6_7-9_12	3.27	4.05	1.15	74.06	0.11	0.07	0.84	0.03	12.17	0.00	95.74
	1518E_31X-3_11-13_1	3.43	3.71	1.30	73.74	0.08	0.06	0.90	0.06	12.32	0.00	95.59
	1518E_31X-3_11-13_2	3.37	4.32	0.58	73.93	0.05	0.02	0.65	0.00	12.11	0.00	95.04
	1518E_31X-3_11-13_3	3.69	3.57	1.18	75.43	0.12	0.08	0.98	0.00	12.10	0.04	97.20
	1518E_31X-3_11-13_5	3.67	3.41	1.35	74.23	0.19	0.13	0.90	0.01	11.87	0.04	95.81
	1518E_31X-3_11-13_6	4.18	3.56	2.02	71.57	0.15	0.11	0.99	0.00	13.03	0.05	95.66
	1518E_31X-3_11-13_7	3.48	3.31	1.54	69.82	0.21	0.21	1.18	0.11	12.67	0.00	92.54
	1518E_31X-3_11-13_8	2.80	4.12	1.64	69.25	0.21	0.19	1.19	0.03	12.43	0.01	91.87
	1518E_31X-3_11-13_9	3.46	3.37	1.44	73.08	0.16	0.11	1.40	0.02	12.65	0.00	95.70
	1518E_31X-3_11-13_10	3.51	3.81	0.97	73.59	0.06	0.08	0.75	0.03	12.04	0.00	94.83
	1518E_31X-3_11-13_11	4.17	3.55	1.97	71.59	0.19	0.11	1.02	0.05	12.74	0.01	95.41
	1518E_31X-3_11-13_12	3.37	3.44	1.29	72.65	0.10	0.05	1.03	0.11	12.11	0.05	94.20
	1518E_31X-3_11-13_13	3.56	3.89	0.93	72.79	0.13	0.05	0.73	0.03	11.92	0.03	94.07
	1518E_31X-3_11-13_15	3.29	3.70	1.03	73.53	0.07	0.06	1.02	0.09	12.19	0.06	95.04
s75*	1518E-32X-1_20-24-1	3.93	2.70	2.59	69.51	0.37	0.39	2.02	0.06	14.02	0.04	95.63
	1518E-32X-1_20-24-4	3.12	4.03	0.93	72.94	0.14	0.09	0.75	0.07	10.88	0.00	92.95
	1518E-32X-1_20-24-5	4.07	3.01	2.01	71.60	0.17	0.16	1.31	0.05	13.02	0.05	95.45
	1518E-32X-1_20-24-7	3.44	3.69	1.31	75.97	0.14	0.10	0.93	0.00	12.20	0.00	97.78
	1518E-32X-1_20-24-9	4.00	3.29	1.51	72.05	0.12	0.08	0.87	0.05	12.25	0.00	94.22
	1518E-32X-1_20-24-10	3.43	3.52	1.28	74.59	0.11	0.11	0.87	0.07	11.81	0.00	95.79
	1518E-32X-1_20-24-11	3.22	3.43	1.56	70.64	0.19	0.21	1.41	0.07	12.59	0.01	93.32
	1518E-32X-1_20-24-12	3.26	3.83	1.11	74.66	0.13	0.11	0.83	0.03	11.93	0.02	95.92
	1518E-32X-1_20-24-13	3.77	3.62	1.02	74.68	0.06	0.04	0.66	0.06	11.94	0.00	95.85
	1518E-32X-1_20-24-14	4.30	3.29	1.64	73.13	0.16	0.16	1.06	0.00	12.72	0.00	96.47
	1518E-32X-1_20-24-15	4.26	3.19	1.57	72.80	0.17	0.15	1.00	0.06	12.51	0.00	95.71
	1518E-32X-1_20-24-16	3.21	4.16	1.66	70.18	0.14	0.08	1.00	0.05	12.36	0.00	92.84
	1518E-32X-1_20-24-18	2.91	4.39	0.98	73.36	0.11	0.09	0.88	0.01	12.03	0.00	94.77
	1518E-32X-1_20-24-19	3.36	3.88	1.19	73.81	0.15	0.10	0.82	0.00	11.93	0.00	95.25
	1518E-32X-1_20-24-20	3.11	4.16	1.21	72.61	0.06	0.04	0.82	0.00	11.78	0.00	93.79
	1518F-5R-3_60-62-1	4.08	3.28	1.52	71.85	0.19	0.16	1.08	0.00	12.53	0.02	94.71
	1518F-5R-3_60-62-2	3.91	3.23	1.34	74.00	0.13	0.11	0.85	0.04	11.98	0.01	95.60
	1518F-5R-3_60-62-3	3.63	3.48	1.26	74.48	0.13	0.13	0.99	0.02	11.91	0.06	96.08
	1518F-5R-3_60-62-4	3.09	4.05	1.27	73.67	0.11	0.07	0.94	0.04	11.84	0.00	95.08
	1518F-5R-3_60-62-5	4.03	3.42	2.06	72.64	0.15	0.08	1.14	0.07	12.62	0.00	96.21

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s18	1518F-5R-3_60-62-6	3.95	3.35	2.03	72.80	0.18	0.08	1.03	0.09	12.47	0.01	96.00
	1518F-5R-3_60-62-7	3.68	3.73	1.17	75.12	0.08	0.04	0.85	0.03	11.77	0.02	96.48
	1518F-5R-3_60-62-8	4.07	3.27	1.51	72.29	0.10	0.11	0.98	0.00	12.55	0.00	94.88
	1518F-5R-3_60-62-11	3.48	3.76	1.02	75.22	0.09	0.07	0.89	0.03	12.22	0.05	96.82
	1518F-5R-3_60-62-12	3.90	3.32	1.25	74.36	0.13	0.09	1.09	0.01	12.07	0.03	96.25
	1518F-5R-3_60-62-13	2.90	3.70	1.28	72.99	0.24	0.15	1.39	0.03	11.72	0.04	94.43
	1518F-5R-3_60-62-15	3.11	3.65	2.21	72.55	0.17	0.09	1.41	0.06	12.90	0.00	96.15
	1518F-5R-3_60-62-16	4.83	2.29	3.06	68.23	0.69	0.68	2.14	0.15	13.67	0.10	95.83
	1518F-5R-3_60-62-18	3.72	3.60	1.49	73.26	0.11	0.07	0.82	0.03	12.06	0.00	95.16
	1518F-13R-1_113-115-1	3.37	3.54	1.23	73.69	0.17	0.14	0.92	0.08	11.86	0.04	95.04
	1518F-13R-1_113-115-2	3.72	3.33	1.12	73.45	0.15	0.13	0.94	0.06	11.90	0.03	94.82
	1518F-13R-1_113-115-3	3.61	3.47	1.05	74.43	0.12	0.10	0.92	0.04	12.06	0.03	95.82
	1518F-13R-1_113-115-4	3.64	3.45	1.23	73.96	0.15	0.15	0.92	0.00	11.99	0.02	95.51
	1518F-13R-1_113-115-5	3.52	3.74	1.15	74.22	0.14	0.07	0.94	0.04	12.12	0.02	95.97
	1518F-13R-1_113-115-6	3.66	3.45	1.28	74.89	0.18	0.14	0.94	0.03	12.25	0.02	96.83
	1518F-13R-1_113-115-7	3.73	3.33	1.09	73.28	0.19	0.13	0.90	0.03	11.99	0.02	94.70
	1518F-13R-1_113-115-8	3.45	3.45	1.24	72.54	0.16	0.09	0.92	0.05	11.61	0.00	93.51
	1518F-13R-1_113-115-9	3.35	3.90	1.14	73.49	0.16	0.11	0.90	0.02	12.16	0.00	95.23
	1518F-13R-1_113-115-10	3.44	3.52	1.37	74.63	0.18	0.14	0.95	0.02	12.14	0.02	96.41
	1518F-13R-1_113-115-11	3.73	3.27	1.20	73.30	0.12	0.11	0.91	0.12	12.00	0.00	94.76
	1518F-13R-1_113-115-12	3.50	3.49	1.22	73.80	0.16	0.16	0.93	0.08	11.98	0.00	95.32
	1518F-13R-1_113-115-13	3.78	3.32	1.30	73.91	0.14	0.12	0.94	0.09	12.12	0.00	95.72
	1518F-13R-1_113-115-14	3.38	3.40	1.18	74.37	0.10	0.15	0.94	0.07	12.07	0.01	95.68
	1518F-13R-1_113-115-15	3.58	3.42	1.42	74.30	0.18	0.13	0.92	0.08	12.01	0.04	96.07
	1518F-13R-1_113-115-16	3.77	3.50	1.16	74.22	0.14	0.12	0.90	0.01	12.05	0.00	95.86
	1518F-13R-1_113-115-17	3.84	3.40	1.06	73.62	0.15	0.10	0.91	0.04	11.86	0.02	95.01
	1518F-13R-1_113-115-18	3.72	3.41	1.24	73.95	0.15	0.11	0.91	0.06	11.91	0.02	95.47
	1518F-13R-1_113-115-19	3.61	3.43	1.16	73.74	0.12	0.09	0.98	0.06	11.79	0.02	95.00
	1518F-13R-1_113-115-20	3.60	3.39	1.10	74.19	0.15	0.14	0.90	0.04	11.93	0.00	95.44
	1518F 13R-1 113-115_1	3.55	3.30	1.11	72.01	0.15	0.12	0.90	0.08	12.18	0.03	93.41
	1518F 13R-1 113-115_2	3.69	3.30	1.22	74.07	0.13	0.14	0.92	0.09	11.82	0.03	95.42
	1518F 13R-1 113-115_3	3.54	3.53	1.15	74.04	0.14	0.11	0.98	0.00	12.57	0.00	96.06
	1518F 13R-1 113-115_5	3.59	3.35	1.18	72.87	0.14	0.14	0.92	0.03	12.17	0.00	94.39
	1518F 13R-1 113-115_6	3.62	3.39	1.31	73.02	0.15	0.11	0.87	0.09	12.03	0.00	94.59
	1518F 13R-1 113-115_4	3.79	3.39	1.28	73.92	0.14	0.08	0.98	0.00	12.08	0.03	95.69
	1518F 13R-1 113-115_7	3.52	3.36	1.29	72.76	0.14	0.08	0.97	0.08	11.91	0.03	94.13
	1518F 13R-1 113-115_8	3.85	3.35	1.34	73.53	0.12	0.08	0.94	0.01	12.20	0.00	95.42
	1518F 13R-1 113-115_9	3.92	3.33	1.21	74.06	0.12	0.10	0.94	0.05	11.93	0.03	95.69
	1518E-27R-2_13-15-1	4.46	3.14	2.17	71.01	0.17	0.01	0.99	0.15	11.98	0.03	94.11
	1518E-27R-2_13-15-2	3.45	3.03	1.09	74.06	0.10	0.16	1.31	0.04	11.89	0.02	95.14
	1518E-27R-2_13-15-3	3.57	3.20	1.14	74.50	0.10	0.06	0.93	0.02	11.68	0.00	95.21
	1518E-27R-2_13-15-4	3.19	3.59	1.11	74.48	0.12	0.09	1.16	0.04	11.97	0.00	95.75
	1518E-27R-2_13-15-5	3.69	3.42	1.48	74.22	0.16	0.12	0.84	0.02	11.59	0.01	95.56
	1518E-27R-2_13-15-6	3.50	3.61	0.99	73.12	0.07	0.08	0.88	0.05	11.81	0.00	94.11
	1518E-27R-2_13-15-7	3.22	3.18	0.97	73.99	0.16	0.15	1.28	0.05	12.06	0.01	95.06
	1518E-27R-2_13-15-8	3.37	3.34	1.25	71.48	0.11	0.19	1.23	0.00	12.31	0.03	93.30
	1518E-27R-2_13-15-9	3.96	2.55	1.43	71.44	0.26	0.25	1.32	0.10	12.26	0.05	93.62
	1518E-27R-2_13-15-10	3.58	3.67	1.02	74.46	0.09	0.12	0.86	0.07	12.03	0.01	95.92
	1518E-27R-2_13-15-11	3.29	3.05	1.24	73.59	0.16	0.16	1.26	0.04	11.95	0.02	94.77
	1518E-27R-2_13-15-12	3.58	3.84	1.02	74.57	0.11	0.09	0.85	0.00	12.09	0.02	96.17
	1518E-27R-2_13-15-13	2.71	3.56	0.88	73.26	0.05	0.00	0.48	0.03	12.08	0.00	93.05
	1518E-27R-2_13-15-15	3.62	3.79	0.98	74.38	0.09	0.08	0.85	0.04	12.03	0.05	95.90
	1518E-27R-2_13-15-16	3.71	3.68	0.83	72.64	0.02	0.01	0.44	0.01	12.09	0.00	93.44
	1518E-27R-2_13-15-17	3.83	3.86	1.83	72.50	0.14	0.12	1.10	0.02	12.94	0.00	96.34
	1518E-27R-2_13-15-18	3.27	4.08	1.06	73.38	0.08	0.03	0.97	0.06	12.09	0.03	95.06
	1518E-27R-2_13-15-19	4.10	3.29	1.61	71.90	0.14	0.12	1.06	0.06	12.40	0.00	94.68
	1518E-27R-2_13-15-20	3.32	4.70	0.79	74.98	0.03	0.03	0.57	0.06	12.25	0.01	96.74
	1518F-28R-3_52-54-1	3.53	3.62	1.22	75.62	0.11	0.10	0.96	0.04	11.88	0.00	97.09
	1518F-28R-3_52-54-2	3.98	3.20	1.77	72.06	0.20	0.18	1.12	0.02	12.48	0.02	95.03
	1518F-28R-3_52-54-4	3.33	3.76	1.11	74.51	0.12	0.08	0.95	0.07	12.11	0.02	96.05
	1518F-28R-3_52-54-5	4.18	3.43	1.75	72.57	0.13	0.12	1.00	0.07	12.38	0.02	95.65
	1518F-28R-3_52-54-9	3.61	3.62	1.31	73.23	0.14	0.13	1.14	0.08	12.56	0.00	95.82
	1518F-28R-3_52-54-10	4.25	2.02	3.38	66.83	0.40	0.52	2.73	0.15	14.03	0.09	94.40
	1518F-28R-3_52-54-11	3.41	3.16	1.60	72.78	0.15	0.20	1.47	0.05	12.71	0.00	95.54
	1518F-28R-3_52-54-12	3.36	3.88	1.11	74.76	0.11	0.08	0.82	0.04	12.21	0.01	96.37
	1518F-28R-3_52-54-13	3.51	3.41	1.14	74.21	0.13	0.17	0.95	0.08	11.65	0.00	95.25
	1518F-28R-3_52-54-14	3.83	3.49	1.38	73.31	0.13	0.07	0.82	0.09	11.97	0.03	95.12
	1518F-28R-3_52-54-15	4.23	3.22	1.60	71.62	0.18	0.10	0.98	0.09	12.56	0.02	94.61
	1518F-28R-3_52-54-16	3.50	3.94	0.84	73.17	0.05	0.00	0.57	0.04	11.89	0.00	94.00
	1518F-28R-3_52-54-17	3.60	3.65	1.18	74.47	0.14	0.11	0.93	0.00	11.97	0.02	96.08

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1518F-28R-3_52-54-18	3.41	4.00	1.33	73.06	0.07	0.00	0.67	0.03	11.87	0.00	94.44
	1518F-28R-3_52-54-19	3.16	3.82	1.08	73.91	0.11	0.07	1.01	0.02	12.07	0.00	95.25
	1518F-28R-3_52-54-20	4.28	3.04	1.84	72.17	0.27	0.21	1.40	0.07	12.85	0.01	96.14
	1518F-28R-3_59-61-4	3.38	3.63	1.12	74.88	0.10	0.10	0.93	0.02	11.95	0.01	96.11
	1518F-28R-3_59-61-5	3.87	2.73	1.92	69.21	0.32	0.37	2.29	0.19	13.76	0.03	94.69
	1518F-28R-3_59-61-7	4.27	2.09	1.50	68.57	0.25	0.32	3.34	0.16	16.03	0.05	96.59
	1518F-28R-3_59-61-8	4.50	2.37	1.41	69.41	0.24	0.26	2.64	0.15	14.75	0.03	95.75
	1518F-28R-3_59-61-9	4.67	2.20	1.51	68.86	0.26	0.18	3.16	0.04	15.91	0.05	96.84
	1518F-28R-3_59-61-14	2.19	1.84	0.92	40.65	0.15	0.19	1.10	0.12	7.67	0.04	54.87
	1518F-28R-3_59-61-15	4.17	2.41	1.81	69.53	0.26	0.38	2.82	0.19	14.17	0.02	95.76
	1518F-28R-3_59-61-17	3.83	2.63	1.19	69.97	0.30	0.13	2.97	0.00	15.32	0.11	96.44
	1518F-28R-3_59-61-20	3.58	2.83	1.27	71.34	0.25	0.30	1.88	0.12	13.31	0.01	94.90
	1518F-28R-3_59-61_2	3.42	3.84	1.11	74.18	0.08	0.08	0.82	0.08	11.97	0.00	95.58
	1518F-28R-3_59-61_5	3.52	3.76	0.99	75.54	0.06	0.04	0.74	0.07	12.03	0.02	96.78
	1518F-28R-3_59-61_7	3.74	3.41	1.38	73.28	0.16	0.11	0.89	0.04	11.94	0.02	94.98
	1518F-28R-3_60-64-2	3.94	3.29	1.35	74.03	0.17	0.15	1.08	0.01	12.43	0.00	96.45
	1518F-28R-3_60-64-4	3.08	3.89	0.55	74.67	0.35	0.01	0.79	0.04	11.91	0.07	95.34
	1518F-28R-3_60-64-6	3.30	3.83	0.92	73.51	0.11	0.09	0.78	0.06	11.82	0.02	94.45
	1518F-28R-3_60-64-8	3.30	4.24	1.16	74.69	0.11	0.10	0.87	0.04	12.28	0.01	96.79
	1518F-28R-3_60-64-9	4.10	3.18	1.76	71.25	0.21	0.18	1.40	0.09	12.88	0.02	95.07
	1518F-28R-3_60-64-11	3.44	4.43	1.16	73.84	0.06	0.03	0.51	0.00	11.69	0.00	95.15
	1518F-28R-3_60-64-12	3.80	2.89	1.66	72.98	0.18	0.20	1.45	0.00	12.81	0.02	95.99
	1518F-28R-3_60-64-13	3.47	3.62	1.15	75.95	0.13	0.11	0.97	0.01	12.04	0.02	97.47
	1518F-28R-3_60-64-15	3.89	3.27	1.49	73.83	0.18	0.15	1.08	0.05	12.29	0.03	96.26
	1518F-28R-3_60-64-16	2.70	3.98	1.19	75.03	0.35	0.24	0.59	0.05	11.25	0.00	95.37
	1518F-28R-3_60-64-17	3.46	3.43	1.80	71.88	0.14	0.08	0.99	0.06	12.30	0.01	94.15
	1518F-28R-3_60-64-20	3.30	4.04	1.10	74.80	0.11	0.11	0.96	0.04	11.96	0.03	96.45

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

Sample name	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1519C_14R-2_48-50_1	43.30	14.47	3.08	0.32	118.51	52.42	37.03	219.23	10.53	6.00	787.09	30.51	63.59	7.59	29.81
1519C_14R-2_48-50_10	40.47	12.82	1.94	0.25	108.32	48.42	32.57	199.43	9.84	5.64	705.14	26.91	57.12	6.8	26.84
1519C_14R-2_48-50_12	44.79	14.20	2.06	0.27	121.20	53.99	38.85	230.44	11.15	6.50	822.32	31.52	66.23	7.81	31.53
1519C_16R-1_146-148_3	39.33	11.97	2.46	0.74	104.57	95.97	30.29	256.14	9.19	4.95	691.33	24.34	52.91	5.87	24.94
1519C_16R-1_146-148_4	38.38	12.08	2.27	0.68	109.32	107.96	30.21	248.16	9.42	5.14	693.40	24.76	53.49	6.22	24.79
1519C_16R-1_146-148_6	39.20	12.63	2.19	0.77	103.56	114.83	29.63	241.97	9.44	4.94	673.29	23.87	51.55	6.22	23.8
1519C_16R-1_146-148_9	24.99	9.70	1.82	0.83	80.18	102.89	23.28	188.13	7.08	4.01	528.12	18.47	40.62	4.69	18.19
1519C_17R-1_5-7_1	39.31	10.29	2.31	0.52	120.39	83.55	35.73	216.93	9.47	6.28	830.25	30.05	62.64	7.32	29.66
1519C_17R-1_5-7_3	27.96	10.86	1.67	1.50	77.03	135.28	25.12	197.98	8.55	3.82	591.09	21.73	44.49	5.45	20.88
1519C_17R-1_5-7_4	26.89	9.54	2.71	0.67	122.76	76.98	30.74	187.73	9.70	6.66	732.33	25.71	54.04	6.45	23.53
1519C_17R-1_5-7_7	25.05	8.00	4.18	0.94	84.96	65.40	26.86	180.97	7.36	4.75	623.81	21.93	49.53	5.25	20.54
1519C_18R-5_77-78_1	1.72	7.43	2.22	0.98	93.64	50.01	44.20	253.39	9.67	3.71	586.66	26.94	59.56	7.27	28.91
1519C_18R-5_77-78_3	25.83	8.44	3.24	0.77	85.17	67.76	23.97	176.90	7.29	4.72	578.36	20.23	42.85	5.13	20.61
1519C_18R-5_77-78_5	25.15	8.45	5.03	0.90	92.78	133.34	26.01	174.16	7.77	5.01	653.84	22.6	45.83	5.43	22.31
1519C_18R-5_77-78_8	27.31	10.47	3.12	1.34	93.02	72.32	29.71	219.26	8.97	4.56	688.15	24.69	52.92	6.12	23.56
1519C_18R-7_115-117_10	17.29	5.72	2.28	0.54	110.61	53.66	27.36	103.11	6.98	5.76	627.10	20.76	44.6	5.32	20.52
1519C_18R-7_115-117_1	17.50	10.99	7.18	2.66	87.98	110.97	23.70	177.12	6.66	5.12	596.73	18.23	39.13	4.6	18.24
1519C_18R-7_115-117_2	27.44	6.15	6.64	0.83	82.35	66.10	17.14	119.94	5.23	6.06	593.66	19.5	38.34	4.27	15.47
1519C_18R-7_115-117_4	27.92	8.60	2.00	0.56	122.89	65.79	31.13	152.62	8.71	6.16	799.52	29.04	60.04	6.93	27.07
1519C_18R-7_115-117_5	34.90	8.75	11.06	1.61	89.72	101.08	20.67	161.28	7.28	5.09	541.26	19.02	38.17	4.62	17.44
1519C_18R-7_115-117_6	39.70	11.48	2.28	0.67	107.57	122.37	32.76	257.17	9.64	5.71	770.64	27.87	58.6	7.08	27.94
1519C_19R-3_33-35_1	24.93	11.58	2.71	0.38	108.08	97.42	34.21	263.70	9.88	5.56	789.76	27.89	57.8	7.01	26.27
1519C_19R-3_33-35_3	34.93	11.56	1.98	0.51	101.00	111.23	31.54	252.40	9.77	5.27	738.69	25.67	55.66	6.65	25.6
1519C_19R-3_33-35_4	31.22	11.21	3.53	0.66	94.44	109.96	31.49	248.42	9.09	4.91	710.68	24.27	52.81	6.27	24.3
1519C_19R-3_33-35_5	35.50	12.05	2.42	0.56	107.13	112.17	30.80	246.82	9.53	5.27	734.22	25.4	54.12	6.54	25.61
1519C_19R-3_33-35_8	27.64	11.18	2.07	0.59	94.21	120.57	28.65	233.34	8.91	4.90	677.81	24.33	51.96	6.19	24.12
1519C_19R-4_35-36_1	18.89	4.45	2.12	0.61	61.23	33.96	17.00	54.00	3.70	3.47	370.01	15.1	28.03	3.41	13.63
1519C_19R-4_35-36_2	41.67	5.90	2.08	0.92	132.84	53.22	27.45	112.14	7.75	6.91	755.75	25.48	52.58	5.9	22.6
1519C_19R-4_35-36_5	28.69	9.39	2.39	0.35	109.12	61.18	31.92	188.88	8.93	5.34	750.16	26.38	55.75	6.68	26.4
1519C_19R-4_35-36_6	36.09	4.61	1.96	0.36	115.44	47.08	27.42	103.23	7.73	5.76	716.47	24.54	53.94	5.89	24.83
1519C_19R-4_35-36_7	30.04	11.47	3.02	1.68	92.22	135.81	29.32	227.39	8.25	4.67	664.31	22.92	49.99	6.09	23.39
1519C_19R-6_74-76_1	47.12	10.66	2.59	0.21	126.32	57.25	37.57	190.80	11.03	6.07	813.81	30.37	63.4	7.22	28.16
1519C_19R-6_74-76_3	4.17	10.49	2.45	0.25	131.82	57.37	37.62	191.10	11.03	6.38	803.78	30.24	63.09	7.22	27.68
1519C_19R-6_74-76_4	38.21	10.57	2.29	0.18	125.30	55.36	36.46	185.40	10.97	6.10	792.02	29.39	62.14	7.28	27.98
1519C_19R-6_74-76_6	30.28	9.96	4.11	0.16	116.17	56.87	35.26	177.55	9.99	5.73	777.36	28.62	59.93	6.76	26.19
1519C_19R-6_74-76_7	22.00	9.26	2.60	0.27	115.39	56.56	34.71	173.15	10.43	5.60	775.06	28.08	60.12	7.02	28.88
1519C_20R-3_29-31_2	39.82	11.92	1.94	0.57	98.04	100.27	31.28	234.47	8.57	4.74	677.79	24.52	50.97	6.03	24.4
1519C_20R-3_29-31_3	30.86	10.83	6.55	0.71	107.69	89.25	28.63	220.10	9.14	5.37	654.58	22.8	48.6	5.77	22.63
1519C_20R-3_29-31_10	30.37	10.65	1.78	0.65	99.77	96.58	29.05	214.74	8.75	4.91	675.96	23.8	52.73	6.15	23.8
1519D_1H-CC_4-6_3	40.98	12.55	2.84	0.43	111.09	117.86	32.87	221.74	8.43	5.58	658.42	26.8	54.81	6.57	27.3
1519D_1H-CC_4-6_4	42.82	12.05	2.44	0.42	105.60	114.61	31.73	219.53	8.56	5.33	628.83	25.95	53.36	6.26	24.21
1519D_1H-CC_4-6_8	41.94	12.52	2.78	0.32	108.89	120.25	32.58	220.94	8.12	5.06	642.99	26.9	52.41	6.52	26.88
1519D_1H-CC_4-6_9	41.80	12.86	2.87	0.42	114.19	119.27	32.06	218.24	8.20	5.67	628.70	29.33	53.85	6.31	25.29
1519D_1H-CC_4-6_10	45.52	12.88	1.74	0.17	100.13	113.13	31.93	214.77	8.50	5.16	606.47	24.58	50.72	5.74	24.61
1519E_1H-2_7-9_1	41.26	12.07	2.42	0.40	106.01	142.10	31.88	225.04	8.55	5.54	613.19	25.26	53.86	6.69	25.08
1519E_1H-2_7-9_2	39.51	12.18	2.47	0.41	103.40	134.73	29.99	208.11	8.26	5.03	592.84	24.48	51.58	6.17	24.97
1519E_1H-2_7-9_8	44.49	13.15	2.59	0.52	113.97	145.19	32.43	229.11	8.91	5.70	640.82	27.05	56.15	6.48	25.72
1519E_1H-2_7-9_9	34.93	12.42	2.70	0.43	99.79	153.99	33.78	224.18	9.18	5.18	682.32	28.64	64.19	6.88	27.59
1519E_1H-2_7-9_10	36.77	11.83	2.31	0.30	104.70	111.97	30.24	209.25	8.11	5.31	613.48	24.71	52.82	6.15	23.83
1519E_1H-3_95-97_1	41.50	12.68	2.50	0.31	107.70	117.94	32.21	221.73	8.30	5.52	666.60	27.56	54.86	6.59	27.35
1519E_1H-3_95-97_2	36.64	11.96	4.13	0.72	98.59	109.34	29.40	201.44	7.72	5.15	590.29	25.39	51.99	6.43	23.87
1519E_1H-3_95-97_3	42.72	12.60	2.25	0.30	108.02	116.65	32.34	227.25	8.38	5.43	645.42	26.94	56.47	6.68	26.07
1519E_1H-3_95-97_6	39.72	12.72	2.62	0.58	105.74	116.06	33.28	229.35	8.19	5.22	640.96	27.53	56.07	6.75	25.11
1519E_1H-3_95-97_9	38.92	12.84	6.19	0.45	107.14	120.39	33.15	226.09	8.70	5.27	630.00	26.69	54.23	6.1	24.17

Appendix A

Supplementary Table S10: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1519.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1519C_14R-2_48-50_1	6.53	0.99	6.22	1.00	6.49	1.43	4.19	0.65	4.19	0.60	5.84	0.717	20.35	11.76	2.82
1519C_14R-2_48-50_10	6.31	0.92	5.77	0.90	5.85	1.26	3.35	0.54	3.99	0.59	5.93	0.697	17.84	10.64	2.45
1519C_14R-2_48-50_12	6.99	1.08	7.15	1.05	6.78	1.43	4.58	0.67	4.67	0.65	6.78	0.823	20.64	12.42	2.92
1519C_16R-1_146-148_3	5.72	1.15	4.95	0.85	5.18	1.11	3.63	0.38	3.69	0.51	6.72	0.534	17.32	10.1	2.56
1519C_16R-1_146-148_4	5.40	1.14	4.66	0.72	5.47	0.98	3.28	0.37	3.30	0.53	6.54	0.642	17.69	10.48	2.68
1519C_16R-1_146-148_6	5.42	1.05	5.29	0.81	5.07	1.00	2.89	0.42	3.50	0.53	6.22	0.559	16.93	9.87	2.55
1519C_16R-1_146-148_9	3.89	0.85	3.92	0.63	3.71	0.80	2.45	0.46	2.59	0.41	4.97	0.559	13.73	7.9	1.96
1519C_17R-1_5-7_1	6.17	1.05	6.15	0.97	6.23	1.35	3.62	0.57	4.21	0.68	6.33	0.655	19.35	12.95	2.75
1519C_17R-1_5-7_3	5.01	1.14	4.77	0.66	4.43	0.92	2.64	0.36	2.79	0.42	4.77	0.526	12.68	8.31	1.85
1519C_17R-1_5-7_4	4.90	0.98	5.05	0.89	5.16	1.17	3.69	0.50	3.72	0.48	5.27	0.802	23.82	10.39	2.48
1519C_17R-1_5-7_7	4.91	0.93	5.57	0.62	4.94	1.00	2.66	0.37	3.29	0.40	5.21	0.647	28.1	10.43	2.2
1519C_18R-5_77-78_1	6.27	0.99	6.59	1.17	7.11	1.65	5.01	0.86	5.49	0.83	7.34	0.776	13.42	9.6	2.11
1519C_18R-5_77-78_3	4.51	0.77	4.40	0.73	4.25	0.91	2.73	0.39	2.82	0.42	4.89	0.518	13.57	8.22	1.971
1519C_18R-5_77-78_5	5.45	0.85	4.12	0.76	4.52	0.88	3.10	0.47	2.99	0.42	4.16	0.589	13.52	8.94	2.08
1519C_18R-5_77-78_8	5.79	1.03	4.71	0.95	5.67	1.11	3.28	0.47	3.12	0.48	6.31	0.59	19.32	9.53	2.7
1519C_18R-5_77-78_10	4.06	0.54	4.37	0.69	4.70	0.88	2.87	0.48	3.35	0.43	3.89	0.642	13.95	10.03	2.32
1519C_18R-7_115-117_1	4.45	0.78	4.29	0.71	4.82	0.93	2.78	0.42	2.53	0.38	4.97	0.488	16.85	8	2.04
1519C_18R-7_115-117_2	2.78	0.55	2.51	0.51	2.84	0.63	1.93	0.29	1.97	0.34	3.90	0.513	16.49	10.88	2.24
1519C_18R-7_115-117_4	5.61	0.70	5.73	0.92	5.23	1.16	3.54	0.50	3.45	0.54	5.19	0.701	24.31	12.21	2.98
1519C_18R-7_115-117_5	3.78	0.74	3.78	0.60	3.70	0.76	2.42	0.34	2.38	0.39	4.21	0.529	15.56	7.21	1.779
1519C_18R-7_115-117_6	6.71	1.15	5.78	0.89	6.07	1.26	3.69	0.51	3.64	0.57	7.00	0.693	17.97	10.97	2.54
1519C_19R-3_33-35_1	6.63	1.33	6.10	0.92	5.83	1.32	3.80	0.61	4.13	0.60	6.45	0.644	16.77	10.77	2.47
1519C_19R-3_33-35_3	5.27	1.23	6.26	0.81	5.05	1.08	3.74	0.56	3.64	0.49	6.71	0.637	17.77	10.34	2.56
1519C_19R-3_33-35_4	5.91	1.28	4.81	0.72	5.34	1.16	3.63	0.58	3.77	0.61	6.75	0.489	15.58	9.5	2.35
1519C_19R-3_33-35_5	5.68	1.25	5.66	0.91	5.75	1.07	3.32	0.46	3.60	0.56	5.98	0.676	17.67	9.77	2.46
1519C_19R-3_33-35_8	5.05	1.17	5.48	0.84	5.06	1.11	3.25	0.38	3.37	0.51	6.14	0.753	15.5	9.64	2.26
1519C_19R-4_35-36_1	3.22	0.37	2.56	0.48	2.64	0.57	1.65	0.25	1.93	0.27	1.55	0.31	10.58	6.54	1.513
1519C_19R-4_35-36_2	4.85	0.36	4.41	0.69	4.45	0.89	2.68	0.46	3.54	0.47	3.66	0.678	19.05	13.29	2.9
1519C_19R-4_35-36_5	5.20	0.85	4.43	0.85	5.17	1.14	3.46	0.56	3.45	0.55	6.02	0.499	17.51	11.08	2.49
1519C_19R-4_35-36_6	5.15	0.57	5.18	0.66	5.07	1.31	2.91	0.61	3.49	0.46	4.11	0.61	15.59	12.02	2.79
1519C_19R-4_35-36_7	4.96	1.14	5.71	0.81	4.66	1.12	3.42	0.48	3.26	0.47	5.91	0.533	15.18	9.5	2.21
1519C_19R-6_74-76_1	6.39	1.03	5.64	0.97	6.15	1.27	3.75	0.60	4.04	0.56	6.15	0.777	20.63	13.21	3.1
1519C_19R-6_74-76_3	6.41	1.00	6.16	0.98	6.43	1.31	3.80	0.56	3.58	0.64	5.51	0.84	20.65	12.74	3.03
1519C_19R-6_74-76_4	5.98	0.89	5.73	0.90	6.04	1.29	3.67	0.57	4.05	0.60	5.47	0.679	19.33	12.74	2.87
1519C_19R-6_74-76_6	5.04	0.90	6.13	0.92	5.59	1.28	3.48	0.49	3.93	0.58	5.18	0.707	19.41	12.36	2.77
1519C_19R-6_74-76_7	5.82	0.76	5.56	0.95	6.16	1.19	3.88	0.52	3.60	0.54	4.93	0.728	19.73	11.93	2.67
1519C_20R-3_29-31_2	6.75	1.21	4.72	0.76	5.21	1.14	3.00	0.56	3.45	0.67	6.67	0.648	16.87	10.26	2.66
1519C_20R-3_29-31_3	4.98	0.83	4.55	0.69	5.16	0.97	3.21	0.42	3.07	0.46	5.13	0.662	20.96	9.47	2.43
1519C_20R-3_29-31_10	5.00	1.01	4.92	0.81	4.81	1.04	3.40	0.45	2.95	0.53	5.66	0.618	17.75	9.73	2.26
1519D_1H-CC_4-6_3	5.55	1.15	5.23	0.86	5.77	1.16	3.66	0.55	3.59	0.58	6.26	0.572	19.11	11.16	2.51
1519D_1H-CC_4-6_4	5.75	1.16	5.37	0.90	5.32	1.18	3.65	0.54	3.56	0.57	6.06	0.625	18.81	10.9	2.33
1519D_1H-CC_4-6_8	6.16	1.17	4.71	0.89	6.18	1.08	3.57	0.45	3.33	0.57	6.17	0.651	18.4	11.44	2.27
1519D_1H-CC_4-6_9	5.63	1.19	5.24	0.90	5.52	1.09	3.37	0.48	3.35	0.51	6.01	0.578	19.69	10.65	3.66
1519D_1H-CC_4-6_10	4.24	1.33	4.10	0.69	5.61	1.19	2.96	0.73	4.56	0.60	5.53	0.58	17.97	9.7	2.05
1519E_1H-2_7-9_1	5.54	1.31	5.49	0.83	4.98	1.00	3.33	0.55	4.19	0.75	5.59	0.59	19.7	9.91	2.56
1519E_1H-2_7-9_2	4.93	1.12	4.91	0.78	5.05	1.06	3.15	0.44	3.28	0.50	5.89	0.593	18.01	9.72	2.28
1519E_1H-2_7-9_8	5.70	1.25	5.64	0.89	5.31	1.21	3.44	0.53	3.58	0.49	6.04	0.732	19.67	10.6	2.51
1519E_1H-2_7-9_9	4.44	1.26	4.88	1.15	6.31	1.43	3.77	0.59	4.51	0.68	6.65	0.72	19.86	11.22	3.1
1519E_1H-2_7-9_10	5.19	1.15	5.03	0.79	5.49	1.12	3.21	0.41	3.97	0.58	5.81	0.673	18.58	10.2	2.64
1519E_1H-3_95-97_1	5.72	1.16	5.87	0.86	5.69	1.30	3.80	0.49	3.27	0.57	5.89	0.605	18.61	10.57	2.31
1519E_1H-3_95-97_2	5.53	0.99	5.03	0.81	5.09	1.08	3.39	0.47	3.58	0.49	6.25	0.52	17.42	9.86	2.24
1519E_1H-3_95-97_3	5.64	1.02	5.77	0.82	5.51	1.13	3.68	0.54	3.53	0.60	6.11	0.578	19.74	11.07	2.43
1519E_1H-3_95-97_6	6.03	0.94	4.82	1.00	6.36	1.28	3.77	0.58	3.32	0.65	6.09	0.569	18.12	10.34	2.35
1519E_1H-3_95-97_9	5.73	1.34	4.90	1.03	6.01	1.34	4.02	0.50	3.96	0.56	6.60	0.576	17.51	11.44	2.25

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1520D-1H-1_15-16-1	4.00	2.66	1.75	71.85	0.23	0.23	1.48	0.07	12.43	0.02	94.72
	1520D-1H-1_15-16-2	4.33	2.81	1.73	74.50	0.19	0.17	1.44	0.05	12.94	0.07	98.22
	1520D-1H-1_15-16-3	4.37	2.61	2.03	74.63	0.24	0.25	1.47	0.17	13.17	0.02	98.97
	1520D-1H-1_15-16-4	3.31	2.55	1.62	67.19	0.19	0.20	1.37	0.06	11.81	0.05	88.35
	1520D-1H-1_15-16-5	4.31	2.78	2.12	75.09	0.25	0.31	1.41	0.08	13.02	0.04	99.41
	1520D-1H-1_15-16-7	4.37	2.60	1.83	74.09	0.24	0.25	1.53	0.06	13.30	0.01	98.27
	1520D-1H-1_15-16-8	4.59	2.78	2.20	74.52	0.26	0.24	1.52	0.13	13.34	0.02	99.60
	1520D-1H-1_15-16-10	3.30	4.15	1.08	74.33	0.14	0.14	0.78	0.00	11.82	0.00	95.73
	1520D-1H-1_15-16-12	3.76	3.96	0.76	76.36	0.05	0.02	0.49	0.07	12.17	0.02	97.66
	1520D-1H-1_15-16-15	3.77	2.77	1.11	74.09	0.11	0.10	1.10	0.07	11.80	0.00	94.92
	1520D-1H-1_15-16-13	4.30	2.88	2.16	74.63	0.26	0.26	1.50	0.15	13.08	0.01	99.23
	1520D-1H-1_16-17-2	4.28	2.81	1.82	72.58	0.24	0.20	1.40	0.09	12.90	0.01	96.34
	1520D-1H-1_16-17-3	3.75	2.84	1.82	70.20	0.24	0.14	1.26	0.00	12.36	0.01	92.62
	1520D-1H-1_16-17-4	4.30	2.76	2.07	72.73	0.26	0.25	1.59	0.00	13.00	0.00	96.96
	1520D-1H-1_16-17-5	4.50	2.79	2.15	72.48	0.26	0.22	1.58	0.01	13.16	0.03	97.19
	1520D-1H-1_16-17-6	4.26	2.69	1.82	71.37	0.24	0.23	1.45	0.02	12.72	0.05	94.85
	1520D-1H-1_16-17-7	4.29	2.76	1.64	73.04	0.16	0.16	1.32	0.14	12.71	0.02	96.24
	1520D-1H-1_16-17-8	4.22	2.66	1.82	73.87	0.19	0.18	1.26	0.01	12.65	0.02	96.87
	1520D-1H-1_16-17-9	4.21	2.95	2.10	74.51	0.24	0.24	1.49	0.05	12.88	0.05	98.73
	1520D-1H-1_16-17-10	4.48	2.76	1.90	73.75	0.25	0.26	1.42	0.05	12.90	0.02	97.79
	1520D-1H-1_16-17-13	4.21	2.68	1.85	73.08	0.25	0.26	1.51	0.08	13.13	0.03	97.08
	1520D-1H-1_16-17-1	3.66	3.54	1.29	74.06	0.07	0.01	0.86	0.00	12.05	0.02	95.57
	1520D-1H-1_16-17-11	3.56	3.23	1.05	74.21	0.14	0.09	1.04	0.06	11.56	0.02	94.95
	1520D-1H-1_16-17-12	3.88	3.19	1.21	76.26	0.11	0.10	1.07	0.03	12.14	0.00	98.00
	1520D-1H-1_16-17-15	4.36	2.78	1.83	74.29	0.26	0.23	1.43	0.12	13.00	0.04	98.34
	1520D-1H-1_46-48-1	4.14	2.73	1.87	74.85	0.19	0.19	1.29	0.06	12.78	0.02	98.13
	1520D-1H-1_46-48-2	4.02	2.83	1.93	73.68	0.22	0.25	1.66	0.12	13.36	0.01	98.08
	1520D-1H-1_46-48-4	4.13	2.82	1.61	74.91	0.19	0.15	1.36	0.04	12.95	0.04	98.19
	1520D-1H-1_46-48-6	4.23	2.80	2.10	73.93	0.25	0.28	1.51	0.07	13.33	0.04	98.55
	1520D-1H-1_46-48-8	4.28	2.81	1.89	74.02	0.23	0.14	1.31	0.04	12.64	0.01	97.36
	1520D-1H-1_46-48-9	4.40	2.72	1.74	74.98	0.19	0.13	1.29	0.10	12.70	0.05	98.29
	1520D-1H-1_46-48-10	4.22	2.86	1.79	75.45	0.19	0.14	1.30	0.06	12.99	0.02	99.02
	1520D-1H-1_46-48-12	4.31	2.72	1.68	75.28	0.20	0.16	1.31	0.03	12.97	0.02	98.68
	1520D-1H-1_46-48-14	3.65	3.56	1.79	71.92	0.14	0.11	1.10	0.11	12.29	0.00	94.66
	1520D-1H-1_46-48-3	3.89	3.86	0.77	76.77	0.07	0.07	0.50	0.00	12.11	0.03	98.07
	1520D-1H-1_46-48-5	3.72	3.86	0.75	75.70	0.07	0.02	0.50	0.08	11.99	0.01	96.69
	1520D-1H-1_46-48-11	2.17	2.85	1.89	76.39	0.18	0.17	1.28	0.12	12.86	0.03	97.94
	1520D-1H-1_46-48-15	4.23	2.86	1.76	74.65	0.26	0.25	1.47	0.16	12.96	0.03	98.63
	1520D-1H-1_71-73-1	4.35	2.77	1.72	74.67	0.21	0.14	1.30	0.16	12.81	0.03	98.16
	1520D-1H-1_71-73-2	4.41	2.79	1.88	72.79	0.21	0.25	1.50	0.11	13.15	0.02	97.10
	1520D-1H-1_71-73-3	4.27	2.87	1.85	73.74	0.23	0.23	1.51	0.14	13.09	0.06	97.99
	1520D-1H-1_71-73-4	4.35	2.82	1.77	75.20	0.24	0.25	1.54	0.11	13.14	0.03	99.45
	1520D-1H-1_71-73-5	4.31	2.77	2.02	74.72	0.21	0.26	1.56	0.14	13.22	0.03	99.24
	1520D-1H-1_71-73-6	4.38	2.83	2.06	73.99	0.25	0.27	1.53	0.08	13.04	0.04	98.47
	1520D-1H-1_71-73-7	4.32	2.67	1.98	73.26	0.25	0.21	1.44	0.09	12.96	0.04	97.22
	1520D-1H-1_71-73-8	3.44	3.34	1.97	70.77	0.10	0.04	1.32	0.15	12.14	0.00	93.26
	1520D-1H-1_71-73-9	4.39	2.89	2.10	74.32	0.28	0.26	1.49	0.08	13.22	0.03	99.05
	1520D-1H-1_71-73-10	4.12	2.78	1.60	73.63	0.23	0.23	1.47	0.06	12.93	0.04	97.09
	1520D-1H-1_71-73-11	4.52	2.77	1.89	74.85	0.24	0.24	1.40	0.05	12.89	0.01	98.86
	1520D-1H-1_71-73-13	4.27	2.71	1.88	74.76	0.24	0.26	1.44	0.02	13.19	0.03	98.80
	1520D-1H-1_71-73-14	4.33	2.80	1.86	74.86	0.29	0.24	1.53	0.02	13.15	0.01	99.09
	1520D-1H-1_86-88-1	4.27	2.84	1.92	74.86	0.26	0.25	1.52	0.11	13.02	0.03	99.07
	1520D-1H-1_86-88-2	4.30	2.79	1.84	74.61	0.20	0.15	1.37	0.02	12.95	0.02	98.24
	1520D-1H-1_86-88-3	3.86	3.08	1.54	72.72	0.30	0.27	1.54	0.10	12.63	0.00	96.04
	1520D-1H-1_86-88-6	4.30	2.77	1.94	74.81	0.24	0.23	1.58	0.15	13.22	0.04	99.29
	1520D-1H-1_86-88-7	4.26	2.75	1.80	74.97	0.19	0.18	1.30	0.14	12.92	0.05	98.56
	1520D-1H-1_86-88-8	4.24	2.79	1.89	74.59	0.27	0.25	1.39	0.08	12.87	0.04	98.41
	1520D-1H-1_86-88-9	4.18	2.82	2.03	74.88	0.26	0.25	1.56	0.03	13.32	0.02	99.36
	1520D-1H-1_86-88-10	3.94	2.66	2.02	71.24	0.19	0.17	1.57	0.04	12.75	0.00	94.58
	1520D-1H-1_86-88-11	4.39	2.87	1.91	73.62	0.25	0.23	1.52	0.10	13.26	0.00	98.14
	1520D-1H-1_86-88-12	3.97	2.76	2.09	74.26	0.19	0.15	1.31	0.10	12.67	0.03	97.54
	1520D-1H-1_86-88-13	4.28	2.79	1.67	74.27	0.19	0.16	1.35	0.18	12.77	0.02	97.67
	1520D-1H-1_86-88-4	3.88	3.96	0.79	76.51	0.05	0.05	0.50	0.03	12.04	0.00	97.81
	1520D-1H-1_86-88-5	2.98	4.14	0.96	71.68	0.06	0.01	0.63	0.08	11.81	0.02	92.37
	1520D-1H-1_86-88-15	3.65	3.12	1.15	76.19	0.10	0.11	0.96	0.02	11.83	0.04	97.17
	1520D-1H-1_86-88-14	4.08	2.67	2.13	71.55	0.24	0.24	1.49	0.07	12.43	0.04	94.94
s1	1520D-1H-1_119-120-1	4.10	2.68	1.86	71.78	0.28	0.24	1.47	0.05	12.86	0.02	95.34
	1520D-1H-1_119-120-2	4.14	2.71	0.74	73.15	0.26	0.23	1.43	0.00	12.91	0.05	95.62
	1520D-1H-1_119-120-3	4.25	2.77	2.12	72.84	0.25	0.23	1.50	0.04	13.05	0.04	97.08
	1520D-1H-1_119-120-9	4.26	2.64	1.89	74.61	0.22	0.26	1.48	0.02	13.19	0.05	98.63

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1520D-1H-1_119-120-10	4.28	2.72	2.13	74.81	0.23	0.28	1.50	0.06	13.13	0.03	99.17
	1520D-1H-1_119-120-11	4.44	2.69	1.82	73.85	0.24	0.24	1.46	0.11	12.99	0.01	97.84
	1520D-1H-1_119-120-12	4.26	2.79	1.95	75.05	0.28	0.28	1.54	0.16	13.25	0.03	99.59
	1520D-1H-1_119-120-13	4.25	2.71	2.11	74.54	0.27	0.21	1.49	0.13	13.57	0.05	99.33
	1520D-1H-1_119-120-14	4.17	2.58	2.01	74.17	0.25	0.26	1.52	0.12	13.10	0.01	98.19
	1520D-1H-1_119-120-15	4.12	2.74	1.71	75.18	0.17	0.17	1.35	0.09	12.64	0.03	98.20
	1520D-1H-2_67-69-1	4.39	2.82	1.77	74.64	0.18	0.16	1.28	0.10	12.64	0.03	98.02
	1520D-1H-2_67-69-2	4.20	2.77	1.88	73.79	0.18	0.16	1.35	0.09	12.77	0.07	97.26
	1520D-1H-2_67-69-3	3.77	2.51	1.56	69.03	0.18	0.18	1.20	0.02	11.69	0.04	90.18
	1520D-1H-2_67-69-4	4.21	2.76	1.82	74.22	0.17	0.13	1.32	0.13	12.79	0.02	97.58
	1520D-1H-2_67-69-6	4.36	2.78	1.79	74.23	0.20	0.22	1.28	0.00	12.65	0.02	97.54
	1520D-1H-2_67-69-7	4.26	2.80	1.86	74.53	0.15	0.13	1.30	0.09	12.63	0.02	97.77
	1520D-1H-2_67-69-8	4.35	2.75	1.76	75.13	0.21	0.16	1.35	0.00	12.93	0.01	98.65
	1520D-1H-2_67-69-12	4.29	2.78	1.75	73.32	0.18	0.17	1.31	0.10	12.66	0.03	96.59
	1520D-1H-2_67-69-13	4.30	2.65	1.66	72.09	0.21	0.17	1.27	0.09	12.51	0.00	94.96
	1520D-1H-2_67-69-9	3.17	2.79	1.34	69.61	0.12	0.10	1.19	0.10	11.85	0.00	90.27
	1520D-1H-2_67-69-14	4.28	2.77	1.73	73.12	0.18	0.19	1.31	0.07	12.73	0.02	96.39
	1520D-1H-2_67-69-15	4.42	2.76	1.75	73.50	0.18	0.15	1.31	0.10	12.59	0.02	96.79
	1520D-1H-2_81-83-1	4.54	2.69	1.68	74.87	0.17	0.19	1.32	0.07	12.91	0.01	98.44
	1520D-1H-2_81-83-2	4.21	2.73	1.63	74.44	0.19	0.16	1.25	0.07	12.70	0.05	97.43
	1520D-1H-2_81-83-3	4.21	2.76	1.78	73.23	0.19	0.15	1.27	0.18	12.58	0.02	96.37
	1520D-1H-2_81-83-4	4.20	2.70	1.81	73.92	0.21	0.16	1.25	0.10	12.51	0.00	96.85
	1520D-1H-2_81-83-5	4.10	2.80	1.58	74.98	0.19	0.19	1.28	0.04	12.78	0.00	97.94
	1520D-1H-2_81-83-6	4.15	2.60	1.93	74.16	0.20	0.18	1.28	0.14	12.84	0.02	97.50
	1520D-1H-2_81-83-7	4.30	2.77	1.77	74.65	0.20	0.16	1.34	0.05	12.82	0.05	98.11
	1520D-1H-2_81-83-8	4.30	2.69	1.98	74.50	0.18	0.21	1.30	0.11	12.73	0.03	98.04
	1520D-1H-2_81-83-9	4.20	2.71	1.86	73.86	0.20	0.15	1.32	0.09	12.62	0.00	97.01
	1520D-1H-2_81-83-10	4.11	2.88	1.91	74.89	0.15	0.19	1.29	0.03	12.94	0.02	98.42
	1520D-1H-2_81-83-11	4.41	2.73	1.98	73.97	0.20	0.15	1.31	0.05	12.91	0.02	97.73
	1520D-1H-2_81-83-12	4.24	2.70	1.92	74.61	0.20	0.16	1.35	0.09	12.76	0.03	98.06
	1520D-1H-2_81-83-13	4.20	2.78	1.80	75.31	0.19	0.15	1.28	0.13	13.06	0.02	98.92
	1520D-1H-2_81-83-14	4.34	2.66	1.86	74.20	0.19	0.17	1.25	0.04	12.54	0.03	97.27
	1520D-1H-2_81-83-15	3.85	2.67	1.61	69.93	0.20	0.16	1.20	0.04	11.95	0.00	91.62
	1520D-1H-3_14-15-1	4.23	2.68	1.95	74.18	0.17	0.14	1.30	0.00	12.78	0.05	97.48
	1520D-1H-3_14-15-2	4.02	2.75	1.83	74.65	0.21	0.18	1.33	0.04	12.84	0.05	97.89
	1520D-1H-3_14-15-3	4.24	2.72	1.83	73.94	0.18	0.15	1.28	0.05	12.76	0.05	97.20
	1520D-1H-3_14-15-4	4.22	2.76	1.71	74.47	0.19	0.14	1.28	0.08	12.82	0.06	97.74
	1520D-1H-3_14-15-5	4.22	2.77	1.82	74.81	0.19	0.17	1.28	0.00	12.69	0.06	98.02
	1520D-1H-3_14-15-6	4.16	2.77	1.87	75.14	0.18	0.19	1.30	0.14	12.90	0.02	98.67
	1520D-1H-3_14-15-7	4.28	2.84	1.93	74.69	0.22	0.14	1.22	0.08	12.66	0.00	98.05
	1520D-1H-3_14-15-8	4.16	2.72	1.67	75.08	0.20	0.16	1.34	0.12	13.00	0.01	98.46
	1520D-1H-3_14-15-9	4.34	2.77	1.91	74.36	0.18	0.20	1.29	0.04	12.74	0.00	97.83
	1520D-1H-3_14-15-10	4.32	2.79	1.94	75.17	0.21	0.19	1.30	0.02	12.84	0.01	98.79
	1520D-1H-3_14-15-11	4.24	2.75	1.66	74.28	0.20	0.18	1.33	0.09	12.70	0.00	97.43
	1520D-1H-3_14-15-12	4.24	2.76	1.73	75.02	0.24	0.17	1.34	0.08	12.94	0.03	98.55
	1520D-1H-3_14-15-13	4.04	2.83	1.93	74.64	0.20	0.17	1.31	0.10	12.93	0.01	98.16
	1520D-1H-3_14-15-14	4.17	2.75	1.89	74.70	0.19	0.18	1.31	0.08	12.69	0.04	98.00
	1520D-1H-3_14-15-15	4.10	2.84	1.94	75.29	0.19	0.17	1.28	0.03	13.00	0.02	98.85
	1520D-1H-3_19-21-1	4.24	2.68	1.78	73.95	0.18	0.17	1.28	0.15	12.66	0.03	97.12
	1520D-1H-3_19-21-2	3.48	3.90	1.71	74.33	0.18	0.20	1.31	0.11	12.77	0.01	98.00
	1520D-1H-3_19-21-3	4.38	2.69	1.83	74.15	0.15	0.17	1.35	0.09	12.59	0.00	97.40
	1520D-1H-3_19-21-4	4.29	2.69	1.88	74.71	0.18	0.20	1.28	0.10	12.66	0.02	98.01
	1520D-1H-3_19-21-5	4.19	2.75	1.89	74.91	0.20	0.15	1.25	0.02	12.94	0.02	98.32
	1520D-1H-3_19-21-6	4.38	2.65	1.95	74.26	0.19	0.18	1.25	0.06	12.71	0.01	97.64
	1520D-1H-3_19-21-7	4.22	2.71	1.80	74.10	0.18	0.15	1.24	0.06	12.86	0.03	97.34
	1520D-1H-3_19-21-8	4.46	2.63	1.70	72.87	0.19	0.17	1.25	0.07	12.66	0.01	96.01
	1520D-1H-3_19-21-9	4.40	2.77	1.94	74.92	0.20	0.16	1.26	0.17	13.01	0.02	98.85
	1520D-1H-3_19-21-10	4.01	2.72	1.81	73.76	0.20	0.18	1.27	0.13	12.62	0.02	96.72
	1520D-1H-3_19-21-11	4.24	2.77	1.85	74.06	0.18	0.18	1.23	0.00	12.61	0.02	97.15
	1520D-1H-3_19-21-12	4.25	2.84	1.91	75.26	0.19	0.16	1.25	0.10	12.89	0.01	98.86
	1520D-1H-3_19-21-13	4.50	2.73	1.85	74.20	0.20	0.18	1.37	0.17	13.07	0.00	98.26
	1520D-1H-3_19-21-14	4.08	2.73	1.99	74.18	0.16	0.19	1.24	0.05	12.68	0.03	97.32
	1520D-1H-3_19-21-15	4.45	2.83	1.88	74.83	0.17	0.16	1.32	0.09	13.04	0.03	98.80
s2	1520D-1H-3_26-30-2	4.20	2.72	1.81	74.66	0.19	0.15	1.26	0.19	12.90	0.03	98.11
	1520D-1H-3_26-30-3	3.97	2.79	1.61	73.43	0.19	0.14	1.18	0.11	12.67	0.00	96.08
	1520D-1H-3_26-30-4	4.36	2.82	1.72	74.91	0.18	0.16	1.32	0.13	12.78	0.02	98.41
	1520D-1H-3_26-30-5	4.31	2.77	1.71	74.42	0.20	0.19	1.29	0.10	12.65	0.04	97.69
	1520D-1H-3_26-30-6	4.33	2.82	1.70	74.84	0.18	0.13	1.29	0.09	12.78	0.05	98.21
	1520D-1H-3_26-30-7	4.11	2.62	1.89	71.90	0.21	0.18	1.30	0.10	12.41	0.05	94.77
	1520D-1H-3_26-30-8	4.17	2.79	1.71	73.62	0.20	0.14	1.28	0.21	12.75	0.00	96.87

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s3	1520D-1H-3_26-30-9	4.08	2.74	1.94	73.07	0.34	0.19	1.30	0.11	12.69	0.06	96.52
	1520D-1H-3_26-30-10	4.20	2.83	1.67	73.62	0.21	0.17	1.32	0.13	12.67	0.01	96.83
	1520D-1H-3_26-30-12	4.24	2.79	1.84	74.88	0.18	0.16	1.31	0.11	12.91	0.01	98.44
	1520D-1H-3_26-30-13	4.40	2.77	1.72	74.64	0.19	0.17	1.32	0.09	12.79	0.06	98.15
	1520D-1H-3_26-30-14	4.27	2.80	1.85	74.28	0.22	0.17	1.34	0.08	12.88	0.03	97.91
	1520D-1H-3_26-30-15	4.01	2.82	1.95	74.89	0.21	0.14	1.33	0.13	12.62	0.00	98.10
	1520D-1H-3_67-69-1	3.45	3.71	1.07	74.99	0.11	0.12	0.95	0.02	11.95	0.00	96.38
	1520D-1H-3_67-69-4	3.27	3.96	1.30	73.09	0.05	0.03	0.79	0.07	11.62	0.02	94.20
	1520D-1H-3_67-69-5	3.53	3.02	1.17	74.01	0.12	0.09	1.09	0.06	11.91	0.00	95.00
	1520D-1H-3_67-69-6	3.45	3.03	1.34	74.28	0.13	0.11	1.06	0.00	11.68	0.01	95.08
	1520D-1H-3_67-69-8	3.51	3.38	1.04	73.45	0.07	0.08	0.79	0.05	11.57	0.00	93.93
	1520D-1H-3_67-69-9	3.36	3.29	1.01	73.55	0.16	0.17	0.96	0.01	11.50	0.05	94.06
	1520D-1H-3_67-69-10	3.62	3.44	1.29	71.79	0.10	0.06	0.86	0.00	11.84	0.00	93.01
	1520D-1H-3_67-69-11	3.54	3.40	1.42	73.43	0.06	0.09	1.08	0.07	11.82	0.05	94.96
	1520D-1H-3_67-69-12	3.71	3.63	0.94	74.21	0.07	0.06	0.65	0.07	11.73	0.00	95.07
	1520D-1H-3_67-69-13	3.65	3.56	0.82	74.88	0.10	0.10	0.63	0.01	11.79	0.00	95.54
	1520D-1H-3_67-69-14	3.58	2.09	1.10	72.68	0.15	0.28	1.49	0.11	11.86	0.08	93.42
	1520D-1H-3_67-69-15	3.83	3.38	1.43	73.37	0.12	0.09	0.94	0.02	11.67	0.00	94.85
	1520D-1H-4_35-37-13	4.66	4.21	2.62	67.12	0.45	0.73	2.33	0.13	16.16	0.15	98.57
	1520D-1H-4_35-37-14	4.89	4.49	2.17	67.15	0.43	0.55	1.86	0.04	15.87	0.11	97.56
	1520D-1H-4_35-37-15	4.85	4.24	2.61	66.42	0.46	0.87	2.24	0.20	16.11	0.15	98.15
s5	1520D-1H-4_87-90-1	3.62	3.39	1.44	74.37	0.17	0.16	0.88	0.08	11.79	0.01	95.90
	1520D-1H-4_87-90-2	4.27	3.18	1.00	78.42	0.10	0.13	0.80	0.00	12.39	0.00	100.29
	1520D-1H-4_87-90-3	3.93	3.24	0.99	76.79	0.11	0.09	0.79	0.05	12.28	0.04	98.31
	1520D-1H-4_87-90-4	3.77	2.86	1.17	73.06	0.09	0.10	1.00	0.08	11.79	0.00	93.91
	1520D-1H-4_87-90-5	3.47	2.86	1.29	74.14	0.11	0.12	1.00	0.02	11.92	0.00	94.92
	1520D-1H-4_87-90-7	2.94	4.52	1.12	75.10	0.14	0.09	0.66	0.02	11.90	0.00	96.48
	1520D-1H-4_87-90-8	3.52	3.37	1.14	74.88	0.13	0.12	0.96	0.07	11.76	0.00	95.95
	1520D-1H-4_87-90-9	3.68	2.73	1.02	74.75	0.11	0.08	0.99	0.06	11.61	0.00	95.02
	1520D-1H-4_87-90-11	3.71	3.54	1.09	74.93	0.14	0.09	0.79	0.00	11.75	0.00	96.04
	1520D-1H-4_87-90-12	3.45	3.85	0.99	74.69	0.08	0.10	0.75	0.13	11.99	0.02	96.04
	1520D-1H-4_87-90-13	3.48	3.66	1.02	74.89	0.15	0.08	0.77	0.03	11.78	0.03	95.88
	1520D-1H-4_87-90-14	4.15	3.19	0.94	76.70	0.12	0.11	0.77	0.08	11.99	0.04	98.09
	1520D-1H-4_87-90-15	4.06	3.15	0.78	75.60	0.11	0.09	0.75	0.09	12.03	0.00	96.65
	1520D-2H-1_15-19-1	3.95	2.70	1.71	72.36	0.16	0.18	1.46	0.09	12.68	0.03	95.32
	1520D-2H-1_15-19-2	4.02	2.75	1.57	72.62	0.19	0.19	1.47	0.00	12.73	0.04	95.58
s6	1520D-2H-1_15-19-3	3.74	2.71	1.65	71.35	0.18	0.13	1.44	0.06	12.63	0.00	93.88
	1520D-2H-1_15-19-4	3.89	2.80	1.61	74.21	0.18	0.17	1.48	0.08	13.06	0.03	97.51
	1520D-2H-1_15-19-5	4.03	2.80	1.86	74.23	0.17	0.21	1.50	0.03	12.93	0.01	97.78
	1520D-2H-1_15-19-6	4.23	2.79	1.59	73.68	0.16	0.18	1.47	0.12	13.08	0.05	97.35
	1520D-2H-1_15-19-8	4.12	2.77	1.76	73.91	0.18	0.19	1.49	0.05	12.86	0.02	97.35
	1520D-2H-1_15-19-9	4.09	2.82	1.84	73.48	0.17	0.18	1.46	0.08	12.78	0.03	96.93
	1520D-2H-1_15-19-10	3.98	2.79	1.68	72.94	0.21	0.19	1.49	0.03	12.81	0.01	96.13
	1520D-2H-1_15-19-15	4.04	2.77	1.75	74.53	0.16	0.15	1.47	0.03	12.95	0.04	97.89
	1520D-2H-1_15-19-11	3.98	2.80	1.81	71.90	0.17	0.18	1.42	0.08	12.67	0.03	95.05
	1520D-2H-1_15-19-12	4.27	2.71	1.77	75.10	0.20	0.19	1.49	0.06	13.07	0.04	98.90
	1520D-2H-1_15-19-13	3.85	2.78	1.58	71.42	0.16	0.18	1.42	0.04	12.66	0.00	94.09
	1520D-2H-1_15-19-14	4.15	2.80	1.64	73.71	0.18	0.17	1.53	0.02	13.01	0.00	97.21
	U1520D_2H-3_74-75_1	3.26	2.10	6.82	61.38	0.96	2.85	6.29	0.11	15.57	0.16	99.50
	U1520D_2H-3_74-75_3	3.35	2.18	7.31	61.35	0.99	2.99	6.23	0.14	14.76	0.15	99.45
	U1520D_2H-3_74-75_5	3.36	2.14	6.65	60.83	0.89	2.80	6.27	0.06	15.03	0.16	98.19
s7	U1520D_2H-3_74-75_6	3.54	1.87	7.60	62.17	0.98	2.44	6.17	0.17	15.67	0.20	100.81
	U1520D_2H-3_74-75_7	3.41	2.39	6.13	63.11	0.94	2.33	5.57	0.10	15.35	0.26	99.58
	U1520D_2H-3_74-75_8	3.34	2.12	7.05	60.89	0.95	2.84	6.33	0.11	15.56	0.21	99.39
	U1520D_2H-3_74-75_10	3.52	2.05	7.09	60.89	0.89	2.95	6.45	0.14	15.48	0.18	99.63
	U1520D_2H-3_74-75_11	3.48	2.04	6.96	61.33	0.89	2.85	6.46	0.06	15.50	0.19	99.76
	U1520D_2H-3_74-75_12	3.51	1.97	7.19	60.41	0.97	2.92	6.75	0.08	15.18	0.18	99.16
	U1520D_2H-3_74-75_13	3.75	2.30	6.78	61.73	0.96	2.51	5.79	0.13	15.04	0.15	99.13
	U1520D_2H-3_74-75_14	3.38	2.46	5.88	63.71	0.97	2.03	5.25	0.13	14.88	0.17	98.86
	U1520D_2H-3_74-75_15	3.68	2.38	5.93	62.64	0.87	2.46	5.74	0.04	15.41	0.18	99.34
	U1520D_2H-3_74-75_16	3.37	1.92	6.64	61.27	0.92	2.71	6.71	0.15	15.99	0.14	99.82
	U1520D_2H-3_74-75_17	3.55	2.21	6.49	61.76	0.95	2.56	6.21	0.14	15.69	0.16	99.71
	U1520D_2H-3_74-75_18	3.35	2.07	7.08	61.01	0.90	2.87	6.55	0.18	15.59	0.19	99.74
	U1520D_2H-3_74-75_19	3.61	2.57	5.54	64.34	0.89	2.00	5.11	0.09	15.00	0.19	99.34
	U1520D_2H-3_74-75_20	3.59	1.93	6.89	61.15	0.87	2.84	6.74	0.16	16.06	0.17	100.41
	1520D 2H-3 74-75_1	2.99	2.32	7.98	61.49	0.83	4.93	4.85	0.16	13.77	0.15	99.48
	1520D 2H-3 74-75_3	3.43	2.10	6.91	60.15	0.91	2.86	6.53	0.12	16.46	0.16	99.62
	1520D 2H-3 74-75_6	3.31	2.12	7.13	60.85	0.88	2.75	6.48	0.16	16.15	0.17	100.00
	1520D 2H-3 74-75_7	3.44	2.11	6.95	60.00	0.91	2.83	6.46	0.10	16.55	0.19	99.53
	1520D 2H-3 74-75_2	3.32	2.12	7.66	60.31	0.92	3.09	6.52	0.08	16.39	0.08	100.49

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s8	1520D-2H-3_74-75_4	3.70	1.85	6.30	60.93	0.82	2.48	6.82	0.08	17.67	0.17	100.82
	1520D-2H-3_74-75_10	3.49	2.07	6.96	60.05	0.94	2.88	6.43	0.06	16.29	0.12	99.29
	1520D-2H-3_75-75-2	3.49	2.08	6.15	59.81	0.92	2.76	6.27	0.12	15.95	0.14	97.69
	1520D-2H-3_75-75-4	3.64	2.31	6.11	60.12	0.94	2.49	5.77	0.11	15.99	0.16	97.64
	1520D-2H-3_75-75-5	3.51	2.16	6.51	60.54	0.93	2.55	5.98	0.11	16.29	0.19	98.77
	1520D-2H-3_75-75-9	3.31	2.06	7.30	59.52	0.92	2.78	6.23	0.11	15.87	0.18	98.29
	1520D-2H-3_75-75-12	3.38	2.19	6.73	60.23	0.97	2.73	5.94	0.14	16.01	0.16	98.48
	1520D-2H-3_75-75-14	3.06	2.08	7.45	59.60	0.98	2.94	6.20	0.18	15.47	0.22	98.17
	1520D-2H-3_75-75-15	3.52	1.91	6.31	61.00	0.94	2.65	6.45	0.09	16.33	0.18	99.39
	1520D-4H-4_117-119-3	3.91	3.06	4.48	67.88	0.68	0.88	3.24	0.05	14.55	0.16	98.89
	1520D-4H-4_117-119-4	3.91	3.02	4.24	66.99	0.73	0.83	3.09	0.14	14.62	0.08	97.65
	1520D-4H-4_117-119-5	4.00	2.89	4.10	67.02	0.72	0.95	3.42	0.12	14.71	0.15	98.08
	1520D-4H-4_117-119-6	3.72	2.58	5.06	64.66	0.88	1.44	4.21	0.07	15.20	0.14	97.96
	1520D-4H-4_117-119-7	4.10	2.94	4.59	66.84	0.72	0.93	3.32	0.08	14.48	0.16	98.15
	1520D-4H-4_117-119-8	4.19	2.67	4.55	65.00	0.81	1.12	4.29	0.12	15.67	0.19	98.61
	1520D-4H-4_117-119-10	3.76	2.51	5.19	63.86	0.76	1.57	4.34	0.09	15.64	0.15	97.88
	1520D-4H-4_117-119-14	3.86	3.02	4.65	66.86	0.71	0.83	3.08	0.15	14.27	0.17	97.59
	U1520D_13H-7_5-7_1	3.53	3.20	1.52	75.41	0.17	0.12	1.01	0.05	11.51	0.01	96.51
	U1520D_13H-7_5-7_2	3.63	1.71	5.33	60.75	0.85	1.48	7.22	0.06	17.67	0.19	98.90
	U1520D_14H-1_37-38_1	4.52	2.29	2.08	71.25	0.36	0.30	1.36	0.16	12.32	0.03	94.67
	U1520D_14H-1_37-38_2	2.77	4.24	0.98	73.24	0.10	0.12	0.88	0.05	11.58	0.00	93.96
	U1520D_14H-1_37-38_3	3.17	4.28	1.29	75.08	0.13	0.09	0.84	0.04	11.91	0.00	96.83
	U1520D_14H-1_37-38_4	4.11	2.54	4.44	67.72	0.54	0.82	3.47	0.19	14.65	0.12	98.60
	U1520D_14H-1_37-38_5	4.36	2.02	5.40	63.91	0.74	1.16	4.92	0.16	16.10	0.13	98.90
	U1520D_14H-1_37-38_6	3.82	3.27	1.48	73.98	0.13	0.16	0.91	0.11	11.72	0.01	95.59
	U1520D_14H-1_37-38_10	4.13	2.48	4.59	67.09	0.58	0.92	3.57	0.04	14.99	0.11	98.49
	U1520D_14H-1_66-68_1	4.02	3.18	1.90	73.25	0.16	0.10	0.92	0.06	11.88	0.00	95.49
	U1520D_14H-1_66-68_4	3.08	3.91	1.15	73.26	0.10	0.15	1.00	0.01	11.68	0.01	94.34
	U1520D_14H-1_80-81_1	3.73	3.39	1.14	74.80	0.14	0.11	0.94	0.05	11.44	0.00	95.74
	U1520D_14H-1_80-81_2	3.41	3.86	1.08	75.11	0.08	0.05	0.68	0.09	11.22	0.00	95.58
	U1520D_14H-1_80-81_3	3.82	3.19	1.27	74.68	0.15	0.11	1.15	0.05	11.74	0.02	96.18
	U1520D_14H-1_80-81_5	3.53	3.57	1.27	74.95	0.10	0.08	1.01	0.10	11.32	0.01	95.95
	U1520D_14H-1_80-81_6	3.51	3.88	0.89	74.97	0.06	0.06	0.58	0.10	11.42	0.02	95.48
	U1520D_14H-1_80-81_8	3.76	3.39	1.09	75.85	0.10	0.04	0.77	0.04	11.45	0.01	96.50
	U1520D_14H-1_80-81_9	3.78	3.61	1.05	75.45	0.11	0.07	0.61	0.05	11.18	0.00	95.90
	U1520D_14H-1_80-81_11	3.78	3.72	2.05	73.15	0.12	0.10	1.24	0.05	12.04	0.04	96.29
	U1520D_14H-1_80-81_12	4.22	2.50	1.78	71.25	0.17	0.14	1.31	0.05	11.95	0.02	93.39
	U1520D_14H-1_80-81_13	3.52	3.22	2.20	72.57	0.13	0.13	1.49	0.04	12.18	0.02	95.50
	U1520D_14H-1_80-81_14	3.72	3.74	1.20	75.14	0.11	0.08	0.73	0.09	11.54	0.00	96.35
	U1520D_14H-1_80-81_15	3.89	3.37	1.62	73.73	0.13	0.09	0.98	0.03	11.99	0.04	95.86
	U1520D_14H-1_80-81_16	3.93	3.27	1.34	74.76	0.10	0.08	0.69	0.00	11.32	0.02	95.51
	U1520D_14H-1_80-81_17	3.47	3.43	1.12	75.24	0.14	0.07	0.67	0.00	11.43	0.00	95.57
	U1520D_14H-7_12-14_1	3.23	4.00	1.21	73.97	0.08	0.07	0.82	0.02	11.11	0.00	94.51
	U1520D_14H-7_12-14_2	3.78	3.47	2.02	73.04	0.12	0.07	1.23	0.09	11.82	0.00	95.65
	U1520D_14H-7_12-14_3	3.91	3.15	2.57	71.96	0.21	0.17	1.75	0.08	12.79	0.04	96.62
	U1520D_14H-7_12-14_4	3.70	3.42	2.12	74.05	0.10	0.06	1.20	0.00	11.84	0.01	96.50
	U1520D_14H-7_12-14_6	3.50	3.47	1.33	72.47	0.07	0.10	0.87	0.08	11.70	0.05	93.64
	U1520D_14H-7_12-14_7	2.79	4.27	1.13	75.24	0.13	0.12	0.84	0.07	11.42	0.00	96.01
	U1520D_14H-7_12-14_8	3.37	3.56	1.23	74.65	0.09	0.06	0.98	0.04	11.45	0.00	95.42
	U1520D_14H-7_12-14_9	3.75	3.53	1.19	74.91	0.13	0.10	0.88	0.03	11.81	0.02	96.34
	U1520D_14H-7_12-14_10	3.54	3.23	1.01	75.44	0.13	0.07	0.95	0.08	11.45	0.00	95.90
	U1520D_14H-7_12-14_11	3.44	3.71	1.41	72.51	0.11	0.09	0.75	0.05	11.69	0.00	93.77
	U1520D_14H-7_12-14_12	3.89	3.09	2.17	72.65	0.10	0.08	1.03	0.13	11.96	0.00	95.11
	U1520D_14H-7_12-14_14	3.76	3.18	1.34	73.94	0.14	0.09	0.95	0.03	11.50	0.03	94.96
	U1520D_14H-7_12-14_15	3.53	3.53	1.05	74.37	0.09	0.05	0.83	0.02	11.39	0.03	94.89
	U1520D_14H-7_12-14_17	3.36	3.87	1.57	72.34	0.10	0.06	0.86	0.03	10.83	0.00	93.02
	U1520D_14H-7_12-14_18	3.81	3.45	1.57	74.78	0.06	0.04	0.87	0.08	12.09	0.00	96.76
	U1520D_14H-7_12-14_20	3.94	3.21	1.68	72.05	0.16	0.11	1.09	0.00	12.07	0.01	94.32
	U1520D_15H-1_54-55_1	3.61	3.19	1.34	73.94	0.15	0.11	1.14	0.00	11.85	0.05	95.38
	U1520D_15H-1_54-55_2	3.41	2.90	1.30	71.11	0.20	0.19	1.29	0.02	11.94	0.05	92.41
	U1520D_15H-1_54-55_3	3.69	3.24	1.11	73.67	0.13	0.12	1.07	0.02	11.94	0.02	95.01
	U1520D_15H-1_54-55_4	3.41	3.08	1.24	74.47	0.16	0.14	1.10	0.06	11.87	0.00	95.52
	U1520D_15H-1_54-55_5	3.61	3.17	1.19	73.37	0.17	0.09	1.08	0.05	11.53	0.02	94.28
	U1520D_15H-1_54-55_6	3.51	3.20	1.06	74.03	0.16	0.19	1.06	0.04	11.88	0.00	95.14
	U1520D_15H-1_54-55_7	3.46	3.15	1.17	73.61	0.14	0.07	0.93	0.00	11.51	0.04	94.07
	U1520D_15H-1_54-55_8	3.50	3.18	1.10	73.68	0.15	0.11	1.13	0.00	11.92	0.00	94.77
	U1520D_15H-1_54-55_9	3.38	3.18	1.13	74.06	0.18	0.13	1.02	0.02	11.78	0.03	94.91
	U1520D_15H-1_54-55_10	3.52	3.22	0.85	73.63	0.16	0.10	1.04	0.06	11.93	0.00	94.51
	U1520D_15H-1_54-55_11	3.17	2.92	5.97	66.07	0.94	0.55	3.61	0.03	13.38	0.14	96.78
	U1520D_15H-1_54-55_12	3.84	3.65	1.08	75.38	0.09	0.08	0.77	0.01	11.85	0.01	96.77

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	U1520D_15H-1_54-55_13	3.31	3.18	1.15	74.24	0.16	0.13	1.08	0.05	11.84	0.01	95.15
	U1520D_15H-1_54-55_14	3.59	3.18	1.26	74.71	0.15	0.14	1.05	0.07	11.91	0.02	96.09
	U1520D_15H-1_54-55_15	3.49	3.12	1.20	74.00	0.16	0.19	1.17	0.06	11.58	0.04	95.02
	U1520D_15H-1_54-55_16	3.52	3.21	1.27	74.39	0.14	0.13	1.09	0.05	11.82	0.00	95.61
	U1520D_15H-1_54-55_17	3.71	3.13	1.26	74.41	0.16	0.16	1.13	0.05	11.93	0.00	95.94
	U1520D_15H-1_54-55_18	3.71	3.15	1.29	74.42	0.16	0.15	1.05	0.04	11.72	0.04	95.73
	U1520D_15H-1_54-55_19	3.47	3.18	1.15	74.27	0.18	0.16	1.11	0.03	11.95	0.01	95.51
	U1520D_15H-1_54-55_20	3.74	3.17	1.20	74.10	0.16	0.14	1.08	0.00	11.84	0.02	95.46
	1520D_15H-1_54-55_1	3.81	3.25	1.32	73.85	0.27	0.15	1.07	0.02	12.11	0.06	95.90
	1520D_15H-1_54-55_9	3.41	2.79	1.15	71.81	0.26	0.09	1.00	0.06	11.55	0.03	92.15
	1520D_15H-1_54-55_4	3.18	3.06	1.05	72.15	0.22	0.10	1.04	0.09	11.52	0.02	92.43
	1520D_15H-1_54-55_5	3.34	3.20	1.10	73.05	0.21	0.08	1.02	0.00	11.71	0.00	93.70
	1520D_15H-1_54-55_2	3.62	3.14	1.02	72.61	0.21	0.13	1.09	0.00	11.92	0.02	93.76
	1520D_15H-1_54-55_7	3.72	3.10	1.06	72.36	0.23	0.10	1.05	0.07	11.57	0.04	93.31
	U1520D_15H-1_104-105_1	4.00	1.58	6.14	62.86	0.79	2.44	5.62	0.02	15.89	0.08	99.42
	U1520D_15H-1_104-105_4	3.48	3.96	1.24	75.24	0.09	0.08	0.68	0.01	11.27	0.01	96.05
	U1520D_15H-1_104-105_6	4.07	1.49	5.75	61.99	0.80	2.70	5.81	0.12	16.10	0.12	98.95
	U1520D_15H-1_104-105_8	4.22	1.21	5.53	60.35	0.69	2.43	7.19	0.09	18.26	0.10	100.06
	U1520D_15H-1_104-105_10	4.46	1.06	2.72	60.84	0.40	0.91	7.19	0.06	18.87	0.05	96.56
	U1520D_15H-1_104-105_11	3.45	3.05	5.61	63.81	0.95	1.78	4.96	0.14	14.37	0.25	98.37
	U1520D_15H-1_104-105_13	4.04	1.45	6.76	60.45	0.83	3.06	6.37	0.11	16.63	0.15	99.85
	U1520D_15H-1_104-105_14	3.91	1.35	6.91	60.51	0.91	2.94	5.85	0.07	16.19	0.12	98.77
	U1520D_15H-1_104-105_15	4.23	1.23	5.15	61.20	0.69	1.99	6.95	0.12	18.21	0.08	99.84
	U1520D_15H-1_104-105_16	4.03	1.59	6.95	62.02	0.89	3.08	5.38	0.11	15.34	0.10	99.49
	U1520D_15H-1_104-105_17	5.14	3.41	2.64	67.37	0.43	0.61	2.91	0.09	15.88	0.07	98.55
	U1520D_15H-1_104-105_18	4.23	1.35	6.79	60.98	0.84	2.92	6.12	0.12	15.71	0.11	99.16
	U1520D_15H-1_104-105_19	4.03	1.44	7.03	60.71	0.79	2.97	6.12	0.12	16.02	0.09	99.33
	U1520D_15H-1_104-105_20	4.04	2.85	2.66	71.63	0.22	0.21	1.91	0.05	12.66	0.01	96.24
	U1520D_15H-2_103-105_1	3.78	3.06	1.37	73.96	0.22	0.24	1.46	0.07	11.88	0.01	96.04
	U1520D_15H-2_103-105_2	4.04	3.48	1.37	73.89	0.12	0.11	0.87	0.10	11.55	0.00	95.52
	U1520D_15H-2_103-105_3	3.86	3.27	1.64	71.68	0.11	0.13	1.00	0.08	11.93	0.04	93.74
	U1520D_15H-2_103-105_4	3.17	4.37	1.06	76.21	0.16	0.13	0.83	0.08	11.63	0.01	97.65
	U1520D_15H-2_103-105_5	3.66	3.43	1.38	74.87	0.09	0.11	0.98	0.05	11.65	0.00	96.23
	U1520D_15H-2_103-105_6	3.50	3.78	1.13	74.89	0.07	0.04	0.71	0.03	11.46	0.00	95.61
	U1520D_15H-2_103-105_7	4.15	2.59	5.56	66.45	0.91	1.38	4.24	0.10	14.02	0.25	99.66
	U1520D_15H-2_103-105_8	3.50	2.29	6.22	63.99	0.82	1.85	5.36	0.06	15.11	0.12	99.32
	U1520D_15H-2_103-105_9	3.42	3.16	1.03	73.60	0.15	0.17	1.02	0.00	11.08	0.02	93.64
	U1520D_15H-2_103-105_10	3.22	1.67	0.84	76.54	0.11	0.07	0.29	0.01	11.60	0.00	94.35
	U1520D_15H-2_103-105_11	2.70	3.79	1.25	75.91	0.17	0.17	1.29	0.01	11.18	0.02	96.49
	U1520D_15H-2_103-105_12	3.33	1.49	6.25	64.90	0.72	2.04	5.91	0.18	14.88	0.13	99.84
	U1520D_15H-2_103-105_13	3.65	3.48	1.34	73.93	0.16	0.12	1.07	0.06	11.56	0.00	95.37
	U1520D_15H-2_103-105_14	3.66	3.55	1.31	74.78	0.14	0.09	0.87	0.00	11.11	0.00	95.51
	U1520D_15H-2_113-114_1	3.86	3.48	1.51	73.65	0.08	0.04	0.99	0.00	12.33	0.00	95.95
	U1520D_15H-2_113-114_2	3.74	2.29	6.24	64.71	0.90	1.69	4.73	0.12	14.94	0.20	99.56
	U1520D_15H-2_113-114_3	3.42	3.61	1.19	73.20	0.14	0.12	0.95	0.04	11.90	0.02	94.61
	U1520D_15H-2_113-114_4	3.72	3.70	1.87	69.67	0.25	0.18	1.11	0.11	12.73	0.02	93.35
s12	U1520D_15H-4_71-73_1	3.47	3.86	0.99	74.45	0.12	0.10	0.83	0.03	11.78	0.00	95.63
	U1520D_15H-4_71-73_2	3.62	3.33	1.24	73.99	0.17	0.10	0.94	0.07	11.68	0.00	95.13
	U1520D_15H-4_71-73_3	3.76	3.46	1.17	74.76	0.16	0.11	0.95	0.05	11.69	0.01	96.12
	U1520D_15H-4_71-73_4	3.76	3.06	0.92	73.42	0.15	0.19	1.06	0.00	12.20	0.00	94.76
	U1520D_15H-4_71-73_5	3.79	3.54	1.25	74.24	0.12	0.05	0.88	0.08	11.86	0.02	95.82
	U1520D_15H-4_71-73_6	3.47	3.30	1.12	73.94	0.09	0.11	1.01	0.00	11.74	0.03	94.80
	U1520D_15H-4_71-73_7	3.72	3.01	1.28	72.30	0.18	0.13	1.10	0.05	12.06	0.01	93.84
	U1520D_15H-4_71-73_8	3.81	3.41	1.47	73.82	0.13	0.05	0.84	0.04	11.82	0.00	95.39
	U1520D_15H-4_71-73_9	3.32	3.58	1.11	73.98	0.09	0.12	0.83	0.05	11.77	0.03	94.88
	U1520D_15H-4_71-73_10	3.51	3.60	1.04	74.49	0.10	0.04	0.69	0.01	11.72	0.00	95.20
	U1520D_15H-4_71-73_11	3.58	3.17	1.23	72.81	0.13	0.15	1.08	0.02	12.28	0.02	94.48
	U1520D_15H-4_71-73_12	3.87	3.00	1.19	72.44	0.18	0.17	1.14	0.03	12.25	0.02	94.28
	U1520D_15H-4_71-73_13	3.43	3.59	1.32	73.62	0.13	0.11	0.91	0.00	11.92	0.00	95.03
	U1520D_15H-4_71-73_14	3.65	3.49	0.92	74.60	0.11	0.06	0.84	0.10	11.69	0.05	95.51
	U1520D_15H-4_71-73_15	3.50	3.12	1.01	73.48	0.19	0.16	0.98	0.08	11.91	0.04	94.46
	U1520D_15H-4_71-73_16	3.58	3.25	1.06	73.97	0.12	0.09	0.90	0.00	12.01	0.04	95.02
	U1520D_15H-4_71-73_17	3.23	3.59	1.15	72.64	0.14	0.13	0.94	0.04	11.82	0.00	93.68
	U1520D_15H-4_71-73_18	3.94	3.44	1.28	74.45	0.13	0.14	1.00	0.01	12.46	0.08	96.93
	U1520D_15H-4_71-73_19	3.44	3.54	1.13	73.86	0.16	0.09	0.91	0.00	11.62	0.04	94.79
	U1520D_15H-4_71-73_20	3.63	3.43	1.37	73.59	0.12	0.07	0.88	0.04	12.04	0.02	95.19
	1520D_15H-4_71-73_2	3.88	3.06	1.36	73.00	0.15	0.06	0.90	0.06	11.82	0.01	94.30
	1520D_15H-4_71-73_6	3.69	3.48	1.08	75.02	0.14	0.08	0.81	0.02	11.86	0.01	96.20
	1520D_15H-4_71-73_7	3.92	2.85	1.14	71.81	0.30	0.21	1.19	0.05	12.22	0.01	93.71
	1520D_15H-4_71-73_8	3.94	3.28	1.14	74.26	0.17	0.10	0.92	0.06	11.89	0.03	95.80

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u4	1520D_15H-4_71-73_9	4.06	3.49	1.32	75.35	0.21	0.11	1.04	0.05	12.35	0.02	98.01
	1520D_15H-4_71-73_3	3.71	3.17	1.24	71.77	0.22	0.21	1.11	0.10	12.00	0.03	93.56
	1520D_15H-4_71-73_4	3.95	3.07	1.05	72.90	0.19	0.11	1.07	0.06	12.19	0.01	94.60
	1520D_15H-4_71-73_5	4.04	2.99	1.45	72.79	0.26	0.17	1.12	0.05	11.98	0.00	94.84
	1520D_15H-4_71-73_10	3.76	3.19	1.28	72.69	0.16	0.11	0.95	0.08	11.81	0.02	94.05
	U1520D_15H-7_9-10_1	4.54	2.31	2.95	69.41	0.24	0.19	1.74	0.12	12.92	0.01	94.42
	U1520D_15H-7_9-10_2	3.66	3.65	1.46	72.80	0.14	0.13	0.94	0.02	11.91	0.05	94.76
	U1520D_15H-7_9-10_3	4.11	3.15	1.56	70.79	0.13	0.09	1.08	0.03	12.27	0.01	93.22
	U1520D_15H-7_9-10_4	3.32	3.80	1.35	70.63	0.04	0.02	0.94	0.13	12.87	0.01	93.11
	U1520D_15H-7_13-15_1	3.44	3.54	1.61	73.69	0.11	0.08	1.16	0.02	12.23	0.03	95.92
	U1520D_15H-7_13-15_3	3.11	3.88	1.03	73.08	0.09	0.13	1.11	0.04	12.21	0.01	94.70
	U1520D_15H-7_13-15_4	3.26	4.34	0.99	74.58	0.13	0.10	0.80	0.03	11.88	0.02	96.12
	U1520D_15H-7_13-15_5	3.44	3.28	1.41	72.59	0.11	0.07	0.95	0.06	11.65	0.04	93.59
	U1520D_15H-7_13-15_6	3.58	3.12	1.23	72.84	0.10	0.09	0.92	0.11	11.54	0.00	93.53
	U1520D_15H-7_13-15_7	3.22	3.28	1.33	73.73	0.09	0.09	1.28	0.03	12.13	0.02	95.20
	U1520D_15H-7_13-15_8	3.06	4.43	0.87	72.68	0.02	0.03	0.69	0.08	11.87	0.00	93.74
	U1520D_15H-7_13-15_9	3.48	3.19	1.12	73.50	0.15	0.11	1.04	0.04	11.50	0.03	94.16
	U1520D_15H-7_13-15_10	3.08	3.68	1.53	72.21	0.08	0.03	0.98	0.07	11.73	0.00	93.39
	U1520D_15H-7_13-15_11	3.74	2.99	2.77	70.49	0.14	0.11	1.64	0.04	13.03	0.00	94.95
	U1520D_15H-7_13-15_12	3.43	3.67	1.25	74.50	0.13	0.11	0.96	0.11	11.67	0.02	95.85
	U1520D_15H-7_13-15_13	3.05	3.81	1.20	74.25	0.11	0.13	1.14	0.00	12.06	0.03	95.78
	U1520D_15H-7_13-15_14	3.46	3.76	1.32	73.81	0.06	0.03	0.81	0.01	11.85	0.01	95.13
	U1520D_15H-7_13-15_15	3.71	4.50	2.03	72.16	0.15	0.06	1.04	0.06	12.80	0.03	96.54
	U1520D_15H-7_13-15_18	3.22	3.37	2.03	71.29	0.14	0.08	1.27	0.04	11.80	0.02	93.26
	U1520D_15H-7_13-15_19	4.05	3.02	3.14	68.87	0.23	0.17	1.52	0.02	13.57	0.04	94.63
	U1520D_15H-7_13-15_20	3.46	3.08	1.49	74.40	0.12	0.11	1.16	0.07	11.84	0.01	95.73
	1520D_15H-7_13-15_1	3.61	3.78	1.12	74.89	0.10	0.10	0.71	0.00	11.93	0.03	96.27
	1520D_15H-7_13-15_4	3.92	3.53	1.24	75.22	0.19	0.08	0.84	0.08	11.84	0.00	96.94
	1520D_15H-7_13-15_5	3.61	4.23	1.27	74.15	0.22	0.08	0.77	0.04	11.67	0.00	96.04
	1520D_15H-7_13-15_2	3.78	3.42	1.53	73.95	0.12	0.05	0.92	0.01	11.61	0.00	95.38
	1520D_15H-7_13-15_6	3.72	3.37	1.10	73.43	0.15	0.12	0.90	0.03	11.53	0.04	94.38
	1520D_15H-7_13-15_3	3.13	3.90	1.12	72.13	0.16	0.11	0.82	0.01	11.43	0.03	92.85
	1520D_15H-7_13-15_7	3.85	3.46	1.63	74.85	0.15	0.07	0.94	0.09	11.54	0.02	96.59
	U1520D_15H-7_99-101_2	5.33	4.03	3.67	63.87	0.57	0.98	3.34	0.21	17.33	0.14	99.47
	U1520D_15H-7_99-101_3	3.32	3.85	1.20	74.35	0.09	0.11	0.84	0.05	11.77	0.00	95.58
	U1520D_15H-7_99-101_4	5.28	3.80	3.45	63.60	0.55	1.02	3.42	0.16	17.20	0.15	98.64
	U1520D_15H-7_99-101_5	5.26	4.10	3.73	63.89	0.56	1.10	3.49	0.11	17.30	0.10	99.65
	U1520D_15H-7_99-101_7	5.04	4.73	3.64	63.27	0.58	1.13	3.01	0.24	16.83	0.14	98.60
	U1520D_15H-7_99-101_9	4.06	3.06	2.83	72.52	0.21	0.13	1.81	0.00	12.99	0.04	97.64
	U1520D_15H-7_99-101_10	3.87	3.42	1.17	74.37	0.10	0.06	0.71	0.03	11.48	0.03	95.25
	U1520D_15H-7_99-101_12	3.48	4.08	1.13	74.79	0.07	0.04	0.69	0.03	11.89	0.03	96.23
	U1520D_16H-2_65-67_1	2.96	3.24	1.24	74.19	0.17	0.19	1.52	0.06	11.51	0.02	95.10
	U1520D_16H-2_65-67_2	2.95	3.04	1.17	73.32	0.15	0.16	1.29	0.03	11.32	0.00	93.43
	U1520D_16H-2_65-67_3	3.01	3.01	1.18	73.49	0.12	0.15	1.30	0.02	11.40	0.00	93.68
	U1520D_16H-2_65-67_4	3.11	3.05	1.13	73.51	0.14	0.17	1.30	0.07	11.39	0.01	93.89
	U1520D_16H-2_65-67_5	3.13	3.02	1.17	74.17	0.18	0.17	1.37	0.06	11.42	0.02	94.71
	U1520D_16H-2_65-67_6	3.16	3.03	1.10	73.72	0.16	0.13	1.29	0.00	11.41	0.01	94.01
	U1520D_16H-2_65-67_7	3.10	3.08	1.17	73.86	0.14	0.19	1.32	0.04	11.48	0.04	94.42
	U1520D_16H-2_65-67_8	3.23	3.10	1.17	73.61	0.12	0.20	1.29	0.09	11.72	0.01	94.55
	U1520D_16H-2_65-67_9	3.19	3.13	1.19	73.56	0.13	0.16	1.30	0.06	11.53	0.00	94.25
	U1520D_16H-2_65-67_10	2.99	3.15	1.21	73.75	0.15	0.17	1.30	0.08	11.50	0.02	94.32
	U1520D_16H-2_65-67_11	3.10	3.11	1.21	73.69	0.19	0.17	1.31	0.03	11.50	0.00	94.31
	U1520D_16H-2_65-67_12	3.07	3.03	1.14	73.88	0.14	0.15	1.31	0.00	11.63	0.00	94.35
	U1520D_16H-2_65-67_13	3.01	3.18	1.11	73.77	0.15	0.15	1.30	0.00	11.83	0.02	94.52
	U1520D_16H-2_65-67_14	2.94	3.17	1.03	73.31	0.16	0.13	1.30	0.09	11.55	0.01	93.68
	U1520D_16H-2_65-67_15	3.11	3.06	1.22	73.88	0.14	0.16	1.30	0.01	11.24	0.03	94.16
	U1520D_16H-2_65-67_16	3.10	3.15	1.23	73.58	0.15	0.13	1.29	0.04	11.68	0.03	94.37
	U1520D_16H-2_65-67_17	3.39	3.03	1.24	74.01	0.16	0.15	1.33	0.06	11.54	0.02	94.91
	U1520D_16H-2_65-67_18	3.02	2.97	1.08	72.70	0.15	0.16	1.29	0.01	11.38	0.00	92.77
	U1520D_16H-2_65-67_19	3.01	3.07	1.10	73.82	0.14	0.22	1.34	0.02	11.45	0.04	94.21
	U1520D_16H-2_65-67_20	3.14	3.16	1.07	73.72	0.16	0.15	1.32	0.06	11.45	0.04	94.26
	U1520D_16H-2_65-67_1	3.33	3.16	1.27	73.41	0.14	0.21	1.32	0.06	11.43	0.01	94.34
	U1520D_16H-2_65-67_6	3.11	3.20	1.16	73.51	0.14	0.20	1.31	0.03	11.72	0.05	94.42
	U1520D_16H-2_65-67_10	3.31	3.26	1.15	73.11	0.13	0.18	1.24	0.05	11.76	0.00	94.18
	U1520D_16H-2_65-67_11	3.19	3.22	1.15	72.75	0.10	0.16	1.21	0.09	11.37	0.00	93.25
	U1520D_16H-2_65-67_12	3.05	3.01	1.14	73.17	0.18	0.20	1.28	0.05	11.50	0.04	93.61
	U1520D_16H-2_65-67_2	3.23	3.16	1.11	74.04	0.14	0.16	1.26	0.01	11.50	0.04	94.64
	U1520D_16H-2_65-67_3	3.43	3.07	1.04	73.44	0.11	0.16	1.22	0.04	11.45	0.06	94.01
	U1520D_16H-2_65-67_4	3.12	3.17	1.06	71.48	0.16	0.16	1.25	0.05	11.83	0.00	92.28
	U1520D_16H-2_65-67_5	3.24	3.12	1.09	73.93	0.16	0.22	1.33	0.00	11.54	0.05	94.68

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u6	U1520D_16H-2_65-67_7	3.10	3.19	1.12	73.44	0.14	0.22	1.49	0.00	11.68	0.03	94.41
	U1520D_16H-2_65-67_8	3.35	3.12	1.14	74.23	0.14	0.12	1.29	0.05	11.40	0.00	94.83
	U1520D_16H-2_65-67_9	3.33	3.13	1.19	73.29	0.16	0.14	1.27	0.04	11.57	0.00	94.14
	U1520D_18H-2_108-110_1	5.02	3.95	2.52	67.49	0.41	0.80	2.38	0.13	15.57	0.13	98.40
	U1520D_18H-2_108-110_2	5.24	3.95	2.51	67.45	0.40	0.77	2.37	0.23	15.52	0.10	98.54
	U1520D_18H-2_108-110_3	4.99	3.87	2.52	66.37	0.42	0.73	2.15	0.16	15.48	0.08	96.77
	U1520D_18H-2_108-110_4	5.31	3.88	2.51	66.04	0.40	0.76	2.40	0.04	15.12	0.09	96.55
	U1520D_18H-2_108-110_5	4.93	4.47	1.69	68.79	0.33	0.32	1.09	0.05	13.80	0.03	95.50
	U1520D_18H-2_108-110_6	5.25	3.91	2.63	67.63	0.41	0.75	2.37	0.14	15.71	0.14	98.94
	U1520D_18H-2_108-110_8	5.22	3.86	2.64	67.58	0.43	0.70	2.40	0.18	15.40	0.11	98.53
	U1520D_18H-2_108-110_12	5.00	3.86	2.87	67.22	0.40	0.77	2.53	0.11	15.60	0.12	98.49
	U1520D_18H-2_108-110_14	4.94	3.93	2.55	67.70	0.42	0.80	2.51	0.26	15.65	0.11	98.88
	U1520D_18H-2_108-110_16	5.01	3.87	2.57	66.91	0.40	0.69	2.24	0.08	15.49	0.12	97.38
	U1520D_18H-2_108-110_17	5.15	3.88	2.54	67.06	0.40	0.72	2.42	0.13	15.45	0.07	97.82
	U1520D_18H-2_108-110_19	4.93	4.01	2.69	67.88	0.40	0.76	2.42	0.11	15.79	0.10	99.08
	U1520D_18H-2_108-110_20	5.17	3.89	2.62	67.98	0.44	0.77	2.33	0.04	15.92	0.10	99.26
	1520D_18H-2_108-110_8	5.10	3.63	2.78	66.97	0.60	0.69	2.47	0.09	15.44	0.14	97.90
	U1520D_18H-4_40-42_2	3.84	2.33	7.49	61.85	1.10	2.17	4.97	0.11	14.99	0.18	99.03
	U1520D_18H-4_40-42_3	3.95	1.69	5.85	60.42	0.83	2.54	6.16	0.14	17.59	0.16	99.32
	U1520D_18H-4_40-42_9	3.82	3.42	1.66	69.84	0.13	0.05	0.92	0.00	11.95	0.02	91.81
	U1520D_18H-4_40-42_10	3.13	3.36	1.00	71.40	0.06	0.14	0.97	0.06	11.53	0.00	91.65
	U1520D_18H-4_63-65_1	3.99	1.81	6.55	61.99	0.90	2.08	5.02	0.16	16.04	0.18	98.71
	U1520D_18H-4_63-65_2	3.83	1.96	5.79	62.13	0.91	2.04	5.04	0.07	15.93	0.10	97.80
	U1520D_18H-4_63-65_4	3.28	3.36	3.39	66.79	0.65	0.56	2.28	0.00	12.26	0.11	92.67
	U1520D_18H-4_63-65_5	4.54	1.47	4.56	62.21	0.64	1.20	5.51	0.08	17.54	0.12	97.87
	U1520D_18H-4_63-65_6	4.24	1.67	6.46	61.92	0.80	2.76	5.34	0.07	16.39	0.13	99.78
	U1520D_18H-4_63-65_7	3.67	1.38	8.99	60.91	1.26	2.57	5.81	0.15	13.97	0.15	98.86
	U1520D_18H-4_63-65_8	4.77	1.37	3.99	61.43	0.65	1.10	6.54	0.07	19.26	0.14	99.33
	U1520D_18H-4_63-65_9	4.18	1.79	6.16	62.25	0.86	2.11	5.31	0.14	16.22	0.14	99.16
	U1520D_18H-4_63-65_10	3.53	3.04	5.31	66.28	0.94	1.18	4.22	0.07	14.16	0.18	98.91
	U1520D_18H-4_63-65_11	4.63	1.70	5.32	62.66	0.76	1.86	5.58	0.08	17.25	0.18	100.02
	U1520D_18H-4_63-65_12	4.11	1.72	4.75	57.39	0.78	1.19	5.07	0.06	15.91	0.11	91.08
	U1520D_18H-4_63-65_13	4.84	1.17	5.30	59.40	0.55	1.83	6.55	0.13	18.94	0.10	98.81
	U1520D_18H-4_63-65_15	3.35	2.15	8.52	63.15	1.04	3.90	3.90	0.16	13.95	0.15	100.28
	U1520D_18H-4_63-65_16	4.79	1.48	4.42	61.45	0.62	1.22	6.35	0.04	19.31	0.11	99.79
u7	U1520D_18H-5_123-125_1	3.76	2.23	2.67	70.44	0.47	0.76	3.19	0.00	14.23	0.14	97.88
	U1520D_18H-5_123-125_4	3.77	2.34	3.01	69.81	0.44	0.79	3.23	0.01	14.16	0.11	97.67
	U1520D_18H-5_123-125_5	3.91	2.40	2.85	70.94	0.44	0.70	3.03	0.05	14.15	0.10	98.57
	U1520D_18H-5_123-125_6	3.82	2.31	2.87	69.95	0.43	0.66	3.04	0.07	14.22	0.14	97.51
	U1520D_18H-5_123-125_7	3.94	2.13	3.22	68.97	0.58	1.05	3.77	0.15	14.77	0.12	98.70
	U1520D_18H-5_123-125_8	4.04	2.27	2.55	69.63	0.44	0.74	2.94	0.05	14.12	0.10	96.89
	U1520D_18H-5_123-125_9	3.98	2.15	3.44	68.84	0.54	1.17	3.90	0.09	15.02	0.11	99.24
	U1520D_18H-5_123-125_10	3.87	2.42	2.93	71.64	0.42	0.71	3.08	0.06	14.25	0.08	99.45
	U1520D_18H-5_123-125_12	4.03	2.31	3.00	70.84	0.43	0.79	3.22	0.05	14.38	0.11	99.16
	U1520D_18H-5_123-125_15	3.76	2.42	2.61	72.15	0.37	0.65	2.90	0.01	14.06	0.06	98.99
	U1520D_18H-5_123-125_17	2.94	3.41	1.47	74.87	0.22	0.23	1.49	0.10	11.96	0.03	96.73
	1520D_18H-5_123-125_4	3.88	2.20	4.11	69.53	0.72	1.58	2.95	0.12	13.48	0.11	98.68
	1520D_18H-5_123-125_2	0.51	2.29	2.98	69.85	0.63	0.11	3.08	0.08	14.08	0.09	93.70
	1520D_18H-5_123-125_6	4.15	2.33	2.81	70.89	0.63	0.70	3.05	0.06	14.22	0.11	98.95
u8	U1520D_18H-6_107-109_1	3.65	3.27	2.05	72.03	0.15	0.10	1.53	0.08	12.52	0.06	95.44
	U1520D_18H-6_107-109_2	3.49	3.12	2.09	71.42	0.16	0.11	1.51	0.04	12.59	0.04	94.57
	U1520D_18H-6_107-109_3	3.73	3.15	2.01	71.39	0.17	0.14	1.51	0.00	12.32	0.03	94.44
	U1520D_18H-6_107-109_4	3.43	3.15	1.83	70.70	0.14	0.11	1.41	0.05	12.37	0.04	93.23
	U1520D_18H-6_107-109_5	3.71	3.25	2.03	72.47	0.15	0.11	1.50	0.00	12.52	0.02	95.75
	U1520D_18H-6_107-109_7	3.84	3.32	2.13	72.03	0.14	0.13	1.47	0.08	12.67	0.00	95.81
	U1520D_18H-6_107-109_8	3.63	3.32	2.03	72.07	0.13	0.12	1.49	0.06	12.53	0.00	95.38
	U1520D_18H-6_107-109_9	3.02	3.75	1.50	74.58	0.11	0.04	0.71	0.07	10.60	0.02	94.39
	U1520D_18H-6_107-109_10	3.61	3.17	2.09	71.72	0.15	0.08	1.50	0.06	12.40	0.05	94.83
	U1520D_18H-6_107-109_11	3.43	3.65	2.11	72.56	0.12	0.12	1.52	0.04	12.60	0.06	96.21
	U1520D_18H-6_107-109_12	3.63	3.22	2.06	72.03	0.12	0.14	1.49	0.00	12.39	0.02	95.10
	U1520D_18H-6_107-109_13	3.40	3.23	2.07	70.73	0.12	0.13	1.50	0.04	12.34	0.04	93.60
	U1520D_18H-6_107-109_14	3.44	3.18	1.99	71.66	0.14	0.11	1.52	0.08	12.45	0.01	94.59
	U1520D_18H-6_107-109_15	3.55	3.13	2.10	71.42	0.15	0.11	1.50	0.04	12.21	0.04	94.25
	U1520D_18H-6_107-109_16	3.75	3.24	2.07	71.18	0.15	0.13	1.51	0.03	12.51	0.00	94.57
	U1520D_18H-6_107-109_17	3.58	3.34	2.15	71.83	0.14	0.14	1.55	0.07	12.55	0.00	95.35
	U1520D_18H-6_107-109_18	3.53	3.18	2.01	71.41	0.14	0.11	1.50	0.08	12.43	0.01	94.40
	U1520D_18H-6_107-109_19	3.79	3.13	2.07	71.29	0.11	0.13	1.55	0.00	12.43	0.02	94.51
	U1520D_18H-6_107-109_20	3.68	3.23	2.02	71.55	0.15	0.15	1.54	0.06	12.60	0.01	94.98
	1520D_18H-6_107-109_1	4.05	3.20	1.97	70.41	0.19	0.12	1.49	0.03	12.37	0.01	93.83
	1520D_18H-6_107-109_3	4.07	3.16	2.00	70.80	0.18	0.09	1.43	0.00	12.63	0.00	94.37

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u9	1520D_18H-6_107-109_2	3.70	3.11	2.15	70.50	0.21	0.11	1.51	0.08	12.41	0.00	93.77
	1520D_18H-6_107-109_6	3.68	3.06	1.79	66.09	0.17	0.10	1.49	0.00	12.55	0.03	88.95
	1520D_18H-6_107-109_7	3.65	3.10	2.03	70.37	0.20	0.12	1.51	0.04	12.49	0.00	93.52
	1520D_18H-6_107-109_4	3.86	3.02	1.78	70.30	0.18	0.10	1.50	0.06	12.28	0.06	93.13
	1520D_18H-6_107-109_9	3.85	3.47	2.06	71.01	0.17	0.12	1.51	0.04	12.59	0.03	94.85
	1520D_18H-6_107-109_10	4.05	3.33	1.17	72.32	0.18	0.00	1.38	0.01	12.67	0.02	95.14
	U1520D_20F-1_125-127_1	4.03	2.91	2.04	70.13	0.33	0.34	1.67	0.09	13.00	0.05	94.59
	U1520D_20F-1_125-127_2	3.90	1.23	7.43	61.30	0.84	2.38	5.91	0.13	16.07	0.16	99.34
	U1520D_20F-1_125-127_3	4.06	1.25	6.65	61.49	0.84	2.32	5.86	0.12	16.63	0.15	99.37
	U1520D_20F-1_125-127_4	3.89	3.30	1.25	72.44	0.09	0.08	0.69	0.00	11.43	0.00	93.17
	U1520D_20F-1_125-127_7	4.19	1.23	6.87	61.34	0.85	2.22	5.93	0.17	16.36	0.17	99.33
	U1520D_20F-1_125-127_8	4.12	1.30	6.12	61.88	0.85	2.21	5.87	0.10	16.47	0.14	99.06
	U1520D_20F-1_125-127_11	4.28	1.34	6.16	62.55	0.84	2.12	5.34	0.11	16.07	0.15	98.96
	U1520D_20F-1_125-127_13	3.75	1.53	7.17	62.39	0.93	2.63	5.08	0.09	15.36	0.14	99.07
	U1520D_20F-1_125-127_14	3.97	1.24	6.97	61.49	0.81	2.21	6.01	0.15	16.37	0.14	99.36
	U1520D_20F-1_125-127_16	2.76	3.58	1.02	62.66	0.10	0.06	0.86	0.01	10.43	0.00	81.47
	U1520D_20F-1_125-127_17	3.66	1.14	5.15	54.98	0.70	1.94	4.95	0.12	14.88	0.14	87.65
	U1520D_20F-1_125-127_18	4.07	1.35	7.41	62.45	0.87	2.60	5.23	0.16	15.56	0.19	99.88
	U1520D_20F-1_125-127_19	3.88	1.94	6.75	66.18	1.01	1.66	4.63	0.09	14.30	0.17	100.61
	U1520D_20F-1_125-127_21	4.15	1.51	6.75	62.84	0.88	2.06	5.29	0.15	16.31	0.17	100.10
	U1520D_20F-1_125-127_22	4.09	1.33	6.67	62.24	0.84	2.09	5.76	0.13	16.89	0.16	100.19
u10	1520D_20F-1_125-127_2	4.71	1.32	5.52	62.93	1.15	1.94	5.31	0.17	16.78	0.19	100.02
	U1520D_21F-4_6-8_1	3.30	3.36	1.59	72.64	0.14	0.04	1.09	0.04	11.73	0.00	93.94
	U1520D_21F-4_6-8_2	3.64	3.17	2.01	71.08	0.19	0.17	1.53	0.01	12.68	0.00	94.48
	U1520D_21F-4_6-8_3	3.76	3.08	1.49	72.56	0.16	0.05	1.45	0.00	12.47	0.01	95.02
	U1520D_21F-4_6-8_4	3.38	3.24	1.66	73.20	0.12	0.07	1.07	0.00	11.70	0.01	94.45
	U1520D_21F-4_6-8_5	3.48	3.29	1.83	72.64	0.12	0.17	1.26	0.06	11.68	0.03	94.57
	U1520D_21F-4_6-8_6	3.43	3.18	1.79	71.13	0.18	0.09	1.29	0.06	12.08	0.02	93.26
	U1520D_21F-4_6-8_7	3.51	3.24	1.94	72.56	0.18	0.11	1.26	0.10	11.77	0.00	94.67
	U1520D_21F-4_6-8_8	3.27	3.32	1.73	72.38	0.16	0.07	1.10	0.04	11.62	0.03	93.72
	U1520D_21F-4_6-8_9	3.46	3.19	1.78	71.77	0.15	0.06	1.31	0.05	12.15	0.05	93.97
	U1520D_21F-4_6-8_10	3.28	3.34	1.41	72.52	0.12	0.07	0.93	0.00	11.39	0.00	93.06
	U1520D_21F-4_6-8_11	3.27	3.42	1.41	73.18	0.11	0.03	0.94	0.00	11.11	0.03	93.50
	U1520D_21F-4_6-8_12	3.95	2.94	1.20	72.29	0.12	0.02	1.43	0.03	12.57	0.01	94.56
	U1520D_21F-4_6-8_13	3.25	3.28	1.59	72.30	0.11	0.09	1.13	0.00	11.59	0.00	93.34
	U1520D_21F-4_6-8_14	3.75	3.17	2.23	71.70	0.18	0.19	1.56	0.08	12.58	0.04	95.48
	U1520D_21F-4_6-8_15	3.39	3.19	1.67	72.41	0.15	0.08	1.21	0.01	11.71	0.02	93.85
	U1520D_21F-4_6-8_16	3.47	3.34	1.49	72.81	0.15	0.09	1.07	0.05	11.57	0.00	94.04
	U1520D_21F-4_6-8_17	3.67	3.18	1.84	70.67	0.23	0.14	1.42	0.03	12.54	0.03	93.74
	U1520D_21F-4_6-8_18	3.79	3.11	2.24	69.96	0.22	0.18	1.68	0.00	12.50	0.02	93.70
	U1520D_21F-4_6-8_19	3.42	3.22	1.63	71.93	0.14	0.11	1.08	0.02	11.63	0.04	93.22
	U1520D_21F-4_6-8_20	3.62	3.24	1.73	71.84	0.17	0.09	1.17	0.03	11.61	0.03	93.53
	U1520D_21F-4_18-20_1	3.36	3.34	1.75	73.47	0.13	0.10	1.14	0.08	11.49	0.00	94.86
	U1520D_21F-4_18-20_2	3.69	3.25	1.90	74.12	0.11	0.07	1.16	0.02	11.91	0.04	96.28
	U1520D_21F-4_18-20_3	3.73	3.59	1.11	74.92	0.09	0.06	0.64	0.00	11.75	0.03	95.93
	U1520D_21F-4_18-20_4	3.74	3.10	2.12	72.38	0.20	0.13	1.49	0.05	12.56	0.02	95.79
	U1520D_21F-4_18-20_5	3.55	3.40	1.07	74.20	0.12	0.06	0.62	0.06	11.50	0.00	94.58
	U1520D_21F-4_18-20_6	3.55	3.73	1.14	73.96	0.13	0.10	0.70	0.02	11.67	0.01	95.00
	U1520D_21F-4_18-20_7	3.55	3.15	2.42	72.27	0.21	0.20	1.63	0.05	12.67	0.06	96.22
	U1520D_21F-4_18-20_8	3.78	3.24	1.23	74.12	0.12	0.04	0.77	0.11	11.52	0.01	94.93
	U1520D_21F-4_18-20_9	3.66	3.15	1.25	72.57	0.13	0.07	0.68	0.10	11.66	0.00	93.28
	U1520D_21F-4_18-20_10	4.43	3.02	1.89	71.45	0.24	0.20	1.30	0.09	12.92	0.03	95.57
	U1520D_21F-4_48-50_1	3.54	3.69	1.25	74.15	0.08	0.05	0.84	0.01	11.41	0.00	95.02
	U1520D_21F-4_48-50_2	3.84	3.38	1.28	74.61	0.11	0.07	0.72	0.12	11.69	0.00	95.81
	U1520D_21F-4_48-50_3	3.27	3.79	1.50	71.22	0.07	0.00	1.01	0.00	11.95	0.00	92.81
	U1520D_21F-4_48-50_4	4.00	3.20	1.34	74.06	0.11	0.08	0.67	0.03	11.31	0.02	94.82
	U1520D_21F-4_48-50_5	3.71	3.35	1.16	74.95	0.13	0.08	0.67	0.04	11.50	0.01	95.59
	U1520D_21F-4_48-50_6	4.03	3.34	1.94	72.63	0.12	0.06	0.87	0.14	12.14	0.00	95.26
	U1520D_21F-4_48-50_7	4.05	3.12	1.89	72.40	0.15	0.14	1.05	0.11	12.43	0.03	95.36
	U1520D_21F-4_48-50_8	3.54	3.30	1.52	73.06	0.17	0.16	0.99	0.10	11.91	0.00	94.75
	U1520D_21F-4_48-50_9	3.69	3.30	1.28	73.55	0.08	0.04	0.72	0.05	11.64	0.00	94.35
	U1520D_21F-4_48-50_10	3.78	3.51	1.51	75.02	0.12	0.07	0.92	0.08	11.84	0.00	96.85
	U1520D_21F-4_48-50_11	3.59	3.82	1.12	74.09	0.06	0.08	0.52	0.04	11.53	0.00	94.84
	U1520D_21F-4_48-50_12	3.80	3.24	1.48	74.14	0.13	0.10	0.90	0.08	11.97	0.00	95.84
	U1520D_21F-4_48-50_13	3.33	3.46	1.37	73.62	0.10	0.02	0.73	0.03	11.27	0.00	93.94
	U1520D_21F-4_48-50_14	3.11	4.28	1.16	75.21	0.12	0.06	0.80	0.04	11.85	0.04	96.68
	U1520D_21F-4_48-50_15	2.74	4.39	0.66	75.42	0.14	0.05	0.69	0.01	11.88	0.00	95.99
	1520D_21F-4_48-50_1	3.85	3.36	1.32	73.79	0.12	0.04	0.68	0.00	11.60	0.00	94.76
	1520D_21F-4_48-50_7	3.55	3.37	1.31	73.45	0.16	0.09	0.97	0.03	11.69	0.02	94.64
	1520D_21F-4_48-50_8	3.61	3.57	1.34	74.44	0.20	0.11	0.93	0.02	11.87	0.01	96.10

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u12	U1520D_22F-1_111-113_1	3.78	3.30	1.28	74.63	0.11	0.07	0.65	0.02	11.45	0.02	95.31
	U1520D_22F-1_111-113_2	3.86	3.50	0.94	74.93	0.13	0.06	0.61	0.06	11.73	0.00	95.81
	U1520D_22F-1_111-113_3	3.84	3.36	1.14	75.53	0.09	0.07	0.67	0.00	11.63	0.00	96.33
	U1520D_22F-1_111-113_4	3.96	3.38	1.32	74.40	0.13	0.04	0.62	0.08	11.73	0.00	95.66
	U1520D_22F-1_111-113_5	3.75	3.34	1.15	74.32	0.12	0.08	0.63	0.04	11.62	0.00	95.05
	U1520D_22F-1_111-113_6	3.74	3.22	1.81	72.29	0.10	0.08	1.18	0.06	12.21	0.03	94.72
	U1520D_22F-1_111-113_7	3.60	3.47	1.16	74.69	0.11	0.05	0.61	0.00	11.47	0.00	95.16
	U1520D_22F-1_111-113_8	3.68	3.35	1.45	74.68	0.14	0.03	0.67	0.11	11.54	0.00	95.65
	U1520D_22F-1_111-113_9	3.90	3.32	1.28	74.57	0.12	0.07	0.66	0.08	11.48	0.02	95.51
	U1520D_22F-1_111-113_10	3.83	3.35	1.23	74.21	0.08	0.05	0.65	0.05	11.56	0.00	95.01
	U1520D_22F-1_111-113_11	3.97	3.29	1.13	74.38	0.11	0.08	0.67	0.07	11.61	0.02	95.32
	U1520D_22F-1_111-113_12	3.68	3.40	1.00	74.86	0.11	0.06	0.63	0.01	11.38	0.02	95.15
	U1520D_22F-1_111-113_13	3.84	3.65	0.95	75.06	0.12	0.03	0.61	0.05	11.44	0.03	95.77
	U1520D_22F-1_111-113_14	3.83	3.27	1.21	73.42	0.11	0.08	0.70	0.07	11.31	0.02	94.02
	U1520D_22F-1_111-113_15	3.78	3.36	1.24	74.72	0.12	0.11	0.66	0.10	11.38	0.00	95.47
	U1520D_22F-1_111-113_16	3.75	3.36	1.26	74.71	0.10	0.08	0.65	0.04	11.52	0.00	95.47
	U1520D_22F-1_111-113_17	3.73	3.34	1.34	74.53	0.11	0.05	0.66	0.08	11.55	0.02	95.40
	U1520D_22F-1_111-113_18	4.06	3.35	1.19	74.61	0.13	0.05	0.68	0.02	11.59	0.03	95.71
	U1520D_22F-1_111-113_19	3.93	3.36	0.95	73.86	0.11	0.02	0.67	0.05	11.40	0.00	94.37
	U1520D_22F-1_111-113_20	3.81	3.46	1.16	75.22	0.11	0.03	0.68	0.07	11.65	0.00	96.20
	1520D_22F-1_111-113_1	4.07	3.41	1.24	74.89	0.16	0.06	0.61	0.02	11.66	0.04	96.15
	1520D_22F-1_111-113_8	3.79	3.61	1.16	73.40	0.18	0.05	0.53	0.00	11.56	0.03	94.30
	1520D_22F-1_111-113_2	3.77	3.26	1.10	73.01	0.11	0.04	0.67	0.10	11.26	0.01	93.34
	1520D_22F-1_111-113_9	4.02	3.34	1.10	73.97	0.14	0.07	0.64	0.05	11.44	0.02	94.79
	1520D_22F-1_111-113_10	4.10	3.35	1.05	74.27	0.13	0.05	0.59	0.05	11.79	0.00	95.38
	1520D_22F-1_111-113_3	4.35	3.30	1.25	73.76	0.12	0.06	0.59	0.08	11.55	0.03	95.11
	1520D_22F-1_111-113_4	3.97	3.25	1.31	73.40	0.14	0.06	0.63	0.07	11.59	0.01	94.44
	1520D_22F-1_111-113_5	3.86	3.30	1.22	73.31	0.17	0.07	0.67	0.11	11.51	0.03	94.24
	1520D_22F-1_111-113_6	4.08	3.46	1.25	74.20	0.15	0.07	0.62	0.10	11.61	0.00	95.53
	1520D_22F-1_111-113_7	4.07	3.16	1.32	72.76	0.13	0.07	0.63	0.05	11.50	0.01	93.71
	U1520D_22F-2_60-62_1	4.03	3.27	1.30	74.50	0.11	0.04	0.70	0.12	11.22	0.00	95.28
	U1520D_22F-2_60-62_2	3.80	3.30	1.05	74.33	0.10	0.09	0.67	0.00	11.13	0.03	94.50
	U1520D_22F-2_60-62_3	3.85	3.30	1.12	74.63	0.10	0.03	0.69	0.00	11.10	0.00	94.82
	U1520D_22F-2_60-62_4	3.78	3.33	1.00	74.00	0.09	0.07	0.69	0.08	11.19	0.02	94.25
	U1520D_22F-2_60-62_5	3.86	3.23	1.10	74.09	0.11	0.09	0.66	0.00	11.21	0.00	94.35
	U1520D_22F-2_60-62_6	4.08	3.38	1.24	74.88	0.08	0.07	0.67	0.06	11.21	0.01	95.68
	U1520D_22F-2_60-62_7	4.04	3.25	1.26	74.92	0.12	0.06	0.67	0.04	11.31	0.00	95.66
	U1520D_22F-2_60-62_8	3.94	3.26	1.14	74.85	0.08	0.07	0.68	0.06	11.14	0.00	95.23
	U1520D_22F-2_60-62_9	3.79	3.38	1.17	75.84	0.08	0.07	0.71	0.00	11.42	0.00	96.46
	U1520D_22F-2_60-62_10	3.95	3.24	1.25	75.05	0.08	0.09	0.65	0.07	11.38	0.00	95.78
	U1520D_22F-2_60-62_11	3.75	3.32	1.19	74.94	0.11	0.05	0.70	0.03	11.31	0.00	95.40
	U1520D_22F-2_60-62_12	3.97	3.25	1.18	74.79	0.08	0.06	0.69	0.06	11.11	0.00	95.19
	U1520D_22F-2_60-62_13	3.95	3.37	1.19	75.41	0.09	0.06	0.69	0.00	11.37	0.02	96.15
	U1520D_22F-2_60-62_14	3.93	3.28	1.12	75.52	0.11	0.04	0.70	0.04	11.18	0.00	95.93
	U1520D_22F-2_60-62_15	3.79	3.27	1.19	74.98	0.12	0.03	0.68	0.11	11.18	0.02	95.38
	U1520D_22F-2_60-62_16	3.74	3.23	1.23	74.86	0.09	0.05	0.69	0.10	11.25	0.00	95.24
	U1520D_22F-2_60-62_17	3.96	3.30	1.11	74.77	0.09	0.07	0.67	0.05	11.27	0.00	95.29
	U1520D_22F-2_60-62_18	3.76	3.44	1.25	75.06	0.13	0.07	0.66	0.07	11.20	0.00	95.65
	U1520D_22F-2_60-62_19	3.79	3.44	1.26	75.39	0.09	0.09	0.68	0.07	11.47	0.00	96.28
	U1520D_22F-2_60-62_20	3.85	3.29	1.03	74.61	0.12	0.06	0.67	0.04	11.35	0.00	95.01
	1520D_22F-2_60-62_3	3.91	3.29	1.29	73.29	0.19	0.07	0.68	0.10	11.57	0.00	94.39
	1520D_22F-2_60-62_5	4.09	3.18	1.16	72.16	0.19	0.07	0.69	0.05	11.37	0.00	92.96
	1520D_22F-2_60-62_6	4.03	3.27	1.09	73.25	0.15	0.04	0.67	0.05	11.62	0.00	94.16
	1520D_22F-2_60-62_8	3.93	3.26	1.21	72.54	0.12	0.08	0.72	0.05	11.53	0.00	93.44
	1520D_22F-2_60-62_10	3.98	3.46	1.12	69.88	0.17	0.06	0.60	0.03	11.55	0.00	90.84
	1520D_22F-2_60-62_1	4.30	3.20	1.19	71.48	0.13	0.06	0.68	0.07	11.39	0.02	92.53
	1520D_22F-2_60-62_2	3.99	3.29	1.07	71.72	0.20	0.05	0.65	0.01	11.25	0.02	92.24
	1520D_22F-2_60-62_9	4.00	3.20	1.21	72.15	0.12	0.08	0.66	0.07	11.50	0.00	93.00
	U1520D_22F-2_69-71_2	3.83	2.92	2.57	70.18	0.34	0.35	2.18	0.09	12.63	0.01	95.10
	U1520D_22F-2_69-71_3	3.59	2.93	2.67	71.08	0.37	0.41	2.48	0.17	13.01	0.02	96.74
	U1520D_22F-2_69-71_4	3.61	2.93	2.54	71.28	0.34	0.37	2.18	0.16	12.74	0.10	96.25
	U1520D_22F-2_69-71_5	3.92	2.72	1.26	72.05	0.22	0.16	1.17	0.08	11.94	0.01	93.53
	U1520D_22F-2_69-71_7	3.76	3.76	1.12	75.10	0.10	0.04	0.59	0.07	11.27	0.01	95.82
	U1520D_22F-2_69-71_8	3.45	2.99	2.66	71.02	0.37	0.33	2.15	0.06	12.64	0.00	95.67
	U1520D_22F-2_69-71_9	3.22	3.41	1.26	72.59	0.11	0.08	0.89	0.06	11.58	0.03	93.24
	U1520D_22F-2_69-71_10	3.83	3.28	1.23	74.76	0.12	0.07	0.68	0.09	11.33	0.00	95.39
	U1520D_22F-2_69-71_11	3.53	2.92	2.64	70.73	0.37	0.44	2.24	0.06	12.60	0.06	95.58
	U1520D_22F-2_69-71_14	4.13	3.16	2.00	74.36	0.14	0.10	1.05	0.08	12.31	0.02	97.35
	U1520D_22F-2_69-71_15	3.51	2.97	2.92	70.71	0.38	0.34	2.25	0.12	12.76	0.06	96.02
	U1520D_22F-2_69-71_16	3.78	2.97	2.78	71.57	0.35	0.41	2.28	0.16	12.86	0.05	97.21

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u13	U1520D_22F-2_69-71_17	3.97	3.24	1.18	75.50	0.12	0.05	0.70	0.03	11.52	0.00	96.31
	U1520D_22F-2_69-71_18	3.43	3.04	2.68	69.96	0.31	0.30	2.11	0.09	12.71	0.05	94.67
	U1520D_22F-2_69-71_19	4.13	2.29	1.62	72.72	0.09	0.02	1.24	0.05	12.15	0.02	94.34
	U1520D_22F-2_69-71_20	3.50	2.92	2.85	70.72	0.35	0.42	2.21	0.04	12.74	0.03	95.79
	U1520D_22F-2_80-82_2	3.82	2.95	2.63	71.16	0.38	0.43	2.25	0.05	12.81	0.09	96.57
	U1520D_22F-2_80-82_4	3.50	3.03	2.80	70.01	0.32	0.36	2.20	0.13	12.83	0.05	95.23
	U1520D_22F-2_80-82_5	3.52	2.99	2.68	70.84	0.34	0.39	2.25	0.08	12.85	0.04	95.97
	U1520D_22F-2_80-82_6	3.53	3.05	2.69	71.02	0.36	0.42	2.19	0.09	13.03	0.05	96.43
	U1520D_22F-2_80-82_7	3.61	3.07	3.20	72.94	0.33	0.58	2.33	0.02	12.85	0.05	98.97
	U1520D_22F-2_80-82_8	3.59	3.03	2.90	72.62	0.35	0.34	2.15	0.00	13.03	0.01	98.03
	U1520D_22F-2_80-82_9	3.34	2.98	2.63	71.17	0.34	0.43	2.30	0.08	13.12	0.05	96.43
	U1520D_22F-2_80-82_10	3.88	3.00	2.92	71.21	0.37	0.44	2.32	0.08	13.06	0.07	97.34
	U1520D_22F-2_80-82_12	3.46	2.91	2.76	70.45	0.36	0.42	2.26	0.03	12.69	0.03	95.37
	U1520D_22F-2_80-82_13	3.80	3.04	2.63	72.07	0.36	0.42	2.32	0.06	13.05	0.04	97.79
	U1520D_22F-2_80-82_14	3.78	3.03	2.67	71.31	0.30	0.33	2.21	0.08	12.74	0.05	96.50
	U1520D_22F-2_80-82_15	3.71	3.09	2.70	72.65	0.36	0.40	2.23	0.05	12.90	0.04	98.13
	U1520D_22F-2_80-82_16	0.88	2.83	2.60	69.90	0.37	0.07	2.50	0.07	12.88	0.06	92.15
	U1520D_22F-2_80-82_17	2.51	3.11	2.95	72.73	0.37	0.30	2.29	0.07	12.91	0.08	97.32
	U1520D_22F-2_80-82_18	3.11	3.02	2.64	70.84	0.40	0.42	1.96	0.11	12.27	0.07	94.84
	U1520D_22F-2_80-82_1	3.76	3.17	2.82	72.88	0.36	0.42	2.25	0.09	13.47	0.03	99.24
	U1520D_22F-2_80-82_3	3.92	3.01	2.72	71.99	0.40	0.38	2.22	0.05	13.28	0.09	98.06
	U1520D_22F-2_80-82_4	4.19	3.07	2.61	70.80	0.38	0.40	2.24	0.09	13.34	0.05	97.17
	U1520D_22F-2_80-82_5	3.71	3.07	2.74	70.45	0.38	0.42	2.29	0.09	12.95	0.06	96.16
	U1520D_22F-2_80-82_7	3.81	3.00	2.77	72.58	0.42	0.40	2.30	0.08	13.43	0.01	98.79
	U1520D_22F-2_109-111_1	3.15	4.33	1.16	75.62	0.17	0.10	0.76	0.05	11.91	0.02	97.28
	U1520D_22F-2_109-111_2	3.76	3.44	1.60	73.69	0.17	0.11	1.15	0.02	12.49	0.00	96.44
	U1520D_22F-2_109-111_3	4.02	3.35	1.42	74.08	0.13	0.08	0.67	0.05	11.50	0.01	95.30
	U1520D_22F-2_109-111_4	3.88	3.30	1.30	74.56	0.15	0.05	0.66	0.08	11.40	0.01	95.39
	U1520D_22F-2_109-111_5	3.76	3.31	1.16	74.53	0.12	0.07	0.66	0.04	11.46	0.00	95.10
	U1520D_22F-2_109-111_6	3.65	3.43	1.26	74.59	0.11	0.05	0.66	0.06	11.35	0.00	95.16
	U1520D_22F-2_109-111_7	3.68	3.26	1.09	72.87	0.11	0.05	0.71	0.08	11.08	0.02	92.95
	U1520D_22F-2_109-111_8	4.03	2.83	2.27	69.62	0.33	0.30	1.58	0.07	12.74	0.07	93.84
	U1520D_22F-2_109-111_9	3.48	3.64	1.31	75.40	0.13	0.12	0.93	0.05	11.70	0.00	96.77
	U1520D_22F-2_109-111_10	3.63	4.02	1.06	74.88	0.11	0.05	0.50	0.08	11.58	0.02	95.94
	U1520D_22F-2_109-111_11	3.90	3.44	1.45	74.53	0.14	0.06	0.81	0.05	11.72	0.00	96.10
	U1520D_22F-2_109-111_12	3.47	3.96	1.16	74.17	0.11	0.06	0.77	0.09	11.67	0.00	95.47
	U1520D_22F-2_109-111_13	3.63	3.45	1.32	74.69	0.11	0.05	0.71	0.10	11.73	0.04	95.83
	U1520D_22F-2_109-111_14	3.56	3.18	1.73	71.15	0.14	0.08	1.11	0.09	11.80	0.02	92.86
	U1520D_22F-2_109-111_15	3.73	3.29	1.51	72.96	0.12	0.09	0.92	0.07	11.86	0.01	94.56
	U1520D_22F-2_109-111_16	2.93	3.78	1.17	72.10	0.15	0.13	0.85	0.00	11.24	0.00	92.35
	U1520D_22F-2_109-111_17	3.96	3.39	1.38	74.91	0.10	0.11	0.69	0.08	11.63	0.00	96.24
	U1520D_22F-2_109-111_18	3.57	3.73	1.01	73.74	0.08	0.07	0.55	0.04	11.45	0.00	94.24
	U1520D_22F-2_109-111_19	3.81	3.42	1.08	74.71	0.12	0.05	0.61	0.04	11.55	0.04	95.43
	U1520D_22F-2_109-111_20	2.77	4.23	1.21	74.67	0.16	0.07	0.79	0.03	11.77	0.00	95.70
	1520D_22F-2_109-111_2	4.09	3.48	1.42	71.38	0.17	0.07	0.89	0.03	11.87	0.03	93.43
	1520D_22F-2_109-111_4	5.52	2.61	0.76	71.80	0.10	0.03	1.23	0.00	14.06	0.01	96.12
	1520D_22F-2_109-111_6	3.84	2.88	2.03	69.80	0.17	0.09	1.32	0.05	12.48	0.00	92.66
	1520D_22F-2_109-111_1	3.76	2.89	1.46	72.04	0.16	0.13	1.17	0.10	11.87	0.04	93.63
	1520D_22F-2_109-111_5	4.03	3.38	1.10	73.83	0.13	0.05	0.67	0.05	11.72	0.00	94.97
	1520D_22F-2_109-111_8	3.50	3.13	1.04	71.71	0.21	0.16	0.97	0.06	11.27	0.00	92.05
	1520D_22F-2_109-111_9	3.76	3.48	1.37	73.57	0.14	0.07	0.76	0.00	11.46	0.02	94.63
	1520D_22F-2_109-111_10	3.87	3.05	1.19	72.34	0.26	0.19	1.03	0.10	11.58	0.00	93.59
	U1520D_22F-2_118-119_2	4.19	3.20	2.11	68.93	0.15	0.09	1.03	0.03	12.83	0.00	92.57
	U1520D_22F-2_118-119_3	3.45	2.96	2.17	70.57	0.22	0.27	1.88	0.04	12.61	0.03	94.20
	U1520D_22F-2_118-119_4	3.76	3.44	1.83	70.44	0.13	0.05	0.99	0.09	12.57	0.01	93.32
	U1520D_22F-2_118-119_5	4.04	2.55	2.30	72.10	0.35	0.44	2.25	0.09	12.89	0.06	97.08
	U1520D_22F-2_118-119_6	3.77	3.33	1.04	73.28	0.08	0.00	0.65	0.03	11.61	0.02	93.80
	U1520D_22F-2_118-119_9	4.19	2.96	1.99	70.00	0.27	0.20	1.30	0.09	12.85	0.03	93.88
	U1520D_22F-2_135-137_3	3.61	2.98	2.12	71.88	0.22	0.23	1.87	0.11	12.20	0.00	95.23
	U1520D_22F-2_135-137_4	3.90	3.24	1.28	75.71	0.07	0.08	0.63	0.12	11.37	0.02	96.41
	U1520D_22F-2_135-137_5	3.44	3.02	2.18	72.16	0.25	0.30	1.77	0.08	12.32	0.04	95.56
	U1520D_22F-2_135-137_6	3.29	3.06	2.17	71.59	0.21	0.30	1.85	0.03	12.10	0.01	94.61
	U1520D_22F-2_135-137_7	3.51	3.30	1.10	73.74	0.05	0.04	0.84	0.06	11.56	0.00	94.20
	U1520D_22F-2_135-137_8	3.24	2.94	2.20	66.83	0.21	0.29	1.70	0.01	11.12	0.04	88.58
	U1520D_22F-2_135-137_9	3.79	3.38	1.13	75.01	0.08	0.04	0.69	0.00	11.47	0.01	95.60
	U1520D_22F-2_135-137_10	3.47	3.08	1.86	71.23	0.22	0.28	1.74	0.07	12.25	0.03	94.24
	U1520D_22F-2_135-137_11	3.46	3.09	2.01	72.67	0.22	0.18	1.76	0.02	12.10	0.00	95.51
	U1520D_22F-2_135-137_12	3.35	3.11	1.04	68.19	0.08	0.08	0.70	0.04	10.75	0.03	87.37
	U1520D_22F-2_135-137_13	3.85	3.06	2.11	71.87	0.44	0.40	1.69	0.03	12.12	0.06	95.64
	U1520D_22F-2_135-137_14	3.58	3.41	1.20	74.60	0.11	0.02	0.65	0.05	11.35	0.02	94.99

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	U1520D_22F-2_135-137_15	3.87	3.43	1.15	75.86	0.12	0.05	0.69	0.08	11.52	0.01	96.78
	U1520D_22F-2_135-137_16	3.61	3.44	1.22	74.64	0.16	0.15	1.07	0.00	12.02	0.00	96.30
	U1520D_22F-2_135-137_17	4.13	3.13	1.19	74.95	0.12	0.09	0.71	0.05	11.39	0.02	95.78
	U1520D_22F-2_135-137_18	3.71	3.44	1.05	74.41	0.10	0.11	0.85	0.06	11.56	0.00	95.28
	U1520D_22F-3_69-71_1	3.92	3.40	1.06	74.39	0.06	0.06	0.71	0.05	11.56	0.03	95.25
	U1520D_22F-3_69-71_2	3.91	3.38	1.13	74.37	0.08	0.07	0.74	0.05	11.67	0.00	95.41
	U1520D_22F-3_69-71_3	3.82	3.30	1.33	71.92	0.15	0.11	1.17	0.11	12.54	0.01	94.45
	U1520D_22F-3_69-71_4	4.07	3.40	1.23	74.38	0.13	0.06	0.75	0.04	11.56	0.00	95.63
	U1520D_22F-3_69-71_5	3.55	3.56	1.15	74.22	0.07	0.07	0.62	0.05	11.54	0.01	94.84
	U1520D_22F-3_69-71_6	3.70	3.29	1.06	73.55	0.10	0.08	0.73	0.10	11.50	0.04	94.14
	U1520D_22F-3_69-71_7	3.77	3.40	1.04	74.11	0.07	0.05	0.77	0.02	11.58	0.02	94.83
	U1520D_22F-3_69-71_8	3.82	3.38	1.27	74.16	0.10	0.06	0.72	0.11	11.68	0.02	95.31
	U1520D_22F-3_69-71_9	3.74	3.50	1.08	74.84	0.09	0.06	0.63	0.05	11.61	0.04	95.64
	U1520D_22F-3_69-71_10	3.87	3.44	1.08	74.81	0.10	0.08	0.65	0.03	11.50	0.00	95.54
	U1520D_22F-3_69-71_11	3.80	3.46	1.01	74.59	0.10	0.09	0.59	0.10	11.54	0.02	95.30
	U1520D_22F-3_69-71_12	3.84	3.39	1.20	74.60	0.09	0.04	0.76	0.03	11.56	0.01	95.53
	U1520D_22F-3_69-71_13	3.79	3.44	1.06	74.03	0.09	0.05	0.70	0.03	11.70	0.00	94.89
	U1520D_22F-3_69-71_14	3.61	3.35	1.15	74.70	0.09	0.06	0.70	0.05	11.47	0.03	95.22
	U1520D_22F-3_69-71_15	3.81	3.39	1.06	74.44	0.07	0.09	0.70	0.02	11.56	0.00	95.15
	U1520D_22F-3_69-71_16	3.67	3.51	1.14	74.30	0.12	0.05	0.71	0.00	11.65	0.00	95.16
	U1520D_22F-3_69-71_17	3.87	3.41	1.08	74.27	0.08	0.07	0.65	0.01	11.42	0.01	94.87
	U1520D_22F-3_69-71_18	3.60	3.48	1.10	74.44	0.11	0.07	0.64	0.05	11.56	0.00	95.04
	U1520D_22F-3_69-71_19	3.96	3.35	1.09	74.10	0.06	0.06	0.73	0.00	11.58	0.00	94.94
	U1520D_22F-3_69-71_20	3.83	3.50	1.15	73.98	0.07	0.03	0.70	0.06	11.42	0.01	94.75
	U1520D_22F-3_77-79_1	3.57	3.25	1.19	74.05	0.09	0.07	0.66	0.00	11.58	0.03	94.49
	U1520D_22F-3_77-79_2	3.99	3.32	1.25	74.60	0.08	0.06	0.73	0.03	11.57	0.00	95.62
	U1520D_22F-3_77-79_3	3.64	3.49	1.12	74.76	0.11	0.04	0.61	0.05	11.71	0.01	95.56
	U1520D_22F-3_77-79_5	3.79	3.55	1.06	74.45	0.10	0.02	0.69	0.11	11.87	0.02	95.66
	U1520D_22F-3_77-79_6	4.11	3.49	1.34	75.01	0.09	0.04	0.71	0.00	11.95	0.02	96.76
	U1520D_22F-3_77-79_7	3.89	3.34	1.20	74.73	0.09	0.07	0.66	0.10	11.57	0.00	95.65
	U1520D_22F-3_77-79_8	3.58	3.55	1.10	74.56	0.09	0.07	0.68	0.06	11.65	0.02	95.35
	U1520D_22F-3_77-79_9	3.67	3.72	1.17	73.65	0.09	0.08	0.62	0.06	11.44	0.00	94.50
	U1520D_22F-3_77-79_10	3.89	3.66	1.07	75.12	0.09	0.07	0.60	0.06	11.56	0.00	96.12
	U1520D_22F-3_77-79_11	3.11	4.23	0.97	74.73	0.09	0.02	0.37	0.05	10.95	0.00	94.52
	U1520D_22F-3_77-79_12	4.10	3.30	1.20	74.78	0.08	0.10	0.72	0.06	11.82	0.00	96.17
	U1520D_22F-3_77-79_13	3.94	3.33	1.32	75.12	0.11	0.04	0.70	0.00	11.74	0.00	96.29
	U1520D_22F-3_77-79_14	3.52	3.53	1.12	73.66	0.10	0.07	1.12	0.01	11.94	0.02	95.09
	U1520D_22F-3_77-79_15	3.91	3.60	1.19	74.99	0.09	0.05	0.65	0.10	11.67	0.00	96.24
	U1520D_22F-3_77-79_16	3.79	3.29	1.23	74.57	0.11	0.06	0.67	0.03	11.60	0.00	95.36
	U1520D_22F-3_77-79_17	4.05	3.12	1.19	73.49	0.16	0.11	0.96	0.10	12.50	0.01	95.68
	U1520D_22F-3_77-79_18	4.04	3.27	1.19	74.35	0.10	0.04	0.74	0.03	11.45	0.03	95.24
	U1520D_22F-3_77-79_19	3.67	3.58	0.97	74.01	0.08	0.03	0.62	0.02	11.62	0.04	94.64
	U1520D_22F-3_77-79_20	3.89	3.37	1.12	74.45	0.09	0.06	0.71	0.11	11.78	0.03	95.61
	1520D_22F-3_77-79_3	3.83	3.14	1.13	73.17	0.14	0.07	0.70	0.02	11.46	0.03	93.69
	1520D_22F-3_77-79_4	3.96	3.25	1.21	73.70	0.11	0.04	0.68	0.00	11.66	0.03	94.64
	1520D_22F-3_77-79_10	4.06	3.30	1.25	74.04	0.12	0.08	0.70	0.03	11.70	0.03	95.30
	1520D_22F-3_77-79_2	3.96	3.50	1.09	73.95	0.15	0.05	0.62	0.07	11.55	0.00	94.94
	1520D_22F-3_77-79_6	4.07	3.62	1.20	73.68	0.15	0.07	0.63	0.00	11.72	0.01	95.16
	1520D_22F-3_77-79_8	3.48	3.65	0.93	70.85	0.14	0.11	0.80	0.07	11.68	0.02	91.74
	1520D_22F-3_77-79_9	3.83	3.54	1.11	72.65	0.15	0.06	0.67	0.03	11.66	0.00	93.70
	U1520D_22F-4_8-9_1	3.99	3.68	1.02	74.96	0.08	0.05	0.56	0.11	11.71	0.00	96.16
	U1520D_22F-4_8-9_2	3.79	3.60	1.04	74.70	0.10	0.03	0.62	0.03	11.77	0.00	95.68
	U1520D_22F-4_8-9_3	3.69	3.97	1.09	74.43	0.09	0.03	0.50	0.04	11.52	0.02	95.38
	U1520D_22F-4_8-9_4	3.81	3.50	1.08	73.43	0.11	0.05	0.63	0.05	11.43	0.01	94.09
	U1520D_22F-4_8-9_5	3.75	3.66	1.10	73.88	0.09	0.10	0.59	0.11	11.49	0.01	94.77
	U1520D_22F-4_8-9_6	3.78	3.57	1.07	74.59	0.09	0.03	0.59	0.09	11.64	0.00	95.45
	U1520D_22F-4_8-9_7	3.76	3.61	1.04	73.70	0.11	0.03	0.63	0.05	11.78	0.00	94.72
	U1520D_22F-4_8-9_8	3.69	3.50	1.17	73.80	0.09	0.06	0.59	0.05	11.69	0.00	94.64
	U1520D_22F-4_8-9_9	3.78	3.73	1.05	73.63	0.08	0.05	0.63	0.00	11.50	0.02	94.46
	U1520D_22F-4_8-9_10	3.95	3.60	1.15	74.31	0.11	0.02	0.63	0.04	11.79	0.01	95.61
	U1520D_22F-4_8-9_11	4.00	3.49	1.07	71.95	0.09	0.04	0.59	0.04	11.54	0.00	92.82
	U1520D_22F-4_8-9_12	3.74	3.61	1.06	74.17	0.11	0.03	0.66	0.11	11.76	0.01	95.27
	U1520D_22F-4_8-9_13	3.55	3.63	1.12	72.30	0.10	0.06	0.58	0.08	11.68	0.00	93.10
	U1520D_22F-4_8-9_14	3.74	3.46	1.09	71.57	0.09	0.02	0.64	0.06	11.65	0.03	92.35
	U1520D_22F-4_8-9_15	3.79	3.49	1.08	70.99	0.12	0.04	0.57	0.09	11.63	0.04	91.84
	U1520D_22F-4_8-9_17	3.61	3.50	1.16	71.39	0.10	0.04	0.60	0.00	11.57	0.00	91.96
	U1520D_22F-4_8-9_18	3.65	3.52	0.96	71.41	0.11	0.08	0.61	0.06	11.59	0.00	91.98
	U1520D_22F-4_8-9_19	3.86	3.63	1.17	72.96	0.09	0.05	0.64	0.03	11.72	0.00	94.16
	U1520D_22F-4_8-9_20	3.87	3.61	1.24	73.83	0.07	0.04	0.63	0.00	11.67	0.02	94.98
	U1520D_22F-4_31-32_2	3.38	3.02	2.12	70.25	0.23	0.22	1.84	0.02	12.35	0.00	93.43

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	U1520D_22F-4_31-32_4	4.11	2.98	2.09	68.42	0.18	0.12	1.10	0.07	12.23	0.00	91.31
	U1520D_22F-4_31-32_5	3.47	3.60	1.19	70.83	0.13	0.10	0.96	0.04	11.86	0.02	92.20
	U1520D_22F-4_31-32_6	4.18	3.24	1.41	73.55	0.13	0.10	0.68	0.00	11.72	0.01	95.01
	U1520D_22F-4_31-32_7	3.79	3.57	1.14	73.71	0.10	0.03	0.51	0.00	11.62	0.01	94.48
	U1520D_22F-4_31-32_8	3.96	3.25	1.09	73.30	0.10	0.08	0.70	0.08	11.50	0.00	94.07
	U1520D_22F-4_31-32_10	3.19	3.45	1.68	72.78	0.24	0.07	1.18	0.00	11.34	0.01	93.94
	U1520D_22F-4_31-32_11	3.93	3.35	1.27	74.22	0.12	0.08	0.69	0.09	11.75	0.01	95.52
	U1520D_22F-4_54-55_1	3.67	3.41	1.39	72.69	0.13	0.12	1.00	0.05	12.09	0.01	94.56
	U1520D_22F-4_54-55_2	3.75	3.44	1.13	74.80	0.08	0.03	0.67	0.10	11.73	0.00	95.73
	U1520D_22F-4_54-55_3	3.63	3.03	2.10	72.43	0.20	0.23	1.69	0.04	12.53	0.03	95.90
	U1520D_22F-4_54-55_4	5.76	1.99	2.49	70.55	0.31	0.21	1.11	0.06	13.19	0.05	95.72
	U1520D_22F-4_54-55_5	4.10	3.32	1.08	74.70	0.08	0.04	0.69	0.11	11.81	0.03	95.97
	U1520D_22F-4_54-55_7	3.44	3.05	2.17	71.62	0.25	0.27	1.84	0.11	12.44	0.02	95.21
	U1520D_22F-4_54-55_8	3.41	3.01	2.33	71.35	0.22	0.26	1.82	0.00	12.58	0.01	94.99
	U1520D_22F-4_54-55_9	3.73	2.98	2.06	71.32	0.25	0.24	1.84	0.10	12.60	0.04	95.16
	U1520D_22F-4_54-55_10	3.17	3.34	1.80	73.23	0.24	0.13	1.40	0.03	11.86	0.02	95.21
	U1520D_23F-2_16-18_1	2.87	3.46	1.47	71.45	0.21	0.15	0.88	0.02	11.94	0.01	92.47
	U1520D_23F-2_16-18_2	3.54	3.62	1.20	75.16	0.16	0.12	0.88	0.01	11.71	0.06	96.47
	U1520D_23F-2_16-18_3	3.44	3.73	1.41	74.49	0.15	0.12	0.95	0.05	11.66	0.01	96.01
	U1520D_23F-2_16-18_4	4.00	3.33	1.27	74.20	0.13	0.10	0.83	0.08	11.56	0.02	95.52
	U1520D_23F-2_16-18_5	3.60	3.51	1.31	73.60	0.13	0.09	0.79	0.06	11.89	0.04	95.02
	U1520D_23F-2_16-18_6	3.64	3.61	1.16	74.51	0.13	0.11	1.04	0.04	11.89	0.00	96.13
	U1520D_23F-2_16-18_7	3.65	3.74	1.06	75.10	0.09	0.11	0.81	0.06	11.92	0.00	96.54
	U1520D_23F-2_16-18_8	3.82	3.10	1.23	74.30	0.09	0.08	0.73	0.06	11.51	0.01	94.93
	U1520D_23F-2_16-18_9	3.17	3.62	1.08	73.45	0.12	0.14	1.02	0.04	11.28	0.02	93.94
	U1520D_23F-2_16-18_10	3.79	3.53	1.12	74.67	0.10	0.08	0.67	0.10	11.75	0.00	95.81
	U1520D_23F-2_60-62_1	3.88	3.26	1.82	72.30	0.14	0.10	1.20	0.06	12.14	0.01	94.92
	U1520D_23F-2_60-62_2	3.92	3.41	1.31	74.69	0.10	0.06	0.70	0.03	11.65	0.04	95.91
	U1520D_23F-2_60-62_3	3.13	3.99	0.99	74.99	0.11	0.07	0.94	0.06	11.83	0.01	96.11
	U1520D_23F-2_60-62_5	3.59	3.22	1.26	74.36	0.14	0.05	0.71	0.04	11.72	0.01	95.10
	U1520D_23F-2_60-62_6	3.94	3.19	1.06	74.40	0.10	0.08	0.69	0.10	11.48	0.01	95.03
	U1520D_23F-2_60-62_7	4.06	3.21	1.14	74.40	0.13	0.10	0.70	0.00	11.79	0.00	95.54
	U1520D_23F-2_60-62_8	3.87	3.90	1.07	74.20	0.09	0.03	0.52	0.10	11.54	0.00	95.31
	U1520D_23F-2_60-62_9	3.24	4.04	1.19	74.09	0.14	0.10	0.83	0.03	11.82	0.00	95.47
	U1520D_23F-2_113-115_1	4.20	3.26	1.18	74.94	0.11	0.05	0.69	0.08	11.67	0.05	96.23
	U1520D_23F-2_113-115_2	3.91	3.24	1.17	74.40	0.12	0.10	0.78	0.05	11.74	0.02	95.53
	U1520D_23F-2_113-115_3	3.58	3.44	1.05	74.09	0.12	0.08	0.65	0.03	11.45	0.03	94.52
	U1520D_23F-2_113-115_4	4.19	3.50	2.19	72.08	0.14	0.10	1.06	0.14	12.84	0.01	96.26
	U1520D_23F-2_113-115_5	3.77	3.25	1.15	74.35	0.13	0.05	0.72	0.13	11.63	0.03	95.21
	U1520D_23F-2_113-115_6	3.77	3.27	1.19	73.88	0.10	0.08	0.68	0.09	11.40	0.01	94.48
	U1520D_23F-2_113-115_7	3.57	3.35	1.26	74.31	0.11	0.05	0.68	0.05	11.45	0.01	94.84
	U1520D_23F-2_113-115_8	3.90	3.24	1.29	74.00	0.13	0.08	0.72	0.10	11.53	0.00	94.99
	U1520D_23F-2_113-115_9	4.13	3.33	1.61	73.88	0.13	0.03	0.67	0.02	11.63	0.03	95.46
	U1520D_23F-2_113-115_10	3.90	3.25	1.14	74.40	0.14	0.10	0.74	0.01	11.77	0.02	95.46
	U1520D_23F-2_113-115_12	3.80	3.40	1.08	73.97	0.11	0.08	0.78	0.02	11.74	0.00	94.97
	U1520D_23F-2_113-115_13	4.02	3.27	1.23	74.39	0.11	0.05	0.69	0.04	11.61	0.02	95.44
	U1520D_23F-2_113-115_14	3.58	3.54	1.14	73.85	0.11	0.09	0.64	0.02	11.57	0.00	94.54
	U1520D_23F-2_113-115_16	3.90	3.17	1.08	74.35	0.13	0.06	0.65	0.04	11.68	0.02	95.09
	U1520D_23F-2_113-115_17	3.41	3.84	1.67	73.02	0.09	0.07	1.00	0.02	12.30	0.02	95.45
	U1520D_23F-2_113-115_18	3.98	3.44	1.25	75.15	0.12	0.04	0.70	0.03	11.90	0.03	96.64
	U1520D_23F-2_113-115_19	1.92	3.39	1.37	76.01	0.12	0.07	0.73	0.00	11.67	0.04	95.31
s13	U1520D_23F-2_113-115_3	3.75	3.61	0.99	72.96	0.09	0.04	0.54	0.03	11.42	0.00	93.43
	U1520D_23F-3_6-8_1	3.39	4.04	0.91	74.23	0.05	0.02	0.52	0.07	11.41	0.00	94.64
	U1520D_23F-3_6-8_2	3.97	3.77	0.96	75.85	0.07	0.05	0.52	0.00	11.39	0.00	96.58
	U1520D_23F-3_6-8_3	3.89	2.10	5.04	63.17	0.71	1.19	3.85	0.13	14.55	0.21	94.84
	U1520D_23F-3_6-8_4	3.62	3.55	1.62	74.24	0.12	0.04	0.86	0.06	11.51	0.03	95.65
	U1520D_23F-3_6-8_5	3.81	3.64	1.15	74.33	0.08	0.04	0.62	0.08	11.37	0.00	95.12
	U1520D_23F-3_6-8_6	3.74	3.35	0.99	75.00	0.10	0.05	0.72	0.06	11.40	0.03	95.44
	U1520D_23F-3_6-8_8	4.00	3.29	1.26	75.21	0.13	0.06	0.69	0.16	11.44	0.00	96.24
	U1520D_23F-3_6-8_9	2.94	4.30	0.91	75.65	0.11	0.09	1.01	0.04	12.14	0.00	97.19
	U1520D_23F-3_6-8_10	3.11	4.46	0.83	75.80	0.08	0.04	0.77	0.00	11.63	0.02	96.73
	U1520D_23F-3_6-8_11	3.49	3.83	1.13	75.41	0.06	0.10	0.81	0.08	11.48	0.02	96.42
	U1520D_23F-3_6-8_12	4.50	2.11	1.31	72.27	0.23	0.17	0.85	0.03	11.68	0.03	93.19
	U1520D_23F-3_6-8_13	3.93	3.98	0.70	75.25	0.10	0.04	0.55	0.11	11.79	0.04	96.49
	U1520D_23F-3_6-8_14	3.55	3.30	1.60	73.99	0.18	0.12	0.86	0.02	11.39	0.00	95.01
	U1520D_23F-3_6-8_15	3.74	3.42	1.20	75.00	0.08	0.05	0.71	0.06	11.37	0.03	95.66
	U1520D_23F-3_6-8_16	3.71	3.52	1.35	74.81	0.13	0.12	0.85	0.03	11.52	0.00	96.04
	U1520D_23F-3_6-8_18	3.64	3.00	1.59	72.73	0.11	0.09	1.20	0.02	12.07	0.00	94.45
	U1520D_23F-3_6-8_19	3.43	3.24	0.95	73.83	0.12	0.12	1.03	0.02	11.77	0.01	94.52
	U1520D_23F-3_6-8_20	3.21	4.17	1.29	74.55	0.14	0.21	1.10	0.01	12.15	0.02	96.85

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1520D_23F-3_6-8_1	3.80	3.89	1.09	72.63	0.18	0.08	0.83	0.05	11.79	0.00	94.34
	1520D_23F-3_6-8_3	3.48	3.58	0.79	73.93	0.13	0.06	0.96	0.09	11.90	0.00	94.91
	1520D_23F-3_6-8_8	4.05	3.19	1.16	73.71	0.17	0.07	0.69	0.03	11.59	0.03	94.69
	1520D_23F-3_6-8_9	3.66	3.88	1.33	73.71	0.22	0.08	0.89	0.00	11.93	0.01	95.71
	1520D_23F-3_6-8_6	3.87	3.54	1.12	73.80	0.17	0.03	0.76	0.11	11.50	0.00	94.91
	U1520D_23F-CC_2-5_1	3.20	4.69	0.89	74.38	0.09	0.03	0.53	0.12	11.68	0.00	95.60
	U1520D_23F-CC_2-5_2	3.97	3.62	1.14	76.05	0.09	0.09	0.71	0.05	11.56	0.00	97.28
	U1520D_23F-CC_2-5_3	3.67	2.90	1.14	73.80	0.08	0.04	0.66	0.07	11.18	0.01	93.55
	U1520D_23F-CC_2-5_4	3.66	3.63	1.34	75.85	0.11	0.05	0.79	0.03	11.54	0.03	97.04
	U1520D_23F-CC_2-5_5	3.24	3.85	1.21	74.68	0.13	0.10	1.18	0.00	11.86	0.00	96.25
	U1520D_23F-CC_2-5_6	4.23	3.21	1.76	72.39	0.16	0.16	1.07	0.01	12.08	0.00	95.07
	U1520D_23F-CC_2-5_7	4.10	3.72	1.56	71.49	0.12	0.07	0.86	0.06	12.24	0.00	94.21
	U1520D_23F-CC_2-5_8	3.39	3.38	1.74	71.48	0.13	0.10	1.16	0.00	11.71	0.00	93.09
	U1520D_23F-CC_2-5_9	3.62	3.43	1.30	74.42	0.14	0.11	0.96	0.03	11.82	0.01	95.84
	U1520D_23F-CC_2-5_10	3.52	3.42	1.32	73.49	0.15	0.15	1.23	0.12	12.07	0.03	95.49
	U1520D_23F-CC_2-5_11	3.78	3.46	1.33	75.09	0.09	0.06	0.82	0.03	11.60	0.00	96.25
	U1520D_23F-CC_2-5_12	5.17	2.44	2.06	71.62	0.33	0.26	1.10	0.14	12.57	0.04	95.72
	U1520D_23F-CC_2-5_13	3.87	3.58	1.26	75.05	0.11	0.07	0.79	0.10	11.52	0.02	96.36
	U1520D_23F-CC_2-5_14	3.54	3.26	1.20	75.62	0.18	0.13	1.02	0.04	11.38	0.01	96.38
	U1520D_23F-CC_2-5_15	4.04	3.27	1.18	74.20	0.12	0.07	0.76	0.03	11.17	0.03	94.87
	U1520D_23F-CC_2-5_16	3.85	3.17	1.26	73.25	0.12	0.08	0.93	0.02	11.58	0.00	94.26
	U1520D_23F-CC_2-5_17	3.69	3.42	1.61	74.82	0.05	0.06	0.91	0.08	11.55	0.01	96.20
	U1520D_23F-CC_2-5_18	3.17	2.89	1.34	70.93	0.17	0.18	1.26	0.06	11.94	0.01	91.96
	U1520D_23F-CC_2-5_19	3.74	3.55	1.78	73.10	0.11	0.08	1.04	0.08	11.78	0.00	95.26
	U1520D_23F-CC_2-5_20	3.62	2.37	1.19	73.61	0.07	0.05	0.42	0.03	11.43	0.04	92.82
	U1520D_23F-CC_29-31_1	2.98	4.22	1.18	75.05	0.14	0.09	0.88	0.02	12.04	0.02	96.62
	U1520D_25F-2_5-8_1	3.77	3.38	1.30	74.01	0.14	0.14	0.95	0.00	11.88	0.00	95.56
	U1520D_25F-2_5-8_2	4.01	3.36	1.46	73.77	0.15	0.16	1.11	0.00	12.38	0.03	96.42
	U1520D_25F-2_5-8_3	3.79	3.39	1.11	74.11	0.15	0.10	0.92	0.03	11.68	0.02	95.29
	U1520D_25F-2_5-8_4	3.60	3.66	0.90	74.52	0.10	0.05	0.81	0.08	11.49	0.01	95.22
	U1520D_25F-2_5-8_5	3.79	3.40	1.22	73.55	0.15	0.06	0.84	0.04	11.58	0.00	94.64
	U1520D_25F-2_5-8_7	3.69	3.41	1.10	73.75	0.14	0.11	0.87	0.03	11.52	0.01	94.62
	U1520D_25F-2_5-8_8	3.37	3.61	1.12	73.83	0.11	0.06	0.70	0.04	11.19	0.03	94.06
	U1520D_25F-2_5-8_9	3.77	3.64	1.13	74.34	0.10	0.09	0.69	0.03	11.58	0.02	95.40
	U1520D_25F-2_5-8_10	3.63	3.36	1.26	73.46	0.12	0.12	0.92	0.00	11.45	0.00	94.32
	U1520D_25F-2_5-8_11	3.51	3.51	1.17	74.48	0.11	0.06	0.89	0.06	11.61	0.02	95.42
	U1520D_25F-2_5-8_12	3.65	3.47	1.36	74.55	0.12	0.10	0.88	0.09	11.62	0.01	95.85
	U1520D_25F-2_5-8_13	3.55	3.52	1.24	74.62	0.11	0.09	0.87	0.06	11.92	0.00	95.97
	U1520D_25F-2_5-8_14	3.44	3.67	1.03	74.54	0.06	0.09	0.69	0.07	11.51	0.01	95.11
	U1520D_25F-2_5-8_15	3.53	2.03	1.41	73.52	0.09	0.07	0.48	0.05	11.35	0.01	92.55
	U1520D_25F-2_5-8_16	3.44	3.34	1.07	74.20	0.13	0.07	0.86	0.03	11.71	0.01	94.85
	U1520D_25F-2_5-8_17	3.84	3.38	1.25	73.84	0.12	0.08	0.87	0.11	11.59	0.01	95.08
	U1520D_25F-2_5-8_18	3.36	3.71	1.18	71.54	0.10	0.10	0.74	0.06	11.22	0.02	92.02
	U1520D_25F-2_5-8_19	3.77	0.00	1.33	74.78	0.13	0.09	0.00	0.06	11.70	0.00	91.86
	U1520D_25F-2_5-8_20	3.57	2.71	1.08	75.45	0.06	0.06	0.55	0.04	11.58	0.01	95.10
sl7	U1520D_25F-2_10-14_1	3.76	3.62	1.22	73.89	0.13	0.09	0.93	0.03	11.49	0.04	95.20
	U1520D_25F-2_10-14_2	3.65	3.40	1.22	74.01	0.13	0.10	0.87	0.01	11.66	0.00	95.06
	U1520D_25F-2_10-14_3	3.97	3.53	1.36	75.94	0.06	0.08	0.89	0.03	11.82	0.00	97.67
	U1520D_25F-2_10-14_4	4.10	2.83	1.56	72.88	0.23	0.19	1.17	0.04	12.15	0.03	95.18
	U1520D_25F-2_10-14_5	3.84	3.32	1.32	73.99	0.12	0.07	0.88	0.08	11.51	0.01	95.14
	U1520D_25F-2_10-14_6	3.57	3.60	1.00	74.15	0.12	0.07	0.74	0.06	11.51	0.02	94.84
	U1520D_25F-2_10-14_7	3.59	3.83	1.20	72.84	0.17	0.15	1.01	0.01	11.85	0.06	94.72
	U1520D_25F-2_10-14_8	3.31	3.43	1.09	73.43	0.12	0.08	0.83	0.04	11.36	0.00	93.71
	U1520D_25F-2_10-14_9	3.65	3.39	1.35	73.54	0.16	0.15	1.04	0.05	11.74	0.00	95.06
	U1520D_25F-2_10-14_10	3.28	3.72	1.11	75.67	0.11	0.10	0.85	0.05	11.45	0.02	96.36
	U1520D_25F-2_10-14_11	3.64	3.61	1.20	74.42	0.13	0.10	0.93	0.04	11.74	0.00	95.82
	U1520D_25F-2_10-14_12	3.45	3.17	0.99	73.15	0.15	0.14	1.00	0.08	10.94	0.00	93.08
	U1520D_25F-2_10-14_13	3.72	3.41	0.99	75.49	0.13	0.12	0.97	0.15	11.58	0.03	96.59
	U1520D_25F-2_10-14_14	3.46	3.32	1.60	74.00	0.11	0.07	0.82	0.06	11.54	0.00	94.97
	U1520D_25F-2_10-14_15	3.38	3.75	1.20	72.61	0.10	0.09	0.77	0.03	11.37	0.00	93.30
	U1520D_25F-2_10-14_16	3.70	3.37	1.19	73.52	0.18	0.09	0.94	0.05	11.73	0.04	94.81
	U1520D_25F-2_10-14_17	3.64	3.42	1.27	73.63	0.14	0.10	0.86	0.00	11.47	0.01	94.55
	U1520D_25F-2_10-14_18	3.70	3.43	1.27	73.97	0.14	0.06	0.82	0.11	11.66	0.02	95.18
	U1520D_25F-2_10-14_19	3.62	3.35	1.18	73.17	0.13	0.10	0.83	0.03	11.53	0.04	93.98
	U1520D_25F-2_10-14_20	3.82	3.31	1.28	73.99	0.14	0.11	1.00	0.06	11.69	0.02	95.42
	1520D_25F-2_10-14_2	3.55	3.33	1.21	72.99	0.13	0.06	0.82	0.00	11.77	0.00	93.86
	1520D_25F-2_10-14_5	3.65	3.42	1.27	72.82	0.19	0.08	0.87	0.05	11.82	0.02	94.19
	1520D_25F-2_10-14_4	3.78	3.07	1.50	70.04	0.31	0.16	0.98	0.06	12.13	0.01	92.03
	1520D_25F-2_10-14_8	3.84	3.59	1.26	75.55	0.16	0.05	0.84	0.09	11.99	0.01	97.39
	1520D_25F-2_10-14_1	4.28	3.54	1.32	74.24	0.18	0.12	0.96	0.00	12.13	0.00	96.77

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1520D_25F-2_10-14_3	3.77	3.42	1.08	73.14	0.17	0.10	0.79	0.06	11.58	0.00	94.10
	1520D_25F-2_10-14_6	3.48	3.40	1.03	72.96	0.18	0.05	0.72	0.10	11.55	0.02	93.49
	1520D_25F-2_10-14_7	3.68	3.43	1.16	72.95	0.16	0.09	0.75	0.08	11.53	0.01	93.84
	1520D_25F-2_10-14_10	3.13	3.74	0.89	72.48	0.11	0.07	0.69	0.01	11.61	0.01	92.74
	U1520D_25F-3_79-81_1	3.46	3.47	1.17	73.68	0.08	0.04	0.76	0.04	11.65	0.00	94.35
	U1520D_25F-3_79-81_2	3.68	3.43	1.24	74.25	0.15	0.06	0.84	0.08	11.85	0.01	95.58
	U1520D_25F-3_79-81_3	3.86	3.66	1.24	73.11	0.14	0.10	0.98	0.02	12.10	0.00	95.21
	U1520D_25F-3_79-81_4	3.60	3.47	0.96	74.08	0.13	0.08	0.81	0.03	11.87	0.00	95.03
	U1520D_25F-3_79-81_5	3.79	3.39	1.30	73.60	0.12	0.08	0.83	0.09	11.88	0.01	95.08
	U1520D_25F-3_79-81_6	3.96	3.28	1.26	73.03	0.17	0.12	0.99	0.10	12.20	0.00	95.11
	U1520D_25F-3_79-81_7	3.90	3.39	1.20	73.58	0.13	0.10	1.00	0.01	12.28	0.00	95.59
	U1520D_25F-3_79-81_8	3.58	3.38	1.33	73.61	0.12	0.09	0.90	0.11	11.92	0.00	95.04
	U1520D_25F-3_79-81_9	3.86	3.28	1.14	73.65	0.16	0.14	0.98	0.08	12.24	0.00	95.53
	U1520D_25F-3_79-81_10	3.52	3.43	1.28	73.99	0.10	0.09	0.87	0.04	11.93	0.00	95.25
	U1520D_25F-3_79-81_11	3.92	3.32	1.42	72.95	0.19	0.12	0.92	0.00	12.26	0.04	95.15
	U1520D_25F-3_79-81_12	3.92	3.42	1.19	73.82	0.12	0.10	0.82	0.00	11.81	0.02	95.22
	U1520D_25F-3_79-81_13	3.94	3.35	1.38	72.56	0.19	0.17	1.03	0.06	12.57	0.02	95.26
	U1520D_25F-3_79-81_14	3.81	3.51	1.05	74.65	0.13	0.10	0.85	0.07	12.00	0.00	96.17
	U1520D_25F-3_79-81_15	3.47	4.33	0.97	74.62	0.14	0.09	0.82	0.01	11.88	0.01	96.34
	U1520D_25F-3_79-81_16	3.82	3.50	1.04	74.23	0.16	0.07	0.80	0.03	11.97	0.00	95.62
	U1520D_25F-3_79-81_17	4.08	3.42	1.31	74.25	0.13	0.10	0.81	0.09	12.08	0.00	96.27
	U1520D_25F-3_79-81_18	3.72	3.45	1.20	74.94	0.11	0.13	0.89	0.10	12.20	0.01	96.75
	U1520D_25F-3_79-81_19	3.18	2.70	1.09	72.38	0.13	0.11	1.20	0.07	11.60	0.01	92.47
	U1520D_25F-3_79-81_20	3.60	3.37	1.21	74.05	0.12	0.09	0.85	0.00	11.94	0.01	95.24
	U1520D_25F-4_10-12_1	3.81	3.26	1.37	74.54	0.10	0.03	0.78	0.04	11.46	0.04	95.43
	U1520D_25F-4_10-12_2	3.87	3.51	1.60	74.44	0.10	0.08	0.95	0.07	11.61	0.02	96.26
	U1520D_25F-4_10-12_3	3.59	3.67	0.94	73.72	0.07	0.02	0.64	0.01	11.37	0.04	94.06
	U1520D_25F-4_10-12_4	3.62	3.30	1.41	73.45	0.09	0.08	0.86	0.02	11.63	0.01	94.47
	U1520D_25F-4_10-12_5	3.73	3.46	1.31	74.43	0.08	0.08	0.77	0.04	11.43	0.03	95.35
	U1520D_25F-4_10-12_6	3.69	3.58	1.62	74.08	0.09	0.09	0.89	0.09	11.59	0.00	95.72
	U1520D_25F-4_10-12_7	4.06	3.35	1.53	73.46	0.11	0.04	0.88	0.04	11.77	0.01	95.24
	U1520D_25F-4_10-12_8	3.94	3.13	1.53	73.80	0.14	0.08	0.89	0.11	11.73	0.00	95.35
	U1520D_25F-4_10-12_9	3.42	3.77	1.05	73.98	0.05	0.07	0.89	0.02	11.69	0.01	94.94
	U1520D_25F-4_10-12_10	3.74	3.32	0.06	72.44	0.00	0.13	1.35	0.01	12.08	0.01	93.14
	U1520D_25F-4_10-12_11	3.70	3.29	1.36	73.89	0.03	0.07	0.86	0.00	11.57	0.00	94.78
	U1520D_25F-4_10-12_12	3.40	3.43	1.21	73.04	0.06	0.10	0.88	0.05	11.16	0.00	93.33
	U1520D_25F-4_10-12_13	3.89	3.28	1.45	74.32	0.03	0.09	0.90	0.04	11.58	0.01	95.59
	U1520D_25F-4_10-12_14	3.54	3.30	1.31	74.63	0.12	0.06	0.89	0.06	11.38	0.01	95.29
	U1520D_25F-4_10-12_15	3.65	3.67	1.67	74.00	0.14	0.14	1.11	0.01	12.24	0.02	96.66
	U1520D_25F-4_10-12_16	3.84	3.25	1.56	73.73	0.09	0.10	0.86	0.09	11.81	0.03	95.35
	U1520D_25F-4_10-12_17	3.99	3.19	1.36	73.55	0.12	0.07	0.87	0.06	11.58	0.02	94.81
	U1520D_25F-4_10-12_18	3.75	3.25	1.62	73.67	0.09	0.11	0.88	0.11	11.74	0.00	95.22
	U1520D_25F-4_10-12_19	3.69	3.10	1.43	73.17	0.11	0.10	0.90	0.06	11.71	0.01	94.28
	U1520D_25F-4_10-12_20	3.87	3.23	1.43	73.98	0.13	0.05	0.85	0.00	11.53	0.00	95.08
	1520D_25F-4_10-12_5	3.77	3.39	1.42	73.90	0.21	0.09	0.89	0.01	12.01	0.01	95.70
	1520D_25F-4_10-12_7	3.69	3.51	1.07	74.03	0.12	0.08	0.93	0.00	11.66	0.03	95.13
	1520D_25F-4_10-12_10	3.57	3.96	1.12	74.69	0.18	0.09	0.67	0.05	11.66	0.00	95.99
	1520D_25F-4_10-12_8	3.84	3.29	1.24	73.92	0.12	0.01	0.71	0.07	11.43	0.00	94.63
	1520D_25F-4_10-12_9	4.17	3.22	1.50	73.59	0.18	0.08	0.89	0.04	11.86	0.00	95.54
	1520D_25F-4_10-12_2	4.12	3.10	1.39	73.17	0.15	0.09	0.87	0.08	11.96	0.02	94.96
	1520D_25F-4_10-12_3	3.72	3.42	1.24	74.17	0.14	0.07	0.77	0.06	11.62	0.02	95.24
	1520D_25F-4_10-12_4	3.65	3.45	1.05	73.44	0.11	0.06	0.74	0.05	11.61	0.02	94.19
	1520D_25F-4_10-12_6	4.06	3.14	1.34	72.78	0.15	0.07	0.88	0.02	11.73	0.02	94.20
	U1520D_25F-4_19-21_1	3.20	4.33	0.93	74.66	0.13	0.14	0.78	0.00	11.88	0.01	96.06
	U1520D_25F-4_19-21_3	4.00	3.19	1.35	73.30	0.11	0.08	0.89	0.06	11.84	0.00	94.82
	U1520D_25F-4_19-21_4	4.01	2.72	2.34	69.88	0.37	0.35	1.60	0.09	13.15	0.01	94.52
	U1520D_25F-4_19-21_5	3.93	3.33	1.42	74.16	0.11	0.05	0.82	0.03	11.88	0.00	95.73
	U1520D_25F-4_19-21_6	3.66	3.21	1.59	73.11	0.09	0.07	0.86	0.00	11.95	0.02	94.57
	U1520D_25F-4_19-21_7	3.99	3.26	1.29	73.52	0.10	0.05	0.88	0.09	12.15	0.01	95.34
	U1520D_25F-4_19-21_8	3.72	3.54	1.04	73.73	0.09	0.04	0.73	0.02	11.55	0.00	94.45
	U1520D_25F-4_19-21_9	4.39	3.04	1.94	72.49	0.19	0.09	0.98	0.05	12.41	0.00	95.59
	U1520D_25F-4_19-21_10	4.01	3.17	1.35	73.03	0.13	0.10	0.88	0.06	12.01	0.00	94.73
	U1520D_25F-4_19-21_11	3.31	4.51	0.78	73.10	0.06	0.04	0.55	0.05	11.85	0.02	94.27
	U1520D_25F-4_19-21_12	3.97	3.36	1.32	72.93	0.12	0.09	0.87	0.12	11.92	0.04	94.73
	U1520D_25F-4_19-21_13	3.53	3.49	1.19	74.58	0.15	0.08	0.83	0.08	11.39	0.04	95.36
	U1520D_25F-4_19-21_14	3.15	4.27	1.10	74.92	0.17	0.12	0.82	0.01	12.14	0.00	96.69
	U1520D_25F-4_19-21_15	3.43	3.59	1.32	74.40	0.06	0.04	0.73	0.04	11.75	0.03	95.39
	U1520D_25F-4_19-21_16	3.45	4.44	0.81	74.15	0.06	0.03	0.54	0.02	11.90	0.04	95.44
	U1520D_25F-4_19-21_17	3.28	3.80	0.91	73.09	0.04	0.07	0.86	0.00	11.78	0.00	93.83
	U1520D_25F-4_19-21_18	3.47	3.47	1.09	73.67	0.10	0.04	0.75	0.08	11.62	0.01	94.30

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	U1520D_25F-4_19-21_19	3.43	3.66	0.92	74.56	0.10	0.04	0.65	0.00	11.55	0.03	94.93
	U1520D_25F-4_19-21_20	3.72	3.31	1.17	73.25	0.10	0.08	0.78	0.07	11.59	0.00	94.09
	1520D_25F-4_19-21_3	4.05	3.08	1.38	72.92	0.16	0.12	0.85	0.08	11.69	0.02	94.36
	1520D_25F-4_19-21_7	3.72	3.40	1.07	73.36	0.17	0.05	0.80	0.02	11.77	0.00	94.37
	1520D_25F-4_19-21_5	4.04	3.16	1.39	71.97	0.11	0.05	0.86	0.07	11.68	0.00	93.32
	1520D_25F-4_19-21_6	3.88	3.32	1.23	73.66	0.13	0.06	0.78	0.05	11.70	0.04	94.86
	U1520D_26F-1_34-36_1	3.53	3.56	1.06	74.04	0.07	0.06	0.75	0.01	11.45	0.00	94.53
	U1520D_26F-1_34-36_2	3.62	3.48	1.10	73.96	0.12	0.05	0.76	0.06	11.54	0.01	94.70
	U1520D_26F-1_34-36_3	3.65	3.63	1.16	74.80	0.10	0.05	0.76	0.09	11.56	0.00	95.79
	U1520D_26F-1_34-36_4	3.66	3.42	1.26	74.12	0.10	0.06	0.75	0.00	11.68	0.00	95.06
	U1520D_26F-1_34-36_5	3.40	3.64	0.98	74.23	0.06	0.05	0.68	0.03	11.56	0.03	94.66
	U1520D_26F-1_34-36_6	3.51	3.82	0.77	74.73	0.11	0.03	0.68	0.04	11.62	0.00	95.31
	U1520D_26F-1_34-36_7	3.31	3.76	0.96	74.46	0.06	0.05	0.66	0.01	11.49	0.00	94.76
	U1520D_26F-1_34-36_8	3.48	3.57	0.95	74.52	0.06	0.03	0.71	0.06	11.51	0.00	94.90
	U1520D_26F-1_34-36_9	3.37	3.50	1.16	73.79	0.11	0.09	0.77	0.04	11.59	0.00	94.41
	U1520D_26F-1_34-36_10	3.40	3.42	1.16	72.94	0.13	0.08	0.77	0.03	11.42	0.02	93.35
	U1520D_26F-1_34-36_11	3.47	3.64	0.94	74.82	0.09	0.06	0.66	0.00	11.39	0.01	95.08
	U1520D_26F-1_34-36_12	3.71	3.44	1.14	73.82	0.09	0.06	0.71	0.05	11.55	0.01	94.58
	U1520D_26F-1_34-36_13	3.38	3.57	0.85	74.01	0.08	0.06	0.68	0.05	11.54	0.00	94.23
	U1520D_26F-1_34-36_14	3.45	3.56	1.05	74.31	0.08	0.05	0.67	0.07	11.48	0.01	94.74
	U1520D_26F-1_34-36_15	3.46	3.50	1.02	74.40	0.06	0.06	0.76	0.00	11.67	0.03	94.96
	U1520D_26F-1_34-36_16	3.76	3.46	1.10	74.70	0.06	0.01	0.77	0.01	11.61	0.00	95.47
	U1520D_26F-1_34-36_17	3.53	3.48	1.13	74.05	0.08	0.08	0.77	0.00	11.50	0.00	94.62
	U1520D_26F-1_34-36_18	3.47	3.56	1.00	73.97	0.08	0.05	0.68	0.06	11.50	0.03	94.41
	U1520D_26F-1_34-36_19	3.64	3.59	0.88	74.33	0.10	0.03	0.69	0.03	11.49	0.00	94.77
	U1520D_26F-1_34-36_20	3.33	3.58	1.00	73.82	0.10	0.09	0.67	0.00	11.56	0.01	94.16
	U1520D_26F-1_73-75_1	3.67	3.37	1.20	74.16	0.11	0.07	0.77	0.07	11.51	0.01	94.93
	U1520D_26F-1_73-75_2	3.68	3.35	1.17	73.47	0.11	0.07	0.82	0.12	11.74	0.02	94.55
	U1520D_26F-1_73-75_3	3.64	3.46	1.04	74.72	0.08	0.07	0.75	0.13	11.61	0.02	95.52
	U1520D_26F-1_73-75_4	3.52	3.44	1.24	74.55	0.10	0.08	0.80	0.00	11.66	0.00	95.39
	U1520D_26F-1_73-75_5	3.47	3.39	1.27	73.92	0.11	0.08	0.76	0.01	11.63	0.01	94.65
	U1520D_26F-1_73-75_6	3.63	3.51	1.03	74.10	0.06	0.05	0.66	0.05	11.58	0.01	94.68
	U1520D_26F-1_73-75_7	3.46	3.47	1.02	74.58	0.09	0.04	0.78	0.16	11.66	0.01	95.27
	U1520D_26F-1_73-75_8	3.56	3.66	0.96	74.59	0.07	0.07	0.67	0.00	11.57	0.00	95.15
	U1520D_26F-1_73-75_9	3.61	3.38	1.06	74.24	0.10	0.05	0.79	0.07	11.44	0.00	94.74
	U1520D_26F-1_73-75_10	3.60	3.61	0.65	74.18	0.05	0.00	0.63	0.01	11.56	0.02	94.30
	U1520D_26F-1_73-75_11	3.72	3.47	1.35	74.11	0.12	0.06	0.83	0.08	11.73	0.00	95.47
	U1520D_26F-1_73-75_12	3.72	3.54	0.94	73.94	0.10	0.05	0.66	0.05	11.71	0.02	94.72
	U1520D_26F-1_73-75_13	3.41	3.61	1.17	74.46	0.07	0.06	0.77	0.03	11.83	0.02	95.42
	U1520D_26F-1_73-75_14	3.61	3.48	1.16	74.65	0.10	0.07	0.77	0.02	11.83	0.01	95.69
	U1520D_26F-1_73-75_15	3.74	3.41	1.31	73.91	0.10	0.06	0.85	0.08	11.90	0.02	95.39
	U1520D_26F-1_73-75_16	3.63	3.44	1.09	74.33	0.10	0.06	0.77	0.04	11.64	0.03	95.12
	U1520D_26F-1_73-75_17	3.48	3.63	1.03	74.42	0.11	0.03	0.69	0.06	11.59	0.03	95.08
	U1520D_26F-1_73-75_18	3.62	3.51	0.98	73.92	0.11	0.03	0.70	0.04	11.76	0.02	94.70
	U1520D_26F-1_73-75_20	3.58	3.54	1.14	74.60	0.06	0.08	0.74	0.08	11.58	0.00	95.40
	1520D_26F-1_73-75_1	3.49	3.63	1.05	72.55	0.07	0.00	0.65	0.06	11.94	0.02	93.46
	1520D_26F-1_73-75_2	3.72	3.44	1.25	73.27	0.11	0.06	0.76	0.04	11.98	0.04	94.68
	1520D_26F-1_73-75_6	3.72	3.44	1.11	73.01	0.08	0.05	0.76	0.06	11.71	0.00	93.93
	1520D_26F-1_73-75_7	3.61	3.60	1.09	72.11	0.05	0.09	0.66	0.03	12.03	0.00	93.28
	1520D_26F-1_73-75_9	3.78	3.45	1.13	73.16	0.10	0.03	0.78	0.02	11.98	0.02	94.45
	1520D_26F-1_73-75_3	3.77	3.46	1.10	73.13	0.10	0.05	0.74	0.00	12.17	0.00	94.52
	1520D_26F-1_73-75_4	3.70	3.36	1.14	71.99	0.12	0.08	0.74	0.03	11.77	0.02	92.95
	1520D_26F-1_73-75_5	3.68	3.55	1.08	72.89	0.13	0.07	0.76	0.11	11.98	0.01	94.26
	1520D_26F-1_73-75_8	3.59	3.48	0.92	73.84	0.08	0.02	0.72	0.02	11.98	0.00	94.66
	1520D_26F-1_73-75_10	3.64	3.62	0.87	73.39	0.09	0.02	0.72	0.06	11.83	0.00	94.24
	U1520D_26F-1_76-78_1	3.51	3.48	1.02	73.47	0.09	0.08	0.78	0.03	11.69	0.03	94.18
	U1520D_26F-1_76-78_2	3.60	3.43	1.14	73.15	0.09	0.08	0.78	0.00	11.69	0.01	93.98
	U1520D_26F-1_76-78_3	3.49	3.62	1.12	73.94	0.10	0.03	0.73	0.06	11.53	0.01	94.63
	U1520D_26F-1_76-78_4	3.49	3.41	1.16	73.06	0.12	0.05	0.78	0.05	11.76	0.02	93.90
	U1520D_26F-1_76-78_5	3.60	3.41	1.19	73.18	0.13	0.10	0.88	0.08	11.72	0.02	94.31
	U1520D_26F-1_76-78_6	3.56	3.60	0.87	74.10	0.06	0.04	0.62	0.07	11.71	0.00	94.64
	U1520D_26F-1_76-78_7	3.26	3.89	1.16	73.55	0.10	0.11	0.78	0.02	11.68	0.01	94.56
	U1520D_26F-1_76-78_8	3.43	3.42	1.03	73.46	0.09	0.08	0.74	0.03	11.54	0.01	93.82
	U1520D_26F-1_76-78_9	3.67	3.60	1.11	73.07	0.10	0.03	0.72	0.06	11.55	0.00	93.91
	U1520D_26F-1_76-78_10	3.49	3.51	1.16	73.12	0.08	0.07	0.71	0.08	11.57	0.01	93.80
	U1520D_26F-1_76-78_11	3.78	3.45	1.10	73.72	0.09	0.09	0.77	0.01	11.83	0.02	94.86
	U1520D_26F-1_76-78_12	3.39	3.62	1.18	73.23	0.08	0.01	0.86	0.05	11.65	0.01	94.08
	U1520D_26F-1_76-78_13	3.63	3.44	0.97	73.45	0.08	0.04	0.73	0.06	11.62	0.00	94.02
	U1520D_26F-1_76-78_14	3.89	3.43	1.20	72.93	0.11	0.06	0.82	0.03	11.72	0.00	94.18
	U1520D_26F-1_76-78_15	3.66	3.41	0.96	73.57	0.10	0.07	0.75	0.02	11.63	0.00	94.16

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u16	U1520D_26F-1_76-78_16	3.59	3.43	1.12	73.18	0.08	0.09	0.80	0.01	11.85	0.00	94.14
	U1520D_26F-1_76-78_17	3.76	3.45	1.17	73.76	0.08	0.06	0.76	0.08	11.64	0.02	94.79
	U1520D_26F-1_76-78_18	3.85	3.25	3.28	72.11	0.18	0.00	0.77	0.00	11.55	0.01	95.01
	U1520D_26F-1_76-78_19	3.25	3.57	1.05	73.03	0.07	0.09	0.68	0.11	11.55	0.00	93.40
	U1520D_26F-1_76-78_20	3.10	4.33	1.01	73.67	0.09	0.05	0.67	0.07	11.71	0.04	94.74
	1520D_26F-1_76-78_3	3.77	3.51	1.20	74.18	0.12	0.05	0.77	0.06	11.57	0.01	95.23
	1520D_26F-1_76-78_4	3.63	3.50	1.20	73.56	0.09	0.10	0.77	0.00	11.81	0.05	94.71
	1520D_26F-1_76-78_6	3.58	3.63	0.75	74.09	0.09	0.05	0.61	0.05	11.89	0.02	94.74
	1520D_26F-1_76-78_7	3.53	3.34	1.07	72.51	0.08	0.09	0.76	0.02	11.78	0.00	93.17
	1520D_26F-1_76-78_9	3.76	3.40	1.30	73.24	0.11	0.10	0.87	0.06	12.28	0.02	95.14
	1520D_26F-1_76-78_11	3.53	3.63	0.85	73.84	0.05	0.01	0.64	0.00	11.77	0.08	94.39
	1520D_26F-1_76-78_12	3.74	3.54	1.12	73.25	0.08	0.06	0.75	0.10	11.57	0.04	94.25
	1520D_26F-1_76-78_1	3.76	3.55	1.20	73.33	0.09	0.04	0.75	0.02	11.68	0.01	94.42
	1520D_26F-1_76-78_2	3.72	3.54	1.11	73.59	0.08	0.03	0.77	0.04	11.81	0.00	94.69
	1520D_26F-1_76-78_5	3.69	3.53	1.07	73.44	0.09	0.06	0.72	0.05	11.94	0.00	94.58
	1520D_26F-1_76-78_8	3.90	3.40	1.16	73.16	0.09	0.05	0.87	0.06	12.35	0.00	95.05
	1520D_26F-1_76-78_10	3.52	3.68	0.95	73.22	0.08	0.11	0.69	0.05	12.04	0.01	94.35
	U1520D_26F-1_97-101_1	3.62	3.45	1.09	74.90	0.12	0.06	0.82	0.02	11.85	0.01	95.94
	U1520D_26F-1_97-101_2	3.79	3.33	1.23	74.10	0.13	0.08	0.84	0.02	11.64	0.02	95.19
	U1520D_26F-1_97-101_3	3.72	3.40	1.32	73.87	0.12	0.10	0.79	0.01	11.57	0.04	94.93
	U1520D_26F-1_97-101_4	3.84	3.06	1.45	73.23	0.15	0.12	1.07	0.04	12.19	0.01	95.16
	U1520D_26F-1_97-101_5	3.61	3.40	1.21	73.92	0.14	0.02	0.80	0.01	11.62	0.00	94.73
	U1520D_26F-1_97-101_6	3.79	3.22	1.43	73.04	0.15	0.08	1.01	0.03	12.12	0.00	94.88
	U1520D_26F-1_97-101_7	3.73	3.39	1.30	74.35	0.11	0.11	0.77	0.04	11.73	0.00	95.52
	U1520D_26F-1_97-101_8	3.82	3.04	1.46	73.68	0.15	0.08	1.02	0.03	12.05	0.00	95.34
	U1520D_26F-1_97-101_9	3.62	3.42	1.00	73.84	0.12	0.09	0.79	0.03	11.51	0.01	94.43
	U1520D_26F-1_97-101_10	3.59	3.38	1.21	74.10	0.13	0.07	0.77	0.00	11.71	0.00	94.96
	U1520D_26F-1_97-101_11	3.62	3.62	1.30	74.82	0.10	0.08	0.76	0.06	11.88	0.02	96.27
	U1520D_26F-1_97-101_12	3.61	3.41	1.19	74.02	0.08	0.07	0.81	0.09	11.74	0.00	95.03
	U1520D_26F-1_97-101_13	3.45	3.43	1.06	73.99	0.12	0.08	0.79	0.01	11.78	0.02	94.73
	U1520D_26F-1_97-101_14	3.47	3.38	1.17	73.38	0.13	0.08	0.78	0.05	11.46	0.00	93.90
	U1520D_26F-1_97-101_15	3.68	3.20	1.17	73.54	0.14	0.07	0.91	0.08	11.67	0.03	94.48
	U1520D_26F-1_97-101_16	3.66	3.41	1.21	74.41	0.09	0.07	0.80	0.05	11.97	0.00	95.68
	U1520D_26F-1_97-101_17	3.59	3.32	1.06	73.36	0.12	0.09	0.79	0.06	11.48	0.00	93.87
	U1520D_26F-1_97-101_18	3.43	3.44	1.06	73.79	0.11	0.08	0.82	0.07	11.85	0.00	94.65
	U1520D_26F-1_97-101_19	2.96	2.96	1.12	71.69	0.15	0.11	1.02	0.04	11.42	0.01	91.49
	U1520D_26F-1_97-101_20	3.87	3.10	1.71	73.84	0.14	0.10	1.05	0.04	12.09	0.02	95.95
	U1520D_26F-1_103-105_1	4.24	3.16	1.59	74.02	0.14	0.06	1.00	0.06	11.85	0.03	96.15
	U1520D_26F-1_103-105_2	3.96	3.15	1.35	73.81	0.14	0.11	1.05	0.02	11.77	0.00	95.36
	U1520D_26F-1_103-105_3	3.67	3.54	1.26	73.39	0.14	0.08	0.77	0.08	11.39	0.03	94.35
	U1520D_26F-1_103-105_4	3.61	3.41	1.08	73.87	0.09	0.10	0.79	0.11	11.41	0.01	94.46
	U1520D_26F-1_103-105_5	3.93	3.22	1.07	75.14	0.08	0.07	0.89	0.08	11.68	0.00	96.17
	U1520D_26F-1_103-105_6	3.79	3.55	1.43	74.97	0.11	0.07	0.78	0.05	11.53	0.01	96.29
	U1520D_26F-1_103-105_7	3.91	3.07	1.49	73.31	0.13	0.10	0.96	0.01	11.90	0.01	94.89
	U1520D_26F-1_103-105_8	4.01	3.06	1.68	72.63	0.14	0.10	1.03	0.06	11.70	0.00	94.42
	U1520D_26F-1_103-105_9	3.83	3.48	0.98	75.09	0.09	0.08	0.86	0.10	11.62	0.01	96.14
	U1520D_26F-1_103-105_10	3.91	3.07	1.44	73.30	0.16	0.10	1.05	0.08	11.60	0.02	94.72
	U1520D_26F-1_103-105_11	3.70	3.40	1.12	74.26	0.12	0.09	0.77	0.04	11.45	0.01	94.97
	U1520D_26F-1_103-105_12	3.96	3.34	1.50	74.02	0.12	0.12	1.06	0.11	12.08	0.02	96.33
	U1520D_26F-1_103-105_13	3.60	3.39	1.20	74.62	0.11	0.07	0.80	0.04	11.44	0.00	95.28
	U1520D_26F-1_103-105_14	3.65	3.39	1.14	73.69	0.08	0.03	0.81	0.03	11.22	0.00	94.05
	U1520D_26F-1_103-105_15	3.70	3.48	1.06	73.42	0.15	0.03	0.80	0.01	11.30	0.01	93.96
	U1520D_26F-1_103-105_16	4.00	3.29	1.41	72.18	0.13	0.09	0.98	0.10	11.76	0.04	93.98
	U1520D_26F-1_103-105_17	3.63	3.41	1.14	74.01	0.09	0.07	0.85	0.04	11.47	0.00	94.71
	U1520D_26F-1_103-105_18	3.83	3.03	1.62	72.83	0.11	0.08	1.02	0.00	11.71	0.00	94.24
	U1520D_26F-1_103-105_19	3.70	3.52	1.04	74.33	0.09	0.03	0.83	0.03	11.33	0.00	94.90
	U1520D_26F-1_103-105_20	4.28	3.13	1.59	72.80	0.12	0.13	1.06	0.07	12.01	0.04	95.23
	1520D_26F-1_103-105_2	3.49	3.42	1.16	74.03	0.18	0.07	0.75	0.00	11.61	0.02	94.73
	1520D_26F-1_103-105_3	3.77	3.44	1.21	74.41	0.16	0.09	0.78	0.03	11.50	0.00	95.39
	1520D_26F-1_103-105_6	3.89	3.26	1.09	74.27	0.19	0.09	0.87	0.12	11.85	0.00	95.63
	1520D_26F-1_103-105_8	3.96	3.39	1.24	73.18	0.21	0.11	0.93	0.03	11.94	0.00	94.99
	1520D_26F-1_103-105_7	3.33	3.37	1.14	70.28	0.14	0.06	0.76	0.02	11.15	0.00	90.26
	1520D_26F-1_103-105_10	3.92	3.43	1.25	73.71	0.17	0.08	0.84	0.02	11.74	0.00	95.17
	1520D_26F-1_103-105_4	4.17	2.96	1.41	73.24	0.19	0.10	1.02	0.05	12.16	0.01	95.31
	1520D_26F-1_103-105_9	3.94	3.18	1.36	72.54	0.21	0.07	1.00	0.08	12.01	0.04	94.43
	1520D_26F-1_103-105_1	4.14	2.96	1.58	73.22	0.20	0.10	0.99	0.00	12.17	0.00	95.36
	U1520D_26F-1_138-142_1	3.57	3.39	1.12	73.28	0.11	0.07	0.79	0.11	11.50	0.01	93.96
	U1520D_26F-1_138-142_2	3.71	3.41	1.09	74.31	0.14	0.07	0.82	0.08	11.79	0.02	95.43
	U1520D_26F-1_138-142_3	3.74	3.34	1.26	73.95	0.10	0.12	0.87	0.08	11.72	0.02	95.21
	U1520D_26F-1_138-142_4	3.53	3.35	1.02	74.16	0.09	0.05	0.78	0.00	11.62	0.02	94.63

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u17	U1520D_26F-1_138-142_5	3.71	3.33	1.32	73.63	0.14	0.08	0.89	0.07	11.72	0.00	94.89
	U1520D_26F-1_138-142_6	3.56	3.43	1.33	74.05	0.13	0.08	0.85	0.03	11.80	0.02	95.29
	U1520D_26F-1_138-142_7	3.87	3.46	1.20	74.44	0.10	0.07	0.75	0.06	11.79	0.00	95.74
	U1520D_26F-1_138-142_8	3.87	3.32	1.19	73.98	0.09	0.06	0.85	0.11	11.79	0.01	95.27
	U1520D_26F-1_138-142_9	3.53	3.39	1.37	74.85	0.10	0.07	0.85	0.09	11.97	0.00	96.23
	U1520D_26F-1_138-142_10	3.61	3.39	1.26	74.69	0.09	0.08	0.78	0.09	11.75	0.00	95.75
	U1520D_26F-1_138-142_11	3.56	3.41	1.19	74.77	0.10	0.06	0.79	0.15	11.74	0.03	95.79
	U1520D_26F-1_138-142_12	3.76	3.31	1.30	74.28	0.10	0.06	0.88	0.08	11.91	0.00	95.68
	U1520D_26F-1_138-142_13	3.97	3.25	1.35	73.98	0.11	0.09	0.87	0.09	11.76	0.03	95.50
	U1520D_26F-1_138-142_14	3.91	3.35	1.31	74.23	0.11	0.09	0.95	0.01	11.95	0.04	95.95
	U1520D_26F-1_138-142_15	3.88	3.06	1.20	74.30	0.11	0.07	0.70	0.00	11.70	0.01	95.03
	U1520D_26F-1_138-142_16	3.82	3.19	1.21	73.95	0.13	0.09	0.80	0.00	11.78	0.00	94.97
	U1520D_26F-1_138-142_20	3.85	3.03	1.83	73.64	0.15	0.21	1.05	0.06	11.75	0.04	95.62
	U1520D_26F-1_141-143_1	3.64	3.45	0.99	74.37	0.10	0.09	0.79	0.06	11.76	0.00	95.24
	U1520D_26F-1_141-143_2	3.22	3.82	1.24	74.23	0.11	0.08	0.79	0.08	11.69	0.00	95.27
	U1520D_26F-1_141-143_3	3.92	2.99	1.26	73.37	0.14	0.09	1.01	0.07	12.04	0.01	94.89
	U1520D_26F-1_141-143_4	4.05	3.00	1.42	73.39	0.15	0.09	1.05	0.13	12.16	0.00	95.43
	U1520D_26F-1_141-143_5	3.66	3.47	1.16	74.41	0.10	0.05	0.76	0.07	11.84	0.02	95.54
	U1520D_26F-1_141-143_7	3.95	3.03	1.53	73.75	0.10	0.09	1.06	0.07	12.09	0.01	95.69
	U1520D_26F-1_141-143_8	3.88	3.01	1.44	73.78	0.16	0.09	1.05	0.06	12.16	0.02	95.65
	U1520D_26F-1_141-143_9	3.75	3.27	1.35	73.22	0.15	0.08	1.00	0.04	12.06	0.03	94.96
	U1520D_26F-1_141-143_10	3.68	3.30	1.20	74.43	0.09	0.06	0.81	0.03	11.74	0.03	95.38
	U1520D_26F-1_141-143_11	3.64	3.31	1.24	74.02	0.11	0.09	0.88	0.07	11.83	0.00	95.20
	U1520D_26F-1_141-143_12	3.94	2.99	1.58	73.08	0.17	0.11	1.03	0.09	11.96	0.00	94.95
	U1520D_26F-1_141-143_13	1.25	3.22	1.24	75.70	0.11	0.06	0.80	0.11	11.59	0.00	94.09
	U1520D_26F-1_141-143_14	3.36	3.18	1.57	73.88	0.15	0.07	0.96	0.03	11.81	0.02	95.03
	U1520D_26F-1_141-143_17	3.35	3.41	1.10	75.26	0.11	0.04	0.81	0.02	11.74	0.00	95.84
	U1520D_26F-1_141-143_18	3.71	3.41	1.08	73.67	0.11	0.07	0.81	0.08	11.63	0.02	94.59
	U1520D_26F-1_141-143_19	3.69	3.32	0.99	73.68	0.09	0.08	0.77	0.03	11.60	0.00	94.24
	U1520D_26F-1_141-143_20	3.70	3.36	1.29	74.38	0.13	0.07	0.82	0.08	11.75	0.04	95.62
	U1520D_26F-2_6-8_1	3.81	3.08	1.56	73.38	0.10	0.11	1.02	0.11	11.90	0.02	95.09
	U1520D_26F-2_6-8_2	4.08	3.13	1.53	74.45	0.14	0.11	1.07	0.07	12.08	0.03	96.69
	U1520D_26F-2_6-8_3	3.95	3.14	1.49	73.62	0.12	0.08	0.95	0.09	11.69	0.00	95.13
	U1520D_26F-2_6-8_4	4.26	3.09	1.30	73.20	0.15	0.11	0.99	0.07	11.86	0.04	95.06
	U1520D_26F-2_6-8_5	3.74	3.49	1.25	75.03	0.08	0.06	0.82	0.01	11.68	0.00	96.16
	U1520D_26F-2_6-8_6	3.69	3.41	1.18	74.52	0.08	0.07	0.80	0.06	11.57	0.03	95.41
	U1520D_26F-2_6-8_7	3.68	3.42	1.12	74.47	0.14	0.05	0.74	0.05	11.35	0.01	95.03
	U1520D_26F-2_6-8_8	3.94	3.48	1.19	74.94	0.09	0.07	0.78	0.06	11.82	0.01	96.38
	U1520D_26F-2_6-8_9	3.86	3.41	1.16	73.98	0.09	0.07	0.80	0.02	11.20	0.00	94.58
	U1520D_26F-2_6-8_10	3.67	3.45	0.96	73.73	0.09	0.05	0.74	0.01	11.37	0.01	94.08
	U1520D_26F-2_6-8_11	4.11	3.15	1.56	73.03	0.13	0.09	1.03	0.04	11.79	0.01	94.94
	U1520D_26F-2_6-8_12	3.89	3.01	1.52	74.27	0.14	0.11	1.04	0.10	11.90	0.00	95.98
	U1520D_26F-2_6-8_13	3.92	2.98	1.36	73.26	0.15	0.08	1.00	0.00	11.76	0.00	94.51
	U1520D_26F-2_6-8_14	4.23	3.06	1.38	73.04	0.11	0.08	1.03	0.03	11.94	0.00	94.90
	U1520D_26F-2_6-8_15	3.73	3.43	1.18	74.11	0.10	0.08	0.76	0.06	11.56	0.02	95.03
	U1520D_26F-2_6-8_16	4.09	3.35	1.03	74.05	0.12	0.00	0.83	0.05	11.89	0.03	95.44
	U1520D_26F-2_6-8_17	3.60	3.43	1.14	73.95	0.08	0.06	0.76	0.11	11.40	0.00	94.54
	U1520D_26F-2_6-8_18	3.66	3.48	1.25	73.79	0.10	0.00	0.76	0.02	11.14	0.00	94.21
	U1520D_26F-2_6-8_19	3.82	3.36	1.05	74.33	0.11	0.04	0.75	0.00	11.37	0.00	94.83
	U1520D_26F-2_6-8_20	3.79	3.42	1.17	74.31	0.08	0.09	0.76	0.06	11.37	0.02	95.06
	U1520D_26F-2_23-27_1	4.13	3.03	1.54	73.66	0.11	0.08	1.04	0.02	12.02	0.03	95.66
	U1520D_26F-2_23-27_2	4.04	3.01	1.33	73.60	0.12	0.11	1.00	0.07	12.01	0.03	95.32
	U1520D_26F-2_23-27_3	4.01	3.00	1.54	73.69	0.12	0.05	1.01	0.12	12.08	0.01	95.63
	U1520D_26F-2_23-27_4	3.88	3.41	1.17	74.46	0.10	0.07	0.78	0.06	11.33	0.01	95.28
	U1520D_26F-2_23-27_5	4.16	3.07	1.48	73.47	0.10	0.10	1.01	0.13	11.69	0.00	95.21
	U1520D_26F-2_23-27_6	3.77	3.55	1.13	74.24	0.13	0.08	0.81	0.03	11.44	0.01	95.18
	U1520D_26F-2_23-27_7	4.02	3.35	1.28	74.34	0.14	0.09	0.97	0.08	11.72	0.00	95.99
	U1520D_26F-2_23-27_8	3.92	3.30	1.22	73.89	0.12	0.09	0.86	0.00	11.44	0.02	94.87
	U1520D_26F-2_23-27_9	3.66	3.37	1.15	74.47	0.11	0.08	0.78	0.05	11.62	0.00	95.29
	U1520D_26F-2_23-27_10	4.10	3.16	1.27	73.46	0.12	0.12	1.01	0.13	11.75	0.00	95.12
	U1520D_26F-2_23-27_11	4.29	3.00	1.55	73.01	0.15	0.10	1.07	0.08	11.90	0.00	95.14
	U1520D_26F-2_23-27_12	4.04	3.02	1.48	72.76	0.16	0.12	1.01	0.04	11.62	0.03	94.28
	U1520D_26F-2_23-27_13	3.85	3.45	1.17	74.04	0.10	0.07	0.79	0.06	11.22	0.00	94.75
	U1520D_26F-2_23-27_14	3.89	3.28	1.09	74.20	0.10	0.08	0.77	0.02	11.27	0.00	94.70
	U1520D_26F-2_23-27_15	4.39	2.89	1.36	73.46	0.11	0.11	1.06	0.07	12.26	0.00	95.72
	U1520D_26F-2_23-27_16	3.92	3.50	0.94	74.05	0.10	0.08	0.80	0.00	11.20	0.00	94.59
	U1520D_26F-2_23-27_17	4.12	3.07	1.42	73.56	0.13	0.14	1.01	0.02	11.71	0.02	95.20
	U1520D_26F-2_23-27_18	3.72	3.05	1.56	73.44	0.14	0.13	1.04	0.03	11.82	0.01	94.94
	U1520D_26F-2_23-27_19	3.91	3.43	1.15	74.48	0.10	0.02	0.81	0.00	11.35	0.01	95.25
	U1520D_26F-2_23-27_20	3.89	3.21	1.60	72.48	0.13	0.10	1.00	0.06	11.62	0.01	94.10

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1520D_26F-2_23-27_4	3.85	3.32	1.10	74.07	0.20	0.05	0.78	0.14	11.62	0.05	95.17
	1520D_26F-2_23-27_8	3.96	3.41	1.24	75.10	0.14	0.04	0.78	0.06	11.76	0.03	96.50
	1520D_26F-2_23-27_9	3.99	3.45	1.14	74.40	0.17	0.02	0.77	0.00	11.65	0.02	95.61
	1520D_26F-2_23-27_10	3.96	3.40	1.29	73.97	0.16	0.07	0.89	0.05	11.94	0.02	95.75
	1520D_26F-2_23-27_1	3.84	3.46	1.23	73.84	0.12	0.04	0.76	0.04	11.58	0.00	94.91
	1520D_26F-2_23-27_2	3.79	3.42	1.19	74.15	0.18	0.07	0.78	0.02	11.69	0.02	95.30
	1520D_26F-2_23-27_3	3.63	2.92	1.12	72.84	0.21	0.12	1.02	0.03	11.52	0.02	93.43
	1520D_26F-2_23-27_5	4.11	3.34	1.15	72.64	0.23	0.11	0.98	0.04	12.01	0.00	94.62
	1520D_26F-2_23-27_6	4.23	3.01	1.38	73.48	0.19	0.12	1.04	0.00	12.01	0.00	95.45
	U1520D_26F-2_49-51_1	3.55	3.40	1.32	74.48	0.13	0.11	0.82	0.00	11.78	0.00	95.59
	U1520D_26F-2_49-51_2	4.06	3.00	1.35	73.43	0.14	0.10	1.06	0.06	12.15	0.00	95.35
	U1520D_26F-2_49-51_3	3.66	3.39	1.11	74.51	0.09	0.04	0.78	0.04	11.69	0.02	95.32
	U1520D_26F-2_49-51_4	4.28	3.40	1.10	75.02	0.13	0.05	0.72	0.03	11.94	0.04	96.72
	U1520D_26F-2_49-51_5	3.67	3.55	1.26	74.84	0.10	0.08	0.81	0.00	11.75	0.00	96.06
	U1520D_26F-2_49-51_6	3.46	3.74	1.16	74.75	0.10	0.07	0.78	0.09	11.70	0.01	95.87
	U1520D_26F-2_49-51_7	4.00	2.99	1.50	73.14	0.13	0.11	1.05	0.03	12.12	0.01	95.09
	U1520D_26F-2_49-51_8	3.41	3.45	1.10	74.13	0.14	0.06	0.80	0.02	11.80	0.00	94.89
	U1520D_26F-2_49-51_9	3.78	3.41	1.19	74.59	0.10	0.10	0.82	0.05	11.81	0.03	95.90
	U1520D_26F-2_49-51_10	3.72	3.35	1.08	74.13	0.13	0.06	0.79	0.03	11.26	0.02	94.57
	U1520D_26F-2_49-51_11	3.91	3.09	1.76	73.17	0.13	0.21	1.10	0.08	12.15	0.00	95.60
	U1520D_26F-2_49-51_12	3.70	3.34	1.04	74.19	0.15	0.06	0.80	0.08	11.80	0.04	95.20
	U1520D_26F-2_49-51_13	3.51	3.40	1.14	74.48	0.10	0.07	0.78	0.05	11.82	0.00	95.35
	U1520D_26F-2_49-51_14	3.73	3.43	1.15	74.03	0.13	0.08	0.88	0.10	11.76	0.02	95.31
	U1520D_26F-2_49-51_15	3.83	3.41	1.51	73.61	0.12	0.11	1.02	0.03	12.26	0.01	95.91
	U1520D_26F-2_49-51_16	4.08	3.10	1.52	73.50	0.15	0.06	0.98	0.03	12.28	0.00	95.70
	U1520D_26F-2_49-51_17	3.50	3.77	1.14	74.36	0.11	0.07	0.78	0.02	11.72	0.01	95.48
	U1520D_26F-2_49-51_18	4.03	3.09	1.54	73.88	0.12	0.09	1.03	0.05	12.27	0.03	96.13
	U1520D_26F-2_49-51_19	3.59	3.83	1.11	73.46	0.12	0.04	0.90	0.02	12.03	0.01	95.13
	U1520D_26F-2_49-51_20	3.60	3.44	1.17	73.90	0.12	0.06	0.78	0.07	11.64	0.02	94.80
	U1520D_26F-3_9-11_1	3.57	3.33	1.05	74.20	0.13	0.08	0.86	0.08	11.89	0.00	95.20
	U1520D_26F-3_9-11_2	3.57	3.36	1.18	74.49	0.10	0.05	0.85	0.06	12.00	0.00	95.66
	U1520D_26F-3_9-11_3	3.65	3.30	1.16	74.41	0.09	0.08	0.88	0.02	11.91	0.02	95.53
	U1520D_26F-3_9-11_4	3.68	3.31	1.34	73.69	0.14	0.10	1.01	0.11	12.03	0.03	95.46
	U1520D_26F-3_9-11_5	3.59	3.32	1.11	73.64	0.12	0.06	0.87	0.04	11.79	0.01	94.54
	U1520D_26F-3_9-11_7	3.79	3.50	1.09	74.24	0.10	0.10	0.82	0.03	11.81	0.00	95.49
	U1520D_26F-3_9-11_8	3.70	3.35	1.16	73.58	0.10	0.11	1.02	0.00	12.04	0.01	95.08
	U1520D_26F-3_9-11_9	3.42	3.44	1.23	74.04	0.11	0.04	0.79	0.04	11.61	0.01	94.73
	U1520D_26F-3_9-11_10	3.57	3.48	1.20	74.61	0.12	0.08	0.84	0.08	11.85	0.00	95.82
	U1520D_26F-3_9-11_11	3.62	3.46	1.08	73.79	0.08	0.06	0.91	0.07	11.81	0.00	94.88
	U1520D_26F-3_9-11_12	3.63	3.06	1.00	74.45	0.12	0.12	0.91	0.03	11.69	0.01	95.02
	U1520D_26F-3_9-11_13	3.75	3.43	1.20	74.37	0.09	0.09	0.86	0.07	11.52	0.00	95.37
	U1520D_26F-3_9-11_15	3.58	3.45	1.08	74.22	0.10	0.06	0.79	0.00	11.71	0.02	95.00
	U1520D_26F-3_9-11_17	3.97	3.27	1.64	72.63	0.13	0.10	1.20	0.10	12.38	0.01	95.44
	U1520D_26F-3_9-11_19	3.64	3.33	1.21	72.94	0.11	0.09	0.96	0.03	11.86	0.04	94.20
	U1520D_26F-3_9-11_20	3.96	3.10	1.55	72.72	0.19	0.14	1.31	0.05	12.49	0.01	95.53
ul8	U1520D_26F-3_29-31_1	3.73	3.37	1.15	73.61	0.07	0.05	0.85	0.03	11.69	0.00	94.55
	U1520D_26F-3_29-31_2	3.62	3.50	1.14	74.08	0.11	0.09	0.81	0.08	11.30	0.02	94.75
	U1520D_26F-3_29-31_3	3.73	3.33	1.32	72.84	0.13	0.12	0.98	0.07	11.56	0.00	94.07
	U1520D_26F-3_29-31_4	3.84	3.20	1.33	71.76	0.13	0.13	1.02	0.05	11.64	0.03	93.13
	U1520D_26F-3_29-31_5	3.76	3.26	1.38	73.15	0.15	0.12	0.94	0.06	11.52	0.00	94.34
	U1520D_26F-3_29-31_6	3.80	3.27	1.34	73.40	0.11	0.07	0.99	0.05	11.89	0.00	94.92
	U1520D_26F-3_29-31_7	3.93	3.43	1.12	74.05	0.10	0.05	0.82	0.09	11.29	0.00	94.86
	U1520D_26F-3_29-31_8	3.70	3.19	0.89	74.37	0.11	0.12	0.86	0.06	11.42	0.03	94.76
	U1520D_26F-3_29-31_9	3.82	3.42	1.19	73.01	0.12	0.10	0.93	0.03	11.98	0.01	94.61
	U1520D_26F-3_29-31_10	3.96	3.37	1.25	73.15	0.12	0.13	1.02	0.11	11.78	0.03	94.93
	U1520D_26F-3_29-31_11	3.48	3.52	1.07	74.68	0.09	0.10	0.81	0.07	11.36	0.01	95.18
	U1520D_26F-3_29-31_12	3.56	3.29	1.24	72.79	0.09	0.07	0.88	0.04	11.50	0.01	93.48
	U1520D_26F-3_29-31_13	3.76	3.24	1.41	72.78	0.16	0.12	1.08	0.03	11.78	0.00	94.36
	U1520D_26F-3_29-31_14	3.63	3.28	1.30	73.70	0.15	0.11	0.94	0.00	11.65	0.01	94.77
	U1520D_26F-3_29-31_15	3.66	3.33	1.27	72.41	0.11	0.06	0.90	0.02	11.54	0.01	93.31
	U1520D_26F-3_29-31_16	4.00	3.26	1.31	73.66	0.14	0.07	1.01	0.02	11.82	0.02	95.31
	U1520D_26F-3_29-31_17	3.90	3.19	1.68	72.27	0.15	0.09	1.15	0.03	11.88	0.03	94.38
	U1520D_26F-3_29-31_18	3.85	3.26	1.14	72.83	0.11	0.07	0.78	0.03	11.37	0.01	93.46
	U1520D_26F-3_29-31_19	3.87	3.22	1.49	72.24	0.15	0.10	1.04	0.02	11.66	0.02	93.80
	1520D_26F-3_29-31_1	3.91	3.22	1.20	73.14	0.17	0.11	0.88	0.08	12.01	0.06	94.78
	1520D_26F-3_29-31_2	3.91	3.39	1.01	73.78	0.18	0.09	0.86	0.00	11.62	0.00	94.84
	1520D_26F-3_29-31_6	3.71	3.24	1.14	73.13	0.16	0.07	0.96	0.07	11.85	0.01	94.34
	1520D_26F-3_29-31_8	3.86	3.45	1.15	74.42	0.15	0.07	0.78	0.04	11.62	0.00	95.54
	1520D_26F-3_29-31_3	3.93	3.46	1.14	73.80	0.16	0.04	0.85	0.06	11.48	0.00	94.92
	1520D_26F-3_29-31_9	3.77	3.17	1.42	72.70	0.15	0.12	0.99	0.11	12.04	0.00	94.47

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	I520D_26F-3_29-31_10	4.00	3.13	1.52	73.87	0.22	0.11	1.05	0.08	12.36	0.00	96.33
	U1520D_26F-3_80-81_1	3.80	3.34	1.49	72.87	0.18	0.32	1.23	0.05	12.30	0.03	95.60
	U1520D_26F-3_80-81_2	3.21	3.55	1.02	73.65	0.09	0.06	0.73	0.06	11.64	0.01	94.01
	U1520D_26F-3_80-81_3	3.82	3.24	1.28	71.85	0.20	0.22	1.16	0.09	12.23	0.03	94.12
	U1520D_26F-3_80-81_4	3.73	3.01	1.40	70.99	0.23	0.26	1.41	0.08	12.64	0.04	93.78
	U1520D_26F-3_80-81_5	3.52	3.49	1.05	73.05	0.13	0.05	0.80	0.01	11.62	0.04	93.76
	U1520D_26F-3_80-81_6	3.90	3.52	0.95	73.50	0.11	0.07	0.79	0.00	11.82	0.02	94.69
	U1520D_26F-3_80-81_8	3.71	3.18	1.50	72.08	0.19	0.20	1.24	0.03	12.57	0.00	94.70
	U1520D_26F-3_80-81_9	3.86	3.04	1.46	71.51	0.23	0.25	1.28	0.08	12.67	0.04	94.43
	U1520D_26F-3_80-81_10	4.15	3.40	1.07	72.65	0.15	0.06	0.96	0.05	12.24	0.02	94.74
	U1520D_26F-3_80-81_11	3.71	3.60	1.05	73.34	0.09	0.05	0.69	0.05	11.60	0.02	94.21
	U1520D_26F-3_80-81_12	4.00	3.23	1.41	71.64	0.21	0.19	1.18	0.07	12.50	0.02	94.46
	U1520D_26F-3_80-81_13	3.73	3.52	1.15	72.43	0.09	0.07	0.70	0.10	11.56	0.00	93.35
	U1520D_26F-3_80-81_14	3.88	3.49	0.96	73.98	0.11	0.05	0.68	0.06	11.81	0.00	95.03
	U1520D_26F-3_80-81_15	4.04	3.25	1.33	72.28	0.19	0.15	1.17	0.04	12.50	0.00	94.96
	U1520D_26F-3_80-81_16	3.88	3.50	1.21	73.82	0.08	0.02	0.71	0.09	11.69	0.00	95.00
	U1520D_26F-3_80-81_17	3.92	3.47	0.98	73.39	0.09	0.05	0.70	0.07	11.69	0.03	94.37
	U1520D_26F-3_80-81_18	3.70	3.50	1.02	73.46	0.07	0.10	0.78	0.07	11.76	0.03	94.49
	U1520D_26F-3_80-81_19	3.70	3.45	1.14	73.06	0.14	0.05	0.85	0.00	11.87	0.00	94.27
	U1520D_26F-3_80-81_20	3.77	3.32	1.51	71.62	0.22	0.23	1.19	0.09	12.15	0.04	94.14
	U1520D_26F-3_87-89_1	3.62	3.96	1.01	74.00	0.11	0.13	0.79	0.04	11.54	0.03	95.23
	U1520D_26F-3_87-89_2	3.76	3.54	0.98	73.95	0.11	0.08	0.75	0.10	11.35	0.00	94.62
	U1520D_26F-3_87-89_3	3.52	3.43	1.27	74.03	0.10	0.07	0.75	0.05	11.49	0.00	94.71
	U1520D_26F-3_87-89_4	3.72	3.22	1.55	72.57	0.14	0.10	1.07	0.00	12.28	0.05	94.71
	U1520D_26F-3_87-89_5	3.43	3.62	0.98	73.70	0.06	0.07	0.67	0.00	11.37	0.01	93.91
	U1520D_26F-3_87-89_6	3.75	3.90	1.72	73.48	0.15	0.09	0.97	0.06	11.76	0.01	95.89
	U1520D_26F-3_87-89_7	3.78	3.36	1.02	73.95	0.12	0.13	0.90	0.01	11.43	0.00	94.70
	U1520D_26F-3_87-89_8	3.66	3.39	1.06	73.66	0.12	0.08	0.88	0.08	11.32	0.01	94.26
	U1520D_26F-3_87-89_9	3.30	3.46	1.07	73.49	0.12	0.09	0.84	0.08	11.06	0.02	93.53
	U1520D_26F-3_87-89_10	4.19	3.12	1.51	73.49	0.13	0.08	1.04	0.06	11.87	0.03	95.53
	U1520D_26F-3_87-89_11	3.63	3.17	1.01	73.36	0.14	0.15	0.96	0.06	11.17	0.01	93.66
	U1520D_26F-3_87-89_12	3.60	3.74	1.03	73.88	0.08	0.06	0.64	0.00	11.34	0.00	94.37
	U1520D_26F-3_87-89_13	3.74	3.31	1.35	72.74	0.10	0.05	0.91	0.00	11.64	0.03	93.87
	U1520D_26F-3_87-89_14	3.42	3.56	1.04	72.96	0.10	0.04	0.66	0.00	11.26	0.02	93.06
	U1520D_26F-3_87-89_15	3.50	3.77	1.13	74.15	0.11	0.05	0.71	0.08	11.52	0.01	95.02
	U1520D_26F-3_87-89_16	3.83	3.47	1.33	73.01	0.09	0.07	0.86	0.06	11.61	0.00	94.33
	U1520D_26F-3_87-89_17	3.68	3.39	1.10	73.38	0.10	0.06	0.81	0.00	11.56	0.00	94.08
	U1520D_26F-3_87-89_18	3.68	3.32	1.36	72.76	0.14	0.11	1.07	0.08	11.84	0.03	94.40
	U1520D_26F-3_87-89_19	3.60	3.09	1.18	70.66	0.12	0.09	1.02	0.07	11.43	0.01	91.28
	U1520D_26F-3_97-99_1	3.82	3.40	1.23	74.40	0.13	0.13	0.91	0.03	11.70	0.00	95.75
	U1520D_26F-3_97-99_2	3.59	3.34	1.21	74.61	0.13	0.11	0.89	0.09	11.68	0.00	95.64
	U1520D_26F-3_97-99_3	3.48	3.38	1.16	74.62	0.15	0.12	0.87	0.06	11.81	0.01	95.66
	U1520D_26F-3_97-99_4	3.86	3.67	1.53	73.86	0.15	0.17	1.17	0.07	12.65	0.03	97.15
	U1520D_26F-3_97-99_5	3.59	3.40	1.11	74.11	0.14	0.12	0.87	0.05	11.70	0.00	95.10
	U1520D_26F-3_97-99_6	3.71	3.40	1.34	75.05	0.15	0.14	0.88	0.06	11.97	0.00	96.70
	U1520D_26F-3_97-99_7	3.70	3.21	1.15	73.83	0.11	0.08	0.83	0.05	11.72	0.01	94.69
	U1520D_26F-3_97-99_8	3.52	3.34	1.25	73.89	0.12	0.09	0.83	0.06	11.54	0.00	94.64
	U1520D_26F-3_97-99_9	3.51	3.45	1.14	74.21	0.12	0.14	0.87	0.06	11.61	0.02	95.11
	U1520D_26F-3_97-99_10	3.63	3.31	1.13	74.41	0.14	0.09	0.92	0.11	11.94	0.02	95.70
	U1520D_26F-3_97-99_11	3.57	3.40	1.20	73.93	0.13	0.10	0.80	0.07	11.61	0.00	94.80
	U1520D_26F-3_97-99_12	3.62	3.33	1.13	73.16	0.13	0.11	0.90	0.03	11.77	0.01	94.19
	U1520D_26F-3_97-99_13	3.71	3.41	1.01	73.92	0.06	0.09	0.86	0.07	11.50	0.01	94.63
	U1520D_26F-3_97-99_14	3.73	3.39	1.09	74.12	0.15	0.12	0.89	0.05	11.68	0.00	95.22
	U1520D_26F-3_97-99_15	3.36	3.41	1.10	74.49	0.13	0.11	0.87	0.09	11.85	0.02	95.43
	U1520D_26F-3_97-99_16	3.41	3.42	1.18	73.49	0.14	0.06	0.87	0.05	11.70	0.00	94.31
	U1520D_26F-3_97-99_17	3.72	3.58	1.17	74.59	0.16	0.10	0.89	0.08	11.81	0.02	96.12
	U1520D_26F-3_97-99_18	3.37	3.40	1.16	73.63	0.16	0.09	0.83	0.07	11.62	0.00	94.33
	U1520D_26F-3_97-99_19	3.56	3.61	0.97	75.88	0.09	0.07	0.85	0.02	11.81	0.00	96.87
	U1520D_26F-3_97-99_20	3.81	3.43	1.68	73.73	0.15	0.15	1.15	0.02	12.71	0.03	96.87
	U1520D_26F-3_102-104_1	3.81	3.34	1.13	74.00	0.14	0.12	0.88	0.01	11.65	0.01	95.08
	U1520D_26F-3_102-104_2	3.89	3.34	1.23	74.01	0.13	0.11	0.87	0.07	11.79	0.03	95.48
	U1520D_26F-3_102-104_3	3.42	3.36	1.25	74.18	0.11	0.09	0.88	0.03	11.63	0.02	94.98
	U1520D_26F-3_102-104_4	3.66	3.58	0.99	74.80	0.14	0.12	0.87	0.09	11.63	0.02	95.90
	U1520D_26F-3_102-104_5	3.63	3.46	1.14	74.62	0.11	0.08	0.86	0.04	11.79	0.01	95.75
	U1520D_26F-3_102-104_6	3.76	3.46	1.25	74.01	0.11	0.09	0.90	0.06	11.79	0.05	95.49
	U1520D_26F-3_102-104_7	3.49	3.36	1.26	74.05	0.18	0.11	1.01	0.02	11.93	0.00	95.40
	U1520D_26F-3_102-104_8	3.52	3.47	1.08	74.13	0.13	0.10	0.80	0.10	11.42	0.04	94.80
	U1520D_26F-3_102-104_9	3.61	3.37	1.13	74.41	0.07	0.05	0.80	0.07	11.41	0.00	94.93
	U1520D_26F-3_102-104_10	3.59	3.37	1.11	74.50	0.12	0.12	0.86	0.04	11.66	0.01	95.38
	U1520D_26F-3_102-104_11	3.60	3.47	1.23	74.39	0.14	0.12	0.86	0.06	11.70	0.03	95.60

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	U1520D_26F-3_102-104_12	3.58	3.38	1.06	74.31	0.17	0.11	0.87	0.06	11.53	0.00	95.06
	U1520D_26F-3_102-104_13	3.73	3.33	1.10	74.81	0.14	0.09	0.85	0.06	11.89	0.00	95.99
	U1520D_26F-3_102-104_14	3.75	3.20	1.05	74.44	0.15	0.12	0.83	0.09	11.73	0.01	95.37
	U1520D_26F-3_102-104_15	3.62	3.38	1.08	73.59	0.11	0.12	0.77	0.06	11.32	0.02	94.07
	U1520D_26F-3_102-104_16	3.60	3.35	1.14	74.16	0.16	0.10	0.91	0.03	11.73	0.02	95.20
	U1520D_26F-3_102-104_17	3.82	3.31	1.20	73.65	0.11	0.08	0.87	0.04	11.56	0.02	94.66
	U1520D_26F-3_102-104_18	3.47	3.62	1.17	74.07	0.12	0.09	0.83	0.05	11.69	0.00	95.11
	U1520D_26F-3_102-104_19	3.11	4.37	0.74	73.13	0.06	0.03	0.54	0.03	11.94	0.00	93.94
	U1520D_26F-3_102-104_20	3.64	3.36	1.24	74.22	0.13	0.10	0.85	0.06	11.50	0.00	95.09
	U1520D_26F-4_8-12_1	3.75	3.37	1.17	74.19	0.12	0.14	0.85	0.09	11.68	0.00	95.35
	U1520D_26F-4_8-12_2	3.68	3.44	1.21	73.93	0.13	0.12	0.85	0.02	11.73	0.00	95.11
	U1520D_26F-4_8-12_3	3.49	3.43	1.17	73.20	0.15	0.11	0.84	0.03	11.63	0.00	94.05
	U1520D_26F-4_8-12_4	3.62	3.38	1.09	74.53	0.12	0.11	0.88	0.02	11.72	0.00	95.46
	U1520D_26F-4_8-12_5	3.41	3.27	1.21	73.50	0.16	0.08	0.86	0.03	11.33	0.02	93.87
	U1520D_26F-4_8-12_6	3.70	3.37	1.26	73.16	0.10	0.06	0.90	0.03	11.77	0.01	94.36
	U1520D_26F-4_8-12_7	3.72	3.66	1.17	74.53	0.16	0.11	0.89	0.07	11.71	0.01	96.02
	U1520D_26F-4_8-12_8	3.92	3.38	1.34	73.61	0.10	0.13	0.91	0.00	11.67	0.02	95.08
	U1520D_26F-4_8-12_9	3.85	3.39	1.21	74.39	0.13	0.08	0.88	0.04	11.68	0.02	95.68
	U1520D_26F-4_8-12_10	3.59	3.36	1.29	74.25	0.13	0.11	0.90	0.03	11.77	0.02	95.44
	U1520D_26F-4_8-12_11	3.71	3.43	1.08	74.12	0.10	0.13	0.87	0.01	11.54	0.04	95.03
	U1520D_26F-4_8-12_12	3.77	3.33	1.13	74.11	0.12	0.09	0.88	0.01	11.80	0.02	95.26
	U1520D_26F-4_8-12_13	3.55	3.28	1.19	74.06	0.14	0.10	0.86	0.08	11.57	0.00	94.83
	U1520D_26F-4_8-12_14	3.56	3.35	1.15	74.12	0.15	0.10	0.87	0.00	11.53	0.01	94.85
	U1520D_26F-4_8-12_15	2.95	3.42	1.20	74.66	0.14	0.06	0.86	0.08	11.82	0.00	95.19
	U1520D_26F-4_16-20_1	3.70	3.44	1.33	74.95	0.12	0.10	0.92	0.05	11.80	0.03	96.43
	U1520D_26F-4_16-20_2	3.09	3.61	0.95	71.35	0.10	0.06	0.79	0.08	11.24	0.03	91.32
	U1520D_26F-4_16-20_3	3.50	3.53	1.14	74.16	0.11	0.07	0.83	0.07	11.78	0.03	95.22
	U1520D_26F-4_16-20_4	3.63	3.46	1.33	73.99	0.13	0.10	0.86	0.03	11.77	0.01	95.32
	U1520D_26F-4_16-20_5	3.41	3.48	1.13	74.43	0.16	0.10	0.87	0.02	11.66	0.04	95.30
	U1520D_26F-4_16-20_6	3.61	3.34	1.22	74.39	0.14	0.10	0.90	0.00	11.88	0.00	95.58
	U1520D_26F-4_16-20_7	3.53	3.52	1.28	73.91	0.14	0.08	0.87	0.01	11.85	0.00	95.19
	U1520D_26F-4_16-20_8	3.51	3.51	1.29	74.74	0.11	0.07	0.87	0.07	11.90	0.00	96.07
	U1520D_26F-4_16-20_9	3.68	2.52	2.07	74.87	0.18	0.03	1.32	0.02	11.80	0.00	96.49
	U1520D_26F-4_16-20_10	3.73	3.37	1.21	74.46	0.14	0.08	0.86	0.08	11.64	0.00	95.57
	U1520D_26F-4_16-20_11	3.60	3.57	1.19	74.64	0.14	0.11	0.89	0.00	11.83	0.00	95.98
	U1520D_26F-4_16-20_12	3.33	3.38	1.10	73.06	0.13	0.09	0.85	0.03	11.61	0.00	93.58
	U1520D_26F-4_16-20_13	3.79	3.48	1.05	74.84	0.09	0.05	0.79	0.01	11.60	0.00	95.71
	U1520D_26F-4_16-20_14	3.63	3.59	1.08	74.47	0.09	0.03	0.77	0.13	11.62	0.01	95.43
	U1520D_26F-4_16-20_15	3.57	3.46	1.14	73.71	0.12	0.10	0.85	0.00	11.67	0.00	94.62
	U1520D_26F-4_16-20_16	3.67	3.28	1.16	73.17	0.15	0.06	0.85	0.06	11.40	0.02	93.82
	U1520D_26F-4_16-20_17	3.69	3.46	1.14	74.81	0.11	0.10	0.80	0.09	11.71	0.00	95.91
	U1520D_26F-4_16-20_18	3.54	3.39	1.08	74.42	0.14	0.10	0.85	0.00	11.70	0.00	95.22
	U1520D_26F-4_16-20_19	3.45	3.38	1.05	73.91	0.15	0.09	0.86	0.00	11.66	0.00	94.55
	U1520D_26F-4_16-20_20	3.50	3.36	1.12	73.28	0.12	0.09	0.76	0.08	11.31	0.04	93.66
	U1520D_26F-4_26-28_1	3.63	3.40	1.13	73.89	0.12	0.10	0.84	0.03	11.54	0.03	94.72
	U1520D_26F-4_26-28_2	3.88	3.34	1.25	74.76	0.10	0.12	0.88	0.03	11.80	0.00	96.16
	U1520D_26F-4_26-28_3	3.61	3.41	1.27	74.23	0.16	0.11	0.86	0.01	11.59	0.02	95.27
	U1520D_26F-4_26-28_4	3.56	3.43	0.99	73.28	0.15	0.08	0.86	0.04	11.77	0.00	94.16
	U1520D_26F-4_26-28_5	3.61	3.46	1.26	73.99	0.12	0.08	0.86	0.00	11.80	0.02	95.19
	U1520D_26F-4_26-28_6	3.73	3.33	1.19	73.87	0.15	0.07	0.89	0.04	11.87	0.01	95.14
	U1520D_26F-4_26-28_7	3.54	3.31	1.19	74.06	0.14	0.14	0.87	0.05	11.62	0.02	94.94
	U1520D_26F-4_26-28_8	3.68	3.31	1.12	73.95	0.12	0.12	0.83	0.00	11.72	0.00	94.86
	U1520D_26F-4_26-28_9	3.98	3.37	1.52	72.60	0.14	0.13	1.13	0.00	12.36	0.02	95.25
	U1520D_26F-4_26-28_10	3.59	3.41	1.15	73.59	0.11	0.13	0.88	0.05	11.74	0.04	94.70
	U1520D_26F-4_26-28_11	3.55	3.43	1.14	73.22	0.09	0.10	0.76	0.09	11.19	0.01	93.58
	U1520D_26F-4_26-28_12	3.31	3.43	1.05	73.78	0.14	0.07	0.80	0.02	11.63	0.05	94.27
	U1520D_26F-4_26-28_13	3.44	3.43	1.02	73.63	0.15	0.10	0.84	0.04	11.65	0.00	94.30
	U1520D_26F-4_26-28_14	3.35	3.43	1.21	73.10	0.15	0.11	0.88	0.06	11.59	0.03	93.90
	U1520D_26F-4_26-28_15	3.72	3.43	1.27	74.53	0.09	0.08	0.86	0.00	11.59	0.02	95.59
	U1520D_26F-4_26-28_16	3.53	3.45	1.16	74.32	0.14	0.08	0.90	0.03	11.90	0.01	95.51
	U1520D_26F-4_26-28_17	3.53	3.41	1.00	74.25	0.09	0.10	0.93	0.03	12.09	0.00	95.45
	U1520D_26F-4_26-28_18	3.58	3.50	1.23	73.84	0.16	0.12	0.87	0.08	11.72	0.00	95.10
	U1520D_26F-4_26-28_19	3.82	3.44	1.20	74.33	0.10	0.06	0.86	0.03	11.79	0.02	95.65
	U1520D_26F-4_26-28_20	3.46	3.28	1.12	73.43	0.10	0.09	0.88	0.04	11.65	0.03	94.09
u19	U1520D_26F-4_51-55_1	3.73	3.35	1.27	73.96	0.15	0.11	0.89	0.00	11.86	0.02	95.34
	U1520D_26F-4_51-55_2	3.53	3.51	1.08	73.40	0.10	0.09	0.81	0.05	11.52	0.00	94.09
	U1520D_26F-4_51-55_3	4.15	3.25	1.54	73.16	0.10	0.06	0.88	0.18	12.18	0.00	95.50
	U1520D_26F-4_51-55_4	3.61	3.43	1.09	73.97	0.09	0.07	0.88	0.08	11.78	0.00	95.00
	U1520D_26F-4_51-55_5	3.73	3.33	0.98	74.09	0.13	0.08	0.82	0.01	11.76	0.01	94.93
	U1520D_26F-4_51-55_6	3.36	3.48	1.10	72.79	0.10	0.07	0.87	0.05	11.40	0.00	93.23

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	U1520D_26F-4_51-55_7	3.58	3.35	1.17	73.45	0.10	0.09	0.81	0.03	11.76	0.00	94.34
	U1520D_26F-4_51-55_8	3.62	3.45	1.16	73.66	0.14	0.09	0.85	0.08	11.69	0.00	94.74
	U1520D_26F-4_51-55_9	3.43	3.45	1.05	73.54	0.11	0.12	0.83	0.04	11.84	0.03	94.44
	U1520D_26F-4_51-55_10	3.41	3.57	1.14	73.28	0.15	0.13	0.85	0.07	11.64	0.00	94.25
	U1520D_26F-4_51-55_11	3.25	3.67	1.38	74.78	0.12	0.14	0.57	0.06	10.99	0.00	94.96
	U1520D_26F-4_51-55_12	3.63	3.45	1.20	73.49	0.16	0.09	0.88	0.03	11.65	0.00	94.59
	U1520D_26F-4_51-55_13	3.52	3.37	1.16	72.85	0.09	0.10	0.78	0.08	11.53	0.00	93.49
	U1520D_26F-4_51-55_14	3.64	3.31	1.29	73.36	0.14	0.11	0.88	0.00	11.53	0.00	94.26
	U1520D_26F-4_51-55_15	3.37	3.50	1.05	74.03	0.09	0.05	0.73	0.00	11.62	0.00	94.44
	U1520D_26F-4_51-55_16	3.54	3.51	0.98	74.50	0.13	0.11	0.78	0.08	11.67	0.00	95.30
	U1520D_26F-4_51-55_17	3.63	3.38	1.24	74.06	0.15	0.08	0.89	0.13	11.76	0.00	95.31
	U1520D_26F-4_51-55_18	3.50	3.43	0.95	74.05	0.11	0.07	0.78	0.06	11.61	0.02	94.59
	U1520D_26F-4_51-55_19	3.71	3.43	1.12	74.24	0.12	0.09	0.88	0.07	11.76	0.00	95.42
	U1520D_26F-4_51-55_20	3.50	3.41	1.15	73.10	0.15	0.09	0.85	0.06	11.70	0.01	94.02
	1520D_26F-4_51-55_3	3.68	3.33	1.25	73.55	0.21	0.08	0.84	0.06	11.48	0.02	94.50
	1520D_26F-4_51-55_6	3.95	3.26	1.15	74.79	0.14	0.10	0.87	0.10	11.90	0.01	96.26
	1520D_26F-4_51-55_7	3.77	3.31	1.16	73.86	0.16	0.11	0.87	0.00	11.77	0.00	95.01
	1520D_26F-4_51-55_8	4.04	3.11	1.17	74.72	0.12	0.05	0.83	0.01	11.92	0.00	95.97
	1520D_26F-4_51-55_10	3.52	3.25	1.01	74.18	0.12	0.07	0.88	0.03	11.80	0.00	94.87
	1520D_26F-4_51-55_1	3.83	3.47	1.13	73.37	0.16	0.11	0.87	0.09	11.70	0.00	94.73
	1520D_26F-4_51-55_2	3.56	3.38	1.13	73.92	0.18	0.10	0.86	0.03	11.64	0.00	94.81
	1520D_26F-4_51-55_4	3.71	3.20	1.16	73.41	0.21	0.05	0.84	0.00	11.82	0.03	94.43
	1520D_26F-4_51-55_5	3.70	3.25	0.91	74.49	0.15	0.09	0.74	0.06	11.44	0.02	94.85
	1520D_26F-4_51-55_9	3.59	3.37	1.33	74.32	0.19	0.14	0.91	0.11	11.79	0.00	95.75
	U1520D_27F-1_19-20_2	3.76	3.31	1.23	74.08	0.15	0.12	1.07	0.10	12.35	0.03	96.20
	U1520D_27F-1_19-20_3	3.65	3.24	1.22	73.72	0.13	0.15	0.98	0.04	12.15	0.00	95.28
	U1520D_27F-1_19-20_4	3.35	3.28	1.09	73.53	0.15	0.16	0.99	0.03	11.64	0.00	94.22
	U1520D_27F-1_19-20_5	3.39	3.75	1.23	74.52	0.14	0.11	0.91	0.02	11.82	0.03	95.93
	U1520D_27F-1_19-20_6	3.81	3.27	1.43	73.57	0.15	0.13	1.03	0.04	12.15	0.02	95.60
	U1520D_27F-1_19-20_7	3.78	3.10	1.22	74.03	0.12	0.09	1.11	0.07	12.14	0.02	95.67
	U1520D_27F-1_19-20_8	3.66	3.40	1.29	73.40	0.16	0.13	1.08	0.08	12.18	0.02	95.41
	U1520D_27F-1_19-20_9	3.57	3.42	1.32	73.85	0.14	0.16	1.04	0.00	12.02	0.00	95.52
	U1520D_27F-1_19-20_10	3.58	3.60	1.35	74.25	0.14	0.11	0.93	0.04	11.51	0.01	95.52
	U1520D_27F-1_19-20_11	3.70	3.78	1.10	74.70	0.12	0.09	0.89	0.06	11.84	0.00	96.27
	U1520D_27F-1_19-20_12	3.75	3.30	1.39	73.32	0.14	0.14	1.05	0.05	12.02	0.00	95.16
	U1520D_27F-1_19-20_13	3.48	3.33	1.12	73.89	0.15	0.14	1.03	0.07	12.25	0.03	95.48
	U1520D_27F-1_19-20_14	3.69	3.48	1.19	74.16	0.13	0.13	0.96	0.01	11.83	0.01	95.58
	U1520D_27F-1_19-20_15	3.49	3.60	1.12	74.16	0.13	0.09	0.88	0.05	11.60	0.00	95.12
	U1520D_27F-1_19-20_16	3.49	3.33	1.03	73.40	0.11	0.09	0.97	0.03	11.77	0.00	94.23
	U1520D_27F-1_19-20_17	3.83	3.21	1.03	74.51	0.15	0.15	1.00	0.08	11.75	0.00	95.70
	U1520D_27F-1_19-20_18	3.68	3.32	1.34	73.48	0.13	0.12	1.06	0.03	12.24	0.00	95.41
	U1520D_27F-1_19-20_19	3.47	3.53	1.27	73.79	0.16	0.12	1.02	0.02	11.99	0.04	95.41
	U1520D_27F-1_19-20_20	3.72	3.49	1.25	74.02	0.17	0.14	1.05	0.09	12.35	0.00	96.27
	1520D_27F-1_19-20_1	3.91	3.13	1.06	74.09	0.13	0.08	0.97	0.04	11.71	0.03	95.14
	1520D_27F-1_19-20_2	3.12	4.23	1.13	74.26	0.14	0.08	0.76	0.01	11.95	0.03	95.70
	1520D_27F-1_19-20_7	3.63	3.66	1.29	73.92	0.16	0.09	1.00	0.05	11.75	0.01	95.55
	1520D_27F-1_19-20_9	3.51	3.54	1.23	73.29	0.15	0.13	1.01	0.08	12.28	0.02	95.23
	1520D_27F-1_19-20_3	3.53	3.64	1.28	73.11	0.17	0.10	0.95	0.06	12.09	0.00	94.94
	1520D_27F-1_19-20_4	3.79	3.61	1.12	73.87	0.10	0.09	0.71	0.00	11.93	0.04	95.26
	1520D_27F-1_19-20_6	3.39	3.72	1.20	74.13	0.10	0.11	0.89	0.05	12.04	0.00	95.63
	1520D_27F-1_19-20_8	3.73	3.38	1.25	72.38	0.15	0.14	1.03	0.04	12.43	0.00	94.53
	1520D_27F-1_19-20_10	3.49	4.19	1.09	73.91	0.15	0.03	0.39	0.04	11.97	0.05	95.32
	U1520D_27F-1_28-30_1	3.43	3.12	1.06	73.21	0.10	0.09	1.01	0.02	11.75	0.00	93.79
	U1520D_27F-1_28-30_2	3.53	3.47	1.20	73.45	0.18	0.16	1.14	0.00	11.85	0.00	94.97
	U1520D_27F-1_28-30_3	3.68	3.58	1.17	74.09	0.14	0.10	0.89	0.00	11.72	0.03	95.40
	U1520D_27F-1_28-30_4	3.65	3.59	1.09	73.97	0.16	0.10	1.00	0.04	12.13	0.00	95.74
	U1520D_27F-1_28-30_5	3.46	3.16	1.00	73.69	0.17	0.14	1.00	0.03	11.52	0.01	94.18
	U1520D_27F-1_28-30_7	3.67	3.33	1.39	73.07	0.17	0.15	1.28	0.04	12.31	0.02	95.44
	U1520D_27F-1_28-30_8	3.49	3.41	1.27	73.61	0.17	0.14	1.00	0.00	11.95	0.02	95.06
	U1520D_27F-1_28-30_10	3.38	3.47	1.17	73.57	0.16	0.13	0.95	0.08	11.52	0.03	94.46
	U1520D_27F-1_28-30_11	3.83	3.54	1.20	74.87	0.15	0.08	0.95	0.00	11.65	0.00	96.27
	U1520D_27F-1_28-30_12	3.70	3.31	1.09	73.97	0.11	0.14	0.86	0.01	11.74	0.00	94.94
	U1520D_27F-1_28-30_13	3.91	3.43	1.00	73.99	0.08	0.06	0.80	0.00	12.08	0.01	95.36
	U1520D_27F-1_28-30_14	3.33	3.65	1.13	73.13	0.13	0.12	0.90	0.01	11.79	0.03	94.22
	U1520D_27F-1_28-30_15	3.35	3.18	1.21	73.54	0.13	0.13	1.13	0.07	11.91	0.00	94.64
	U1520D_27F-1_28-30_16	3.45	3.55	1.26	73.44	0.14	0.11	0.98	0.01	11.71	0.03	94.67
	U1520D_27F-1_28-30_17	3.63	3.53	1.22	73.36	0.11	0.14	1.01	0.07	12.19	0.02	95.27
	U1520D_27F-1_28-30_18	3.55	3.68	1.21	73.79	0.11	0.08	0.88	0.07	11.60	0.02	94.99
	U1520D_27F-1_28-30_19	3.31	3.06	1.28	73.00	0.12	0.09	1.17	0.03	11.80	0.00	93.86
	U1520D_27F-1_28-30_20	3.43	3.42	1.20	73.00	0.16	0.15	1.03	0.02	12.12	0.04	94.57

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1520D_27F-1_28-30_2	3.47	3.22	1.09	74.03	0.10	0.10	1.00	0.02	11.79	0.01	94.83
	1520D_27F-1_28-30_5	3.65	2.94	1.20	72.97	0.20	0.18	1.10	0.07	12.14	0.02	94.46
	1520D_27F-1_28-30_6	3.66	3.09	1.29	74.02	0.26	0.15	1.00	0.08	11.63	0.00	95.18
	1520D_27F-1_28-30_8	3.74	3.28	1.12	73.63	0.23	0.16	1.08	0.07	12.31	0.03	95.64
	1520D_27F-1_28-30_1	3.49	3.62	1.33	74.45	0.22	0.10	0.89	0.00	11.58	0.00	95.68
	1520D_27F-1_28-30_10	3.59	3.49	1.32	73.45	0.24	0.14	1.10	0.03	11.85	0.02	95.23
	U1520D_27F-1_30-34_1	3.47	3.47	1.07	73.63	0.15	0.11	1.05	0.01	12.22	0.03	95.20
	U1520D_27F-1_30-34_2	3.42	3.60	1.31	73.47	0.12	0.12	0.98	0.05	11.66	0.02	94.75
	U1520D_27F-1_30-34_3	3.44	3.51	1.21	73.87	0.17	0.12	1.05	0.00	11.98	0.02	95.36
	U1520D_27F-1_30-34_4	3.72	3.33	1.17	72.86	0.11	0.14	1.04	0.07	12.08	0.01	94.52
	U1520D_27F-1_30-34_5	3.51	3.56	1.21	73.64	0.14	0.12	1.05	0.13	12.13	0.01	95.50
	U1520D_27F-1_30-34_6	3.38	3.41	1.17	72.88	0.13	0.16	1.06	0.05	11.89	0.00	94.13
	U1520D_27F-1_30-34_7	3.51	3.83	1.30	73.87	0.15	0.10	0.91	0.02	11.92	0.04	95.65
	U1520D_27F-1_30-34_8	3.69	3.40	1.06	73.61	0.15	0.11	0.91	0.06	11.76	0.00	94.75
	U1520D_27F-1_30-34_9	3.53	3.49	1.30	73.76	0.16	0.13	0.95	0.00	12.01	0.02	95.34
	U1520D_27F-1_30-34_10	3.78	3.54	1.22	73.77	0.12	0.10	1.06	0.07	12.26	0.03	95.96
	U1520D_27F-1_30-34_11	3.33	3.86	2.15	72.79	0.18	0.18	0.98	0.03	12.06	0.02	95.58
	U1520D_27F-1_30-34_12	3.42	3.49	1.30	73.87	0.13	0.16	0.92	0.04	11.76	0.01	95.10
	U1520D_27F-1_30-34_13	3.65	3.27	1.07	73.07	0.15	0.11	1.00	0.07	12.31	0.03	94.73
	U1520D_27F-1_30-34_14	3.33	3.58	1.15	73.89	0.15	0.20	1.10	0.03	12.35	0.02	95.81
	U1520D_27F-1_30-34_15	3.47	3.71	1.17	74.04	0.15	0.08	0.86	0.03	11.53	0.04	95.07
	U1520D_27F-1_30-34_16	3.53	3.67	1.23	74.04	0.14	0.11	0.87	0.02	11.66	0.01	95.28
	U1520D_27F-1_30-34_17	3.85	3.23	1.19	73.07	0.13	0.13	1.06	0.08	12.05	0.02	94.80
	U1520D_27F-1_30-34_18	3.49	3.40	1.15	73.93	0.15	0.14	1.05	0.08	12.10	0.00	95.48
	U1520D_27F-1_30-34_19	3.66	3.50	1.20	73.49	0.15	0.11	0.95	0.03	11.77	0.05	94.92
	U1520D_27F-1_30-34_20	3.35	3.69	1.14	73.46	0.10	0.08	0.85	0.03	11.60	0.04	94.35
	U1520D_27F-1_35-39_1	3.26	3.70	0.98	72.77	0.14	0.09	0.80	0.00	11.40	0.00	93.15
	U1520D_27F-1_35-39_2	3.49	3.52	1.09	73.80	0.13	0.11	0.91	0.02	11.56	0.02	94.64
	U1520D_27F-1_35-39_3	3.58	3.40	1.07	73.05	0.14	0.14	1.05	0.04	11.94	0.00	94.41
	U1520D_27F-1_35-39_4	3.50	3.35	1.32	72.24	0.17	0.14	1.15	0.00	11.80	0.02	93.70
	U1520D_27F-1_35-39_5	3.31	3.73	1.18	73.66	0.14	0.08	0.84	0.00	11.61	0.02	94.57
	U1520D_27F-1_35-39_6	3.87	3.15	1.06	72.48	0.19	0.16	1.14	0.02	11.82	0.03	93.91
	U1520D_27F-1_35-39_7	3.81	3.23	1.24	72.49	0.18	0.15	1.08	0.09	12.18	0.00	94.45
	U1520D_27F-1_35-39_8	3.64	3.44	1.16	73.03	0.15	0.15	1.11	0.03	11.98	0.02	94.71
	U1520D_27F-1_35-39_9	3.65	3.43	1.20	74.17	0.15	0.16	1.02	0.00	11.64	0.01	95.43
	U1520D_27F-1_35-39_10	3.57	3.63	1.23	73.26	0.14	0.11	0.84	0.12	11.54	0.00	94.44
	U1520D_27F-1_35-39_11	3.72	3.32	1.33	72.96	0.17	0.12	1.06	0.00	12.20	0.00	94.88
	U1520D_27F-1_35-39_12	3.58	3.62	1.24	73.25	0.16	0.11	0.83	0.00	11.38	0.01	94.18
	U1520D_27F-1_35-39_13	3.79	3.53	1.32	72.29	0.16	0.18	1.14	0.05	12.18	0.00	94.63
	U1520D_27F-1_35-39_14	3.56	3.67	1.10	73.36	0.12	0.09	0.87	0.03	11.53	0.01	94.34
	U1520D_27F-1_35-39_15	3.67	3.44	1.29	72.66	0.15	0.15	1.07	0.02	12.07	0.03	94.54
	U1520D_27F-1_35-39_16	3.69	3.49	1.11	73.31	0.14	0.14	0.92	0.05	11.95	0.04	94.85
	U1520D_27F-1_35-39_17	3.70	3.46	1.16	73.30	0.13	0.13	1.02	0.04	12.22	0.01	95.17
	U1520D_27F-1_35-39_18	3.43	3.64	1.18	73.49	0.15	0.09	0.92	0.02	11.51	0.00	94.43
	U1520D_27F-1_35-39_19	3.53	3.49	1.05	72.17	0.12	0.11	1.01	0.07	11.81	0.01	93.37
	U1520D_27F-1_35-39_20	3.70	3.29	1.25	72.66	0.11	0.13	1.09	0.08	12.13	0.04	94.47
	U1520D_27F-1_38-40_1	3.42	3.74	1.18	73.70	0.14	0.10	0.71	0.11	10.98	0.03	94.11
	U1520D_27F-1_38-40_2	3.95	2.96	1.14	71.39	0.20	0.20	1.22	0.00	11.96	0.02	93.04
	U1520D_27F-1_38-40_3	3.31	4.01	0.96	73.12	0.14	0.12	0.76	0.03	11.00	0.01	93.45
	U1520D_27F-1_38-40_4	3.49	3.56	1.12	72.68	0.12	0.13	1.00	0.04	11.71	0.04	93.89
	U1520D_27F-1_38-40_5	3.24	3.55	1.17	73.00	0.11	0.08	0.87	0.05	11.42	0.03	93.53
	U1520D_27F-1_38-40_6	3.78	3.28	1.09	72.48	0.15	0.16	1.08	0.04	12.06	0.04	94.16
	U1520D_27F-1_38-40_7	3.47	3.59	1.24	74.06	0.15	0.05	0.82	0.05	11.55	0.02	95.00
	U1520D_27F-1_38-40_8	3.46	3.47	1.17	72.24	0.16	0.09	0.97	0.00	11.74	0.01	93.31
	U1520D_27F-1_38-40_9	3.68	3.32	1.25	72.85	0.12	0.20	1.00	0.05	11.54	0.02	94.02
	U1520D_27F-1_38-40_10	3.66	3.51	1.13	73.46	0.16	0.11	0.99	0.07	11.82	0.00	94.92
	U1520D_27F-1_38-40_12	3.64	3.53	1.23	73.04	0.14	0.14	0.99	0.05	12.06	0.01	94.82
	U1520D_27F-1_38-40_13	4.33	3.06	0.99	71.26	0.14	0.07	1.67	0.02	13.59	0.01	95.13
	U1520D_27F-1_38-40_14	3.67	3.33	1.29	71.08	0.17	0.18	1.08	0.06	12.05	0.00	92.90
	U1520D_27F-1_38-40_15	3.61	3.69	1.16	73.10	0.14	0.07	0.84	0.00	11.52	0.02	94.15
	U1520D_27F-1_38-40_16	3.49	3.71	1.19	73.20	0.13	0.10	0.91	0.06	11.48	0.00	94.28
	U1520D_27F-1_38-40_17	3.40	3.58	1.32	73.60	0.14	0.11	0.89	0.06	11.42	0.02	94.54
	U1520D_27F-1_38-40_18	3.71	3.53	1.12	73.34	0.12	0.13	1.02	0.03	11.97	0.03	95.01
	U1520D_27F-1_38-40_19	3.56	3.50	1.18	74.03	0.16	0.13	0.93	0.01	11.47	0.02	94.99
	U1520D_27F-1_41-43_1	3.23	3.65	1.16	72.47	0.15	0.12	0.90	0.00	11.49	0.02	93.18
	U1520D_27F-1_41-43_2	3.65	3.62	1.06	72.98	0.13	0.07	0.89	0.03	11.53	0.01	93.97
	U1520D_27F-1_41-43_3	3.95	3.29	1.10	72.70	0.13	0.09	1.01	0.06	12.24	0.01	94.59
	U1520D_27F-1_41-43_4	3.33	3.61	1.26	72.43	0.14	0.08	0.81	0.05	11.32	0.02	93.05
	U1520D_27F-1_41-43_5	3.56	3.50	1.11	72.36	0.15	0.15	1.05	0.04	11.99	0.05	93.96
	U1520D_27F-1_41-43_6	3.69	3.23	1.15	73.61	0.16	0.18	1.05	0.08	12.10	0.00	95.24

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s18	U1520D_27F-1_41-43_7	4.08	3.40	1.14	72.94	0.17	0.14	1.06	0.05	12.14	0.05	95.18
	U1520D_27F-1_41-43_8	3.57	3.55	1.14	73.38	0.10	0.12	0.97	0.03	11.66	0.00	94.52
	U1520D_27F-1_41-43_9	3.55	3.58	1.20	73.54	0.13	0.14	1.07	0.03	12.27	0.03	95.55
	U1520D_27F-1_41-43_10	3.67	3.60	1.18	73.25	0.14	0.11	0.95	0.02	11.62	0.02	94.56
	U1520D_27F-1_41-43_11	3.34	3.70	1.20	73.49	0.14	0.13	0.88	0.03	11.77	0.00	94.67
	U1520D_27F-1_41-43_13	3.62	3.32	1.15	73.02	0.16	0.15	1.03	0.11	11.95	0.00	94.51
	U1520D_27F-1_41-43_14	3.60	3.39	1.11	73.59	0.15	0.17	1.05	0.02	11.93	0.03	95.04
	U1520D_27F-1_41-43_15	3.72	3.42	1.23	72.48	0.12	0.12	1.07	0.13	12.21	0.01	94.51
	U1520D_27F-1_41-43_16	3.51	3.46	1.20	72.27	0.15	0.16	1.00	0.04	11.84	0.02	93.65
	U1520D_27F-1_41-43_17	3.76	3.34	1.09	71.40	0.14	0.15	1.09	0.00	11.74	0.03	92.74
	U1520D_27F-1_41-43_18	3.84	3.42	1.11	72.40	0.14	0.16	1.02	0.02	12.14	0.01	94.26
	U1520D_27F-1_41-43_19	3.71	3.26	1.16	72.10	0.13	0.16	1.03	0.05	12.00	0.01	93.62
	U1520D_27F-1_41-43_20	3.72	3.14	1.29	72.72	0.15	0.15	1.04	0.00	11.98	0.03	94.22
	U1520D_27F-1_44-46_1	3.37	3.49	1.41	71.43	0.15	0.09	0.92	0.00	11.45	0.02	92.33
	U1520D_27F-1_44-46_2	3.42	3.56	1.19	73.50	0.13	0.09	0.93	0.02	11.71	0.00	94.54
	U1520D_27F-1_44-46_3	3.68	3.43	1.15	73.03	0.12	0.11	1.04	0.07	12.06	0.05	94.74
	U1520D_27F-1_44-46_4	3.69	3.56	1.21	72.51	0.12	0.16	1.03	0.00	11.85	0.03	94.16
	U1520D_27F-1_44-46_5	3.98	3.00	1.97	70.33	0.22	0.29	1.46	0.04	13.17	0.04	94.51
	U1520D_27F-1_44-46_6	3.40	3.52	1.24	74.34	0.14	0.13	0.94	0.08	11.60	0.00	95.39
	U1520D_27F-1_44-46_7	3.49	3.73	1.22	73.65	0.13	0.10	0.88	0.03	11.68	0.03	94.93
	U1520D_27F-1_44-46_8	3.42	3.60	1.33	73.82	0.11	0.10	0.93	0.00	11.61	0.01	94.94
	U1520D_27F-1_44-46_9	3.60	3.43	1.37	74.39	0.21	0.13	1.08	0.00	11.75	0.01	95.97
	U1520D_27F-1_44-46_10	3.52	3.75	1.29	74.11	0.14	0.07	0.87	0.03	11.45	0.00	95.23
	U1520D_27F-1_44-46_11	3.78	3.30	1.02	73.17	0.14	0.14	1.06	0.05	12.03	0.03	94.72
	U1520D_27F-1_44-46_12	3.49	3.56	1.11	73.04	0.14	0.13	0.98	0.03	11.73	0.00	94.20
	U1520D_27F-1_44-46_13	3.10	3.63	1.17	72.76	0.11	0.09	0.83	0.09	11.58	0.01	93.37
	U1520D_27F-1_44-46_14	3.49	3.79	1.12	73.87	0.12	0.08	0.86	0.07	11.66	0.01	95.07
	U1520D_27F-1_44-46_15	3.48	3.55	1.21	73.99	0.15	0.06	0.82	0.01	11.74	0.02	95.04
	U1520D_27F-1_44-46_16	3.60	3.55	1.20	74.07	0.13	0.07	0.85	0.04	11.56	0.00	95.07
	U1520D_27F-1_44-46_17	3.54	3.60	1.20	73.46	0.16	0.06	0.86	0.11	11.42	0.04	94.43
	U1520D_27F-1_44-46_18	3.50	3.53	1.09	72.97	0.16	0.12	0.96	0.05	11.46	0.01	93.86
	U1520D_27F-1_44-46_19	3.68	3.65	1.17	73.74	0.12	0.12	0.91	0.00	11.71	0.02	95.12
	U1520D_27F-1_44-46_20	3.41	3.61	1.22	73.77	0.12	0.06	0.94	0.00	11.43	0.03	94.59
	1520D_27F-1_44-46_7	3.77	3.41	1.13	73.23	0.12	0.16	1.09	0.03	12.39	0.01	95.35
	1520D_27F-1_44-46_9	3.43	3.60	1.07	74.12	0.13	0.08	0.89	0.04	12.17	0.01	95.54
	1520D_27F-1_44-46_4	3.67	3.34	1.37	73.49	0.17	0.16	1.10	0.04	12.54	0.02	95.89
	1520D_27F-1_44-46_8	3.70	3.41	1.24	73.88	0.16	0.13	1.06	0.08	12.28	0.00	95.95
	1520D_27F-1_44-46_10	3.67	3.65	1.25	74.65	0.14	0.12	1.09	0.05	12.64	0.01	97.26
	U1520D_27F-1_73-75_1	3.17	3.37	1.09	73.76	0.09	0.10	1.00	0.04	11.78	0.00	94.40
	U1520D_27F-1_73-75_2	3.37	3.33	1.18	73.80	0.10	0.08	1.00	0.03	11.69	0.00	94.58
	U1520D_27F-1_73-75_3	3.50	3.23	1.09	73.53	0.09	0.14	1.03	0.00	11.64	0.02	94.27
	U1520D_27F-1_73-75_4	3.40	3.29	1.17	73.50	0.11	0.11	1.08	0.02	11.62	0.00	94.31
	U1520D_27F-1_73-75_5	3.59	3.32	1.15	73.78	0.09	0.11	1.00	0.10	11.59	0.01	94.74
	U1520D_27F-1_73-75_6	3.26	3.38	1.14	73.02	0.08	0.09	0.98	0.03	11.61	0.00	93.59
	U1520D_27F-1_73-75_7	3.29	3.29	1.10	73.54	0.10	0.12	1.01	0.03	11.58	0.02	94.08
	U1520D_27F-1_73-75_8	3.22	3.36	1.06	73.01	0.10	0.09	0.98	0.05	11.74	0.02	93.63
	U1520D_27F-1_73-75_9	3.40	3.26	1.26	73.87	0.11	0.10	1.00	0.03	11.68	0.00	94.72
	U1520D_27F-1_73-75_10	3.62	3.32	1.04	72.67	0.10	0.09	0.97	0.01	11.85	0.01	93.67
	U1520D_27F-1_73-75_11	3.40	3.30	0.99	73.33	0.07	0.11	0.95	0.05	11.70	0.01	93.91
	U1520D_27F-1_73-75_12	3.64	3.22	1.15	72.99	0.13	0.13	1.08	0.03	11.94	0.03	94.34
	U1520D_27F-1_73-75_14	3.59	3.36	1.12	73.57	0.11	0.09	1.02	0.06	11.73	0.00	94.64
	U1520D_27F-1_73-75_15	3.40	3.06	1.20	73.26	0.10	0.10	1.08	0.03	11.71	0.00	93.94
	U1520D_27F-1_73-75_16	3.54	3.29	1.21	72.92	0.08	0.15	1.12	0.02	11.82	0.00	94.14
	U1520D_27F-1_73-75_17	3.48	3.39	1.19	73.35	0.09	0.10	0.96	0.05	11.71	0.00	94.33
	U1520D_27F-1_73-75_18	3.50	3.37	1.12	73.45	0.06	0.07	0.96	0.09	11.67	0.00	94.30
	U1520D_27F-1_73-75_19	3.50	3.20	1.24	73.40	0.08	0.13	1.10	0.02	11.78	0.02	94.47
	U1520D_27F-1_73-75_20	3.47	3.16	1.06	73.17	0.10	0.10	0.95	0.00	11.72	0.01	93.74
	U1520D_27F-1_85-89_1	3.51	3.39	0.95	73.76	0.09	0.09	1.02	0.00	11.48	0.01	94.31
	U1520D_27F-1_85-89_2	3.40	3.32	1.14	73.85	0.10	0.10	1.07	0.02	11.75	0.00	94.74
	U1520D_27F-1_85-89_3	3.38	3.24	1.09	73.02	0.14	0.12	1.07	0.03	11.74	0.00	93.83
	U1520D_27F-1_85-89_4	3.60	3.26	0.98	73.62	0.09	0.09	0.99	0.00	11.66	0.00	94.30
	U1520D_27F-1_85-89_5	3.61	3.27	1.26	73.53	0.08	0.15	1.12	0.05	11.86	0.00	94.93
	U1520D_27F-1_85-89_6	3.41	3.30	0.99	73.20	0.11	0.08	0.97	0.06	11.53	0.00	93.66
	U1520D_27F-1_85-89_7	3.49	3.23	1.10	73.89	0.10	0.11	1.14	0.06	11.83	0.00	94.95
	U1520D_27F-1_85-89_8	3.59	3.24	1.02	73.30	0.10	0.11	1.07	0.05	11.49	0.00	93.97
	U1520D_27F-1_85-89_9	3.59	3.43	1.06	73.65	0.09	0.07	0.97	0.05	11.77	0.04	94.71
	U1520D_27F-1_85-89_10	3.34	3.26	0.97	73.01	0.09	0.13	1.05	0.07	11.81	0.00	93.74
	U1520D_27F-1_85-89_11	3.49	3.41	1.06	73.19	0.08	0.10	1.01	0.04	11.56	0.00	93.95
	U1520D_27F-1_85-89_12	3.51	3.19	1.19	73.35	0.11	0.10	1.06	0.06	11.76	0.04	94.37
	U1520D_27F-1_85-89_13	3.29	3.17	1.15	72.74	0.08	0.10	1.10	0.07	11.80	0.04	93.54

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u20	U1520D_27F-1_85-89_14	3.58	3.31	1.12	73.32	0.10	0.12	1.00	0.03	11.59	0.00	94.16
	U1520D_27F-1_85-89_15	3.50	3.26	1.05	73.24	0.08	0.09	1.01	0.00	12.02	0.00	94.25
	U1520D_27F-1_85-89_16	3.45	3.21	1.04	73.60	0.13	0.11	1.07	0.01	11.83	0.01	94.46
	U1520D_27F-1_85-89_17	3.59	3.37	1.07	73.42	0.11	0.08	0.97	0.04	11.78	0.01	94.44
	U1520D_27F-1_85-89_18	3.33	3.35	1.13	73.31	0.08	0.09	1.00	0.06	11.67	0.00	94.01
	U1520D_27F-1_85-89_19	3.10	3.34	1.10	72.73	0.08	0.11	0.95	0.01	11.68	0.00	93.11
	U1520D_27F-1_85-89_20	3.37	3.35	0.92	73.54	0.07	0.08	0.98	0.00	11.62	0.00	93.94
	U1520D_27F-1_96-98_1	3.62	3.31	1.21	74.00	0.09	0.12	1.04	0.06	11.91	0.00	95.36
	U1520D_27F-1_96-98_2	3.30	3.29	1.07	73.54	0.09	0.07	1.01	0.06	11.80	0.00	94.23
	U1520D_27F-1_96-98_3	1.84	3.19	1.19	72.50	0.08	0.05	1.06	0.09	11.83	0.00	91.83
	U1520D_27F-1_96-98_13	3.52	3.29	1.12	73.91	0.09	0.11	1.00	0.01	11.70	0.02	94.79
	U1520D_27F-1_96-98_14	3.58	3.25	1.08	73.41	0.09	0.13	1.08	0.00	11.87	0.00	94.50
	U1520D_27F-1_96-98_15	3.43	3.24	1.02	73.59	0.12	0.12	1.10	0.04	11.94	0.01	94.62
	U1520D_27F-1_96-98_16	3.43	3.36	1.05	73.73	0.13	0.09	1.00	0.07	11.75	0.01	94.62
	U1520D_27F-1_96-98_17	3.56	3.17	1.09	72.91	0.10	0.12	1.02	0.06	11.81	0.01	93.86
	U1520D_27F-1_96-98_18	2.63	5.39	0.78	74.21	0.15	0.09	0.38	0.09	11.83	0.02	95.56
	U1520D_27F-1_96-98_19	3.29	3.21	1.00	73.63	0.09	0.12	1.09	0.03	11.80	0.00	94.25
	U1520D_27F-1_96-98_20	3.85	3.34	1.12	73.64	0.15	0.13	1.08	0.07	12.07	0.00	95.44
	1520D_27F-1_96-98_1	3.73	3.16	1.25	73.95	0.15	0.11	1.05	0.00	11.73	0.00	95.13
	1520D_27F-1_96-98_4	3.63	3.07	1.20	72.42	0.15	0.12	1.10	0.04	11.67	0.02	93.41
u21	1520D_27F-1_96-98_6	3.63	3.22	1.04	73.86	0.11	0.14	1.06	0.00	11.71	0.00	94.77
	1520D_27F-1_96-98_9	3.71	3.23	1.27	73.33	0.15	0.15	1.11	0.00	11.73	0.02	94.70
	1520D_27F-1_96-98_10	3.62	3.16	1.14	73.23	0.14	0.08	1.06	0.01	11.79	0.00	94.23
	1520D_27F-1_96-98_2	3.68	3.32	1.25	74.08	0.13	0.10	0.97	0.03	11.65	0.02	95.24
	1520D_27F-1_96-98_3	3.77	3.14	1.19	73.14	0.13	0.14	1.10	0.02	11.88	0.01	94.51
	1520D_27F-1_96-98_5	3.94	3.17	0.98	73.32	0.17	0.16	1.06	0.07	11.81	0.03	94.71
	1520D_27F-1_96-98_7	3.74	3.25	1.12	73.26	0.15	0.13	1.07	0.04	11.91	0.01	94.68
	1520D_27F-1_96-98_8	3.45	3.28	1.03	72.83	0.15	0.08	1.08	0.04	11.54	0.04	93.52
	U1520D_27F-2_78-80_1	3.53	3.22	1.16	74.23	0.19	0.16	1.04	0.03	11.94	0.04	95.54
	U1520D_27F-2_78-80_2	3.46	3.63	0.94	74.45	0.10	0.06	0.76	0.06	11.76	0.00	95.22
	U1520D_27F-2_78-80_3	3.62	3.69	0.87	74.22	0.06	0.05	0.79	0.00	11.63	0.02	94.95
	U1520D_27F-2_78-80_4	3.67	3.57	1.00	74.11	0.06	0.09	0.78	0.05	11.61	0.00	94.94
	U1520D_27F-2_78-80_5	3.79	3.11	1.30	73.78	0.21	0.20	1.04	0.06	11.86	0.00	95.34
	U1520D_27F-2_78-80_6	3.62	3.41	0.96	72.78	0.17	0.17	0.97	0.02	11.54	0.00	93.64
	U1520D_27F-2_78-80_7	3.44	3.30	1.25	73.86	0.15	0.13	1.10	0.01	11.90	0.02	95.16
	U1520D_27F-2_78-80_8	3.26	3.76	0.92	75.09	0.07	0.06	0.82	0.05	12.11	0.01	96.15
	U1520D_27F-2_78-80_9	3.60	3.62	0.97	74.34	0.09	0.08	0.75	0.05	11.62	0.03	95.15
	U1520D_27F-2_78-80_10	3.35	3.41	0.98	74.56	0.17	0.16	0.98	0.00	11.81	0.03	95.46
	U1520D_27F-2_78-80_11	3.60	3.22	1.12	73.78	0.13	0.09	1.00	0.13	11.51	0.02	94.60
	U1520D_27F-2_78-80_12	3.77	3.63	0.97	73.94	0.09	0.10	0.67	0.05	11.71	0.00	94.93
	U1520D_27F-2_78-80_13	3.21	3.25	1.05	73.71	0.15	0.13	0.96	0.04	11.40	0.01	93.91
	U1520D_27F-2_78-80_14	3.80	3.18	1.24	72.88	0.14	0.20	1.16	0.08	11.89	0.02	94.59
	U1520D_27F-2_78-80_15	3.55	3.07	1.09	72.88	0.19	0.20	1.01	0.03	11.66	0.05	93.72
	U1520D_27F-2_78-80_16	4.16	2.44	1.55	70.39	0.27	0.39	1.72	0.10	13.15	0.05	94.21
	U1520D_27F-2_78-80_17	3.27	3.42	1.29	73.45	0.08	0.10	0.98	0.04	11.73	0.00	94.37
	U1520D_27F-2_78-80_18	3.45	3.37	1.13	74.31	0.10	0.10	0.94	0.03	11.65	0.00	95.09
	U1520D_27F-2_78-80_19	3.81	3.21	1.06	73.65	0.22	0.18	1.04	0.17	11.84	0.02	95.20
	U1520D_27F-2_78-80_20	3.65	3.23	1.06	73.53	0.20	0.13	0.95	0.09	11.76	0.03	94.63
	U1520D_27F-2_83-85_2	3.47	3.08	1.09	73.21	0.15	0.21	1.01	0.06	11.82	0.06	94.15
	U1520D_27F-2_83-85_3	3.70	3.10	1.01	74.07	0.16	0.20	1.06	0.13	11.90	0.01	95.35
	U1520D_27F-2_83-85_4	3.75	2.40	1.62	70.89	0.32	0.38	1.76	0.08	12.99	0.06	94.25
	U1520D_27F-2_83-85_5	3.37	3.27	0.94	73.95	0.13	0.11	0.92	0.06	11.59	0.03	94.37
	U1520D_27F-2_83-85_6	3.34	3.53	0.97	74.44	0.10	0.07	0.78	0.06	11.71	0.01	95.00
	U1520D_27F-2_83-85_7	3.50	3.40	0.97	74.84	0.11	0.12	0.94	0.03	11.66	0.02	95.58
	U1520D_27F-2_83-85_8	3.51	3.26	1.20	74.23	0.17	0.15	1.08	0.08	11.93	0.00	95.61
	U1520D_27F-2_83-85_9	3.67	3.20	1.10	73.61	0.17	0.14	0.95	0.01	11.95	0.01	94.81
	U1520D_27F-2_83-85_10	3.69	3.15	1.01	74.47	0.17	0.16	1.04	0.07	11.94	0.00	95.70
	U1520D_27F-2_83-85_11	3.34	3.13	0.97	74.26	0.20	0.16	1.04	0.08	11.86	0.00	95.04
	U1520D_27F-2_83-85_12	3.39	3.07	1.08	74.33	0.21	0.15	1.02	0.02	11.76	0.02	95.05
	U1520D_27F-2_83-85_13	3.54	3.09	0.86	74.32	0.18	0.14	1.03	0.10	11.61	0.02	94.90
	U1520D_27F-2_83-85_14	3.63	3.55	0.84	74.98	0.12	0.12	0.87	0.03	11.91	0.00	96.05
	U1520D_27F-2_83-85_15	3.53	3.16	1.12	73.98	0.23	0.22	1.19	0.06	12.06	0.01	95.56
	U1520D_27F-2_83-85_16	3.47	3.11	0.91	74.25	0.16	0.19	1.05	0.11	11.82	0.00	95.07
	U1520D_27F-2_83-85_17	3.80	3.23	1.18	74.74	0.22	0.15	1.03	0.09	11.97	0.02	96.44
	U1520D_27F-2_83-85_18	3.51	3.08	1.07	73.96	0.21	0.15	1.08	0.01	11.87	0.01	94.95
	U1520D_27F-2_83-85_19	3.51	3.37	1.30	73.78	0.17	0.17	1.20	0.11	11.82	0.00	95.44
	U1520D_27F-2_83-85_20	3.44	3.21	0.96	74.01	0.15	0.16	0.93	0.00	11.70	0.01	94.57
	U1520D_27F-2_88-89_1	3.82	3.08	1.00	74.09	0.19	0.15	1.04	0.08	11.83	0.05	95.34
	U1520D_27F-2_88-89_2	3.67	3.66	0.88	75.00	0.10	0.08	0.70	0.03	11.91	0.03	96.05
	U1520D_27F-2_88-89_3	3.42	3.35	1.04	72.95	0.22	0.17	0.98	0.05	11.58	0.01	93.76

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s19	U1520D_27F-2_88-89_4	3.51	3.30	1.08	74.78	0.17	0.14	1.07	0.01	11.66	0.01	95.73
	U1520D_27F-2_88-89_5	3.72	2.99	0.95	73.25	0.20	0.21	1.09	0.01	11.91	0.05	94.39
	U1520D_27F-2_88-89_6	3.47	3.51	1.02	75.13	0.10	0.08	0.84	0.05	11.89	0.05	96.14
	U1520D_27F-2_88-89_7	3.60	3.06	1.15	73.61	0.23	0.19	1.15	0.00	12.00	0.05	95.05
	U1520D_27F-2_88-89_8	3.67	3.06	1.01	73.27	0.13	0.13	0.95	0.07	11.52	0.00	93.81
	U1520D_27F-2_88-89_9	3.68	3.08	1.07	74.30	0.17	0.17	1.02	0.04	11.99	0.01	95.54
	U1520D_27F-2_88-89_10	3.78	3.20	1.07	74.35	0.09	0.10	0.89	0.01	11.86	0.02	95.38
	U1520D_27F-2_88-89_11	3.78	3.06	1.08	74.16	0.21	0.17	1.06	0.09	11.94	0.03	95.59
	U1520D_27F-2_88-89_12	3.65	3.31	1.31	74.12	0.15	0.17	1.22	0.00	12.29	0.02	96.25
	U1520D_27F-2_88-89_13	3.54	3.10	1.08	74.40	0.17	0.13	1.05	0.10	11.86	0.00	95.43
	U1520D_27F-2_88-89_14	3.85	2.92	1.07	74.30	0.20	0.18	1.08	0.10	12.12	0.00	95.82
	U1520D_27F-2_88-89_15	3.69	3.04	1.08	73.50	0.22	0.16	1.03	0.11	11.85	0.06	94.74
	U1520D_27F-2_88-89_16	3.80	3.51	0.96	74.26	0.10	0.09	0.91	0.15	11.93	0.00	95.70
	U1520D_27F-2_88-89_17	3.42	3.27	0.97	74.74	0.13	0.13	0.97	0.08	11.77	0.01	95.49
	U1520D_27F-2_88-89_18	3.54	3.00	1.08	73.33	0.19	0.16	1.10	0.08	11.90	0.02	94.40
	U1520D_27F-2_88-89_19	2.94	4.06	1.16	73.39	0.15	0.09	0.78	0.00	11.43	0.02	94.03
	U1520D_27F-2_88-89_20	3.10	2.91	1.09	73.39	0.22	0.17	1.06	0.04	11.88	0.01	93.87
	U1520D_27F-2_92-96_1	3.71	2.91	1.17	73.08	0.20	0.19	1.08	0.02	11.82	0.02	94.19
	U1520D_27F-2_92-96_2	3.41	3.14	1.10	73.98	0.15	0.17	1.09	0.05	11.72	0.01	94.83
	U1520D_27F-2_92-96_3	3.59	3.34	1.12	74.05	0.15	0.16	0.96	0.05	11.65	0.02	95.08
	U1520D_27F-2_92-96_4	3.83	3.04	1.05	73.37	0.19	0.17	1.04	0.09	12.05	0.01	94.83
	U1520D_27F-2_92-96_5	3.72	3.35	1.04	74.52	0.15	0.17	1.00	0.05	11.70	0.02	95.72
	U1520D_27F-2_92-96_6	3.64	3.19	1.18	74.00	0.16	0.13	1.13	0.04	11.84	0.03	95.35
	U1520D_27F-2_92-96_7	3.48	3.27	1.13	73.73	0.14	0.12	0.90	0.14	11.67	0.02	94.60
	U1520D_27F-2_92-96_8	3.65	3.27	0.96	73.93	0.10	0.12	0.95	0.01	11.62	0.00	94.62
	U1520D_27F-2_92-96_9	3.49	3.29	1.04	72.41	0.18	0.17	1.04	0.00	11.43	0.00	93.04
	U1520D_27F-2_92-96_10	3.85	3.07	1.11	74.02	0.19	0.16	1.02	0.05	11.89	0.02	95.37
	U1520D_27F-2_92-96_11	3.75	3.20	1.10	74.32	0.17	0.16	1.03	0.02	11.75	0.00	95.50
	U1520D_27F-2_92-96_12	3.60	3.05	1.22	73.33	0.21	0.22	1.15	0.03	11.83	0.01	94.65
	U1520D_27F-2_92-96_13	3.74	3.22	1.09	73.63	0.20	0.15	1.14	0.05	11.64	0.05	94.90
	U1520D_27F-2_92-96_14	3.40	3.29	1.23	73.58	0.17	0.14	1.07	0.00	11.83	0.01	94.72
	U1520D_27F-2_92-96_15	3.39	3.07	0.92	73.33	0.20	0.17	1.03	0.05	11.59	0.04	93.79
	U1520D_27F-2_92-96_16	3.65	3.33	1.05	73.67	0.11	0.08	0.86	0.00	11.54	0.02	94.32
	U1520D_27F-2_92-96_17	3.58	2.98	0.93	74.30	0.18	0.15	1.06	0.13	11.58	0.00	94.89
	U1520D_27F-2_92-96_18	3.65	3.06	1.16	73.27	0.16	0.20	1.11	0.07	11.77	0.00	94.45
	U1520D_27F-2_92-96_19	3.23	3.70	1.00	74.17	0.11	0.12	0.92	0.09	11.67	0.03	95.05
	U1520D_27F-2_92-96_20	3.75	3.11	1.06	73.89	0.20	0.19	1.12	0.06	11.72	0.00	95.11
	1520D_27F-2_92-96_1	3.84	2.90	1.15	72.53	0.28	0.19	1.06	0.03	11.77	0.00	93.74
	1520D_27F-2_92-96_6	3.87	3.35	0.96	74.13	0.20	0.26	1.03	0.08	11.87	0.03	95.78
	1520D_27F-2_92-96_8	3.76	3.02	1.15	73.69	0.28	0.21	1.09	0.08	11.91	0.00	95.19
	1520D_27F-2_92-96_2	3.94	3.08	1.09	74.03	0.19	0.11	0.99	0.02	11.66	0.00	95.10
	1520D_27F-2_92-96_3	3.71	3.11	0.98	73.42	0.29	0.16	1.04	0.12	11.73	0.02	94.58
	1520D_27F-2_92-96_4	3.75	3.34	0.98	74.20	0.21	0.16	0.91	0.00	11.63	0.04	95.21
	1520D_27F-2_92-96_5	3.65	3.25	1.19	73.76	0.15	0.11	1.04	0.06	11.69	0.01	94.91
	1520D_27F-2_92-96_7	3.65	3.08	1.19	73.53	0.26	0.18	1.13	0.08	11.88	0.03	95.01
	U1520D_27F-3_37-41_1	3.69	3.27	1.03	73.63	0.13	0.08	0.99	0.00	11.51	0.00	94.34
	U1520D_27F-3_37-41_2	3.71	3.67	1.10	74.08	0.12	0.04	0.76	0.03	11.76	0.00	95.27
	U1520D_27F-3_37-41_3	3.40	3.53	0.85	73.39	0.08	0.07	0.77	0.07	11.89	0.00	94.06
	U1520D_27F-3_37-41_4	3.44	3.26	1.14	73.90	0.13	0.11	0.94	0.07	11.62	0.00	94.61
	U1520D_27F-3_37-41_5	3.45	3.32	1.11	74.26	0.14	0.09	0.96	0.02	11.69	0.00	95.04
	U1520D_27F-3_37-41_6	3.99	2.35	1.60	70.82	0.31	0.39	1.89	0.06	13.39	0.06	94.86
	U1520D_27F-3_37-41_7	3.51	3.55	0.95	74.53	0.13	0.09	0.82	0.00	11.77	0.00	95.35
	U1520D_27F-3_37-41_8	3.73	3.22	1.09	74.37	0.18	0.15	1.01	0.00	11.65	0.04	95.44
	U1520D_27F-3_37-41_9	3.51	3.34	1.04	73.44	0.12	0.09	0.86	0.03	11.59	0.02	94.03
	U1520D_27F-3_37-41_10	3.59	3.26	1.00	74.10	0.10	0.10	0.91	0.05	11.76	0.01	94.87
	U1520D_27F-3_37-41_13	3.64	3.23	1.15	74.23	0.17	0.17	1.05	0.01	11.80	0.02	95.46
	U1520D_27F-3_37-41_14	3.85	3.16	1.15	74.75	0.16	0.14	1.02	0.06	11.85	0.01	96.14
	U1520D_27F-3_37-41_15	3.32	3.52	0.96	73.75	0.15	0.08	0.99	0.02	11.77	0.00	94.56
	U1520D_27F-3_37-41_16	3.79	3.15	0.94	73.85	0.19	0.19	1.09	0.06	11.76	0.01	95.02
	U1520D_27F-3_37-41_17	3.62	3.24	0.86	73.15	0.12	0.12	0.88	0.01	11.52	0.05	93.57
	U1520D_27F-3_37-41_18	3.76	3.21	0.95	74.15	0.13	0.10	0.90	0.06	11.59	0.01	94.86
	U1520D_27F-3_37-41_19	3.44	3.31	1.18	74.27	0.15	0.12	1.01	0.09	11.78	0.02	95.37
	U1520D_27F-3_37-41_20	3.95	2.99	1.24	72.36	0.22	0.20	1.27	0.03	12.19	0.04	94.49
	U1520D_27F-3_65-67_1	3.69	3.24	1.00	72.76	0.08	0.14	0.96	0.05	11.80	0.00	93.72
	U1520D_27F-3_65-67_2	3.93	2.97	1.20	73.27	0.20	0.18	1.09	0.01	11.91	0.03	94.78
	U1520D_27F-3_65-67_3	3.58	3.35	1.00	73.62	0.14	0.05	0.87	0.05	11.49	0.03	94.19
	U1520D_27F-3_65-67_4	3.42	3.33	0.98	73.45	0.12	0.11	0.96	0.04	11.85	0.00	94.27
	U1520D_27F-3_65-67_5	3.56	3.39	1.03	73.47	0.13	0.11	0.87	0.04	11.53	0.01	94.14
	U1520D_27F-3_65-67_7	3.38	3.25	1.19	73.24	0.16	0.11	1.09	0.02	11.59	0.02	94.05
	U1520D_27F-3_65-67_8	3.42	3.17	1.06	73.09	0.19	0.21	1.04	0.10	11.64	0.00	93.91

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s19	U1520D_27F-3_65-67_9	3.59	3.17	1.12	73.25	0.20	0.14	1.07	0.04	11.79	0.03	94.40
	U1520D_27F-3_65-67_10	3.76	3.41	1.23	74.39	0.09	0.11	0.90	0.00	11.81	0.01	95.72
	U1520D_27F-3_65-67_11	3.68	3.35	1.41	71.65	0.22	0.21	1.49	0.05	12.74	0.06	94.86
	U1520D_27F-3_65-67_12	3.70	3.53	0.95	73.62	0.09	0.09	0.73	0.02	11.54	0.00	94.27
	U1520D_27F-3_65-67_13	3.73	3.06	0.97	73.61	0.19	0.19	0.99	0.09	11.73	0.01	94.58
	U1520D_27F-3_65-67_14	3.50	3.18	1.22	73.57	0.14	0.17	1.04	0.02	11.83	0.03	94.70
	U1520D_27F-3_65-67_17	3.28	2.51	0.96	72.97	0.11	0.10	0.60	0.00	11.67	0.00	92.20
	U1520D_27F-3_65-67_18	3.48	3.57	1.00	74.04	0.12	0.10	0.90	0.04	11.73	0.02	95.00
	U1520D_27F-3_65-67_19	3.94	2.39	1.41	70.92	0.28	0.32	1.77	0.15	13.01	0.03	94.22
	U1520D_27F-3_65-67_20	4.07	2.39	1.55	70.46	0.31	0.43	1.80	0.19	13.27	0.04	94.51
	U1520D_27F-3_74-78_1	3.39	3.44	1.01	74.11	0.11	0.08	0.83	0.09	11.69	0.00	94.74
	U1520D_27F-3_74-78_2	3.82	3.30	1.03	74.59	0.13	0.12	0.98	0.06	11.75	0.00	95.78
	U1520D_27F-3_74-78_3	3.56	3.66	1.02	73.93	0.11	0.09	0.79	0.06	11.67	0.04	94.94
	U1520D_27F-3_74-78_4	3.67	3.09	0.98	73.42	0.20	0.17	1.09	0.01	11.89	0.02	94.54
	U1520D_27F-3_74-78_5	3.52	3.68	1.05	74.31	0.09	0.07	0.78	0.01	11.74	0.01	95.27
	U1520D_27F-3_74-78_6	3.26	3.93	0.91	74.19	0.14	0.12	0.73	0.08	11.36	0.01	94.72
	U1520D_27F-3_74-78_7	3.56	3.38	0.97	74.17	0.08	0.05	0.89	0.00	11.46	0.00	94.56
	U1520D_27F-3_74-78_8	3.81	3.00	1.09	73.17	0.16	0.17	1.13	0.05	12.04	0.02	94.64
	U1520D_27F-3_74-78_9	3.59	3.30	1.15	73.41	0.16	0.16	1.09	0.09	11.79	0.02	94.74
	U1520D_27F-3_74-78_10	3.64	3.34	1.00	73.67	0.14	0.09	0.90	0.02	11.73	0.01	94.54
	U1520D_27F-3_74-78_11	4.06	2.33	1.46	69.78	0.27	0.38	1.85	0.07	13.14	0.03	93.37
	U1520D_27F-3_74-78_12	3.65	3.47	0.96	75.09	0.13	0.13	0.96	0.04	12.13	0.01	96.57
	U1520D_27F-3_74-78_13	3.72	3.34	1.03	74.02	0.16	0.17	1.18	0.04	12.04	0.00	95.69
	U1520D_27F-3_74-78_14	3.84	3.08	1.20	72.08	0.30	0.27	1.31	0.05	12.67	0.03	94.81
	U1520D_27F-3_74-78_15	3.40	3.61	1.05	74.36	0.08	0.10	0.81	0.04	11.83	0.01	95.29
	U1520D_27F-3_74-78_16	3.64	3.09	1.15	73.08	0.18	0.14	1.11	0.05	11.96	0.03	94.43
	U1520D_27F-3_74-78_17	3.49	3.12	1.03	73.79	0.22	0.20	1.05	0.01	11.92	0.04	94.87
	U1520D_27F-3_74-78_18	3.72	2.85	1.14	74.08	0.14	0.15	0.84	0.03	11.82	0.04	94.81
	U1520D_27F-3_74-78_19	3.45	3.58	1.06	74.05	0.12	0.09	0.76	0.00	11.67	0.01	94.79
	U1520D_27F-3_74-78_20	3.48	3.23	0.93	73.14	0.13	0.06	0.95	0.06	11.73	0.02	93.73
	1520D_27F-3_74-78_3	3.73	3.04	1.10	74.10	0.30	0.18	1.07	0.02	11.91	0.01	95.45
	1520D_27F-3_74-78_7	3.87	2.94	1.16	73.34	0.26	0.16	1.15	0.07	11.99	0.03	94.97
	1520D_27F-3_74-78_8	3.93	3.03	1.05	74.20	0.29	0.20	1.06	0.05	12.02	0.01	95.85
	1520D_27F-3_74-78_1	4.05	3.05	1.23	73.65	0.24	0.18	1.06	0.06	11.76	0.02	95.28
	1520D_27F-3_74-78_4	3.67	3.27	1.12	73.39	0.30	0.16	1.00	0.07	11.68	0.02	94.67
	1520D_27F-3_74-78_6	3.76	3.01	1.01	72.69	0.25	0.19	1.00	0.03	11.63	0.04	93.61
	1520D_27F-3_74-78_9	3.81	3.53	0.84	74.59	0.17	0.06	0.92	0.11	11.86	0.02	95.90
	1520D_27F-3_74-78_10	3.87	3.08	1.00	74.30	0.22	0.17	1.00	0.06	11.78	0.01	95.48
	U1520D_28F-1_55-57_1	3.35	3.80	0.97	74.28	0.06	0.07	0.69	0.04	12.03	0.01	95.31
	U1520D_28F-1_55-57_2	3.31	4.36	1.10	74.78	0.11	0.09	0.78	0.04	11.66	0.01	96.24
	U1520D_28F-1_55-57_3	3.57	4.55	0.90	74.43	0.07	0.01	0.56	0.01	12.01	0.00	96.11
	U1520D_28F-1_55-57_4	3.32	4.13	1.19	73.95	0.15	0.06	0.77	0.01	11.58	0.00	95.16
	U1520D_28F-1_55-57_5	3.45	3.74	1.05	74.59	0.08	0.07	0.79	0.00	11.88	0.02	95.68
	U1520D_28F-1_55-57_6	3.21	4.05	0.99	74.35	0.14	0.10	0.84	0.04	11.51	0.00	95.25
	U1520D_28F-1_55-57_7	3.08	3.80	0.97	74.08	0.08	0.07	0.80	0.03	11.90	0.00	94.81
	U1520D_28F-1_55-57_8	0.89	3.63	1.22	72.89	0.10	0.01	1.15	0.00	11.63	0.00	91.52
	U1520D_28F-1_55-57_11	2.97	4.29	0.96	74.31	0.14	0.10	0.78	0.02	11.98	0.00	95.56
	U1520D_28F-1_55-57_12	3.58	4.16	1.21	73.96	0.09	0.10	0.78	0.01	11.64	0.00	95.53
	U1520D_28F-1_55-57_13	3.54	4.12	1.17	74.67	0.10	0.07	0.71	0.04	11.94	0.01	96.37
	U1520D_28F-1_55-57_14	3.24	4.13	1.02	73.26	0.12	0.10	0.79	0.02	11.70	0.04	94.44
	U1520D_28F-1_55-57_15	3.25	4.20	0.91	74.18	0.12	0.09	0.75	0.00	11.60	0.00	95.09
	U1520D_28F-1_55-57_16	3.64	3.07	1.26	74.37	0.16	0.11	1.24	0.06	11.64	0.01	95.57
	U1520D_28F-1_55-57_17	3.35	4.25	1.02	74.31	0.11	0.14	0.83	0.00	11.85	0.01	95.87
	U1520D_28F-1_55-57_18	3.33	4.15	1.03	73.81	0.15	0.14	0.81	0.00	11.80	0.00	95.22
	U1520D_28F-1_55-57_19	2.76	4.31	1.03	75.45	0.17	0.08	0.96	0.00	11.77	0.03	96.56
	U1520D_28F-1_55-57_20	3.57	4.28	0.89	74.18	0.09	0.05	0.60	0.10	11.64	0.02	95.42
	1520D_28F-1_55-57_2	3.48	4.08	1.03	73.25	0.21	0.06	0.81	0.02	11.68	0.03	94.65
	1520D_28F-1_55-57_10	2.77	4.33	1.05	75.42	0.19	0.12	0.95	0.04	11.77	0.00	96.63
	1520D_28F-1_55-57_3	3.42	3.97	1.08	73.00	0.17	0.08	0.83	0.00	11.74	0.03	94.34
	1520D_28F-1_55-57_5	3.12	4.11	1.10	73.57	0.20	0.06	0.75	0.04	11.68	0.00	94.62
	1520D_28F-1_55-57_9	3.54	4.23	1.02	74.36	0.14	0.15	0.78	0.08	11.83	0.00	96.14
	1520D_28F-1_55-57_1	3.69	3.94	1.03	74.88	0.19	0.09	0.78	0.08	11.60	0.00	96.28
	1520D_28F-1_55-57_4	3.40	4.60	1.29	73.56	0.25	0.06	0.86	0.06	12.70	0.02	96.80
	1520D_28F-1_55-57_7	3.74	4.38	0.95	70.10	0.11	0.02	0.53	0.03	11.86	0.00	91.72
	U1520D_28F-1_75-77_1	2.90	4.44	0.93	74.31	0.15	0.11	0.73	0.08	11.85	0.06	95.57
	U1520D_28F-1_75-77_2	3.63	3.72	0.95	73.93	0.08	0.06	0.75	0.00	11.81	0.01	94.94
	U1520D_28F-1_75-77_3	3.40	3.68	0.85	73.67	0.09	0.07	0.75	0.09	11.47	0.01	94.09
	U1520D_28F-1_75-77_4	3.14	4.29	0.94	74.85	0.13	0.09	0.82	0.04	11.84	0.01	96.15
	U1520D_28F-1_75-77_5	3.39	3.76	0.85	73.07	0.08	0.05	0.73	0.02	11.64	0.03	93.63
	U1520D_28F-1_75-77_6	3.39	3.72	0.97	74.02	0.09	0.06	0.75	0.08	11.92	0.01	95.00

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s20	U1520D_28F-1_75-77_7	3.42	3.62	0.85	74.22	0.11	0.07	0.79	0.06	11.85	0.00	94.99
	U1520D_28F-1_75-77_8	3.61	3.60	1.18	72.77	0.16	0.10	0.89	0.04	12.06	0.04	94.45
	U1520D_28F-1_75-77_9	3.24	4.23	1.01	73.03	0.12	0.09	0.78	0.00	11.69	0.01	94.20
	U1520D_28F-1_75-77_10	3.34	3.71	0.97	73.43	0.06	0.05	0.75	0.08	11.75	0.00	94.15
	U1520D_28F-1_75-77_11	3.46	4.16	1.08	73.77	0.11	0.10	0.77	0.05	11.71	0.00	95.22
	U1520D_28F-1_75-77_12	3.31	4.24	1.05	73.46	0.13	0.09	0.79	0.05	11.54	0.00	94.67
	U1520D_28F-1_75-77_13	3.28	3.73	0.95	72.98	0.07	0.09	0.75	0.02	11.54	0.02	93.43
	U1520D_28F-1_75-77_14	3.52	3.69	0.99	73.65	0.05	0.08	0.71	0.08	11.86	0.01	94.64
	U1520D_28F-1_75-77_15	3.51	3.64	0.95	73.22	0.09	0.05	0.81	0.04	11.85	0.01	94.17
	U1520D_28F-1_75-77_16	3.73	3.65	1.04	74.14	0.05	0.06	0.77	0.03	11.80	0.03	95.31
	U1520D_28F-1_75-77_17	3.37	3.74	0.92	73.31	0.05	0.05	0.76	0.06	11.78	0.03	94.07
	U1520D_28F-1_75-77_18	3.49	3.72	1.01	73.22	0.06	0.07	0.74	0.06	11.76	0.00	94.13
	U1520D_28F-1_75-77_19	3.73	3.82	0.93	74.46	0.08	0.04	0.76	0.03	11.94	0.00	95.80
	U1520D_28F-1_75-77_20	3.53	3.71	0.96	73.39	0.07	0.08	0.77	0.10	11.60	0.03	94.24
	U1520D_28F-1_93-95_1	3.92	2.97	1.56	72.07	0.19	0.16	1.04	0.04	12.28	0.07	94.30
	U1520D_28F-1_93-95_2	3.10	4.22	1.13	74.72	0.15	0.09	0.83	0.01	12.05	0.02	96.32
	U1520D_28F-1_93-95_3	3.50	3.87	0.71	74.53	0.06	0.05	0.72	0.03	11.98	0.01	95.46
	U1520D_28F-1_93-95_4	3.15	4.29	1.08	75.37	0.15	0.08	0.82	0.10	11.75	0.01	96.81
	U1520D_28F-1_93-95_5	3.42	4.15	1.18	74.67	0.12	0.11	0.84	0.04	11.88	0.02	96.44
	U1520D_28F-1_93-95_6	3.32	4.13	1.07	74.68	0.12	0.13	0.79	0.04	11.68	0.00	95.95
s21*	U1520D_28F-1_93-95_7	3.01	4.37	0.89	75.84	0.11	0.05	0.74	0.08	12.16	0.02	97.27
	U1520D_28F-1_93-95_8	3.32	3.85	1.17	73.76	0.08	0.08	0.89	0.02	11.83	0.02	95.02
	U1520D_28F-1_93-95_9	3.64	2.57	1.16	71.87	0.24	0.19	1.32	0.07	12.04	0.04	93.14
	U1520D_28F-1_93-95_10	3.18	4.30	0.99	74.77	0.14	0.11	0.81	0.00	11.96	0.00	96.25
	U1520D_28F-1_93-95_11	3.59	3.70	0.99	75.17	0.10	0.10	0.88	0.08	11.73	0.02	96.36
	U1520D_28F-1_93-95_12	3.07	4.33	0.52	75.87	0.15	0.04	0.76	0.02	11.68	0.00	96.44
	U1520D_28F-1_93-95_13	2.86	4.35	1.10	75.13	0.15	0.07	0.82	0.06	11.96	0.00	96.49
	U1520D_28F-1_93-95_14	3.38	3.52	1.09	74.02	0.06	0.08	0.80	0.09	11.92	0.00	94.97
	U1520D_28F-1_93-95_15	3.08	4.23	1.19	74.42	0.13	0.11	0.82	0.01	11.85	0.02	95.86
	U1520D_28F-1_93-95_16	3.05	3.52	0.95	70.70	0.09	0.14	0.94	0.06	11.01	0.00	90.46
	U1520D_28F-1_93-95_17	3.43	3.53	1.17	73.67	0.12	0.07	0.83	0.00	11.57	0.02	94.41
	U1520D_28F-1_93-95_18	2.73	4.02	1.58	72.74	0.14	0.09	1.04	0.00	11.93	0.00	94.27
	U1520D_28F-1_93-95_19	3.13	4.31	1.16	75.44	0.12	0.10	0.85	0.04	11.77	0.03	96.95
	U1520D_28F-1_93-95_20	3.41	3.76	1.07	73.69	0.16	0.12	0.84	0.04	11.40	0.02	94.51
	1520D_28F-1_93-95_1	3.43	3.68	1.10	73.70	0.15	0.06	0.91	0.00	11.84	0.00	94.87
	1520D_28F-1_93-95_4	3.40	3.87	0.77	74.17	0.10	0.03	0.76	0.02	12.00	0.01	95.12
	1520D_28F-1_93-95_3	3.33	4.27	1.03	75.75	0.15	0.13	0.79	0.00	12.02	0.00	97.47
	1520D_28F-1_93-95_8	3.74	3.19	1.13	73.59	0.11	0.11	0.92	0.09	11.55	0.04	94.46
	1520D_28F-1_93-95_9	3.01	4.32	1.03	74.77	0.23	0.13	0.78	0.00	11.66	0.00	95.92
	1520D_28F-1_93-95_2	3.40	4.07	1.03	73.92	0.16	0.09	0.81	0.10	11.62	0.01	95.20
s21*	1520D_28F-1_93-95_5	3.53	4.43	0.54	75.42	0.17	0.00	0.70	0.00	11.99	0.00	96.79
	1520D_28F-1_93-95_6	3.67	3.76	1.07	74.70	0.11	0.06	0.77	0.05	12.01	0.00	96.20
	1520D_28F-1_93-95_10	3.21	4.32	1.12	75.17	0.16	0.07	0.83	0.04	12.03	0.00	96.95
	U1520D_28F-3_13-15_1	3.74	3.17	1.57	72.98	0.07	0.04	0.93	0.09	11.80	0.01	94.38
	U1520D_28F-3_13-15_2	3.09	4.24	1.04	74.79	0.14	0.09	0.81	0.01	11.63	0.00	95.85
	U1520D_28F-3_13-15_3	3.21	4.22	1.09	73.97	0.13	0.10	0.77	0.07	11.59	0.03	95.16
	U1520D_28F-3_13-15_4	3.25	4.15	1.12	73.81	0.14	0.12	0.77	0.01	11.55	0.01	94.94
	U1520D_28F-3_13-15_5	3.34	4.29	1.06	74.71	0.13	0.10	0.77	0.06	11.81	0.04	96.31
	U1520D_33X-3_40-42_3	3.76	3.44	1.03	72.71	0.13	0.11	0.91	0.04	11.60	0.01	93.73
	U1520D_33X-3_40-42_4	4.36	3.02	1.57	73.56	0.14	0.05	0.85	0.12	11.95	0.01	95.63
	U1520D_33X-3_40-42_5	3.86	3.13	1.40	71.87	0.16	0.11	0.97	0.11	12.54	0.02	94.17
	U1520D_33X-3_40-42_6	4.19	2.92	1.80	71.13	0.23	0.19	1.14	0.02	12.62	0.03	94.28
	U1520D_33X-3_40-42_7	3.16	3.45	1.19	73.96	0.07	0.12	1.08	0.04	11.75	0.01	94.82
	U1520D_33X-3_40-42_8	3.72	3.70	1.10	74.37	0.09	0.10	0.82	0.06	12.03	0.00	96.00
	U1520D_33X-3_40-42_9	3.89	3.49	1.33	73.45	0.16	0.07	0.80	0.06	11.74	0.02	95.01
	U1520D_33X-3_40-42_10	3.56	3.45	1.34	72.96	0.18	0.06	0.90	0.05	11.78	0.01	94.28
	U1520D_33X-3_60-62_1	3.91	3.41	1.39	73.48	0.16	0.11	1.01	0.06	11.66	0.03	95.22
	U1520D_33X-3_60-62_2	3.38	4.32	0.66	73.83	0.06	0.03	0.62	0.06	11.94	0.04	94.94
	U1520D_33X-3_60-62_3	3.75	3.36	1.40	73.35	0.20	0.16	1.14	0.04	12.24	0.03	95.66
	U1520D_33X-3_60-62_4	4.24	2.35	3.03	68.19	0.53	0.62	2.61	0.11	13.68	0.13	95.48
	U1520D_33X-3_60-62_5	3.76	3.38	1.54	72.87	0.16	0.14	0.92	0.11	11.61	0.00	94.49
	U1520D_33X-3_60-62_6	3.94	3.24	1.48	71.85	0.16	0.21	1.28	0.11	12.68	0.00	94.95
	U1520D_33X-3_60-62_7	4.28	2.95	1.80	72.40	0.20	0.13	1.05	0.05	12.41	0.02	95.29
	U1520D_33X-3_60-62_8	3.43	3.95	1.33	72.12	0.17	0.22	1.17	0.07	12.47	0.04	94.98
	U1520D_33X-3_60-62_9	3.15	3.27	1.19	73.47	0.18	0.15	1.24	0.08	11.64	0.00	94.36
	U1520D_33X-3_60-62_10	3.53	4.05	1.44	71.40	0.18	0.25	1.20	0.07	12.83	0.00	94.95
	U1520D_33X-3_60-62_11	4.10	2.96	1.63	71.04	0.32	0.24	1.33	0.08	12.73	0.05	94.48
	U1520D_33X-3_60-62_12	4.09	3.20	1.63	72.55	0.25	0.15	1.02	0.05	12.35	0.01	95.31
	U1520D_33X-3_60-62_13	4.00	3.14	1.70	71.91	0.17	0.15	1.11	0.03	12.37	0.00	94.58
	U1520D_33X-3_60-62_14	4.11	2.88	1.88	70.24	0.30	0.31	1.58	0.00	13.19	0.03	94.52

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s23*	U1520D_33X-3_60-62_15	4.25	2.90	2.16	70.29	0.44	0.45	1.75	0.08	13.23	0.00	95.55
	U1520D_33X-3_60-62_16	3.09	3.40	1.33	73.75	0.13	0.15	1.34	0.05	11.94	0.01	95.19
	U1520D_33X-3_60-62_17	3.39	3.52	1.04	73.94	0.12	0.12	0.92	0.05	11.69	0.05	94.83
	U1520D_33X-3_60-62_18	3.95	3.37	1.72	71.55	0.22	0.25	1.26	0.04	12.80	0.02	95.18
	U1520D_33X-3_60-62_19	3.98	3.23	1.46	72.59	0.18	0.20	1.20	0.01	12.26	0.02	95.12
	U1520D_33X-3_60-62_20	3.48	3.53	1.01	73.65	0.13	0.10	0.86	0.00	11.35	0.00	94.11
	1520D_33X-3_60-62_1	3.72	3.74	1.02	74.66	0.13	0.09	0.83	0.00	11.91	0.00	96.10
	1520D_33X-3_60-62_2	3.69	3.43	1.25	72.47	0.23	0.14	0.98	0.00	12.03	0.00	94.21
	1520D_33X-3_60-62_6	3.97	3.31	1.35	74.07	0.17	0.07	0.80	0.03	11.52	0.04	95.32
	1520D_33X-3_60-62_7	2.99	3.57	0.87	71.42	0.20	0.11	0.89	0.04	11.25	0.02	91.37
	1520D_33X-3_60-62_4	3.84	3.58	1.08	74.82	0.16	0.06	0.78	0.10	11.66	0.00	96.08
	1520D_33X-3_60-62_3	4.07	3.20	1.40	73.77	0.18	0.05	0.89	0.04	12.11	0.00	95.72
	1520D_33X-3_60-62_5	4.27	2.95	1.75	71.63	0.35	0.23	1.37	0.03	12.67	0.02	95.28
	U1520D_35X-7_56-58_1	4.15	3.05	1.23	72.83	0.13	0.09	0.92	0.11	12.14	0.02	94.68
	U1520D_35X-7_56-58_2	4.53	2.85	2.30	70.69	0.14	0.14	1.26	0.06	12.90	0.01	94.88
	U1520D_35X-7_56-58_3	4.25	2.69	2.01	70.92	0.34	0.33	1.71	0.10	13.09	0.05	95.49
	U1520D_35X-7_56-58_4	3.78	3.24	1.16	73.69	0.12	0.10	0.96	0.03	11.77	0.01	94.86
	U1520D_35X-7_56-58_5	3.81	4.14	1.67	71.51	0.11	0.07	0.81	0.00	12.46	0.01	94.58
	U1520D_35X-7_56-58_6	3.95	3.15	1.38	72.72	0.19	0.08	0.82	0.11	11.93	0.00	94.33
	U1520D_35X-7_56-58_7	3.36	3.46	1.08	73.13	0.17	0.14	1.01	0.00	11.73	0.03	94.11
	U1520D_35X-7_56-58_8	4.06	3.42	1.51	72.83	0.11	0.03	0.78	0.09	11.87	0.00	94.70
	U1520D_35X-7_56-58_9	4.08	3.36	1.50	72.78	0.09	0.02	0.73	0.07	11.79	0.01	94.44
	U1520D_35X-7_56-58_10	3.99	3.46	2.22	70.98	0.32	0.25	1.36	0.03	12.59	0.05	95.25
	U1520D_35X-7_56-58_11	3.19	3.62	0.95	73.17	0.13	0.08	1.00	0.00	11.60	0.04	93.79
	U1520D_35X-7_56-58_12	4.34	3.18	1.71	70.78	0.13	0.10	1.02	0.09	12.10	0.03	93.48
	U1520D_35X-7_56-58_14	4.07	3.18	1.58	71.28	0.22	0.11	0.94	0.07	12.02	0.00	93.47
	U1520D_35X-7_56-58_15	4.19	3.14	1.66	72.42	0.21	0.14	1.00	0.11	12.06	0.04	94.97
	U1520D_35X-7_56-58_16	3.63	3.23	1.22	73.48	0.08	0.06	0.80	0.03	11.44	0.00	93.97
	U1520D_35X-7_56-58_18	4.36	3.16	1.52	72.52	0.18	0.14	1.13	0.02	12.45	0.01	95.49
	U1520D_35X-7_56-58_19	4.43	3.18	1.97	70.04	0.18	0.08	0.94	0.14	12.74	0.00	93.70
	U1520D_35X-7_56-58_20	3.92	2.84	1.93	69.90	0.20	0.17	1.15	0.09	12.58	0.01	92.79
	U1520D_35X-7_72-74_1	4.01	2.84	2.19	68.30	0.36	0.42	1.89	0.08	13.30	0.04	93.42
	U1520D_35X-7_72-74_2	3.74	3.24	1.47	71.88	0.15	0.07	0.99	0.07	12.29	0.02	93.92
	U1520D_35X-7_72-74_3	3.66	3.36	1.43	72.33	0.12	0.10	0.87	0.01	11.82	0.00	93.70
	U1520D_35X-7_72-74_4	4.16	3.05	1.86	70.89	0.24	0.20	1.04	0.14	12.30	0.02	93.90
	U1520D_35X-7_72-74_5	4.31	3.20	1.53	71.72	0.13	0.11	0.99	0.05	12.30	0.00	94.34
	U1520D_35X-7_72-74_6	3.75	3.39	1.15	72.48	0.10	0.11	0.88	0.06	11.87	0.00	93.79
	U1520D_35X-7_72-74_7	3.77	3.20	1.70	71.30	0.20	0.17	1.14	0.03	12.20	0.04	93.75
	U1520D_35X-7_72-74_8	3.84	3.16	1.64	71.19	0.16	0.12	1.06	0.06	12.35	0.06	93.65
	U1520D_35X-7_72-74_9	3.59	3.41	1.48	72.03	0.17	0.11	1.12	0.00	12.07	0.01	93.99
	U1520D_35X-7_72-74_10	3.77	3.33	1.30	72.20	0.12	0.08	0.87	0.04	12.08	0.00	93.79
	U1520D_35X-7_72-74_11	3.37	3.35	1.30	69.39	0.15	0.11	1.08	0.04	11.95	0.01	90.75
	U1520D_35X-7_72-74_12	3.83	3.23	1.46	70.83	0.13	0.09	0.96	0.11	12.41	0.00	93.05
	U1520D_35X-7_72-74_14	4.10	3.14	1.49	71.37	0.17	0.11	1.02	0.05	12.47	0.00	93.91
	U1520D_35X-7_72-74_15	4.08	2.79	2.44	66.03	0.41	0.38	1.95	0.06	13.54	0.05	91.74
	U1520D_35X-7_72-74_16	3.96	3.32	1.44	69.04	0.17	0.09	0.97	0.08	12.41	0.03	91.51
	U1520D_35X-7_72-74_18	4.05	2.98	2.24	70.10	0.26	0.26	1.59	0.08	13.32	0.04	94.92
	U1520D_35X-7_72-74_20	3.93	3.12	1.49	71.92	0.14	0.09	1.01	0.11	12.18	0.00	93.99
	U1520D_35X-7_72-74_1	3.96	3.42	1.29	72.00	0.14	0.10	1.00	0.04	12.28	0.01	94.24
	U1520D_35X-7_72-74_4	3.95	3.31	1.36	72.04	0.11	0.09	0.89	0.03	12.02	0.02	93.82
	U1520D_35X-7_72-74_6	4.47	3.45	1.34	74.74	0.13	0.13	0.86	0.01	12.32	0.01	97.45
	U1520D_35X-7_72-743_9	3.77	3.63	1.37	69.94	0.14	0.09	0.96	0.06	11.92	0.02	91.89
	U1520D_35X-7_72-74_3	3.90	3.12	1.42	71.78	0.15	0.14	0.95	0.05	12.02	0.00	93.53
	U1520D_35X-7_72-74_5	3.89	3.44	1.42	72.61	0.16	0.13	1.04	0.08	12.56	0.00	95.33
	U1520D_35X-7_72-74_7	3.98	3.41	1.37	73.36	0.12	0.05	0.79	0.10	12.14	0.01	95.33
	U1520D_35X-7_72-74_10	3.98	3.41	1.20	72.81	0.10	0.09	0.83	0.00	11.98	0.03	94.43
s23*	U1520D_35X-7_86-88_1	4.54	2.71	2.33	69.11	0.40	0.39	1.72	0.09	13.03	0.05	94.38
	U1520D_35X-7_86-88_2	3.24	3.60	1.09	73.01	0.15	0.14	0.99	0.03	11.58	0.00	93.82
	U1520D_35X-7_86-88_3	3.31	3.70	1.01	72.99	0.11	0.11	0.95	0.00	11.75	0.04	93.98
	U1520D_35X-7_86-88_4	3.10	3.79	1.04	73.81	0.08	0.08	1.11	0.08	12.04	0.00	95.14
	U1520D_35X-7_86-88_5	3.43	3.60	1.04	73.43	0.11	0.11	0.95	0.02	11.81	0.00	94.51
	U1520D_35X-7_86-88_6	3.44	3.69	0.95	73.16	0.09	0.14	0.98	0.06	11.67	0.03	94.21
	U1520D_35X-7_86-88_7	3.42	3.74	1.19	73.60	0.14	0.15	0.98	0.03	11.96	0.00	95.21
	U1520D_35X-7_86-88_8	3.01	3.57	1.08	72.34	0.14	0.11	0.98	0.12	11.65	0.03	93.04
	U1520D_35X-7_86-88_9	3.37	3.60	1.17	73.49	0.11	0.09	1.01	0.04	11.71	0.00	94.59
	U1520D_35X-7_86-88_10	2.91	3.88	1.11	73.42	0.10	0.12	0.84	0.05	11.48	0.03	93.93
	U1520D_35X-7_86-88_11	3.99	2.80	1.73	70.06	0.20	0.16	1.00	0.04	12.20	0.04	92.22
	U1520D_35X-7_86-88_12	3.13	3.65	0.86	72.58	0.08	0.13	1.04	0.00	11.91	0.00	93.38
	U1520D_35X-7_86-88_13	3.36	3.59	1.04	73.11	0.12	0.14	0.93	0.01	11.86	0.05	94.22
	U1520D_35X-7_86-88_15	3.26	3.72	1.02	74.22	0.10	0.10	1.01	0.05	11.55	0.04	95.07

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s28	U1520D_35X-7_86-88_16	3.62	3.72	1.02	74.00	0.10	0.09	0.92	0.01	11.96	0.00	95.44
	U1520D_35X-7_86-88_17	3.37	3.97	0.78	74.21	0.14	0.04	0.80	0.04	12.15	0.00	95.49
	U1520D_35X-7_86-88_18	4.17	2.90	1.82	71.08	0.24	0.21	1.25	0.10	12.63	0.04	94.45
	U1520D_35X-7_86-88_19	3.86	3.81	1.11	73.64	0.10	0.11	0.77	0.05	11.99	0.04	95.48
	U1520D_35X-7_86-88_20	3.88	3.29	1.39	72.21	0.21	0.17	1.00	0.03	12.39	0.04	94.60
	U1520D_35X-CC_2-4_1	3.29	3.69	1.10	73.64	0.11	0.11	0.95	0.06	11.70	0.03	94.68
	U1520D_35X-CC_2-4_2	3.30	3.70	1.05	74.63	0.13	0.12	0.96	0.07	11.53	0.01	95.51
	U1520D_35X-CC_2-4_3	3.21	3.66	1.14	73.76	0.11	0.12	1.01	0.00	11.55	0.00	94.56
	U1520D_35X-CC_2-4_4	3.11	3.89	1.05	74.54	0.13	0.08	1.03	0.07	11.77	0.01	95.68
	U1520D_35X-CC_2-4_5	3.25	3.63	0.97	73.75	0.13	0.17	1.00	0.00	11.58	0.00	94.48
	U1520D_35X-CC_2-4_6	3.06	3.61	1.02	73.76	0.09	0.14	0.93	0.02	11.59	0.04	94.25
	U1520D_35X-CC_2-4_7	3.16	3.84	1.04	74.49	0.13	0.12	0.96	0.07	11.87	0.00	95.69
	U1520D_35X-CC_2-4_8	3.15	3.73	0.97	72.34	0.13	0.13	0.81	0.05	11.11	0.04	92.46
	U1520D_35X-CC_2-4_9	3.16	3.64	1.09	73.26	0.12	0.13	1.01	0.02	11.51	0.00	93.95
	U1520D_35X-CC_2-4_11	3.02	3.67	1.18	73.60	0.15	0.13	1.00	0.05	11.62	0.00	94.41
	U1520D_35X-CC_2-4_12	3.20	3.64	1.01	74.20	0.13	0.11	0.97	0.02	11.53	0.00	94.81
	U1520D_35X-CC_2-4_13	3.13	3.73	0.99	73.89	0.12	0.12	0.96	0.04	11.63	0.00	94.62
	U1520D_35X-CC_2-4_14	3.16	3.83	1.12	74.19	0.14	0.11	1.05	0.02	11.59	0.04	95.24
	U1520D_35X-CC_2-4_15	3.08	3.89	1.02	74.66	0.12	0.11	0.95	0.00	11.55	0.04	95.42
	U1520D_35X-CC_2-4_16	3.23	3.84	1.01	74.87	0.15	0.11	0.98	0.05	11.78	0.00	96.03
	U1520D_35X-CC_2-4_17	3.24	3.61	1.11	73.41	0.08	0.13	1.19	0.06	12.04	0.02	94.89
	U1520D_35X-CC_2-4_18	3.24	3.76	1.05	74.46	0.13	0.09	0.93	0.01	11.68	0.00	95.35
	U1520D_35X-CC_2-4_19	3.12	3.74	0.94	74.25	0.13	0.12	0.98	0.00	11.57	0.04	94.89
	U1520D_35X-CC_2-4_20	3.30	3.85	1.02	73.82	0.10	0.14	0.97	0.09	11.65	0.00	94.93
	1520D_35X-CC_2-5_2	3.44	3.73	1.09	73.23	0.22	0.10	0.94	0.04	11.82	0.02	94.64
	1520D_35X-CC_2-5_5	3.34	3.84	1.03	73.25	0.16	0.10	0.98	0.06	11.73	0.00	94.50
	1520D_35X-CC_2-5_6	3.42	3.77	1.10	73.88	0.21	0.15	0.97	0.05	11.84	0.00	95.39
	1520D_35X-CC_2-5_10	3.44	3.81	1.14	73.87	0.20	0.13	0.97	0.04	11.60	0.01	95.22
	1520D_35X-CC_2-4_1	3.19	3.77	1.07	73.67	0.16	0.11	0.95	0.00	11.63	0.00	94.55
	1520D_35X-CC_2-5_8	3.12	3.76	0.98	73.09	0.17	0.13	0.97	0.08	11.79	0.00	94.10
s33	U1520D_38X-CC_37-39_1	4.31	3.10	1.95	69.17	0.29	0.21	1.25	0.10	12.97	0.02	93.36
	U1520D_38X-CC_37-39_2	3.99	2.96	1.83	68.64	0.28	0.25	1.30	0.08	12.60	0.03	91.96
	U1520D_38X-CC_37-39_3	4.43	2.96	1.95	70.07	0.29	0.25	1.35	0.05	12.80	0.02	94.16
	U1520D_38X-CC_37-39_4	3.68	3.39	1.23	68.85	0.13	0.06	0.76	0.05	11.38	0.00	89.53
	U1520D_38X-CC_37-39_5	4.40	3.01	2.04	70.28	0.29	0.22	1.33	0.13	12.95	0.03	94.68
	U1520D_38X-CC_37-39_6	4.20	2.98	1.74	70.41	0.27	0.28	1.32	0.04	12.91	0.02	94.17
	U1520D_38X-CC_37-39_7	4.11	3.02	1.88	68.04	0.24	0.23	1.23	0.05	12.80	0.00	91.60
	U1520D_38X-CC_37-39_8	4.23	3.02	1.77	71.62	0.33	0.24	1.28	0.03	12.77	0.01	95.31
	U1520D_38X-CC_37-39_9	4.13	3.02	1.74	68.59	0.33	0.18	1.28	0.07	12.69	0.03	92.07
	U1520D_38X-CC_37-39_10	4.08	3.09	1.84	67.40	0.29	0.23	1.25	0.08	12.97	0.04	91.28
	U1520D_38X-CC_37-39_11	3.82	3.01	2.02	66.53	0.27	0.30	1.31	0.09	12.77	0.04	90.17
	U1520D_38X-CC_37-39_12	4.20	3.02	1.88	70.04	0.30	0.23	1.21	0.02	12.78	0.04	93.72
	U1520D_38X-CC_37-39_13	3.78	3.46	1.36	71.56	0.16	0.14	1.05	0.02	12.27	0.00	93.81
	U1520D_38X-CC_37-39_15	4.04	2.89	2.00	68.50	0.30	0.22	1.47	0.03	12.66	0.00	92.11
	U1520D_38X-CC_37-39_16	3.85	3.19	1.43	69.64	0.23	0.14	1.02	0.12	12.28	0.02	91.92
	U1520D_38X-CC_37-39_17	4.39	2.94	1.77	70.36	0.30	0.26	1.32	0.08	12.86	0.06	94.33
	U1520D_38X-CC_37-39_18	4.24	2.94	1.78	71.11	0.28	0.28	1.21	0.06	12.50	0.05	94.46
	U1520D_38X-CC_37-39_19	4.03	2.96	1.84	70.42	0.28	0.31	1.32	0.08	12.76	0.00	94.01
	U1520D_38X-CC_37-39_20	4.18	3.03	2.02	70.79	0.30	0.26	1.31	0.03	12.67	0.05	94.64
	1520D_38X-CC_37-39_9	3.91	3.22	1.44	71.17	0.23	0.16	0.74	0.01	11.88	0.03	92.78
	1520D_38X-CC_37-39_10	3.61	2.92	1.19	71.30	0.15	0.06	0.90	0.01	11.54	0.02	91.70
	1520D_38X-CC_37-39_4	3.29	3.89	1.55	72.71	0.22	0.08	0.85	0.12	12.22	0.01	94.93
	1520D_38X-CC_37-39_3	4.07	2.88	1.82	66.20	0.44	0.27	1.51	0.06	12.22	0.04	89.52
	1520D_38X-CC_37-39_5	4.35	2.95	1.88	71.15	0.41	0.23	1.43	0.02	12.62	0.02	95.06
	1520D_38X-CC_37-39_1	4.29	2.88	1.88	68.87	0.36	0.25	1.24	0.08	12.59	0.05	92.49
	1520D_38X-CC_37-39_2	4.29	2.97	1.76	69.98	0.35	0.23	1.23	0.02	12.59	0.01	93.44
	1520D_38X-CC_37-39_7	4.39	3.00	1.79	71.01	0.42	0.22	1.22	0.08	12.63	0.05	94.81
	U1520D_39X-2_43-45_1	3.85	3.17	1.30	73.50	0.15	0.10	0.90	0.04	11.85	0.04	94.90
	U1520D_39X-2_43-45_2	3.93	3.15	1.47	72.91	0.16	0.09	0.91	0.04	11.98	0.02	94.65
	U1520D_39X-2_43-45_3	3.65	3.33	1.33	73.43	0.17	0.06	0.91	0.03	11.96	0.00	94.87
	U1520D_39X-2_43-45_4	3.70	3.15	1.35	72.59	0.15	0.11	0.88	0.05	11.89	0.03	93.90
	U1520D_39X-2_43-45_5	3.49	3.25	1.34	73.70	0.12	0.10	0.76	0.07	11.35	0.01	94.19
	U1520D_39X-2_43-45_6	3.65	3.29	1.29	73.26	0.12	0.11	0.88	0.03	11.84	0.01	94.47
	U1520D_39X-2_43-45_7	3.78	3.15	1.40	72.81	0.14	0.09	0.88	0.06	11.85	0.01	94.17
	U1520D_39X-2_43-45_8	3.79	3.47	1.44	74.25	0.12	0.12	0.91	0.03	11.85	0.00	95.98
	U1520D_39X-2_43-45_9	3.79	3.23	1.22	73.14	0.14	0.11	0.93	0.02	11.80	0.02	94.40
	U1520D_39X-2_43-45_10	3.93	3.33	1.37	73.90	0.14	0.08	0.83	0.00	11.38	0.02	94.97
	U1520D_39X-2_43-45_11	3.85	3.12	1.39	73.02	0.13	0.10	0.91	0.04	11.74	0.02	94.32
	U1520D_39X-2_43-45_12	3.33	3.43	1.15	73.24	0.13	0.07	0.76	0.04	11.08	0.00	93.23
	U1520D_39X-2_43-45_13	3.96	3.21	1.44	72.76	0.14	0.08	0.90	0.01	11.97	0.00	94.47

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	U1520D_39X-2_43-45_14	3.68	3.57	1.11	73.57	0.12	0.05	0.66	0.01	11.55	0.01	94.32
	U1520D_39X-2_43-45_15	3.69	3.69	1.23	74.06	0.13	0.10	0.78	0.05	11.51	0.00	95.25
	U1520D_39X-2_43-45_16	3.90	3.11	1.28	73.16	0.13	0.07	0.91	0.07	11.73	0.02	94.39
	U1520D_39X-2_43-45_17	4.00	3.26	1.42	72.93	0.17	0.07	0.92	0.07	11.88	0.00	94.72
	U1520D_39X-2_43-45_18	3.88	3.25	1.38	73.39	0.14	0.12	0.90	0.08	11.84	0.00	94.98
	U1520D_39X-2_43-45_19	4.04	3.21	1.30	73.01	0.12	0.08	0.93	0.04	11.63	0.00	94.36
	U1520D_39X-2_43-45_20	3.60	3.29	1.26	73.81	0.13	0.06	0.77	0.04	11.47	0.02	94.45
	1520D_39X-2_43-45_2	4.00	3.13	1.41	72.42	0.15	0.11	0.91	0.01	11.92	0.00	94.05
	1520D_39X-2_43-45_3	4.05	3.20	1.45	72.32	0.22	0.10	0.88	0.07	12.06	0.03	94.38
	1520D_39X-2_43-45_5	3.90	2.99	1.31	72.08	0.19	0.08	0.88	0.01	11.91	0.00	93.35
	1520D_39X-2_43-45_6	3.98	3.24	1.24	73.23	0.18	0.08	0.77	0.00	11.18	0.00	93.90
	1520D_39X-2_43-45_7	4.13	3.15	1.46	72.32	0.20	0.07	0.91	0.13	11.85	0.00	94.22
	1520D_39X-2_43-45_1	3.75	3.64	1.11	73.01	0.15	0.11	0.62	0.02	11.29	0.01	93.70
	1520D_39X-2_43-45_4	3.69	3.31	1.32	72.06	0.16	0.09	0.79	0.03	11.52	0.00	92.97
	1520D_39X-2_43-45_8	3.95	3.44	1.40	73.72	0.17	0.10	0.91	0.02	11.82	0.05	95.57
	1520D_39X-2_43-45_9	4.16	3.01	1.32	72.54	0.19	0.08	0.92	0.00	11.98	0.01	94.21
	1520D_39X-2_43-45_10	3.73	3.54	1.02	72.74	0.15	0.03	0.61	0.05	11.39	0.00	93.26
	U1520D_39X-2_74-75_1	3.69	3.15	1.38	72.87	0.12	0.13	0.90	0.11	11.90	0.00	94.24
	U1520D_39X-2_74-75_2	3.58	3.51	1.15	73.96	0.14	0.05	0.78	0.07	11.70	0.00	94.94
	U1520D_39X-2_74-75_3	3.85	3.25	1.49	73.63	0.10	0.11	0.92	0.07	12.05	0.00	95.46
	U1520D_39X-2_74-75_4	3.87	3.59	1.25	74.51	0.12	0.08	0.78	0.00	11.68	0.03	95.92
	U1520D_39X-2_74-75_5	3.83	3.62	1.19	75.07	0.12	0.09	0.80	0.05	11.89	0.03	96.69
	U1520D_39X-2_74-75_6	3.82	3.56	1.36	73.84	0.19	0.07	0.92	0.09	11.89	0.02	95.77
	U1520D_39X-2_74-75_7	3.71	3.47	1.28	73.99	0.15	0.14	0.80	0.07	11.70	0.00	95.31
	U1520D_39X-2_74-75_8	4.09	3.30	1.31	73.89	0.14	0.09	0.88	0.09	12.02	0.07	95.89
	U1520D_39X-2_74-75_9	4.00	3.38	1.41	73.57	0.14	0.13	0.95	0.15	11.96	0.00	95.69
	U1520D_39X-2_74-75_10	4.03	3.09	1.46	73.58	0.16	0.15	0.91	0.08	11.94	0.03	95.44
	U1520D_39X-2_74-75_11	3.87	3.33	1.42	73.29	0.13	0.11	0.94	0.01	11.89	0.02	95.01
	U1520D_39X-2_74-75_12	3.98	3.40	1.34	74.30	0.14	0.10	0.81	0.09	11.52	0.00	95.69
	U1520D_39X-2_74-75_13	3.79	3.31	1.29	73.58	0.12	0.07	0.75	0.06	11.61	0.01	94.59
	U1520D_39X-2_74-75_14	3.75	3.22	1.33	72.63	0.14	0.09	0.90	0.09	12.15	0.01	94.32
	U1520D_39X-2_74-75_15	3.38	3.53	1.19	74.20	0.10	0.04	0.62	0.02	11.47	0.03	94.57
	U1520D_39X-2_74-75_18	3.86	3.31	1.35	72.75	0.13	0.10	0.92	0.04	12.14	0.00	94.60
	U1520D_39X-2_74-75_19	4.14	3.07	1.50	72.53	0.12	0.10	0.85	0.01	11.89	0.00	94.21
	U1520D_39X-2_137-139_1	3.87	3.31	1.08	72.79	0.11	0.06	0.79	0.07	11.72	0.01	93.82
	U1520D_39X-2_137-139_2	4.05	3.17	1.15	72.91	0.14	0.11	0.91	0.02	11.98	0.00	94.45
	U1520D_39X-2_137-139_3	4.13	3.28	1.30	73.45	0.12	0.10	0.85	0.16	11.56	0.00	94.95
	U1520D_39X-2_137-139_4	4.04	3.36	1.45	73.27	0.12	0.07	0.93	0.03	11.85	0.03	95.15
	U1520D_39X-2_137-139_5	3.59	3.33	1.15	73.38	0.12	0.08	0.81	0.04	11.40	0.03	93.93
	U1520D_39X-2_137-139_6	3.52	3.67	1.36	73.37	0.13	0.16	1.05	0.08	12.30	0.02	95.67
	U1520D_39X-2_137-139_7	3.62	3.22	1.31	72.92	0.12	0.04	0.79	0.04	11.53	0.02	93.60
	U1520D_39X-2_137-139_8	3.82	3.34	1.16	73.49	0.12	0.10	0.75	0.04	11.56	0.04	94.43
	U1520D_39X-2_137-139_9	3.79	3.18	2.01	69.57	0.31	0.27	1.38	0.02	12.61	0.04	93.19
	U1520D_39X-2_137-139_10	3.26	3.64	0.98	73.32	0.11	0.11	0.62	0.10	11.39	0.01	93.55
	U1520D_39X-2_137-139_11	3.87	3.24	1.44	72.98	0.15	0.10	0.90	0.05	11.87	0.00	94.59
	U1520D_39X-2_137-139_12	4.08	3.04	1.21	72.23	0.11	0.08	0.93	0.12	11.60	0.03	93.42
	U1520D_39X-2_137-139_13	3.88	3.16	1.33	72.12	0.13	0.11	0.89	0.13	11.90	0.02	93.67
	U1520D_39X-2_137-139_14	3.89	3.21	1.28	73.63	0.12	0.09	0.77	0.04	11.32	0.00	94.35
	U1520D_39X-2_137-139_15	3.91	3.20	1.34	72.82	0.15	0.12	0.89	0.08	11.88	0.00	94.39
	U1520D_39X-2_137-139_16	3.65	3.23	1.24	72.39	0.11	0.09	0.93	0.00	11.78	0.00	93.42
	U1520D_39X-2_137-139_17	3.87	3.17	1.30	72.76	0.15	0.09	0.92	0.00	11.80	0.02	94.08
	U1520D_39X-2_137-139_18	3.62	3.51	1.23	73.36	0.10	0.06	0.61	0.07	11.32	0.03	93.91
	U1520D_39X-2_137-139_19	4.02	3.08	1.48	72.13	0.15	0.07	1.04	0.05	12.23	0.06	94.31
	U1520D_39X-2_137-139_20	4.05	3.21	1.26	72.59	0.13	0.10	0.92	0.08	11.82	0.01	94.17
	1520D_39X-2_137-139_1	3.55	3.35	1.19	73.52	0.18	0.07	0.81	0.00	11.44	0.01	94.11
	1520D_39X-2_137-139_2	3.84	3.48	1.29	73.70	0.19	0.08	0.90	0.04	12.01	0.04	95.56
	1520D_39X-2_137-139_3	4.01	3.14	1.49	72.26	0.17	0.09	0.88	0.01	11.79	0.00	93.84
s34	U1520D_39X-3_20-22_1	3.66	3.66	1.20	74.53	0.14	0.08	0.71	0.09	11.64	0.00	95.70
	U1520D_39X-3_20-22_2	3.66	3.52	1.17	73.28	0.13	0.12	1.01	0.02	12.05	0.06	95.02
	U1520D_39X-3_20-22_3	3.81	3.10	1.41	72.46	0.17	0.11	0.85	0.10	11.89	0.01	93.90
	U1520D_39X-3_20-22_4	3.89	3.24	1.42	72.54	0.13	0.09	0.94	0.10	11.82	0.01	94.19
	U1520D_39X-3_20-22_5	3.79	3.07	1.48	71.88	0.12	0.11	0.90	0.05	11.91	0.00	93.31
	U1520D_39X-3_20-22_6	3.69	3.26	1.11	73.10	0.13	0.08	0.76	0.00	11.40	0.00	93.54
	U1520D_39X-3_20-22_7	3.88	3.24	1.35	72.65	0.15	0.10	0.88	0.00	11.84	0.00	94.09
	U1520D_39X-3_20-22_8	3.77	3.18	1.28	72.12	0.15	0.07	0.88	0.08	11.91	0.00	93.45
	U1520D_39X-3_20-22_9	3.85	3.21	1.22	72.23	0.15	0.09	0.89	0.01	11.94	0.00	93.59
	U1520D_39X-3_20-22_10	3.80	3.14	1.38	73.37	0.16	0.10	0.90	0.04	11.86	0.00	94.75
	U1520D_39X-3_20-22_11	3.88	3.23	1.41	72.50	0.13	0.09	0.92	0.06	11.88	0.03	94.14
	U1520D_39X-3_20-22_12	3.74	3.49	1.39	73.19	0.15	0.09	0.78	0.06	11.60	0.02	94.52
	U1520D_39X-3_20-22_13	3.82	3.21	1.36	72.95	0.17	0.06	0.91	0.08	11.94	0.02	94.53

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s36	U1520D_39X-3_20-22_14	3.83	3.40	1.23	74.63	0.12	0.05	0.79	0.04	11.79	0.00	95.89
	U1520D_39X-3_20-22_15	3.83	3.34	1.43	73.31	0.09	0.12	0.90	0.11	12.15	0.01	95.28
	U1520D_39X-3_20-22_16	3.77	3.19	1.27	72.61	0.12	0.07	0.91	0.09	12.02	0.01	94.06
	U1520D_39X-3_20-22_17	3.51	3.42	1.15	73.57	0.10	0.07	0.82	0.03	11.49	0.02	94.18
	U1520D_39X-3_20-22_18	3.79	3.12	1.37	72.56	0.14	0.13	0.87	0.08	11.78	0.00	93.84
	U1520D_39X-3_20-22_19	3.66	3.25	1.27	71.98	0.14	0.10	0.90	0.13	11.91	0.02	93.35
	U1520D_39X-3_20-22_20	3.55	3.39	1.17	73.21	0.16	0.03	0.78	0.04	11.64	0.00	93.96
	1520D_39X-3_20-22_1	3.69	3.08	1.26	72.46	0.20	0.11	0.92	0.08	11.94	0.00	93.75
	1520D_39X-3_20-22_5	4.06	3.13	1.21	72.85	0.19	0.09	0.91	0.11	11.95	0.01	94.52
	1520D_39X-3_20-22_7	3.74	3.19	1.14	73.90	0.14	0.10	0.74	0.07	11.57	0.00	94.59
	1520D_39X-3_20-22_9	3.88	3.11	1.35	72.85	0.22	0.08	0.86	0.04	11.86	0.01	94.25
	1520D_39X-3_20-22_10	3.92	3.10	1.39	73.28	0.15	0.09	0.89	0.01	11.87	0.00	94.70
	1520D_39X-3_20-22_2	3.85	3.37	1.29	74.22	0.17	0.09	0.78	0.00	11.74	0.00	95.50
	1520D_39X-3_20-22_3	4.04	3.24	1.43	73.42	0.17	0.09	0.92	0.09	11.99	0.04	95.42
	1520D_39X-3_20-22_4	3.74	3.50	1.43	73.25	0.19	0.08	0.95	0.07	11.83	0.03	95.06
	1520D_39X-3_20-22_6	3.96	3.08	1.32	72.46	0.22	0.08	0.90	0.02	11.91	0.00	93.95
	1520D_39X-3_20-22_8	3.80	3.20	1.12	73.87	0.20	0.10	0.78	0.02	11.40	0.03	94.51
	U1520D_39X-5_64-66_1	3.72	3.34	1.20	72.86	0.14	0.13	0.96	0.08	11.73	0.00	94.17
	U1520D_39X-5_64-66_2	3.70	3.33	1.40	73.17	0.19	0.13	0.90	0.05	11.71	0.04	94.62
	U1520D_39X-5_64-66_3	3.58	3.38	1.30	73.42	0.11	0.11	0.92	0.03	11.85	0.01	94.71
	U1520D_39X-5_64-66_4	3.64	3.34	1.34	73.68	0.18	0.07	0.91	0.04	11.68	0.00	94.88
	U1520D_39X-5_64-66_5	3.22	3.62	1.42	72.95	0.20	0.13	0.84	0.10	11.42	0.02	93.92
	U1520D_39X-5_64-66_6	3.54	3.42	1.29	73.75	0.15	0.12	0.91	0.04	11.93	0.00	95.15
	U1520D_39X-5_64-66_7	3.96	3.36	1.33	73.01	0.20	0.11	0.96	0.07	12.14	0.04	95.19
	U1520D_39X-5_64-66_8	3.71	3.46	1.11	74.69	0.13	0.08	0.82	0.10	12.00	0.02	96.12
	U1520D_39X-5_64-66_9	3.36	3.74	0.99	73.74	0.13	0.07	0.73	0.03	11.85	0.00	94.62
	U1520D_39X-5_64-66_10	3.54	3.40	1.44	73.23	0.19	0.08	0.93	0.08	11.67	0.04	94.60
	U1520D_39X-5_64-66_11	3.68	3.29	1.39	72.38	0.20	0.11	1.03	0.05	12.27	0.00	94.41
	U1520D_39X-5_64-66_12	3.28	3.46	1.37	71.73	0.18	0.08	0.86	0.06	11.50	0.02	92.55
	U1520D_39X-5_64-66_13	3.71	3.71	1.00	74.07	0.11	0.08	0.72	0.05	11.64	0.00	95.08
	U1520D_39X-5_64-66_14	3.58	3.33	1.40	72.87	0.17	0.09	0.93	0.05	11.71	0.03	94.16
	U1520D_39X-5_64-66_15	3.49	3.71	1.13	73.32	0.08	0.13	0.68	0.00	11.61	0.01	94.16
	U1520D_39X-5_64-66_16	3.23	4.19	0.95	73.80	0.11	0.12	0.71	0.04	11.47	0.01	94.63
	U1520D_39X-5_64-66_17	3.67	3.36	1.41	73.26	0.15	0.11	0.92	0.04	11.61	0.02	94.54
	U1520D_39X-5_64-66_18	3.85	3.06	1.52	73.17	0.19	0.15	0.88	0.07	12.00	0.02	94.90
	U1520D_39X-5_64-66_20	3.53	3.35	1.43	73.25	0.15	0.12	0.90	0.08	11.70	0.00	94.51
s39	U1520D_40X-1_60-62_1	3.72	3.08	2.12	71.24	0.35	0.36	1.68	0.09	12.86	0.01	95.51
	U1520D_40X-1_60-62_2	3.75	3.12	1.93	70.74	0.34	0.30	1.70	0.06	12.82	0.05	94.81
	U1520D_40X-1_60-62_3	3.67	3.36	1.58	72.91	0.16	0.11	0.92	0.01	11.75	0.01	94.49
	U1520D_40X-1_60-62_4	3.91	3.01	2.03	71.00	0.35	0.30	1.59	0.10	12.68	0.03	95.00
	U1520D_40X-1_60-62_5	3.93	3.10	2.08	71.19	0.33	0.33	1.65	0.06	12.79	0.03	95.49
	U1520D_40X-1_60-62_6	3.78	3.17	1.97	71.60	0.36	0.34	1.75	0.02	12.81	0.04	95.84
	U1520D_40X-1_60-62_7	4.04	3.21	2.06	71.78	0.39	0.39	1.70	0.10	12.58	0.03	96.29
	U1520D_40X-1_60-62_8	3.93	3.11	2.27	70.77	0.36	0.41	1.73	0.08	12.91	0.04	95.61
	U1520D_40X-1_60-62_9	3.92	3.07	2.03	71.29	0.37	0.33	1.60	0.03	12.74	0.03	95.42
	U1520D_40X-1_60-62_10	3.72	3.21	1.49	70.52	0.16	0.10	0.78	0.07	10.88	0.02	90.95
	U1520D_40X-1_60-62_11	3.80	2.98	2.09	70.36	0.38	0.35	1.71	0.06	12.62	0.03	94.37
	U1520D_40X-1_60-62_12	3.73	3.20	1.90	71.41	0.37	0.38	1.64	0.04	12.63	0.08	95.38
	U1520D_40X-1_60-62_13	3.83	3.01	1.99	70.27	0.36	0.34	1.64	0.04	12.79	0.02	94.29
	U1520D_40X-1_60-62_14	3.94	3.09	2.09	70.95	0.36	0.35	1.61	0.06	12.65	0.04	95.14
	U1520D_40X-1_60-62_15	3.77	3.03	1.95	71.02	0.40	0.31	1.62	0.02	12.65	0.00	94.78
	U1520D_40X-1_60-62_16	3.92	3.11	2.03	70.32	0.36	0.34	1.66	0.05	12.61	0.00	94.40
	U1520D_40X-1_60-62_17	3.82	3.57	1.09	74.11	0.11	0.04	0.72	0.02	11.61	0.01	95.10
	U1520D_40X-1_60-62_18	3.47	3.53	1.02	73.74	0.06	0.06	0.77	0.01	11.73	0.03	94.42
	U1520D_40X-1_60-62_19	3.90	3.22	2.01	71.08	0.37	0.31	1.70	0.04	12.62	0.04	95.29
	U1520D_40X-1_60-62_20	3.92	3.09	1.98	70.79	0.32	0.33	1.67	0.03	12.95	0.04	95.12
	1520D_40X-1_60-62_1	4.11	2.96	1.99	69.96	0.54	0.35	1.74	0.06	12.82	0.04	94.58
	1520D_40X-1_60-62_10	4.02	3.11	2.27	65.54	0.45	0.35	1.58	0.05	12.46	0.05	89.89
	1520D_40X-1_60-62_5	3.96	3.09	2.08	70.27	0.49	0.34	1.64	0.10	12.78	0.06	94.82
	1520D_40X-1_60-62_6	3.95	3.17	2.04	68.40	0.55	0.27	1.62	0.07	12.64	0.05	92.76
	1520D_40X-1_60-62_2	4.02	3.05	2.11	70.72	0.49	0.37	1.67	0.00	12.65	0.05	95.13
	1520D_40X-1_60-62_3	3.81	3.40	1.44	73.40	0.26	0.13	0.88	0.00	11.50	0.00	94.82
	1520D_40X-1_60-62_4	4.28	3.04	2.04	69.75	0.50	0.37	1.66	0.04	12.78	0.03	94.48
	1520D_40X-1_60-62_8	3.82	3.21	1.46	72.86	0.21	0.14	0.94	0.10	11.41	0.02	94.16
	1520D_40X-1_60-62_9	4.04	3.10	1.97	66.85	0.54	0.32	1.68	0.04	12.67	0.01	91.22
s40	U1520D_40X-1_77-79_1	3.83	3.87	1.00	74.30	0.08	0.05	0.63	0.06	11.78	0.02	95.62
	U1520D_40X-1_77-79_2	3.74	3.36	1.46	73.59	0.19	0.12	0.98	0.05	11.79	0.00	95.27
	U1520D_40X-1_77-79_3	3.69	3.77	1.14	74.25	0.10	0.06	0.63	0.01	11.72	0.01	95.39
	U1520D_40X-1_77-79_4	3.87	3.18	1.76	70.95	0.35	0.37	1.74	0.05	12.96	0.06	95.29
	U1520D_40X-1_77-79_5	3.87	3.30	1.43	73.47	0.17	0.15	0.94	0.05	11.56	0.04	94.99

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s41	U1520D_40X-1_77-79_6	3.52	3.42	1.56	73.62	0.18	0.12	0.94	0.00	11.65	0.02	95.02
	U1520D_40X-1_77-79_7	3.61	3.61	1.09	74.27	0.11	0.11	0.81	0.08	11.33	0.02	95.04
	U1520D_40X-1_77-79_8	3.74	3.30	1.49	74.05	0.22	0.09	0.94	0.08	11.59	0.00	95.49
	U1520D_40X-1_77-79_9	3.55	3.81	1.11	73.96	0.09	0.06	0.65	0.00	11.68	0.03	94.94
	U1520D_40X-1_77-79_10	3.59	3.32	1.39	73.54	0.14	0.11	0.92	0.02	11.69	0.01	94.73
	U1520D_40X-1_77-79_11	4.23	3.19	1.59	72.71	0.15	0.10	1.09	0.09	12.50	0.00	95.65
	U1520D_40X-1_77-79_12	3.58	3.89	1.11	74.91	0.11	0.04	0.62	0.03	11.69	0.01	96.00
	U1520D_40X-1_77-79_13	3.48	3.57	1.16	74.53	0.12	0.06	1.11	0.05	11.98	0.00	96.07
	U1520D_40X-1_77-79_14	3.44	4.31	0.69	74.46	0.06	0.00	0.64	0.12	11.78	0.04	95.54
	U1520D_40X-1_77-79_15	3.52	3.81	1.03	74.26	0.06	0.04	0.66	0.02	11.62	0.03	95.06
	U1520D_40X-1_77-79_16	3.92	3.33	1.49	73.84	0.16	0.12	1.03	0.03	11.98	0.00	95.90
	U1520D_40X-1_77-79_17	3.73	3.76	0.94	74.66	0.12	0.04	0.70	0.00	11.50	0.01	95.46
	U1520D_40X-1_77-79_18	3.62	3.44	1.30	74.69	0.14	0.08	0.86	0.07	11.44	0.00	95.64
	U1520D_40X-1_77-79_2	3.58	3.72	1.05	74.04	0.09	0.04	0.65	0.04	11.39	0.00	94.60
	U1520D_40X-1_77-79_9	3.44	3.65	1.08	73.36	0.10	0.05	0.63	0.08	11.41	0.02	93.82
	U1520D_40X-1_77-79_12	3.55	3.69	1.12	73.55	0.10	0.05	0.65	0.02	11.47	0.02	94.22
	U1520D_40X-1_77-79_13	3.82	3.40	1.36	73.19	0.17	0.15	0.92	0.03	12.01	0.00	95.06
	U1520D_40X-1_77-79_14	3.57	3.46	1.25	73.95	0.17	0.08	0.79	0.10	11.72	0.00	95.08
	U1520D_40X-1_77-79_1	3.75	3.63	1.08	73.41	0.15	0.05	0.83	0.03	11.46	0.01	94.38
	U1520D_40X-1_77-79_3	3.95	3.36	1.34	73.51	0.19	0.14	0.97	0.07	11.54	0.04	95.11
	U1520D_40X-1_77-79_4	3.66	3.32	1.36	72.68	0.20	0.10	1.05	0.02	11.65	0.00	94.04
	U1520D_40X-1_77-79_5	3.66	3.40	1.24	73.73	0.15	0.12	0.84	0.07	11.15	0.02	94.38
	U1520D_40X-1_77-79_6	3.74	3.86	1.20	74.12	0.08	0.06	0.64	0.05	11.75	0.00	95.49
	U1520D_40X-1_77-79_7	3.70	3.33	1.53	72.93	0.16	0.14	0.94	0.03	11.91	0.00	94.67
	U1520D_40X-1_77-79_8	3.63	3.80	0.98	73.94	0.11	0.04	0.66	0.03	11.93	0.02	95.14
	U1520D_40X-1_77-79_10	3.68	3.61	1.16	73.98	0.17	0.09	0.78	0.00	11.29	0.02	94.78
	U1520D_40X-1_77-79_15	3.73	3.79	1.03	73.85	0.10	0.07	0.64	0.05	11.52	0.00	94.77
	U1520D_40X-CC_38-40_1	3.78	3.04	1.70	71.82	0.27	0.26	1.35	0.03	12.47	0.02	94.74
	U1520D_40X-CC_38-40_2	3.61	3.46	1.30	74.09	0.08	0.04	0.74	0.00	11.67	0.00	95.00
	U1520D_40X-CC_38-40_3	4.08	3.40	1.62	73.37	0.16	0.12	0.99	0.05	12.15	0.00	95.95
	U1520D_40X-CC_38-40_4	3.80	3.36	1.17	73.58	0.16	0.12	0.77	0.06	11.55	0.00	94.57
	U1520D_40X-CC_38-40_5	3.80	2.94	1.85	71.60	0.28	0.25	1.34	0.03	12.34	0.04	94.47
	U1520D_40X-CC_38-40_6	3.90	3.40	1.41	74.37	0.16	0.08	0.82	0.05	11.69	0.00	95.88
	U1520D_40X-CC_38-40_7	3.78	2.98	1.95	71.28	0.30	0.25	1.30	0.00	12.52	0.03	94.40
	U1520D_40X-CC_38-40_8	3.90	2.96	1.95	71.07	0.26	0.28	1.37	0.05	12.25	0.03	94.12
	U1520D_40X-CC_38-40_9	3.72	3.14	1.48	72.62	0.18	0.16	0.95	0.02	11.74	0.00	94.01
	U1520D_40X-CC_38-40_10	3.64	3.25	1.44	74.42	0.14	0.10	0.81	0.04	11.62	0.00	95.46
	U1520D_40X-CC_38-40_11	3.74	3.47	1.13	74.14	0.10	0.05	0.63	0.05	11.47	0.01	94.79
	U1520D_40X-CC_38-40_12	3.96	2.97	1.92	71.86	0.26	0.27	1.29	0.08	12.18	0.04	94.84
	U1520D_40X-CC_38-40_13	4.02	3.00	1.72	71.51	0.31	0.25	1.37	0.02	12.26	0.04	94.49
	U1520D_40X-CC_38-40_14	3.99	2.97	1.96	71.53	0.30	0.25	1.30	0.09	12.37	0.03	94.79
	U1520D_40X-CC_38-40_15	4.00	3.01	1.64	71.97	0.27	0.23	1.28	0.05	12.38	0.06	94.88
	U1520D_40X-CC_38-40_16	3.58	3.02	1.85	71.69	0.31	0.24	1.34	0.06	12.47	0.05	94.61
	U1520D_40X-CC_38-40_17	3.86	2.95	1.81	71.64	0.29	0.22	1.32	0.05	12.38	0.02	94.54
	U1520D_40X-CC_38-40_18	3.92	3.08	1.74	72.36	0.27	0.24	1.26	0.09	12.39	0.04	95.39
	U1520D_40X-CC_38-40_19	3.70	3.01	1.72	71.32	0.25	0.26	1.31	0.02	12.28	0.03	93.90
	U1520D_40X-CC_38-40_20	3.75	2.96	1.98	71.52	0.24	0.25	1.32	0.05	12.53	0.00	94.59
	1520D_40X-CC_38-40_1	4.14	3.14	1.98	72.02	0.40	0.24	1.31	0.00	12.46	0.03	95.72
	1520D_40X-CC_38-40_2	3.96	3.02	1.78	71.09	0.41	0.21	1.29	0.06	12.37	0.03	94.22
	1520D_40X-CC_38-40_3	4.06	2.95	1.90	68.91	0.44	0.26	1.39	0.06	12.44	0.04	92.44
	1520D_40X-CC_38-40_9	4.26	3.03	1.98	71.24	0.45	0.26	1.36	0.11	12.49	0.01	95.18
	1520D_40X-CC_38-40_6	4.00	2.99	1.89	70.88	0.43	0.22	1.35	0.07	12.26	0.03	94.12
	1520D_40X-CC_38-40_4	4.07	2.91	2.02	68.18	0.42	0.28	1.36	0.11	12.46	0.02	91.83
	1520D_40X-CC_38-40_8	3.64	3.47	1.27	73.57	0.13	0.09	0.74	0.07	11.55	0.02	94.55
	1520D_40X-CC_38-40_10	4.06	3.37	1.42	72.83	0.20	0.11	0.83	0.00	11.54	0.00	94.36
	1520D_40X-CC_38-40_7	3.85	3.41	1.11	72.86	0.21	0.11	0.79	0.12	11.52	0.04	94.02
	U1520D_42X-1_17-19_1	3.65	3.27	1.33	72.54	0.15	0.15	1.08	0.00	12.13	0.02	94.32
	U1520D_42X-1_17-19_2	3.88	2.88	2.47	69.49	0.53	0.45	1.86	0.03	12.85	0.04	94.48
	U1520D_42X-1_17-19_3	3.74	3.46	1.37	72.48	0.17	0.11	0.98	0.03	12.24	0.03	94.61
	U1520D_42X-1_17-19_4	3.80	3.47	1.16	73.86	0.12	0.13	0.88	0.02	12.08	0.02	95.54
	U1520D_42X-1_17-19_5	3.78	3.27	1.44	73.02	0.16	0.18	1.04	0.03	12.10	0.02	95.04
	U1520D_42X-1_17-19_6	3.81	3.38	1.30	73.51	0.15	0.13	0.94	0.09	12.11	0.00	95.43
	U1520D_42X-1_17-19_7	3.97	3.01	2.22	70.14	0.43	0.39	1.58	0.08	12.45	0.04	94.31
	U1520D_42X-1_17-19_8	3.96	2.99	2.25	70.19	0.43	0.38	1.56	0.09	12.30	0.03	94.17
	U1520D_42X-1_17-19_9	4.07	3.18	1.77	70.83	0.29	0.25	1.36	0.05	12.98	0.03	94.80
	U1520D_42X-1_17-19_10	3.97	3.54	1.26	72.61	0.16	0.13	1.04	0.05	12.35	0.03	95.14
	U1520D_42X-1_17-19_11	3.94	2.94	2.26	70.61	0.43	0.40	1.65	0.06	12.52	0.06	94.87
	U1520D_42X-1_17-19_12	3.43	3.41	1.24	72.44	0.16	0.14	1.10	0.00	12.32	0.01	94.25
	U1520D_42X-1_17-19_13	3.98	3.00	2.15	70.94	0.47	0.39	1.68	0.06	12.77	0.06	95.50
	U1520D_42X-1_17-19_14	3.90	2.90	2.25	70.91	0.42	0.37	1.60	0.05	12.48	0.05	94.93

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u32*	U1520D_42X-1_17-19_15	4.16	2.89	2.31	71.11	0.46	0.35	1.60	0.04	12.49	0.08	95.49
	U1520D_42X-1_17-19_16	3.67	3.30	1.39	73.20	0.16	0.14	1.05	0.06	12.30	0.00	95.27
	U1520D_42X-1_17-19_17	3.42	3.68	0.98	75.00	0.14	0.08	0.88	0.08	11.97	0.00	96.24
	U1520D_42X-1_17-19_18	3.81	3.62	1.13	74.81	0.13	0.10	0.82	0.02	11.99	0.00	96.44
	U1520D_42X-1_17-19_19	3.91	2.95	2.30	71.25	0.49	0.38	1.58	0.09	12.59	0.03	95.56
	U1520D_42X-1_17-19_20	3.87	3.41	1.36	73.31	0.17	0.12	1.01	0.09	12.32	0.03	95.69
	U1520D_42X-1_97-99_1	3.61	3.28	1.28	73.32	0.15	0.20	1.09	0.10	12.19	0.01	95.23
	U1520D_42X-1_97-99_2	4.02	3.15	1.85	72.03	0.33	0.24	1.20	0.08	12.26	0.01	95.17
	U1520D_42X-1_97-99_3	3.41	3.31	1.38	73.05	0.19	0.19	1.21	0.06	12.33	0.04	95.17
	U1520D_42X-1_97-99_4	3.37	3.34	1.02	73.54	0.11	0.12	0.93	0.11	12.06	0.02	94.63
	U1520D_42X-1_97-99_5	3.61	3.69	1.30	72.68	0.20	0.18	1.17	0.00	12.35	0.00	95.18
	U1520D_42X-1_97-99_6	3.69	3.15	2.04	72.13	0.37	0.28	1.37	0.05	12.35	0.03	95.46
	U1520D_42X-1_97-99_7	3.76	3.51	1.22	73.86	0.09	0.13	0.95	0.08	11.99	0.04	95.63
	U1520D_42X-1_97-99_8	3.58	3.39	1.26	73.46	0.20	0.16	1.20	0.04	12.14	0.00	95.44
	U1520D_42X-1_97-99_9	3.65	3.14	2.27	71.47	0.42	0.33	1.48	0.07	12.50	0.05	95.38
	U1520D_42X-1_97-99_10	3.64	3.37	1.48	73.16	0.18	0.17	1.12	0.02	12.18	0.04	95.36
	U1520D_42X-1_97-99_11	3.91	3.39	1.23	73.56	0.17	0.12	1.21	0.03	12.66	0.00	96.29
	U1520D_42X-1_97-99_12	3.64	3.39	1.32	72.60	0.17	0.17	1.18	0.03	12.40	0.01	94.91
	U1520D_42X-1_97-99_13	3.77	3.14	2.23	71.69	0.40	0.33	1.40	0.15	12.29	0.05	95.46
	U1520D_42X-1_97-99_15	3.57	3.48	0.99	73.06	0.10	0.13	0.99	0.01	12.00	0.00	94.33
	U1520D_42X-1_97-99_16	3.84	3.15	2.23	71.63	0.43	0.34	1.39	0.04	12.20	0.05	95.30
	U1520D_42X-1_97-99_17	4.18	3.02	2.27	71.60	0.45	0.31	1.41	0.13	12.53	0.07	95.96
	U1520D_42X-1_97-99_18	3.67	3.36	1.25	73.55	0.20	0.19	1.14	0.09	12.23	0.02	95.70
	U1520D_42X-1_97-99_19	3.45	3.26	1.31	72.83	0.17	0.17	1.17	0.01	12.35	0.04	94.76
	U1520D_42X-1_97-99_20	3.64	3.33	1.66	72.71	0.18	0.16	1.10	0.00	12.41	0.05	95.23
	U1520D_44X-1_5-7_1	4.13	3.21	1.83	71.54	0.15	0.08	0.96	0.03	12.46	0.00	94.40
	U1520D_44X-1_5-7_2	4.79	2.90	2.17	70.72	0.26	0.20	1.29	0.12	12.82	0.02	95.29
	U1520D_44X-1_5-7_3	4.65	2.87	2.09	70.64	0.31	0.25	1.26	0.04	12.88	0.00	94.99
	U1520D_44X-1_5-7_4	4.46	2.96	1.86	70.04	0.25	0.24	1.28	0.09	12.92	0.04	94.14
	U1520D_44X-1_5-7_5	4.30	3.29	1.42	72.92	0.18	0.09	0.89	0.06	12.34	0.04	95.53
	U1520D_44X-1_5-7_6	3.63	3.45	1.17	72.83	0.14	0.06	0.77	0.07	12.07	0.01	94.19
	U1520D_44X-1_5-7_7	4.31	2.86	1.89	70.41	0.28	0.25	1.32	0.02	12.74	0.01	94.09
	U1520D_44X-1_5-7_8	4.01	3.50	0.96	72.66	0.17	0.08	0.80	0.10	11.99	0.01	94.28
	U1520D_44X-1_5-7_9	4.05	3.38	1.24	72.84	0.15	0.08	0.76	0.06	12.05	0.01	94.62
	U1520D_44X-1_5-7_10	4.20	2.92	2.09	71.09	0.28	0.20	1.32	0.13	12.96	0.05	95.24
	U1520D_44X-1_5-7_11	4.38	2.98	1.92	70.53	0.24	0.21	1.19	0.06	12.70	0.03	94.25
	U1520D_44X-1_5-7_12	4.39	2.89	1.99	70.01	0.27	0.23	1.33	0.06	12.90	0.00	94.07
	U1520D_44X-1_5-7_13	4.46	2.95	1.84	70.46	0.32	0.27	1.36	0.11	12.69	0.07	94.54
	U1520D_44X-1_5-7_14	4.24	2.99	1.90	70.60	0.27	0.19	1.20	0.18	12.76	0.03	94.37
	U1520D_44X-1_5-7_15	3.99	2.88	1.76	70.15	0.33	0.21	1.29	0.05	12.69	0.00	93.34
	U1520D_44X-1_5-7_16	4.23	2.85	1.79	69.95	0.27	0.26	1.27	0.06	12.91	0.05	93.63
	U1520D_44X-1_5-7_17	4.36	2.90	1.97	70.94	0.27	0.22	1.28	0.07	12.97	0.04	95.03
	U1520D_44X-1_5-7_18	4.22	2.90	1.91	70.72	0.29	0.22	1.25	0.13	12.94	0.00	94.58
	U1520D_44X-1_5-7_19	4.36	2.96	2.04	70.68	0.27	0.24	1.29	0.09	12.74	0.00	94.67
	U1520D_44X-1_5-7_20	3.95	2.86	1.95	70.34	0.30	0.28	1.24	0.15	12.79	0.00	93.85
s44	U1520D_44X-1_5-7_2_1	4.00	3.37	1.11	72.71	0.15	0.10	0.79	0.04	12.12	0.01	94.39
	U1520D_44X-1_5-7_2_2	3.78	3.38	1.25	72.20	0.14	0.10	0.79	0.09	11.87	0.00	93.60
	U1520D_44X-1_5-7_2_3	3.49	3.88	0.90	72.79	0.14	0.03	0.66	0.04	11.72	0.02	93.67
	U1520D_44X-1_5-7_2_4	4.50	2.85	1.97	70.53	0.31	0.26	1.30	0.06	12.76	0.03	94.57
	U1520D_44X-1_5-7_2_5	4.26	2.86	2.15	70.37	0.29	0.25	1.32	0.08	12.95	0.03	94.56
	U1520D_44X-1_5-7_2_6	3.89	3.64	1.10	73.15	0.18	0.12	0.72	0.09	12.35	0.01	95.25
	U1520D_44X-1_5-7_2_7	4.46	2.93	1.95	70.34	0.31	0.27	1.24	0.11	12.93	0.06	94.59
	U1520D_44X-1_5-7_2_8	4.34	2.92	2.11	70.82	0.31	0.21	1.32	0.08	12.90	0.04	95.05
	U1520D_44X-1_5-7_2_9	4.22	2.88	1.92	70.76	0.29	0.26	1.33	0.07	12.72	0.01	94.47
	U1520D_44X-1_5-7_2_10	3.82	3.39	1.43	73.11	0.16	0.12	0.80	0.07	11.95	0.04	94.90
	U1520D_44X-1_5-7_2_11	4.17	3.46	1.23	72.95	0.17	0.08	0.73	0.02	12.16	0.00	94.96
	U1520D_44X-1_5-7_2_12	4.20	2.90	1.84	70.63	0.29	0.25	1.31	0.19	12.96	0.03	94.60
	U1520D_44X-1_5-7_2_13	3.84	3.41	1.15	72.32	0.15	0.02	0.75	0.03	11.95	0.02	93.63
	U1520D_44X-1_5-7_2_14	4.47	2.92	1.93	70.69	0.26	0.23	1.27	0.12	12.84	0.01	94.74
	U1520D_44X-1_5-7_2_15	4.59	2.92	1.87	71.09	0.30	0.28	1.29	0.05	12.77	0.03	95.17
	U1520D_44X-1_5-7_2_16	4.33	2.92	1.86	70.18	0.30	0.26	1.34	0.11	12.90	0.03	94.22
	U1520D_44X-1_5-7_2_17	4.53	3.00	2.00	70.41	0.29	0.25	1.27	0.09	12.83	0.00	94.67
	U1520D_44X-1_5-7_2_18	4.31	2.91	2.02	70.45	0.28	0.23	1.36	0.05	12.94	0.03	94.57
	U1520D_44X-1_5-7_2_19	4.10	3.03	1.69	71.31	0.26	0.14	1.07	0.06	12.88	0.01	94.56
	U1520D_44X-1_5-7_2_20	4.13	2.91	2.02	70.55	0.28	0.27	1.31	0.11	13.09	0.02	94.69
	1520D_44X-1_5-7_(2)_10	3.77	3.46	1.08	73.12	0.22	0.04	0.65	0.00	11.92	0.02	94.27
	1520D_44X-1_5-7_(2)_2	3.41	4.11	1.11	71.81	0.24	0.05	0.62	0.06	11.40	0.03	92.83
	1520D_44X-1_5-7_(2)_1	4.10	3.11	1.29	71.69	0.20	0.12	0.93	0.05	12.20	0.00	93.69
	1520D_44X-1_5-7_(2)_6	4.55	2.83	1.97	70.16	0.41	0.24	1.27	0.06	12.74	0.03	94.26
	1520D_44X-1_5-7_(2)_7	4.02	3.33	1.09	71.51	0.21	0.04	0.74	0.04	11.97	0.00	92.96

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1520D_44X-1_5-7_(2)_3	4.13	3.39	1.02	71.80	0.22	0.05	0.70	0.05	12.01	0.02	93.40
	1520D_44X-1_5-7_(2)_5	4.44	2.90	1.84	70.39	0.40	0.24	1.28	0.05	12.67	0.01	94.22
	1520D_44X-1_5-7_(2)_8	4.05	3.40	1.22	71.63	0.18	0.03	0.78	0.00	12.02	0.00	93.32
	1520D_44X-1_5-7_(2)_9	4.01	3.32	1.13	70.89	0.23	0.06	0.73	0.07	11.87	0.01	92.33
	U1520D_44X-1_38-39_1	4.17	3.18	1.78	72.63	0.19	0.15	1.09	0.06	12.71	0.04	95.99
	U1520D_44X-1_38-39_2	4.04	2.94	2.09	69.97	0.31	0.26	1.52	0.00	13.38	0.03	94.55
	U1520D_44X-1_38-39_5	3.83	3.16	1.94	70.16	0.22	0.18	1.16	0.10	12.49	0.02	93.25
	U1520D_44X-1_38-39_6	4.23	3.04	1.95	70.36	0.27	0.27	1.48	0.01	13.30	0.00	94.91
	U1520D_44X-1_38-39_8	4.16	3.19	1.50	70.78	0.20	0.10	0.84	0.06	12.47	0.00	93.30
	U1520D_44X-1_38-39_9	3.67	3.04	1.89	70.26	0.21	0.17	1.15	0.01	12.67	0.03	93.11
	U1520D_44X-1_38-39_10	4.40	3.03	2.57	69.74	0.34	0.39	1.71	0.14	13.47	0.06	95.84
	U1520D_44X-1_38-39_11	3.84	3.00	2.01	69.46	0.32	0.26	1.56	0.12	13.06	0.03	93.66
	U1520D_44X-1_38-39_12	4.14	3.21	1.86	71.35	0.18	0.12	1.03	0.07	12.47	0.00	94.43
	U1520D_44X-1_38-39_13	4.12	2.96	2.08	69.90	0.31	0.29	1.54	0.10	13.13	0.04	94.48
	U1520D_44X-1_38-39_14	4.26	3.26	1.68	71.62	0.13	0.14	0.96	0.08	12.55	0.00	94.68
	U1520D_44X-1_38-39_15	4.14	2.95	1.92	69.33	0.30	0.30	1.50	0.09	13.39	0.05	93.98
	U1520D_44X-1_38-39_16	4.39	2.93	2.14	69.77	0.30	0.29	1.56	0.03	13.23	0.04	94.68
	U1520D_44X-1_38-39_17	3.08	3.67	1.95	67.51	0.22	0.14	1.10	0.06	12.23	0.03	90.00
	U1520D_44X-1_38-39_18	3.60	3.03	1.95	69.60	0.22	0.22	1.14	0.04	12.56	0.03	92.38
	U1520D_44X-1_38-39_19	3.94	2.98	2.04	70.06	0.30	0.32	1.47	0.14	13.05	0.04	94.34
	U1520D_44X-1_38-39_20	4.32	2.91	2.11	69.28	0.30	0.31	1.59	0.10	13.03	0.00	93.95
s46	U1520D_44X-1_43-45_1	4.09	3.01	2.02	66.89	0.24	0.15	1.08	0.07	12.59	0.00	90.14
	U1520D_44X-1_43-45_2	4.34	2.97	1.90	68.65	0.20	0.16	1.17	0.12	13.00	0.01	92.52
	U1520D_44X-1_43-45_3	4.34	2.95	1.94	67.36	0.21	0.19	1.19	0.06	12.64	0.03	90.91
	U1520D_44X-1_43-45_4	3.98	2.89	1.90	67.65	0.21	0.18	1.19	0.10	12.69	0.04	90.82
	U1520D_44X-1_43-45_5	4.07	2.94	1.92	67.85	0.07	0.18	1.17	0.11	12.83	0.00	91.14
	U1520D_44X-1_43-45_6	4.02	2.81	1.85	67.76	0.15	0.24	1.15	0.13	12.47	0.06	90.62
	U1520D_44X-1_43-45_7	4.28	2.95	1.84	70.20	0.22	0.22	1.16	0.04	12.78	0.04	93.71
	U1520D_44X-1_43-45_8	4.07	3.06	1.79	70.15	0.23	0.18	1.15	0.07	12.68	0.00	93.38
	U1520D_44X-1_43-45_9	4.05	3.19	1.70	71.54	0.19	0.09	0.94	0.04	12.46	0.03	94.24
	U1520D_44X-1_43-45_10	4.24	2.97	1.85	70.81	0.23	0.18	1.18	0.12	12.69	0.04	94.31
	U1520D_44X-1_43-45_11	3.83	3.27	1.30	70.91	0.21	0.21	0.98	0.04	12.18	0.00	92.94
	U1520D_44X-1_43-45_12	3.92	3.13	1.84	71.16	0.22	0.14	1.19	0.01	12.75	0.00	94.36
	U1520D_44X-1_43-45_13	4.22	3.00	1.86	70.78	0.20	0.19	1.21	0.07	12.59	0.02	94.14
	U1520D_44X-1_43-45_14	4.08	3.03	1.80	71.04	0.20	0.11	1.13	0.05	12.77	0.03	94.24
	U1520D_44X-1_43-45_15	4.07	2.87	1.94	69.61	0.28	0.18	1.12	0.03	12.62	0.01	92.74
	U1520D_44X-1_43-45_16	3.95	2.95	1.92	70.15	0.25	0.21	1.20	0.04	12.53	0.04	93.23
	U1520D_44X-1_43-45_17	4.08	2.91	1.78	70.59	0.25	0.18	1.18	0.05	12.73	0.03	93.78
	U1520D_44X-1_43-45_18	4.25	2.92	2.09	70.61	0.22	0.17	1.16	0.08	12.70	0.01	94.21
	U1520D_44X-1_43-45_19	3.99	2.95	1.81	70.28	0.22	0.15	1.16	0.03	12.43	0.04	93.07
	U1520D_44X-1_43-45_20	3.96	2.94	1.89	69.49	0.20	0.20	1.15	0.14	12.36	0.02	92.36
s48	U1520D_44X-1_47-49_1	3.96	3.01	1.58	72.53	0.14	0.08	0.92	0.12	12.45	0.04	94.83
	U1520D_44X-1_47-49_2	4.13	3.16	1.43	72.66	0.17	0.11	0.97	0.03	12.54	0.01	95.22
	U1520D_44X-1_47-49_3	4.01	3.24	1.70	72.68	0.15	0.10	0.94	0.03	12.44	0.00	95.30
	U1520D_44X-1_47-49_4	4.17	3.23	1.63	72.65	0.12	0.09	1.01	0.08	12.62	0.03	95.64
	U1520D_44X-1_47-49_5	3.82	3.29	1.31	73.61	0.11	0.06	0.79	0.06	11.93	0.02	95.00
	U1520D_44X-1_47-49_6	3.98	3.34	1.48	72.67	0.14	0.11	0.94	0.06	12.23	0.01	94.95
	U1520D_44X-1_47-49_7	4.25	3.28	1.60	72.79	0.16	0.10	0.97	0.10	12.76	0.01	96.02
	U1520D_44X-1_47-49_8	4.05	3.22	1.36	72.74	0.15	0.13	1.02	0.05	12.53	0.01	95.27
	U1520D_44X-1_47-49_9	3.97	3.31	1.38	72.40	0.12	0.11	0.83	0.06	12.28	0.00	94.47
	U1520D_44X-1_47-49_10	3.78	3.40	1.33	72.72	0.13	0.05	0.80	0.00	11.85	0.01	94.07
	U1520D_44X-1_47-49_11	3.93	3.26	1.69	72.53	0.14	0.09	0.95	0.05	12.48	0.00	95.12
	U1520D_44X-1_47-49_12	4.38	2.91	1.98	71.56	0.21	0.17	1.16	0.03	12.60	0.04	95.03
	U1520D_44X-1_47-49_16	3.83	3.25	1.47	72.20	0.15	0.12	0.91	0.09	12.15	0.00	94.16
	U1520D_44X-1_47-49_17	3.69	3.12	1.62	71.99	0.13	0.11	0.97	0.07	12.23	0.01	93.93
	U1520D_44X-1_47-49_18	3.96	3.30	1.33	73.13	0.10	0.07	0.79	0.05	11.88	0.04	94.65
	U1520D_44X-1_47-49_19	4.11	3.03	1.59	71.60	0.19	0.10	0.97	0.10	12.35	0.04	94.08
	U1520D_44X-1_47-49_20	4.10	3.30	1.53	72.70	0.18	0.12	1.11	0.03	12.38	0.02	95.48
	1520D_44X-1_47-49_1	4.16	3.27	1.60	72.36	0.24	0.11	0.97	0.02	12.49	0.03	95.26
	1520D_44X-1_47-49_6	4.14	3.30	1.51	72.31	0.18	0.08	0.94	0.09	12.44	0.00	95.00
	1520D_44X-1_47-49_9	4.05	3.08	1.73	71.47	0.21	0.09	0.96	0.12	12.46	0.05	94.23
	1520D_44X-1_47-49_2	4.43	3.24	1.32	70.41	0.19	0.10	0.86	0.03	12.11	0.00	92.70
s51	1520D_44X-1_47-49_4	4.28	3.23	1.54	67.96	0.21	0.09	0.92	0.08	12.19	0.01	90.51
	1520D_44X-1_47-49_5	3.87	3.36	1.20	72.63	0.16	0.06	0.84	0.00	12.22	0.00	94.33
	1520D_44X-1_47-49_7	4.39	3.05	1.88	69.93	0.34	0.24	1.40	0.07	12.93	0.01	94.24
	1520D_44X-1_47-49_8	3.95	3.15	1.30	70.92	0.22	0.11	0.97	0.08	12.47	0.01	93.19
	1520D_44X-1_47-49_10	4.36	3.05	1.61	70.41	0.25	0.14	0.99	0.08	12.42	0.04	93.35
	U1520D_44X-1_96-98_1	3.63	3.55	1.20	73.62	0.12	0.08	0.78	0.02	11.93	0.02	94.95
	U1520D_44X-1_96-98_2	2.76	4.03	1.40	68.93	0.11	0.11	0.97	0.04	11.99	0.00	90.34
	U1520D_44X-1_96-98_3	4.00	3.61	1.28	73.88	0.10	0.10	0.78	0.07	11.99	0.00	95.82

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u41	U1520D_44X-1_96-98_4	3.82	3.53	1.16	73.99	0.10	0.08	0.78	0.00	12.15	0.00	95.62
	U1520D_44X-1_96-98_5	3.64	3.65	1.16	74.06	0.12	0.10	0.74	0.05	11.97	0.00	95.49
	U1520D_44X-1_96-98_6	3.48	3.50	1.01	73.39	0.12	0.06	0.83	0.01	12.05	0.01	94.45
	U1520D_44X-1_96-98_7	3.58	3.66	1.07	74.31	0.11	0.04	0.77	0.00	12.02	0.00	95.56
	U1520D_44X-1_96-98_8	3.89	3.51	1.16	73.68	0.13	0.05	0.79	0.06	12.09	0.00	95.36
	U1520D_44X-1_96-98_9	4.04	3.23	1.39	71.54	0.21	0.16	1.24	0.07	13.04	0.03	94.95
	U1520D_44X-1_96-98_10	3.64	3.55	1.26	73.33	0.13	0.06	0.74	0.09	11.96	0.02	94.78
	U1520D_44X-1_96-98_11	3.58	3.58	1.25	73.47	0.12	0.09	0.81	0.10	11.84	0.01	94.84
	U1520D_44X-1_96-98_12	3.79	3.54	1.33	73.06	0.12	0.09	0.80	0.02	11.73	0.00	94.48
	U1520D_44X-1_96-98_13	3.66	3.53	1.24	73.46	0.11	0.10	0.79	0.06	12.03	0.02	95.01
	U1520D_44X-1_96-98_14	3.74	3.52	1.28	74.44	0.11	0.11	0.79	0.04	12.07	0.04	96.15
	U1520D_44X-1_96-98_15	3.94	3.60	1.28	74.10	0.08	0.08	0.81	0.04	11.94	0.00	95.88
	U1520D_44X-1_96-98_16	3.91	3.50	1.28	73.94	0.12	0.10	0.78	0.07	12.11	0.00	95.81
	U1520D_44X-1_96-98_17	3.67	3.51	1.09	73.51	0.13	0.10	0.83	0.01	11.78	0.02	94.64
	U1520D_44X-1_96-98_18	3.83	2.85	2.40	68.19	0.45	0.50	2.15	0.15	13.45	0.03	94.00
	U1520D_44X-1_96-98_19	3.69	3.69	1.33	73.37	0.10	0.05	0.82	0.03	12.20	0.00	95.28
	U1520D_44X-1_96-98_20	3.80	3.54	1.46	73.58	0.15	0.08	0.87	0.06	12.07	0.00	95.61
	U1520D_44X-2_94-96_1	4.17	1.66	5.02	59.16	0.87	1.11	7.24	0.10	18.82	0.17	98.33
	U1520D_44X-2_94-96_2	3.78	3.55	1.43	71.06	0.17	0.12	1.01	0.09	12.36	0.03	93.60
	U1520D_44X-2_94-96_4	2.77	1.53	9.41	58.51	1.14	4.59	6.38	0.21	14.61	0.19	99.34
	U1520D_44X-2_94-96_5	3.19	2.22	8.83	60.81	1.44	1.97	4.80	0.19	13.52	0.27	97.24
	U1520D_44X-2_94-96_6	2.60	1.26	11.56	56.48	1.20	6.05	7.41	0.28	12.84	0.12	99.80
	U1520D_44X-2_94-96_7	4.01	1.46	7.30	57.84	1.05	1.74	7.44	0.12	17.22	0.19	98.37
	U1520D_46X-1_11-12_1	3.61	3.46	1.17	73.77	0.15	0.14	0.98	0.08	11.79	0.00	95.15
	U1520D_46X-1_11-12_2	3.44	3.48	1.16	74.49	0.08	0.12	0.99	0.04	11.72	0.05	95.56
	U1520D_46X-1_11-12_3	3.37	3.47	1.23	73.85	0.11	0.12	1.01	0.06	11.80	0.02	95.05
	U1520D_46X-1_11-12_4	3.35	3.46	1.04	73.24	0.09	0.08	0.91	0.08	11.80	0.00	94.05
	U1520D_46X-1_11-12_5	3.56	3.40	1.10	73.60	0.12	0.12	0.96	0.00	11.81	0.02	94.68
	U1520D_46X-1_11-12_6	3.47	3.48	1.25	73.37	0.13	0.14	1.05	0.02	11.89	0.02	94.81
	U1520D_46X-1_11-12_7	3.59	3.40	1.08	73.39	0.10	0.08	0.93	0.06	11.69	0.02	94.35
	U1520D_46X-1_11-12_8	3.08	3.39	1.05	73.15	0.12	0.09	0.95	0.00	11.58	0.00	93.41
	U1520D_46X-1_11-12_9	3.28	3.46	1.16	73.95	0.12	0.11	0.94	0.03	11.62	0.03	94.69
	U1520D_46X-1_11-12_10	3.50	3.35	1.03	73.49	0.12	0.11	0.97	0.06	11.68	0.00	94.31
	U1520D_46X-1_11-12_11	3.52	3.49	1.06	73.32	0.13	0.09	1.00	0.04	11.63	0.01	94.29
	U1520D_46X-1_11-12_12	3.49	3.43	1.16	73.55	0.14	0.11	0.98	0.04	11.88	0.00	94.77
	U1520D_46X-1_11-12_13	3.59	3.53	1.07	72.79	0.12	0.09	1.03	0.09	11.76	0.01	94.08
	U1520D_46X-1_11-12_14	3.41	3.42	1.18	73.25	0.12	0.12	0.96	0.07	11.62	0.00	94.15
	U1520D_46X-1_11-12_15	3.43	3.37	1.15	72.90	0.13	0.13	0.97	0.01	11.74	0.03	93.85
	U1520D_46X-1_11-12_16	3.43	3.47	1.21	73.04	0.13	0.10	0.97	0.00	11.74	0.01	94.10
	U1520D_46X-1_11-12_17	3.45	3.40	1.06	73.38	0.12	0.11	0.99	0.06	11.50	0.01	94.08
	U1520D_46X-1_11-12_18	3.56	3.49	1.10	73.26	0.10	0.11	0.99	0.05	11.72	0.01	94.40
	U1520D_46X-1_11-12_19	3.65	3.44	1.31	73.57	0.12	0.07	1.00	0.08	11.64	0.00	94.89
	U1520D_46X-1_11-12_20	3.26	3.58	1.07	73.21	0.11	0.06	0.95	0.00	11.64	0.00	93.87
u44	U1520D_47X-1_17-19_1	3.40	3.41	1.46	73.35	0.16	0.15	1.35	0.09	12.11	0.01	95.50
	U1520D_47X-1_17-19_2	3.42	3.22	1.43	72.54	0.16	0.17	1.27	0.06	12.37	0.04	94.69
	U1520D_47X-1_17-19_3	3.71	3.33	1.51	73.11	0.17	0.19	1.27	0.05	12.05	0.00	95.38
	U1520D_47X-1_17-19_4	3.32	3.41	1.51	73.14	0.18	0.16	1.41	0.03	12.35	0.03	95.54
	U1520D_47X-1_17-19_5	3.79	3.51	1.14	73.76	0.14	0.09	0.94	0.05	11.78	0.03	95.24
	U1520D_47X-1_17-19_6	3.38	3.43	1.21	73.68	0.13	0.12	1.08	0.01	11.77	0.00	94.81
	U1520D_47X-1_17-19_7	3.37	3.55	1.15	73.86	0.12	0.10	1.13	0.05	11.91	0.01	95.24
	U1520D_47X-1_17-19_8	3.71	3.33	1.39	73.36	0.18	0.18	1.29	0.08	12.25	0.06	95.83
	U1520D_47X-1_17-19_9	3.41	3.41	1.36	73.49	0.16	0.11	1.30	0.09	12.08	0.03	95.43
	U1520D_47X-1_17-19_10	3.54	3.98	1.24	74.70	0.11	0.11	0.84	0.01	11.68	0.02	96.22
	U1520D_47X-1_17-19_11	3.35	3.82	1.27	73.99	0.15	0.11	1.02	0.06	12.10	0.03	95.90
	U1520D_47X-1_17-19_12	3.39	3.38	1.22	73.05	0.13	0.10	1.24	0.10	11.84	0.02	94.48
	U1520D_47X-1_17-19_13	3.70	3.29	1.47	72.95	0.16	0.22	1.44	0.08	12.37	0.00	95.68
	U1520D_47X-1_17-19_14	3.51	3.14	1.55	72.47	0.16	0.16	1.47	0.19	12.52	0.02	95.19
	U1520D_47X-1_17-19_15	3.73	3.31	1.59	72.77	0.18	0.18	1.40	0.07	12.46	0.02	95.71
	U1520D_47X-1_17-19_16	3.68	3.25	1.60	72.06	0.19	0.18	1.50	0.11	12.67	0.03	95.27
	U1520D_47X-1_17-19_17	3.40	3.61	1.19	73.48	0.12	0.08	0.79	0.03	11.66	0.01	94.39
	U1520D_47X-1_17-19_18	3.34	3.36	1.49	72.96	0.13	0.17	1.32	0.05	12.23	0.02	95.07
	U1520D_47X-1_17-19_19	3.17	3.79	1.05	74.24	0.14	0.09	0.95	0.07	11.97	0.00	95.47
	U1520D_47X-1_17-19_20	3.56	3.32	1.34	73.20	0.16	0.13	1.24	0.05	12.16	0.02	95.19
	1520D_47X-1_17-19_1	3.93	3.16	1.60	69.83	0.28	0.19	1.46	0.00	12.28	0.02	92.76
	1520D_47X-1_17-19_3	3.76	3.19	1.84	69.53	0.31	0.21	1.43	0.10	12.31	0.03	92.71
	1520D_47X-1_17-19_4	3.48	3.95	1.25	71.65	0.18	0.13	1.12	0.08	11.75	0.02	93.62
	1520D_47X-1_17-19_8	3.85	3.45	1.48	71.59	0.22	0.15	1.27	0.04	12.20	0.00	94.25
	1520D_47X-1_17-19_9	3.46	3.44	1.46	72.46	0.17	0.14	1.22	0.00	11.88	0.06	94.29
	1520D_47X-1_17-19_2	3.43	3.12	1.53	70.61	0.26	0.18	1.43	0.00	12.13	0.02	92.71
	1520D_47X-1_17-19_5	3.78	3.32	1.74	70.83	0.29	0.18	1.38	0.00	12.12	0.00	93.64

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s61	1520D_47X-1_17-19_6	3.73	3.22	1.49	71.30	0.25	0.17	1.30	0.05	12.02	0.02	93.55
	1520D_47X-1_17-19_7	3.60	3.18	1.65	71.09	0.25	0.14	1.41	0.09	12.20	0.03	93.63
	1520D_47X-1_17-19_10	3.71	3.27	1.52	71.92	0.26	0.18	1.39	0.00	12.12	0.04	94.42
	U1520D_47X-3_0-2_1	3.57	3.85	1.04	74.41	0.09	0.09	0.61	0.01	11.60	0.00	95.28
	U1520D_47X-3_0-2_2	3.54	3.76	1.01	73.86	0.06	0.07	0.57	0.00	11.50	0.04	94.41
	U1520D_47X-3_0-2_3	3.69	3.88	0.87	75.12	0.08	0.04	0.55	0.05	11.89	0.01	96.18
	U1520D_47X-3_0-2_4	3.52	3.75	1.00	73.95	0.11	0.11	0.62	0.04	11.69	0.00	94.79
	U1520D_47X-3_0-2_5	3.56	4.24	1.03	74.08	0.08	0.00	0.52	0.00	11.81	0.01	95.34
	U1520D_47X-3_0-2_6	3.61	3.84	0.93	74.20	0.12	0.10	0.65	0.09	11.66	0.00	95.20
	U1520D_47X-3_0-2_7	3.55	3.98	0.93	73.83	0.09	0.07	0.57	0.01	11.83	0.03	94.88
	U1520D_47X-3_0-2_8	3.67	3.56	1.04	73.71	0.11	0.10	0.75	0.04	11.82	0.03	94.81
	U1520D_47X-3_0-2_9	3.61	3.85	0.87	73.70	0.09	0.00	0.64	0.04	11.68	0.01	94.50
	U1520D_47X-3_0-2_10	3.52	3.93	1.08	74.04	0.10	0.14	0.61	0.05	11.94	0.03	95.45
	U1520D_47X-3_0-2_11	3.59	3.82	0.84	74.17	0.10	0.08	0.63	0.05	11.69	0.01	94.98
	U1520D_47X-3_0-2_12	3.51	3.89	0.94	74.20	0.08	0.08	0.61	0.03	11.88	0.00	95.23
	U1520D_47X-3_0-2_13	3.65	3.92	1.13	73.75	0.11	0.07	0.60	0.00	11.75	0.00	94.99
	U1520D_47X-3_0-2_15	3.48	3.88	1.01	73.76	0.07	0.08	0.64	0.03	11.69	0.01	94.66
	U1520D_47X-3_0-2_16	3.65	3.80	0.97	74.60	0.08	0.10	0.63	0.01	11.80	0.00	95.64
	U1520D_47X-3_0-2_17	3.55	3.78	1.09	73.71	0.11	0.04	0.59	0.05	11.58	0.00	94.50
	U1520D_47X-3_0-2_18	3.46	3.86	0.81	73.97	0.10	0.09	0.63	0.02	11.80	0.01	94.75
	U1520D_47X-3_0-2_19	3.49	3.84	1.13	74.42	0.09	0.08	0.65	0.09	11.76	0.00	95.55
	U1520D_47X-3_0-2_20	3.41	3.82	0.95	74.11	0.10	0.05	0.62	0.06	11.61	0.00	94.73
	1520D_47X-3_0-2_1	3.85	3.82	0.97	74.48	0.14	0.07	0.60	0.00	11.60	0.02	95.54
	1520D_47X-3_0-2_4	3.42	3.96	1.15	73.14	0.20	0.09	0.74	0.05	11.16	0.01	93.92
	1520D_47X-3_0-2_8	3.79	3.49	1.08	74.07	0.13	0.11	0.68	0.00	11.47	0.00	94.83
	1520D_47X-3_0-2_9	3.34	3.57	1.12	73.80	0.10	0.09	0.71	0.02	11.54	0.02	94.31
	1520D_47X-3_0-2_10	3.77	3.88	1.02	73.91	0.13	0.06	0.63	0.07	11.62	0.02	95.10
	1520D_47X-3_0-2_2	3.98	3.90	1.10	74.77	0.07	0.02	0.43	0.01	11.67	0.01	95.97
	1520D_47X-3_0-2_5	3.75	3.76	0.82	73.59	0.15	0.09	0.66	0.03	11.46	0.02	94.32
	1520D_47X-3_0-2_6	3.40	4.39	0.91	74.28	0.15	0.04	0.63	0.01	11.59	0.03	95.43
	1520D_47X-3_0-2_7	3.51	4.36	0.92	73.69	0.13	0.11	0.66	0.07	11.64	0.01	95.10
	U1520D_47X-3_100-102_1	3.48	3.83	1.16	74.19	0.12	0.05	0.68	0.06	11.71	0.00	95.28
	U1520D_47X-3_100-102_3	3.73	3.51	1.13	74.04	0.11	0.06	0.74	0.07	11.82	0.04	95.24
	U1520D_47X-3_100-102_4	3.54	3.85	1.00	74.00	0.10	0.07	0.61	0.07	11.84	0.00	95.07
	U1520D_47X-3_100-102_6	3.39	3.86	0.99	73.58	0.08	0.05	0.61	0.08	11.80	0.05	94.48
	U1520D_47X-3_100-102_7	3.77	3.54	1.10	73.69	0.12	0.10	0.74	0.05	11.61	0.03	94.74
	U1520D_47X-3_100-102_8	3.69	3.51	1.18	73.88	0.11	0.07	0.70	0.04	11.87	0.02	95.07
	U1520D_47X-3_100-102_9	3.60	3.81	1.21	73.75	0.11	0.04	0.75	0.05	11.66	0.03	95.01
	U1520D_47X-3_100-102_10	3.86	3.57	1.22	74.51	0.10	0.06	0.75	0.01	11.62	0.03	95.73
	U1520D_47X-3_111-113_1	2.98	3.58	1.52	69.98	0.12	0.12	0.96	0.06	11.33	0.06	90.70
	U1520D_47X-3_111-113_2	3.84	3.53	1.17	69.01	0.09	0.08	0.64	0.07	11.30	0.02	89.75
	U1520D_47X-3_111-113_3	3.65	3.91	1.11	72.55	0.05	0.07	0.63	0.09	11.70	0.00	93.76
	U1520D_47X-3_111-113_4	3.73	3.74	0.99	72.61	0.10	0.03	0.59	0.00	11.52	0.00	93.31
	U1520D_47X-3_111-113_5	3.84	3.35	1.23	71.87	0.09	0.06	0.73	0.04	11.81	0.00	93.01
	U1520D_47X-3_111-113_6	3.78	3.87	1.09	72.47	0.07	0.03	0.58	0.05	11.58	0.02	93.53
	U1520D_47X-3_111-113_7	3.47	3.74	0.86	71.60	0.10	0.06	0.58	0.00	11.66	0.01	92.07
	U1520D_47X-3_111-113_10	3.47	3.95	0.86	72.95	0.06	0.00	0.54	0.00	11.62	0.00	93.46
	U1520D_47X-3_111-113_11	3.51	3.45	1.20	71.11	0.08	0.10	0.93	0.00	11.67	0.02	92.07
	U1520D_47X-3_111-113_12	3.47	3.33	1.91	69.38	0.16	0.09	1.05	0.06	12.15	0.04	91.64
	U1520D_47X-3_111-113_13	3.50	3.45	1.17	71.33	0.15	0.11	0.94	0.10	11.68	0.01	92.44
	U1520D_47X-3_111-113_14	3.92	3.39	1.17	73.70	0.11	0.07	0.78	0.06	11.44	0.00	94.65
	U1520D_47X-3_111-113_15	3.76	1.18	1.13	73.33	0.08	0.00	0.19	0.03	11.71	0.01	91.41
	U1520D_47X-3_111-113_16	3.58	2.86	0.97	74.68	0.06	0.06	0.67	0.02	11.91	0.01	94.82
	U1520D_47X-3_111-113_18	3.91	3.73	1.27	73.67	0.08	0.03	0.54	0.04	11.69	0.00	94.96
	U1520D_47X-3_111-113_19	4.93	2.11	1.73	69.77	0.29	0.24	1.21	0.06	12.70	0.00	93.05
	U1520D_47X-3_111-113_20	3.76	3.54	1.09	73.47	0.10	0.08	0.75	0.02	11.61	0.01	94.44
u46	1520D_47X-3_111-113_5	4.10	3.55	1.71	73.01	0.13	0.05	0.88	0.09	11.98	0.01	95.51
	1520D_47X-3_111-113_8	3.75	3.42	1.07	73.62	0.14	0.06	0.76	0.04	11.56	0.00	94.42
	1520D_47X-3_111-113_6	3.89	3.49	1.19	74.19	0.15	0.08	0.69	0.08	11.55	0.00	95.30
	1520D_47X-3_111-113_4	3.69	3.85	0.91	73.57	0.11	0.00	0.57	0.01	11.57	0.00	94.28
	1520D_47X-3_111-113_9	3.94	3.42	1.11	73.81	0.14	0.08	0.73	0.03	11.38	0.00	94.64
	U1520D_48X-2_47-49_1	4.29	3.77	1.51	73.90	0.07	0.02	0.68	0.12	11.68	0.00	96.05
	U1520D_48X-2_47-49_2	4.32	3.32	1.56	73.64	0.08	0.04	0.67	0.10	11.58	0.00	95.32
	U1520D_48X-2_47-49_3	4.15	3.12	2.11	71.67	0.18	0.11	1.03	0.01	12.33	0.01	94.71
	U1520D_48X-2_47-49_4	4.27	3.21	1.45	72.94	0.13	0.04	0.72	0.06	11.46	0.03	94.29
	U1520D_48X-2_47-49_5	3.79	3.24	1.40	70.67	0.12	0.13	1.11	0.04	12.28	0.00	92.79
	U1520D_48X-2_47-49_6	4.12	3.22	1.40	72.25	0.13	0.05	0.76	0.14	11.64	0.00	93.70
	U1520D_48X-2_47-49_7	3.71	3.29	1.34	73.58	0.09	0.06	0.52	0.06	11.34	0.01	94.01
	U1520D_48X-2_47-49_8	3.97	3.20	1.48	73.24	0.10	0.03	0.66	0.06	11.64	0.01	94.39
	U1520D_48X-2_47-49_9	3.88	3.12	2.12	71.47	0.18	0.14	0.99	0.10	12.17	0.01	94.18

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s65	U1520D_48X-2_47-49_10	4.04	3.27	1.52	72.80	0.11	0.06	0.67	0.12	11.72	0.01	94.32
	U1520D_48X-2_47-49_11	3.87	3.33	1.59	74.04	0.09	0.07	0.66	0.00	11.46	0.00	95.11
	U1520D_48X-2_47-49_13	4.05	3.30	1.49	73.08	0.11	0.06	0.56	0.02	11.20	0.00	93.87
	U1520D_48X-2_47-49_14	4.41	3.20	1.97	72.34	0.16	0.10	1.01	0.08	12.27	0.00	95.54
	U1520D_48X-2_47-49_15	4.20	3.10	1.98	71.64	0.19	0.11	0.97	0.09	12.20	0.02	94.50
	U1520D_48X-2_47-49_16	4.32	3.19	1.63	72.66	0.11	0.03	0.84	0.05	12.09	0.00	94.92
	U1520D_48X-2_47-49_17	3.94	3.46	1.40	73.27	0.09	0.03	0.63	0.07	11.42	0.00	94.31
	U1520D_48X-2_47-49_18	4.06	3.26	1.90	71.82	0.16	0.12	0.99	0.09	12.30	0.01	94.72
	U1520D_48X-2_47-49_19	4.30	3.10	1.73	73.38	0.14	0.05	0.74	0.10	11.85	0.01	95.40
	U1520D_48X-2_47-49_20	3.96	3.32	1.30	73.07	0.08	0.05	0.61	0.07	11.57	0.01	94.04
	U1520D_48X-CC_22-24_1	4.07	3.09	2.25	71.04	0.22	0.16	1.18	0.06	12.29	0.00	94.37
	U1520D_48X-CC_22-24_2	3.59	3.40	1.50	71.71	0.10	0.01	1.08	0.10	12.27	0.00	93.76
	U1520D_48X-CC_22-24_3	3.98	3.21	1.81	72.47	0.18	0.08	0.91	0.10	11.61	0.02	94.37
	U1520D_48X-CC_22-24_4	4.39	3.29	1.81	72.62	0.13	0.07	0.99	0.03	12.41	0.01	95.77
	U1520D_48X-CC_22-24_5	4.23	3.06	2.08	71.16	0.25	0.16	1.21	0.04	12.14	0.02	94.35
	U1520D_48X-CC_22-24_6	3.82	3.48	1.39	73.55	0.12	0.02	0.76	0.08	11.43	0.01	94.66
	U1520D_48X-CC_22-24_7	4.24	3.09	2.23	71.61	0.23	0.15	1.18	0.08	12.50	0.01	95.32
	U1520D_48X-CC_22-24_8	3.86	3.30	1.71	72.48	0.15	0.08	0.85	0.08	11.64	0.00	94.15
	U1520D_48X-CC_22-24_9	4.16	3.05	1.81	71.31	0.14	0.10	1.16	0.05	12.24	0.00	94.02
	U1520D_48X-CC_22-24_10	4.21	3.24	1.84	72.49	0.20	0.12	0.89	0.10	12.05	0.04	95.20
	U1520D_48X-CC_22-24_11	4.18	3.10	2.14	71.34	0.20	0.17	1.21	0.00	12.12	0.00	94.47
	U1520D_48X-CC_22-24_12	3.88	3.02	2.62	70.80	0.21	0.15	1.40	0.03	12.67	0.01	94.79
	U1520D_48X-CC_22-24_13	3.44	2.71	2.00	65.40	0.19	0.12	1.06	0.01	11.23	0.01	86.18
	U1520D_48X-CC_22-24_14	4.09	3.07	2.25	71.55	0.25	0.15	1.16	0.06	12.29	0.02	94.88
	U1520D_48X-CC_22-24_15	3.90	3.36	1.78	70.35	0.23	0.11	0.99	0.07	12.10	0.00	92.88
	U1520D_48X-CC_22-24_16	4.03	3.01	2.20	71.07	0.21	0.17	1.20	0.06	12.45	0.00	94.40
	U1520D_48X-CC_22-24_17	4.07	3.35	1.56	72.27	0.11	0.03	0.79	0.03	12.04	0.00	94.25
	U1520D_48X-CC_22-24_18	4.28	3.18	2.00	72.06	0.17	0.10	0.88	0.00	11.91	0.02	94.60
	U1520D_48X-CC_22-24_20	4.12	3.09	2.11	71.48	0.21	0.15	1.26	0.05	12.84	0.04	95.34
	1520D_48X-CC_22-24_5	3.85	3.44	1.30	73.24	0.17	0.02	0.74	0.00	11.72	0.00	94.48
	1520D_48X-CC_22-24_1	4.06	2.82	2.14	69.35	0.36	0.15	1.38	0.08	12.57	0.00	92.91
	1520D_48X-CC_22-24_2	4.17	3.02	2.00	69.90	0.23	0.11	1.20	0.08	12.66	0.06	93.42
	1520D_48X-CC_22-24_3	4.57	3.00	2.17	70.45	0.37	0.12	1.15	0.04	12.21	0.00	94.08
	1520D_48X-CC_22-24_4	4.20	2.94	2.37	69.68	0.34	0.17	1.37	0.06	12.62	0.02	93.76
	1520D_48X-CC_22-24_10	4.10	3.04	1.86	71.44	0.17	0.13	1.23	0.06	12.44	0.02	94.49
s73	U1520D_49X-1_15-17_1	3.96	3.50	1.42	72.70	0.13	0.07	0.97	0.07	12.29	0.01	95.12
	U1520D_49X-1_15-17_2	4.03	3.30	1.71	72.97	0.13	0.07	1.05	0.08	12.29	0.00	95.63
	U1520D_49X-1_15-17_3	3.45	3.67	1.26	73.51	0.05	0.03	0.75	0.03	11.82	0.01	94.58
	U1520D_49X-1_15-17_4	4.41	3.13	2.06	71.39	0.16	0.08	1.03	0.11	12.88	0.00	95.26
	U1520D_49X-1_15-17_5	3.68	3.46	1.57	73.14	0.11	0.02	0.92	0.00	12.13	0.01	95.04
	U1520D_49X-1_15-17_6	3.91	3.38	1.50	72.76	0.09	0.05	1.02	0.01	12.45	0.01	95.19
	U1520D_49X-1_15-17_7	3.78	3.31	1.69	72.31	0.12	0.06	1.00	0.00	12.11	0.00	94.39
	U1520D_49X-1_15-17_8	3.65	3.24	1.60	72.65	0.07	0.05	0.94	0.07	12.17	0.00	94.44
	U1520D_49X-1_15-17_9	3.66	3.64	1.32	73.51	0.06	0.04	0.79	0.03	11.84	0.01	94.89
	U1520D_49X-1_15-17_10	3.61	3.60	1.20	73.11	0.07	0.02	0.78	0.00	11.77	0.00	94.16
	U1520D_49X-1_15-17_11	4.09	3.30	1.86	72.80	0.13	0.05	1.05	0.09	12.54	0.00	95.91
	U1520D_49X-1_15-17_12	3.61	3.65	1.39	73.40	0.10	0.09	0.88	0.04	11.86	0.00	95.02
	U1520D_49X-1_15-17_13	4.15	3.35	1.71	73.56	0.10	0.04	0.92	0.02	12.47	0.00	96.32
	U1520D_49X-1_15-17_14	3.55	3.64	1.35	73.67	0.08	0.03	0.83	0.04	12.04	0.00	95.23
	U1520D_49X-1_15-17_15	3.89	3.42	1.55	72.57	0.10	0.03	0.95	0.02	12.24	0.00	94.77
	U1520D_49X-1_15-17_16	3.41	3.94	1.21	74.89	0.10	0.05	0.84	0.01	12.04	0.02	96.52
	U1520D_49X-1_15-17_17	3.87	3.41	1.39	73.15	0.08	0.04	0.89	0.08	12.07	0.01	95.00
	U1520D_49X-1_15-17_18	3.81	3.27	1.55	73.18	0.10	0.05	0.88	0.00	12.29	0.01	95.13
	U1520D_49X-1_15-17_19	4.07	3.34	1.55	73.03	0.09	0.05	0.92	0.04	12.31	0.00	95.41
	U1520D_49X-1_15-17_20	3.73	3.34	1.36	73.31	0.06	0.08	0.91	0.07	12.11	0.00	94.98
	1520D_49X-1_15-17cm_1	3.90	3.47	1.56	73.16	0.11	0.05	0.95	0.06	12.38	0.01	95.66
	1520D_49X-1_15-17cm_2	4.04	3.41	1.70	72.55	0.14	0.05	0.94	0.06	12.27	0.00	95.16
	1520D_49X-1_15-17cm_4	3.95	3.46	1.63	73.81	0.11	0.05	0.88	0.01	12.06	0.02	95.97
	1520D_49X-1_15-17cm_10	4.12	3.24	1.61	72.88	0.11	0.04	0.95	0.04	12.46	0.00	95.44
	1520D_49X-1_15-17cm_3	3.77	3.48	1.45	73.20	0.11	0.05	0.84	0.07	11.96	0.03	94.97
	1520D_49X-1_15-17cm_5	3.48	3.43	1.49	68.65	0.08	0.09	0.93	0.00	11.51	0.02	89.68
	1520D_49X-1_15-17cm_7	3.86	3.80	1.63	73.02	0.09	0.09	0.94	0.06	12.17	0.00	95.66
	1520D_49X-1_15-17cm_8	3.85	3.32	1.66	72.81	0.12	0.07	0.97	0.03	12.47	0.00	95.30
s75*	U1520D_49X-1_28-30_1	3.78	3.37	1.57	73.40	0.12	0.12	1.10	0.13	12.41	0.00	95.99
	U1520D_49X-1_28-30_2	3.90	3.27	1.83	71.86	0.15	0.10	1.19	0.08	12.70	0.02	95.10
	U1520D_49X-1_28-30_3	3.67	3.62	1.30	73.78	0.12	0.02	0.82	0.02	11.74	0.03	95.12
	U1520D_49X-1_28-30_4	3.78	3.38	1.63	71.75	0.13	0.08	1.09	0.05	12.45	0.02	94.37
	U1520D_49X-1_28-30_5	3.90	3.17	1.91	72.00	0.15	0.11	1.21	0.13	12.52	0.02	95.14
	U1520D_49X-1_28-30_6	3.60	3.55	1.45	72.57	0.10	0.02	0.89	0.07	12.02	0.01	94.28
	U1520D_49X-1_28-30_7	3.94	3.43	1.64	72.89	0.13	0.07	1.13	0.00	12.68	0.01	95.92

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u55	U1520D_49X-1_28-30_8	3.87	3.37	1.68	72.86	0.12	0.08	1.10	0.03	12.59	0.00	95.71
	U1520D_49X-1_28-30_9	3.66	3.44	1.25	70.78	0.11	0.09	0.79	0.03	11.70	0.04	91.89
	U1520D_49X-1_28-30_10	4.05	3.38	1.72	71.77	0.13	0.09	1.24	0.00	12.61	0.01	95.00
	U1520D_49X-1_28-30_11	3.88	3.41	1.65	72.49	0.13	0.09	1.07	0.04	12.45	0.02	95.23
	U1520D_49X-1_28-30_12	3.86	3.17	1.85	70.10	0.17	0.15	1.17	0.06	12.39	0.06	92.97
	U1520D_49X-1_28-30_13	3.60	3.49	1.50	72.91	0.10	0.06	0.95	0.04	12.32	0.00	94.97
	U1520D_49X-1_28-30_14	4.18	3.54	1.96	72.16	0.16	0.05	1.03	0.05	12.85	0.00	95.98
	U1520D_49X-1_28-30_15	3.38	3.69	1.53	72.84	0.13	0.08	1.00	0.02	12.44	0.01	95.12
	U1520D_49X-1_28-30_16	3.74	3.40	1.66	72.46	0.13	0.12	1.07	0.10	12.33	0.00	95.01
	U1520D_49X-1_28-30_17	4.19	3.23	2.06	71.72	0.14	0.12	1.18	0.00	12.73	0.04	95.40
	U1520D_49X-1_28-30_18	3.85	3.42	1.73	72.87	0.09	0.11	1.08	0.10	12.48	0.00	95.72
	U1520D_49X-1_28-30_19	4.18	3.10	1.51	72.50	0.11	0.10	1.35	0.05	13.31	0.03	96.24
	U1520D_49X-1_28-30_20	4.02	3.35	1.86	71.58	0.14	0.08	1.27	0.05	12.98	0.03	95.36
	1520D_49X-1_28-30_2	3.62	3.51	1.62	71.95	0.15	0.09	0.96	0.03	12.31	0.00	94.24
	1520D_49X-1_28-30_7	3.66	3.48	1.40	72.31	0.13	0.07	1.00	0.07	12.08	0.02	94.22
	1520D_49X-1_28-30_3	3.51	3.60	1.73	71.05	0.27	0.20	1.50	0.07	12.85	0.02	94.80
	1520D_49X-1_28-30_5	3.88	3.16	1.57	70.45	0.17	0.11	1.17	0.05	12.35	0.03	92.94
	1520D_49X-1_28-30_6	3.88	3.44	1.80	71.68	0.19	0.07	1.14	0.02	12.78	0.00	95.00
	1520D_49X-1_28-30_1	3.89	3.23	1.62	70.17	0.18	0.07	1.09	0.01	12.25	0.00	92.51
	1520D_49X-1_28-30_8	4.20	3.43	1.61	71.95	0.17	0.08	1.12	0.01	12.78	0.01	95.37
	1520D_49X-1_28-30_9	3.94	3.31	1.43	71.81	0.11	0.08	0.97	0.03	12.15	0.00	93.83
	1520D_49X-1_28-30_10	3.71	3.43	1.42	73.34	0.14	0.09	1.07	0.06	12.34	0.00	95.59
	U1520D_49X-CC_29-31_1	3.73	3.34	1.47	71.97	0.15	0.17	1.08	0.11	12.05	0.04	94.12
	U1520D_49X-CC_29-31_2	3.56	3.44	1.55	72.06	0.17	0.16	1.16	0.07	12.01	0.02	94.20
	U1520D_49X-CC_29-31_3	3.70	3.37	1.44	72.61	0.16	0.14	0.96	0.04	12.14	0.02	94.58
	U1520D_49X-CC_29-31_4	4.02	3.41	1.29	72.45	0.15	0.15	1.07	0.03	12.49	0.06	95.12
	U1520D_49X-CC_29-31_5	3.70	3.32	1.30	72.17	0.12	0.13	1.06	0.13	12.26	0.02	94.22
	U1520D_49X-CC_29-31_6	3.56	3.49	1.35	73.10	0.14	0.15	0.95	0.01	12.21	0.01	94.97
	U1520D_49X-CC_29-31_7	4.00	3.15	1.92	71.16	0.18	0.19	1.50	0.00	12.92	0.00	95.02
	U1520D_49X-CC_29-31_8	3.71	3.49	1.51	72.26	0.14	0.16	1.08	0.09	12.41	0.01	94.86
	U1520D_49X-CC_29-31_9	3.81	3.21	1.52	71.26	0.14	0.19	1.25	0.06	12.40	0.01	93.84
	U1520D_49X-CC_29-31_10	3.70	3.44	1.34	72.05	0.12	0.13	1.04	0.00	12.23	0.01	94.06
	U1520D_49X-CC_29-31_11	3.51	3.62	1.27	72.33	0.12	0.09	0.85	0.12	11.87	0.00	93.78
	U1520D_49X-CC_29-31_13	3.81	3.53	1.48	71.81	0.14	0.12	1.05	0.00	12.19	0.02	94.16
	U1520D_49X-CC_29-31_14	3.84	3.27	1.50	70.94	0.15	0.14	1.19	0.09	12.36	0.01	93.49
	U1520D_49X-CC_29-31_15	3.61	3.23	1.36	71.35	0.17	0.13	1.07	0.00	12.07	0.00	92.98
	U1520D_49X-CC_29-31_16	3.70	3.20	1.38	71.98	0.13	0.14	1.06	0.03	12.29	0.00	93.91
	U1520D_49X-CC_29-31_17	2.75	3.32	1.24	70.33	0.18	0.16	0.93	0.00	12.60	0.00	91.52
	U1520D_49X-CC_29-31_18	3.64	3.44	1.95	71.32	0.22	0.26	1.63	0.03	13.27	0.05	95.80
	U1520D_49X-CC_29-31_19	3.84	3.44	1.47	72.82	0.17	0.16	1.11	0.01	12.55	0.02	95.60
	U1520D_49X-CC_29-31_20	3.60	3.45	1.42	72.41	0.14	0.14	1.09	0.07	12.41	0.02	94.76
	1520D_49X-CC_29-31_2	3.76	3.33	1.36	71.85	0.22	0.19	1.06	0.08	12.35	0.04	94.24
	1520D_49X-CC_29-31_6	3.42	3.19	1.28	70.92	0.19	0.11	1.08	0.12	11.92	0.03	92.26
	1520D_49X-CC_29-31_4	3.16	3.70	1.45	69.80	0.22	0.13	1.14	0.09	12.03	0.02	91.74
	1520D_49X-CC_29-31_9	3.94	3.45	1.75	71.57	0.25	0.11	1.09	0.00	12.05	0.01	94.23
	1520D_49X-CC_29-31_10	4.13	3.27	1.47	72.48	0.22	0.12	1.09	0.03	12.19	0.04	95.05
	1520D_49X-CC_29-31_1	3.96	3.32	1.54	71.45	0.19	0.13	1.17	0.07	12.18	0.02	94.03
	1520D_49X-CC_29-31_3	3.95	3.43	1.49	72.08	0.22	0.06	0.91	0.05	11.77	0.02	93.98
	1520D_49X-CC_29-31_5	4.06	3.44	1.43	72.21	0.22	0.14	1.03	0.10	12.42	0.00	95.04
	1520D_49X-CC_29-31_7	3.93	3.56	1.39	71.83	0.21	0.11	0.99	0.00	12.15	0.00	94.17
	1520D_49X-CC_29-31_8	3.77	3.36	1.52	68.08	0.23	0.12	1.10	0.02	12.49	0.02	90.71
	U1520D_50X-CC_11-13_1	4.40	3.18	2.17	71.64	0.14	0.08	1.07	0.07	12.65	0.00	95.39
	U1520D_50X-CC_11-13_2	4.16	3.15	2.03	71.16	0.14	0.07	1.10	0.06	12.75	0.00	94.63
	U1520D_50X-CC_11-13_3	3.77	3.40	1.82	72.19	0.10	0.02	0.89	0.09	12.29	0.02	94.60
	U1520D_50X-CC_11-13_4	4.35	3.34	2.10	71.26	0.14	0.08	1.09	0.11	12.76	0.01	95.24
	U1520D_50X-CC_11-13_5	4.28	3.41	2.18	71.69	0.14	0.07	1.02	0.11	12.77	0.00	95.67
	U1520D_50X-CC_11-13_6	4.15	3.37	1.70	72.24	0.11	0.04	0.75	0.04	12.13	0.00	94.54
	U1520D_50X-CC_11-13_7	3.61	3.41	1.74	71.43	0.16	0.06	0.90	0.11	12.16	0.06	93.64
	U1520D_50X-CC_11-13_8	4.17	3.25	1.86	71.05	0.13	0.09	1.06	0.08	12.62	0.03	94.34
	U1520D_50X-CC_11-13_9	4.14	3.12	2.09	69.80	0.15	0.05	1.07	0.07	12.42	0.02	92.94
	U1520D_50X-CC_11-13_10	4.32	3.11	2.10	71.00	0.16	0.06	1.10	0.13	12.61	0.01	94.60
	U1520D_50X-CC_11-13_11	4.08	3.15	2.12	71.39	0.12	0.01	1.10	0.11	12.53	0.00	94.62
	U1520D_50X-CC_11-13_12	4.01	3.29	2.11	70.04	0.17	0.04	1.09	0.02	12.49	0.01	93.27
	U1520D_50X-CC_11-13_13	4.34	3.03	2.06	71.73	0.15	0.16	1.26	0.04	12.51	0.02	95.30
	U1520D_50X-CC_11-13_15	4.30	3.35	2.12	71.40	0.14	0.09	1.07	0.07	12.65	0.02	95.20
	U1520D_50X-CC_11-13_16	4.18	3.47	1.81	71.60	0.11	0.06	1.09	0.09	12.53	0.03	94.96
	U1520D_50X-CC_11-13_17	3.34	3.76	1.18	74.34	0.03	0.00	0.84	0.03	11.58	0.03	95.13
	U1520D_50X-CC_11-13_18	3.07	4.77	0.99	72.58	0.07	0.02	0.73	0.09	11.69	0.02	94.02
	U1520D_50X-CC_11-13_19	4.19	3.17	2.09	70.66	0.16	0.08	1.07	0.11	12.57	0.01	94.13
	U1520D_50X-CC_11-13_20	3.34	3.86	1.20	73.97	0.05	0.02	0.76	0.03	11.74	0.00	94.96

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s83	U1520D_50X-CC_37-39_1	4.03	3.40	2.25	72.52	0.15	0.06	0.96	0.02	12.50	0.03	95.92
	U1520D_50X-CC_37-39_2	4.04	3.41	2.03	71.47	0.15	0.03	1.02	0.07	12.24	0.00	94.47
	U1520D_50X-CC_37-39_3	3.92	3.49	2.07	71.53	0.13	0.08	0.96	0.06	12.30	0.04	94.59
	U1520D_50X-CC_37-39_4	4.22	3.42	2.16	71.58	0.16	0.09	1.05	0.03	12.33	0.00	95.04
	U1520D_50X-CC_37-39_5	4.10	3.45	2.32	71.56	0.15	0.07	1.02	0.03	12.44	0.03	95.16
	U1520D_50X-CC_37-39_6	4.71	3.21	2.26	71.38	0.16	0.14	1.12	0.07	12.99	0.00	96.03
	U1520D_50X-CC_37-39_7	3.84	3.15	4.66	69.31	0.16	0.73	1.79	0.12	11.94	0.00	95.69
	U1520D_50X-CC_37-39_8	4.07	3.49	2.21	71.89	0.16	0.10	1.06	0.05	12.40	0.05	95.48
	U1520D_50X-CC_37-39_9	3.76	3.25	2.13	71.22	0.14	0.09	1.00	0.05	12.31	0.00	93.95
	U1520D_50X-CC_37-39_10	4.02	3.41	1.88	71.32	0.15	0.07	1.01	0.10	12.27	0.02	94.25
	U1520D_50X-CC_37-39_11	4.01	3.40	2.24	71.19	0.13	0.06	1.01	0.00	12.21	0.00	94.25
	U1520D_50X-CC_37-39_12	4.07	3.43	1.97	71.16	0.15	0.05	0.99	0.09	12.09	0.02	94.02
	U1520D_50X-CC_37-39_13	4.48	3.23	1.75	70.77	0.19	0.09	1.03	0.06	12.76	0.00	94.36
	U1520D_50X-CC_37-39_14	3.84	3.34	2.05	71.19	0.13	0.08	1.03	0.01	12.28	0.00	93.95
	U1520D_50X-CC_37-39_15	4.02	3.42	2.12	71.32	0.17	0.10	1.01	0.05	12.20	0.01	94.42
	U1520D_50X-CC_37-39_16	4.05	3.49	2.23	71.93	0.19	0.06	1.03	0.08	12.28	0.01	95.35
	U1520D_50X-CC_37-39_17	4.47	3.26	2.04	71.68	0.11	0.09	1.09	0.07	12.98	0.02	95.80
	U1520D_50X-CC_37-39_18	4.53	3.20	1.97	71.81	0.18	0.05	1.05	0.14	12.85	0.00	95.77
	U1520D_50X-CC_37-39_19	4.05	3.49	2.10	72.11	0.16	0.05	1.04	0.11	12.29	0.02	95.43
	U1520D_50X-CC_37-39_20	3.89	3.39	2.13	72.24	0.15	0.08	0.99	0.00	12.48	0.01	95.36
	1520D_50X-CC_37-39_1	4.07	3.31	2.11	70.96	0.21	0.08	0.99	0.08	12.00	0.00	93.82
	1520D_50X-CC_37-39_2	4.05	3.37	2.15	71.36	0.22	0.06	1.03	0.05	12.34	0.00	94.62
	1520D_50X-CC_37-39_3	4.57	3.27	2.09	72.10	0.19	0.05	0.99	0.00	12.25	0.00	95.51
	1520D_50X-CC_37-39_4	4.12	3.22	2.08	70.71	0.17	0.08	1.02	0.03	12.13	0.01	93.56
	1520D_50X-CC_37-39_5	4.54	3.06	2.16	69.84	0.20	0.10	1.06	0.05	12.65	0.00	93.66
	1520D_50X-CC_37-39_6	3.83	3.41	2.19	70.68	0.18	0.06	1.01	0.09	12.14	0.00	93.59
	1520D_50X-CC_37-39_7	4.21	3.35	2.23	70.99	0.22	0.05	1.01	0.09	12.25	0.02	94.41
	1520D_50X-CC_37-39_8	4.28	3.47	2.00	71.72	0.21	0.08	1.02	0.04	12.35	0.03	95.20
	1520D_50X-CC_37-39_9	4.28	3.39	1.98	71.13	0.20	0.08	0.98	0.09	12.29	0.01	94.43
	1520D_50X-CC_37-39_10	4.36	3.38	2.23	71.42	0.20	0.09	0.98	0.11	12.33	0.01	95.11
	U1520D_50X-CC_46-48_1	4.23	3.78	1.56	72.43	0.14	0.10	1.01	0.05	12.81	0.00	96.11
	U1520D_50X-CC_46-48_2	4.83	3.09	2.39	71.18	0.18	0.06	1.12	0.10	12.66	0.03	95.63
	U1520D_50X-CC_46-48_3	4.55	2.96	2.15	70.52	0.18	0.15	1.10	0.09	12.80	0.05	94.55
	U1520D_50X-CC_46-48_4	4.61	3.04	2.30	70.63	0.18	0.12	1.12	0.14	12.99	0.04	95.18
	U1520D_50X-CC_46-48_5	4.77	3.01	2.41	70.82	0.17	0.09	1.11	0.07	12.76	0.01	95.22
	U1520D_50X-CC_46-48_6	3.85	3.25	2.19	70.90	0.18	0.05	1.05	0.06	11.94	0.00	93.47
	U1520D_50X-CC_46-48_7	4.56	3.07	2.17	70.31	0.22	0.06	1.12	0.19	12.72	0.00	94.42
	U1520D_50X-CC_46-48_8	4.13	3.07	2.14	70.42	0.13	0.07	1.18	0.11	12.70	0.00	93.96
	U1520D_50X-CC_46-48_9	4.69	3.14	2.06	70.73	0.18	0.11	1.14	0.06	12.87	0.02	95.00
	U1520D_50X-CC_46-48_10	4.65	3.13	2.17	71.35	0.16	0.15	1.15	0.05	12.82	0.06	95.68
	U1520D_50X-CC_46-48_11	4.36	2.94	2.55	70.47	0.19	0.10	1.19	0.05	12.85	0.03	94.74
	U1520D_50X-CC_46-48_12	4.32	3.02	2.20	70.18	0.15	0.13	1.10	0.07	12.75	0.02	93.94
	U1520D_50X-CC_46-48_14	4.40	2.96	2.50	70.29	0.21	0.13	1.21	0.12	12.99	0.03	94.84
	U1520D_50X-CC_46-48_15	4.45	3.09	2.38	71.04	0.12	0.09	1.13	0.10	13.04	0.03	95.46
	U1520D_50X-CC_46-48_16	4.21	3.09	2.25	71.17	0.17	0.12	1.11	0.11	12.78	0.02	95.02
	U1520D_50X-CC_46-48_17	4.42	2.96	2.29	70.67	0.18	0.07	1.15	0.06	12.82	0.00	94.62
	U1520D_50X-CC_46-48_18	4.33	2.96	2.29	69.74	0.20	0.09	1.12	0.09	12.69	0.00	93.52
	U1520D_50X-CC_46-48_19	4.48	2.98	2.25	70.67	0.19	0.12	1.08	0.05	12.82	0.00	94.64
	U1520D_50X-CC_46-48_20	4.52	3.15	1.91	70.99	0.18	0.09	1.07	0.01	12.78	0.02	94.72
u59	U1520D_51X-1_26-28_1	4.72	3.22	2.11	70.00	0.19	0.15	1.26	0.04	13.00	0.02	94.71
	U1520D_51X-1_26-28_2	4.13	3.23	2.19	70.25	0.20	0.12	1.24	0.08	12.92	0.00	94.36
	U1520D_51X-1_26-28_3	4.42	3.25	2.11	70.18	0.21	0.20	1.24	0.03	12.94	0.00	94.58
	U1520D_51X-1_26-28_4	4.00	3.29	2.14	69.58	0.21	0.14	1.26	0.05	13.10	0.02	93.78
	U1520D_51X-1_26-28_5	4.45	3.21	2.19	70.14	0.23	0.16	1.22	0.06	12.91	0.03	94.61
	U1520D_51X-1_26-28_6	4.40	3.48	2.26	70.56	0.18	0.18	1.26	0.11	13.14	0.04	95.61
	U1520D_51X-1_26-28_7	4.37	3.26	2.17	70.62	0.22	0.18	1.19	0.10	12.93	0.03	95.07
	U1520D_51X-1_26-28_8	4.60	3.37	2.38	69.86	0.17	0.15	1.20	0.14	13.05	0.02	94.95
	U1520D_51X-1_26-28_9	4.25	3.36	2.30	69.66	0.22	0.18	1.23	0.02	13.05	0.02	94.29
	U1520D_51X-1_26-28_10	4.15	3.61	2.24	70.06	0.17	0.18	1.27	0.14	13.10	0.04	94.96
	U1520D_51X-1_26-28_11	4.51	3.26	2.14	69.79	0.22	0.16	1.18	0.07	13.18	0.03	94.54
	U1520D_51X-1_26-28_12	4.18	3.25	2.09	69.91	0.22	0.19	1.21	0.00	12.97	0.02	94.04
	U1520D_51X-1_26-28_13	4.31	3.25	2.25	69.35	0.18	0.19	1.21	0.02	12.77	0.00	93.54
	U1520D_51X-1_26-28_14	4.14	3.24	1.99	69.29	0.21	0.18	1.22	0.01	12.85	0.04	93.17
	U1520D_51X-1_26-28_15	4.39	3.23	2.12	69.91	0.18	0.20	1.20	0.00	12.92	0.03	94.18
	U1520D_51X-1_26-28_16	4.41	3.23	2.17	69.70	0.20	0.17	1.19	0.00	12.78	0.02	93.87
	U1520D_51X-1_26-28_17	4.30	3.30	2.25	69.97	0.22	0.17	1.19	0.13	13.19	0.00	94.72
	U1520D_51X-1_26-28_18	4.08	3.20	2.17	70.08	0.21	0.17	1.19	0.13	12.94	0.04	94.21
	U1520D_51X-1_26-28_19	4.06	3.27	2.40	69.81	0.19	0.15	1.23	0.09	13.09	0.02	94.31
	U1520D_51X-1_26-28_20	4.35	3.20	2.14	69.73	0.20	0.16	1.24	0.14	13.09	0.04	94.28
	1520D_51X-1_26-28_1	4.37	3.10	2.00	68.33	0.28	0.17	1.17	0.04	13.07	0.02	92.55

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u60	1520D_51X-1_26-28_7	4.45	3.26	2.32	68.60	0.30	0.18	1.28	0.11	13.03	0.02	93.55
	1520D_51X-1_26-28_8	4.25	3.12	1.94	68.52	0.27	0.19	1.19	0.15	13.01	0.00	92.64
	1520D_51X-1_26-28_9	4.15	3.17	2.16	67.99	0.28	0.18	1.19	0.06	12.96	0.05	92.20
	1520D_51X-1_26-28_10	4.36	3.15	2.24	68.49	0.28	0.19	1.22	0.10	13.03	0.02	93.07
	1520D_51X-1_26-28_3	4.50	3.54	1.96	69.51	0.22	0.09	1.07	0.09	12.92	0.01	93.91
	1520D_51X-1_26-28_4	3.73	3.30	1.77	68.67	0.28	0.21	1.56	0.03	12.44	0.00	91.99
	1520D_51X-1_26-28_5	4.29	3.41	2.10	68.35	0.29	0.17	1.21	0.08	12.96	0.02	92.89
	1520D_51X-1_26-28_6	4.34	3.19	2.06	68.58	0.27	0.16	1.19	0.10	12.77	0.02	92.68
	U1520D_51X-1_35-37_1	3.58	3.29	2.32	69.50	0.25	0.30	1.87	0.08	13.72	0.05	94.96
	U1520D_51X-1_35-37_2	3.48	3.45	1.56	71.04	0.19	0.21	1.61	0.00	12.85	0.03	94.42
	U1520D_51X-1_35-37_3	3.36	3.41	1.90	70.78	0.19	0.23	1.60	0.06	12.89	0.01	94.43
	U1520D_51X-1_35-37_4	3.73	3.38	1.93	71.08	0.22	0.18	1.63	0.05	12.84	0.01	95.04
	U1520D_51X-1_35-37_5	3.46	3.49	1.74	71.26	0.21	0.19	1.58	0.05	12.87	0.00	94.85
	U1520D_51X-1_35-37_6	3.62	3.54	2.05	71.22	0.23	0.20	1.59	0.04	12.85	0.03	95.38
	U1520D_51X-1_35-37_7	3.39	3.43	1.86	71.17	0.24	0.19	1.60	0.00	12.73	0.01	94.62
	U1520D_51X-1_35-37_8	3.47	3.47	1.82	71.45	0.24	0.22	1.53	0.01	12.81	0.00	95.02
	U1520D_51X-1_35-37_9	3.56	3.36	1.90	70.86	0.21	0.26	1.69	0.04	12.85	0.03	94.76
	U1520D_51X-1_35-37_10	3.56	3.39	1.88	71.39	0.20	0.25	1.61	0.07	12.86	0.02	95.24
	U1520D_51X-1_35-37_11	3.48	3.43	1.64	71.58	0.19	0.20	1.54	0.10	12.77	0.00	94.93
	U1520D_51X-1_35-37_12	3.68	3.55	1.57	71.79	0.18	0.15	1.51	0.01	12.63	0.04	95.10
	U1520D_51X-1_35-37_13	3.79	3.28	1.93	70.91	0.21	0.26	1.73	0.09	13.19	0.03	95.43
	U1520D_51X-1_35-37_14	3.77	3.33	1.94	70.69	0.22	0.20	1.60	0.02	12.98	0.03	94.78
	U1520D_51X-1_35-37_15	3.27	3.31	1.73	69.88	0.17	0.18	1.55	0.00	12.73	0.01	92.82
	U1520D_51X-1_35-37_16	3.72	3.35	1.84	70.19	0.24	0.22	1.71	0.08	12.95	0.03	94.34
	U1520D_51X-1_35-37_17	3.77	3.29	1.98	70.96	0.20	0.19	1.74	0.09	12.81	0.02	95.05
	U1520D_51X-1_35-37_18	3.58	3.25	2.18	70.54	0.21	0.23	1.72	0.06	12.78	0.00	94.56
	U1520D_51X-1_35-37_19	3.57	3.23	1.71	70.57	0.21	0.21	1.59	0.00	12.85	0.02	93.96
	U1520D_51X-1_35-37_20	3.80	3.47	1.95	71.58	0.21	0.20	1.57	0.04	13.02	0.01	95.85
	U1520D_51X-1_48-49_1	3.89	3.56	1.76	71.65	0.10	0.09	0.78	0.03	12.43	0.02	94.31
	U1520D_51X-1_48-49_2	3.84	3.74	1.55	70.92	0.09	0.05	0.82	0.06	12.36	0.00	93.43
	U1520D_51X-1_48-49_3	3.86	3.72	1.63	72.10	0.09	0.06	0.76	0.02	12.32	0.01	94.58
	U1520D_51X-1_48-49_4	3.79	3.60	1.57	71.14	0.11	0.07	0.79	0.00	12.28	0.01	93.36
	U1520D_51X-1_48-49_5	4.13	3.57	1.34	72.35	0.09	0.05	0.78	0.05	12.73	0.00	95.08
	U1520D_51X-1_48-49_6	4.14	3.70	1.65	71.81	0.12	0.08	0.78	0.01	12.41	0.01	94.70
	U1520D_51X-1_48-49_7	3.98	3.68	1.78	70.29	0.10	0.08	0.80	0.02	12.53	0.03	93.30
	U1520D_51X-1_48-49_8	4.07	3.53	1.47	71.85	0.10	0.03	0.80	0.03	12.53	0.00	94.41
	U1520D_51X-1_48-49_9	3.91	3.73	1.80	72.24	0.13	0.04	0.79	0.01	12.45	0.00	95.10
	U1520D_51X-1_48-49_10	3.92	3.84	1.33	72.04	0.09	0.05	0.78	0.00	12.39	0.00	94.44
	U1520D_51X-1_48-49_11	3.80	3.90	1.49	72.23	0.09	0.06	0.59	0.12	12.07	0.00	94.35
	U1520D_51X-1_48-49_12	3.66	3.94	1.48	73.01	0.09	0.03	0.64	0.05	11.99	0.03	94.91
	U1520D_51X-1_48-49_13	4.01	3.59	1.56	72.30	0.08	0.06	0.81	0.04	12.35	0.00	94.80
	U1520D_51X-1_48-49_14	3.98	3.69	1.81	72.18	0.09	0.05	0.84	0.06	12.58	0.00	95.28
	U1520D_51X-1_48-49_15	3.88	3.63	1.77	71.52	0.12	0.06	0.78	0.09	12.47	0.02	94.33
	U1520D_51X-1_48-49_16	3.92	3.72	1.63	71.64	0.12	0.08	0.83	0.08	12.44	0.03	94.48
	U1520D_51X-1_48-49_17	3.97	3.76	1.51	72.76	0.12	0.07	0.60	0.02	12.07	0.03	94.91
	U1520D_51X-1_48-49_18	4.35	2.65	3.20	67.02	0.47	0.63	2.51	0.00	14.72	0.06	95.62
	U1520D_51X-1_48-49_19	3.87	3.98	1.46	72.31	0.09	0.05	0.77	0.09	12.49	0.01	95.11
	U1520D_51X-1_48-49_20	4.32	3.59	1.53	72.34	0.10	0.05	0.82	0.05	12.55	0.02	95.35
u61	U1520D_51X-1_49-50_1	4.05	3.60	1.60	71.34	0.08	0.05	0.76	0.08	12.15	0.03	93.74
	U1520D_51X-1_49-50_2	4.21	3.80	1.42	71.85	0.11	0.02	0.66	0.07	11.91	0.01	94.07
	U1520D_51X-1_49-50_3	3.94	3.77	1.52	72.10	0.09	0.02	0.65	0.09	12.25	0.01	94.43
	U1520D_51X-1_49-50_4	3.98	3.65	1.36	70.60	0.11	0.08	0.79	0.04	12.20	0.00	92.81
	U1520D_51X-1_49-50_5	3.98	3.72	1.40	72.06	0.08	0.02	0.57	0.04	11.87	0.00	93.74
	U1520D_51X-1_49-50_6	3.80	3.85	1.36	72.00	0.07	0.05	0.61	0.03	11.94	0.00	93.72
	U1520D_51X-1_49-50_7	3.69	3.80	1.55	71.99	0.11	0.05	0.63	0.00	11.99	0.00	93.81
	U1520D_51X-1_49-50_8	3.63	3.20	2.06	68.98	0.22	0.20	1.67	0.01	13.04	0.02	93.02
	U1520D_51X-1_49-50_9	3.80	3.69	1.60	70.08	0.11	0.02	0.80	0.02	12.26	0.00	92.38
	U1520D_51X-1_49-50_10	4.03	3.57	1.50	70.83	0.12	0.05	0.80	0.11	12.45	0.02	93.48
	U1520D_51X-1_49-50_11	4.10	3.81	1.46	71.16	0.14	0.10	0.78	0.06	12.53	0.00	94.14
	U1520D_51X-1_49-50_12	3.98	3.71	1.47	71.54	0.10	0.07	0.73	0.00	12.19	0.00	93.80
	U1520D_51X-1_49-50_13	3.72	3.33	1.81	70.34	0.16	0.21	1.52	0.03	12.60	0.05	93.77
	U1520D_51X-1_49-50_14	4.04	3.75	1.47	71.46	0.07	0.06	0.62	0.06	11.89	0.02	93.45
	U1520D_51X-1_49-50_15	4.01	3.65	1.63	70.65	0.12	0.07	0.79	0.07	12.28	0.00	93.27
	U1520D_51X-1_49-50_16	3.98	3.49	1.53	71.15	0.10	0.04	0.80	0.08	12.30	0.03	93.50
	U1520D_51X-1_49-50_17	3.62	3.40	2.01	70.20	0.24	0.22	1.73	0.09	12.96	0.02	94.49
	U1520D_51X-1_49-50_18	4.00	3.77	1.29	71.44	0.08	0.04	0.66	0.00	12.05	0.01	93.33
	U1520D_51X-1_49-50_19	4.24	3.65	1.73	70.26	0.10	0.02	0.78	0.05	12.64	0.00	93.48
	U1520D_51X-1_49-50_20	3.83	3.77	1.58	71.43	0.07	0.07	0.62	0.03	12.13	0.00	93.54
	1520D_51X-1_49-50_1	4.14	3.65	1.35	70.84	0.16	0.08	0.65	0.05	12.00	0.00	92.92
	1520D_51X-1_49-50_3	3.92	3.72	1.46	70.99	0.12	0.03	0.66	0.07	11.78	0.03	92.77

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u62	1520D_51X-1_49-50_8	4.04	3.65	1.31	71.71	0.14	0.03	0.64	0.00	11.97	0.04	93.54
	1520D_51X-1_49-50_9	4.29	3.67	1.42	71.33	0.16	0.05	0.65	0.01	12.00	0.01	93.58
	1520D_51X-1_49-50_10	4.06	3.68	1.39	71.34	0.18	0.05	0.65	0.03	12.04	0.00	93.43
	1520D_51X-1_49-50_2	4.11	3.65	1.46	70.21	0.15	0.05	0.78	0.05	12.31	0.01	92.77
	1520D_51X-1_49-50_4	4.03	3.53	1.45	70.87	0.15	0.03	0.64	0.04	11.91	0.01	92.66
	1520D_51X-1_49-50_5	3.85	3.80	1.48	70.44	0.13	0.04	0.62	0.01	11.84	0.02	92.23
	1520D_51X-1_49-50_6	4.23	3.61	1.75	70.26	0.12	0.07	0.81	0.04	12.28	0.00	93.17
	1520D_51X-1_49-50_7	4.03	3.61	1.56	70.25	0.13	0.06	0.82	0.10	12.20	0.00	92.76
	U1520D_51X-1_51-52_1	3.80	3.33	2.07	69.55	0.18	0.17	1.31	0.00	13.06	0.03	93.51
	U1520D_51X-1_51-52_2	3.96	3.36	2.28	69.38	0.19	0.17	1.34	0.08	13.05	0.04	93.84
	U1520D_51X-1_51-52_3	3.76	4.16	1.89	71.83	0.18	0.10	0.90	0.01	12.61	0.00	95.44
	U1520D_51X-1_51-52_4	4.31	3.15	2.18	70.66	0.20	0.12	1.20	0.08	13.07	0.01	94.98
	U1520D_51X-1_51-52_5	4.10	3.31	2.14	70.10	0.19	0.14	1.13	0.02	12.88	0.03	94.04
	U1520D_51X-1_51-52_7	3.89	3.81	1.95	71.84	0.11	0.09	0.93	0.05	12.63	0.06	95.36
	U1520D_51X-1_51-52_8	4.16	3.45	2.27	70.58	0.21	0.14	1.25	0.04	12.80	0.01	94.92
	U1520D_51X-1_51-52_9	3.77	3.45	2.03	70.79	0.16	0.16	1.18	0.03	12.89	0.02	94.48
	U1520D_51X-1_51-52_10	3.76	3.35	2.19	69.37	0.20	0.15	1.33	0.06	13.25	0.02	93.69
	U1520D_51X-1_51-52_11	3.85	3.72	1.57	71.88	0.11	0.02	0.83	0.06	12.54	0.02	94.60
	U1520D_51X-1_51-52_12	3.89	3.57	1.93	70.42	0.16	0.10	1.04	0.09	12.29	0.02	93.52
	U1520D_51X-1_51-52_13	4.12	3.44	1.94	70.79	0.18	0.13	1.20	0.06	12.94	0.02	94.82
	U1520D_51X-1_51-52_14	3.78	3.67	1.99	71.26	0.15	0.12	1.13	0.00	12.77	0.01	94.88
u63	U1520D_51X-1_51-52_15	3.87	3.46	2.07	70.43	0.21	0.19	1.28	0.04	13.01	0.01	94.56
	U1520D_51X-1_51-52_16	3.88	3.44	2.43	70.48	0.22	0.14	1.35	0.07	13.33	0.01	95.35
	U1520D_51X-1_51-52_17	3.90	3.41	1.85	70.00	0.16	0.11	1.12	0.00	12.58	0.03	93.17
	U1520D_51X-1_51-52_18	4.03	3.45	2.08	70.13	0.19	0.13	1.21	0.10	12.92	0.03	94.27
	U1520D_51X-1_51-52_19	4.05	3.60	2.26	70.52	0.20	0.10	1.25	0.09	13.10	0.00	95.17
	U1520D_51X-1_51-52_20	4.03	3.42	2.24	69.35	0.20	0.17	1.34	0.10	13.16	0.00	94.01
	U1520D_51X-1_54-55_1	3.91	3.61	1.89	70.66	0.09	0.10	0.94	0.07	12.75	0.00	94.01
	U1520D_51X-1_54-55_2	3.59	3.77	1.66	70.95	0.09	0.02	0.87	0.05	12.55	0.03	93.58
	U1520D_51X-1_54-55_3	3.66	4.12	1.46	70.60	0.08	0.06	0.84	0.04	12.41	0.03	93.31
	U1520D_51X-1_54-55_4	3.89	3.86	1.77	70.88	0.09	0.05	0.92	0.00	12.46	0.01	93.93
	U1520D_51X-1_54-55_5	3.83	3.79	1.91	70.77	0.12	0.03	0.93	0.00	12.72	0.03	94.13
	U1520D_51X-1_54-55_6	3.66	3.84	1.79	70.97	0.10	0.07	0.86	0.08	12.51	0.00	93.88
	U1520D_51X-1_54-55_7	3.69	3.54	1.80	70.91	0.18	0.19	1.60	0.13	12.82	0.01	94.88
	U1520D_51X-1_54-55_9	3.89	3.75	1.70	71.25	0.11	0.02	0.86	0.10	12.59	0.01	94.29
	U1520D_51X-1_54-55_10	3.76	3.74	1.48	70.88	0.12	0.07	0.87	0.02	12.45	0.00	93.39
	U1520D_51X-1_54-55_11	3.78	3.55	1.60	70.65	0.09	0.07	0.90	0.07	12.68	0.04	93.43
	U1520D_51X-1_54-55_12	3.99	3.62	2.55	68.64	0.18	0.15	1.37	0.10	13.44	0.05	94.09
	U1520D_51X-1_54-55_13	3.73	3.56	1.65	71.01	0.17	0.17	1.57	0.04	12.79	0.05	94.74
	U1520D_51X-1_54-55_14	3.83	3.74	1.78	70.42	0.11	0.05	0.91	0.07	12.73	0.01	93.63
	U1520D_51X-1_54-55_15	4.08	3.81	1.85	71.09	0.08	0.10	0.94	0.09	12.60	0.00	94.64
	U1520D_51X-1_54-55_16	4.04	3.71	1.71	71.14	0.12	0.08	0.84	0.05	12.70	0.01	94.40
s87	U1520D_51X-1_54-55_17	3.99	3.75	1.77	71.19	0.11	0.03	0.91	0.05	12.68	0.00	94.47
	U1520D_51X-1_54-55_18	3.86	3.70	1.83	71.26	0.12	0.05	0.93	0.07	12.74	0.00	94.56
	U1520D_51X-1_54-55_19	3.85	3.88	1.81	71.54	0.12	0.08	0.85	0.03	12.53	0.04	94.73
	U1520D_51X-1_54-55_20	3.77	3.77	1.59	71.15	0.09	0.08	0.88	0.07	12.71	0.02	94.13
	1520D_51X-1_54-55_2	2.59	3.60	1.68	71.65	0.13	0.05	0.93	0.00	12.50	0.00	93.13
	1520D_51X-1_54-55_3	4.16	3.62	1.54	70.15	0.14	0.06	0.84	0.05	12.29	0.00	92.85
	1520D_51X-1_54-55_7	4.10	3.79	1.69	71.56	0.16	0.05	0.87	0.00	12.48	0.00	94.70
	1520D_51X-1_54-55_9	4.08	3.69	1.81	70.64	0.18	0.10	0.93	0.07	12.64	0.01	94.14
	1520D_51X-1_54-55_1	3.94	3.38	1.95	69.81	0.24	0.23	1.76	0.11	13.23	0.02	94.67
	1520D_51X-1_54-55_4	3.90	3.83	1.56	71.25	0.12	0.07	0.79	0.01	12.49	0.00	94.02
	1520D_51X-1_54-55_5	4.04	3.76	1.87	71.19	0.16	0.09	0.92	0.08	12.62	0.03	94.76
	U1520D_51X-1_55-56_1	3.37	2.91	1.10	72.30	0.20	0.28	1.48	0.07	12.32	0.01	94.06
	U1520D_51X-1_55-56_3	3.30	3.05	1.24	72.81	0.17	0.20	1.46	0.01	12.33	0.00	94.57
	U1520D_51X-1_55-56_4	2.97	3.54	1.07	73.95	0.09	0.10	1.10	0.01	12.01	0.01	94.86
	U1520D_51X-1_55-56_5	3.24	2.98	1.30	72.72	0.17	0.23	1.55	0.03	12.69	0.02	94.93
	U1520D_51X-1_55-56_7	3.16	3.60	1.01	73.59	0.08	0.09	1.02	0.01	12.16	0.01	94.73
	U1520D_51X-1_55-56_8	3.12	3.24	1.05	73.73	0.11	0.29	1.09	0.05	11.72	0.03	94.43
	U1520D_51X-1_55-56_9	3.57	3.34	1.82	70.11	0.22	0.24	1.71	0.00	13.05	0.05	94.11
	U1520D_51X-1_55-56_10	3.33	2.97	0.99	73.01	0.19	0.22	1.34	0.00	12.04	0.06	94.15
	U1520D_51X-1_55-56_11	3.48	2.98	1.36	73.21	0.19	0.28	1.49	0.06	12.26	0.01	95.32
	U1520D_51X-1_55-56_12	3.40	3.02	1.28	72.21	0.19	0.22	1.50	0.11	12.19	0.01	94.13
	U1520D_51X-1_55-56_13	3.01	3.84	0.87	73.63	0.10	0.12	0.99	0.00	11.95	0.01	94.53
	U1520D_51X-1_55-56_14	3.32	2.98	1.21	73.21	0.18	0.24	1.43	0.07	12.04	0.03	94.70
	U1520D_51X-1_55-56_15	3.09	3.61	1.03	73.56	0.06	0.13	0.98	0.02	11.89	0.00	94.36
	U1520D_51X-1_55-56_17	3.38	3.07	1.24	72.88	0.20	0.22	1.43	0.00	12.38	0.00	94.80
	U1520D_51X-1_55-56_18	3.20	3.77	1.25	73.99	0.13	0.17	0.97	0.00	12.01	0.01	95.49
	1520D_51X-1_55-56_2	3.48	3.00	1.27	72.39	0.22	0.27	1.50	0.09	12.32	0.02	94.56
	1520D_51X-1_55-56_6	3.34	3.03	1.14	72.58	0.21	0.19	1.32	0.01	12.01	0.01	93.84

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u64	1520D_51X-1_55-56_7	3.40	3.13	1.10	73.55	0.20	0.19	1.25	0.02	12.13	0.03	95.00
	1520D_51X-1_55-56_10	3.84	3.10	1.22	72.18	0.22	0.20	1.36	0.08	12.15	0.05	94.40
	U1520D_51X-1_64-65_1	3.20	4.61	1.52	71.81	0.15	0.12	0.97	0.06	12.13	0.04	94.61
	U1520D_51X-1_64-65_2	2.99	4.49	1.35	70.99	0.15	0.08	1.01	0.08	11.78	0.04	92.95
	U1520D_51X-1_64-65_3	2.99	4.49	1.34	71.73	0.15	0.15	0.99	0.02	12.02	0.00	93.89
	U1520D_51X-1_64-65_4	3.63	3.35	1.94	70.37	0.17	0.23	1.57	0.01	12.80	0.01	94.08
	U1520D_51X-1_64-65_5	3.00	4.52	1.40	71.92	0.16	0.14	1.02	0.00	11.85	0.00	94.01
	U1520D_51X-1_64-65_6	3.03	4.53	1.52	71.68	0.16	0.16	1.02	0.05	11.82	0.00	93.97
	U1520D_51X-1_64-65_7	2.99	4.60	1.43	71.63	0.17	0.12	1.06	0.06	12.22	0.03	94.31
	U1520D_51X-1_64-65_8	3.38	4.53	1.35	71.85	0.13	0.13	1.00	0.04	12.10	0.02	94.52
	U1520D_51X-1_64-65_9	2.95	4.56	1.53	71.58	0.16	0.17	1.00	0.06	12.10	0.03	94.14
	U1520D_51X-1_64-65_10	2.82	4.59	1.46	71.81	0.16	0.17	1.04	0.03	11.86	0.03	93.97
	U1520D_51X-1_64-65_11	3.69	3.30	1.62	69.35	0.23	0.23	1.62	0.05	12.83	0.05	92.96
	U1520D_51X-1_64-65_12	4.03	3.72	1.63	70.66	0.13	0.06	0.86	0.02	12.43	0.01	93.56
	U1520D_51X-1_64-65_13	3.06	4.46	1.42	71.90	0.14	0.12	0.92	0.05	11.71	0.04	93.82
	U1520D_51X-1_64-65_14	3.13	4.52	1.48	69.67	0.19	0.13	1.09	0.01	12.11	0.05	92.38
	U1520D_51X-1_64-65_15	3.27	4.51	1.59	71.27	0.17	0.16	1.02	0.00	11.81	0.01	93.81
	U1520D_51X-1_64-65_16	3.02	4.52	1.38	71.41	0.15	0.09	1.01	0.06	11.96	0.02	93.62
	U1520D_51X-1_64-65_17	3.06	4.40	1.34	71.70	0.19	0.15	1.03	0.05	12.09	0.03	94.04
	U1520D_51X-1_64-65_18	3.27	2.93	1.04	73.21	0.10	0.20	1.30	0.12	11.74	0.02	93.93
	U1520D_51X-1_64-65_19	3.09	4.60	1.51	71.59	0.14	0.11	1.02	0.00	11.86	0.04	93.95
s88	U1520D_51X-1_64-65_20	2.90	4.57	1.47	71.62	0.21	0.14	0.99	0.04	11.92	0.00	93.85
	1520D_51X-1_64-65_8	3.77	3.43	1.77	71.69	0.28	0.27	1.59	0.03	12.64	0.06	95.53
	1520D_51X-1_64-65_5	3.05	4.35	1.35	73.17	0.20	0.10	0.87	0.03	11.35	0.00	94.46
	1520D_51X-1_64-65_1	3.22	4.52	1.31	71.68	0.23	0.08	0.96	0.05	12.18	0.00	94.22
	1520D_51X-1_64-65_3	3.24	4.58	1.68	71.79	0.23	0.10	1.03	0.00	12.09	0.02	94.76
	1520D_51X-1_64-65_7	3.27	4.46	1.41	71.96	0.20	0.11	0.95	0.07	12.26	0.01	94.69
	1520D_51X-1_64-65_2	3.32	4.58	1.44	72.51	0.22	0.12	0.97	0.00	11.96	0.00	95.13
	1520D_51X-1_64-65_4	3.98	3.25	1.63	71.13	0.26	0.12	1.59	0.02	12.79	0.02	94.79
	1520D_51X-1_64-65_6	3.07	4.45	1.36	72.50	0.26	0.14	1.04	0.04	11.86	0.03	94.75
	1520D_51X-1_64-65_9	3.00	4.42	1.50	71.79	0.20	0.08	1.01	0.08	11.75	0.01	93.84
	U1520D_51X-1_64-65_2_1	4.20	3.31	2.36	70.29	0.19	0.16	1.24	0.05	13.06	0.01	94.87
	U1520D_51X-1_64-65_2_2	4.43	3.20	1.96	69.68	0.20	0.16	1.30	0.08	12.98	0.01	94.00
	U1520D_51X-1_64-65_2_3	4.17	3.23	2.33	69.70	0.16	0.18	1.21	0.00	13.11	0.01	94.11
	U1520D_51X-1_64-65_2_4	3.73	3.65	2.23	68.59	0.17	0.15	1.17	0.14	12.67	0.01	92.51
	U1520D_51X-1_64-65_2_5	4.33	3.26	2.40	69.11	0.17	0.12	1.20	0.04	13.05	0.01	93.69
	U1520D_51X-1_64-65_2_6	4.44	3.33	1.88	71.30	0.11	0.09	1.00	0.02	12.81	0.02	94.99
	U1520D_51X-1_64-65_2_7	4.48	3.27	2.15	69.80	0.22	0.18	1.23	0.17	13.25	0.02	94.77
	U1520D_51X-1_64-65_2_8	4.50	3.30	2.05	69.96	0.14	0.11	1.04	0.01	12.69	0.02	93.83
	U1520D_51X-1_64-65_2_9	4.30	3.24	2.15	69.91	0.19	0.14	1.23	0.06	12.96	0.00	94.19
	U1520D_51X-1_64-65_2_10	3.91	3.37	1.90	69.87	0.14	0.09	1.13	0.10	12.71	0.01	93.24
	U1520D_51X-1_64-65_2_11	4.21	3.27	2.35	69.54	0.18	0.10	1.23	0.01	13.15	0.02	94.07
	U1520D_51X-1_64-65_2_12	3.94	3.49	1.81	70.12	0.13	0.07	0.93	0.08	12.33	0.02	92.91
	U1520D_51X-1_64-65_2_13	4.26	3.34	2.01	70.42	0.15	0.09	1.04	0.08	13.02	0.04	94.46
	U1520D_51X-1_64-65_2_14	4.15	3.23	2.25	69.93	0.13	0.09	1.07	0.07	12.65	0.00	93.57
	U1520D_51X-1_64-65_2_15	4.39	3.27	2.39	69.54	0.17	0.13	1.21	0.08	12.88	0.02	94.08
	U1520D_51X-1_64-65_2_16	4.38	3.37	2.08	70.29	0.15	0.07	1.08	0.11	12.92	0.00	94.45
	U1520D_51X-1_64-65_2_17	3.37	4.36	1.90	69.92	0.10	0.09	0.90	0.05	12.46	0.04	93.20
	U1520D_51X-1_64-65_2_19	4.05	3.30	2.10	68.92	0.20	0.11	1.24	0.12	12.99	0.00	93.04
	U1520D_51X-1_64-65_2_20	4.30	3.41	2.34	69.10	0.16	0.14	1.19	0.07	13.00	0.04	93.76
	1520D_51X-1_64-65_2_3	4.42	3.17	2.37	68.70	0.21	0.11	1.23	0.05	12.96	0.02	93.25
	1520D_51X-1_64-65_2_8	4.35	3.36	1.87	70.03	0.21	0.11	0.93	0.03	12.63	0.02	93.54
	1520D_51X-1_64-65_2_10	4.30	3.52	1.75	69.19	0.15	0.06	0.89	0.00	12.52	0.00	92.38
	1520D_51X-1_64-65_2_7	3.68	4.50	0.52	69.83	0.29	0.02	1.07	0.04	13.14	0.01	93.11
	1520D_51X-1_64-65_2_5	4.09	3.29	2.18	67.30	0.22	0.09	1.22	0.00	12.99	0.03	91.41
	1520D_51X-1_64-65_2_1	4.38	3.13	2.42	68.46	0.26	0.13	1.19	0.10	12.90	0.02	92.98
	1520D_51X-1_64-65_2_2	4.33	3.46	1.86	69.99	0.17	0.09	0.96	0.14	12.75	0.03	93.78
	1520D_51X-1_64-65_2_4	4.08	3.32	2.01	68.91	0.15	0.05	0.94	0.13	12.44	0.02	92.04
	1520D_51X-1_64-65_2_6	4.63	3.29	2.27	67.72	0.25	0.14	1.23	0.14	12.88	0.03	92.58
	U1520D_51X-1_117-119_1	3.59	3.55	0.94	73.43	0.09	0.04	0.91	0.00	11.91	0.01	94.46
	U1520D_51X-1_117-119_2	4.05	2.70	1.73	71.19	0.22	0.21	1.51	0.07	12.62	0.02	94.33
	U1520D_51X-1_117-119_3	3.51	3.30	2.48	69.85	0.38	0.39	2.04	0.01	12.53	0.06	94.55
	U1520D_51X-1_117-119_4	3.45	2.43	1.15	73.45	0.07	0.11	0.77	0.04	11.78	0.02	93.26
	U1520D_51X-1_117-119_5	3.67	1.03	1.32	73.44	0.19	0.16	0.53	0.08	11.43	0.00	91.85
	U1520D_51X-1_117-119_6	3.62	3.36	1.52	73.97	0.11	0.08	0.92	0.12	11.77	0.02	95.49
	U1520D_51X-1_117-119_7	3.54	3.77	1.26	72.31	0.05	0.06	0.88	0.03	12.75	0.04	94.69
	U1520D_51X-1_117-119_8	3.81	3.08	1.27	72.69	0.11	0.13	1.24	0.06	11.97	0.05	94.41
	U1520D_51X-1_117-119_9	3.63	3.38	1.57	72.53	0.12	0.06	1.17	0.11	12.22	0.04	94.82
	U1520D_51X-1_117-119_10	3.45	2.97	1.51	73.51	0.24	0.18	1.49	0.08	11.57	0.06	95.05
	U1520D_51X-1_117-119_11	3.18	3.34	1.23	74.12	0.09	0.10	1.12	0.05	11.81	0.02	95.05

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s89*	U1520D_51X-1_117-119_12	4.18	3.14	1.46	73.74	0.10	0.06	0.96	0.05	11.78	0.01	95.48
	U1520D_51X-1_117-119_13	3.61	3.27	1.68	72.48	0.29	0.21	1.69	0.06	12.78	0.02	96.09
	U1520D_51X-1_117-119_14	4.00	3.06	1.72	71.06	0.28	0.30	1.51	0.06	12.66	0.03	94.68
	U1520D_51X-1_117-119_15	3.94	3.13	1.81	71.76	0.15	0.08	1.32	0.13	12.47	0.07	94.86
	U1520D_51X-1_117-119_16	3.43	3.53	1.58	72.79	0.14	0.17	1.21	0.01	12.58	0.03	95.46
	U1520D_51X-1_117-119_17	3.46	3.86	1.28	72.54	0.05	0.10	0.87	0.06	12.70	0.00	94.92
	U1520D_51X-1_117-119_18	3.71	3.92	1.49	72.39	0.01	0.00	1.00	0.04	13.30	0.01	95.87
	U1520D_51X-1_117-119_19	3.30	3.30	1.32	72.81	0.08	0.06	0.88	0.00	11.59	0.00	93.34
	U1520D_51X-1_117-119_20	3.25	3.07	1.48	73.01	0.16	0.18	1.33	0.05	11.47	0.02	94.02
	U1520D_52X-1_8-10_1	3.99	3.09	1.70	72.79	0.16	0.16	1.25	0.05	11.99	0.03	95.22
	U1520D_52X-1_8-10_2	3.51	3.60	1.46	73.17	0.07	0.03	0.90	0.03	11.49	0.02	94.28
	U1520D_52X-1_8-10_3	3.72	3.14	1.59	73.80	0.08	0.03	0.90	0.00	11.64	0.04	94.93
	U1520D_52X-1_8-10_4	3.63	3.26	1.45	73.26	0.09	0.04	0.81	0.01	11.47	0.01	94.02
	U1520D_52X-1_8-10_5	3.74	3.04	1.41	72.15	0.07	0.04	0.94	0.03	11.80	0.00	93.22
	U1520D_52X-1_8-10_6	4.06	3.08	1.55	73.42	0.07	0.08	0.98	0.04	11.62	0.01	94.92
	U1520D_52X-1_8-10_7	3.72	3.04	1.26	73.06	0.10	0.04	0.96	0.02	11.93	0.00	94.14
	U1520D_52X-1_8-10_8	3.70	3.16	1.49	72.31	0.07	0.06	0.86	0.04	11.58	0.02	93.29
	U1520D_52X-1_8-10_9	3.71	3.37	1.46	73.63	0.07	0.03	0.83	0.13	11.54	0.00	94.78
	U1520D_52X-1_8-10_10	3.93	2.89	1.77	71.15	0.21	0.17	1.47	0.04	12.63	0.03	94.29
	U1520D_52X-1_8-10_11	3.91	3.09	1.67	73.45	0.06	0.05	0.95	0.06	11.84	0.00	95.08
	U1520D_52X-1_8-10_12	3.62	3.35	1.46	73.38	0.05	0.06	0.82	0.03	11.56	0.01	94.34
	U1520D_52X-1_8-10_13	3.55	3.34	1.23	73.14	0.09	0.03	0.80	0.03	11.51	0.02	93.75
	U1520D_52X-1_8-10_14	4.20	3.11	1.54	72.65	0.10	0.05	0.97	0.00	11.83	0.00	94.46
	U1520D_52X-1_8-10_15	3.83	3.13	1.44	73.06	0.08	0.03	0.95	0.00	11.78	0.03	94.33
	U1520D_52X-1_8-10_16	3.66	3.43	1.30	73.14	0.05	0.05	0.81	0.06	11.69	0.01	94.19
	U1520D_52X-1_8-10_17	4.17	2.83	2.00	71.29	0.20	0.25	1.71	0.02	12.91	0.01	95.40
	U1520D_52X-1_8-10_18	3.61	3.26	1.40	73.02	0.10	0.04	0.90	0.02	11.44	0.03	93.82
	U1520D_52X-1_8-10_19	3.68	3.27	1.40	74.33	0.10	0.07	0.90	0.08	11.68	0.00	95.50
	U1520D_52X-1_8-10_20	3.59	3.30	0.97	73.99	0.08	0.00	0.82	0.00	11.52	0.02	94.29
	1520D_52X-1_8-10_1	3.58	3.31	1.30	71.56	0.13	0.05	0.86	0.05	11.45	0.00	92.29
	1520D_52X-1_8-10_4	3.58	3.33	1.62	72.10	0.15	0.03	0.87	0.07	11.44	0.02	93.20
	1520D_52X-1_8-10_6	3.41	3.49	1.47	72.05	0.08	0.02	0.86	0.06	11.44	0.01	92.89
	1520D_52X-1_8-10_3	3.91	3.30	1.46	72.07	0.15	0.04	1.03	0.10	11.71	0.03	93.82
	1520D_52X-1_8-10_10	3.97	3.45	1.44	71.49	0.11	0.03	0.76	0.05	11.47	0.00	92.77
	1520D_52X-1_8-10_2	3.73	3.26	1.87	71.63	0.10	0.16	1.01	0.09	11.28	0.00	93.14
	1520D_52X-1_8-10_7	3.96	3.24	1.46	71.36	0.13	0.04	0.76	0.00	11.46	0.00	92.41
	1520D_52X-1_8-10_9	3.95	3.40	1.59	71.97	0.14	0.06	0.94	0.08	11.69	0.00	93.81
	U1520D_53X-1_27-29_1	3.04	4.20	1.09	73.37	0.11	0.06	0.87	0.00	11.76	0.00	94.52
	U1520D_53X-1_27-29_2	3.41	2.94	1.33	73.36	0.20	0.16	1.36	0.06	11.60	0.00	94.41
	U1520D_53X-1_27-29_3	3.34	2.96	1.43	73.48	0.18	0.16	1.39	0.04	11.54	0.00	94.52
	U1520D_53X-1_27-29_4	3.33	3.66	1.16	73.61	0.08	0.07	0.91	0.04	11.97	0.00	94.84
	U1520D_53X-1_27-29_5	3.18	3.02	1.37	74.79	0.19	0.19	1.40	0.00	11.49	0.00	95.63
	U1520D_53X-1_27-29_6	3.35	3.90	1.12	74.19	0.05	0.06	0.90	0.00	12.03	0.01	95.61
	U1520D_53X-1_27-29_7	3.38	2.89	1.52	74.47	0.18	0.16	1.30	0.04	11.61	0.03	95.59
	U1520D_53X-1_27-29_8	3.45	2.98	1.42	73.61	0.17	0.18	1.36	0.13	11.45	0.01	94.76
	U1520D_53X-1_27-29_9	3.34	2.94	1.40	73.91	0.19	0.22	1.28	0.00	11.51	0.02	94.81
	U1520D_53X-1_27-29_10	3.35	3.06	1.28	73.48	0.18	0.14	1.30	0.00	11.53	0.00	94.31
	U1520D_53X-1_27-29_11	3.28	2.93	1.15	74.43	0.18	0.13	1.27	0.05	11.52	0.00	94.94
	U1520D_53X-1_27-29_12	3.43	2.90	1.23	73.57	0.16	0.17	1.33	0.04	11.47	0.00	94.29
	U1520D_53X-1_27-29_13	3.28	3.88	1.07	74.31	0.05	0.06	0.93	0.00	11.92	0.00	95.50
	U1520D_53X-1_27-29_14	3.45	2.99	1.45	74.32	0.14	0.20	1.32	0.05	11.51	0.02	95.45
	U1520D_53X-1_27-29_15	3.22	2.95	1.43	74.11	0.19	0.15	1.32	0.00	11.42	0.00	94.79
	U1520D_53X-1_27-29_16	3.33	2.92	1.27	73.82	0.18	0.15	1.43	0.00	11.46	0.01	94.56
	U1520D_53X-1_27-29_17	3.32	2.83	1.54	73.90	0.19	0.16	1.33	0.00	11.61	0.02	94.91
	U1520D_53X-1_27-29_18	3.36	2.92	1.38	73.48	0.15	0.19	1.36	0.07	11.49	0.02	94.42
	U1520D_53X-1_27-29_19	3.40	2.89	1.20	73.43	0.17	0.18	1.28	0.01	11.40	0.03	93.98
	U1520D_53X-1_27-29_20	3.51	3.09	1.30	73.83	0.17	0.18	1.29	0.02	11.44	0.00	94.83
s92	U1520D_53X-1_31-33_1	3.34	3.71	1.19	73.94	0.10	0.07	0.92	0.02	11.85	0.01	95.14
	U1520D_53X-1_31-33_2	3.41	2.90	1.39	74.13	0.20	0.12	1.27	0.00	11.36	0.00	94.79
	U1520D_53X-1_31-33_3	3.51	3.02	1.35	73.73	0.19	0.16	1.34	0.06	11.48	0.02	94.86
	U1520D_53X-1_31-33_4	3.36	2.85	1.41	74.05	0.20	0.17	1.37	0.00	11.39	0.02	94.81
	U1520D_53X-1_31-33_5	3.42	3.32	1.35	72.96	0.17	0.14	1.30	0.07	11.67	0.04	94.45
	U1520D_53X-1_31-33_6	3.62	3.71	1.04	73.81	0.07	0.07	0.90	0.11	11.74	0.01	95.08
	U1520D_53X-1_31-33_7	3.40	3.66	1.05	73.61	0.08	0.08	0.90	0.00	11.72	0.00	94.52
	U1520D_53X-1_31-33_8	3.09	4.02	1.20	74.24	0.08	0.10	0.91	0.10	11.79	0.00	95.54
	U1520D_53X-1_31-33_9	3.08	3.78	1.08	73.43	0.08	0.07	0.92	0.04	11.79	0.00	94.28
	U1520D_53X-1_31-33_10	3.33	3.65	1.22	72.47	0.08	0.09	0.87	0.00	12.03	0.03	93.76
	U1520D_53X-1_31-33_11	3.29	2.93	1.40	72.45	0.15	0.13	1.26	0.02	11.50	0.00	93.13
	U1520D_53X-1_31-33_12	3.18	2.91	1.50	73.41	0.18	0.19	1.29	0.00	11.65	0.00	94.31
	U1520D_53X-1_31-33_13	3.37	3.96	1.16	74.37	0.07	0.08	0.89	0.08	11.96	0.00	95.94

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	U1520D_53X-1_31-33_14	3.59	2.90	1.43	73.78	0.17	0.18	1.36	0.02	11.60	0.05	95.09
	U1520D_53X-1_31-33_15	3.07	3.89	1.17	74.44	0.07	0.06	0.89	0.01	11.82	0.05	95.47
	U1520D_53X-1_31-33_16	3.49	3.12	1.21	73.46	0.16	0.18	1.35	0.02	11.55	0.03	94.57
	U1520D_53X-1_31-33_17	3.29	3.91	1.01	73.59	0.10	0.08	0.90	0.04	11.93	0.01	94.86
	U1520D_53X-1_31-33_18	3.21	2.82	1.24	72.89	0.18	0.19	1.33	0.09	11.41	0.02	93.39
	U1520D_53X-1_31-33_19	3.21	2.93	1.30	73.61	0.16	0.17	1.33	0.02	11.25	0.00	93.98
	U1520D_53X-1_31-33_20	3.32	3.72	0.97	74.33	0.07	0.05	0.86	0.05	11.98	0.00	95.35
	1520D_53X-1_31-33_3	3.76	2.94	1.49	71.70	0.24	0.14	1.28	0.06	11.42	0.01	93.04
	1520D_53X-1_31-33_5	3.66	2.92	1.46	72.42	0.24	0.17	1.32	0.04	11.45	0.03	93.70
	1520D_53X-1_31-33_8	3.65	2.79	1.32	72.44	0.28	0.18	1.37	0.02	11.44	0.01	93.51
	1520D_53X-1_31-33_10	3.65	3.02	1.45	72.79	0.21	0.20	1.29	0.06	11.72	0.03	94.42
	1520D_53X-1_31-33_1	3.41	3.76	1.18	72.70	0.14	0.10	0.90	0.03	11.67	0.00	93.90
	1520D_53X-1_31-33_2	3.42	3.79	1.21	71.81	0.15	0.07	0.86	0.01	11.70	0.00	93.01
	1520D_53X-1_31-33_6	3.61	2.92	1.35	72.40	0.23	0.17	1.28	0.05	11.44	0.01	93.46
	1520D_53X-1_31-33_7	3.51	3.73	1.17	71.11	0.12	0.11	0.83	0.05	11.65	0.04	92.33
s97*	U1520D_54X-2_3-5_1	3.60	2.64	1.55	71.28	0.17	0.21	1.52	0.09	12.40	0.04	93.50
	U1520D_54X-2_3-5_2	3.65	2.89	1.02	72.21	0.13	0.10	1.05	0.01	11.67	0.03	92.77
	U1520D_54X-2_3-5_3	3.23	3.76	1.16	73.11	0.10	0.13	0.98	0.03	11.98	0.02	94.50
	U1520D_54X-2_3-5_4	3.88	2.82	1.33	72.44	0.17	0.15	1.39	0.00	12.61	0.00	94.80
	U1520D_54X-2_3-5_5	3.62	2.92	1.01	73.54	0.12	0.14	1.02	0.08	11.67	0.02	94.14
	U1520D_54X-2_3-5_6	3.69	2.79	1.17	73.58	0.14	0.13	1.07	0.04	11.67	0.03	94.30
	U1520D_54X-2_3-5_7	3.51	2.95	1.25	72.92	0.16	0.15	1.08	0.06	11.79	0.01	93.89
	U1520D_54X-2_3-5_8	3.51	2.79	1.55	71.93	0.16	0.22	1.38	0.08	12.25	0.02	93.90
	U1520D_54X-2_3-5_9	3.73	2.84	1.15	72.82	0.14	0.11	1.12	0.00	11.65	0.03	93.57
	U1520D_54X-2_3-5_10	3.62	2.87	1.21	72.72	0.14	0.13	1.11	0.00	11.82	0.04	93.65
	U1520D_54X-2_3-5_11	3.66	2.92	1.18	72.90	0.15	0.12	1.08	0.07	11.72	0.01	93.81
	U1520D_54X-2_3-5_12	3.46	2.80	1.44	71.59	0.17	0.16	1.25	0.02	11.99	0.01	92.89
	U1520D_54X-2_3-5_13	3.75	2.85	1.36	72.41	0.20	0.19	1.21	0.07	12.19	0.00	94.22
	U1520D_54X-2_3-5_14	3.63	2.76	1.33	71.29	0.19	0.20	1.32	0.02	12.27	0.03	93.03
	U1520D_54X-2_3-5_15	3.70	2.82	1.40	71.70	0.17	0.19	1.41	0.05	12.34	0.00	93.78
	U1520D_54X-2_3-5_16	3.69	2.79	1.27	71.78	0.17	0.20	1.39	0.06	12.36	0.05	93.76
	U1520D_54X-2_3-5_17	3.82	2.71	1.65	71.70	0.19	0.26	1.49	0.01	12.34	0.04	94.20
	U1520D_54X-2_3-5_18	3.56	2.92	1.41	73.14	0.11	0.16	1.26	0.07	12.04	0.00	94.66
	U1520D_54X-2_3-5_19	3.36	2.83	1.19	72.49	0.15	0.15	1.11	0.03	11.71	0.02	93.03
	U1520D_54X-2_3-5_20	3.88	2.74	1.54	71.16	0.18	0.18	1.49	0.09	12.67	0.01	93.94
	1520D_54X-2_3-5_1	3.83	2.81	1.41	72.07	0.18	0.15	1.37	0.09	12.47	0.00	94.39
	1520D_54X-2_3-5_5	3.85	2.91	1.63	71.29	0.12	0.17	1.40	0.04	12.63	0.04	94.09
	1520D_54X-2_3-5_6	3.89	2.74	1.62	71.79	0.12	0.17	1.38	0.00	12.69	0.07	94.47
	1520D_54X-2_3-5_7	3.73	2.69	1.39	71.83	0.19	0.16	1.40	0.06	12.25	0.02	93.71
	1520D_54X-2_3-5_2	3.86	2.94	1.36	72.83	0.16	0.16	1.21	0.07	12.42	0.04	95.05
	1520D_54X-2_3-5_3	3.88	2.90	1.44	71.46	0.20	0.14	1.21	0.08	12.38	0.04	93.73
	1520D_54X-2_3-5_10	3.69	2.66	1.49	70.73	0.17	0.17	1.38	0.00	12.56	0.03	92.88
	1520D_54X-2_3-5_9	3.60	2.97	1.32	72.57	0.10	0.10	1.08	0.00	11.89	0.00	93.64
	1520D_54X-2_3-5_4	3.54	2.90	1.06	72.11	0.09	0.14	0.95	0.00	11.64	0.00	92.43
	1520D_54X-2_3-5_8	3.60	2.85	1.28	72.09	0.15	0.13	1.13	0.05	11.62	0.00	92.90

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1520D-1H-1_119-120-12	44.20	12.79	227.45	2.92	113.09	139.59	32.87	228.95	9.12	5.95	658.64	26.12	56.5	6.27	27.05
1520D-1H-1_119-120-13	38.91	12.60	7.74	0.48	111.05	137.89	31.53	221.43	8.82	5.44	624.48	25.68	54.21	6.09	25.23
1520D-1H-1_119-120-14	39.30	12.39	7.21	0.48	112.43	140.17	32.27	224.98	8.50	5.63	613.31	25.36	54.58	6.22	23.43
1520D-1H-1_119-120-15	40.58	13.36	6.07	0.56	118.22	146.70	33.60	236.72	8.89	5.93	650.24	27.1	57.16	6.64	24.46
1520D-1H-3_26-30-14	46.12	12.80	5.78	0.30	115.56	117.24	31.64	218.80	9.42	6.02	647.69	25.69	56.62	6.51	25.06
1520D-1H-3_26-30-15	44.49	12.08	5.70	0.39	109.47	115.91	29.90	206.90	8.66	5.87	617.92	25.11	54.31	6.13	24.89
1520D-1H-3_67-69-13	1.06	0.93	0.79	0.60	2.52	43.59	0.68	3.97	0.28	0.15	23.13	0.591	1.67	0.125	0.73
1520D-1H-3_67-69-14	84.05	7.09	18.60	15.82	51.29	270.58	18.95	11.95	0.18	1.18	1021.91	24.1	64.61	7.57	36.79
1520D-1H-3_67-69-15	26.60	5.85	16.24	0.80	121.89	64.20	24.34	87.50	5.35	6.62	641.78	21.13	46.49	4.94	18.77
1520D-1H-4_35-37-13	41.16	6.55	1289.77	18.33	119.18	59.54	22.28	75.95	8.96	5.24	844.87	23.12	47.93	4.89	18.15
1520D-1H-4_35-37-14	37.59	10.38	29.91	1.63	98.74	132.79	24.89	183.74	6.82	5.25	542.39	19.99	41.12	4.91	19.59
1520D-1H-4_35-37-15	32.56	8.98	6.61	0.68	112.87	67.48	28.72	156.11	8.80	5.24	664.25	23.57	50.71	6.05	23.06
1520D-1H-4_87-90-12	84.71	15.71	12.03	1.18	271.03	169.36	49.45	235.90	14.07	14.16	1484.55	48.47	99.26	10.35	39.46
1520D-1H-4_87-90-13	58.89	13.60	12.58	0.82	343.00	98.04	52.30	169.88	14.66	17.54	1994.34	54.02	115.66	12.17	45.58
1520D-1H-4_87-90-14	71.42	21.86	13.62	2.05	182.14	183.84	54.09	359.66	16.22	8.69	1032.90	42.45	88.45	9.86	44.24
1520D-1H-4_87-90-15	99.98	10.20	63.48	3.98	335.66	155.58	48.37	182.41	17.10	17.55	1897.38	63.7	123.36	12.71	50.54
1520D-2H-1_15-19-11	40.52	10.68	4.79	0.86	99.84	124.29	27.11	204.74	7.26	5.02	580.77	21.74	45.98	5.59	20.81
1520D-2H-1_15-19-12	45.72	11.77	11.81	0.94	112.75	123.45	29.97	200.10	8.71	6.14	651.43	23.94	52.09	5.82	23.29
1520D-2H-1_15-19-13	44.86	10.77	16.69	0.80	109.49	114.64	27.95	190.20	7.39	5.91	625.37	22.82	48.75	5.69	21.09
1520D-2H-1_15-19-14	37.27	11.25	17.88	1.11	99.24	120.60	26.38	198.35	6.86	5.30	600.94	23.45	48.08	5.78	20.06
1520D 2H-3 74-75_1	27.59	15.85	2.75	13.48	85.92	191.68	19.34	126.42	5.41	4.91	368.95	14.32	30.86	3.76	13.69
1520D 2H-3 74-75_3	30.44	20.45	5.28	18.71	86.39	255.46	22.45	140.43	5.56	4.83	433.31	15.7	34.07	4.16	16.8
1520D 2H-3 74-75_6	27.38	26.28	41.41	24.44	77.83	214.45	21.70	132.36	5.38	4.48	369.61	14.35	30.43	3.69	15.21
1520D 2H-3 74-75_7	23.72	16.33	6.09	14.59	75.56	254.96	18.77	128.77	4.97	4.35	359.79	13.57	28.29	3.51	14.1
1520D-4H-4_117-119-8	48.25	18.29	3.85	8.89	129.22	203.65	32.59	240.19	10.38	7.22	662.30	29.18	64.23	7.74	30.2
1520D-4H-4_117-119-10	49.13	10.03	7.17	0.84	166.95	120.18	29.16	156.09	10.07	8.95	933.63	30.23	63.02	6.99	25.27
1520D-4H-4_117-119-14	42.59	16.19	13.40	8.16	105.19	203.49	28.27	204.74	8.70	5.99	559.53	24.54	53.02	6.2	25.45
1520D_15H-1_54-55_1	46.95	7.14	6.00	0.90	135.62	81.09	18.41	128.14	7.17	6.22	702.33	20.51		4.59	16.31
1520D_15H-1_54-55_9	39.92	6.03	5.24	0.79	119.50	76.31	17.97	127.27	6.12	5.59	631.68	19.32	38.98	4.17	15.16
1520D_15H-1_54-55_4	38.56	5.87	3.67	0.82	122.49	77.33	16.43	117.14	5.96	6.41	642.01	18.56	38.83	4.05	14.11
1520D_15H-1_54-55_5	50.64	7.02	4.75	0.93	144.75	82.73	17.18	119.46	7.25	6.32	684.06	19.95	43.96	4.33	14.78
1520D_15H-4_71-73_2	55.26	10.00	3.84	0.47	144.11	72.46	29.91	155.98	9.91	6.32	804.16	28.37	59.87	6.6	25.15
1520D_15H-4_71-73_6	39.04	5.47	3.09	0.36	129.09	65.33	19.65	95.48	7.34	4.84	716.35	21.27	43.99	4.77	17.6
1520D_15H-4_71-73_7	42.68	6.78	3.25	0.49	124.46	107.91	21.70	153.75	7.30	4.94	678.89	21.24	43.89	4.82	17
1520D_15H-4_71-73_8	37.68	4.96	3.33	0.44	134.18	72.59	18.29	113.43	6.55	4.94	708.25	20.96	42.55	4.48	16.21
1520D_15H-4_71-73_9	45.75	5.87	3.16	0.43	137.32	90.74	20.92	133.99	8.05	4.77	769.84	22.95	48.32	5.16	18.38
1520D_15H-7_13-15_1	39.08	5.38	3.07	0.35	141.59	42.82	21.21	72.31	7.20	7.67	754.12	25.95	53.89	5.62	18.84
1520D_15H-7_13-15_4	46.71	13.51	4.77	0.75	173.68	74.64	39.41	193.55	11.70	6.90	980.63	33.7	76.6	7.93	31.09
1520D_15H-7_13-15_5	42.41	6.43	2.78	0.85	150.84	46.13	17.09	101.57	6.55	6.69	814.79	21.17	42.87	4.3	14.75
1520D_15H-7_13-15_2	26.06	9.37	4.18	0.64	129.56	62.11	27.74	128.46	7.38	6.17	812.98	25.35	53.32	6.01	20.88
1520D_15H-7_13-15_6	44.92	6.22	2.75	0.71	137.69	69.74	17.02	97.53	6.56	5.20	715.65	20.45	43.84	4.11	13.84
U1520D_16H-2_65-67_1	50.72	5.73	4.03	0.97	118.00	97.26	12.28	110.69	5.07	5.98	1194.63	15.74	30.01	2.82	8.91
U1520D_16H-2_65-67_6	52.84	5.66	2.67	0.93	113.90	95.70	11.81	115.29	5.04	6.52	1227.55	15.82	29.71	3.13	9.26
U1520D_16H-2_65-67_10	47.92	5.28	2.60	0.84	108.13	94.31	11.40	102.94	4.91	5.66	1111.63	15.46	27.53	2.69	9.21
U1520D_16H-2_65-67_11	47.57	5.45	3.00	1.03	120.77	93.89	11.78	109.84	5.14	6.34	1191.49	16.04	29.52	2.77	9.81
U1520D_16H-2_65-67_12	51.12	5.25	2.81	0.86	112.15	95.92	10.85	110.94	4.87	6.53	1219.05	17.1	30.9	2.96	9.65
1520D_18H-2_108-110_8	24.71	3.73	5.76	2.93	88.89	394.74	11.12	165.86	5.87	4.33	988.39	17.35	36.74	4.21	14.53
1520D_18H-5_123-125_4	23.03	10.63	2.87	6.37	69.03	133.85	20.42	141.93	4.15	4.45	477.17	11.52	27.51	2.98	13.47
1520D_18H-5_123-125_2	29.30	9.32	2.48	4.98	64.24	140.44	18.06	133.12	3.97	4.21	436.99	10.92	24.59	2.82	12.65
1520D_18H-5_123-125_6	36.74	10.42	3.13	7.46	83.27	169.50	23.35	157.48	4.63	5.28	559.67	14.13	29.86	3.57	15.48
1520D_18H-6_107-109_1	63.84	10.39	4.38	1.30	146.94	85.63	33.01	189.34	6.95	8.24	654.09	25.58	59.04	6.76	25.08
1520D_18H-6_107-109_3	44.25	8.02	3.72	1.30	105.71	76.41	23.34	133.83	4.81	6.05	467.22	18.42	40.69	4.81	17.83
1520D_18H-6_107-109_2	57.79	10.44	3.31	1.16	132.96	79.26	30.29	176.35	6.94	7.42	617.93	24.43	57.61	6.41	23.77
1520D_18H-6_107-109_6	65.68	11.04	3.94	1.31	136.14	82.38	32.48	183.62	6.86	7.85	647.17	25.2	56.6	6.19	25.41
1520D_18H-6_107-109_7	60.39	10.56	3.53	1.26	137.29	88.76	34.24	192.44	6.44	7.19	635.63	24.94	57.43	6.22	26.21
1520D_20F-1_125-127_2	17.80	20.70	5.01	17.50	39.27	191.99	24.24	97.94	3.83	2.37	339.67	8.97	21.03	2.82	12.37
1520D_21F-4_48-50_1	47.33	8.34	4.16	0.24	133.64	48.50	29.95	113.95	8.71	5.21	750.31	26.77	59.48	6.6	24.56
1520D_21F-4_48-50_7	50.75	5.12	3.53	0.86	135.76	83.02	17.59	87.99	6.23	6.75	733.44	22.18	45.59	4.8	17.57
1520D_21F-4_48-50_8	28.26	8.64	3.77	0.48	134.98	76.30	25.18	136.42	7.31	5.50	807.17	25.8	53.61	5.79	21.02
1520D_22F-1_111-113_1	43.91	8.29	4.70	0.33	123.03	38.39	31.34	125.19	9.59	5.29	722.49	26.12	57.8	6.57	25.09
1520D_22F-1_111-113_8	40.59	6.50	6.99	0.34	110.74	30.60	25.68	105.42	8.11	4.53	614.18	22.28	48.99	5.55	20.44
1520D_22F-1_111-113_2	47.07	8.81	4.81	0.37	130.86	41.11	34.56	136.06	10.06	5.70	768.32	28.17	61.92	7.14	26.25
1520D_22F-1_111-113_9	48.01	9.27	4.16	0.45	139.75	41.02	34.77	140.12	10.55	6.26	831.42	29.37	65.24	7.39	25.83
1520D_22F-1_111-113_10	36.38	7.19	3.58	0.23	106.03	33.76	28.31	110.74	8.43	4.54	637.68	22.75	49.53	5.55	22.24
1520D_22F-2_60-62_3	39.07	8.85	4.80	0.48	123.44	42.78	33.12	124.56	9.12	5.02	725.22	27.41	58.47	6.68	25.15
1520D_22F-2_60-62_5	41.75	8.92	4.82	0.38	120.31	41.58	32.69	131.68	9.93	5.19	754.09	27.04	58.67	6.8	25.66
1520D_22F-2_60-62_6	39.29	8.98	6.10	0.37	125.52	42.32	33.29	129.46	10.14	5.28	753.91	27.23	58.77	6.71	25.76
1520D_22F-2_60-62_8	42.35	8.45	5.50	0.50	125.67	44.74	35.11								

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1520D-1H-1_119-120-12	5.49	1.11	5.64	0.88	5.64	1.35	3.56	0.52	3.69	0.58	5.44	0.504	19.95	10.38	2.66
1520D-1H-1_119-120-13	5.46	1.23	5.35	0.92	5.64	1.22	3.40	0.47	3.46	0.57	6.15	0.65	19.39	10.34	2.52
1520D-1H-1_119-120-14	5.62	1.17	5.40	0.82	5.64	1.16	3.47	0.51	3.74	0.50	5.57	0.571	19.07	10.55	2.44
1520D-1H-1_119-120-15	5.93	1.17	5.04	0.77	5.93	1.27	3.68	0.58	4.06	0.57	6.26	0.629	20.5	10.54	2.87
1520D-1H-3_26-30-14	5.57	1.13	5.13	0.80	5.76	1.15	3.25	0.57	3.51	0.54	6.05	0.629	20.21	10.41	2.67
1520D-1H-3_26-30-15	5.20	1.13	4.36	0.84	5.19	1.02	3.02	0.47	3.87	0.52	5.61	0.585	19.82	10.04	2.75
1520D-1H-3_67-69-13	0.14	0.04	0.13	0.01	0.19	0.03	0.12	0.01	0.07	0.01	0.08	0.018	0.831	0.203	0.069
1520D-1H-3_67-69-14	7.03	1.36	6.47	0.86	5.68	0.87	2.17	0.14	1.70	0.18	0.47	0.037	6.34	6.35	2.02
1520D-1H-3_67-69-15	3.78	0.37	4.52	0.53	4.15	0.90	2.54	0.43	2.62	0.46	2.79	0.426	17.51	10.07	2.43
1520D-1H-4_35-37-13	3.35	0.62	2.83	0.61	3.60	0.73	2.14	0.36	1.65	0.44	2.74	0.621	19.13	9.91	2.6
1520D-1H-4_35-37-14	3.75	1.00	4.41	0.64	3.78	0.98	2.68	0.41	2.64	0.43	5.02	0.441	14.85	8.95	1.98
1520D-1H-4_35-37-15	5.17	0.90	4.70	0.82	4.45	1.02	2.94	0.51	2.47	0.52	4.93	0.573	18.24	10.06	2.31
1520D-1H-4_87-90-12	7.98	1.19	5.78	1.32	8.08	1.54	4.98	0.88	6.25	0.80	8.12	1.17	31.14	24.01	6.08
1520D-1H-4_87-90-13	8.73	1.04	7.76	1.39	8.32	1.69	5.44	0.78	6.34	0.90	6.66	1.3	43.87	30.95	7.53
1520D-1H-4_87-90-14	8.96	2.06	8.99	1.41	8.01	1.82	5.46	1.00	6.40	0.78	10.21	1.35	29.63	16.88	4.32
1520D-1H-4_87-90-15	7.68	0.71	7.48	1.29	7.48	1.77	5.07	0.61	5.29	1.07	6.39	1.53	48.24	31.92	7.95
1520D-2H-1_15-19-11	4.61	0.96	4.31	0.67	4.67	0.96	2.93	0.53	3.22	0.47	5.44	0.509	15.94	9.14	2.34
1520D-2H-1_15-19-12	5.49	0.96	4.30	0.74	4.42	1.03	3.33	0.41	3.32	0.59	6.09	0.447	17.35	10.29	2.34
1520D-2H-1_15-19-13	4.40	0.97	5.13	0.71	5.26	1.05	3.31	0.47	3.07	0.51	5.79	0.528	17.69	9.69	2.78
1520D-2H-1_15-19-14	3.33	1.20	4.43	0.66	4.68	0.86	2.55	0.49	3.01	0.48	5.77	0.657	16.52	9.26	2.26
1520D_2H-3_74-75_1	3.12	0.91	3.70	0.55	3.10	0.72	1.82	0.30	1.99	0.29	3.56	0.385	13.36	6.16	1.81
1520D_2H-3_74-75_3	3.63	1.05	3.46	0.67	3.99	0.80	2.59	0.31	2.37	0.27	3.70	0.401	11.58	6.93	1.676
1520D_2H-3_74-75_6	3.69	0.96	3.92	0.57	3.79	0.77	2.24	0.35	2.28	0.32	3.86	0.349	10.49	6.31	1.557
1520D_2H-3_74-75_7	3.18	0.83	3.43	0.48	3.23	0.61	2.04	0.33	2.03	0.28	3.73	0.355	9.72	5.91	1.613
1520D-4H-4_117-119-8	6.28	1.13	5.76	0.92	5.70	1.21	3.45	0.53	3.22	0.51	6.41	0.681	21.75	12.51	2.86
1520D-4H-4_117-119-10	5.06	0.77	5.17	0.77	4.69	1.03	2.94	0.47	3.30	0.54	4.77	0.804	20.89	15.34	4.03
1520D-4H-4_117-119-14	5.23	1.21	5.25	0.88	4.53	1.10	3.33	0.51	3.32	0.36	5.53	0.569	19.44	10.26	2.34
1520D_15H-1_54-55_1	3.31	0.60	2.71	0.46	3.25	0.64	1.96	0.34	2.30	0.40	4.00	0.566	16.92	11.65	3.17
1520D_15H-1_54-55_9	3.00	0.43	2.61	0.47	2.98	0.57	1.81	0.27	2.22	0.33	3.56	0.529	13.34	10.39	2.77
1520D_15H-1_54-55_4	2.45	0.60	2.85	0.38	2.39	0.60	1.81	0.32	1.95	0.33	3.53	0.52	15.57	10.16	2.84
1520D_15H-1_54-55_5	2.94	0.50	2.93	0.41	2.66	0.59	1.77	0.27	2.25	0.29	3.54	0.589	18.32	11.26	3.44
1520D_15H-4_71-73_2	4.91	0.89	5.02	0.76	5.00	1.03	3.11	0.45	3.14	0.54	5.00	0.786	22.26	12.8	3.16
1520D_15H-4_71-73_6	3.69	0.51	3.03	0.46	2.87	0.62	1.93	0.29	2.19	0.28	3.02	0.56	15.81	10.59	2.82
1520D_15H-4_71-73_7	3.44	0.73	3.10	0.52	3.40	0.72	2.10	0.31	2.45	0.38	4.02	0.557	14.7	10.57	2.7
1520D_15H-4_71-73_8	3.01	0.49	2.41	0.44	2.68	0.58	1.97	0.28	2.21	0.29	3.10	0.605	15.2	10.6	2.68
1520D_15H-4_71-73_9	3.36	0.59	3.47	0.53	3.34	0.73	2.33	0.27	2.47	0.36	3.70	0.679	16.41	11.68	2.94
1520D_15H-7_13-15_1	3.58	0.44	3.17	0.55	3.30	0.72	2.16	0.34	2.70	0.41	2.72	0.714	18.16	13.37	3.27
1520D_15H-7_13-15_4	6.63	0.95	6.14	1.03	6.29	1.21	4.54	0.55	3.77	0.60	6.17	0.88	26.83	13.89	3.7
1520D_15H-7_13-15_5	3.02	0.36	2.46	0.41	2.54	0.54	1.80	0.28	2.25	0.28	3.10	0.554	15.01	12.57	3.11
1520D_15H-7_13-15_2	5.04	0.67	4.11	0.75	5.22	0.90	2.83	0.41	2.76	0.53	4.23	0.47	18.44	11.02	2.45
1520D_15H-7_13-15_6	2.19	0.53	2.58	0.40	2.39	0.55	1.64	0.27	1.88	0.29	2.89	0.485	15.67	10.82	2.97
U1520D_16H-2_65-67_1	1.84	0.45	1.62	0.32	1.94	0.40	1.35	0.19	1.70	0.32	3.23	0.425	11.9	10.18	2.41
U1520D_16H-2_65-67_6	1.84	0.33	1.76	0.27	1.82	0.34	1.24	0.13	1.40	0.36	3.26	0.477	12.4	10.28	2.31
U1520D_16H-2_65-67_10	1.55	0.33	1.85	0.25	2.28	0.50	1.21	0.13	1.28	0.27	3.50	0.389	12.19	10.26	2.31
U1520D_16H-2_65-67_11	2.02	0.40	1.53	0.29	1.88	0.42	1.36	0.22	1.59	0.27	3.70	0.477	12.15	10.18	2.39
U1520D_16H-2_65-67_12	1.84	0.34	1.75	0.24	2.09	0.51	1.21	0.19	1.78	0.21	3.36	0.58	12.57	10.47	2.48
1520D_18H-2_108-110_8	2.31	0.81	1.31	0.38	1.88	0.43	1.51	0.19	1.38	0.26	4.90	0.355	17.69	7.31	2.15
1520D_18H-5_123-125_4	3.46	0.74	3.21	0.49	3.08	0.70	2.04	0.29	2.23	0.35	3.74	0.354	11.65	5.13	1.659
1520D_18H-5_123-125_2	2.75	0.75	3.12	0.48	2.71	0.55	1.65	0.29	2.07	0.29	3.30	0.332	10	5.13	1.62
1520D_18H-5_123-125_6	3.46	0.79	3.63	0.60	3.83	0.79	2.22	0.40	2.60	0.39	4.44	0.37	25.79	6.12	2.68
1520D_18H-6_107-109_1	5.23	0.78	5.04	0.84	5.50	1.18	3.84	0.52	3.69	0.58	5.19	0.557	21.84	11.71	3.02
1520D_18H-6_107-109_3	4.20	0.59	3.69	0.63	4.06	0.86	2.69	0.38	2.79	0.40	3.57	0.366	14.56	8.26	2.04
1520D_18H-6_107-109_2	5.41	0.73	5.16	0.86	5.78	1.15	3.21	0.50	3.16	0.45	5.12	0.535	21.35	11.19	2.91
1520D_18H-6_107-109_6	5.69	0.76	5.07	0.91	5.24	1.12	3.57	0.42	3.82	0.45	5.21	0.498	20.04	11.5	2.93
1520D_18H-6_107-109_7	5.34	0.88	5.28	0.84	6.21	1.22	3.53	0.55	3.54	0.46	5.55	0.542	20.35	12.2	2.96
1520D_20F-1_125-127_2	3.40	1.05	3.38	0.60	3.96	0.93	2.65	0.35	2.88	0.39	2.83	0.229	8.84	2.76	0.898
1520D_21F-4_48-50_1	4.87	0.69	4.26	0.77	5.22	1.10	3.39	0.49	3.21	0.49	4.09	0.709	20.98	13	3.15
1520D_21F-4_48-50_7	3.20	0.43	3.26	0.42	3.04	0.66	1.64	0.26	2.10	0.28	2.93	0.612	15.8	11.96	3.15
1520D_21F-4_48-50_8	4.11	0.74	3.90	0.66	4.34	1.05	2.81	0.40	2.62	0.44	4.46	0.709	18.77	13.06	3.11
1520D_22F-1_111-113_1	5.39	0.65	4.87	0.81	5.33	1.11	3.25	0.49	3.45	0.53	4.06	0.721	17.67	11.18	2.84
1520D_22F-1_111-113_8	4.20	0.54	4.15	0.64	4.44	0.89	2.77	0.46	2.70	0.44	3.46	0.704	15.82	9.36	2.35
1520D_22F-1_111-113_2	6.01	0.71	4.96	0.87	6.04	1.19	3.93	0.57	3.70	0.58	4.21	0.752	19.13	11.83	2.99
1520D_22F-1_111-113_9	5.28	0.69	5.88	0.91	5.88	1.29	3.88	0.55	4.29	0.62	4.42	0.86	20.43	12.22	3.36
1520D_22F-1_111-113_10	4.72	0.64	4.30	0.72	4.53	1.00	2.91	0.44	3.40	0.49	3.49	0.59	15.93	9.75	2.53
1520D_22F-2_60-62_3	6.23	0.69	5.04	0.84	5.70	1.20	3.77	0.46	3.26	0.47	4.20	0.677	17.69	10.99	2.77
1520D_22F-2_60-62_5	6.17	0.77	4.81	0.85	5.54	1.19	3.60	0.55	3.98	0.53	4.11	0.812	17.93	11.05	2.69
1520D_22F-2_60-62_6	5.61	0.65	5.23	0.85	5.38	1.16	3.47	0.49	3.77	0.55	4.19	0.736	17.6	11.32	2.8
1520D_22F-2_60-62_8	5.75	0.58	5.03	0.81	5.97	1.13	4.23	0.54	3.72	0.61	4.46	0.724	18.77	11.66	2.82
1520D_22F-2_60-62_10	6.27	0.78	5.80	1.05	6.43	1.36	4.02	0.61	4.21	0.64	4.85	0.711	20.8	12.63	3.17
U1520D_22F-2_80-82_1	5.05	0.84	5.34	0.82	5.07	1.12	3.68	0.57	4.12	0.55	6.46	0.52	17.64	10.75	2.48

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
U1520D_22F-2_80-82_3	40.66	13.71	3.22	2.98	119.33	146.67	32.99	219.78	8.17	6.54	913.28	23.61	51.94	6.08	24.75
U1520D_22F-2_80-82_4	36.89	13.70	22.86	2.77	111.21	150.68	33.73	221.63	7.44	5.79	932.08	23.75	50.79	5.94	25.89
U1520D_22F-2_80-82_5	37.75	14.21	3.12	4.29	118.90	152.12	32.57	217.52	8.29	6.48	902.38	23.47	51.31	6.24	24.57
U1520D_22F-2_80-82_7	36.74	14.38	24.99	2.77	111.64	151.64	31.90	211.04	8.14	5.85	885.93	23.38	49.32	6.01	22.92
1520D_22F-2_109-111_2	3.84	7.90	4.90	0.51	136.62	49.90	32.97	158.68	7.86	5.66	732.98	27.83	59.21	6.58	25.12
1520D_22F-2_109-111_4	80.18	17.83	7.13	0.91	312.31	65.46	68.45	250.15	19.57	11.80	1436.31	55.12	122.1	13.62	55.19
1520D_22F-2_109-111_6	10.58	8.54	4.15	2.05	89.50	80.82	27.71	147.94	6.34	5.26	561.15	21.41	46.52	5.67	21.9
1520D_22F-2_109-111_1	30.04	7.42	4.49	0.77	114.85	100.28	20.57	128.25	6.98	5.23	827.57	22.72	45.92	4.76	18.01
1520D_22F-2_109-111_5	41.90	8.39	5.46	0.40	124.02	40.56	33.22	122.20	9.58	5.20	734.69	27.59	58.13	6.67	25.15
1520D_22F-3_77-79_3	48.31	10.69	5.03	0.37	128.02	43.23	34.88	123.96	9.39	5.59	772.25	28.45	61.08	7.06	27.16
1520D_22F-3_77-79_4	42.09	9.88	4.05	0.38	121.78	41.24	33.11	118.70	9.38	5.25	747.48	27.06	58.89	6.59	26.81
1520D_22F-3_77-79_10	45.36	10.64	4.09	0.55	131.68	44.72	37.60	130.33	9.62	5.85	809.02	30.21	64.44	7.61	27.86
1520D_23F-2_113-115_3	11.25	2.01	1.48	0.48	27.09	16.70	6.88	17.99	1.82	1.28	145.44	5.54	11.83	1.344	5.23
1520D_23F-3_6-8_1	56.99	6.89	4.52	1.05	168.68	52.57	20.09	114.61	7.38	7.66	954.34	24.75	48.31	4.86	17.58
1520D_23F-3_6-8_3	33.98	3.90	3.28	0.71	102.14	63.32	16.99	63.99	5.62	5.77	682.11	21.02	40.66	4.37	16.03
1520D_23F-3_6-8_8	47.62	10.00	3.66	0.64	121.65	45.75	37.70	141.84	9.53	5.64	762.92	27.83	59.85	7.08	28.75
1520D_23F-3_6-8_9	39.58	6.71	3.84	1.47	137.05	55.40	30.58	113.78	8.11	7.71	786.99	26.46	55.48	6.54	22.52
1520D_25F-2_10-14_2	46.72	10.31	3.99	0.51	140.58	59.33	28.77	127.77	9.28	5.79	809.39	26.65	59.79	6.43	25.13
1520D_25F-2_10-14_5	37.12	9.95	5.77	0.62	139.62	64.23	26.67	140.59	9.10	5.78	757.11	25.27	55.33	6.09	22.88
1520D_25F-2_10-14_4	37.23	11.07	4.70	0.54	120.39	75.77	29.58	227.85	9.62	5.57	715.65	24.5	53.97	6.27	23.76
1520D_25F-2_10-14_8	39.04	10.22	5.59	0.51	143.00	60.50	27.27	126.27	8.75	6.28	764.37	25.87	56.53	6.27	24.36
1520D_25F-4_10-12_5	18.50	4.11	5.97	1.64	33.63	39.87	6.92	33.30	2.03	2.31	192.94	6.18	12.52	1.432	5.42
1520D_25F-4_10-12_7	38.09	9.82	2.65	0.67	123.03	64.68	21.20	103.04	7.76	6.70	789.97	23.85	50.15	5.18	18.86
1520D_25F-4_10-12_10	34.64	8.56	3.61	0.49	179.68	47.37	17.68	83.29	6.26	5.05	690.34	20.83	42.28	4.59	16.54
1520D_25F-4_10-12_8	46.41	11.89	2.36	0.28	125.12	49.02	26.65	108.85	8.09	5.30	724.91	25.41	53.82	6.15	22.39
1520D_25F-4_10-12_9	43.35	12.79	3.20	0.45	128.15	70.25	28.23	142.01	8.56	5.41	760.38	26.98	57.14	6.29	25.15
1520D_25F-4_19-21_3	46.49	9.38	2.69	0.46	128.17	64.95	27.81	134.98	8.53	5.55	760.18	27.1	55.69	6.12	24.83
1520D_25F-4_19-21_7	34.06	5.52	3.49	0.96	112.64	63.39	17.87	85.16	6.40	4.25	680.34	19.43	40.02	4.23	15.39
1520D_25F-4_19-21_5	44.09	9.79	2.86	0.47	128.36	64.55	27.52	134.39	8.66	5.73	743.40	26.44	54.2	6.09	23.82
1520D_25F-4_19-21_6	44.86	9.53	3.82	0.71	165.98	77.40	30.34	122.51	8.45	5.64	925.89	30.47	70.52	7.39	27.15
1520D_26F-1_73-75_3	34.89	7.85	2.25	0.32	118.62	53.36	24.57	95.70	7.07	4.71	646.63	22.51	45.64	5.31	19.74
1520D_26F-1_73-75_4	34.25	7.38	2.41	0.34	119.30	53.12	24.44	91.34	7.35	4.67	661.04	23.15	46.61	5.06	19.31
1520D_26F-1_73-75_5	39.24	8.13	2.34	0.36	128.38	55.18	26.11	96.76	7.84	5.08	705.95	24.99	49.93	5.66	21.04
1520D_26F-1_73-75_8	41.30	7.81	2.18	0.26	123.32	51.96	25.37	94.90	7.48	4.97	692.34	24.29	49.64	5.85	21.65
1520D_26F-1_73-75_10	46.00	8.35	2.13	0.31	134.59	52.23	29.72	89.98	8.14	5.83	878.59	28.01	57.93	6.39	24.66
1520D_26F-1_76-78_1	33.75	9.83	2.45	0.34	110.17	50.47	24.03	89.14	6.83	4.91	698.18	24.44	48.05	5.74	20.15
1520D_26F-1_76-78_2	14.76	3.81	2.12	0.29	46.87	37.92	9.55	35.32	2.89	1.94	275.19	9.34	19.64	2.24	7.99
1520D_26F-1_76-78_5	35.15	9.61	3.18	0.29	123.60	55.13	24.61	95.74	7.59	5.33	709.69	23.97	49.32	5.85	21.23
1520D_26F-1_76-78_8	35.27	8.92	1.58	0.38	101.38	66.92	22.15	97.93	6.73	4.22	603.88	20.94	43.76	5.09	17.77
1520D_26F-1_76-78_10	32.95	7.28	1.61	0.31	99.87	36.31	21.43	60.08	5.97	4.44	641.27	20	43.18	4.77	16.96
1520D_26F-1_103-105_2	39.61	12.52	2.95	0.28	125.02	55.72	26.46	123.42	8.02	5.34	739.55	25.38	52.34	5.65	21.71
1520D_26F-1_103-105_3	38.25	12.44	3.78	0.48	132.70	57.60	26.69	126.51	8.73	5.56	750.76	25.65	53.44	6.05	22.72
1520D_26F-1_103-105_6	38.44	11.99	3.39	0.28	116.30	67.44	25.73	138.12	8.36	5.10	649.18	23.14	49.1	5.43	21.24
1520D_26F-1_103-105_8	42.02	13.12	2.99	0.34	128.59	68.81	26.51	147.85	7.92	5.33	726.07	23.81	51.27	5.56	21.18
1520D_26F-1_103-105_4	37.31	12.52	3.04	0.35	102.86	79.29	27.75	163.92	8.02	4.78	644.10	22.15	47.43	5.7	22.67
1520D_26F-2_23-27_4	27.89	11.66	4.40	0.45	140.86	60.19	28.47	130.39	8.31	5.72	748.34	26.65	54.79	6.01	24.32
1520D_26F-2_23-27_8	39.38	11.30	3.21	0.39	130.73	56.05	24.72	113.74	7.98	5.38	714.22	24.32	52.65	5.39	21.19
1520D_26F-2_23-27_9	35.72	10.62	3.79	0.36	128.50	60.46	25.91	126.57	7.98	5.20	675.61	23.89	51.01	5.52	21.63
1520D_26F-2_23-27_10	43.89	12.71	3.66	0.49	141.83	69.81	27.40	133.23	9.13	6.12	793.48	26.59	57.63	6.28	23.57
1520D_26F-3_29-31_1	42.40	11.02	3.57	0.61	137.41	69.86	25.54	128.10	8.00	5.71	748.33	25.74	53.37	5.89	22.33
1520D_26F-3_29-31_2	40.10	9.53	2.46	0.66	118.46	60.06	22.16	116.61	7.45	5.06	663.75	22.97	48.33	5.48	19.82
1520D_26F-3_29-31_6	42.76	11.40	3.50	0.65	141.45	78.91	24.90	146.98	8.33	5.62	756.82	25.98	54.97	5.77	23.14
1520D_26F-3_29-31_8	46.43	12.40	2.80	0.31	152.35	63.79	29.09	138.27	9.44	5.85	806.25	28.03	61.67	6.86	26.4
1520D_26F-4_51-55_3	47.04	11.21	3.76	0.41	142.60	66.09	22.93	122.79	8.07	6.37	714.45	22.86	51.46	5.42	20.74
1520D_26F-4_51-55_6	55.66	10.46	4.10	0.48	147.98	75.77	21.27	90.07	7.81	6.78	883.50	23.4	52.06	5.52	20.41
1520D_26F-4_51-55_7	45.09	11.12	4.56	0.55	147.85	69.41	22.63	124.10	7.96	6.16	738.36	23.5	51.34	5.35	19.37
1520D_26F-4_51-55_8	60.73	9.94	3.37	0.34	138.82	63.20	19.32	73.82	7.66	6.75	888.34	22.77	49.7	5.02	16.34
1520D_26F-4_51-55_10	53.64	11.69	3.94	0.63	160.10	77.02	25.14	131.08	8.54	7.04	854.27	26.84	59.27	6.01	23.22
1520D_27F-1_19-20_1	48.58	6.50	2.38	0.50	123.05	82.12	16.94	106.62	6.37	5.69	755.20	21.19	41.27	4.36	15.83
1520D_27F-1_19-20_2	21.32	4.00	3.32	1.02	86.65	53.81	10.91	61.99	3.83	4.17	507.15	13.72	26.91	2.77	9.6
1520D_27F-1_19-20_7	28.62	4.62	3.27	0.99	80.87	57.70	12.95	74.76	4.64	3.58	453.14	14.13	29.19	2.99	11.55
1520D_27F-1_19-20_9	54.51	8.21	2.00	0.71	137.96	77.70	22.89	133.91	6.75	6.53	770.40	24.24	49.27	5.36	19.69
1520D_27F-1_28-30_2	58.70	7.77	3.51	0.69	146.96	80.14	16.26	78.73	5.90	7.21	727.46	22.05	47.91	4.77	15.32
1520D_27F-1_28-30_5	52.60	8.49	3.74	0.39	131.29	88.88	19.68	128.37	8.59	4.91	793.51	23.03	49.09	5.15	18.7
1520D_27F-1_28-30_6	52.04	8.08	3.44	0.54	128.06	84.99	16.17	101.93	6.66	5.85	747.33	19.81	41.95	4.23	15.19
1520D_27F-1_28-30_8	37.26	7.64	4.19	1.03	121.99	84.07	17.51	114.61	6.65	4.55	689.25	20.58	40.61	4.38	15.92
1520D_27F-1_44-46_4	42.33	10.46	2.83	0.66	134.89	93.40	21.24	143.67	8.14	4.97	817.72	24.86	48.13	5.38	18.83
1520D_27F-1_44-46_8	32.66	7.52	1.94	0.53	102.30	74.44	15.78	103.97	5.82	3.81	619.47	18.03	35.72	4	14.8

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
U1520D_22F-2_80-82_3	5.30	0.96	5.39	0.85	5.91	1.18	3.72	0.51	3.59	0.57	6.05	0.612	18.29	11.28	2.63
U1520D_22F-2_80-82_4	5.31	0.87	5.72	0.86	5.93	1.30	3.71	0.56	4.18	0.61	5.66	0.617	17.81	11.37	2.41
U1520D_22F-2_80-82_5	5.26	0.92	5.09	0.92	5.73	1.16	3.73	0.52	3.77	0.56	6.13	0.536	19.44	11.04	2.68
U1520D_22F-2_80-82_7	5.53	1.03	5.65	0.78	5.68	1.11	3.75	0.52	3.55	0.57	6.00	0.482	17.59	10.73	2.54
1520D_22F-2_109-111_2	5.36	0.65	4.77	0.78	5.35	1.12	3.25	0.45	3.84	0.52	4.59	0.645	18.37	12.83	3
1520D_22F-2_109-111_4	11.04	1.10	10.32	1.72	11.31	2.24	6.81	1.00	7.41	1.18	8.20	1.49	42.03	23.27	5.68
1520D_22F-2_109-111_6	4.59	0.76	4.55	0.72	4.46	0.97	2.95	0.42	2.91	0.44	3.99	0.426	20.09	8.03	2.068
1520D_22F-2_109-111_1	3.61	0.65	3.05	0.49	3.40	0.65	2.16	0.32	2.49	0.35	3.83	0.463	15.7	10.7	2.47
1520D_22F-2_109-111_5	5.29	0.64	5.16	0.91	5.75	1.13	3.66	0.55	3.65	0.56	3.89	0.75	17.42	11.49	2.79
1520D_22F-3_77-79_3	5.87	0.72	5.19	0.88	6.03	1.17	3.64	0.59	4.14	0.62	4.31	0.735	18.9	12.29	3.14
1520D_22F-3_77-79_4	5.31	0.77	5.40	0.84	6.18	1.19	3.64	0.56	3.69	0.60	4.25	0.686	18.97	11.68	2.9
1520D_22F-3_77-79_10	6.34	0.74	5.86	1.01	6.39	1.32	3.81	0.54	4.46	0.67	4.53	0.749	21.3	13.56	3.21
1520D_23F-2_113-115_3	1.09	0.12	0.84	0.17	1.13	0.25	0.73	0.10	0.79	0.11	0.64	0.139	3.82	2.427	0.667
1520D_23F-3_6-8_1	2.75	0.38	3.26	0.49	3.71	0.73	2.25	0.32	2.24	0.38	3.76	0.738	18.06	14.85	3.56
1520D_23F-3_6-8_3	3.17	0.50	2.90	0.38	3.14	0.59	2.03	0.23	1.99	0.35	2.14	0.554	16.53	11.29	2.49
1520D_23F-3_6-8_8	5.49	0.80	6.11	0.80	6.31	1.30	3.77	0.59	4.75	0.67	4.83	0.785	19.57	12.17	2.83
1520D_23F-3_6-8_9	5.01	0.56	4.84	0.74	4.81	0.95	3.22	0.52	3.51	0.54	3.95	0.64	17.79	13.18	3
1520D_25F-2_10-14_2	4.94	0.63	4.50	0.76	4.77	0.94	3.00	0.46	3.50	0.50	4.47	0.736	22.89	12.93	3.59
1520D_25F-2_10-14_5	4.82	0.71	4.56	0.68	4.21	0.99	3.06	0.47	2.91	0.41	4.16	0.699	20.89	12.29	3.09
1520D_25F-2_10-14_4	5.08	0.88	4.85	0.80	5.33	1.05	3.03	0.45	3.29	0.47	5.90	0.716	18.46	10.85	2.78
1520D_25F-2_10-14_8	4.93	0.77	4.94	0.77	4.85	0.90	2.86	0.41	3.17	0.43	4.04	0.661	23.49	12.07	3.06
1520D_25F-4_10-12_5	1.45	0.21	1.24	0.19	1.26	0.22	0.63	0.09	0.93	0.13	0.99	0.147	6.93	2.83	0.754
1520D_25F-4_10-12_7	4.14	0.61	4.07	0.59	3.44	0.73	2.37	0.40	2.67	0.42	3.48	0.649	17.43	12.1	3
1520D_25F-4_10-12_10	3.21	0.50	2.97	0.51	2.95	0.64	1.92	0.29	2.32	0.33	2.96	0.602	15.85	10.79	2.75
1520D_25F-4_10-12_8	5.18	0.64	5.12	0.77	4.59	1.03	2.87	0.42	2.93	0.42	3.92	0.646	21.3	12.11	2.79
1520D_25F-4_10-12_9	5.28	0.80	4.46	0.73	4.83	1.07	3.24	0.45	3.05	0.49	4.71	0.7	21.51	12.44	2.99
1520D_25F-4_19-21_3	4.90	0.82	4.50	0.77	4.76	1.00	2.91	0.45	3.52	0.43	4.27	0.709	20.89	12.01	3.01
1520D_25F-4_19-21_7	3.11	0.48	2.76	0.40	2.78	0.57	1.78	0.27	1.98	0.29	2.82	0.512	13.66	10.1	2.38
1520D_25F-4_19-21_5	4.98	0.74	4.56	0.77	4.65	0.99	2.82	0.42	2.99	0.48	4.48	0.658	20.61	11.88	2.84
1520D_25F-4_19-21_6	5.17	0.58	5.67	0.78	5.49	1.15	3.81	0.54	3.10	0.48	4.17	1	25.44	14.21	3.11
1520D_26F-1_73-75_3	4.17	0.62	3.79	0.63	3.98	0.84	2.40	0.38	2.73	0.35	3.22	0.617	18.21	10.5	2.5
1520D_26F-1_73-75_4	3.87	0.57	4.18	0.61	3.88	0.81	2.49	0.44	2.39	0.38	2.90	0.591	18.2	10.89	2.48
1520D_26F-1_73-75_5	4.59	0.66	4.30	0.69	4.26	0.95	2.49	0.38	2.81	0.37	3.29	0.648	20.29	11.83	2.72
1520D_26F-1_73-75_8	4.36	0.62	4.27	0.63	4.22	0.91	2.56	0.42	2.50	0.38	3.46	0.666	18.91	11.74	2.68
1520D_26F-1_73-75_10	4.86	0.67	5.17	0.74	4.81	1.10	3.19	0.49	3.45	0.46	3.52	0.619	20.39	12.72	3.13
1520D_26F-1_76-78_1	4.74	0.58	4.15	0.73	4.31	0.85	2.82	0.37	2.48	0.40	3.22	0.516	18.11	10.73	2.55
1520D_26F-1_76-78_2	1.65	0.23	1.77	0.27	1.73	0.35	1.02	0.18	1.18	0.18	1.20	0.253	7.07	4.2	1.072
1520D_26F-1_76-78_5	4.34	0.64	3.90	0.64	3.91	0.90	2.69	0.40	2.58	0.38	3.20	0.653	18.06	11.07	2.67
1520D_26F-1_76-78_8	3.77	0.63	4.04	0.60	3.96	0.81	2.58	0.33	2.32	0.31	3.64	0.6	16.47	9.99	2.36
1520D_26F-1_76-78_10	3.93	0.48	3.58	0.51	3.62	0.71	2.21	0.35	2.51	0.32	2.56	0.426	15.12	9.13	2.25
1520D_26F-1_103-105_2	4.44	0.69	4.58	0.68	4.69	0.94	2.73	0.44	2.84	0.49	4.11	0.712	19.48	12.31	2.86
1520D_26F-1_103-105_3	4.73	0.68	4.36	0.75	4.47	0.97	2.85	0.41	3.05	0.40	4.41	0.741	20.14	12.02	3
1520D_26F-1_103-105_6	4.83	0.77	4.47	0.69	4.15	0.96	2.72	0.43	3.06	0.43	4.29	0.657	16.71	10.77	2.7
1520D_26F-1_103-105_8	4.69	0.68	4.69	0.75	5.20	1.00	2.93	0.42	3.26	0.52	4.49	0.638	19.45	10.61	2.56
1520D_26F-1_103-105_4	5.00	0.89	4.66	0.67	4.44	0.97	2.71	0.41	2.99	0.49	4.21	0.634	15.12	10	2.54
1520D_26F-2_23-27_4	5.10	0.70	4.73	0.77	4.76	1.04	2.79	0.47	2.81	0.49	3.93	0.716	20.37	11.91	2.95
1520D_26F-2_23-27_8	4.53	0.61	3.74	0.67	3.78	0.85	2.52	0.36	2.74	0.39	3.94	0.717	21.75	11.44	2.9
1520D_26F-2_23-27_9	4.18	0.69	4.29	0.69	4.42	0.90	2.61	0.37	2.70	0.41	3.86	0.645	19.05	10.95	2.8
1520D_26F-2_23-27_10	4.84	0.76	5.06	0.70	4.56	0.96	3.08	0.43	3.07	0.49	4.37	0.746	22.69	12.16	3.12
1520D_26F-3_29-31_1	4.74	0.73	4.21	0.69	3.86	0.86	2.68	0.41	2.87	0.43	4.03	0.663	19.69	12.51	2.93
1520D_26F-3_29-31_2	4.42	0.62	3.96	0.62	4.12	0.82	2.42	0.34	2.34	0.39	3.68	0.593	18.28	11.01	2.75
1520D_26F-3_29-31_6	4.69	0.76	4.12	0.64	4.49	0.89	2.74	0.40	2.75	0.41	4.46	0.655	21.58	12.49	3.1
1520D_26F-3_29-31_8	4.99	0.77	4.50	0.81	4.86	1.03	3.24	0.44	3.49	0.48	4.44	0.741	23.43	13.53	3.49
1520D_26F-4_51-55_3	4.09	0.70	3.73	0.62	3.82	0.81	2.40	0.42	2.79	0.35	4.07	0.662	20.03	11.57	3.19
1520D_26F-4_51-55_6	3.97	0.53	3.56	0.55	3.70	0.77	2.27	0.37	2.58	0.34	2.77	0.656	18.76	11.66	3.09
1520D_26F-4_51-55_7	4.50	0.57	3.91	0.61	3.67	0.80	2.36	0.42	2.83	0.42	4.14	0.637	20.37	12.31	3.35
1520D_26F-4_51-55_8	3.20	0.56	3.19	0.52	3.18	0.71	2.16	0.29	2.24	0.38	2.73	0.63	18.41	10.85	3.23
1520D_26F-4_51-55_10	4.03	0.73	4.13	0.78	4.80	0.89	2.84	0.50	2.61	0.40	4.17	0.698	24.26	13.79	3.86
1520D_27F-1_19-20_1	3.10	0.58	2.65	0.40	2.69	0.58	1.62	0.27	1.99	0.37	3.54	0.585	16.71	11.07	2.75
1520D_27F-1_19-20_2	1.95	0.31	1.82	0.27	1.75	0.41	1.18	0.17	1.10	0.23	2.02	0.337	8.68	8.04	1.839
1520D_27F-1_19-20_7	2.18	0.36	2.19	0.32	1.99	0.48	1.53	0.18	1.62	0.24	2.34	0.415	14.68	7.37	1.819
1520D_27F-1_19-20_9	4.28	0.65	3.80	0.60	3.69	0.74	2.28	0.37	2.37	0.41	4.22	0.644	17.88	12.82	3.19
1520D_27F-1_28-30_2	3.01	0.60	2.87	0.49	2.85	0.57	1.97	0.32	2.03	0.35	2.67	0.596	17.49	12.12	3.24
1520D_27F-1_28-30_5	3.81	0.65	3.04	0.54	3.62	0.71	1.98	0.37	2.45	0.35	3.74	0.695	18.46	11.59	3.29
1520D_27F-1_28-30_6	2.69	0.55	2.47	0.40	2.56	0.60	1.77	0.25	1.97	0.24	3.32	0.578	17.33	11.12	2.84
1520D_27F-1_28-30_8	3.12	0.63	3.19	0.51	3.01	0.58	1.90	0.27	1.76	0.31	3.42	0.485	16.46	9.84	2.62
1520D_27F-1_44-46_4	4.10	0.74	3.13	0.56	3.67	0.80	2.48	0.31	2.47	0.41	3.92	0.677	17.41	12.28	2.98
1520D_27F-1_44-46_8	3.05	0.55	2.52	0.44	2.63	0.63	1.67	0.29	1.90	0.32	3.07	0.492	12.77	9.02	2.21
1520D_27F-1_44-46_10	3.65	0.70	3.47	0.59	3.62	0.73	2.22	0.42	2.54	0.37	4.34	0.629	17.03	12.09	2.85
1520D_27F-1_96-98_1	3.47	0.46	2.93	0.43	2.50	0.66	1.70	0.26	1.83	0.32	3.11	0.53	14.1	10.56	2.37

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1520D_27F-1_96-98_4	50.10	5.01	3.53	0.95	119.74	83.29	17.16	89.84	5.73	6.20	659.79	20.48	40.71	4.27	16.61
1520D_27F-1_96-98_6	46.85	5.69	3.84	0.63	128.21	87.22	17.60	91.90	6.09	6.31	675.49	21.25	42.75	4.5	16.97
1520D_27F-1_96-98_9	56.32	5.58	4.00	0.78	134.09	92.87	18.15	99.04	6.48	6.63	713.94	22.39	46.49	4.79	17.01
1520D_27F-1_96-98_10	48.36	5.32	4.91	0.86	130.77	88.49	18.14	96.81	6.09	6.61	695.56	21.63	43.37	4.78	16.81
1520D_27F-2_92-96_1	37.61	8.71	4.11	0.48	114.92	90.88	21.37	136.73	6.46	4.75	667.02	20.5	40.81	4.57	16.55
1520D_27F-2_92-96_6	37.25	8.92	3.22	0.46	132.97	85.42	22.53	137.57	6.90	5.24	693.00	21.48	42.33	4.8	17.08
1520D_27F-2_92-96_8	38.84	8.75	3.58	0.46	118.29	94.35	22.35	144.42	6.77	5.04	679.38	21.18	41.78	4.55	17.77
1520D_27F-3_74-78_3	38.00	7.30	3.21	0.88	113.37	89.82	19.95	126.29	6.33	4.90	626.32	18.7	39.37	4.1	15.65
1520D_27F-3_74-78_7	39.17	7.17	11.65	0.83	118.12	107.17	23.05	146.53	7.52	4.82	746.98	22	47.3	5.22	17.84
1520D_27F-3_74-78_8	43.11	7.93	5.19	0.43	129.97	91.13	22.23	141.49	7.36	5.45	731.41	22.08	45.43	4.89	17.8
1520D_28F-1_55-57_2	49.65	8.00	2.75	0.53	158.44	54.07	20.27	118.53	7.18	7.18	913.40	24.29	47.81	5.16	17.97
1520D_28F-1_55-57_10	42.84	7.92	3.04	1.30	169.11	32.30	20.13	113.75	7.33	7.70	928.34	24.18	45.29	4.68	15.82
1520D_28F-1_55-57_3	46.60	8.16	2.87	0.80	159.67	54.41	19.08	112.53	6.94	7.32	912.73	23.07	45.26	4.55	16.89
1520D_28F-1_55-57_5	38.10	7.12	3.46	0.97	132.37	47.96	16.21	96.59	5.72	5.99	742.14	19.44	38.64	3.98	12.92
1520D_28F-1_55-57_9	39.04	8.43	7.23	1.89	148.45	54.27	18.24	104.81	6.56	7.22	788.16	21.14	41.03	4.34	16.48
1520D_28F-1_93-95_1	22.85	5.94	3.16	0.65	153.51	56.90	18.69	79.52	5.65	7.96	822.89	24.21	48.4	4.92	17.11
1520D_28F-1_93-95_4	51.88	7.01	2.28	0.52	126.70	48.73	17.74	66.12	5.94	5.29	751.13	19.91	40.76	4.19	14.85
1520D_28F-1_93-95_3	50.67	8.50	3.87	1.39	190.88	51.96	18.78	113.35	7.83	8.80	910.01	23.12	47.18	4.76	16.48
1520D_28F-1_93-95_8	50.75	6.89	2.79	0.75	131.36	68.12	22.23	106.64	7.69	6.88	805.61	24.77	51.11	5.41	19.18
1520D_28F-1_93-95_9	30.15	7.96	4.25	0.62	173.46	60.91	19.20	115.76	8.24	8.60	976.76	24.51	52.54	4.64	18.48
1520D_33X-3_60-62_1	51.75	4.57	3.73	0.57	147.17	55.15	20.56	79.44	7.80	8.05	865.84	26.08	56.47	5.71	19.7
1520D_33X-3_60-62_2	43.70	5.30	2.49	1.11	132.77	73.52	14.95	118.24	7.18	6.37	715.38	19.64	40.38	3.95	14.37
1520D_33X-3_60-62_6	50.13	7.73	3.31	0.56	134.33	54.58	28.27	132.79	8.38	6.81	780.42	25.88	54.65	6.23	23.92
1520D_33X-3_60-62_7	0.86	4.53	3.24	0.71	137.29	68.86	16.69	103.47	7.45	5.55	890.58	23.89	50.01	5.13	17.17
1520D_33X-3_60-62_5	29.41	8.39	2.20	1.05	100.73	103.60	22.68	188.67	7.65	4.87	626.14	20.63	49.5	4.97	18.58
U1520D_35X-7_72-74_1	43.45	6.96	2.98	0.79	122.79	71.31	26.57	153.05	8.59	6.38	739.96	25.59	53.76	6.03	22.97
U1520D_35X-7_72-74_4	48.44	10.16	4.69	0.58	141.44	66.13	32.13	184.96	10.57	6.94	839.36	30.08	65.18	7.67	27.29
U1520D_35X-7_72-74_6	41.21	8.97	3.18	0.62	132.27	59.48	30.48	162.17	9.69	6.18	778.20	27.62	59.07	6.92	26.5
U1520D_35X-7_72-743_9	6.15	9.96	2.74	0.44	127.39	83.01	32.38	178.97	10.78	6.15	826.19	28.81	67.75	7.62	28.3
1520D_35X-CC_2-5_2	48.25	7.62	3.22	0.96	148.04	62.96	16.08	94.53	6.12	7.07	907.71	20.14	41.03	4.07	14.44
1520D_35X-CC_2-5_5	57.40	8.46	3.12	0.96	159.07	67.53	15.76	93.46	6.64	7.74	952.30	20.04	45.39	4.37	13.31
1520D_35X-CC_2-5_6	47.90	8.11	3.96	0.87	155.37	67.32	16.39	97.55	6.56	7.45	940.75	20.9	42.32	4.13	14.22
1520D_35X-CC_2-5_10	53.10	7.92	3.25	0.88	154.35	62.50	15.20	90.60	6.30	7.29	906.26	19.3	42.37	3.96	13.64
1520D_38X-CC_37-39_9	38.49	9.55	4.36	0.38	122.96	51.16	30.51	156.35	8.71	5.38	694.92	24.47	52.84	6	23
1520D_38X-CC_37-39_10	43.06	8.41	4.81	0.45	121.45	56.05	25.95	114.29	7.29	6.74	711.96	23.38	50.49	5.38	20.83
1520D_38X-CC_37-39_4	21.55	9.58	4.66	0.43	124.74	68.56	29.32	165.85	9.37	6.01	721.35	25.34	55.7	6.45	24.6
1520D_38X-CC_37-39_3	35.18	10.34	4.12	1.09	108.88	113.32	25.63	202.86	8.16	4.94	745.01	22.47	47.76	5.59	21.49
1520D_38X-CC_37-39_5	37.43	12.28	4.29	1.11	117.14	115.85	32.87	275.32	10.61	5.33	786.57	26.23	58.2	6.87	26.07
1520D_39X-2_43-45_2	42.31	9.66	3.24	0.68	128.83	64.39	27.10	150.62	8.70	6.20	743.80	23.78	51.73	5.8	22.69
1520D_39X-2_43-45_3	37.46	9.42	3.43	0.62	126.42	62.31	26.17	142.93	8.03	5.92	705.21	23.19	49.69	5.38	20.7
1520D_39X-2_43-45_5	43.26	8.79	2.92	0.71	116.57	64.01	26.39	140.42	7.45	5.72	707.98	23.31	49.65	5.81	19.65
1520D_39X-2_43-45_6	35.97	9.39	2.58	0.44	130.37	50.73	25.76	120.17	8.16	6.27	741.43	24.11	53.88	5.65	19.91
1520D_39X-2_43-45_7	45.13	9.83	3.42	0.74	127.78	66.37	27.98	150.66	8.45	6.06	730.02	24.24	52.76	5.8	21.81
1520D_39X-2_137-139_1	45.77	9.29	4.00	0.60	145.94	55.81	29.32	131.84	8.69	7.11	802.07	26.68	58.93	6.15	22.63
1520D_39X-2_137-139_2	36.67	8.05	5.05	0.78	128.12	62.94	25.76	143.13	8.42	5.98	704.76	23.51	50.35	5.62	21.18
1520D_39X-2_137-139_3	46.77	8.48	4.40	0.71	128.73	63.22	26.18	142.34	8.10	6.16	753.36	23.84	52.14	5.62	22.1
1520D_39X-3_20-22_1	48.91	7.96	3.58	0.66	131.28	68.84	28.78	156.19	8.61	6.55	770.74	25.77	55.43	6.17	24.07
1520D_39X-3_20-22_5	50.11	8.18	3.22	0.55	131.33	67.80	28.75	152.22	8.64	6.26	785.30	26.22	56.33	6.17	22.85
1520D_39X-3_20-22_7	41.99	7.64	2.85	0.77	134.71	55.03	26.30	121.96	7.52	5.85	749.82	23.74	55.48	5.99	20.71
1520D_39X-3_20-22_9	43.21	7.72	2.64	0.54	123.46	62.88	25.94	141.37	7.86	5.84	694.32	22.97	51.54	5.55	21.66
1520D_39X-3_20-22_10	44.27	7.96	3.40	0.73	131.53	66.20	27.16	149.18	8.52	6.20	762.36	25.05	53.74	5.91	22.16
1520D_40X-1_60-62_1	46.95	9.75	2.64	2.37	111.17	106.55	25.74	225.34	8.22	6.38	689.40	22.9	47.18	5.25	21.7
1520D_40X-1_60-62_10	35.57	8.27	2.49	2.00	107.29	96.26	23.36	211.23	7.56	6.00	667.40	21.32	43.72	4.9	20.25
1520D_40X-1_60-62_5	47.15	8.86	2.53	2.58	129.83	118.13	26.89	226.38	7.88	6.29	695.35	23.83	52.46	6.04	22.4
1520D_40X-1_60-62_6	47.73	8.55	3.62	2.13	112.67	101.75	22.13	202.32	7.89	6.31	619.78	19.96	47.59	5.45	22.96
U1520D_40X-1_77-79_2	52.74	8.34	3.11	0.46	155.33	41.45	33.23	118.04	8.88	7.36	907.80	29.63	63.28	7.07	28.25
U1520D_40X-1_77-79_9	43.92	7.19	2.72	0.43	132.85	40.39	28.19	106.71	7.47	6.16	770.03	25.35	54.24	6.21	22.53
U1520D_40X-1_77-79_12	49.93	7.98	3.13	0.51	149.17	44.30	30.88	118.02	8.21	7.03	850.10	27.82	59.16	6.9	25.18
U1520D_40X-1_77-79_13	41.71	8.28	2.39	0.64	120.41	72.04	28.70	163.61	7.88	5.91	770.62	24.87	54.25	6.31	21.79
U1520D_40X-1_77-79_14	33.19	8.13	2.40	0.82	118.20	58.64	27.10	167.02	7.69	5.85	715.61	23.69	51.02	5.72	20.15
1520D_40X-CC_38-40_1	33.67	11.10	3.27	0.77	109.16	101.56	28.13	251.72	8.56	5.04	672.43	22.71	47.8	5.52	21.74
1520D_40X-CC_38-40_2	34.53	11.99	2.89	0.86	109.75	104.12	29.43	258.60	9.04	4.90	687.48	23.22	48.68	5.53	22.41
1520D_40X-CC_38-40_3	34.60	11.62	3.20	1.01	114.21	108.91	29.37	260.55	8.85	5.05	686.49	23.68	49.96	5.8	22.35
1520D_40X-CC_38-40_8	32.48	8.94	2.30	0.43	113.52	51.36	27.34	122.40	7.02	5.49	635.04	21.99	48.72	5.66	20.67
1520D_40X-CC_38-40_10	35.64	11.69	3.61	0.65	134.95	64.33	33.14	172.66	8.92	6.14	791.85	26.88	56.64	6.54	25.03
1520D_44X-1_5-7_(2)_10	32.34	8.38	3.49	0.36	116.26	42.34	31.47	159.56	9.07	5.85	666.59	25.19	55.19	6.35	24.34
1520D_44X-1_5-7_(2)_2	17.52	5.79	4.19	0.15	86.38	54.35	21.73	117.18	7.05	4.54	539.53	18.91	39.7	4.53	17.65
1520D_44X-1_5-7_(2)_1	48.53	11.33	6.50	0.41	152.43	67.95	40.33	211.01	12.28	8.00	901.58	33.17	71.03	8.04	31.67
1520D_44X-1_5-7_(2)_															

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1520D_27F-1_96-98_4	2.65	0.50	2.57	0.42	2.82	0.50	1.90	0.28	2.06	0.29	2.90	0.435	13.89	10.32	2.51
1520D_27F-1_96-98_6	2.72	0.55	2.45	0.40	2.71	0.51	1.73	0.31	1.94	0.23	3.05	0.561	14.57	10.76	2.6
1520D_27F-1_96-98_9	3.01	0.49	2.90	0.50	2.91	0.60	1.87	0.30	1.69	0.29	2.91	0.557	15.75	11.51	2.76
1520D_27F-1_96-98_10	3.13	0.48	2.66	0.51	2.83	0.66	1.72	0.24	2.16	0.33	3.20	0.504	14.26	11.38	2.74
1520D_27F-2_92-96_1	3.44	0.68	2.97	0.52	3.45	0.73	2.19	0.28	2.12	0.44	3.85	0.509	14.41	10.46	2.4
1520D_27F-2_92-96_6	3.46	0.65	3.24	0.56	3.85	0.67	2.36	0.38	2.69	0.44	3.96	0.498	16.05	11.42	2.67
1520D_27F-2_92-96_8	3.67	0.76	3.36	0.57	3.60	0.74	2.31	0.34	2.56	0.40	4.18	0.577	14.6	10.74	2.74
1520D_27F-3_74-78_3	3.18	0.61	3.34	0.46	3.14	0.61	2.13	0.35	2.44	0.34	3.49	0.516	16.49	9.66	2.53
1520D_27F-3_74-78_7	1.59	0.76	4.46	0.48	4.42	1.08	1.95	0.53	1.85	0.49	3.72	0.76	15.97	10.99	2.57
1520D_27F-3_74-78_8	3.62	0.72	3.13	0.58	3.31	0.77	2.44	0.36	2.57	0.39	4.29	0.632	16.87	11.28	2.95
1520D_28F-1_55-57_2	3.61	0.47	2.72	0.45	2.98	0.67	2.49	0.37	2.23	0.39	3.52	0.766	16.22	15.23	3.64
1520D_28F-1_55-57_10	2.89	0.23	2.56	0.46	3.22	0.58	1.99	0.32	2.20	0.35	3.35	0.693	15.93	14.36	3.45
1520D_28F-1_55-57_3	2.86	0.32	2.39	0.45	3.13	0.63	1.94	0.36	2.40	0.38	3.24	0.691	15.84	13.46	3.33
1520D_28F-1_55-57_5	2.87	0.33	2.60	0.42	2.66	0.58	1.59	0.25	2.02	0.28	2.58	0.588	13.11	11.96	2.9
1520D_28F-1_55-57_9	3.14	0.35	2.48	0.49	2.70	0.56	1.61	0.31	2.03	0.32	3.13	0.618	14.84	12.54	2.74
1520D_28F-1_93-95_1	3.13	0.37	2.55	0.36	2.74	0.62	1.76	0.31	2.18	0.36	2.80	0.503	20.26	13.58	3.18
1520D_28F-1_93-95_4	2.98	0.46	2.94	0.39	2.77	0.63	1.78	0.24	1.85	0.31	2.06	0.531	13.02	10.03	2.47
1520D_28F-1_93-95_3	3.11	0.40	2.92	0.46	2.79	0.59	2.24	0.32	1.99	0.32	3.29	0.748	17.95	14.22	3.55
1520D_28F-1_93-95_8	3.87	0.53	3.18	0.58	3.75	0.79	2.30	0.34	2.61	0.37	3.41	0.627	16.83	11.72	2.8
1520D_28F-1_93-95_9	3.29	0.53	3.04	0.46	3.30	0.71	2.47	0.40	2.25	0.32	3.44	0.627	15.57	15.07	3.82
1520D_33X-3_60-62_1	3.66	0.45	3.15	0.49	3.19	0.68	2.15	0.36	2.77	0.41	2.76	0.696	20.39	13.86	3.61
1520D_33X-3_60-62_2	2.80	0.46	2.25	0.39	2.58	0.61	1.63	0.29	1.96	0.26	3.53	0.615	16.63	11.03	3.01
1520D_33X-3_60-62_6	4.77	0.60	4.60	0.79	4.82	1.04	3.12	0.45	3.52	0.53	4.68	0.655	18.85	12.18	3.09
1520D_33X-3_60-62_7	3.00	0.48	2.69	0.42	2.76	0.59	1.83	0.26	2.36	0.33	3.30	0.602	18.68	13.2	3.47
1520D_33X-3_60-62_5	4.36	0.85	3.94	0.71	4.27	0.89	2.73	0.37	2.86	0.52	5.24	0.624	14.91	8.51	2.36
U1520D_35X-7_72-74_1	4.68	0.75	4.71	0.74	4.84	1.02	2.74	0.42	2.85	0.49	4.46	0.622	17.41	11.84	2.92
U1520D_35X-7_72-74_4	5.76	0.83	5.24	0.84	5.73	1.16	3.74	0.47	3.69	0.55	5.77	0.839	23.44	14.13	3.46
U1520D_35X-7_72-74_6	5.15	0.73	4.74	0.85	5.29	1.19	3.20	0.41	3.54	0.52	5.23	0.789	20.86	12.73	2.96
U1520D_35X-7_72-743_9	5.60	1.13	6.39	0.97	5.93	1.24	3.35	0.53	3.44	0.45	5.38	0.8	23.85	12.72	3.26
1520D_35X-CC-2-5_2	2.71	0.40	2.44	0.37	2.62	0.50	1.69	0.28	1.84	0.28	2.98	0.575	15.82	11.75	2.91
1520D_35X-CC-2-5_5	2.46	0.33	2.34	0.39	2.33	0.51	1.44	0.29	1.88	0.30	2.76	0.554	17.74	12.01	3.09
1520D_35X-CC-2-5_6	2.74	0.44	2.40	0.38	2.42	0.58	1.63	0.26	2.01	0.30	2.66	0.559	15.95	11.53	2.78
1520D_35X-CC-2-5_10	2.68	0.39	2.33	0.38	2.44	0.58	1.56	0.22	1.86	0.27	2.55	0.553	16.63	11.22	3.23
1520D_38X-CC-37-39_9	5.18	0.73	4.50	0.80	4.97	1.06	2.95	0.50	3.46	0.51	4.34	0.575	17.33	10.7	2.73
1520D_38X-CC-37-39_10	4.34	0.58	4.00	0.67	4.62	0.94	2.84	0.45	2.98	0.52	3.47	0.624	20.14	11.27	2.67
1520D_38X-CC-37-39_4	5.15	0.84	4.99	0.81	5.07	1.09	3.10	0.49	3.68	0.48	5.02	0.709	18.99	11.08	2.71
1520D_38X-CC-37-39_3	4.05	0.97	4.32	0.63	4.44	0.90	2.68	0.43	2.72	0.49	5.24	0.584	15.04	9.7	2.37
1520D_38X-CC-37-39_5	5.23	1.14	5.38	0.93	5.84	1.07	3.44	0.55	3.48	0.57	6.96	0.646	17.77	10.92	2.69
1520D_39X-2_43-45_2	4.62	0.69	3.73	0.69	4.39	1.02	2.93	0.50	2.99	0.45	4.18	0.719	18.05	11.02	2.75
1520D_39X-2_43-45_3	4.41	0.68	4.12	0.67	4.47	0.97	2.83	0.42	2.84	0.40	3.93	0.581	17.21	10.02	2.63
1520D_39X-2_43-45_5	4.94	0.62	3.88	0.67	4.37	0.92	2.71	0.38	2.69	0.49	4.05	0.547	15.38	10.28	2.53
1520D_39X-2_43-45_6	4.03	0.65	3.62	0.67	4.27	0.99	2.64	0.40	2.56	0.47	3.81	0.715	18.12	11.36	3.08
1520D_39X-2_43-45_7	4.50	0.79	4.32	0.67	4.66	1.01	2.75	0.45	3.07	0.46	4.59	0.668	17.83	10.95	2.87
1520D_39X-2_137-139_1	4.48	0.60	4.75	0.75	4.75	0.95	3.21	0.48	3.35	0.52	4.52	0.696	20.37	12.52	3.25
1520D_39X-2_137-139_2	4.58	0.72	4.19	0.64	4.21	0.92	2.75	0.43	2.86	0.45	4.07	0.595	16.72	10.65	2.75
1520D_39X-2_137-139_3	4.98	0.80	4.26	0.68	4.63	0.97	2.80	0.43	3.15	0.43	4.31	0.74	17.91	11.16	2.94
1520D_39X-3_20-22_1	5.05	0.70	4.30	0.81	4.97	1.06	3.10	0.49	3.23	0.55	4.84	0.685	18.58	12.13	3.04
1520D_39X-3_20-22_5	4.82	0.82	4.23	0.69	4.79	1.08	3.23	0.43	3.34	0.46	4.80	0.733	18.94	12.58	3.07
1520D_39X-3_20-22_7	4.53	0.55	3.81	0.65	4.51	1.03	2.84	0.44	3.08	0.44	3.79	0.579	17.85	12.2	3.14
1520D_39X-3_20-22_9	4.56	0.74	3.99	0.71	4.57	0.91	2.98	0.43	2.99	0.39	4.54	0.643	17.4	10.98	2.85
1520D_39X-3_20-22_10	4.64	0.72	4.37	0.70	4.71	1.04	3.01	0.48	3.25	0.46	4.76	0.656	18.41	11.61	2.84
1520D_40X-1_60-62_1	4.75	0.94	4.54	0.69	4.30	0.89	2.66	0.40	2.55	0.47	6.74	0.637	16.41	10.01	2.47
1520D_40X-1_60-62_10	4.84	0.90	4.02	0.69	4.69	0.96	2.35	0.38	2.61	0.44	5.48	0.487	14.42	8.95	2.28
1520D_40X-1_60-62_5	4.34	0.72	4.15	0.66	4.77	0.85	2.99	0.49	2.84	0.38	5.12	0.59	18.07	10.81	3.07
1520D_40X-1_60-62_6	4.25	0.86	4.78	0.66	4.16	0.82	2.42	0.39	2.74	0.42	4.42	0.602	15.53	9.32	2.56
U1520D_40X-1_77-79_2	5.75	0.76	5.21	0.87	5.02	1.21	4.07	0.48	4.07	0.59	4.52	0.723	22.69	14.56	3.53
U1520D_40X-1_77-79_9	4.88	0.56	4.49	0.77	4.64	1.06	2.92	0.48	3.28	0.52	3.61	0.706	18.58	12.79	2.94
U1520D_40X-1_77-79_12	6.08	0.63	5.17	0.85	5.31	1.13	3.23	0.54	3.60	0.52	4.11	0.823	20.18	14.2	3.41
U1520D_40X-1_77-79_13	5.10	0.90	5.12	0.79	4.95	1.00	3.11	0.58	3.51	0.51	5.29	0.72	17.44	12.24	2.84
U1520D_40X-1_77-79_14	4.81	0.60	4.07	0.70	4.92	0.97	3.05	0.42	3.06	0.49	5.10	0.604	16.76	11.46	2.52
1520D_40X-CC_38-40_1	4.75	0.88	4.34	0.73	4.49	0.98	3.06	0.46	3.01	0.46	6.07	0.607	15.95	9.75	2.34
1520D_40X-CC_38-40_2	5.12	0.91	5.06	0.75	4.89	1.09	3.29	0.48	3.29	0.51	6.55	0.528	14.94	10.31	2.34
1520D_40X-CC_38-40_3	4.77	1.00	4.85	0.75	4.84	1.09	3.19	0.43	3.45	0.48	6.47	0.652	16.47	10.27	2.65
1520D_40X-CC_38-40_8	4.74	0.52	4.09	0.75	4.41	0.80	2.82	0.48	3.33	0.49	3.80	0.555	16.99	10	2.38
1520D_40X-CC_38-40_10	5.70	0.73	4.97	0.83	5.72	1.25	3.43	0.52	3.87	0.53	5.06	0.625	18.51	11.87	2.83
1520D_44X-1_5-7_(2)_10	5.36	0.63	5.66	0.77	5.24	1.16	3.29	0.42	2.93	0.52	4.63	0.705	15.85	10.87	2.52
1520D_44X-1_5-7_(2)_2	3.74	0.66	3.55	0.56	3.53	0.78	2.35	0.35	2.39	0.37	3.46	0.52	11.72	7.92	1.954
1520D_44X-1_5-7_(2)_1	6.93	0.99	6.44	1.09	6.37	1.45	4.28	0.61	4.42	0.65	6.22	0.851	21.65	14.36	3.6
1520D_44X-1_5-7_(2)_6	6.23	1.23	5.61	0.94	6.12	1.31	3.75	0.58	3.99	0.57	7.13	0.76	16.32	10.11	2.5
1520D_44X-1_5-7_(2)_7	5.14	0.87	5.14	0.80	5.36	1.09	3.46	0.48	3.42	0.50	4.75	0.647	16.06	11.04	2.67

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1520D_44X-1_47-49_1	35.57	9.32	3.40	0.50	123.58	74.57	31.92	208.54	10.51	5.62	742.79	26.73	58.22	6.81	26.84
1520D_44X-1_47-49_6	26.86	8.77	3.04	0.58	121.63	71.72	30.42	155.11	8.75	5.55	747.74	26.83	55.77	6.4	25.15
1520D_44X-1_47-49_9	38.12	9.57	2.79	0.48	120.93	76.10	31.06	199.86	10.13	5.63	717.30	25.74	57.88	6.97	26.82
1520D_44X-1_47-49_2	21.27	5.33	1.90	0.87	73.90	56.53	18.54	103.41	5.40	3.42	420.64	15.11	35.19	4.37	16.79
1520D_47X-1_17-19_1	44.33	8.15	4.94	1.16	120.73	107.32	20.07	179.38	7.21	5.92	755.33	21.32	43.62	4.68	16.54
1520D_47X-1_17-19_3	43.41	7.79	3.95	1.18	119.40	105.55	19.84	165.27	7.22	5.94	723.87	21.4	43.5	4.73	17.32
1520D_47X-1_17-19_4	40.88	7.49	3.64	1.11	124.73	79.71	18.46	135.01	6.59	6.00	678.85	19.68	40.89	4.3	14.57
1520D_47X-1_17-19_8	46.70	7.37	3.85	1.05	125.27	93.01	20.03	157.17	7.17	6.28	737.22	21.64	44.36	4.74	17.17
1520D_47X-1_17-19_9	39.80	7.48	5.20	1.05	145.33	91.03	19.84	131.56	7.33	7.34	781.21	22.42	45.61	4.82	17.16
1520D_47X-3_0-2_1	48.51	4.90	4.68	0.39	144.69	33.63	26.77	88.17	8.82	7.17	736.00	25.74	56.16	5.87	22.33
1520D_47X-3_0-2_4	28.71	7.95	4.79	0.99	137.78	46.60	35.53	122.22	10.70	7.29	793.16	28.96	62.21	7.07	26.79
1520D_47X-3_0-2_8	38.47	8.10	4.68	0.63	146.47	40.79	31.05	115.80	10.27	7.21	775.07	27.14	62.23	6.57	24.75
1520D_47X-3_0-2_9	37.44	8.33	4.03	0.56	150.58	46.23	34.86	128.28	10.79	7.93	840.73	30.09	67.61	7.48	27.11
1520D_47X-3_0-2_10	52.07	5.64	4.77	0.47	160.94	38.23	29.49	89.72	10.50	8.10	820.46	28.43	61.87	6.83	24.64
1520D_47X-3_111-113_5	32.51	7.29	3.67	0.44	96.04	50.76	22.68	98.67	6.70	4.72	555.99	20.01	44.16	5	19.47
1520D_47X-3_111-113_8	46.34	7.92	3.00	0.39	132.12	45.13	35.28	117.31	9.98	7.03	806.95	28.94	63.58	7.06	27.63
1520D_47X-3_111-113_6	10.97	2.12	0.98	0.15	35.69	24.01	9.14	31.00	2.55	1.77	210.06	7.53	16.46	1.83	6.84
1520D_47X-3_111-113_4	37.66	4.62	2.87	0.25	124.65	29.12	26.78	77.68	7.96	6.18	677.31	25.5	52.79	5.81	21.43
1520D_47X-3_111-113_9	33.52	6.88	2.95	0.40	116.80	38.88	30.97	106.08	8.21	5.52	689.91	25.79	54.83	6.24	23.64
1520D_48X-CC_22-24_5	46.89	10.28	5.58	0.31	131.33	46.41	33.66	144.13	10.42	6.57	793.60	28.88	62.66	7.1	28.09
1520D_48X-CC_22-24_1	43.23	12.38	4.49	0.98	117.31	112.25	32.21	268.46	9.85	6.03	776.40	27.87	59.61	6.83	27.05
1520D_48X-CC_22-24_2	39.66	9.19	3.19	0.67	96.29	94.47	28.75	208.53	8.43	4.82	628.88	22.32	55.46	6.33	25.02
1520D_48X-CC_22-24_3	37.10	11.61	4.95	0.63	108.23	91.05	31.36	247.55	9.29	5.41	737.77	25.68	55.46	6.53	24.91
1520D_48X-CC_22-24_4	40.42	12.10	5.28	0.81	113.83	108.70	31.15	252.69	9.62	5.63	732.21	25.75	56.55	6.4	26.39
1520D_49X-1_15-17cm_1	45.67	14.49	2.05	0.62	120.76	73.22	29.74	156.99	8.50	6.19	767.53	26.75	58.84	6.63	25.74
1520D_49X-1_15-17cm_2	36.79	14.55	2.93	0.63	130.23	72.22	29.37	159.12	8.69	6.58	771.49	26.95	57.9	6.66	25.15
1520D_49X-1_15-17cm_4	42.23	14.65	2.01	0.66	132.07	63.00	32.82	145.99	8.54	6.90	819.77	28.95	63.38	7.48	27.56
1520D_49X-1_15-17cm_10	36.78	12.81	1.95	0.57	110.85	64.86	26.86	141.95	7.72	5.76	686.67	24.26	52.29	6.17	23.86
1520D_49X-1_28-30_2	48.53	7.90	3.82	0.75	136.58	70.49	30.46	142.61	8.67	6.85	840.92	27.61	61.24	7.27	27.02
1520D_49X-1_28-30_7	42.33	8.66	3.79	0.86	143.33	71.59	29.12	135.08	8.84	7.02	832.13	28.08	63.03	6.91	26.89
1520D_49X-1_28-30_3	48.25	7.71	4.76	1.39	155.37	105.62	18.39	181.29	7.80	8.45	798.83	23.17	47.67	4.77	18.23
1520D_49X-1_28-30_5	52.04	9.71	4.69	0.98	141.85	87.11	31.99	261.01	10.23	7.08	874.88	29.14	65.06	7.36	28.48
1520D_49X-1_28-30_6	36.62	8.02	3.18	0.65	105.42	68.77	24.13	139.60	7.85	5.41	660.40	20.87	50.17	5.52	21.89
1520D_49X-CC_29-31_2	24.80	5.50	5.01	0.90	129.52	91.27	23.14	148.39	6.46	6.69	778.56	26.25	50.49	5.92	20.92
1520D_49X-CC_29-31_6	33.08	5.23	2.97	0.83	137.11	83.89	22.31	130.02	6.91	6.78	803.01	24.98	53.04	5.64	20.1
1520D_49X-CC_29-31_4	19.24	8.35	4.75	1.14	151.41	80.84	30.66	217.08	8.08	7.86	882.54	30.79	62.42	7.11	27.63
1520D_49X-CC_29-31_9	53.17	9.58	2.94	1.18	141.45	79.60	30.52	185.10	7.39	7.36	781.43	27.5	61.17	7.03	25.56
1520D_49X-CC_29-31_10	36.21	4.52	5.59	1.07	144.65	87.50	23.23	148.81	6.96	7.54	831.84	26.07	52.55	5.61	20.9
1520D_50X-CC_37-39_1	47.14	11.55	2.85	0.48	140.37	65.39	34.04	235.99	9.35	7.42	806.56	28.6	64.33	7.22	27.92
1520D_50X-CC_37-39_2	49.71	11.62	2.71	0.40	138.56	65.02	34.06	257.29	9.85	7.46	843.65	30.06	66.7	7.15	28.46
1520D_50X-CC_37-39_3	51.86	11.67	2.47	0.45	130.47	62.70	33.61	246.18	9.62	7.43	791.43	28.81	62.6	7.14	28.6
1520D_50X-CC_37-39_4	57.09	12.51	2.91	0.36	135.52	64.91	35.31	259.36	10.15	7.90	852.13	30.29	66.68	7.43	29.56
1520D_50X-CC_37-39_5	32.94	10.41	2.76	0.33	122.77	74.95	32.32	228.98	10.13	6.30	800.15	28.05	60.5	6.73	25.08
1520D_51X-1_26-28_1	38.15	12.51	4.80	0.67	119.43	89.09	30.03	253.86	10.36	6.46	725.48	26.25	56.84	6.57	25.52
1520D_51X-1_26-28_7	47.34	12.34	5.44	0.67	140.42	101.25	34.27	286.63	11.99	7.39	832.33	29.99	65.8	7.39	28.83
1520D_51X-1_26-28_8	38.04	11.36	4.67	0.50	130.94	89.76	31.78	254.46	10.96	7.04	760.27	27.53	61.24	6.86	26.35
1520D_51X-1_26-28_9	40.73	11.39	4.87	0.49	126.59	93.92	31.22	259.30	10.95	6.73	737.75	26.47	59.69	6.6	25.76
1520D_51X-1_26-28_10	38.72	12.08	3.94	0.64	131.22	94.64	31.30	264.30	12.45	7.06	804.37	28.21	64.29	7.07	27.29
1520D_51X-1_49-50_1	53.84	12.08	6.27	0.26	161.65	36.14	38.53	155.61	12.05	9.09	852.77	33.34	72.37	8.14	31.28
1520D_51X-1_49-50_3	42.59	9.64	4.40	0.09	146.95	35.20	34.94	136.10	10.12	7.37	729.72	29.7	65.44	7.64	28.21
1520D_51X-1_49-50_8	40.63	11.85	7.08	0.25	156.86	35.32	36.97	148.04	11.37	8.73	818.30	31.92	68.59	7.83	29.91
1520D_51X-1_49-50_9	53.74	11.02	5.98	0.22	155.46	34.66	36.82	147.77	11.31	8.67	809.51	31.51	69.69	7.7	31.03
1520D_51X-1_49-50_10	51.05	11.09	5.78	0.22	156.32	35.17	37.39	150.49	11.14	8.33	807.73	31.84	69.2	7.95	30.91
1520D_51X-1_54-55_2	51.36	9.05	3.96	0.29	149.55	60.00	33.45	173.87	10.33	8.73	800.00	29.4	65.1	7.08	28.71
1520D_51X-1_54-55_3	46.85	9.63	7.09	0.39	153.88	55.50	32.81	165.32	9.74	9.27	781.36	28.49	62.09	6.87	26.81
1520D_51X-1_54-55_7	42.68	8.24	3.51	0.30	134.20	51.43	29.62	150.66	8.67	7.57	715.63	25.58	57.18	6.53	24.3
1520D_51X-1_54-55_9	55.11	9.60	4.59	0.35	156.35	57.69	34.36	175.17	10.07	8.73	809.13	29.82	65.4	7.33	27.92
1520D_51X-1_55-56_2	49.69	5.29	5.75	1.16	128.57	98.30	13.39	109.12	6.20	7.24	723.20	18.32	34.76	3.55	12.41
1520D_51X-1_55-56_6	31.06	5.49	6.38	1.09	123.05	87.23	12.75	103.09	5.73	7.00	704.16	17.6	33	3.43	11.49
1520D_51X-1_55-56_7	49.36	5.07	4.66	0.94	116.64	82.95	11.58	99.88	5.55	6.34	682.04	17.15	31.61	3.19	11.22
1520D_51X-1_55-56_10	46.83	5.29	5.27	1.13	113.00	86.93	12.68	103.19	5.74	6.50	664.12	17.3	31.86	3.24	11.51
1520D_51X-1_64-65_8	38.20	7.21	3.34	1.67	129.36	119.48	16.90	172.57	6.35	7.03	767.43	20.29	44.59	4.28	14.9
1520D_51X-1_64-65_5	40.71	5.54	3.53	1.05	166.58	60.85	18.86	99.53	6.51	9.11	739.48	22.52	46.5	5.07	17.56
1520D_51X-1_64-65_1	59.95	7.72	3.98	1.43	195.83	69.18	26.13	166.71	10.78	10.94	930.61	31.37	63.07	6.73	24.26
1520D_51X-1_64-65_3	49.58	7.26	4.91	1.30	192.32	72.89	25.11	160.81	10.56	10.97	879.64	29.33	61.55	6.52	24.28
1520D_51X-1_64-65_7	46.14	6.28	3.12	1.14	161.91	66.14	22.60	142.09	9.03	9.06	812.67	27.55	55.87	5.92	20.85
1520D_51X-1_64-65_2_3	45.12	11.41	4.27	0.61	132.88	95.09	32.00	254.09	11.21	6.96	784.19	27.74	63.21	7.13	27
1520D_51X-1_64-65_2_8	42.02	10.67	5.32	0.32	139.30	63.55	31.77	192.50	11.51	7.22	783.67	28.03	65.08	6.97	2

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1520D_44X-1_47-49_1	6.14	0.97	5.58	0.82	5.53	1.17	3.42	0.51	3.63	0.57	5.46	0.763	19.26	11.72	2.98
1520D_44X-1_47-49_6	5.42	0.83	4.51	0.90	5.44	1.08	3.28	0.54	3.70	0.41	4.67	0.754	19.39	11.31	2.59
1520D_44X-1_47-49_9	5.66	0.90	5.47	0.78	5.22	1.10	3.53	0.50	3.69	0.53	5.29	0.644	19.37	11.8	2.83
1520D_44X-1_47-49_2	3.26	0.57	2.68	0.50	3.15	0.59	2.12	0.34	2.07	0.29	2.75	0.397	12.12	6.96	1.692
1520D_47X-1_17-19_1	3.28	0.65	3.27	0.50	2.98	0.70	2.19	0.32	2.39	0.32	4.59	0.549	15.13	10.41	2.31
1520D_47X-1_17-19_3	3.36	0.64	3.19	0.48	3.08	0.69	2.16	0.29	2.32	0.37	4.40	0.548	15.4	10.57	2.55
1520D_47X-1_17-19_4	3.13	0.52	2.73	0.44	2.88	0.64	1.93	0.30	2.02	0.35	3.64	0.534	15.54	10.08	2.44
1520D_47X-1_17-19_8	3.44	0.54	2.99	0.50	3.22	0.66	2.06	0.32	2.47	0.32	4.13	0.588	15.8	10.29	2.53
1520D_47X-1_17-19_9	3.54	0.56	2.67	0.44	3.09	0.65	1.95	0.33	2.13	0.34	3.50	0.621	18.17	11.55	2.8
1520D_47X-3_0-2_1	3.99	0.39	3.94	0.72	4.17	0.93	2.98	0.43	3.20	0.47	3.04	0.721	18.19	12.9	3.17
1520D_47X-3_0-2_4	5.96	0.55	4.85	0.91	5.81	1.24	4.02	0.53	4.22	0.60	4.04	0.719	19.17	13.32	2.89
1520D_47X-3_0-2_8	5.19	0.56	5.06	0.87	5.51	1.02	3.45	0.53	3.83	0.49	3.90	0.701	20.49	12.29	3.06
1520D_47X-3_0-2_9	6.15	0.58	4.90	0.93	5.91	1.17	3.86	0.56	3.77	0.59	4.42	0.825	20.31	13.55	3.37
1520D_47X-3_0-2_10	5.22	0.48	4.64	0.75	5.06	1.02	3.17	0.43	3.36	0.52	3.46	0.799	19.49	14.24	3.39
1520D_47X-3_111-113_5	3.53	0.54	3.45	0.58	3.93	0.74	2.31	0.34	2.56	0.38	2.73	0.462	15.15	8.78	2.18
1520D_47X-3_111-113_8	5.16	0.72	5.47	0.92	5.92	1.30	3.59	0.57	3.98	0.49	4.72	0.904	19.02	12.78	2.92
1520D_47X-3_111-113_6	1.46	0.15	1.44	0.27	1.46	0.33	0.94	0.13	1.17	0.15	1.07	0.192	4.92	3.32	0.718
1520D_47X-3_111-113_4	4.54	0.49	3.81	0.63	4.55	0.95	2.79	0.49	3.10	0.48	3.26	0.724	15.86	10.96	2.71
1520D_47X-3_111-113_9	5.70	0.54	4.91	0.75	5.37	1.13	3.37	0.51	3.56	0.55	3.40	0.662	15.79	10.99	2.41
1520D_48X-CC_22-24_5	5.64	0.75	5.60	0.87	5.79	1.20	3.80	0.57	3.70	0.52	4.71	0.747	20.5	12.77	2.98
1520D_48X-CC_22-24_1	6.08	1.16	4.79	0.93	6.08	1.15	3.64	0.50	3.67	0.54	7.09	0.707	18.93	10.95	2.61
1520D_48X-CC_22-24_2	5.81	1.01	4.58	0.76	4.58	1.00	3.20	0.48	3.07	0.44	5.71	0.596	16.34	9.64	2.43
1520D_48X-CC_22-24_3	5.48	1.11	5.05	0.84	5.37	1.18	3.29	0.53	3.61	0.52	6.45	0.603	17.25	10.38	2.62
1520D_48X-CC_22-24_4	5.73	1.09	5.19	0.76	5.20	1.13	2.99	0.51	3.28	0.50	6.47	0.559	18.4	10.56	2.73
1520D_49X-1_15-17cm_1	5.42	0.86	4.76	0.87	5.11	0.99	2.99	0.47	2.89	0.48	5.00	0.662	21.22	12	2.84
1520D_49X-1_15-17cm_2	5.48	0.83	5.02	0.71	5.20	1.10	3.23	0.44	3.32	0.47	4.99	0.669	21.03	11.9	2.83
1520D_49X-1_15-17cm_4	5.90	0.90	5.31	0.84	5.17	1.16	3.75	0.49	4.00	0.53	4.38	0.718	21.88	12.95	3.13
1520D_49X-1_15-17cm_10	5.05	0.77	4.87	0.73	4.66	0.95	2.83	0.44	3.24	0.46	4.64	0.575	19.38	10.6	2.56
1520D_49X-1_28-30_2	5.46	0.84	5.04	0.85	4.93	1.17	3.28	0.45	3.83	0.55	4.48	0.681	21.14	13.01	3.26
1520D_49X-1_28-30_7	5.53	0.82	4.59	0.85	5.29	1.07	3.20	0.50	3.39	0.49	4.59	0.612	24.18	13.01	3.46
1520D_49X-1_28-30_3	3.74	0.63	2.84	0.47	3.06	0.70	2.06	0.28	2.38	0.31	4.79	0.652	20.51	13.95	3.99
1520D_49X-1_28-30_5	6.18	0.89	5.13	0.91	5.71	1.12	3.71	0.48	3.98	0.59	7.37	0.77	26.91	12.97	3.45
1520D_49X-1_28-30_6	4.07	0.68	4.09	0.64	3.91	0.91	2.58	0.32	2.72	0.42	3.89	0.496	18.57	9.34	2.66
1520D_49X-CC_29-31_2	3.63	0.59	3.60	0.60	3.58	0.79	2.60	0.46	3.10	0.41	4.18	0.559	18.47	12.74	2.65
1520D_49X-CC_29-31_6	3.66	0.62	3.44	0.54	3.58	0.82	2.33	0.38	2.24	0.42	4.31	0.552	19.58	12.77	3.16
1520D_49X-CC_29-31_4	5.48	0.86	5.22	0.86	5.75	1.15	3.37	0.54	3.76	0.51	6.61	0.66	26.51	14.23	2.97
1520D_49X-CC_29-31_9	5.30	0.67	4.69	0.79	5.18	1.04	3.11	0.49	3.19	0.52	5.32	0.6	22.77	13.25	3.32
1520D_49X-CC_29-31_10	3.71	0.71	3.30	0.51	3.97	0.80	2.29	0.38	2.61	0.40	4.71	0.568	20.66	12.41	2.79
1520D_50X-CC_37-39_1	6.22	0.72	5.01	0.87	5.84	1.15	3.29	0.52	3.63	0.52	6.23	0.664	20.58	12.48	3.17
1520D_50X-CC_37-39_2	6.22	0.74	5.74	0.94	5.91	1.20	3.63	0.57	3.75	0.58	6.92	0.709	21.1	12.39	3
1520D_50X-CC_37-39_3	6.01	0.79	5.64	0.90	6.00	1.22	3.80	0.50	3.57	0.55	6.44	0.627	20.24	12.22	2.91
1520D_50X-CC_37-39_4	5.97	0.80	5.93	0.95	5.92	1.29	3.67	0.55	3.71	0.58	6.86	0.698	21.47	12.94	3.05
1520D_50X-CC_37-39_5	5.31	0.94	5.02	0.87	5.43	1.21	3.28	0.49	3.46	0.54	6.18	0.702	18.65	11.11	2.72
1520D_51X-1_26-28_1	5.23	0.84	4.89	0.84	5.22	1.20	3.16	0.49	3.34	0.52	6.16	0.68	18.44	11.96	2.97
1520D_51X-1_26-28_7	5.40	1.10	5.95	0.95	6.16	1.24	3.81	0.54	3.71	0.57	7.54	0.813	21.37	13.82	3.58
1520D_51X-1_26-28_8	5.51	0.89	4.80	0.91	5.33	1.15	3.45	0.54	3.47	0.57	6.96	0.745	19.5	12.79	3.34
1520D_51X-1_26-28_9	5.77	0.93	4.91	0.86	5.41	1.15	3.33	0.49	3.53	0.52	6.85	0.744	19.17	12.28	3.17
1520D_51X-1_26-28_10	6.16	0.98	4.86	0.88	5.38	1.12	3.04	0.42	3.80	0.56	7.08	0.828	22.32	13.29	3.51
1520D_51X-1_49-50_1	6.72	0.68	6.82	1.01	6.98	1.46	4.23	0.60	4.12	0.62	5.17	0.887	23.9	17.03	4.2
1520D_51X-1_49-50_3	6.36	0.42	5.52	0.85	6.33	1.40	4.00	0.53	3.59	0.56	4.76	0.723	20.9	15.18	3.75
1520D_51X-1_49-50_8	6.76	0.71	6.25	0.96	6.47	1.26	3.87	0.58	4.29	0.62	5.02	0.89	24.84	15.69	3.83
1520D_51X-1_49-50_9	6.63	0.68	6.11	1.00	6.59	1.37	3.93	0.55	4.05	0.65	5.24	0.848	23.38	15.94	3.97
1520D_51X-1_49-50_10	6.79	0.63	5.77	0.97	6.36	1.39	4.04	0.57	4.08	0.59	4.92	0.913	23.62	16.47	3.84
1520D_51X-1_54-55_2	5.96	0.86	5.53	0.95	5.61	1.16	3.58	0.49	3.57	0.61	5.04	0.811	22.53	15.61	3.82
1520D_51X-1_54-55_3	6.60	0.68	5.51	0.87	5.74	1.25	3.25	0.47	3.27	0.54	4.81	0.804	21.05	15.11	3.8
1520D_51X-1_54-55_7	5.18	0.68	5.02	0.77	5.03	1.11	3.23	0.49	3.33	0.45	4.59	0.739	19.23	13.83	3.24
1520D_51X-1_54-55_9	5.95	0.77	5.65	0.94	5.71	1.23	3.55	0.60	3.97	0.57	5.51	0.823	22.55	15.51	3.9
1520D_51X-1_55-56_2	2.17	0.34	2.11	0.35	1.96	0.44	1.45	0.21	1.60	0.25	3.24	0.675	16.69	11.35	3.05
1520D_51X-1_55-56_6	1.94	0.40	1.97	0.32	2.25	0.40	1.29	0.19	1.47	0.26	2.84	0.64	14.03	11	2.83
1520D_51X-1_55-56_7	2.13	0.37	1.57	0.27	1.76	0.36	1.20	0.19	1.46	0.21	3.03	0.528	13.54	10.89	2.81
1520D_51X-1_55-56_10	1.95	0.36	1.69	0.30	2.20	0.37	1.35	0.22	1.42	0.26	3.06	0.528	13.01	10.56	2.81
1520D_51X-1_64-65_8	3.31	0.74	2.75	0.36	2.77	0.50	1.71	0.21	1.90	0.28	4.56	0.664	19.1	12.39	3.12
1520D_51X-1_64-65_5	3.18	0.40	2.94	0.48	3.18	0.66	1.95	0.29	1.82	0.35	3.17	0.569	19.31	11.29	2.7
1520D_51X-1_64-65_1	4.82	0.55	4.26	0.69	3.94	0.96	2.76	0.39	3.05	0.47	4.57	0.928	24.45	18.82	4.68
1520D_51X-1_64-65_3	4.08	0.43	4.07	0.69	4.12	0.90	2.69	0.41	2.96	0.46	4.40	0.896	28.17	17.64	4.79
1520D_51X-1_64-65_7	4.25	0.59	3.85	0.62	4.00	0.86	2.32	0.35	2.72	0.38	4.39	0.828	21.68	16.71	3.83
1520D_51X-1_64-65_2_3	5.60	1.00	4.77	0.88	5.37	1.16	3.85	0.51	3.72	0.48	6.19	0.805	20.84	12.69	3.37
1520D_51X-1_64-65_2_8	6.04	0.87	4.90	0.90	5.86	1.17	3.51	0.48	3.76	0.56	5.59	0.849	23.21	13.19	3.3
1520D_51X-1_64-65_2_10	6.12	0.76	5.48	0.93	6.41	1.33	3.65	0.53	3.78	0.56	6.06	0.914	24.11	14.68	3.66
1520D_51X-1_64-65_2_7	4.45	0.80	4.33	0.78	5.12	0.99	2.90	0.42	3.36	0.42	6.24	0.691	18	11.12	2.76

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1520D_51X-1_64-65_2_5	64.43	10.39	4.58	1.28	163.87	93.00	33.82	272.71	10.49	7.85	843.46	29.67	65.39	7.47	27.95
1520D_52X-1_8-10_1	10.30	2.59	1.26	0.20	34.21	37.50	7.57	31.71	2.13	1.72	208.71	6.64	14.48	1.595	6.05
1520D_52X-1_8-10_4	49.29	11.43	5.15	0.31	142.93	54.78	32.41	133.69	8.62	7.12	881.16	27.58	60.43	6.63	25.51
1520D_52X-1_8-10_6	25.10	8.74	17.38	0.53	105.92	59.11	27.31	111.31	6.32	6.41	731.58	21.4	45.07	4.67	19.46
1520D_52X-1_8-10_3	62.16	10.34	6.23	0.43	139.01	66.66	30.47	137.46	8.54	7.23	904.75	26.63	57.06	6.36	23.66
1520D_52X-1_8-10_10	40.10	8.56	5.88	0.60	144.26	49.65	28.46	97.63	6.99	7.45	879.71	25.87	54.6	6.02	22.86
1520D_53X-1_31-33_3	45.14	8.00	5.29	1.55	124.54	80.14	19.96	130.62	6.61	6.31	801.40	18.86	42.31	4.36	16.16
1520D_53X-1_31-33_5	53.12	8.15	5.95	1.38	122.09	80.32	19.90	133.65	6.22	6.23	787.15	19.07	42.5	4.33	16.58
1520D_53X-1_31-33_8	44.39	8.00	4.87	1.51	127.89	83.05	19.19	130.58	6.86	6.48	806.68	19.3	43.35	4.64	15.69
1520D_53X-1_31-33_10	43.08	7.99	5.38	1.25	127.25	79.57	20.50	136.01	5.84	5.94	801.59	19.78	41.8	4.62	16.51
1520D_54X-2_3-5_2	9.89	10.18	1.20	5.52	29.22	34.56	8.19	41.08	2.14	1.60	237.49	6.67	13.3	1.58	5.91
1520D_54X-2_3-5_3	43.28	8.05	2.27	1.09	104.55	100.03	19.08	128.64	6.64	5.16	830.14	22.56	44.61	4.71	17.58
1520D_54X-2_3-5_10	41.20	7.62	2.19	0.88	108.36	122.29	19.48	168.76	7.06	5.19	823.49	22.64	45.25	5.06	16.95
1520D_54X-2_3-5_4	28.28	6.49	2.38	0.65	103.58	78.90	18.23	92.90	6.16	5.08	796.83	21.81	42.56	4.5	16.57
1520D_54X-2_3-5_8	29.06	5.86	2.06	0.64	84.05	90.60	16.53	116.89	5.54	3.83	653.46	18.16	35.87	3.77	15.29

Appendix A

Supplementary Table S11: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1520.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1520D_51X-1_64-65_2_5	5.71	1.18	5.14	0.89	5.48	1.31	3.63	0.56	3.70	0.58	6.90	0.796	34.15	14.43	3.7
1520D_52X-1_8-10_1	1.33	0.16	1.32	0.20	1.35	0.27	0.90	0.12	0.81	0.12	1.21	0.17	5.13	3.1	0.767
1520D_52X-1_8-10_4	5.69	0.63	5.11	0.88	5.69	1.16	3.71	0.47	3.44	0.57	4.47	0.686	21.8	12.79	3.05
1520D_52X-1_8-10_6	2.89	0.42	5.35	0.62	3.80	1.15	2.63	0.42	4.07	0.25	3.51	0.338	15.6	10.49	2.24
1520D_52X-1_8-10_3	5.64	0.68	4.72	0.81	4.85	1.11	3.35	0.48	3.34	0.51	4.54	0.744	21.4	12.47	3.02
1520D_52X-1_8-10_10	5.11	0.47	4.86	0.76	4.71	1.07	2.95	0.49	3.24	0.47	3.50	0.599	19.73	12.47	2.95
1520D_53X-1_31-33_3	3.27	0.53	3.11	0.49	3.27	0.65	2.23	0.36	2.31	0.33	4.05	0.542	18.22	9.67	2.72
1520D_53X-1_31-33_5	3.28	0.52	3.03	0.54	3.26	0.65	2.18	0.34	2.23	0.34	4.11	0.488	16.98	9.65	2.72
1520D_53X-1_31-33_8	3.15	0.50	2.78	0.46	3.17	0.62	2.21	0.32	2.53	0.39	3.35	0.556	19.3	9.72	2.88
1520D_53X-1_31-33_10	3.53	0.49	3.14	0.53	3.46	0.80	2.18	0.32	2.33	0.35	3.90	0.466	16.91	10.23	2.73
1520D_54X-2_3-5_2	0.84	0.28	1.16	0.17	1.08	0.41	0.93	0.13	1.53	0.15	1.10	0.208	3.92	2.6	0.653
1520D_54X-2_3-5_3	3.43	0.64	3.03	0.50	3.42	0.70	2.33	0.31	2.33	0.39	3.87	0.536	14.65	10.58	2.52
1520D_54X-2_3-5_10	3.41	0.71	3.06	0.51	3.36	0.70	2.25	0.30	2.53	0.38	4.73	0.532	15.64	10.52	2.5
1520D_54X-2_3-5_4	3.35	0.57	2.93	0.48	3.02	0.60	2.16	0.29	2.27	0.34	3.20	0.579	13.46	10.48	2.2
1520D_54X-2_3-5_8	2.60	0.55	2.79	0.49	2.58	0.58	2.06	0.23	2.31	0.29	3.75	0.567	10.96	9.18	1.94

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1526A_1R-CC_8-9_1	4.00	2.94	0.39	70.04	0.00	0.16	1.89	0.03	12.95	0.00	92.40
	1526A_1R-CC_8-9_2	3.77	3.62	2.00	73.11	0.02	0.09	1.34	0.03	12.53	0.01	96.52
	1526A_1R-CC_8-9_3	3.92	2.92	2.06	70.85	0.00	0.20	1.86	0.06	13.46	0.00	95.33
	1526A_1R-CC_8-9_4	4.13	3.07	2.21	71.75	0.00	0.12	1.61	0.04	13.21	0.00	96.14
	1526A_1R-CC_8-9_5	3.73	3.52	1.77	74.76	0.00	0.07	1.08	0.00	12.71	0.00	97.64
	1526A_1R-CC_8-9_6	3.96	2.90	2.85	70.69	0.01	0.19	1.92	0.03	13.34	0.01	95.90
	1526A_1R-CC_8-9_7	3.66	3.14	1.10	73.82	0.12	0.14	1.06	0.03	12.12	0.00	95.19
	1526A_1R-CC_8-9_8	4.03	2.92	2.58	71.04	0.20	0.16	1.80	0.08	13.40	0.02	96.24
	1526A_1R-CC_8-9_9	3.82	3.42	1.09	74.84	0.11	0.08	0.84	0.04	12.02	0.00	96.26
	1526A_1R-CC_8-9_10	4.03	3.37	2.63	71.98	0.19	0.13	1.67	0.07	13.03	0.00	97.10
	1526A_1R-CC_8-9_11	4.05	3.49	1.24	74.31	0.12	0.12	1.00	0.02	12.57	0.03	96.95
	1526A_1R-CC_8-9_12	3.78	3.85	1.69	71.70	0.15	0.09	0.93	0.12	12.54	0.03	94.87
	1526A_1R-CC_8-9_13	3.61	3.33	1.27	73.49	0.17	0.15	1.14	0.07	11.84	0.00	95.08
	1526A_1R-CC_8-9_14	4.45	2.99	2.67	72.74	0.21	0.24	1.91	0.06	13.78	0.01	99.05
	1526A_1R-CC_8-9_15	3.60	3.62	0.92	74.77	0.08	0.08	0.71	0.00	11.88	0.01	95.68
	1526A_1R-CC_8-9_17	4.00	2.90	2.49	69.92	0.22	0.15	1.87	0.07	13.30	0.01	94.93
	1526A_1R-CC_8-9_18	3.55	2.90	2.53	70.20	0.22	0.35	2.05	0.12	13.33	0.02	95.28
	1526A_1R-CC_8-9_19	3.22	3.46	1.00	73.89	0.10	0.10	0.95	0.04	11.95	0.00	94.72
	1526A_1R-CC_8-9_20	3.67	3.36	2.21	71.66	0.15	0.09	1.43	0.04	12.73	0.00	95.35
	s95 1526A_2R-CC_28-29_9	4.11	2.77	2.16	69.72	0.37	0.38	1.92	0.04	13.77	0.08	95.32
	1526A_2R-CC_28-29_10	3.99	3.15	1.58	72.26	0.19	0.11	1.01	0.10	13.00	0.01	95.40
	1526A_2R-CC_28-29_11	3.90	3.51	1.39	71.32	0.16	0.13	1.10	0.00	12.29	0.01	93.80
	1526A_2R-CC_28-29_12	4.03	3.34	1.48	72.33	0.17	0.13	1.10	0.04	12.81	0.00	95.43
	1526A_2R-CC_28-29_13	4.38	2.57	3.19	67.63	0.60	0.81	2.81	0.12	14.67	0.16	96.96
	1526A_2R-CC_28-29_14	4.55	2.85	2.41	69.94	0.35	0.41	1.93	0.08	13.94	0.05	96.50
	1526A_2R-CC_28-29_15	3.51	3.33	1.43	72.86	0.13	0.09	1.00	0.00	12.38	0.01	94.74
	1526A_2R-CC_28-29_16	4.06	2.85	2.12	69.64	0.34	0.38	1.78	0.07	13.65	0.04	94.92
	1526A_2R-CC_28-29_17	3.63	3.31	1.40	72.02	0.12	0.13	1.09	0.09	12.29	0.01	94.09
	1526A_2R-CC_28-29_18	4.08	3.21	2.02	70.80	0.23	0.22	1.50	0.03	13.39	0.06	95.53
	1526A_2R-CC_28-29_19	3.81	3.33	1.52	72.54	0.17	0.11	1.01	0.06	12.23	0.02	94.79
	1526A_2R-CC_28-29_20	4.31	2.39	3.90	65.44	0.75	0.98	3.07	0.07	14.69	0.16	95.74
	1526A_2R-CC_28-29_1	4.00	3.10	1.28	69.68	0.17	0.12	1.06	0.08	12.17	0.00	91.66
	1526A_2R-CC_28-29_5	4.32	3.17	1.69	71.05	0.18	0.17	1.05	0.07	12.87	0.04	94.62
	1526A_2R-CC_28-29_6	4.34	3.08	2.17	69.03	0.27	0.23	1.50	0.04	13.17	0.03	93.86
	1526A_2R-CC_28-29_9	4.05	3.00	1.40	69.58	0.16	0.10	1.08	0.03	12.01	0.00	91.41
	1526A_2R-CC_28-29_11	4.15	3.15	1.58	69.70	0.14	0.13	1.03	0.09	12.27	0.02	92.25
	1526A_2R-CC_28-29_3	4.56	2.94	2.78	70.38	0.38	0.42	2.08	0.00	14.15	0.06	97.76
	1526A_2R-CC_28-29_8	3.89	3.39	1.21	71.43	0.11	0.07	0.79	0.02	11.63	0.00	92.53
	1526A_2R-CC_28-29_10	3.91	3.39	1.32	71.04	0.14	0.11	0.97	0.04	12.34	0.04	93.30
	s3 1526B_1H-1_93-95-1	4.10	3.24	1.03	77.52	0.15	0.15	0.97	0.05	12.48	0.00	99.69
	1526B_1H-1_93-95-2	3.92	3.15	0.79	76.02	0.13	0.15	0.91	0.11	12.09	0.04	97.31
	1526B_1H-1_93-95-3	3.67	3.13	0.88	73.72	0.11	0.15	0.88	0.04	11.68	0.00	94.26
	1526B_1H-1_93-95-4	3.83	3.18	1.06	77.04	0.13	0.14	0.95	0.03	12.23	0.00	98.59
	1526B_1H-1_93-95-5	3.72	3.09	0.91	75.09	0.12	0.14	0.88	0.04	11.78	0.00	95.76
	1526B_1H-1_93-95-6	3.87	3.25	0.97	77.71	0.12	0.15	0.90	0.13	12.44	0.02	99.54
	1526B_1H-1_93-95-7	3.83	3.13	0.94	75.25	0.12	0.12	0.86	0.04	11.74	0.01	96.04
	1526B_1H-1_93-95-8	4.12	3.03	1.02	75.91	0.15	0.12	0.90	0.02	12.01	0.00	97.28
	1526B_1H-1_93-95-9	3.77	2.89	0.94	74.65	0.11	0.15	0.92	0.11	11.90	0.01	95.46
	1526B_1H-1_93-95-10	3.99	3.15	0.97	76.17	0.14	0.13	0.93	0.05	12.05	0.00	97.59
	1526B_1H-1_93-95-11	3.94	3.31	0.86	77.63	0.14	0.15	0.90	0.08	12.03	0.03	99.07
	1526B_1H-1_93-95-12	4.05	3.42	0.73	77.52	0.15	0.07	0.81	0.01	12.47	0.01	99.24
	1526B_1H-1_93-95-13	3.82	3.23	0.94	76.40	0.13	0.11	0.88	0.07	12.15	0.00	97.73
	1526B_1H-1_93-95-14	4.23	3.19	0.93	77.67	0.14	0.10	0.86	0.12	12.45	0.00	99.69
	1526B_1H-1_93-95-15	3.74	3.16	0.98	77.67	0.13	0.12	0.94	0.00	12.39	0.00	99.13
	1526B_1H-1_93-95-16	3.62	3.11	0.84	76.26	0.14	0.14	0.92	0.04	12.07	0.02	97.16
	1526B_1H-1_93-95-17	4.10	3.18	0.95	77.42	0.12	0.16	0.91	0.05	12.39	0.00	99.27
	1526B_1H-1_93-95-18	4.13	3.22	0.92	77.71	0.11	0.13	0.96	0.06	12.38	0.00	99.62
	1526B_1H-1_93-95-19	3.82	3.12	0.90	76.82	0.10	0.15	0.94	0.06	12.50	0.05	98.44
	1526B_1H-1_93-95-20	3.96	3.21	0.87	77.38	0.12	0.10	0.94	0.00	12.57	0.02	99.18
	1526B_1H-1_93-95_1	3.92	3.24	0.99	75.43	0.12	0.11	0.91	0.05	12.38	0.02	97.18
	1526B_1H-1_93-95_3	3.96	3.54	0.95	75.57	0.16	0.11	0.94	0.05	12.29	0.00	97.56
	1526B_1H-1_93-95_4	3.98	3.19	0.93	75.84	0.12	0.14	0.93	0.07	11.97	0.02	97.19
	1526B_1H-1_93-95_5	4.09	3.03	0.94	75.77	0.12	0.11	0.96	0.08	12.26	0.01	97.37
	1526B_1H-1_93-95_6	4.30	3.34	0.77	76.25	0.13	0.09	0.77	0.05	12.46	0.01	98.17
	1526B_1H-1_93-95_9	4.09	3.25	1.04	75.65	0.15	0.13	0.89	0.00	12.10	0.02	97.31
	1526B_1H-1_93-95_12	3.79	3.25	0.88	75.43	0.11	0.12	0.91	0.13	11.86	0.03	96.51
	1526B_1H-1_93-95_2	4.04	3.14	1.05	75.64	0.12	0.14	0.94	0.12	12.27	0.01	97.48
	1526B_1H-1_93-95_7	3.96	3.24	0.94	75.84	0.14	0.11	0.91	0.05	12.19	0.02	97.40
	1526B_1H-1_93-95_8	4.20	3.17	0.87	76.03	0.13	0.13	0.89	0.00	12.09	0.00	97.50
	1526B_1H-1_93-95_10	4.08	3.03	1.02	75.09	0.15	0.14	0.92	0.02	12.26	0.02	96.72

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s5	1526B_1H-1_93-95_11	4.22	3.24	1.05	75.39	0.11	0.14	0.93	0.03	12.14	0.02	97.27
	1526B_1H-1_122-124_1	3.66	3.15	0.95	74.90	0.10	0.09	0.86	0.11	11.93	0.00	95.75
	1526B_1H-1_122-124_2	3.67	3.12	0.90	75.01	0.12	0.11	0.84	0.01	11.89	0.01	95.67
	1526B_1H-1_122-124_3	3.69	3.88	0.93	75.88	0.09	0.08	0.75	0.04	12.58	0.01	97.93
	1526B_1H-1_122-124_4	3.51	3.75	1.05	74.73	0.09	0.07	0.77	0.04	11.99	0.02	96.02
	1526B_1H-1_122-124_5	3.87	3.14	1.03	75.22	0.11	0.14	0.83	0.11	12.13	0.01	96.60
	1526B_1H-1_122-124_6	3.55	4.07	1.04	77.81	0.09	0.05	0.75	0.00	12.50	0.02	99.87
	1526B_1H-1_122-124_7	3.39	3.77	0.87	74.39	0.07	0.06	0.72	0.10	12.10	0.00	95.47
	1526B_1H-1_122-124_8	3.62	3.03	0.96	74.23	0.10	0.13	0.86	0.08	12.03	0.00	95.05
	1526B_1H-1_122-124_9	3.35	3.75	0.88	74.52	0.07	0.08	0.70	0.09	11.99	0.03	95.45
	1526B_1H-1_122-124_10	3.67	3.90	0.86	76.29	0.06	0.07	0.74	0.10	12.47	0.02	98.18
	1526B_1H-1_122-124_11	3.66	3.06	0.94	74.16	0.08	0.10	0.81	0.05	11.93	0.00	94.80
	1526B_1H-1_122-124_12	3.54	3.80	0.95	73.39	0.09	0.07	0.74	0.05	12.00	0.00	94.63
	1526B_1H-1_122-124_13	3.46	3.80	0.76	74.06	0.08	0.08	0.71	0.00	12.05	0.02	95.02
	1526B_1H-1_122-124_14	3.65	3.18	0.94	74.60	0.09	0.11	0.80	0.07	12.04	0.02	95.49
	1526B_1H-1_122-124_15	4.04	3.35	0.91	76.49	0.09	0.07	0.74	0.09	12.26	0.01	98.04
	1526B_1H-1_122-124_16	4.02	3.11	1.04	75.55	0.10	0.13	0.88	0.04	11.88	0.04	96.79
	1526B_1H-1_122-124_17	3.63	3.09	0.90	74.65	0.13	0.13	0.86	0.04	11.95	0.00	95.38
	1526B_1H-1_122-124_18	3.75	3.11	0.91	73.74	0.13	0.14	0.84	0.02	12.09	0.00	94.74
	1526B_1H-1_122-124_19	3.58	3.69	0.87	73.77	0.06	0.04	0.74	0.05	12.09	0.00	94.89
	1526B_1H-1_122-124_20	3.83	3.11	1.00	74.97	0.10	0.12	0.84	0.05	12.05	0.00	96.08
s9	1526B_1H-3_36-38_1	3.98	2.80	1.26	74.01	0.21	0.18	1.11	0.16	12.37	0.01	96.09
	1526B_1H-3_36-38_2	3.61	1.81	3.41	63.50	0.63	1.22	3.54	0.12	13.97	0.15	91.97
	1526B_1H-3_36-38_3	4.16	2.83	1.18	73.99	0.15	0.18	1.03	0.09	12.35	0.00	95.96
	1526B_1H-3_36-38_4	4.02	2.94	1.24	74.99	0.16	0.15	1.02	0.03	12.33	0.03	96.91
	1526B_1H-3_36-38_5	4.10	2.82	1.20	74.53	0.15	0.14	1.02	0.11	12.52	0.04	96.63
	1526B_1H-3_36-38_6	3.50	2.88	1.17	74.57	0.16	0.22	1.40	0.07	11.94	0.00	95.92
	1526B_1H-3_36-38_7	4.03	2.69	1.14	74.11	0.18	0.14	1.06	0.01	12.51	0.04	95.91
	1526B_1H-3_36-38_8	4.27	2.85	1.03	74.08	0.15	0.07	0.86	0.06	12.22	0.00	95.59
	1526B_1H-3_36-38_9	4.42	2.58	1.66	70.83	0.24	0.29	1.57	0.03	13.22	0.00	94.84
	1526B_1H-3_36-38_10	4.34	2.65	1.21	74.18	0.17	0.10	1.10	0.09	12.59	0.00	96.42
	1526B_1H-3_36-38_11	4.12	2.70	1.23	73.39	0.18	0.15	1.09	0.00	12.53	0.07	95.46
	1526B_1H-3_36-38_12	4.22	2.96	1.38	76.47	0.16	0.15	1.03	0.10	12.90	0.05	99.43
	1526B_1H-3_36-38_13	4.32	2.72	1.19	73.65	0.17	0.17	1.00	0.13	12.29	0.06	95.71
	1526B_1H-3_36-38_14	4.14	2.85	1.24	73.90	0.13	0.20	1.03	0.12	12.30	0.04	95.95
	1526B_1H-3_36-38_15	4.12	2.69	1.29	73.52	0.15	0.21	1.02	0.05	12.35	0.04	95.44
	1526B_1H-3_36-38_16	4.15	2.71	1.12	73.11	0.12	0.16	1.02	0.13	12.59	0.02	95.13
	1526B_1H-3_36-38_17	3.89	2.72	1.49	72.78	0.18	0.18	0.99	0.05	12.23	0.02	94.53
	1526B_1H-3_36-38_18	3.96	2.74	1.37	73.29	0.16	0.19	1.01	0.11	12.36	0.02	95.22
	1526B_1H-3_36-38_19	3.86	2.76	1.23	73.07	0.17	0.10	0.94	0.05	12.27	0.04	94.49
	1526B_1H-3_36-38_20	3.87	2.86	1.24	72.86	0.15	0.15	1.02	0.07	12.49	0.00	94.71
u2	1526B_1H-3_111-113_1	3.31	3.39	0.94	73.17	0.14	0.13	1.00	0.04	11.82	0.00	93.94
	1526B_1H-3_111-113_2	3.43	3.74	1.10	75.56	0.13	0.12	0.97	0.03	12.36	0.01	97.44
	1526B_1H-3_111-113_3	3.37	3.59	0.88	73.95	0.12	0.13	1.01	0.03	11.87	0.01	94.96
	1526B_1H-3_111-113_4	3.63	3.62	1.21	75.16	0.13	0.12	0.98	0.04	12.33	0.03	97.24
	1526B_1H-3_111-113_5	3.30	3.52	1.07	74.03	0.14	0.12	0.97	0.02	11.95	0.00	95.12
	1526B_1H-3_111-113_6	3.62	3.80	0.96	75.49	0.16	0.13	1.03	0.00	12.30	0.05	97.55
	1526B_1H-3_111-113_7	3.39	3.95	1.23	77.49	0.14	0.14	1.03	0.00	12.61	0.00	99.98
	1526B_1H-3_111-113_8	3.66	3.71	1.12	74.89	0.14	0.12	1.01	0.02	12.40	0.02	97.10
	1526B_1H-3_111-113_9	3.19	3.82	1.14	75.89	0.12	0.12	1.03	0.00	12.19	0.02	97.52
	1526B_1H-3_111-113_10	3.45	3.71	1.12	74.42	0.14	0.11	0.98	0.08	12.14	0.01	96.16
	1526B_1H-3_111-113_11	4.35	2.41	2.39	73.55	0.48	0.49	2.06	0.13	13.89	0.07	99.82
	1526B_1H-3_111-113_12	3.55	3.79	1.01	75.15	0.12	0.16	1.04	0.00	12.19	0.00	97.01
	1526B_1H-3_111-113_13	3.46	3.71	1.11	74.63	0.12	0.14	1.04	0.00	12.05	0.03	96.28
	1526B_1H-3_111-113_14	3.40	3.64	1.16	73.46	0.12	0.13	1.00	0.04	11.99	0.01	94.95
	1526B_1H-3_111-113_15	3.70	3.60	1.12	74.03	0.14	0.16	0.95	0.04	12.10	0.03	95.87
	1526B_1H-3_111-113_16	3.25	3.64	1.04	75.24	0.14	0.13	1.01	0.01	12.10	0.03	96.59
	1526B_1H-3_111-113_17	3.33	3.66	1.01	73.91	0.10	0.11	0.92	0.05	11.94	0.00	95.02
	1526B_1H-3_111-113_18	3.64	3.58	1.01	74.72	0.15	0.12	0.96	0.00	11.94	0.02	96.13
	1526B_1H-3_111-113_19	3.58	3.89	1.16	77.06	0.14	0.13	1.03	0.08	12.50	0.03	99.61
u3	1526B_1H-3_116-118_1	3.73	3.51	1.11	73.22	0.14	0.06	0.81	0.02	11.53	0.03	94.16
	1526B_1H-3_116-118_2	4.23	2.24	1.90	69.60	0.34	0.48	2.23	0.09	13.52	0.02	94.65
	1526B_1H-3_116-118_3	4.12	2.25	1.74	71.44	0.31	0.44	1.97	0.06	13.13	0.05	95.52
	1526B_1H-3_116-118_4	4.01	2.41	1.27	71.38	0.20	0.29	1.56	0.06	12.51	0.02	93.72
	1526B_1H-3_116-118_5	3.45	3.68	1.03	74.50	0.12	0.11	0.98	0.00	11.86	0.03	95.76
	1526B_1H-3_116-118_7	3.98	2.24	1.72	68.86	0.36	0.51	2.05	0.10	13.58	0.04	93.44
	1526B_1H-3_116-118_8	4.16	2.38	1.31	72.03	0.25	0.33	1.59	0.10	12.75	0.01	94.91
	1526B_1H-3_116-118_9	3.87	2.39	1.50	70.71	0.24	0.35	1.57	0.15	12.83	0.01	93.62
	1526B_1H-3_116-118_10	3.78	2.26	1.57	68.68	0.30	0.39	1.84	0.06	12.87	0.02	91.76
	1526B_1H-3_116-118_11	3.89	2.42	1.38	72.17	0.24	0.34	1.55	0.13	13.07	0.01	95.20

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s12	1526B_1H-3_116-118_12	3.91	2.08	2.00	66.68	0.39	0.49	2.39	0.10	13.88	0.08	92.00
	1526B_1H-3_116-118_14	4.25	2.26	1.79	69.81	0.30	0.47	2.05	0.12	13.70	0.04	94.79
	1526B_1H-3_116-118_15	4.11	2.43	1.41	71.76	0.23	0.30	1.60	0.09	12.97	0.02	94.93
	1526B_1H-3_116-118_16	4.11	2.41	1.42	72.29	0.25	0.29	1.59	0.04	13.25	0.01	95.66
	1526B_1H-3_116-118_17	4.27	2.30	1.81	71.51	0.33	0.57	2.23	0.13	13.95	0.03	97.13
	1526B_1H-3_116-118_18	3.73	2.45	1.32	71.29	0.21	0.25	1.54	0.06	12.75	0.02	93.62
	1526B_1H-3_116-118_19	3.89	2.38	1.31	71.41	0.23	0.27	1.57	0.02	12.82	0.02	93.92
	1526B_1H-3_116-118_20	4.01	2.50	1.30	72.15	0.24	0.30	1.60	0.07	13.00	0.07	95.24
	1526B_2H-1_94-96_1	3.59	3.76	1.14	75.32	0.10	0.12	1.04	0.00	12.00	0.00	97.07
	1526B_2H-1_94-96_2	3.48	3.76	1.20	75.66	0.13	0.10	1.03	0.00	12.29	0.01	97.65
	1526B_2H-1_94-96_4	3.61	3.69	0.98	74.42	0.12	0.13	0.99	0.05	12.05	0.01	96.03
	1526B_2H-1_94-96_5	3.24	3.21	1.08	73.96	0.14	0.17	1.32	0.06	11.65	0.00	94.83
	1526B_2H-1_94-96_7	3.47	3.82	1.20	76.15	0.14	0.16	0.96	0.06	12.43	0.04	98.44
	1526B_2H-1_94-96_8	3.51	3.76	1.05	75.71	0.13	0.12	1.01	0.03	12.21	0.02	97.56
	1526B_2H-1_94-96_9	3.60	3.67	1.13	74.58	0.12	0.12	0.98	0.03	12.03	0.00	96.26
	1526B_2H-1_94-96_10	3.35	3.80	1.05	74.83	0.12	0.12	0.97	0.08	12.29	0.02	96.63
	1526B_2H-1_94-96_11	3.53	3.65	1.06	74.37	0.18	0.10	1.01	0.06	12.25	0.00	96.22
	1526B_2H-1_94-96_12	3.21	3.51	0.93	70.40	0.13	0.09	0.96	0.06	11.32	0.02	90.62
	1526B_2H-1_94-96_13	3.41	3.75	1.04	74.21	0.13	0.06	1.00	0.02	11.86	0.02	95.51
	1526B_2H-1_94-96_14	3.53	3.70	1.16	74.50	0.14	0.16	1.03	0.05	12.22	0.05	96.54
	1526B_2H-1_94-96_15	3.65	3.75	1.07	75.26	0.13	0.13	1.05	0.06	12.38	0.01	97.49
	1526B_2H-1_94-96_16	3.08	3.04	1.29	73.87	0.14	0.15	1.29	0.00	11.60	0.03	94.49
	1526B_2H-1_94-96_18	3.38	3.59	1.24	74.72	0.13	0.17	1.00	0.01	12.01	0.01	96.26
	1526B_2H-1_94-96_20	5.38	3.97	3.93	71.81	0.22	0.00	0.20	0.07	10.09	0.00	95.68
	1526B_2H-1_94-96_1	3.69	3.86	0.96	73.33	0.11	0.04	0.73	0.01	12.39	0.00	95.12
	1526B_2H-1_94-96_5	3.35	3.72	1.05	73.78	0.10	0.08	1.02	0.04	11.86	0.00	95.01
	1526B_2H-1_94-96_6	3.46	3.64	1.24	75.90	0.14	0.16	1.05	0.00	12.50	0.00	98.10
	1526B_2H-1_94-96_9	3.55	3.84	1.14	74.35	0.11	0.15	1.07	0.00	12.20	0.01	96.42
	1526B_2H-1_94-96_10	3.58	3.51	1.08	71.72	0.08	0.09	0.78	0.02	11.85	0.00	92.71
	1526B_2H-1_94-96_2	3.06	3.20	1.25	70.84	0.13	0.15	1.27	0.06	11.69	0.01	91.66
	1526B_2H-1_94-96_3	3.80	3.59	0.86	72.59	0.11	0.09	0.79	0.02	11.88	0.01	93.74
	1526B_2H-1_94-96_4	3.20	3.75	1.05	72.54	0.12	0.13	0.97	0.00	11.99	0.04	93.79
	1526B_2H-1_94-96_7	3.56	3.72	1.08	72.74	0.10	0.10	0.98	0.06	11.92	0.01	94.27
	1526B_2H-1_94-96_11	3.54	3.44	1.11	71.26	0.10	0.14	1.00	0.03	11.82	0.00	92.44
	1526B_2H-1_94-96_12	3.50	3.71	1.16	71.65	0.15	0.12	1.01	0.04	11.95	0.00	93.30
	1526B_2H-1_94-96_13	3.46	3.59	1.12	71.80	0.10	0.12	1.03	0.07	11.60	0.03	92.91
	1526B_2H-1_94-96_15	3.15	3.54	0.94	72.85	0.12	0.12	1.01	0.12	11.55	0.00	93.40
s17	1526B_2H-2_92-93_1	3.92	3.32	1.17	74.68	0.10	0.10	0.69	0.08	11.91	0.03	96.00
	1526B_2H-2_92-93_2	3.88	3.36	1.23	74.22	0.10	0.04	0.71	0.02	11.68	0.01	95.25
	1526B_2H-2_92-93_3	3.90	3.65	1.26	74.35	0.09	0.06	0.67	0.02	11.75	0.00	95.74
	1526B_2H-2_92-93_4	3.46	3.82	1.04	71.80	0.08	0.04	0.62	0.08	11.23	0.00	92.18
	1526B_2H-2_92-93_5	3.31	3.93	1.10	74.52	0.12	0.11	0.82	0.00	11.90	0.00	95.81
	1526B_2H-2_92-93_6	3.94	2.75	1.72	66.31	0.28	0.25	1.32	0.07	11.92	0.04	88.61
	1526B_2H-2_92-93_7	3.77	3.35	1.24	74.81	0.10	0.06	0.66	0.04	11.83	0.03	95.89
	1526B_2H-2_92-93_8	3.64	3.38	1.15	74.37	0.11	0.09	0.71	0.00	11.88	0.01	95.34
	1526B_2H-2_92-93_9	4.13	3.39	1.20	74.81	0.09	0.05	0.68	0.02	11.87	0.00	96.23
	1526B_2H-2_92-93_10	3.94	3.33	1.28	74.73	0.11	0.06	0.72	0.00	12.04	0.02	96.23
	1526B_2H-2_92-93_11	4.00	3.34	1.11	74.09	0.10	0.07	0.70	0.00	11.80	0.02	95.24
	1526B_2H-2_92-93_12	3.74	3.68	1.05	74.47	0.09	0.09	0.76	0.08	11.74	0.00	95.70
	1526B_2H-2_92-93_14	3.82	3.73	1.07	71.20	0.09	0.02	0.63	0.10	11.44	0.01	92.11
	1526B_2H-2_92-93_15	3.58	3.03	2.66	70.25	0.35	0.40	2.28	0.02	13.10	0.05	95.70
	1526B_2H-2_92-93_16	3.56	2.74	2.50	62.67	0.47	0.57	2.19	0.09	12.64	0.09	87.52
	1526B_2H-2_92-93_17	3.82	3.45	1.04	74.04	0.11	0.07	0.67	0.01	11.77	0.04	95.01
	1526B_2H-2_92-93_18	4.17	3.77	1.13	74.69	0.09	0.04	0.55	0.02	12.00	0.02	96.49
	1526B_2H-2_92-93_19	2.91	3.67	1.09	65.33	0.10	0.07	0.61	0.01	10.27	0.00	84.06
	1526B_2H-2_92-93_20	3.83	3.37	1.11	74.74	0.11	0.05	0.68	0.03	11.78	0.00	95.71
s21*	1526B_2H-2_92-93cm_3	3.90	3.42	1.17	75.59	0.10	0.01	0.60	0.06	11.71	0.05	96.61
	1526B_2H-2_92-93cm_6	3.91	3.65	1.29	75.31	0.08	0.04	0.60	0.02	11.56	0.00	96.46
	1526B_2H-2_92-93cm_8	3.84	3.59	1.00	75.60	0.10	0.04	0.49	0.12	11.85	0.00	96.63
	1526B_2H-2_92-93cm_4	3.96	3.32	1.09	75.31	0.11	0.09	0.65	0.01	11.72	0.00	96.26
	1526B_2H-2_92-93cm_1	3.78	3.63	1.22	75.63	0.10	0.00	0.58	0.06	11.65	0.01	96.66
	1526B_2H-2_92-93cm_5	3.77	3.43	1.14	75.29	0.11	0.05	0.66	0.02	11.80	0.00	96.26
	1526B_2H-2_92-93cm_9	4.05	3.37	1.13	75.13	0.09	0.03	0.70	0.04	12.11	0.02	96.68
	1526B_2H-3_83-85_1	3.90	3.32	1.25	73.32	0.17	0.09	0.98	0.00	12.30	0.03	95.36
	1526B_2H-3_83-85_2	3.91	3.40	1.29	73.22	0.12	0.13	0.93	0.00	12.24	0.00	95.23
	1526B_2H-3_83-85_3	3.89	3.37	1.19	73.35	0.12	0.11	0.81	0.04	11.98	0.03	94.88
s21*	1526B_2H-3_83-85_4	3.62	3.73	1.06	74.09	0.05	0.04	0.66	0.00	11.69	0.00	94.94
	1526B_2H-3_83-85_5	3.49	3.61	1.09	74.66	0.08	0.09	0.70	0.12	11.80	0.02	95.66
	1526B_2H-3_83-85_6	3.91	3.21	1.40	72.82	0.17	0.20	1.29	0.03	12.68	0.02	95.73
	1526B_2H-3_83-85_7	3.72	3.53	1.00	74.20	0.10	0.04	0.72	0.00	11.92	0.00	95.23

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1526B_2H-3_83-85_8	3.72	3.55	0.90	74.50	0.09	0.03	0.75	0.02	11.74	0.00	95.31
	1526B_2H-3_83-85_9	3.59	3.74	0.95	73.70	0.07	0.04	0.72	0.08	11.72	0.02	94.63
	1526B_2H-3_83-85_10	3.55	3.55	1.05	73.89	0.11	0.07	0.69	0.01	11.78	0.04	94.74
	1526B_2H-3_83-85_11	3.63	3.65	0.94	74.07	0.09	0.09	0.67	0.02	11.93	0.00	95.08
	1526B_2H-3_83-85_12	3.93	3.34	1.24	74.43	0.12	0.04	0.69	0.04	11.70	0.01	95.54
	1526B_2H-3_83-85_13	3.70	3.72	1.26	74.24	0.08	0.03	0.78	0.03	11.94	0.00	95.78
	1526B_2H-3_83-85_14	3.83	3.43	1.13	73.96	0.13	0.04	0.85	0.05	12.30	0.03	95.75
	1526B_2H-3_83-85_15	3.59	3.58	1.18	75.09	0.10	0.09	0.79	0.04	11.88	0.00	96.34
	1526B_2H-3_83-85_16	3.54	3.61	1.04	73.57	0.08	0.05	0.70	0.05	11.82	0.00	94.45
	1526B_2H-3_83-85_17	3.24	3.82	1.02	73.23	0.07	0.07	0.67	0.07	11.74	0.00	93.94
	1526B_2H-3_83-85_18	3.52	3.42	1.23	73.77	0.12	0.09	0.82	0.07	11.73	0.02	94.79
	1526B_2H-3_83-85_19	3.80	3.51	1.05	73.08	0.12	0.04	0.84	0.07	12.03	0.00	94.54
	1526B_2H-3_83-85_20	3.61	3.41	1.38	73.35	0.17	0.10	0.84	0.00	11.85	0.03	94.74
	1526B_2H-3_94-96_1	3.87	3.38	1.29	73.38	0.15	0.11	1.10	0.01	12.37	0.04	95.68
	1526B_2H-3_94-96_2	3.72	3.57	1.09	74.72	0.12	0.10	0.90	0.01	12.41	0.02	96.66
	1526B_2H-3_94-96_3	3.78	3.61	0.92	74.30	0.06	0.06	0.77	0.05	12.25	0.02	95.82
	1526B_2H-3_94-96_4	3.41	3.64	0.90	72.27	0.10	0.08	0.84	0.06	11.76	0.01	93.07
	1526B_2H-3_94-96_5	3.44	3.66	1.12	74.40	0.10	0.13	0.96	0.03	12.30	0.02	96.16
	1526B_2H-3_94-96_6	3.64	3.39	1.15	74.81	0.12	0.07	0.85	0.10	12.05	0.02	96.20
	1526B_2H-3_94-96_7	3.95	3.50	1.04	74.09	0.11	0.08	0.94	0.10	12.11	0.03	95.95
	1526B_2H-3_94-96_8	3.74	3.65	1.11	74.57	0.10	0.08	0.82	0.08	12.05	0.00	96.22
	1526B_2H-3_94-96_9	3.76	3.43	1.44	73.94	0.12	0.20	0.97	0.08	12.37	0.04	96.35
	1526B_2H-3_94-96_10	3.90	3.41	1.36	73.12	0.17	0.14	1.23	0.07	12.65	0.02	96.06
	1526B_2H-3_94-96_11	3.99	3.57	0.96	74.94	0.08	0.06	0.83	0.02	12.27	0.00	96.74
	1526B_2H-3_94-96_12	3.93	3.53	1.25	73.59	0.12	0.06	0.92	0.01	12.02	0.00	95.44
	1526B_2H-3_94-96_13	3.80	3.48	1.30	74.43	0.11	0.05	0.80	0.01	12.03	0.01	96.01
	1526B_2H-3_94-96_14	3.89	3.45	1.13	74.13	0.10	0.08	0.84	0.04	11.98	0.04	95.68
	1526B_2H-3_94-96_15	3.47	3.60	1.22	71.55	0.10	0.03	0.88	0.05	11.58	0.02	92.50
	1526B_2H-3_94-96_16	3.79	3.44	1.20	74.40	0.11	0.10	0.92	0.06	12.41	0.01	96.44
	1526B_2H-3_94-96_17	3.84	3.31	1.74	72.48	0.25	0.17	1.31	0.00	12.74	0.00	95.84
	1526B_2H-3_94-96_18	3.72	3.42	0.94	74.42	0.08	0.10	0.84	0.06	12.08	0.01	95.67
	1526B_2H-3_94-96_19	3.50	3.48	1.15	72.26	0.17	0.20	1.48	0.02	12.46	0.02	94.73
	1526B_2H-3_94-96_20	3.65	3.54	0.95	74.58	0.10	0.11	0.90	0.02	12.27	0.00	96.12
s23*	1526B_2H-3_101-103_1	3.68	3.37	1.12	74.46	0.13	0.09	0.90	0.07	11.96	0.01	95.79
	1526B_2H-3_101-103_2	3.91	3.17	1.16	74.35	0.17	0.18	1.19	0.07	12.40	0.05	96.64
	1526B_2H-3_101-103_3	4.15	3.31	1.74	72.66	0.19	0.23	1.28	0.04	12.89	0.02	96.50
	1526B_2H-3_101-103_4	3.95	3.43	1.73	73.49	0.19	0.14	1.22	0.00	12.42	0.04	96.61
	1526B_2H-3_101-103_5	3.80	3.28	1.02	74.69	0.12	0.11	0.90	0.03	12.04	0.02	96.01
	1526B_2H-3_101-103_6	3.80	3.25	1.70	72.44	0.22	0.23	1.38	0.01	12.81	0.02	95.87
	1526B_2H-3_101-103_7	3.79	3.19	1.41	72.86	0.13	0.09	1.03	0.04	12.14	0.01	94.70
	1526B_2H-3_101-103_8	3.74	3.44	1.05	75.01	0.11	0.03	0.82	0.02	11.91	0.00	96.11
	1526B_2H-3_101-103_9	3.48	3.51	0.99	73.92	0.09	0.04	0.76	0.03	11.80	0.01	94.63
	1526B_2H-3_101-103_10	3.64	3.19	1.05	74.58	0.11	0.14	0.87	0.01	12.06	0.06	95.71
	1526B_2H-3_101-103_11	3.76	3.63	0.97	74.94	0.09	0.06	0.71	0.03	11.80	0.01	95.99
	1526B_2H-3_101-103_12	3.90	3.42	1.33	73.42	0.13	0.13	1.12	0.00	12.44	0.01	95.90
	1526B_2H-3_101-103_13	3.83	3.30	1.41	73.01	0.13	0.10	1.07	0.12	12.65	0.00	95.63
	1526B_2H-3_101-103_14	4.06	3.12	1.45	71.79	0.18	0.17	1.27	0.04	12.66	0.04	94.77
	1526B_2H-3_101-103_15	3.81	3.30	1.56	73.29	0.14	0.12	1.16	0.06	12.63	0.01	96.08
	1526B_2H-3_101-103_16	3.64	3.41	1.19	73.82	0.14	0.07	0.87	0.07	12.06	0.00	95.27
	1526B_2H-3_101-103_17	3.92	3.20	1.57	72.31	0.16	0.14	1.25	0.05	12.84	0.02	95.45
	1526B_2H-3_101-103_18	3.92	3.17	0.96	74.67	0.13	0.13	0.89	0.08	12.16	0.03	96.14
	1526B_2H-3_101-103_19	4.04	3.14	1.74	71.75	0.21	0.11	1.26	0.09	12.82	0.04	95.21
	1526B_2H-3_101-103_20	3.96	3.27	1.44	72.68	0.19	0.25	1.24	0.07	12.71	0.04	95.85
	1526B_2H-3_105-106_1	3.51	3.51	1.16	73.24	0.08	0.07	0.86	0.08	11.99	0.00	94.50
	1526B_2H-3_105-106_2	3.27	3.74	0.79	73.93	0.10	0.10	0.89	0.05	11.85	0.00	94.71
	1526B_2H-3_105-106_3	3.66	3.54	0.90	74.48	0.07	0.04	0.73	0.00	11.79	0.03	95.23
	1526B_2H-3_105-106_4	3.54	3.53	1.13	74.64	0.13	0.11	0.80	0.09	11.90	0.02	95.88
	1526B_2H-3_105-106_5	3.70	3.25	1.64	72.11	0.25	0.21	1.36	0.08	12.92	0.06	95.57
	1526B_2H-3_105-106_6	3.89	3.43	1.07	74.17	0.10	0.11	0.82	0.03	12.12	0.00	95.74
	1526B_2H-3_105-106_8	3.71	3.20	1.67	72.95	0.17	0.13	1.11	0.08	12.53	0.00	95.55
	1526B_2H-3_105-106_10	3.65	3.60	1.07	74.91	0.11	0.08	0.84	0.03	11.94	0.00	96.23
	1526B_2H-3_105-106_11	3.77	3.44	1.24	73.53	0.10	0.08	0.86	0.08	11.92	0.02	95.04
	1526B_2H-3_105-106_12	3.79	3.51	1.46	72.65	0.13	0.08	1.03	0.05	12.66	0.00	95.36
	1526B_2H-3_105-106_13	3.73	3.31	1.08	73.55	0.09	0.07	0.85	0.08	12.09	0.03	94.87
	1526B_2H-3_105-106_14	3.65	3.39	1.04	73.98	0.09	0.08	0.83	0.03	11.82	0.00	94.91
	1526B_2H-3_105-106_15	3.89	3.32	1.41	72.26	0.24	0.18	1.21	0.03	12.52	0.02	95.08
	1526B_2H-3_105-106_16	3.48	3.69	0.98	74.28	0.13	0.07	0.71	0.00	12.05	0.00	95.40
	1526B_2H-3_105-106_17	3.81	3.54	0.95	75.17	0.10	0.08	0.77	0.09	11.88	0.00	96.40
	1526B_2H-3_105-106_18	3.78	3.53	1.18	73.97	0.10	0.08	0.85	0.00	12.06	0.02	95.56
	1526B_2H-3_105-106_19	3.75	3.39	1.15	73.88	0.08	0.10	0.87	0.01	12.00	0.01	95.24

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u27	1526B_2H-3_105-106_20	4.02	3.62	0.78	75.06	0.10	0.06	0.74	0.07	12.37	0.01	96.83
	1526B_2H-3_126-128_1	3.53	3.47	0.99	73.83	0.10	0.01	0.76	0.08	11.98	0.00	94.75
	1526B_2H-3_126-128_2	3.59	3.57	1.27	74.22	0.12	0.09	0.81	0.08	11.82	0.00	95.58
	1526B_2H-3_126-128_3	3.69	3.19	1.22	73.56	0.12	0.09	0.98	0.00	12.06	0.00	94.92
	1526B_2H-3_126-128_4	3.43	3.40	1.54	73.04	0.09	0.09	0.83	0.10	11.83	0.00	94.35
	1526B_2H-3_126-128_5	3.73	3.48	1.08	74.28	0.11	0.06	0.74	0.04	11.82	0.02	95.36
	1526B_2H-3_126-128_6	3.78	3.60	1.05	74.70	0.10	0.07	0.72	0.06	11.80	0.01	95.89
	1526B_2H-3_126-128_7	3.62	3.48	1.17	73.86	0.10	0.05	0.82	0.10	11.73	0.02	94.96
	1526B_2H-3_126-128_9	3.71	3.31	1.23	73.63	0.14	0.10	0.97	0.02	11.68	0.03	94.82
	1526B_2H-3_126-128_10	3.64	3.51	1.09	74.29	0.08	0.05	0.79	0.05	11.71	0.02	95.22
	1526B_2H-3_126-128_11	3.83	3.26	1.27	73.61	0.12	0.05	0.95	0.09	12.03	0.03	95.24
	1526B_2H-3_126-128_12	3.65	3.37	1.29	74.04	0.10	0.09	0.95	0.12	12.04	0.03	95.67
	1526B_2H-3_126-128_13	4.07	3.47	1.68	73.52	0.18	0.20	1.25	0.01	12.61	0.02	97.01
	1526B_2H-3_126-128_14	3.95	3.43	1.05	73.77	0.09	0.03	0.62	0.07	11.85	0.00	94.86
	1526B_2H-3_126-128_15	3.56	3.49	1.08	74.24	0.09	0.07	0.80	0.05	11.83	0.04	95.24
	1526B_2H-3_126-128_16	3.67	3.44	1.22	74.06	0.10	0.05	0.77	0.04	12.04	0.00	95.39
	1526B_2H-3_126-128_17	4.04	3.13	2.36	71.29	0.15	0.07	1.53	0.06	12.99	0.02	95.64
	1526B_2H-3_126-128_18	3.89	3.14	1.03	73.12	0.11	0.07	0.75	0.04	11.81	0.01	93.97
	1526B_2H-3_126-128_19	3.42	3.49	1.12	73.51	0.09	0.08	0.83	0.00	11.85	0.02	94.41
	1526B_2H-3_126-128_20	3.76	3.40	1.19	74.02	0.10	0.09	0.86	0.10	11.81	0.02	95.36
	1526B_2H-6_46-48_1	3.22	3.46	1.07	73.94	0.15	0.17	1.30	0.03	11.90	0.03	95.26
	1526B_2H-6_46-48_2	3.06	3.43	0.99	73.29	0.20	0.16	1.29	0.00	11.91	0.06	94.39
	1526B_2H-6_46-48_3	3.29	3.74	1.07	74.04	0.13	0.13	1.04	0.07	12.06	0.03	95.59
	1526B_2H-6_46-48_4	3.29	4.16	0.82	73.76	0.11	0.13	0.73	0.01	11.76	0.01	94.80
	1526B_2H-6_46-48_5	3.30	4.05	0.88	73.98	0.09	0.08	0.86	0.01	12.06	0.00	95.32
	1526B_2H-6_46-48_6	3.55	4.17	0.96	74.41	0.12	0.08	0.77	0.04	12.21	0.02	96.32
	1526B_2H-6_46-48_7	3.41	3.79	1.02	73.36	0.07	0.04	0.92	0.04	12.31	0.01	94.97
	1526B_2H-6_46-48_8	3.40	3.06	1.28	74.50	0.13	0.16	1.25	0.08	12.03	0.04	95.93
	1526B_2H-6_46-48_9	3.38	3.97	0.80	74.38	0.10	0.09	0.81	0.07	11.83	0.00	95.43
	1526B_2H-6_46-48_10	3.56	3.58	0.98	73.81	0.11	0.12	0.92	0.03	12.23	0.00	95.33
	1526B_2H-6_46-48_11	3.24	3.41	1.16	74.26	0.12	0.14	1.19	0.08	11.84	0.01	95.45
	1526B_2H-6_46-48_13	3.82	3.26	1.55	72.57	0.21	0.23	1.45	0.10	12.94	0.00	96.14
	1526B_2H-6_46-48_14	2.75	4.83	0.87	72.60	0.09	0.08	0.83	0.08	11.66	0.03	93.82
	1526B_2H-6_46-48_15	3.20	4.19	0.94	73.52	0.12	0.10	0.75	0.06	12.07	0.00	94.96
	1526B_2H-6_46-48_16	3.38	4.27	0.93	72.90	0.10	0.10	0.76	0.07	11.51	0.03	94.06
	1526B_2H-6_46-48_17	3.28	4.15	0.89	74.67	0.10	0.08	0.77	0.04	11.85	0.00	95.85
	1526B_2H-6_46-48_18	3.33	4.15	1.02	74.39	0.15	0.09	0.74	0.00	11.87	0.03	95.77
	1526B_2H-6_46-48_19	3.66	4.05	1.00	74.99	0.11	0.10	0.76	0.03	12.10	0.00	96.80
	1526B_2H-6_46-48_20	3.31	4.16	0.85	74.28	0.11	0.10	0.79	0.02	11.97	0.00	95.59
s28	1526B_2H-6_78-80_1	3.71	4.29	1.68	71.71	0.19	0.12	0.99	0.09	12.66	0.02	95.45
	1526B_2H-6_78-80_2	3.14	3.87	0.98	73.97	0.11	0.08	0.93	0.00	11.91	0.01	95.01
	1526B_2H-6_78-80_3	3.74	2.80	1.42	72.66	0.17	0.25	1.70	0.01	12.98	0.02	95.75
	1526B_2H-6_78-80_4	3.45	3.91	0.97	74.32	0.13	0.12	0.89	0.02	12.15	0.00	95.96
	1526B_2H-6_78-80_9	1.13	3.52	1.15	73.52	0.15	0.01	0.89	0.03	11.83	0.00	92.23
	1526B_2H-6_78-80_12	4.26	2.78	2.59	68.88	0.44	0.45	2.08	0.07	14.00	0.09	95.64
	1526B_2H-6_78-80_13	3.46	3.96	0.88	74.21	0.15	0.08	0.77	0.00	11.97	0.04	95.53
	1526B_2H-6_78-80_14	3.33	3.73	0.87	73.53	0.11	0.11	0.88	0.10	12.30	0.00	94.96
	1526B_2H-6_78-80_15	3.74	3.94	0.88	74.55	0.13	0.13	0.79	0.03	11.97	0.00	96.15
	1526B_2H-6_78-80_16	3.64	3.85	0.92	74.57	0.12	0.07	0.89	0.08	12.08	0.03	96.26
	1526B_2H-6_78-80_17	3.43	3.24	0.96	74.23	0.11	0.10	1.08	0.06	12.00	0.00	95.20
	1526B_2H-6_78-80_18	3.43	3.84	0.85	73.67	0.12	0.10	0.80	0.00	11.93	0.01	94.74
	1526B_2H-6_78-80_19	4.02	2.53	2.58	70.15	0.27	0.33	2.14	0.06	13.93	0.04	96.05
	1526B_2H-6_78-80_20	3.54	2.91	1.62	71.37	0.27	0.36	1.83	0.04	13.10	0.04	95.08
	1526B_2H-6_78-80_3	3.74	3.30	1.45	71.82	0.10	0.14	0.89	0.00	11.49	0.01	92.94
	1526B_2H-6_78-80_4	3.32	3.52	0.95	72.66	0.14	0.17	1.13	0.00	11.77	0.05	93.71
	1526B_2H-6_78-80_7	3.34	3.85	0.90	71.43	0.11	0.13	0.79	0.09	11.64	0.00	92.29
	1526B_2H-6_78-80_8	3.50	3.94	1.13	72.14	0.13	0.08	0.91	0.04	11.58	0.03	93.48
	1526B_2H-6_78-80_9	3.49	3.83	1.02	71.92	0.14	0.09	0.88	0.02	11.71	0.00	93.09
	1526B_2H-6_78-80_11	3.50	3.99	0.99	72.39	0.12	0.07	0.83	0.07	11.76	0.04	93.77
	1526B_2H-6_78-80_1	3.42	3.93	0.93	71.83	0.12	0.12	0.78	0.01	11.77	0.00	92.91
	1526B_2H-6_78-80_2	3.49	4.07	1.15	72.24	0.14	0.09	0.81	0.00	12.03	0.04	94.05
	1526B_2H-6_78-80_5	3.65	4.00	1.09	71.44	0.08	0.09	0.79	0.05	11.79	0.00	92.98
	1526B_2H-6_78-80_6	3.51	4.01	0.99	71.85	0.13	0.13	0.81	0.08	11.94	0.03	93.47
s44	1526B_3H-2_48-50_1	4.00	3.14	1.49	72.19	0.21	0.18	1.11	0.08	12.55	0.02	94.96
	1526B_3H-2_48-50_2	4.21	2.79	1.91	69.63	0.34	0.36	1.65	0.04	13.33	0.03	94.29
	1526B_3H-2_48-50_3	3.88	2.86	1.78	71.03	0.28	0.28	1.39	0.10	12.82	0.03	94.46
	1526B_3H-2_48-50_4	3.53	3.16	1.03	74.10	0.13	0.12	0.78	0.05	11.69	0.00	94.59
	1526B_3H-2_48-50_5	4.32	2.77	2.24	69.83	0.45	0.47	1.84	0.00	13.49	0.06	95.47
	1526B_3H-2_48-50_6	4.26	2.98	1.83	71.04	0.31	0.33	1.55	0.12	12.85	0.05	95.33
	1526B_3H-2_48-50_7	4.18	2.65	2.49	69.33	0.48	0.50	1.99	0.09	13.88	0.08	95.66

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s46	1526B_3H-2_48-50_8	4.25	3.00	1.65	72.03	0.26	0.19	1.20	0.03	12.72	0.03	95.35
	1526B_3H-2_48-50_9	4.19	2.98	1.90	71.16	0.33	0.25	1.41	0.05	12.95	0.02	95.24
	1526B_3H-2_48-50_10	4.14	3.14	1.41	72.54	0.20	0.16	1.06	0.02	12.88	0.04	95.59
	1526B_3H-2_48-50_11	3.99	2.81	1.82	70.98	0.31	0.24	1.36	0.13	12.89	0.05	94.57
	1526B_3H-2_48-50_12	4.34	2.99	1.88	71.53	0.31	0.30	1.35	0.04	13.02	0.06	95.81
	1526B_3H-2_48-50_14	3.98	2.90	1.92	70.71	0.32	0.32	1.59	0.06	12.95	0.04	94.78
	1526B_3H-2_48-50_15	4.51	2.73	2.20	70.01	0.33	0.36	1.73	0.03	13.58	0.08	95.57
	1526B_3H-2_48-50_16	4.15	2.98	2.00	70.82	0.30	0.30	1.46	0.05	13.14	0.02	95.21
	1526B_3H-2_48-50_17	4.13	2.97	1.89	70.27	0.29	0.25	1.38	0.05	12.92	0.04	94.19
	1526B_3H-2_48-50_18	4.14	3.03	1.74	70.79	0.30	0.28	1.37	0.05	13.08	0.08	94.85
	1526B_3H-2_48-50_19	4.10	3.21	1.45	72.59	0.13	0.12	0.87	0.05	12.39	0.03	94.94
	1526B_3H-2_48-50_20	3.81	3.49	1.18	70.87	0.25	0.17	0.90	0.04	11.89	0.02	92.62
	1526B_3H-2_64-66_1	4.12	3.00	1.44	71.72	0.24	0.23	1.27	0.04	13.01	0.01	95.08
	1526B_3H-2_64-66_2	4.37	2.87	2.07	70.20	0.41	0.37	1.46	0.06	12.94	0.00	94.75
	1526B_3H-2_64-66_3	4.15	2.87	2.01	70.95	0.30	0.34	1.57	0.11	13.14	0.05	95.48
	1526B_3H-2_64-66_4	4.06	3.11	1.45	72.23	0.23	0.21	1.09	0.09	12.82	0.04	95.34
	1526B_3H-2_64-66_5	4.19	2.89	2.05	70.34	0.39	0.32	1.52	0.11	12.91	0.06	94.78
	1526B_3H-2_64-66_6	4.24	2.96	1.97	71.17	0.33	0.31	1.53	0.05	13.02	0.05	95.62
	1526B_3H-2_64-66_7	4.21	2.86	2.00	70.86	0.33	0.34	1.54	0.01	13.14	0.08	95.37
	1526B_3H-2_64-66_8	4.15	3.01	1.77	71.48	0.22	0.22	1.21	0.04	12.75	0.01	94.85
	1526B_3H-2_64-66_9	4.34	2.90	1.96	71.11	0.37	0.34	1.55	0.04	13.33	0.04	95.98
	1526B_3H-2_64-66_10	4.04	2.94	1.93	71.20	0.34	0.37	1.57	0.07	12.87	0.05	95.38
	1526B_3H-2_64-66_11	4.34	2.75	2.28	69.36	0.42	0.39	1.70	0.05	13.34	0.05	94.68
	1526B_3H-2_64-66_12	4.29	2.95	1.97	71.09	0.32	0.37	1.56	0.07	13.26	0.05	95.93
	1526B_3H-2_64-66_13	4.23	2.99	1.96	70.86	0.35	0.30	1.56	0.03	13.19	0.05	95.51
	1526B_3H-2_64-66_15	4.11	3.39	1.28	72.54	0.24	0.14	0.94	0.06	12.72	0.00	95.41
	1526B_3H-2_64-66_16	3.87	2.91	1.91	70.57	0.34	0.35	1.55	0.05	13.14	0.07	94.77
	1526B_3H-2_64-66_17	4.15	2.94	2.00	71.03	0.35	0.32	1.57	0.06	12.85	0.01	95.27
	1526B_3H-2_64-66_18	3.80	3.04	1.94	66.91	0.32	0.35	1.41	0.09	12.18	0.05	90.10
	1526B_3H-2_64-66_19	4.18	3.17	1.55	71.50	0.23	0.20	1.07	0.10	12.61	0.02	94.63
	1526B_3H-2_64-66_20	4.12	2.96	2.07	71.33	0.31	0.32	1.59	0.05	13.11	0.03	95.88
	1526B_3H-2_74-76_2	3.75	3.32	1.06	71.17	0.13	0.10	0.80	0.08	11.43	0.04	91.88
	1526B_3H-2_74-76_3	4.09	2.79	2.46	69.35	0.35	0.37	1.81	0.10	13.23	0.00	94.54
	1526B_3H-2_74-76_4	4.50	2.75	2.51	68.85	0.44	0.47	1.90	0.10	13.57	0.05	95.15
	1526B_3H-2_74-76_5	4.29	3.09	1.74	71.82	0.30	0.21	1.28	0.00	13.10	0.04	95.87
	1526B_3H-2_74-76_6	4.13	3.00	1.75	70.92	0.20	0.24	1.26	0.15	12.88	0.02	94.55
	1526B_3H-2_74-76_7	3.95	3.10	1.52	70.29	0.24	0.23	1.31	0.07	13.00	0.02	93.73
	1526B_3H-2_74-76_8	4.11	2.92	1.92	70.03	0.35	0.27	1.37	0.06	13.19	0.08	94.30
	1526B_3H-2_74-76_9	4.39	2.76	2.39	69.59	0.43	0.49	1.90	0.06	13.65	0.05	95.71
	1526B_3H-2_74-76_10	4.23	2.74	2.35	69.48	0.39	0.42	1.88	0.06	13.71	0.06	95.32
	1526B_3H-2_74-76_11	4.35	2.79	2.36	70.10	0.40	0.40	1.86	0.16	13.42	0.07	95.91
	1526B_3H-2_74-76_12	4.29	2.82	2.37	69.18	0.40	0.40	1.71	0.09	13.39	0.01	94.66
	1526B_3H-2_74-76_13	4.26	2.85	2.21	69.44	0.37	0.40	1.81	0.05	13.72	0.03	95.14
	1526B_3H-2_74-76_14	4.09	3.15	2.20	69.00	0.41	0.41	1.76	0.07	13.28	0.05	94.42
	1526B_3H-2_74-76_15	4.23	2.91	1.74	70.68	0.32	0.29	1.46	0.02	13.27	0.04	94.96
	1526B_3H-2_74-76_16	4.25	2.77	2.40	68.88	0.40	0.45	1.81	0.07	13.37	0.04	94.44
	1526B_3H-2_74-76_17	4.23	2.83	2.18	69.82	0.37	0.42	1.69	0.09	13.42	0.07	95.12
	1526B_3H-2_74-76_18	4.25	2.80	2.18	70.15	0.38	0.41	1.72	0.08	13.48	0.07	95.52
	1526B_3H-2_74-76_19	4.41	2.79	2.33	69.84	0.40	0.44	1.83	0.07	13.43	0.08	95.62
	1526B_3H-2_74-76_20	4.39	2.85	2.27	69.34	0.41	0.36	1.69	0.08	13.53	0.07	94.99
s47	1526B_3H-2_85-87_1	4.16	2.90	1.62	70.36	0.29	0.34	1.61	0.07	13.48	0.06	94.89
	1526B_3H-2_85-87_2	4.84	2.39	1.39	69.67	0.25	0.24	2.51	0.03	15.16	0.05	96.52
	1526B_3H-2_85-87_3	4.32	2.75	2.16	69.70	0.39	0.44	1.84	0.13	13.69	0.08	95.50
	1526B_3H-2_85-87_4	4.34	2.79	1.58	70.50	0.33	0.33	1.57	0.02	13.46	0.03	94.94
	1526B_3H-2_85-87_5	3.91	2.91	1.87	70.22	0.33	0.36	1.55	0.06	13.13	0.06	94.39
	1526B_3H-2_85-87_6	4.03	2.87	1.68	70.57	0.35	0.29	1.55	0.07	13.36	0.04	94.81
	1526B_3H-2_85-87_7	4.35	2.78	2.21	69.23	0.38	0.43	1.86	0.09	13.82	0.01	95.15
	1526B_3H-2_85-87_9	4.21	2.74	1.94	69.17	0.38	0.42	1.91	0.05	13.52	0.07	94.41
	1526B_3H-2_85-87_10	4.41	2.85	1.89	70.48	0.33	0.40	1.68	0.06	13.50	0.08	95.67
	1526B_3H-2_85-87_11	4.08	2.87	1.71	69.95	0.33	0.36	1.55	0.12	13.29	0.03	94.30
	1526B_3H-2_85-87_12	4.17	2.89	1.92	70.44	0.33	0.35	1.55	0.08	13.33	0.04	95.10
	1526B_3H-2_85-87_13	4.56	2.99	2.02	70.96	0.31	0.30	1.55	0.07	13.26	0.02	96.03
	1526B_3H-2_85-87_14	2.49	2.83	1.93	71.62	0.33	0.32	1.53	0.04	13.50	0.05	94.63
	1526B_3H-2_85-87_15	4.21	2.71	2.25	68.15	0.41	0.46	1.90	0.09	13.68	0.06	93.91
	1526B_3H-2_85-87_16	4.25	2.73	2.36	69.04	0.39	0.41	1.87	0.12	13.68	0.06	94.91
	1526B_3H-2_85-87_17	4.35	2.91	1.74	70.66	0.32	0.32	1.51	0.04	13.18	0.07	95.10
	1526B_3H-2_85-87_18	4.35	2.97	1.54	71.65	0.28	0.21	1.34	0.05	12.91	0.03	95.32
	1526B_3H-2_85-87_19	4.30	2.87	1.68	70.76	0.33	0.29	1.58	0.04	13.47	0.03	95.35
	1526B_3H-2_85-87_20	4.21	2.88	1.65	71.00	0.31	0.31	1.52	0.04	12.85	0.04	94.81
	1526B_3H-2_85-87_1	4.38	2.94	1.82	69.01	0.32	0.34	1.69	0.10	13.26	0.02	93.87

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s54	1526B_3H-2_85-87_2	4.24	2.90	1.79	69.20	0.35	0.35	1.59	0.09	12.95	0.03	93.49
	1526B_3H-2_85-87_3	4.34	2.72	2.26	67.40	0.40	0.42	1.84	0.10	13.14	0.06	92.68
	1526B_3H-2_85-87_7	4.24	2.86	1.79	67.74	0.33	0.32	1.55	0.02	12.99	0.05	91.90
	1526B_3H-2_85-87_9	4.20	2.69	2.50	67.59	0.40	0.39	1.81	0.09	13.18	0.03	92.87
	1526B_3H-2_85-87_4	4.29	2.96	2.00	68.50	0.33	0.28	1.53	0.07	13.49	0.06	93.51
	1526B_3H-2_85-87_5	4.47	3.00	2.21	71.25	0.31	0.35	1.76	0.10	13.97	0.05	97.47
	1526B_3H-2_85-87_8	4.46	2.91	1.80	68.51	0.30	0.34	1.56	0.10	13.06	0.05	93.08
	1526B_3H-2_85-87_11	4.35	2.90	1.90	68.44	0.32	0.31	1.59	0.03	12.86	0.05	92.74
	1526B_3H-2_85-87_12	4.36	2.92	1.86	69.64	0.28	0.28	1.41	0.03	13.05	0.05	93.88
	1526B_3H-2_85-87_13	4.30	2.83	2.19	68.85	0.40	0.37	1.79	0.06	13.47	0.07	94.33
	1526B_3H-2_93-94_1	4.29	2.63	2.38	68.80	0.42	0.54	2.27	0.09	14.30	0.06	95.79
	1526B_3H-2_93-94_2	4.42	2.15	3.65	66.67	0.67	0.96	3.39	0.07	15.10	0.20	97.28
	1526B_3H-2_93-94_3	4.19	3.10	1.86	71.79	0.27	0.29	1.55	0.09	13.51	0.07	96.72
	1526B_3H-2_93-94_4	4.57	2.79	2.47	69.41	0.39	0.40	1.88	0.04	13.91	0.03	95.90
	1526B_3H-2_93-94_5	4.44	2.16	3.63	66.39	0.65	0.93	3.70	0.10	15.43	0.16	97.59
	1526B_3H-2_93-94_6	4.40	2.92	2.09	70.10	0.36	0.31	1.56	0.05	13.18	0.06	95.03
	1526B_3H-2_93-94_7	4.27	2.46	2.61	67.98	0.50	0.64	2.45	0.15	14.39	0.11	95.56
	1526B_3H-2_93-94_8	3.82	2.74	2.36	68.13	0.48	0.61	2.27	0.08	14.22	0.11	94.80
	1526B_3H-2_93-94_9	4.50	2.48	3.61	67.23	0.69	1.11	3.14	0.13	14.41	0.10	97.39
	1526B_3H-2_93-94_10	4.29	2.93	1.87	71.01	0.34	0.31	1.48	0.00	13.28	0.04	95.56
	1526B_3H-2_93-94_11	4.70	2.58	2.44	69.05	0.44	0.49	2.13	0.08	13.95	0.10	95.96
	1526B_3H-2_93-94_12	4.47	2.75	2.75	69.99	0.36	0.43	1.76	0.00	13.77	0.07	96.35
	1526B_3H-2_93-94_13	4.42	2.69	2.36	69.08	0.42	0.48	2.09	0.06	13.85	0.12	95.57
	1526B_3H-2_93-94_14	4.44	2.74	2.54	69.34	0.39	0.48	1.99	0.13	14.06	0.05	96.16
	1526B_3H-2_93-94_15	4.44	2.77	2.35	69.22	0.40	0.33	1.81	0.08	14.03	0.02	95.46
	1526B_3H-2_93-94_16	4.39	2.84	2.38	69.63	0.55	0.33	2.18	0.08	14.14	0.10	96.63
	1526B_3H-2_93-94_17	4.44	2.60	2.35	69.18	0.40	0.48	2.04	0.08	14.11	0.05	95.74
	1526B_3H-2_93-94_18	4.25	2.92	2.54	69.86	0.47	0.38	1.77	0.11	13.61	0.14	96.06
	1526B_3H-2_93-94_20	3.77	3.58	1.93	72.24	0.25	0.26	0.98	0.04	11.71	0.13	94.89
	1526B_3H-2_105-107_1	4.30	2.98	2.14	72.02	0.36	0.33	1.47	0.09	13.22	0.03	96.94
	1526B_3H-2_105-107_2	4.10	2.88	1.82	70.96	0.33	0.29	1.58	0.08	13.18	0.03	95.25
	1526B_3H-2_105-107_3	4.30	2.90	1.90	71.17	0.29	0.27	1.48	0.03	13.14	0.00	95.48
	1526B_3H-2_105-107_4	3.91	3.14	1.73	69.82	0.28	0.29	1.50	0.08	12.82	0.04	93.61
	1526B_3H-2_105-107_5	4.40	2.85	1.97	70.13	0.28	0.29	1.50	0.03	13.15	0.03	94.63
	1526B_3H-2_105-107_6	4.02	2.90	1.93	71.19	0.32	0.28	1.55	0.00	13.21	0.03	95.42
	1526B_3H-2_105-107_7	4.11	2.95	1.85	71.20	0.29	0.32	1.41	0.07	13.20	0.02	95.43
	1526B_3H-2_105-107_8	4.31	2.99	1.83	71.65	0.29	0.31	1.49	0.05	13.17	0.02	96.12
	1526B_3H-2_105-107_10	4.25	2.93	2.01	70.41	0.32	0.28	1.47	0.07	13.21	0.02	94.96
	1526B_3H-2_105-107_11	4.06	2.98	1.72	69.77	0.28	0.31	1.46	0.01	12.96	0.04	93.57
	1526B_3H-2_105-107_12	2.88	4.20	1.23	72.57	0.14	0.14	0.78	0.01	11.55	0.00	93.50
	1526B_3H-2_105-107_13	4.28	2.92	2.04	71.35	0.30	0.31	1.43	0.07	13.05	0.00	95.74
	1526B_3H-2_105-107_14	4.31	2.87	1.90	70.99	0.28	0.24	1.45	0.09	13.12	0.04	95.29
	1526B_3H-2_105-107_15	4.05	2.92	1.74	71.85	0.34	0.31	1.60	0.08	13.23	0.05	96.17
	1526B_3H-2_105-107_16	3.90	2.94	1.78	71.17	0.27	0.28	1.39	0.04	12.88	0.07	94.73
	1526B_3H-2_105-107_17	4.19	2.85	1.90	70.44	0.32	0.34	1.59	0.05	13.08	0.09	94.85
	1526B_3H-2_105-107_18	4.49	2.98	1.93	71.72	0.29	0.32	1.50	0.02	13.21	0.00	96.47
	1526B_3H-2_105-107_19	4.29	2.95	1.97	71.20	0.28	0.27	1.50	0.02	12.95	0.00	95.43
	1526B_3H-2_105-107_20	4.26	2.98	1.99	71.25	0.35	0.31	1.55	0.04	12.98	0.03	95.74
u40	1526B_3H-3_37-39_11	4.40	2.90	2.09	71.43	0.21	0.27	1.36	0.05	13.37	0.00	96.08
	1526B_3H-3_37-39_13	4.30	2.86	2.22	70.76	0.38	0.30	1.49	0.15	13.08	0.02	95.56
	1526B_3H-3_37-39_14	3.93	3.51	1.05	73.55	0.12	0.10	0.74	0.05	11.68	0.04	94.76
	1526B_3H-3_37-39_15	4.34	3.13	1.68	72.06	0.17	0.18	1.24	0.08	12.57	0.04	95.48
	1526B_3H-3_37-39_16	4.15	2.80	2.27	70.13	0.32	0.30	1.51	0.11	13.10	0.04	94.73
	1526B_3H-3_37-39_17	4.06	2.86	2.07	71.38	0.35	0.30	1.53	0.04	13.18	0.02	95.78
	1526B_3H-3_37-39_18	4.23	2.89	2.29	70.48	0.32	0.28	1.44	0.10	13.14	0.04	95.21
	1526B_3H-3_37-39_19	4.66	2.83	2.01	71.39	0.33	0.28	1.38	0.09	13.12	0.05	96.14
	1526B_3H-3_37-39_20	4.22	3.01	1.88	70.83	0.31	0.28	1.34	0.11	12.73	0.01	94.72
	1526B_3H-3_46-47-1	4.33	2.90	0.91	71.15	0.00	0.29	1.31	0.10	12.93	0.01	93.93
	1526B_3H-3_46-47-2	4.17	3.12	1.77	70.00	0.22	0.30	1.37	0.11	13.03	0.02	94.10
	1526B_3H-3_46-47-3	4.35	3.02	1.80	71.52	0.18	0.21	1.22	0.01	12.89	0.03	95.23
	1526B_3H-3_46-47-4	4.26	2.97	1.94	70.92	0.17	0.23	1.31	0.05	13.06	0.00	94.90
	1526B_3H-3_46-47-5	4.52	2.84	2.28	70.73	0.38	0.40	1.58	0.11	13.30	0.02	96.17
	1526B_3H-3_46-47-6	4.03	3.33	1.57	72.18	0.16	0.09	0.98	0.03	12.58	0.03	94.98
	1526B_3H-3_46-47-7	4.22	3.15	2.04	71.64	0.28	0.27	1.40	0.08	13.05	0.01	96.14
	1526B_3H-3_46-47-8	4.14	2.99	1.89	71.10	0.27	0.25	1.29	0.10	12.80	0.03	94.86
	1526B_3H-3_46-47-9	3.36	3.85	1.08	72.75	0.06	0.02	0.86	0.04	12.16	0.01	94.19
	1526B_3H-3_46-47-10	4.42	2.97	1.92	70.97	0.21	0.24	1.27	0.05	13.16	0.04	95.24
	1526B_3H-3_46-47-11	4.33	2.82	1.94	70.79	0.31	0.28	1.44	0.08	13.39	0.06	95.43
	1526B_3H-3_46-47-13	4.44	2.72	2.48	69.81	0.42	0.45	1.88	0.13	13.42	0.04	95.78
	1526B_3H-3_46-47-15	4.30	2.77	2.26	69.65	0.36	0.39	1.62	0.07	13.30	0.05	94.77

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s60	1526B_3H-3_46-47-16	4.13	2.75	2.11	70.09	0.36	0.39	1.70	0.05	13.50	0.04	95.12
	1526B_3H-3_46-47-17	3.92	3.28	1.47	72.60	0.17	0.14	0.88	0.05	12.46	0.04	95.01
	1526B_3H-3_46-47-18	4.15	2.95	1.86	71.28	0.28	0.26	1.30	0.09	13.28	0.04	95.49
	1526B_3H-3_46-47-19	4.23	2.76	2.05	69.76	0.38	0.34	1.61	0.07	13.36	0.01	94.57
	1526B_3H-3_46-47-20	4.17	2.91	1.84	70.61	0.31	0.24	1.25	0.03	13.13	0.01	94.51
	1526B_3H-3_133-135_1	4.18	3.12	1.57	72.41	0.18	0.19	1.28	0.03	12.56	0.01	95.53
	1526B_3H-3_133-135_2	3.93	3.08	1.54	71.59	0.22	0.17	1.26	0.04	12.94	0.02	94.79
	1526B_3H-3_133-135_3	4.37	2.67	2.78	67.54	0.53	0.63	2.52	0.06	14.19	0.14	95.44
	1526B_3H-3_133-135_4	4.12	3.14	2.20	69.96	0.26	0.30	1.54	0.02	13.56	0.03	95.13
	1526B_3H-3_133-135_5	3.99	3.14	1.77	72.25	0.22	0.25	1.38	0.00	12.76	0.04	95.82
	1526B_3H-3_133-135_6	4.36	2.74	2.31	69.09	0.41	0.37	1.87	0.08	13.63	0.04	94.90
	1526B_3H-3_133-135_7	4.01	3.15	1.41	72.41	0.17	0.08	1.16	0.06	12.24	0.02	94.71
	1526B_3H-3_133-135_8	3.93	3.17	1.37	72.92	0.15	0.12	1.06	0.10	12.29	0.00	95.12
	1526B_3H-3_133-135_9	4.38	2.80	2.51	69.71	0.36	0.33	1.86	0.18	13.65	0.03	95.81
	1526B_3H-3_133-135_10	4.47	3.03	2.25	71.08	0.26	0.24	1.55	0.12	13.42	0.03	96.45
	1526B_3H-3_133-135_11	4.80	2.68	1.66	71.07	0.28	0.17	1.96	0.04	14.52	0.03	97.21
	1526B_3H-3_133-135_12	4.28	2.97	2.05	70.44	0.30	0.27	1.54	0.05	13.38	0.04	95.32
	1526B_3H-3_133-135_13	3.57	3.79	1.14	74.24	0.11	0.03	0.67	0.03	11.43	0.01	95.02
	1526B_3H-3_133-135_14	4.44	2.63	3.04	67.76	0.58	0.75	2.52	0.08	14.20	0.12	96.12
	1526B_3H-3_133-135_16	3.70	3.59	1.29	72.90	0.13	0.15	1.07	0.01	12.52	0.00	95.36
	1526B_3H-3_133-135_17	3.82	3.17	1.60	72.00	0.17	0.16	1.24	0.00	12.85	0.01	95.02
s62	1526B_3H-3_133-135_18	4.11	3.02	1.90	70.59	0.24	0.24	1.47	0.07	13.19	0.07	94.90
	1526B_3H-3_133-135_20	4.41	2.50	3.14	68.31	0.52	0.72	2.82	0.05	14.10	0.10	96.66
	1526B_3H-4_38-40_1	4.21	3.54	1.45	72.65	0.20	0.16	0.96	0.08	12.79	0.00	96.03
	1526B_3H-4_38-40_2	4.13	3.11	1.53	72.41	0.14	0.12	1.08	0.06	12.76	0.00	95.35
	1526B_3H-4_38-40_3	4.17	3.14	1.63	71.38	0.22	0.15	1.27	0.10	12.96	0.02	95.03
	1526B_3H-4_38-40_4	4.16	3.27	1.61	72.78	0.16	0.13	1.12	0.03	12.70	0.02	95.98
	1526B_3H-4_38-40_5	4.35	3.11	1.85	70.99	0.23	0.23	1.37	0.03	13.03	0.00	95.19
	1526B_3H-4_38-40_6	4.15	3.23	1.57	72.20	0.17	0.11	1.01	0.02	12.66	0.04	95.16
	1526B_3H-4_38-40_7	4.14	3.55	1.49	70.76	0.16	0.17	0.99	0.00	12.29	0.04	93.60
	1526B_3H-4_38-40_8	3.39	3.51	1.49	66.54	0.13	0.15	1.56	0.03	11.62	0.00	88.43
	1526B_3H-4_38-40_9	3.63	3.51	1.48	71.13	0.18	0.14	1.12	0.05	12.47	0.04	93.74
	1526B_3H-4_38-40_10	4.42	3.20	1.61	72.12	0.15	0.09	1.04	0.05	12.78	0.02	95.49
	1526B_3H-4_38-40_11	4.18	3.30	1.44	72.56	0.16	0.11	1.02	0.05	12.44	0.00	95.26
	1526B_3H-4_38-40_12	4.33	3.26	1.54	72.87	0.16	0.14	1.09	0.10	12.66	0.01	96.17
	1526B_3H-4_38-40_13	4.18	3.19	1.46	72.81	0.15	0.19	1.08	0.08	12.71	0.02	95.88
	1526B_3H-4_38-40_14	3.91	3.63	1.24	73.45	0.11	0.11	0.83	0.07	12.19	0.00	95.55
	1526B_3H-4_38-40_15	4.19	3.26	1.42	71.82	0.15	0.09	1.04	0.04	12.55	0.02	94.59
	1526B_3H-4_38-40_16	4.30	3.34	1.53	73.63	0.13	0.12	1.07	0.07	13.02	0.00	97.21
	1526B_3H-4_38-40_18	3.82	3.47	1.18	73.91	0.14	0.13	1.02	0.02	12.10	0.00	95.80
	1526B_3H-4_38-40_19	4.08	3.06	1.91	70.14	0.26	0.21	1.37	0.05	13.34	0.03	94.45
s65	1526B_3H-4_38-40_20	4.33	2.99	1.35	72.45	0.23	0.15	1.23	0.04	12.84	0.00	95.60
	1526B_3H-5_1-3_1	4.00	3.21	1.44	71.59	0.13	0.12	1.10	0.05	12.37	0.01	94.01
	1526B_3H-5_1-3_2	3.84	3.32	1.65	71.31	0.18	0.20	1.19	0.07	12.57	0.00	94.33
	1526B_3H-5_1-3_3	3.50	3.73	1.26	73.29	0.12	0.06	0.93	0.05	12.12	0.00	95.06
	1526B_3H-5_1-3_4	4.14	3.33	1.76	71.94	0.17	0.15	1.08	0.01	12.76	0.00	95.35
	1526B_3H-5_1-3_5	4.41	3.10	1.85	71.56	0.19	0.15	1.14	0.06	12.73	0.00	95.18
	1526B_3H-5_1-3_6	3.64	3.72	1.89	70.38	0.23	0.23	1.27	0.08	12.99	0.04	94.47
	1526B_3H-5_1-3_8	3.85	3.56	1.15	72.78	0.17	0.10	1.07	0.00	12.19	0.02	94.89
	1526B_3H-5_1-3_9	3.59	3.59	1.34	73.43	0.14	0.08	0.72	0.04	11.80	0.05	94.77
	1526B_3H-5_1-3_10	4.03	3.18	1.93	70.18	0.25	0.23	1.43	0.09	13.03	0.00	94.36
	1526B_3H-5_1-3_11	4.33	2.94	2.35	68.47	0.33	0.27	1.60	0.07	12.96	0.02	93.35
	1526B_3H-5_1-3_12	4.20	3.28	2.00	70.77	0.27	0.26	1.48	0.05	13.06	0.06	95.43
	1526B_3H-5_1-3_13	4.20	3.35	1.56	72.41	0.22	0.14	1.11	0.03	12.65	0.05	95.72
	1526B_3H-5_1-3_14	4.09	3.29	1.71	73.06	0.17	0.16	1.10	0.06	13.03	0.00	96.68
	1526B_3H-5_1-3_15	4.10	3.32	2.07	70.14	0.27	0.28	1.57	0.06	13.37	0.01	95.18
	1526B_3H-5_1-3_16	4.25	2.96	1.99	71.24	0.28	0.27	1.34	0.05	12.98	0.03	95.38
	1526B_3H-5_1-3_17	4.11	3.32	1.59	72.03	0.18	0.19	1.06	0.08	12.75	0.03	95.34
	1526B_3H-5_1-3_18	3.65	3.59	1.82	70.82	0.25	0.20	1.19	0.06	12.79	0.01	94.38
	1526B_3H-5_1-3_19	3.84	3.66	1.27	73.44	0.26	0.12	0.88	0.02	12.33	0.02	95.84
	1526B_3H-5_1-3_20	4.16	3.33	1.31	73.40	0.17	0.13	0.92	0.06	12.37	0.03	95.88
s67*	1526B_3H-5_1-3_1	3.86	3.41	1.14	71.63	0.11	0.10	0.77	0.02	11.41	0.02	92.49
	1526B_3H-5_1-3_2	3.01	4.38	1.48	69.62	0.10	0.04	0.85	0.01	11.93	0.02	91.45
	1526B_3H-5_1-3_3	4.20	3.33	1.76	70.83	0.22	0.24	1.19	0.02	12.99	0.00	94.77
	1526B_3H-5_1-3_7	3.94	3.12	1.46	69.65	0.18	0.20	1.27	0.02	12.55	0.01	92.40
	1526B_3H-5_1-3_10	4.04	3.32	1.70	68.52	0.23	0.17	1.24	0.04	12.66	0.05	91.96
	1526B_3H-5_1-3_8	4.05	3.01	1.91	68.75	0.24	0.30	1.51	0.02	12.83	0.03	92.64
	1526B_3H-5_8-10_1	3.56	3.34	1.57	71.80	0.24	0.23	1.35	0.02	12.49	0.03	94.63
	1526B_3H-5_8-10_2	3.78	3.25	1.62	71.85	0.13	0.12	1.30	0.04	12.82	0.03	94.95
	1526B_3H-5_8-10_3	3.79	3.42	1.34	72.76	0.20	0.12	1.07	0.00	12.46	0.02	95.19

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1526B_3H-5_8-10_4	4.23	3.20	1.89	70.86	0.22	0.22	1.54	0.03	13.30	0.03	95.53
	1526B_3H-5_8-10_6	3.32	3.00	1.29	74.78	0.18	0.20	1.76	0.09	12.27	0.02	96.92
	1526B_3H-5_8-10_7	3.80	3.63	1.26	74.11	0.15	0.07	0.91	0.02	12.42	0.04	96.41
	1526B_3H-5_8-10_8	3.68	3.47	1.32	72.50	0.16	0.12	1.01	0.05	12.13	0.02	94.46
	1526B_3H-5_8-10_9	3.56	3.38	1.13	73.94	0.13	0.14	1.11	0.03	12.03	0.00	95.45
	1526B_3H-5_8-10_10	4.01	3.46	1.26	72.94	0.10	0.13	1.01	0.05	12.38	0.03	95.37
	1526B_3H-5_8-10_11	3.64	3.38	1.32	72.17	0.10	0.08	0.90	0.05	12.13	0.02	93.79
	1526B_3H-5_8-10_12	3.95	3.44	1.76	71.48	0.19	0.14	1.03	0.02	12.66	0.03	94.70
	1526B_3H-5_8-10_13	3.82	3.38	1.39	71.75	0.15	0.13	0.96	0.04	12.25	0.01	93.87
	1526B_3H-5_8-10_14	3.64	3.20	1.53	72.28	0.18	0.15	1.45	0.02	12.54	0.01	95.00
	1526B_3H-5_8-10_15	4.02	3.80	1.17	73.14	0.14	0.08	0.91	0.02	12.52	0.01	95.81
	1526B_3H-5_8-10_16	3.51	3.51	1.17	70.50	0.12	0.12	0.97	0.08	12.03	0.01	92.01
	1526B_3H-5_8-10_17	3.96	3.28	1.44	70.97	0.17	0.16	1.31	0.02	12.86	0.02	94.19
	1526B_3H-5_8-10_18	3.91	3.59	1.18	72.58	0.12	0.09	0.96	0.02	12.04	0.00	94.49
	1526B_3H-5_8-10_19	3.79	3.50	1.26	72.43	0.13	0.10	0.93	0.09	12.06	0.03	94.31
	1526B_3H-5_8-10_20	3.79	3.47	1.28	71.53	0.14	0.11	0.98	0.00	12.29	0.03	93.63
	s69 1526B_3H-5_51-53_1	3.42	3.62	1.05	73.70	0.10	0.09	0.89	0.02	11.78	0.00	94.67
	1526B_3H-5_51-53_2	3.43	3.70	1.10	74.60	0.10	0.08	0.88	0.03	11.94	0.05	95.92
	1526B_3H-5_51-53_3	3.43	3.79	1.08	74.66	0.12	0.08	0.88	0.06	11.96	0.01	96.07
	1526B_3H-5_51-53_4	3.71	3.63	1.13	73.82	0.11	0.07	0.89	0.07	11.96	0.03	95.41
	1526B_3H-5_51-53_5	3.45	3.54	1.14	73.41	0.11	0.07	0.93	0.09	11.96	0.05	94.75
	1526B_3H-5_51-53_7	3.23	4.07	1.11	73.48	0.12	0.08	0.85	0.07	12.14	0.02	95.17
	1526B_3H-5_51-53_8	3.30	3.60	0.98	74.09	0.13	0.07	0.91	0.03	11.92	0.00	95.03
	1526B_3H-5_51-53_9	3.28	3.69	1.05	73.70	0.11	0.09	0.92	0.00	12.04	0.01	94.90
	1526B_3H-5_51-53_10	3.40	3.89	0.86	74.65	0.11	0.01	0.77	0.02	11.67	0.01	95.40
	1526B_3H-5_51-53_11	3.52	3.76	1.19	73.23	0.10	0.15	0.83	0.00	12.13	0.02	94.93
	1526B_3H-5_51-53_12	3.33	3.63	1.08	73.97	0.11	0.09	0.85	0.00	11.89	0.03	94.99
	1526B_3H-5_51-53_13	3.36	3.78	0.92	73.68	0.10	0.09	0.85	0.04	11.84	0.00	94.65
	1526B_3H-5_51-53_14	3.72	3.41	1.05	74.20	0.11	0.15	1.01	0.07	11.99	0.02	95.73
	1526B_3H-5_51-53_15	3.30	3.99	0.97	73.51	0.08	0.06	0.88	0.03	11.79	0.03	94.65
	1526B_3H-5_51-53_16	3.39	3.63	1.00	73.56	0.09	0.12	0.86	0.03	12.29	0.05	95.02
	1526B_3H-5_51-53_17	3.53	3.51	0.93	73.62	0.11	0.09	0.87	0.00	11.82	0.00	94.49
	1526B_3H-5_51-53_18	3.40	3.59	1.09	73.76	0.14	0.07	0.85	0.06	11.70	0.02	94.68
	1526B_3H-5_51-53_19	3.42	3.68	1.16	74.05	0.10	0.10	0.88	0.00	11.93	0.03	95.35
	1526B_3H-5_51-53_20	3.54	3.74	0.99	73.31	0.09	0.05	0.85	0.03	11.92	0.01	94.53
	1526B_3H-5_83-85_2	3.68	3.45	1.09	73.16	0.15	0.09	0.98	0.10	11.81	0.00	94.51
	1526B_3H-5_83-85_3	4.34	3.15	1.79	71.21	0.25	0.14	1.78	0.04	14.01	0.02	96.72
	1526B_3H-5_83-85_4	3.50	3.57	1.20	74.81	0.15	0.09	1.06	0.04	11.97	0.05	96.44
	1526B_3H-5_83-85_5	3.52	3.81	0.98	75.35	0.07	0.05	0.78	0.07	12.17	0.03	96.84
	1526B_3H-5_83-85_6	3.36	3.70	1.15	73.71	0.07	0.01	1.00	0.04	12.13	0.04	95.21
	1526B_3H-5_83-85_7	3.44	3.70	1.25	73.30	0.12	0.12	0.91	0.01	11.83	0.03	94.70
	1526B_3H-5_83-85_8	3.39	3.75	1.01	73.74	0.11	0.11	0.89	0.07	11.75	0.03	94.85
	1526B_3H-5_83-85_9	3.23	3.85	1.02	73.48	0.12	0.09	0.94	0.00	11.90	0.02	94.65
	1526B_3H-5_83-85_10	3.43	3.76	0.99	74.15	0.07	0.10	0.97	0.06	12.28	0.05	95.85
	1526B_3H-5_83-85_11	3.50	3.60	1.18	73.60	0.13	0.07	0.95	0.00	11.71	0.02	94.76
	1526B_3H-5_83-85_12	3.55	3.48	1.04	74.27	0.13	0.11	1.02	0.08	11.95	0.02	95.64
	1526B_3H-5_83-85_13	3.55	3.57	1.06	73.71	0.11	0.10	1.01	0.10	11.88	0.02	95.11
	1526B_3H-5_83-85_14	3.40	3.71	1.11	73.29	0.13	0.08	0.93	0.05	11.83	0.00	94.52
	1526B_3H-5_83-85_15	3.57	3.77	0.97	73.71	0.09	0.12	0.89	0.03	11.82	0.01	94.98
	1526B_3H-5_83-85_16	3.41	3.51	1.14	73.23	0.17	0.13	0.98	0.07	11.91	0.02	94.56
	1526B_3H-5_83-85_17	3.79	3.59	1.02	73.77	0.12	0.05	0.80	0.04	11.81	0.00	95.00
	1526B_3H-5_83-85_18	3.65	2.90	1.88	71.58	0.16	0.20	1.74	0.12	12.65	0.02	94.90
	1526B_3H-5_83-85_19	3.48	3.86	0.97	73.59	0.08	0.08	0.61	0.00	11.77	0.00	94.45
	1526B_3H-5_83-85_20	3.83	3.35	1.20	74.32	0.10	0.08	1.00	0.07	12.14	0.00	96.08
	1526B_4H-1_73-75_8	3.65	1.24	6.94	56.06	0.66	3.97	6.04	0.14	14.02	0.12	92.84
	1526B_4H-1_73-75_11	3.82	3.59	0.95	73.89	0.06	0.05	0.61	0.05	11.84	0.02	94.88
	1526B_4H-1_73-75_13	3.65	1.95	6.89	61.86	0.99	2.33	5.01	0.08	15.75	0.21	98.72
	1526B_4H-1_73-75_14	4.35	1.45	5.79	61.15	0.79	1.57	5.83	0.08	17.88	0.13	99.01
	1526B_4H-1_73-75_15	2.91	4.67	0.99	75.57	0.13	0.09	0.87	0.02	12.04	0.01	97.30
	1526B_4H-1_73-75_16	4.08	2.36	3.50	68.77	0.58	0.98	3.54	0.09	15.15	0.16	99.22
	1526B_4H-1_73-75_17	4.03	3.52	1.08	74.68	0.09	0.05	0.66	0.05	11.55	0.01	95.73
	1526B_4H-1_73-75_19	3.96	3.46	1.17	74.64	0.09	0.05	0.69	0.01	11.81	0.02	95.90
	1526B_4H-1_99-101_1	3.91	3.05	1.69	71.21	0.13	0.08	1.05	0.00	12.47	0.00	93.59
	1526B_4H-1_99-101_2	3.42	3.55	2.06	68.55	0.20	0.15	1.38	0.05	12.75	0.01	92.13
	1526B_4H-1_99-101_3	3.87	2.90	1.85	70.51	0.17	0.11	0.99	0.11	12.11	0.00	92.61
	1526B_4H-1_99-101_4	3.77	3.41	1.79	72.03	0.12	0.09	1.47	0.01	12.74	0.03	95.46
	1526B_4H-1_99-101_5	4.00	3.25	1.61	71.85	0.17	0.07	1.06	0.07	12.23	0.02	94.33
	1526B_4H-1_99-101_6	4.43	2.97	1.96	72.68	0.14	0.09	1.05	0.05	12.56	0.05	95.99
	1526B_4H-1_99-101_7	4.16	3.19	1.77	72.06	0.15	0.10	1.04	0.06	12.49	0.01	95.03
	1526B_4H-1_99-101_8	4.27	2.98	2.45	71.29	0.21	0.15	1.58	0.06	13.16	0.03	96.18

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s84*	1526B_4H-1_99-101_9	4.17	3.02	1.79	72.27	0.16	0.11	1.05	0.11	12.73	0.03	95.44
	1526B_4H-1_99-101_10	4.59	2.83	2.24	71.20	0.18	0.16	1.32	0.10	13.13	0.00	95.75
	1526B_4H-1_99-101_11	3.82	3.13	1.60	71.13	0.14	0.11	1.04	0.05	12.42	0.04	93.49
	1526B_4H-1_99-101_12	4.04	2.98	1.85	71.90	0.20	0.11	1.02	0.08	12.58	0.01	94.77
	1526B_4H-1_99-101_13	3.69	3.46	1.35	74.69	0.09	0.07	0.97	0.02	12.12	0.03	96.50
	1526B_4H-1_99-101_14	4.30	2.98	2.14	72.06	0.16	0.11	1.01	0.02	12.67	0.01	95.46
	1526B_4H-1_99-101_15	4.05	3.09	1.99	72.50	0.14	0.12	1.00	0.06	12.44	0.01	95.40
	1526B_4H-1_99-101_16	3.84	3.61	1.14	73.78	0.10	0.03	0.76	0.06	12.17	0.04	95.53
	1526B_4H-1_99-101_17	4.00	3.27	1.50	72.68	0.14	0.03	0.79	0.14	12.43	0.04	95.01
	1526B_4H-1_99-101_18	3.98	3.01	1.30	76.48	0.15	0.09	1.16	0.03	12.43	0.02	98.65
	1526B_4H-1_99-101_19	4.03	3.13	1.85	71.56	0.11	0.10	1.03	0.05	12.47	0.02	94.35
	1526B_4H-1_99-101_20	4.31	3.14	1.89	72.24	0.17	0.11	1.13	0.05	12.57	0.03	95.63
	1526B_4H-1_103-105_2	4.28	3.34	1.97	71.63	0.17	0.15	1.09	0.04	12.94	0.01	95.60
	1526B_4H-1_103-105_4	4.01	3.38	1.61	71.98	0.13	0.03	0.88	0.09	12.40	0.01	94.51
	1526B_4H-1_103-105_5	4.27	3.30	1.86	71.49	0.14	0.04	1.01	0.07	12.70	0.03	94.90
	1526B_4H-1_103-105_6	4.00	3.31	1.79	73.13	0.16	0.06	0.83	0.12	11.88	0.02	95.29
	1526B_4H-1_103-105_8	4.31	3.38	2.25	71.58	0.15	0.11	1.17	0.10	13.32	0.00	96.37
	1526B_4H-1_103-105_9	3.45	4.45	0.94	74.10	0.08	0.03	0.64	0.05	11.89	0.01	95.63
	1526B_4H-1_103-105_10	3.64	3.65	1.04	73.79	0.11	0.06	0.89	0.06	12.26	0.02	95.54
	1526B_4H-1_103-105_11	4.28	3.22	2.38	70.48	0.22	0.16	1.34	0.03	13.31	0.03	95.45
	1526B_4H-1_103-105_12	4.19	3.26	1.45	73.51	0.11	0.03	0.79	0.09	11.79	0.00	95.22
s89*	1526B_4H-1_103-105_13	4.43	3.20	2.34	69.42	0.27	0.31	1.74	0.02	13.88	0.04	95.66
	1526B_4H-1_103-105_14	4.10	3.39	1.46	74.67	0.10	0.03	0.68	0.07	11.95	0.02	96.46
	1526B_4H-1_103-105_15	3.80	3.51	1.10	74.37	0.11	0.07	0.69	0.03	11.61	0.00	95.29
	1526B_4H-1_103-105_16	4.38	3.34	2.18	70.85	0.13	0.12	1.03	0.12	12.58	0.00	94.74
	1526B_4H-1_103-105_17	4.70	3.21	2.07	71.45	0.19	0.12	1.15	0.07	13.21	0.02	96.19
	1526B_4H-1_103-105_18	4.13	3.21	1.65	73.02	0.13	0.05	0.69	0.15	11.70	0.00	94.73
	1526B_4H-1_103-105_19	4.24	2.73	2.62	69.55	0.27	0.25	1.91	0.01	13.34	0.03	94.95
	1526B_4H-1_103-105_20	3.65	3.63	1.18	73.70	0.10	0.09	0.93	0.00	12.20	0.01	95.48
	1526B_4H-2_57-59_1	3.21	3.68	1.58	70.13	0.17	0.15	1.33	0.04	12.54	0.01	92.85
	1526B_4H-2_57-59_2	4.42	2.88	2.93	67.70	0.39	0.43	2.07	0.12	14.01	0.08	95.03
	1526B_4H-2_57-59_3	3.77	3.30	1.30	72.61	0.16	0.11	1.11	0.00	12.34	0.03	94.73
	1526B_4H-2_57-59_4	4.16	3.06	2.03	69.05	0.16	0.09	1.33	0.02	12.85	0.01	92.77
	1526B_4H-2_57-59_5	4.30	3.21	2.25	70.85	0.20	0.12	1.37	0.00	13.43	0.03	95.76
	1526B_4H-2_57-59_6	3.34	3.50	1.29	73.74	0.04	0.04	0.92	0.01	11.99	0.02	94.88
	1526B_4H-2_57-59_7	3.00	4.36	1.61	72.48	0.20	0.19	1.30	0.07	12.25	0.04	95.50
	1526B_4H-2_57-59_8	3.57	3.51	1.28	73.48	0.09	0.04	0.95	0.05	12.08	0.01	95.06
	1526B_4H-2_57-59_9	3.56	3.73	1.15	73.69	0.06	0.03	0.91	0.00	12.05	0.00	95.19
	1526B_4H-2_57-59_10	3.67	3.59	0.87	73.01	0.07	0.01	0.86	0.02	11.92	0.00	94.02
	1526B_4H-2_57-59_11	4.31	3.25	2.17	71.62	0.18	0.12	1.14	0.10	12.98	0.03	95.89
	1526B_4H-2_57-59_12	3.90	3.31	1.33	72.71	0.13	0.13	1.14	0.03	12.64	0.04	95.36
	1526B_4H-2_57-59_13	4.44	3.34	2.28	70.68	0.21	0.15	1.31	0.04	13.43	0.02	95.91
	1526B_4H-2_57-59_14	3.73	3.11	3.62	68.44	0.81	0.58	2.10	0.06	12.75	0.12	95.31
	1526B_4H-2_57-59_15	4.25	3.28	2.21	70.80	0.17	0.16	1.21	0.05	13.26	0.02	95.40
	1526B_4H-2_57-59_16	3.60	3.48	1.30	73.63	0.05	0.04	0.96	0.01	11.91	0.01	95.00
	1526B_4H-2_57-59_17	3.76	3.25	1.29	74.28	0.06	0.04	0.65	0.05	11.70	0.00	95.08
	1526B_4H-2_57-59_18	3.52	3.51	1.06	74.06	0.06	0.03	0.85	0.07	11.88	0.00	95.05
	1526B_4H-2_57-59_19	3.09	3.53	1.16	73.38	0.05	0.03	1.00	0.05	11.97	0.00	94.26
	1526B_4H-2_57-59_20	3.57	3.60	1.38	73.68	0.09	0.03	0.67	0.07	11.81	0.02	94.92
	1526B_4H-2_57-59_3	4.22	3.29	1.93	69.24	0.13	0.06	0.99	0.04	12.64	0.00	92.54
	1526B_4H-2_57-59_7	3.49	3.43	1.19	71.05	0.05	0.03	0.91	0.09	11.80	0.01	92.05
	1526B_4H-2_57-59_8	3.50	3.59	1.15	71.86	0.08	0.03	0.83	0.03	11.84	0.00	92.90
	1526B_4H-2_57-59_9	4.52	3.32	2.06	69.63	0.16	0.05	1.00	0.06	12.91	0.00	93.71
	1526B_4H-2_57-59_11	4.33	3.28	2.01	68.37	0.11	0.09	0.92	0.06	12.67	0.01	91.85
	1526B_4H-2_57-59_6	3.66	3.47	1.34	71.50	0.06	0.02	0.93	0.05	11.69	0.01	92.73
	1526B_4H-2_57-59_10	4.06	2.70	1.36	70.20	0.21	0.25	1.35	0.07	12.03	0.04	92.26
	1526B_4H-2_63-65_1	3.75	3.38	1.17	74.25	0.06	0.02	0.97	0.00	12.25	0.00	95.85
	1526B_4H-2_63-65_2	4.32	3.22	1.93	71.37	0.20	0.15	1.19	0.03	13.37	0.06	95.83
	1526B_4H-2_63-65_3	4.33	3.29	1.95	71.14	0.15	0.11	1.15	0.05	13.25	0.01	95.43
	1526B_4H-2_63-65_4	3.62	3.88	1.07	75.01	0.12	0.09	0.85	0.08	11.68	0.01	96.41
	1526B_4H-2_63-65_5	3.47	3.55	0.93	73.76	0.06	0.04	0.87	0.02	11.96	0.00	94.67
	1526B_4H-2_63-65_6	4.30	3.13	2.33	70.18	0.23	0.21	1.42	0.13	13.63	0.02	95.59
	1526B_4H-2_63-65_7	4.24	3.37	1.83	72.35	0.14	0.09	1.09	0.12	12.94	0.00	96.17
	1526B_4H-2_63-65_8	4.59	3.27	2.25	70.96	0.18	0.10	1.18	0.02	13.28	0.01	95.83
	1526B_4H-2_63-65_9	3.50	3.80	1.08	73.87	0.11	0.05	0.83	0.05	11.81	0.00	95.09
	1526B_4H-2_63-65_10	3.38	3.60	1.26	74.40	0.05	0.02	0.94	0.04	11.73	0.02	95.43
	1526B_4H-2_63-65_11	4.54	2.49	1.84	71.10	0.31	0.29	1.35	0.10	12.90	0.04	94.95
	1526B_4H-2_63-65_12	3.85	3.33	1.35	72.41	0.19	0.10	1.08	0.03	12.56	0.00	94.90
	1526B_4H-2_63-65_13	3.55	3.32	1.34	72.15	0.16	0.15	1.17	0.03	12.65	0.05	94.56
	1526B_4H-2_63-65_14	3.34	3.72	1.13	73.93	0.07	0.00	0.85	0.02	11.96	0.00	95.02

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1526B_4H-2_63-65_15	3.85	3.03	2.07	69.46	0.19	0.16	1.29	0.08	12.99	0.01	93.12
	1526B_4H-2_63-65_16	3.84	3.30	1.37	72.91	0.15	0.16	1.20	0.05	12.82	0.01	95.81
	1526B_4H-2_63-65_17	3.94	2.86	1.59	72.47	0.14	0.18	1.45	0.09	12.60	0.06	95.37
	1526B_4H-2_63-65_18	4.38	3.27	2.37	70.49	0.17	0.11	1.31	0.11	13.26	0.01	95.48
	1526B_4H-2_63-65_19	4.41	3.25	2.20	71.31	0.22	0.18	1.23	0.09	13.24	0.00	96.12
	1526B_4H-2_63-65_20	3.63	3.55	1.18	73.56	0.07	0.03	0.83	0.04	12.07	0.00	94.96

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

Sample name	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1526A_2R-CC_28-29_1	38.50	9.31	1.92	0.55	114.96	79.41	30.93	184.68	9.64	5.42	726.29	27.89	58.04	6.64	24.46
1526A_2R-CC_28-29_5	44.97	10.51	1.85	0.54	116.48	82.13	34.78	223.39	10.35	5.79	793.92	28.7	62.97	7.31	28.75
1526A_2R-CC_28-29_6	27.17	11.07	2.58	0.87	97.92	117.08	29.50	266.06	9.55	4.83	690.22	25.9	53.16	6.13	26.17
1526A_2R-CC_28-29_9	45.16	9.32	1.93	0.68	115.52	81.30	28.92	165.86	8.42	5.65	744.41	25.36	52.36	6.2	23.02
1526A_2R-CC_28-29_11	44.07	10.19	2.19	0.62	122.15	77.98	32.48	211.38	10.21	5.65	749.07	27.83	59.82	6.97	26.65
1526B_1H-1_93-95_2	42.05	8.85	2.64	0.37	116.74	83.18	24.30	101.57	7.62	4.93	914.91	24.74	50.04	5.67	21.04
1526B_1H-1_93-95_7	39.64	9.09	2.76	0.48	118.39	79.94	23.99	99.29	7.80	5.08	877.46	23.98	48.11	5.35	19.95
1526B_1H-1_93-95_8	38.97	7.96	2.66	0.46	108.79	78.81	22.44	94.21	7.19	4.56	849.56	23.1	46.82	5.16	18.69
1526B_1H-1_93-95_10	40.08	8.55	2.42	0.44	111.70	82.49	23.63	100.47	7.71	4.90	888.17	24.31	47.99	5.31	18.81
1526B_1H-1_93-95_11	45.88	8.82	2.41	0.45	113.98	81.43	24.69	103.97	7.89	4.98	914.82	24.97	49.73	5.59	21.19
1526B_2H-1_94-96_1	48.79	10.32	2.41	0.37	145.23	52.59	19.40	70.50	7.04	6.94	807.45	25.13	49.66	5.21	15.43
1526B_2H-1_94-96_5	48.25	10.52	2.46	1.27	140.20	69.22	16.80	91.38	5.72	7.21	721.28	20.73	41.52	4.43	14.59
1526B_2H-1_94-96_6	49.12	10.33	2.97	0.77	141.39	69.76	17.74	98.28	5.93	7.28	751.35	21.98	42.01	4.4	16.09
1526B_2H-1_94-96_9	43.89	11.09	4.81	0.99	150.19	82.90	18.14	99.74	5.44	7.52	714.27	23.17	46.94	4.72	15.49
1526B_2H-1_94-96_10	47.54	8.86	2.14	0.67	129.65	52.17	22.96	83.87	6.42	6.25	710.62	24.23	50.27	5.26	19.28
1526B_2H-2_92-93cm_3	38.26	7.03	4.84	0.19	114.68	39.12	32.71	115.74	8.14	4.93	706.03	26.71	58.58	6.88	27.08
1526B_2H-2_92-93cm_6	43.79	8.10	2.44	0.34	131.46	35.89	35.27	111.44	9.07	5.70	759.51	29.09	62.32	7.09	28.75
1526B_2H-2_92-93cm_8	41.79	6.86	2.22	0.28	123.78	30.80	30.12	99.89	8.31	5.67	687.07	25.65	55.3	6.31	24.19
1526B_2H-6_78-80_1	52.31	9.45	2.18	0.77	161.53	55.00	18.73	98.55	7.07	7.39	843.20	23.55	46.03	4.7	16.3
1526B_2H-6_78-80_2	43.81	8.18	1.92	0.54	143.26	53.16	16.82	88.37	6.11	6.70	761.36	20.92	40.75	4.22	15.08
1526B_2H-6_78-80_5	49.52	9.51	1.89	0.78	149.68	53.08	18.24	99.37	7.02	7.54	856.26	23.14	46.86	4.82	16.46
1526B_2H-6_78-80_6	44.90	8.75	2.32	0.73	157.53	57.79	17.43	98.61	6.67	7.56	831.01	23	44.3	4.6	15.16
1526B_3H-2_85-87_1	29.72	9.83	2.06	1.01	96.97	139.31	30.90	266.41	8.81	4.74	704.56	24.43	51.84	6.05	22.94
1526B_3H-2_85-87_2	34.35	10.08	1.98	0.84	100.02	118.04	28.80	247.21	8.59	4.83	703.03	23.95	49.61	5.71	22.91
1526B_3H-2_85-87_3	31.76	10.85	2.45	1.71	107.04	135.95	30.02	249.93	9.40	5.35	723.79	24.57	51.15	6.15	24.1
1526B_3H-2_85-87_7	35.01	10.09	2.09	1.03	101.41	116.01	28.69	248.08	8.98	4.86	710.84	24.07	50.39	5.88	24.01
1526B_3H-2_85-87_9	26.56	9.23	2.07	1.79	76.69	129.51	24.31	203.59	7.35	3.88	572.09	19.63	40.56	4.88	17.84
1526B_3H-5_1-3_1	21.79	4.61	1.39	0.39	74.20	41.05	13.88	72.84	4.66	3.38	434.38	14.65		3.31	11.86
1526B_3H-5_1-3_2	4.48	5.13	5.93	1.92	71.04	55.78	14.87	67.37	4.02	3.50	425.19	13.11	25.7	2.91	10.41
1526B_3H-5_1-3_3	38.72	9.40	2.38	1.14	122.30	89.64	26.14	206.68	8.55	5.83	730.93	25.38	51.81	5.73	21.63
1526B_3H-5_1-3_7	32.63	10.37	1.74	0.77	101.78	92.90	27.09	190.11	8.04	5.22	672.44	23.41	47.67	5.69	23.91
1526B_3H-5_1-3_10	43.30	10.29	2.43	1.20	131.57	95.49	28.04	223.31	9.02	6.06	764.49	26.25	54.83	6.03	24.71
1526B_4H-2_57-59_3	38.21	13.04	1.87	4.64	122.74	68.86	36.74	229.84	10.56	7.00	835.08	30.45	63.5	7.37	26.67
1526B_4H-2_57-59_7	57.29	11.46	2.20	0.27	130.29	62.28	25.44	89.83	6.46	7.48	848.40	26.55	54.69	6.02	22.69
1526B_4H-2_57-59_8	61.02	10.90	2.67	0.19	136.28	55.51	26.37	83.99	6.73	7.53	861.58	25.62	54.14	5.94	22.15
1526B_4H-2_57-59_9	39.30	11.90	1.75	0.21	107.61	63.94	33.04	253.67	9.75	5.85	773.51	28.2	58.41	6.7	27.98
1526B_4H-2_57-59_11	36.62	10.91	2.68	1.11	101.32	60.31	27.93	195.97	8.88	5.43	630.35	23.17	49.98	5.75	22.59

Appendix A

Supplementary Table S12: Individual glass shard analyses of Quaternary marine tephra layers, IODP Exp. 375 - Site U1526.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1526A_2R-CC_28-29_1	5.16	0.89	4.77	0.83	5.13	1.15	3.23	0.41	3.42	0.62	5.58	0.765	18.88	12.45	2.93
1526A_2R-CC_28-29_5	5.63	0.95	6.16	1.10	5.22	1.17	3.67	0.47	3.61	0.55	6.70	0.921	21.27	12.97	3.27
1526A_2R-CC_28-29_6	5.80	0.97	5.85	0.79	6.18	1.23	3.34	0.52	3.31	0.60	6.54	0.668	18.4	10.88	2.76
1526A_2R-CC_28-29_9	5.38	0.88	4.39	0.76	5.56	1.19	3.05	0.47	3.42	0.49	5.21	0.607	19.36	11.68	2.66
1526A_2R-CC_28-29_11	5.52	0.85	4.93	0.89	5.67	1.16	3.53	0.54	3.90	0.55	5.99	0.81	21.19	12.32	2.86
1526B_1H-1_93-95_2	4.26	0.87	3.44	0.62	4.16	0.83	2.67	0.39	2.73	0.38	3.36	0.581	15.21	10.36	2.36
1526B_1H-1_93-95_7	3.93	0.76	3.75	0.61	3.93	0.81	2.45	0.37	2.89	0.41	3.49	0.634	16.56	10.12	2.46
1526B_1H-1_93-95_8	3.92	0.76	3.65	0.52	3.52	0.76	2.49	0.35	2.66	0.40	3.20	0.562	15.14	9.33	2.2
1526B_1H-1_93-95_10	4.44	0.70	3.50	0.56	3.77	0.81	2.34	0.36	2.59	0.42	3.29	0.593	15.25	9.77	2.42
1526B_1H-1_93-95_11	4.03	0.83	4.14	0.58	4.30	0.83	2.68	0.42	2.73	0.45	3.21	0.66	16.67	10.53	2.5
1526B_2H-1_94-96_1	3.40	0.43	2.87	0.47	2.81	0.60	1.99	0.32	2.55	0.36	2.80	0.704	17.8	14.22	3.39
1526B_2H-1_94-96_5	2.76	0.34	2.69	0.43	2.45	0.64	1.85	0.26	2.38	0.31	2.76	0.521	13.45	13.13	2.76
1526B_2H-1_94-96_6	3.12	0.42	2.61	0.43	2.65	0.61	1.71	0.28	2.16	0.36	3.28	0.605	13.64	13.32	3.09
1526B_2H-1_94-96_9	2.83	0.40	2.29	0.43	2.42	0.90	1.70	0.17	2.24	0.35	2.73	0.584	17.51	12.98	2.7
1526B_2H-1_94-96_10	3.97	0.47	3.51	0.51	3.56	0.76	2.50	0.40	2.67	0.41	3.05	0.592	15.26	11.31	2.85
1526B_2H-2_92-93cm_3	5.62	0.63	5.39	0.75	4.88	1.52	3.92	0.46	3.87	0.52	4.52	0.83	19.25	12.7	2.77
1526B_2H-2_92-93cm_6	6.22	0.73	4.68	1.01	5.84	1.28	4.10	0.55	4.07	0.63	3.73	0.832	19.81	12.96	3.23
1526B_2H-2_92-93cm_8	4.99	0.46	5.11	0.81	5.19	1.16	3.20	0.50	3.67	0.57	3.87	0.679	17.9	11.47	2.86
1526B_2H-6_78-80_1	3.41	0.41	2.78	0.44	2.67	0.62	1.99	0.29	2.19	0.36	3.30	0.689	19.6	14.95	3.77
1526B_2H-6_78-80_2	3.01	0.40	2.65	0.40	2.65	0.61	1.77	0.27	2.10	0.34	3.01	0.609	16.46	13.24	3.2
1526B_2H-6_78-80_5	3.92	0.41	2.78	0.39	3.11	0.63	1.64	0.31	2.39	0.38	3.50	0.697	17.89	14.78	3.61
1526B_2H-6_78-80_6	2.96	0.44	2.50	0.41	2.98	0.61	1.55	0.30	2.17	0.35	3.14	0.638	17.52	14.13	3.34
1526B_3H-2_85-87_1	5.77	1.43	5.23	0.84	5.43	1.11	3.50	0.62	2.25	0.54	7.00	0.57	15.6	12.14	2.19
1526B_3H-2_85-87_2	5.11	1.11	5.25	0.83	5.55	0.94	3.51	0.47	3.36	0.53	6.27	0.657	14.75	10.1	2.4
1526B_3H-2_85-87_3	5.09	1.08	5.21	0.81	4.79	1.09	3.28	0.50	3.45	0.50	6.61	0.589	15.58	9.67	2.42
1526B_3H-2_85-87_7	4.69	0.99	5.33	0.81	4.79	1.16	3.27	0.49	3.40	0.52	6.74	0.61	14.99	10.1	2.43
1526B_3H-2_85-87_9	4.55	0.85	3.97	0.75	3.85	0.98	2.61	0.33	2.87	0.42	5.37	0.595	11.03	8.16	1.82
1526B_3H-5_1-3_1	2.39	0.37	2.50	0.33	2.20	0.44	1.55	0.23	1.53	0.26	2.55	0.383	10.19	6.96	1.622
1526B_3H-5_1-3_2	2.68	0.40	2.40	0.31	2.45	0.61	1.82	0.23	1.53	0.29	1.40	0.33	9.59	4.88	1.3
1526B_3H-5_1-3_3	4.54	0.76	4.44	0.67	4.46	0.90	2.48	0.42	2.94	0.39	5.42	0.672	18.16	11.39	2.74
1526B_3H-5_1-3_7	4.38	0.82	4.89	0.71	5.01	0.96	2.86	0.47	3.13	0.52	6.27	0.576	18.03	10.62	2.53
1526B_3H-5_1-3_10	4.79	0.86	4.63	0.71	4.38	1.06	3.01	0.46	2.95	0.46	5.90	0.656	18.69	12.52	3
1526B_4H-2_57-59_3	4.97	1.20	6.20	0.98	6.21	1.30	4.53	0.59	3.78	0.72	6.98	0.876	20.47	13.8	3.29
1526B_4H-2_57-59_7	4.16	0.57	4.44	0.77	4.62	0.98	2.49	0.40	2.86	0.42	3.63	0.707	19.93	12.69	3.04
1526B_4H-2_57-59_8	5.12	0.52	4.90	0.86	4.43	0.98	3.14	0.37	2.47	0.44	3.42	0.621	19.67	12.18	3.13
1526B_4H-2_57-59_9	6.06	0.74	4.97	0.97	6.12	1.21	3.70	0.60	3.69	0.58	7.15	0.662	19.37	11.69	2.89
1526B_4H-2_57-59_11	4.91	0.87	4.45	0.78	5.06	1.01	3.13	0.45	3.26	0.48	5.25	0.575	16.36	10.62	2.5

Appendix A

Supplementary Table S13: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1122.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s10	1122A_1H-4_20-22_1	3.73	3.29	0.95	74.80	0.16	0.15	0.98	0.02	11.83	0.00	95.91
	1122A_1H-4_20-22_2	3.99	2.84	1.16	73.45	0.13	0.14	0.93	0.10	11.69	0.05	94.49
	1122A_1H-4_20-22_4	3.97	2.91	1.17	73.16	0.09	0.10	0.96	0.05	11.86	0.01	94.28
	1122A_1H-4_26-28_1	4.25	2.66	1.09	72.43	0.12	0.07	1.09	0.03	11.91	0.02	93.66
	1122A_1H-4_26-28_2	4.19	2.66	1.17	73.10	0.14	0.11	1.04	0.05	11.85	0.03	94.35
	1122A_1H-4_26-28_3	4.28	2.75	1.16	72.86	0.11	0.11	0.97	0.13	11.62	0.00	93.98
	1122A_1H-4_26-28_4	3.88	2.98	1.17	71.58	0.09	0.09	0.94	0.03	11.53	0.00	92.29
	1122A_1H-4_26-28_5	4.16	2.94	1.12	74.09	0.12	0.09	0.96	0.00	11.96	0.00	95.44
	1122A_1H-4_26-28_6	4.38	2.63	1.19	72.95	0.13	0.12	1.07	0.09	11.83	0.00	94.38
	1122A_1H-4_26-28_7	4.53	2.93	1.13	75.03	0.12	0.10	0.98	0.05	11.94	0.00	96.81
	1122A_1H-4_26-28_8	4.44	2.84	1.13	73.66	0.10	0.11	0.98	0.08	11.80	0.01	95.15
	1122A_1H-4_26-28_9	4.00	2.80	1.14	71.39	0.13	0.14	0.93	0.00	11.72	0.02	92.27
	1122A_1H-4_26-28_10	4.01	2.65	1.11	71.29	0.09	0.13	1.10	0.00	11.69	0.02	92.08
	1122A_1H-4_26-28_11	3.90	2.65	1.17	71.75	0.11	0.12	1.07	0.00	11.73	0.00	92.50
	1122A_1H-4_26-28_12	4.15	2.88	1.04	72.63	0.11	0.13	0.96	0.00	11.70	0.01	93.60
	1122A_1H-4_26-28_13	4.22	2.89	1.07	72.83	0.11	0.09	1.01	0.01	11.65	0.00	93.89
	1122A_1H-4_26-28_14	4.32	2.72	1.22	72.50	0.14	0.14	1.05	0.06	11.68	0.05	93.87
	1122A_1H-4_26-28_15	4.19	2.63	1.04	73.30	0.13	0.09	1.09	0.03	11.90	0.00	94.41
	1122A_1H-4_26-28_16	4.14	2.65	1.11	73.24	0.14	0.09	1.01	0.02	11.91	0.02	94.33
	1122A_1H-4_26-28_17	4.10	2.86	1.20	71.98	0.09	0.09	0.95	0.07	11.54	0.03	92.91
s41	1122A_1H-4_26-28_18	4.06	2.61	1.12	72.04	0.14	0.10	1.05	0.07	11.59	0.01	92.79
	1122A_1H-4_26-28_19	3.87	3.69	1.05	72.11	0.10	0.09	0.64	0.05	11.49	0.03	93.12
	1122A_1H-4_26-28_20	4.11	2.87	1.10	72.42	0.11	0.09	0.98	0.02	11.74	0.01	93.45
	1122C_37X-1_37-38_1	4.54	3.09	1.53	71.19	0.12	0.07	0.92	0.12	12.11	0.00	93.68
	1122C_37X-1_37-38_2	4.36	3.13	1.57	70.66	0.13	0.08	0.97	0.02	12.03	0.00	92.95
	1122C_37X-1_37-38_3	4.58	3.17	1.66	70.59	0.12	0.09	0.94	0.12	12.21	0.01	93.49
	1122C_37X-1_37-38_4	4.70	2.98	1.47	70.88	0.14	0.10	0.94	0.07	11.89	0.00	93.18
	1122C_37X-1_37-38_5	4.57	3.15	1.76	71.09	0.14	0.07	0.97	0.07	12.09	0.01	93.92
	1122C_37X-1_37-38_6	4.42	3.04	1.48	71.80	0.14	0.07	0.98	0.06	12.33	0.03	94.36
	1122C_37X-1_37-38_7	4.21	2.97	1.45	69.85	0.16	0.10	0.93	0.04	11.84	0.01	91.57
	1122C_37X-1_37-38_8	4.80	2.71	1.73	69.90	0.18	0.18	1.29	0.02	12.53	0.05	93.40
	1122C_37X-1_37-38_9	4.61	3.06	1.49	71.03	0.11	0.12	0.91	0.15	12.29	0.01	93.77
	1122C_37X-1_37-38_10	4.28	3.19	1.62	71.19	0.15	0.12	0.95	0.03	12.28	0.00	93.80
	1122C_37X-1_37-38_11	4.43	3.16	1.57	70.67	0.14	0.08	0.92	0.10	11.95	0.04	93.07
	1122C_37X-1_37-38_12	4.26	3.15	1.57	70.90	0.09	0.07	0.94	0.04	11.78	0.00	92.80
	1122C_37X-1_37-38_13	4.21	3.02	1.36	70.27	0.12	0.12	0.96	0.01	11.76	0.00	91.84
	1122C_37X-1_37-38_14	4.00	3.40	1.40	70.51	0.13	0.10	0.86	0.04	11.89	0.00	92.33
	1122C_37X-1_37-38_15	4.34	3.26	1.33	70.87	0.10	0.07	0.88	0.08	11.79	0.00	92.72
	1122C_37X-1_37-38_16	4.52	3.17	1.56	71.36	0.13	0.13	0.97	0.10	11.79	0.03	93.76
	1122C_37X-1_37-38_17	4.24	3.11	1.49	71.48	0.10	0.08	0.93	0.05	12.06	0.00	93.55
s86	1122C_37X-1_37-38_18	4.64	3.19	1.65	71.30	0.16	0.11	0.95	0.02	12.00	0.00	94.02
	1122C_37X-1_37-38_19	4.30	3.16	1.48	70.22	0.16	0.07	0.95	0.05	12.03	0.00	92.42
	1122C_37X-1_37-38_20	4.51	3.22	1.48	70.71	0.13	0.11	0.99	0.04	12.17	0.02	93.39
	1122C_37X-1_37-39em_1	4.55	3.15	1.41	73.25	0.15	0.10	0.94	0.07	12.34	0.00	95.95
	1122C_37X-1_37-39em_4	4.38	3.03	1.48	73.53	0.15	0.10	0.94	0.04	12.52	0.05	96.22
	1122C_37X-1_37-39em_5	4.12	3.14	1.51	72.42	0.10	0.09	0.88	0.07	12.03	0.00	94.37
	1122C_37X-1_37-39em_6	4.09	3.31	1.56	73.76	0.13	0.08	0.91	0.13	12.44	0.00	96.41
	1122C_37X-1_37-39em_9	4.29	3.02	1.41	73.22	0.15	0.09	0.89	0.01	12.49	0.01	95.58
	1122C_37X-1_37-39em_2	4.00	3.22	1.56	72.40	0.15	0.09	0.87	0.02	12.44	0.04	94.79
	1122C_37X-1_37-39em_3	4.14	3.16	1.59	73.05	0.11	0.09	0.90	0.07	12.41	0.01	95.54
	1122C_37X-1_37-39em_7	4.40	3.12	1.58	73.97	0.14	0.03	0.87	0.08	12.29	0.00	96.48
	1122C_37X-1_37-39em_8	4.34	3.10	1.58	74.12	0.12	0.09	0.86	0.11	12.57	0.00	96.88
	1122C_37X-1_37-39em_10	4.22	3.27	1.42	71.58	0.13	0.11	0.87	0.01	12.06	0.00	93.67
	1122C_44X-2_57-59_1	3.98	4.40	1.94	70.00	0.14	0.09	0.90	0.03	12.49	0.01	93.96
	1122C_44X-2_57-59_2	4.28	4.13	1.98	69.19	0.14	0.03	0.91	0.01	12.50	0.05	93.22
	1122C_44X-2_57-59_3	3.67	4.58	1.46	70.90	0.11	0.04	0.75	0.03	12.12	0.01	93.66
	1122C_44X-2_57-59_4	3.88	4.45	1.65	71.08	0.11	0.04	0.83	0.06	12.19	0.00	94.29
	1122C_44X-2_57-59_5	4.03	4.48	2.06	69.41	0.14	0.09	0.90	0.08	12.23	0.00	93.41
	1122C_44X-2_57-59_6	4.31	4.25	2.04	69.46	0.15	0.08	0.95	0.01	12.44	0.00	93.69
	1122C_44X-2_57-59_7	3.95	4.44	1.70	69.17	0.18	0.07	0.99	0.08	12.37	0.00	92.95
	1122C_44X-2_57-59_8	4.01	4.40	1.94	69.16	0.13	0.09	0.94	0.06	12.46	0.01	93.21
	1122C_44X-2_57-59_9	4.19	4.38	2.02	69.56	0.12	0.06	0.96	0.05	12.58	0.03	93.95
	1122C_44X-2_57-59_10	4.01	4.43	1.79	69.53	0.12	0.07	0.95	0.04	12.60	0.02	93.57
	1122C_44X-2_57-59_11	3.82	4.53	1.73	69.25	0.10	0.08	0.96	0.03	12.46	0.00	92.96
	1122C_44X-2_57-59_12	3.89	4.33	1.76	69.72	0.14	0.09	0.94	0.00	12.38	0.00	93.26
	1122C_44X-2_57-59_13	3.82	4.31	1.82	69.28	0.12	0.06	0.93	0.06	12.64	0.01	93.05
	1122C_44X-2_57-59_14	3.74	4.37	1.91	69.30	0.14	0.07	0.92	0.06	12.37	0.05	92.92
	1122C_44X-2_57-59_15	4.05	4.35	1.79	69.73	0.15	0.08	0.97	0.05	12.55	0.02	93.75
	1122C_44X-2_57-59_16	3.87	4.35	2.01	70.23	0.14	0.07	0.96	0.10	12.57	0.03	94.33
	1122C_44X-2_57-59_17	4.05	4.33	1.68	69.64	0.15	0.12	0.97	0.03	12.51	0.00	93.48

Appendix A

Supplementary Table S13: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1122.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s89*	1122C_44X-2_57-59_18	3.94	4.30	1.92	69.27	0.15	0.06	0.96	0.05	12.65	0.00	93.30
	1122C_44X-2_57-59_19	4.00	4.30	1.78	69.13	0.14	0.08	0.92	0.10	12.43	0.06	92.94
	1122C_44X-2_57-59_20	3.70	4.46	1.92	70.10	0.13	0.09	0.93	0.02	12.54	0.04	93.93
	1122C_44X-2_57-59cm_1	3.86	4.27	1.93	71.97	0.13	0.09	0.89	0.05	12.88	0.00	96.07
	1122C_44X-2_57-59cm_2	3.82	4.35	1.90	71.89	0.15	0.07	0.91	0.07	12.65	0.06	95.86
	1122C_44X-2_57-59cm_6	3.67	4.30	1.83	72.19	0.15	0.07	0.89	0.11	12.74	0.01	95.95
	1122C_44X-2_57-59cm_8	3.82	4.42	1.81	71.44	0.10	0.03	0.89	0.06	12.79	0.00	95.36
	1122C_44X-2_57-59cm_10	3.63	4.58	1.88	72.20	0.11	0.08	0.90	0.00	12.65	0.00	96.03
	1122C_44X-2_57-59cm_11	4.04	4.09	1.86	69.67	0.14	0.09	0.87	0.06	12.89	0.00	93.71
	1122C_44X-2_57-59cm_3	3.92	4.42	1.90	72.23	0.12	0.11	0.91	0.04	12.82	0.03	96.49
	1122C_44X-2_57-59cm_4	3.58	4.50	1.81	71.80	0.16	0.06	0.89	0.00	12.46	0.00	95.26
	1122C_44X-2_57-59cm_5	3.64	4.63	1.85	72.12	0.13	0.12	0.92	0.00	13.01	0.05	96.46
	1122C_44X-2_57-59cm_7	4.04	4.32	1.74	71.17	0.13	0.07	0.89	0.09	12.57	0.01	95.03
	1122C_44X-2_57-59cm_9	3.84	4.43	1.74	71.39	0.15	0.03	0.88	0.00	12.81	0.00	95.27
	1122C_44X-2_57-59cm_12	4.02	4.29	2.01	70.99	0.11	0.07	0.89	0.03	12.86	0.00	95.27
	1122C_50X-5_5-7_1	4.25	2.94	1.62	69.74	0.12	0.09	1.08	0.13	12.06	0.00	92.02
	1122C_50X-5_5-7_2	4.18	3.06	1.60	70.67	0.13	0.09	1.13	0.02	12.33	0.00	93.21
	1122C_50X-5_5-7_3	4.57	2.91	1.77	70.41	0.17	0.09	1.20	0.01	12.44	0.02	93.60
	1122C_50X-5_5-7_4	4.22	3.08	1.61	70.36	0.13	0.09	1.01	0.02	12.12	0.02	92.67
	1122C_50X-5_5-7_5	4.19	3.20	1.85	70.53	0.11	0.10	1.11	0.00	12.30	0.00	93.39
	1122C_50X-5_5-7_6	4.35	3.02	1.69	69.99	0.13	0.11	1.19	0.10	12.26	0.01	92.84
	1122C_50X-5_5-7_7	4.30	2.98	1.55	70.27	0.11	0.09	1.07	0.06	11.99	0.00	92.42
	1122C_50X-5_5-7_8	4.20	2.95	1.70	70.18	0.14	0.06	1.04	0.01	12.04	0.00	92.33
	1122C_50X-5_5-7_9	4.28	3.15	1.57	70.94	0.12	0.15	1.03	0.02	12.04	0.03	93.32
	1122C_50X-5_5-7_10	4.33	3.06	1.70	70.24	0.16	0.13	1.17	0.03	12.30	0.04	93.16
	1122C_50X-5_5-7_11	4.37	2.97	1.58	69.26	0.14	0.08	1.06	0.07	11.83	0.00	91.36
	1122C_50X-5_5-7_12	4.30	3.01	1.46	71.31	0.13	0.11	1.10	0.06	11.99	0.02	93.50
	1122C_50X-5_5-7_13	4.25	3.06	1.51	70.30	0.14	0.11	1.06	0.00	12.06	0.00	92.49
	1122C_50X-5_5-7_14	4.09	3.02	1.60	70.09	0.12	0.08	1.09	0.00	12.01	0.00	92.10
	1122C_50X-5_5-7_15	4.30	2.93	1.67	69.86	0.17	0.10	1.21	0.04	12.21	0.01	92.50
	1122C_50X-5_5-7_16	4.37	3.09	1.63	70.31	0.11	0.10	1.11	0.02	12.05	0.06	92.85
	1122C_50X-5_5-7_17	4.27	2.94	1.64	70.01	0.15	0.11	1.08	0.00	12.08	0.02	92.29
	1122C_50X-5_5-7_18	3.92	3.05	1.49	69.75	0.14	0.11	1.04	0.09	12.12	0.00	91.72
	1122C_50X-5_5-7_19	4.11	3.00	1.61	70.30	0.12	0.07	1.08	0.13	12.03	0.04	92.48
	1122C_50X-5_5-7_20	4.03	3.11	1.75	70.06	0.14	0.09	1.09	0.00	12.08	0.11	92.45

Appendix A

Supplementary Table S13: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1122.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1122C 44X-2 57-59cm_2	67.01	13.57	2.58	0.68	181.30	70.53	31.93	212.88	11.60	11.02	893.67	32.22	70.8	7.95	29.47
1122C 44X-2 57-59cm_6	58.89	13.03	2.61	0.67	178.95	69.24	31.03	204.86	11.29	10.79	856.62	31.07	67.56	7.68	28.18
1122C 44X-2 57-59cm_8	47.59	12.11	5.70	0.66	176.41	69.64	31.83	205.75	10.59	10.28	860.67	31.39	66.58	7.62	29.25
1122C 44X-2 57-59cm_10	36.71	11.58	3.20	0.51	175.67	69.97	31.15	203.44	10.55	10.13	856.93	31.28	65.32	7.43	27.81
1122C 44X-2 57-59cm_11	58.67	12.39	2.57	0.56	183.09	68.70	31.52	207.74	11.44	10.89	869.72	31.58	67.96	7.58	29.2
1122C 37X-1 37-39cm_1	26.97	15.37	3.48	0.97	126.15	75.33	30.82	169.11	9.63	5.93	754.89	26.69	57.08	6.75	26.82
1122C 37X-1 37-39cm_4	36.18	15.52	3.46	0.49	125.15	75.76	31.88	173.05	9.98	6.04	771.78	27.4	58.17	6.78	26.69
1122C 37X-1 37-39cm_5	34.05	14.41	3.06	0.54	119.30	73.33	31.36	174.04	9.63	5.57	747.02	26.35	57.76	6.62	26.33
1122C 37X-1 37-39cm_6	29.75	13.89	4.61	0.52	120.64	74.71	31.36	169.24	8.99	5.63	738.31	26.46	54.18	6.57	25.92
1122C 37X-1 37-39cm_9	44.69	14.55	2.32	0.35	120.33	72.50	30.57	172.71	9.57	5.74	743.41	26.43	57.33	6.6	26.1

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1122C 44X-2 57-59cm_2	6.10	0.90	5.68	0.87	5.64	1.16	3.23	0.51	3.66	0.55	6.44	0.89	25.33	18.66	4.76
1122C 44X-2 57-59cm_6	6.07	0.80	5.26	0.89	5.63	1.19	3.21	0.47	3.36	0.51	5.66	0.868	25.06	17.94	4.57
1122C 44X-2 57-59cm_8	5.81	0.87	5.70	0.88	5.41	1.10	3.10	0.52	3.49	0.55	6.07	0.786	23.29	17.49	4.28
1122C 44X-2 57-59cm_10	5.94	0.90	5.05	0.80	5.14	1.19	2.99	0.44	3.31	0.47	5.79	0.765	23.93	16.55	4.08
1122C 44X-2 57-59cm_11	6.10	0.81	5.84	0.86	5.49	1.06	3.20	0.51	3.42	0.51	6.13	0.862	24.88	17.89	4.41
1122C 37X-1 37-39cm_1	5.50	0.94	4.96	0.86	5.35	1.17	3.12	0.43	3.34	0.46	4.93	0.696	32.93	10.8	2.55
1122C 37X-1 37-39cm_4	5.87	0.97	5.27	0.86	5.06	1.15	3.42	0.48	3.30	0.55	4.94	0.67	22.9	11.01	2.75
1122C 37X-1 37-39cm_5	5.63	1.01	5.38	0.87	5.12	1.09	3.22	0.47	3.53	0.52	4.82	0.654	22.48	11.29	2.7
1122C 37X-1 37-39cm_6	5.81	0.96	4.99	0.84	5.01	1.04	3.10	0.43	3.33	0.41	4.34	0.596	22.18	10.55	2.33
1122C 37X-1 37-39cm_9	5.77	1.01	5.44	0.84	5.34	1.08	3.17	0.49	3.39	0.55	5.02	0.693	21.1	11.42	2.63

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
sl0	1123A_1H-2_6-8_1	4.59	2.72	1.16	73.24	0.15	0.15	1.01	0.04	12.21	0.00	95.28
	1123A_1H-2_6-8_2	4.50	2.55	1.03	72.26	0.15	0.13	1.08	0.00	12.07	0.02	93.80
	1123A_1H-2_6-8_3	4.58	2.65	1.13	73.80	0.13	0.16	1.05	0.09	12.19	0.00	95.78
	1123A_1H-2_6-8_4	4.48	2.73	1.05	72.83	0.17	0.14	1.00	0.04	12.13	0.01	94.58
	1123A_1H-2_6-8_5	4.25	2.72	1.19	71.94	0.13	0.16	1.03	0.00	12.21	0.03	93.67
	1123A_1H-2_6-8_6	4.54	2.66	1.07	72.38	0.15	0.14	1.02	0.08	12.28	0.00	94.33
	1123A_1H-2_6-8_7	4.54	2.68	1.33	72.74	0.16	0.21	1.09	0.11	12.33	0.04	95.24
	1123A_1H-2_6-8_8	4.69	2.67	1.11	72.23	0.16	0.16	1.10	0.11	12.10	0.00	94.34
	1123A_1H-2_6-8_9	4.26	2.54	1.11	72.03	0.15	0.15	1.16	0.05	12.37	0.03	93.84
	1123A_1H-2_6-8_10	4.79	2.69	1.13	74.93	0.18	0.18	1.04	0.06	12.44	0.02	97.45
	1123A_1H-2_6-8_11	4.46	2.60	1.13	70.37	0.16	0.14	1.00	0.04	12.07	0.00	91.96
	1123A_1H-2_6-8_12	4.59	2.62	1.23	73.54	0.16	0.17	1.06	0.01	12.41	0.03	95.82
	1123A_1H-2_6-8_13	4.56	2.62	1.19	72.39	0.16	0.13	1.00	0.06	12.08	0.00	94.18
	1123A_1H-2_6-8_14	4.55	2.62	1.11	73.05	0.18	0.12	1.06	0.13	12.23	0.03	95.09
	1123A_1H-2_6-8_15	4.57	2.62	1.25	72.74	0.17	0.20	1.16	0.05	12.58	0.01	95.35
	1123A_1H-2_6-8_16	4.28	2.72	1.06	72.63	0.17	0.18	1.04	0.05	12.01	0.00	94.14
	1123A_1H-2_6-8_17	4.41	2.73	1.07	71.45	0.17	0.15	1.00	0.08	12.11	0.03	93.19
	1123A_1H-2_6-8_18	4.58	2.59	1.19	71.89	0.16	0.16	1.04	0.01	12.23	0.01	93.86
	1123A_1H-2_6-8_19	4.59	2.76	1.15	71.74	0.16	0.16	1.00	0.08	12.08	0.03	93.75
sl4	1123A_2H-5_66-68_1	4.15	3.56	1.11	74.71	0.08	0.05	0.69	0.07	11.45	0.01	95.88
	1123A_2H-5_66-68_2	3.90	3.61	0.96	74.09	0.07	0.07	0.61	0.02	11.58	0.01	94.93
	1123A_2H-5_66-68_3	4.04	3.50	1.20	74.20	0.09	0.04	0.65	0.07	11.44	0.04	95.27
	1123A_2H-5_66-68_4	4.67	2.91	2.83	70.54	0.21	0.14	1.47	0.07	12.96	0.06	95.86
	1123A_2H-5_66-68_5	4.33	3.26	1.44	72.85	0.11	0.02	0.78	0.07	11.49	0.00	94.35
	1123A_2H-5_66-68_6	4.27	3.27	1.28	73.34	0.12	0.04	0.79	0.06	11.61	0.00	94.79
	1123A_2H-5_66-68_7	4.36	3.49	1.12	74.44	0.12	0.08	0.88	0.00	11.89	0.00	96.38
	1123A_2H-5_66-68_8	4.31	3.38	1.36	73.93	0.13	0.05	0.73	0.04	11.73	0.00	95.66
	1123A_2H-5_66-68_9	4.21	3.32	1.31	73.12	0.09	0.04	0.78	0.06	11.55	0.00	94.49
	1123A_2H-5_66-68_10	4.16	3.39	1.32	72.94	0.11	0.05	0.80	0.05	11.65	0.00	94.47
	1123A_2H-5_66-68_11	4.81	2.69	3.75	68.64	0.30	0.29	1.76	0.12	12.92	0.09	95.37
	1123A_2H-5_66-68_12	4.12	3.54	1.28	74.06	0.11	0.06	0.59	0.09	11.27	0.01	95.12
	1123A_2H-5_66-68_13	4.36	3.30	1.50	73.00	0.09	0.04	0.79	0.07	11.35	0.00	94.50
	1123A_2H-5_66-68_14	3.60	3.74	1.30	74.19	0.10	0.02	0.66	0.00	11.47	0.01	95.10
	1123A_2H-5_66-68_15	3.10	4.49	1.05	74.21	0.16	0.10	0.67	0.05	11.61	0.02	95.47
	1123A_2H-5_66-68_16	4.06	3.45	1.20	74.51	0.11	0.03	0.69	0.07	11.62	0.02	95.76
	1123A_2H-5_66-68_17	3.98	3.57	1.22	74.41	0.08	0.03	0.65	0.03	11.31	0.00	95.28
	1123A_2H-5_66-68_18	4.05	3.47	1.19	73.71	0.13	0.08	0.68	0.04	11.67	0.00	95.03
	1123A_2H-5_66-68_19	4.19	3.35	1.25	73.27	0.11	0.06	0.71	0.03	11.32	0.03	94.33
	1123A_2H-5_66-68_20	3.89	3.63	1.32	72.35	0.08	0.04	0.70	0.04	11.38	0.03	93.47
	1123A_2H-5_136-138_1	4.31	3.46	1.46	73.41	0.09	0.07	0.83	0.00	11.62	0.02	95.27
	1123A_2H-5_136-138_2	4.16	3.18	1.34	72.68	0.09	0.01	0.81	0.02	11.83	0.00	94.13
	1123A_2H-5_136-138_3	4.16	3.47	1.24	74.17	0.08	0.07	0.88	0.06	12.21	0.01	96.36
	1123A_2H-5_136-138_4	4.38	3.55	1.43	73.48	0.11	0.07	0.83	0.10	11.86	0.04	95.85
	1123A_2H-5_136-138_5	4.22	3.60	1.13	73.85	0.15	0.06	0.65	0.04	11.44	0.04	95.17
	1123A_2H-5_136-138_6	4.12	3.31	1.41	72.62	0.11	0.10	0.77	0.03	11.61	0.01	94.10
	1123A_2H-5_136-138_7	4.31	3.22	1.69	72.98	0.06	0.06	0.79	0.01	11.68	0.05	94.85
	1123A_2H-5_136-138_8	4.32	3.13	1.09	71.68	0.14	0.08	0.88	0.05	11.61	0.02	93.00
	1123A_2H-5_136-138_9	4.24	3.32	1.41	73.08	0.12	0.07	0.79	0.00	11.75	0.00	94.79
	1123A_2H-5_136-138_10	4.16	3.37	1.34	74.22	0.11	0.03	0.68	0.09	11.66	0.00	95.66
	1123A_2H-5_136-138_11	4.26	3.46	1.13	74.27	0.06	0.05	0.61	0.04	11.67	0.02	95.58
	1123A_2H-5_136-138_12	4.16	3.25	1.34	73.03	0.12	0.04	0.69	0.02	11.55	0.01	94.21
	1123A_2H-5_136-138_13	4.16	3.35	1.18	72.46	0.09	0.06	0.65	0.06	11.37	0.00	93.37
	1123A_2H-5_136-138_14	3.88	3.36	1.35	73.36	0.12	0.04	0.70	0.06	11.30	0.03	94.19
	1123A_2H-5_136-138_15	4.41	3.26	1.33	72.20	0.09	0.05	0.66	0.06	11.64	0.00	93.71
	1123A_2H-5_136-138_16	4.36	3.58	1.36	74.53	0.11	0.05	0.68	0.10	11.72	0.01	96.50
	1123A_2H-5_136-138_17	4.24	3.59	1.30	74.19	0.09	0.03	0.67	0.05	11.33	0.00	95.49
	1123A_2H-5_136-138_18	4.20	3.46	1.31	72.64	0.12	0.06	0.81	0.00	11.75	0.00	94.35
	1123A_2H-5_136-138_19	4.28	3.39	1.50	74.14	0.08	0.03	0.82	0.08	11.74	0.02	96.07
	1123A_2H-5_136-138_20	4.02	3.60	1.25	74.66	0.10	0.05	0.70	0.01	11.52	0.00	95.90
sl5	1123A_2H-6_18-20_1	3.52	3.37	0.86	74.20	0.11	0.13	0.93	0.00	11.68	0.03	94.82
	1123A_2H-6_18-20_2	3.96	3.39	1.58	70.57	0.12	0.06	1.08	0.09	12.00	0.00	92.86
	1123A_2H-6_18-20_3	4.25	3.41	1.34	73.18	0.15	0.12	1.02	0.03	12.04	0.02	95.57
	1123A_2H-6_18-20_4	3.78	3.46	1.24	73.08	0.15	0.11	0.94	0.07	11.65	0.00	94.48
	1123A_2H-6_18-20_5	4.67	2.96	2.36	70.91	0.26	0.26	1.59	0.01	13.03	0.03	96.08
	1123A_2H-6_18-20_6	4.20	3.25	1.30	72.07	0.10	0.03	1.01	0.03	11.79	0.01	93.79
	1123A_2H-6_18-20_7	3.67	3.47	1.06	74.13	0.15	0.13	1.00	0.03	11.60	0.00	95.23
	1123A_2H-6_18-20_8	4.16	3.29	1.53	72.60	0.16	0.12	0.99	0.08	11.92	0.00	94.85
	1123A_2H-6_18-20_9	4.30	3.27	1.20	73.17	0.15	0.11	1.00	0.10	11.87	0.00	95.17
	1123A_2H-6_18-20_10	4.01	3.64	1.31	74.13	0.15	0.13	1.05	0.03	12.21	0.02	96.67
	1123A_2H-6_18-20_11	4.09	3.26	1.22	71.47	0.11	0.13	0.94	0.13	11.93	0.00	93.28

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s16	1123A_2H-6_18-20_12	3.98	3.32	1.26	72.77	0.13	0.10	0.96	0.06	11.93	0.02	94.53
	1123A_2H-6_18-20_13	3.95	3.26	1.54	72.17	0.12	0.13	1.00	0.02	12.16	0.00	94.35
	1123A_2H-6_18-20_14	3.96	3.33	1.25	71.58	0.13	0.11	1.03	0.06	11.85	0.01	93.30
	1123A_2H-6_18-20_15	3.86	3.45	1.31	72.11	0.14	0.08	0.95	0.01	11.72	0.01	93.64
	1123A_2H-6_18-20_16	4.08	3.22	1.43	72.33	0.13	0.14	0.96	0.04	11.96	0.03	94.31
	1123A_2H-6_18-20_17	3.87	3.35	1.15	72.00	0.13	0.08	0.85	0.03	11.45	0.03	92.96
	1123A_2H-6_18-20_18	4.11	3.27	1.30	72.64	0.12	0.09	0.98	0.09	11.67	0.01	94.28
	1123A_2H-6_18-20_19	3.88	3.32	1.30	72.46	0.11	0.14	0.95	0.00	11.97	0.01	94.14
	1123A_2H-6_18-20_20	2.87	3.31	1.32	73.01	0.15	0.11	0.95	0.16	11.92	0.03	93.83
	1123A_2H-6_70-72_1	4.43	3.08	1.20	73.35	0.10	0.07	0.89	0.04	11.75	0.01	94.93
	1123A_2H-6_70-72_2	4.31	3.13	1.30	73.75	0.11	0.06	0.87	0.00	11.77	0.00	95.30
	1123A_2H-6_70-72_3	4.07	3.14	1.20	72.41	0.10	0.09	0.96	0.03	11.72	0.03	93.76
	1123A_2H-6_70-72_4	4.27	2.77	1.36	73.64	0.10	0.08	0.93	0.05	11.87	0.03	95.11
	1123A_2H-6_70-72_5	4.06	2.41	1.27	73.34	0.09	0.10	0.73	0.07	11.90	0.02	93.98
	1123A_2H-6_70-72_6	4.04	3.10	1.41	73.35	0.12	0.10	0.93	0.04	11.89	0.04	95.03
	1123A_2H-6_70-72_7	4.32	3.17	1.15	73.19	0.11	0.09	0.95	0.00	11.53	0.03	94.54
	1123A_2H-6_70-72_8	4.01	3.07	1.32	73.07	0.13	0.09	1.02	0.01	11.91	0.00	94.63
	1123A_2H-6_70-72_9	4.20	3.11	1.25	73.02	0.12	0.07	0.90	0.06	11.65	0.00	94.38
	1123A_2H-6_70-72_10	4.04	2.99	1.33	71.92	0.09	0.09	0.87	0.04	11.65	0.02	93.05
	1123A_2H-6_70-72_11	3.98	3.41	1.09	73.99	0.12	0.05	0.83	0.11	11.64	0.01	95.23
	1123A_2H-6_70-72_12	4.00	3.23	1.24	73.76	0.12	0.06	0.93	0.00	11.90	0.03	95.27
	1123A_2H-6_70-72_13	4.09	3.01	1.22	72.63	0.12	0.07	0.98	0.11	11.73	0.02	93.98
	1123A_2H-6_70-72_14	4.05	3.18	1.23	73.34	0.14	0.05	1.00	0.03	11.88	0.03	94.93
	1123A_2H-6_70-72_15	4.16	3.28	1.18	73.90	0.12	0.09	0.92	0.05	11.57	0.00	95.27
	1123A_2H-6_70-72_16	4.08	3.27	1.21	72.76	0.14	0.08	0.96	0.00	11.80	0.00	94.31
	1123A_2H-6_70-72_17	4.27	3.02	1.44	72.84	0.15	0.11	1.14	0.08	12.06	0.01	95.13
	1123A_2H-6_70-72_18	4.15	3.15	1.31	73.77	0.13	0.04	0.94	0.05	11.80	0.00	95.35
	1123A_2H-6_70-72_19	4.17	3.18	1.23	74.26	0.13	0.11	0.94	0.01	11.92	0.02	95.97
	1123A_2H-6_70-72_20	4.17	3.10	1.17	72.56	0.15	0.12	1.10	0.02	12.26	0.00	94.65
	1123A_4H-4_59-61_1	3.66	3.43	1.13	74.09	0.14	0.10	0.97	0.09	11.27	0.05	94.93
	1123A_4H-4_59-61_2	3.84	3.51	1.15	73.11	0.13	0.14	0.94	0.07	11.55	0.01	94.44
	1123A_4H-4_59-61_3	3.89	3.09	1.24	72.80	0.15	0.10	1.00	0.06	11.48	0.00	93.82
	1123A_4H-4_59-61_4	3.73	3.49	1.16	74.20	0.14	0.10	0.96	0.05	11.61	0.02	95.46
	1123A_4H-4_59-61_5	3.79	3.36	1.03	73.26	0.14	0.14	0.94	0.05	11.41	0.02	94.13
	1123A_4H-4_59-61_6	4.15	3.40	1.13	73.93	0.15	0.17	0.97	0.04	11.65	0.01	95.59
	1123A_4H-4_59-61_7	3.81	3.34	0.97	74.03	0.12	0.12	0.95	0.08	11.43	0.04	94.89
	1123A_4H-4_59-61_8	3.75	3.36	1.08	73.57	0.14	0.14	0.97	0.04	11.42	0.02	94.48
	1123A_4H-4_59-61_9	3.68	3.46	0.94	73.81	0.14	0.11	0.95	0.02	11.46	0.00	94.58
	1123A_4H-4_59-61_10	3.55	3.31	1.12	74.22	0.16	0.11	0.95	0.03	11.59	0.04	95.06
	1123A_4H-4_59-61_11	4.02	3.19	0.84	73.82	0.16	0.10	0.94	0.12	11.57	0.00	94.76
	1123A_4H-4_59-61_12	3.94	3.45	1.14	74.12	0.16	0.16	0.96	0.01	11.59	0.08	95.60
	1123A_4H-4_59-61_13	3.51	3.46	1.12	68.95	0.12	0.12	0.84	0.10	10.76	0.00	88.97
	1123A_4H-4_59-61_14	3.96	3.42	1.17	74.75	0.12	0.12	0.95	0.03	11.38	0.02	95.92
	1123A_4H-4_59-61_15	3.88	3.34	1.14	73.37	0.14	0.10	0.95	0.02	11.35	0.05	94.35
	1123A_4H-4_59-61_16	3.79	3.39	1.04	74.88	0.11	0.13	0.94	0.05	11.59	0.02	95.93
	1123A_4H-4_59-61_17	3.89	3.51	1.13	74.17	0.12	0.15	0.91	0.02	11.54	0.00	95.45
	1123A_4H-4_59-61_18	3.88	3.47	1.17	74.14	0.15	0.14	0.95	0.01	11.52	0.01	95.43
	1123A_4H-4_59-61_19	3.89	3.31	1.02	74.01	0.17	0.15	0.94	0.00	11.69	0.02	95.20
	1123A_4H-4_59-61_20	3.89	3.33	1.08	73.55	0.13	0.13	0.99	0.00	11.38	0.00	94.48
	1123A_4H-4_105-107_1	3.96	3.32	1.17	73.46	0.14	0.11	1.00	0.03	11.73	0.02	94.95
	1123A_4H-4_105-107_2	3.88	3.44	1.21	73.40	0.14	0.12	1.04	0.09	11.78	0.02	95.11
	1123A_4H-4_105-107_3	3.61	3.29	0.99	73.48	0.16	0.11	0.96	0.00	11.38	0.00	93.98
	1123A_4H-4_105-107_4	4.01	3.33	1.17	73.10	0.16	0.13	0.98	0.00	11.71	0.00	94.59
	1123A_4H-4_105-107_5	4.02	3.31	1.10	73.36	0.11	0.14	0.96	0.04	11.56	0.00	94.60
	1123A_4H-4_105-107_6	3.97	3.37	1.10	73.36	0.09	0.18	0.96	0.04	11.80	0.01	94.89
	1123A_4H-4_105-107_7	3.76	3.36	1.01	73.20	0.12	0.12	0.83	0.03	11.58	0.00	94.02
	1123A_4H-4_105-107_8	4.24	3.37	1.45	71.32	0.21	0.17	1.05	0.00	11.97	0.00	93.77
	1123A_4H-4_105-107_9	3.81	3.31	1.00	72.46	0.13	0.10	0.95	0.05	11.39	0.00	93.20
	1123A_4H-4_105-107_10	3.81	3.35	1.21	73.41	0.15	0.14	0.90	0.03	11.64	0.00	94.65
	1123A_4H-4_105-107_11	3.72	3.27	1.05	73.10	0.15	0.14	1.03	0.07	11.66	0.05	94.25
	1123A_4H-4_105-107_12	3.58	3.54	1.12	73.84	0.14	0.14	0.94	0.02	11.61	0.00	94.92
	1123A_4H-4_105-107_13	3.67	3.46	1.32	73.77	0.12	0.14	0.99	0.08	11.66	0.03	95.24
	1123A_4H-4_105-107_14	3.53	3.39	0.94	73.50	0.12	0.14	0.92	0.03	11.68	0.02	94.27
	1123A_4H-4_105-107_15	4.03	3.14	0.96	73.74	0.14	0.08	0.95	0.07	11.61	0.00	94.73
	1123A_4H-4_105-107_16	3.70	3.56	1.08	73.30	0.14	0.14	1.00	0.04	11.59	0.00	94.55
	1123A_4H-4_105-107_17	3.87	3.33	1.01	72.77	0.13	0.07	0.92	0.00	11.51	0.00	93.60
	1123A_4H-4_105-107_18	3.76	3.32	1.02	72.97	0.13	0.11	0.99	0.02	11.73	0.00	94.06
	1123A_4H-4_105-107_19	3.85	3.43	1.14	72.86	0.13	0.11	0.99	0.02	11.54	0.00	94.07
	1123A_4H-4_105-107_20	3.81	3.25	1.01	73.29	0.19	0.12	0.95	0.03	11.48	0.01	94.15
	1123A_4H-4_128-130_1	3.71	3.57	1.12	74.17	0.12	0.14	0.94	0.01	11.70	0.01	95.49

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u28	1123A_4H-4_128-130_2	3.74	3.53	1.10	75.29	0.16	0.14	0.98	0.02	11.66	0.01	96.62
	1123A_4H-4_128-130_3	3.89	3.42	1.19	74.51	0.14	0.12	0.93	0.05	11.65	0.00	95.91
	1123A_4H-4_128-130_4	3.88	3.41	1.03	73.88	0.10	0.08	0.98	0.02	11.55	0.02	94.95
	1123A_4H-4_128-130_5	3.72	3.51	1.08	74.70	0.13	0.12	0.93	0.00	11.67	0.00	95.86
	1123A_4H-4_128-130_6	3.86	3.44	1.12	74.05	0.14	0.14	0.96	0.00	11.72	0.01	95.44
	1123A_4H-4_128-130_7	3.89	3.60	1.16	75.37	0.13	0.13	0.99	0.05	11.77	0.00	97.09
	1123A_4H-4_128-130_8	3.94	3.39	1.00	74.32	0.15	0.10	0.98	0.03	11.91	0.02	95.84
	1123A_4H-4_128-130_9	3.90	3.38	0.98	74.06	0.15	0.10	0.98	0.05	11.52	0.04	95.16
	1123A_4H-4_128-130_10	3.98	3.34	1.11	74.00	0.12	0.10	0.99	0.00	11.41	0.00	95.04
	1123A_4H-4_128-130_11	3.79	3.44	1.24	73.24	0.15	0.12	0.93	0.02	11.80	0.02	94.75
	1123A_4H-4_128-130_12	3.89	3.34	1.06	73.37	0.13	0.10	0.97	0.03	11.74	0.02	94.65
	1123A_4H-4_128-130_13	4.00	3.35	1.10	73.01	0.11	0.12	0.98	0.06	11.58	0.01	94.33
	1123A_4H-4_128-130_14	3.91	3.25	1.00	72.82	0.18	0.10	0.93	0.06	11.56	0.02	93.84
	1123A_4H-4_128-130_15	3.99	3.35	1.13	72.61	0.12	0.12	0.93	0.00	11.70	0.00	93.94
	1123A_4H-4_128-130_16	3.83	3.25	1.00	72.84	0.11	0.13	0.95	0.02	11.82	0.01	93.96
	1123A_4H-4_128-130_17	3.78	3.50	1.07	71.99	0.14	0.13	0.94	0.02	11.47	0.00	93.04
	1123A_4H-4_128-130_18	3.81	3.25	1.16	72.59	0.15	0.12	0.92	0.04	11.57	0.02	93.63
	1123A_4H-4_128-130_19	3.99	3.36	1.09	74.51	0.12	0.14	1.01	0.01	11.70	0.01	95.95
	1123A_4H-4_128-130_20	3.89	3.49	1.18	74.26	0.12	0.13	0.97	0.00	11.68	0.01	95.74
	1123A_4H-5_71-73_1	4.07	3.48	1.15	73.37	0.15	0.12	1.08	0.00	11.84	0.00	95.27
s33	1123A_4H-5_71-73_2	3.99	3.39	1.14	74.11	0.13	0.10	1.08	0.01	11.73	0.04	95.71
	1123A_4H-5_71-73_3	3.90	3.36	1.03	73.53	0.17	0.11	0.96	0.04	11.59	0.00	94.68
	1123A_4H-5_71-73_4	3.84	3.41	1.06	74.21	0.13	0.13	1.01	0.10	11.50	0.00	95.39
	1123A_4H-5_71-73_5	3.77	3.42	1.10	73.92	0.14	0.10	1.12	0.11	11.54	0.02	95.23
	1123A_4H-5_71-73_6	3.62	3.28	0.99	72.90	0.12	0.09	0.95	0.05	11.56	0.00	93.56
	1123A_4H-5_71-73_7	3.98	3.49	0.99	74.01	0.14	0.14	1.04	0.07	11.74	0.01	95.60
	1123A_4H-5_71-73_9	3.90	3.56	1.01	73.26	0.13	0.12	1.07	0.05	11.63	0.02	94.75
	1123A_4H-5_71-73_10	3.87	3.35	1.02	73.53	0.14	0.13	0.97	0.08	11.51	0.02	94.63
	1123A_4H-5_71-73_11	4.05	3.48	0.99	73.65	0.18	0.11	1.03	0.03	11.78	0.00	95.31
	1123A_4H-5_71-73_12	4.08	3.25	1.05	73.56	0.12	0.13	0.98	0.00	11.63	0.04	94.84
	1123A_4H-5_71-73_13	3.96	3.38	1.11	73.66	0.15	0.13	1.01	0.06	11.62	0.01	95.09
	1123A_4H-5_71-73_14	3.85	3.37	0.91	73.10	0.12	0.14	1.09	0.02	11.63	0.02	94.27
	1123A_4H-5_71-73_15	3.83	3.26	0.93	73.28	0.14	0.08	1.00	0.00	11.33	0.03	93.88
	1123A_4H-5_71-73_16	3.76	3.46	1.11	73.47	0.14	0.09	0.97	0.09	11.56	0.01	94.67
	1123A_4H-5_71-73_17	3.96	3.42	0.90	73.78	0.12	0.08	1.02	0.06	11.56	0.00	94.90
	1123A_4H-5_71-73_1	3.65	3.25	1.18	73.69	0.19	0.15	1.12	0.06	11.57	0.05	94.90
	1123A_4H-5_71-73_4	3.65	3.57	1.07	74.10	0.19	0.14	1.04	0.01	11.48	0.03	95.28
	1123A_4H-5_71-73_5	3.52	3.42	1.06	74.42	0.17	0.15	1.03	0.00	11.74	0.00	95.51
	1123A_4H-5_71-73_8	3.73	3.31	1.07	73.48	0.21	0.12	1.00	0.13	11.58	0.01	94.65
s43	1123A_4H-5_71-73_9	3.66	3.35	1.10	73.67	0.19	0.10	1.08	0.00	11.67	0.02	94.84
	1123A_4H-5_71-73_2	3.51	3.56	1.30	73.61	0.21	0.10	1.18	0.00	11.71	0.00	95.18
	1123A_4H-5_71-73_3	3.63	3.44	1.15	74.40	0.19	0.12	1.10	0.02	11.82	0.00	95.87
	1123A_4H-5_71-73_6	3.86	3.36	1.23	74.32	0.21	0.13	1.08	0.09	11.54	0.00	95.82
	1123A_4H-5_71-73_7	3.75	3.36	1.11	74.39	0.11	0.10	1.05	0.00	11.63	0.01	95.51
	1123A_4H-5_71-73_10	3.61	3.45	1.13	74.72	0.19	0.10	1.01	0.12	11.82	0.00	96.15
	1123A_4H-6_125-127_1	4.32	2.80	2.17	69.79	0.37	0.46	1.35	0.06	12.38	0.04	93.74
	1123A_4H-6_125-127_2	5.16	2.15	1.97	67.16	0.35	0.36	3.25	0.00	15.87	0.05	96.31
	1123A_4H-6_125-127_3	4.02	3.23	1.64	71.11	0.11	0.11	0.97	0.08	11.79	0.01	93.06
	1123A_4H-6_125-127_4	4.64	2.69	2.46	69.04	0.37	0.45	1.84	0.08	13.21	0.05	94.83
	1123A_4H-6_125-127_5	4.49	3.00	1.74	71.61	0.28	0.23	1.21	0.10	12.43	0.02	95.11
	1123A_4H-6_125-127_6	5.07	2.27	3.44	66.26	0.64	0.73	2.51	0.10	13.59	0.15	94.75
	1123A_4H-6_125-127_7	4.50	2.86	1.82	70.66	0.29	0.28	1.38	0.01	12.62	0.08	94.51
	1123A_4H-6_125-127_8	4.43	3.07	1.63	71.38	0.25	0.17	1.17	0.08	12.35	0.02	94.55
	1123A_4H-6_125-127_9	4.84	2.79	2.00	70.83	0.30	0.26	1.39	0.09	12.77	0.05	95.33
	1123A_4H-6_125-127_10	5.07	2.44	3.06	67.49	0.56	0.54	2.20	0.09	13.67	0.14	95.26
	1123A_4H-6_125-127_11	4.75	2.87	1.75	70.01	0.32	0.33	1.41	0.14	12.65	0.00	94.24
	1123A_4H-6_125-127_12	4.73	3.05	2.12	71.38	0.33	0.30	1.41	0.06	12.71	0.06	96.14
	1123A_4H-6_125-127_14	4.50	2.94	2.12	70.40	0.27	0.27	1.43	0.06	12.86	0.03	94.88
	1123A_4H-6_125-127_15	4.52	2.84	2.00	70.35	0.31	0.34	1.61	0.10	12.78	0.05	94.90
	1123A_4H-6_125-127_16	4.56	2.81	2.18	70.17	0.32	0.32	1.51	0.00	12.98	0.00	94.86
s43	1123A_4H-6_125-127_17	4.53	3.07	1.57	72.01	0.23	0.17	1.10	0.03	12.36	0.03	95.10
	1123A_4H-6_125-127_18	4.67	2.83	2.00	70.02	0.34	0.33	1.48	0.02	12.76	0.01	94.46
	1123A_4H-6_125-127_19	4.40	2.78	1.86	69.73	0.31	0.27	1.37	0.14	12.51	0.03	93.39
	1123A_4H-6_125-127_20	4.45	3.42	1.62	73.02	0.16	0.10	1.07	0.01	12.61	0.03	96.50
	1123A_5H-2_98-100_1	4.23	3.17	1.71	70.25	0.24	0.26	1.37	0.05	12.86	0.01	94.15
	1123A_5H-2_98-100_2	3.92	3.43	1.45	72.31	0.18	0.13	1.03	0.09	12.18	0.02	94.74
s43	1123A_5H-2_98-100_3	4.31	3.18	1.85	71.06	0.24	0.25	1.46	0.00	12.90	0.01	95.26
	1123A_5H-2_98-100_4	4.20	3.17	1.78	70.99	0.22	0.25	1.36	0.11	12.84	0.04	94.95
	1123A_5H-2_98-100_5	4.08	3.21	1.90	71.16	0.25	0.28	1.46	0.00	12.97	0.02	95.33
	1123A_5H-2_98-100_6	4.22	3.20	1.95	70.07	0.25	0.28	1.59	0.03	13.26	0.05	94.90

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s51	1123A_5H-2_98-100_7	4.25	3.28	1.51	71.82	0.16	0.13	1.07	0.03	12.53	0.05	94.83
	1123A_5H-2_98-100_8	4.17	3.31	1.63	72.36	0.19	0.15	1.04	0.01	12.54	0.03	95.43
	1123A_5H-2_98-100_9	3.63	3.67	1.38	72.17	0.16	0.14	1.01	0.03	12.52	0.01	94.71
	1123A_5H-2_98-100_10	3.88	3.40	1.49	71.74	0.18	0.13	1.02	0.05	12.23	0.03	94.15
	1123A_5H-2_98-100_11	3.71	3.27	1.81	70.35	0.25	0.24	1.36	0.00	12.65	0.03	93.67
	1123A_5H-2_98-100_12	3.78	3.12	1.83	70.69	0.26	0.27	1.42	0.09	12.95	0.02	94.43
	1123A_5H-2_98-100_13	4.16	3.20	1.80	70.33	0.22	0.26	1.43	0.10	13.10	0.00	94.60
	1123A_5H-2_98-100_14	3.39	3.15	2.20	67.56	0.29	0.26	1.66	0.07	13.13	0.02	91.73
	1123A_5H-2_98-100_15	4.02	3.22	1.54	71.31	0.21	0.20	1.20	0.00	12.56	0.02	94.28
	1123A_5H-2_98-100_16	4.11	3.09	2.00	69.72	0.26	0.23	1.53	0.08	13.24	0.05	94.31
	1123A_5H-2_98-100_17	3.99	3.20	1.75	71.77	0.19	0.17	1.26	0.05	12.54	0.03	94.95
	1123A_5H-2_98-100_18	4.06	3.21	1.76	71.40	0.24	0.21	1.28	0.09	12.88	0.00	95.13
	1123A_5H-2_98-100_19	4.32	3.16	1.82	70.16	0.26	0.27	1.48	0.03	13.03	0.02	94.56
	1123A_5H-2_98-100_20	3.90	3.35	1.56	71.72	0.23	0.18	1.15	0.06	12.77	0.05	94.97
	1123A_5H-2_98-100_1	4.06	3.33	1.31	71.75	0.14	0.05	0.83	0.11	11.78	0.00	93.35
	1123A_5H-2_98-100_3	4.17	3.25	1.99	69.30	0.39	0.26	1.63	0.02	13.07	0.02	94.10
	1123A_5H-2_98-100_4	4.03	3.34	1.60	70.28	0.24	0.18	1.08	0.07	12.15	0.03	93.00
	1123A_5H-2_98-100_5	4.32	3.23	1.76	69.76	0.30	0.22	1.45	0.07	12.78	0.01	93.91
	1123A_5H-2_98-100_7	4.17	3.05	1.66	68.87	0.36	0.21	1.35	0.03	12.43	0.01	92.15
	1123A_5H-2_98-100_2	4.14	3.25	1.41	70.45	0.26	0.19	1.10	0.00	12.16	0.00	92.95
	1123A_5H-2_98-100_6	4.16	3.37	1.49	70.56	0.26	0.17	1.06	0.03	12.23	0.01	93.33
	1123A_5H-2_98-100_9	4.14	3.20	1.29	69.55	0.26	0.10	1.03	0.10	12.02	0.01	91.70
	1123A_5H-3_66-68_1	3.66	3.99	0.86	72.99	0.09	0.09	0.71	0.11	11.56	0.00	94.06
	1123A_5H-3_66-68_2	3.90	3.43	1.01	73.50	0.12	0.09	0.92	0.05	11.55	0.01	94.58
	1123A_5H-3_66-68_3	4.03	3.19	1.29	72.24	0.13	0.10	0.94	0.09	11.69	0.00	93.70
	1123A_5H-3_66-68_4	3.82	3.45	0.94	72.42	0.08	0.05	0.78	0.06	11.58	0.00	93.18
	1123A_5H-3_66-68_5	3.57	3.70	0.89	71.82	0.09	0.07	0.73	0.04	11.76	0.03	92.70
	1123A_5H-3_66-68_6	3.88	3.27	1.07	73.55	0.11	0.09	0.96	0.08	11.73	0.00	94.75
	1123A_5H-3_66-68_7	3.60	3.68	1.07	73.57	0.08	0.06	0.81	0.02	11.37	0.00	94.27
	1123A_5H-3_66-68_8	3.53	4.10	1.12	73.91	0.07	0.04	0.69	0.03	11.69	0.01	95.19
	1123A_5H-3_66-68_9	3.80	3.34	1.15	74.16	0.12	0.12	0.96	0.04	11.60	0.01	95.31
	1123A_5H-3_66-68_10	3.50	3.84	1.00	72.86	0.08	0.06	0.74	0.01	11.72	0.02	93.83
	1123A_5H-3_66-68_11	3.67	3.75	0.96	72.74	0.10	0.08	0.81	0.04	11.54	0.02	93.72
	1123A_5H-3_66-68_12	3.86	3.20	1.14	73.52	0.12	0.13	0.98	0.08	11.53	0.01	94.57
	1123A_5H-3_66-68_13	4.00	3.28	1.26	72.61	0.11	0.13	1.05	0.07	11.76	0.00	94.28
	1123A_5H-3_66-68_14	2.87	3.80	1.77	69.72	0.13	0.08	1.04	0.03	12.04	0.03	91.50
	1123A_5H-3_66-68_15	3.96	3.42	0.94	72.12	0.07	0.06	0.80	0.00	11.64	0.00	93.01
	1123A_5H-3_66-68_16	4.00	3.62	0.93	73.63	0.09	0.08	0.76	0.01	11.43	0.01	94.56
	1123A_5H-3_66-68_17	3.82	3.51	1.16	72.46	0.07	0.09	0.90	0.00	11.69	0.02	93.72
	1123A_5H-3_66-68_18	3.76	3.61	1.13	73.49	0.10	0.07	0.91	0.00	11.60	0.00	94.67
	1123A_5H-3_66-68_19	3.54	3.52	1.24	72.54	0.08	0.10	1.02	0.01	11.28	0.00	93.33
	1123A_5H-3_66-68_20	3.95	3.25	1.15	72.55	0.10	0.09	1.07	0.04	11.45	0.01	93.65
	1123A_5H-3_66-68_1	3.75	3.29	1.09	73.13	0.18	0.08	0.98	0.04	11.54	0.02	94.10
	1123A_5H-3_66-68_5	3.79	3.46	1.11	74.46	0.13	0.07	1.04	0.01	11.91	0.04	96.02
	1123A_5H-3_66-68_7	3.48	3.66	1.02	74.78	0.15	0.07	0.78	0.07	11.61	0.00	95.62
	1123A_5H-3_66-68_3	3.91	3.64	1.00	74.24	0.10	0.03	0.81	0.03	11.77	0.00	95.54
	1123A_5H-3_66-68_6	3.86	3.31	1.22	73.56	0.14	0.09	0.96	0.03	11.50	0.01	94.69
	1123A_5H-3_66-68_10	3.89	3.37	1.09	74.50	0.17	0.09	1.00	0.00	11.92	0.02	96.06
	1123A_6H-2_108-110_1	4.95	2.96	2.17	69.15	0.15	0.10	1.17	0.03	12.54	0.01	93.23
	1123A_6H-2_108-110_2	4.08	3.27	1.43	72.40	0.18	0.17	1.22	0.00	12.38	0.04	95.17
	1123A_6H-2_108-110_3	4.31	3.06	1.90	71.06	0.27	0.27	1.61	0.03	13.14	0.03	95.68
	1123A_6H-2_108-110_4	4.12	2.97	1.82	70.02	0.20	0.29	1.71	0.02	13.07	0.02	94.24
	1123A_6H-2_108-110_5	4.15	3.01	1.97	70.79	0.16	0.10	1.31	0.11	12.37	0.04	94.02
	1123A_6H-2_108-110_6	4.26	3.04	1.82	70.31	0.23	0.28	1.65	0.10	12.94	0.02	94.65
	1123A_6H-2_108-110_7	4.17	2.97	1.95	69.45	0.25	0.28	1.73	0.07	12.79	0.02	93.69
	1123A_6H-2_108-110_8	4.29	3.06	2.11	70.45	0.23	0.22	1.67	0.01	13.00	0.04	95.09
	1123A_6H-2_108-110_9	3.55	3.63	1.33	72.63	0.15	0.14	1.10	0.00	11.85	0.04	94.43
	1123A_6H-2_108-110_10	4.53	2.86	1.91	71.46	0.14	0.11	1.31	0.12	12.70	0.02	95.15
	1123A_6H-2_108-110_11	3.98	3.20	1.56	71.33	0.16	0.17	1.22	0.06	12.28	0.00	93.96
	1123A_6H-2_108-110_12	4.23	2.98	1.87	70.60	0.22	0.27	1.84	0.07	13.00	0.02	95.11
	1123A_6H-2_108-110_13	3.66	3.29	1.03	73.03	0.15	0.10	0.96	0.06	11.21	0.00	93.48
	1123A_6H-2_108-110_14	4.56	2.90	1.86	71.42	0.15	0.08	1.02	0.15	12.02	0.03	94.19
	1123A_6H-2_108-110_15	4.56	2.83	2.05	69.88	0.15	0.16	1.48	0.11	12.49	0.02	93.73
	1123A_6H-2_108-110_16	4.20	3.04	1.71	71.79	0.17	0.12	1.09	0.06	12.22	0.02	94.43
	1123A_6H-2_108-110_17	3.89	3.23	1.56	72.89	0.17	0.16	1.30	0.06	12.48	0.02	95.75
	1123A_6H-2_108-110_18	4.38	3.31	1.56	71.61	0.12	0.08	1.15	0.03	12.38	0.03	94.66
	1123A_6H-3_139-140_1	4.15	3.43	1.07	71.98	0.08	0.03	0.93	0.05	11.76	0.00	93.49
	1123A_6H-3_139-140_2	4.50	3.01	2.12	70.10	0.21	0.28	1.73	0.05	13.03	0.03	95.06
	1123A_6H-3_139-140_3	4.16	3.09	2.09	69.74	0.23	0.31	1.83	0.02	13.01	0.04	94.53
	1123A_6H-3_139-140_4	4.05	3.70	1.26	72.55	0.12	0.09	0.95	0.07	11.66	0.01	94.45

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1123A_6H-3_139-140_5	4.05	3.06	1.95	69.60	0.22	0.27	1.56	0.10	12.99	0.05	93.85
	1123A_6H-3_139-140_6	4.82	2.97	2.24	68.94	0.16	0.09	1.15	0.07	12.74	0.02	93.21
	1123A_6H-3_139-140_7	4.21	3.05	1.97	69.84	0.22	0.23	1.61	0.07	12.84	0.02	94.06
	1123A_6H-3_139-140_8	3.92	3.41	1.35	72.32	0.07	0.03	0.93	0.00	11.92	0.00	93.95
	1123A_6H-3_139-140_9	4.58	3.13	1.97	70.53	0.16	0.09	1.09	0.03	12.26	0.02	93.86
	1123A_6H-3_139-140_10	5.22	3.02	2.29	69.34	0.15	0.12	1.13	0.06	12.87	0.07	94.27
	1123A_6H-3_139-140_11	4.72	3.33	2.18	70.24	0.15	0.14	1.22	0.05	13.09	0.04	95.16
	1123A_6H-3_139-140_12	3.93	3.48	1.35	72.53	0.06	0.05	0.95	0.03	11.82	0.00	94.21
	1123A_6H-3_139-140_13	4.83	2.97	1.88	71.93	0.15	0.08	1.04	0.02	12.29	0.02	95.21
	1123A_6H-3_139-140_14	3.61	3.47	1.17	73.37	0.03	0.09	1.08	0.03	12.19	0.04	95.08
	1123A_6H-3_139-140_15	4.36	3.06	1.96	69.51	0.22	0.26	1.68	0.08	12.85	0.04	94.02
	1123A_6H-3_139-140_16	5.01	3.04	2.23	70.29	0.17	0.12	1.18	0.04	12.76	0.01	94.84
	1123A_6H-3_139-140_17	4.13	3.62	1.38	72.52	0.13	0.10	0.84	0.04	11.76	0.04	94.54
	1123A_6H-3_139-140_18	3.86	3.34	1.31	71.95	0.05	0.05	0.95	0.09	11.68	0.01	93.29
	1123A_6H-3_139-140_19	4.05	3.00	1.98	68.98	0.23	0.28	1.72	0.03	13.11	0.05	93.44
	1123A_6H-3_139-140_20	4.23	3.31	1.54	71.00	0.18	0.17	1.25	0.03	12.31	0.00	94.02
s66*	1123A_6H-4_131-131_1	4.65	3.24	2.08	71.18	0.15	0.09	1.02	0.04	12.53	0.00	94.99
	1123A_6H-4_131-131_2	4.84	3.13	2.25	71.39	0.16	0.09	1.00	0.09	12.74	0.02	95.70
	1123A_6H-4_131-131_3	4.98	3.20	2.10	71.15	0.14	0.07	1.02	0.07	12.60	0.00	95.33
	1123A_6H-4_131-131_4	4.79	3.31	2.23	71.27	0.16	0.12	1.03	0.10	12.62	0.02	95.65
	1123A_6H-4_131-131_5	5.05	3.30	2.14	71.08	0.16	0.08	1.01	0.11	12.50	0.00	95.43
	1123A_6H-4_131-131_6	4.90	3.33	2.06	69.98	0.14	0.09	0.98	0.03	12.65	0.04	94.19
	1123A_6H-4_131-131_7	4.40	3.40	1.89	70.08	0.16	0.09	1.00	0.07	12.31	0.02	93.41
	1123A_6H-4_131-131_8	4.83	3.11	2.33	71.22	0.16	0.10	1.00	0.10	12.25	0.01	95.11
	1123A_6H-4_131-131_9	4.87	3.31	1.96	71.55	0.16	0.07	0.94	0.11	12.55	0.03	95.56
	1123A_6H-4_131-131_10	5.13	3.23	2.20	70.12	0.17	0.08	0.99	0.11	12.74	0.04	94.81
	1123A_6H-4_131-131_11	4.71	3.29	2.01	70.33	0.13	0.05	0.92	0.03	12.33	0.00	93.81
	1123A_6H-4_131-131_12	4.99	3.35	1.99	71.52	0.13	0.06	1.01	0.10	12.53	0.00	95.67
	1123A_6H-4_131-131_13	4.65	3.32	1.89	69.44	0.14	0.06	0.94	0.05	12.53	0.02	93.04
	1123A_6H-4_131-131_14	4.53	3.18	2.15	70.86	0.16	0.06	1.01	0.10	12.39	0.00	94.44
	1123A_6H-4_131-131_15	4.63	3.29	2.02	70.34	0.13	0.06	0.96	0.10	12.60	0.05	94.20
	1123A_6H-4_131-131_16	4.62	3.19	2.11	70.69	0.15	0.05	1.00	0.06	12.60	0.02	94.50
	1123A_6H-4_131-131_17	3.81	3.58	1.85	69.32	0.16	0.07	1.00	0.03	12.40	0.03	92.25
	1123A_6H-4_131-131_18	4.99	3.35	1.87	67.50	0.17	0.06	1.01	0.11	12.53	0.01	91.61
	1123A_6H-4_131-131_19	4.81	3.19	2.14	70.71	0.16	0.12	1.00	0.13	12.51	0.02	94.77
	1123A_6H-4_131-131_20	4.90	3.24	2.15	70.48	0.16	0.08	1.01	0.08	12.60	0.01	94.70
s68	1123A_6H-4_131-133_1	4.30	3.18	1.97	71.29	0.22	0.09	1.00	0.04	12.81	0.00	94.90
	1123A_6H-4_131-133_5	4.45	3.25	2.03	71.08	0.21	0.08	1.03	0.08	12.68	0.03	94.92
	1123A_6H-4_131-133_2	4.41	3.23	2.37	71.77	0.22	0.10	1.01	0.09	12.51	0.03	95.74
	1123A_6H-4_131-133_6	4.41	3.07	2.14	70.96	0.23	0.07	0.94	0.12	12.76	0.03	94.73
	1123A_6H-4_131-133_10	4.23	3.24	2.08	70.52	0.23	0.09	0.95	0.13	12.48	0.01	93.95
	1123A_6H-4_131-133_3	4.29	3.14	2.27	70.15	0.22	0.06	1.00	0.12	12.50	0.04	93.80
	1123A_6H-4_131-133_4	4.60	2.97	2.07	70.94	0.23	0.07	1.05	0.10	12.58	0.00	94.61
	1123A_6H-4_131-133_7	4.30	3.31	2.05	71.19	0.18	0.08	1.02	0.06	12.55	0.03	94.76
	1123A_6H-4_131-133_8	4.33	3.23	2.17	71.13	0.21	0.10	0.95	0.04	12.52	0.02	94.69
	1123A_6H-4_131-133_9	4.43	3.05	2.22	70.75	0.21	0.12	1.02	0.03	12.52	0.00	94.35
	1123A_6H-5_18-20_1	4.96	2.95	2.09	69.97	0.17	0.10	1.09	0.12	12.61	0.01	94.06
	1123A_6H-5_18-20_2	5.02	2.99	2.25	69.87	0.15	0.12	1.13	0.13	12.74	0.04	94.45
	1123A_6H-5_18-20_3	4.88	3.00	2.05	70.50	0.17	0.09	1.16	0.08	12.87	0.00	94.79
	1123A_6H-5_18-20_4	4.33	3.25	3.28	69.19	0.67	0.35	1.58	0.04	12.65	0.19	95.54
	1123A_6H-5_18-20_5	4.63	3.27	2.08	71.01	0.15	0.07	1.01	0.10	12.64	0.01	94.98
	1123A_6H-5_18-20_6	4.65	2.98	2.07	70.34	0.18	0.12	1.05	0.13	12.90	0.05	94.47
	1123A_6H-5_18-20_7	4.76	3.09	2.25	70.73	0.16	0.11	1.11	0.07	12.66	0.04	94.97
	1123A_6H-5_18-20_8	4.25	3.53	1.67	70.87	0.14	0.12	0.90	0.04	12.49	0.02	94.03
	1123A_6H-5_18-20_9	4.70	3.12	2.19	69.40	0.18	0.11	1.11	0.13	12.70	0.01	93.65
	1123A_6H-5_18-20_10	5.00	3.01	2.29	70.45	0.16	0.08	1.08	0.03	12.50	0.05	94.65
	1123A_6H-5_18-20_11	4.71	3.05	2.26	70.36	0.15	0.10	1.11	0.05	12.88	0.01	94.69
	1123A_6H-5_18-20_12	4.84	3.05	2.37	70.85	0.16	0.12	1.13	0.09	12.80	0.03	95.44
	1123A_6H-5_18-20_13	5.02	3.10	2.18	70.97	0.15	0.10	1.09	0.15	12.67	0.02	95.45
	1123A_6H-5_18-20_14	4.75	2.94	2.14	70.37	0.18	0.11	1.07	0.05	12.79	0.03	94.43
	1123A_6H-5_18-20_15	5.08	3.09	2.02	70.86	0.19	0.09	1.07	0.10	13.07	0.00	95.57
	1123A_6H-5_18-20_16	3.50	4.44	2.31	67.97	0.17	0.15	1.15	0.06	12.48	0.03	92.26
	1123A_6H-5_18-20_17	5.08	3.02	2.35	70.64	0.16	0.12	1.13	0.08	12.89	0.02	95.48
	1123A_6H-5_18-20_18	4.84	3.03	2.16	71.01	0.16	0.12	1.11	0.13	12.59	0.00	95.15
	1123A_6H-5_18-20_19	4.84	3.18	2.23	71.31	0.18	0.12	1.11	0.10	12.93	0.03	96.02
	1123A_6H-5_18-20_20	5.06	3.13	2.42	71.01	0.18	0.06	1.13	0.09	12.81	0.00	95.89
	1123A_6H-5_18-20_1	4.53	2.98	1.94	70.89	0.18	0.11	1.11	0.09	12.81	0.02	94.65
	1123A_6H-5_18-20_2	4.31	2.97	2.29	70.34	0.13	0.12	1.12	0.06	12.74	0.04	94.12
	1123A_6H-5_18-20_3	4.74	3.14	2.33	70.65	0.19	0.14	1.14	0.03	13.16	0.02	95.54
	1123A_6H-5_18-20_4	4.59	3.01	2.08	70.55	0.14	0.10	1.06	0.06	12.65	0.03	94.28

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u49	1123A_6H-5_18-20_10	4.95	3.02	2.09	70.62	0.19	0.10	1.12	0.05	12.80	0.01	94.96
	1123A_6H-5_18-20_11	4.56	3.08	2.15	70.71	0.14	0.16	1.07	0.12	12.66	0.00	94.65
	1123A_6H-5_18-20_12	4.58	3.11	1.87	70.67	0.19	0.15	1.10	0.15	13.08	0.02	94.92
	1123A_6H-5_18-20_5	4.61	3.22	2.23	71.32	0.16	0.10	1.04	0.03	12.59	0.01	95.31
	1123A_6H-5_18-20_6	4.22	3.01	2.21	70.50	0.16	0.11	1.06	0.04	12.58	0.00	93.89
	1123A_6H-5_18-20_7	4.62	3.07	2.06	71.21	0.15	0.06	1.12	0.03	13.12	0.00	95.44
	1123A_6H-5_18-20_8	4.61	3.11	1.90	71.31	0.19	0.10	1.12	0.08	12.94	0.00	95.36
	1123A_6H-5_18-20_9	4.49	2.98	2.21	69.89	0.15	0.09	1.16	0.03	13.02	0.00	94.03
	1123A_6H-6_64-66_1	4.90	2.97	2.09	69.52	0.18	0.11	1.13	0.15	12.71	0.03	93.79
	1123A_6H-6_64-66_2	4.79	3.07	2.69	68.54	0.35	0.21	1.57	0.02	13.44	0.05	94.73
	1123A_6H-6_64-66_3	4.38	3.21	2.32	68.00	0.17	0.10	1.21	0.10	12.48	0.06	92.03
	1123A_6H-6_64-66_4	4.65	3.04	2.15	69.18	0.18	0.14	1.14	0.06	12.52	0.01	93.06
	1123A_6H-6_64-66_5	4.85	3.01	2.17	69.84	0.17	0.10	1.15	0.06	12.74	0.04	94.12
	1123A_6H-6_64-66_6	4.66	2.97	2.16	68.78	0.15	0.10	1.05	0.00	12.57	0.02	92.46
	1123A_6H-6_64-66_7	4.91	3.08	2.33	69.04	0.15	0.10	1.15	0.09	12.70	0.02	93.57
	1123A_6H-6_64-66_8	4.98	3.10	2.18	70.22	0.16	0.10	1.12	0.12	12.73	0.02	94.72
	1123A_6H-6_64-66_9	4.63	3.20	2.16	70.37	0.16	0.14	1.09	0.02	12.88	0.04	94.69
	1123A_6H-6_64-66_10	4.54	3.00	2.21	69.33	0.19	0.10	1.11	0.00	12.55	0.03	93.05
	1123A_6H-6_64-66_11	3.90	3.38	1.15	72.77	0.08	0.04	0.98	0.04	11.96	0.00	94.30
	1123A_6H-6_64-66_12	4.38	3.23	1.99	71.11	0.15	0.11	1.07	0.03	12.56	0.00	94.62
s73	1123A_6H-6_64-66_13	3.81	3.26	1.23	72.01	0.08	0.04	0.91	0.07	11.61	0.01	93.03
	1123A_6H-6_64-66_14	4.87	2.99	2.22	69.00	0.17	0.08	1.16	0.14	12.51	0.03	93.17
	1123A_6H-6_64-66_15	4.57	3.20	1.97	70.19	0.14	0.08	0.98	0.09	12.59	0.00	93.81
	1123A_6H-6_64-66_16	4.65	3.04	2.25	69.39	0.17	0.11	1.11	0.05	12.58	0.01	93.36
	1123A_6H-6_64-66_17	4.78	3.06	2.18	70.08	0.18	0.12	1.11	0.09	12.43	0.01	94.04
	1123A_6H-6_64-66_18	4.62	3.37	2.10	70.97	0.13	0.07	1.04	0.13	12.77	0.00	95.20
	1123A_6H-6_64-66_19	3.87	4.11	1.63	69.36	0.14	0.09	0.87	0.05	12.51	0.03	92.67
	1123A_6H-6_64-66_20	4.86	2.84	2.25	69.24	0.16	0.12	1.14	0.08	12.72	0.02	93.42
	1123A_6H-6_125-127_1	3.66	3.91	0.92	73.74	0.01	0.04	0.84	0.04	12.01	0.00	95.16
	1123A_6H-6_125-127_2	3.49	4.22	0.78	72.86	0.03	0.03	0.69	0.06	11.99	0.02	94.16
	1123A_6H-6_125-127_3	3.70	3.85	0.95	73.19	0.04	0.03	0.85	0.00	11.95	0.02	94.58
	1123A_6H-6_125-127_4	3.65	4.27	0.92	73.13	0.02	0.00	0.69	0.04	11.92	0.00	94.64
	1123A_6H-6_125-127_5	3.67	3.85	0.93	73.70	0.02	0.09	0.87	0.00	12.06	0.00	95.19
	1123A_6H-6_125-127_6	3.61	4.47	0.73	73.51	0.03	0.00	0.64	0.13	12.10	0.02	95.23
	1123A_6H-6_125-127_7	3.67	3.62	1.10	73.46	0.05	0.07	0.92	0.04	11.92	0.01	94.87
	1123A_6H-6_125-127_8	3.73	3.83	0.91	73.02	0.03	0.06	0.84	0.12	11.90	0.00	94.44
	1123A_6H-6_125-127_9	3.52	4.00	0.98	73.23	0.04	0.02	0.88	0.04	11.80	0.03	94.53
	1123A_6H-6_125-127_10	3.70	3.78	0.93	73.56	0.05	0.05	0.85	0.07	12.00	0.00	94.98
	1123A_6H-6_125-127_11	3.82	3.45	0.98	73.62	0.04	0.07	1.06	0.00	11.98	0.02	95.03
	1123A_6H-6_125-127_12	3.54	3.79	0.97	72.91	0.05	0.09	0.84	0.00	11.80	0.00	93.99
u52	1123A_6H-6_125-127_13	3.67	3.74	0.89	73.89	0.04	0.06	0.83	0.05	11.99	0.03	95.20
	1123A_6H-6_125-127_14	3.47	3.92	0.98	73.27	0.03	0.02	0.85	0.04	11.99	0.05	94.63
	1123A_6H-6_125-127_15	3.85	3.39	1.09	73.05	0.07	0.06	1.06	0.06	11.94	0.02	94.59
	1123A_6H-6_125-127_16	3.81	3.57	1.24	73.66	0.07	0.07	1.09	0.09	12.08	0.00	95.68
	1123A_6H-6_125-127_17	3.54	3.87	0.96	73.27	0.04	0.04	0.86	0.05	11.81	0.00	94.43
	1123A_6H-6_125-127_18	3.54	3.88	0.98	74.16	0.02	0.08	0.81	0.05	12.11	0.00	95.64
	1123A_6H-6_125-127_19	3.68	3.34	1.10	73.21	0.06	0.08	1.05	0.13	11.97	0.00	94.62
	1123A_6H-6_125-127_20	3.53	3.86	1.00	73.39	0.04	0.06	0.87	0.07	12.06	0.03	94.91
	1123A_6H-6_125-127_1	3.62	3.61	1.02	70.68	0.02	0.05	0.88	0.10	11.94	0.01	91.93
	1123A_6H-6_125-127_2	3.43	3.69	1.06	72.29	0.08	0.03	0.83	0.09	11.90	0.00	93.40
	1123A_6H-6_125-127_3	3.53	3.39	1.12	72.99	0.10	0.07	1.08	0.04	12.04	0.00	94.37
	1123A_6H-6_125-127_6	3.77	3.84	0.78	72.92	0.02	0.03	0.88	0.05	11.72	0.01	94.03
	1123A_6H-6_125-127_10	3.51	3.37	1.21	69.52	0.10	0.05	1.09	0.06	11.84	0.01	90.74
	1123A_6H-6_125-127_4	3.65	3.74	1.03	69.62	0.05	0.04	0.87	0.10	12.18	0.01	91.29
	1123A_6H-6_125-127_5	3.40	3.42	0.97	72.52	0.12	0.03	1.05	0.06	11.97	0.01	93.55
	1123A_6H-6_125-127_7	3.61	4.02	0.97	72.01	0.06	0.04	0.84	0.10	11.89	0.00	93.54
	1123A_6H-6_125-127_8	3.71	3.37	1.14	72.85	0.09	0.06	1.12	0.04	11.88	0.00	94.26
	1123A_6H-6_125-127_9	3.24	3.75	0.84	73.47	0.05	0.04	0.84	0.01	11.87	0.01	94.12
	1123A_6H-7_15-17_1	4.62	2.69	1.05	73.40	0.18	0.17	1.01	0.08	12.00	0.03	95.22
	1123A_6H-7_15-17_2	4.52	2.61	1.06	73.77	0.14	0.17	1.00	0.05	12.31	0.01	95.64
	1123A_6H-7_15-17_3	4.60	2.61	1.02	72.86	0.16	0.17	1.00	0.09	11.91	0.03	94.45
	1123A_6H-7_15-17_4	4.31	2.73	1.12	73.57	0.14	0.16	1.01	0.07	12.26	0.05	95.42
	1123A_6H-7_15-17_5	4.72	2.70	1.24	74.47	0.17	0.16	1.04	0.09	12.30	0.01	96.89
	1123A_6H-7_15-17_6	4.27	2.62	1.13	74.17	0.16	0.18	1.02	0.06	12.32	0.01	95.95
	1123A_6H-7_15-17_7	4.46	2.62	1.22	73.15	0.16	0.13	1.00	0.04	12.02	0.00	94.79
	1123A_6H-7_15-17_8	4.79	2.64	1.09	75.32	0.17	0.16	1.04	0.05	12.43	0.01	97.71
	1123A_6H-7_15-17_9	4.61	2.65	1.18	73.57	0.16	0.17	1.03	0.12	12.31	0.05	95.85
	1123A_6H-7_15-17_10	4.39	2.62	1.19	73.18	0.17	0.19	1.05	0.00	12.36	0.02	95.17
	1123A_6H-7_15-17_11	4.51	2.57	1.05	73.37	0.13	0.16	1.01	0.09	12.00	0.01	94.91
	1123A_6H-7_15-17_12	4.73	2.71	1.16	73.08	0.15	0.18	1.02	0.06	12.07	0.05	95.20

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s74	1123A_6H-7_15-17_13	4.43	2.63	1.01	72.46	0.16	0.16	1.02	0.07	12.44	0.02	94.40
	1123A_6H-7_15-17_14	4.34	2.74	1.09	72.68	0.18	0.14	1.01	0.07	11.83	0.02	94.10
	1123A_6H-7_15-17_15	4.32	2.53	1.20	71.92	0.15	0.16	0.95	0.07	11.90	0.03	93.23
	1123A_6H-7_15-17_16	4.31	2.61	1.13	73.19	0.10	0.16	0.96	0.05	12.11	0.01	94.64
	1123A_6H-7_15-17_17	4.63	2.69	1.13	72.65	0.15	0.15	1.01	0.06	11.90	0.03	94.40
	1123A_6H-7_15-17_18	4.44	2.52	1.11	72.94	0.15	0.14	1.06	0.06	11.80	0.05	94.27
	1123A_6H-7_15-17_19	4.58	2.59	1.16	73.42	0.15	0.14	0.98	0.00	12.08	0.03	95.13
	1123A_6H-7_15-17_20	4.61	2.67	1.23	74.13	0.18	0.13	1.00	0.09	12.29	0.01	96.34
	1123A_6H-7_40-42_1	5.00	3.26	2.27	70.48	0.16	0.11	1.17	0.11	12.97	0.03	95.56
	1123A_6H-7_40-42_2	4.69	3.48	2.18	70.00	0.16	0.11	1.21	0.09	12.73	0.02	94.68
	1123A_6H-7_40-42_3	4.92	3.28	2.34	70.04	0.17	0.18	1.20	0.06	12.97	0.03	95.18
	1123A_7H-1_52-54_1	4.03	3.74	1.23	73.44	0.08	0.06	0.80	0.03	11.72	0.00	95.14
	1123A_7H-1_52-54_2	3.78	3.77	1.23	73.59	0.13	0.11	0.79	0.04	11.65	0.04	95.12
	1123A_7H-1_52-54_3	3.94	3.78	1.24	73.26	0.14	0.11	0.86	0.08	11.71	0.00	95.12
	1123A_7H-1_52-54_4	3.89	3.82	1.30	72.94	0.10	0.09	0.81	0.00	11.67	0.02	94.64
	1123A_7H-1_52-54_5	4.07	3.60	1.36	73.12	0.11	0.06	0.82	0.00	11.86	0.00	95.00
	1123A_7H-1_52-54_6	3.86	3.74	1.34	73.10	0.11	0.04	0.84	0.10	11.61	0.00	94.74
	1123A_7H-1_52-54_7	4.02	3.52	1.30	72.72	0.10	0.13	0.88	0.02	11.75	0.00	94.45
	1123A_7H-1_52-54_8	3.98	3.59	1.32	72.96	0.12	0.11	0.83	0.02	11.69	0.01	94.64
	1123A_7H-1_52-54_9	4.06	3.71	1.22	72.94	0.12	0.07	0.82	0.09	11.67	0.00	94.69
	1123A_7H-1_52-54_10	3.75	3.44	1.17	73.43	0.11	0.09	0.90	0.06	11.56	0.00	94.50
	1123A_7H-1_52-54_11	4.61	3.35	1.97	70.27	0.12	0.07	0.97	0.07	12.63	0.03	94.09
	1123A_7H-1_52-54_12	3.88	3.42	1.43	72.98	0.12	0.10	0.88	0.03	11.39	0.01	94.25
	1123A_7H-1_52-54_13	3.69	3.73	1.42	73.92	0.12	0.12	0.90	0.04	11.52	0.00	95.46
	1123A_7H-1_52-54_14	3.98	3.45	1.22	73.56	0.12	0.12	0.91	0.06	11.67	0.03	95.12
	1123A_7H-1_52-54_15	3.80	3.75	1.23	73.76	0.11	0.11	0.84	0.10	11.36	0.02	95.08
	1123A_7H-1_52-54_16	3.67	4.21	1.08	73.09	0.11	0.05	0.68	0.07	11.99	0.00	94.94
	1123A_7H-1_52-54_17	3.90	3.50	1.42	72.96	0.12	0.11	0.88	0.04	11.56	0.00	94.49
	1123A_7H-1_52-54_18	3.94	3.93	1.34	72.98	0.08	0.08	0.81	0.00	11.84	0.00	94.99
	1123A_7H-1_52-54_19	4.02	3.54	1.23	73.48	0.12	0.13	0.90	0.06	11.50	0.01	95.00
	1123A_7H-1_52-54_20	3.83	3.41	1.26	73.73	0.12	0.10	0.89	0.01	11.49	0.00	94.84
	1123A_7H-1_52-54_1	3.83	3.79	1.23	71.63	0.14	0.09	0.81	0.00	11.67	0.05	93.24
	1123A_7H-1_52-54_4	3.59	3.43	1.22	72.08	0.15	0.10	0.90	0.05	11.44	0.00	92.96
	1123A_7H-1_52-54_6	3.45	3.85	1.24	72.28	0.14	0.05	0.82	0.05	11.74	0.01	93.63
	1123A_7H-1_52-54_7	3.48	3.55	1.29	72.81	0.23	0.09	0.93	0.03	11.73	0.00	94.14
	1123A_7H-1_52-54_10	3.87	3.72	1.18	72.28	0.18	0.09	0.88	0.05	11.88	0.00	94.13
	1123A_7H-1_52-54_2	3.67	3.51	1.28	72.11	0.23	0.13	0.85	0.06	11.51	0.01	93.37
	1123A_7H-1_52-54_3	3.87	3.41	1.26	72.44	0.16	0.07	0.92	0.07	11.36	0.04	93.60
	1123A_7H-1_52-54_8	3.65	3.61	1.25	72.66	0.18	0.10	0.95	0.00	11.73	0.00	94.13
	1123A_7H-1_52-54_9	3.64	3.70	1.20	72.01	0.15	0.08	0.80	0.00	11.54	0.00	93.12
	1123A_7H-3_26-28_1	4.73	3.28	1.53	71.63	0.13	0.02	0.86	0.02	12.17	0.00	94.37
	1123A_7H-3_26-28_2	4.69	3.32	2.05	70.79	0.13	0.11	1.05	0.09	12.61	0.02	94.85
	1123A_7H-3_26-28_3	4.67	3.22	2.05	70.79	0.14	0.11	1.07	0.08	12.67	0.01	94.81
	1123A_7H-3_26-28_4	4.80	3.24	2.04	70.68	0.13	0.09	1.03	0.09	12.67	0.00	94.77
	1123A_7H-3_26-28_5	4.70	3.30	2.09	70.88	0.12	0.09	1.08	0.07	12.37	0.00	94.71
	1123A_7H-3_26-28_6	4.82	3.23	2.08	70.69	0.14	0.10	1.03	0.07	12.20	0.02	94.38
	1123A_7H-3_26-28_7	4.54	3.18	2.09	70.64	0.14	0.07	1.01	0.06	12.66	0.00	94.39
	1123A_7H-3_26-28_8	4.81	3.12	2.21	70.45	0.17	0.05	1.06	0.13	12.40	0.05	94.44
	1123A_7H-3_26-28_9	4.92	3.08	2.03	70.70	0.17	0.05	1.07	0.05	12.54	0.04	94.65
	1123A_7H-3_26-28_10	4.54	3.13	2.18	70.85	0.14	0.08	1.06	0.08	12.67	0.05	94.78
	1123A_7H-3_26-28_11	4.72	3.07	2.11	71.10	0.15	0.09	1.04	0.03	12.46	0.02	94.80
	1123A_7H-3_26-28_12	4.76	3.05	2.17	69.83	0.16	0.08	1.01	0.08	12.42	0.00	93.56
	1123A_7H-3_26-28_13	4.66	3.33	2.19	70.99	0.13	0.10	1.13	0.02	12.59	0.01	95.16
	1123A_7H-3_26-28_14	4.81	3.21	2.07	70.45	0.12	0.09	1.14	0.13	12.65	0.01	94.67
	1123A_7H-3_26-28_15	4.82	3.22	2.06	71.31	0.17	0.03	1.09	0.09	12.77	0.00	95.57
	1123A_7H-3_26-28_16	4.91	3.22	2.07	70.57	0.12	0.08	1.04	0.01	12.54	0.03	94.59
	1123A_7H-3_26-28_17	4.79	3.15	2.04	70.50	0.16	0.11	1.06	0.05	12.53	0.00	94.39
	1123A_7H-3_26-28_18	4.03	3.91	1.96	68.61	0.14	0.10	1.03	0.06	12.28	0.01	92.13
	1123A_7H-3_26-28_19	4.73	3.25	2.05	70.80	0.14	0.09	1.02	0.06	12.59	0.01	94.74
	1123A_7H-3_26-28_20	4.80	3.33	2.20	70.96	0.14	0.09	1.10	0.09	12.64	0.02	95.36
s78	1123A_7H-3_48-50_1	4.34	3.58	2.01	72.62	0.15	0.02	0.77	0.09	12.26	0.00	95.83
	1123A_7H-3_48-50_2	4.89	3.11	2.03	70.37	0.16	0.09	1.02	0.00	12.67	0.05	94.38
	1123A_7H-3_48-50_3	4.62	3.29	2.09	70.72	0.15	0.10	0.99	0.01	12.67	0.00	94.64
	1123A_7H-3_48-50_4	4.77	3.10	2.22	70.72	0.16	0.07	0.99	0.12	12.67	0.03	94.85
	1123A_7H-3_48-50_5	4.82	3.20	2.19	71.40	0.15	0.09	1.01	0.04	12.53	0.01	95.45
	1123A_7H-3_48-50_6	4.83	3.27	2.05	72.12	0.13	0.09	1.00	0.08	12.63	0.00	96.19
	1123A_7H-3_48-50_7	4.87	3.24	2.10	71.40	0.14	0.05	0.98	0.05	12.73	0.00	95.56
	1123A_7H-3_48-50_8	4.84	3.32	2.07	71.41	0.16	0.07	1.03	0.08	12.93	0.04	95.95
	1123A_7H-3_48-50_9	4.66	3.16	2.05	71.01	0.14	0.03	0.99	0.12	12.71	0.01	94.88
	1123A_7H-3_48-50_10	4.90	3.22	2.16	70.96	0.17	0.10	1.02	0.12	12.75	0.00	95.39

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s79	1123A_7H-3_48-50_11	4.89	3.24	2.05	71.76	0.14	0.08	1.02	0.04	12.45	0.00	95.66
	1123A_7H-3_48-50_12	4.50	3.34	2.29	71.38	0.14	0.10	1.01	0.10	12.88	0.01	95.74
	1123A_7H-3_48-50_13	5.04	3.30	2.05	72.67	0.14	0.09	0.94	0.06	12.85	0.00	97.12
	1123A_7H-3_48-50_14	4.75	3.34	1.99	72.39	0.18	0.06	1.07	0.09	12.83	0.00	96.69
	1123A_7H-3_48-50_15	4.50	3.29	2.14	70.22	0.20	0.09	1.07	0.12	12.83	0.01	94.48
	1123A_7H-3_48-50_16	4.54	3.29	2.16	71.01	0.16	0.07	1.00	0.04	12.78	0.02	95.07
	1123A_7H-3_48-50_17	4.50	3.26	2.23	70.52	0.13	0.10	0.95	0.04	12.11	0.02	93.86
	1123A_7H-3_48-50_18	4.79	3.22	2.04	71.83	0.16	0.11	1.04	0.05	12.79	0.02	96.05
	1123A_7H-3_48-50_19	4.88	3.14	2.12	71.12	0.17	0.07	1.01	0.16	12.57	0.02	95.26
	1123A_7H-3_48-50_20	4.80	3.31	2.29	72.02	0.12	0.08	1.01	0.02	12.88	0.00	96.52
	1123A_7H-3_48-50_5	4.40	3.16	2.01	69.72	0.20	0.06	1.00	0.09	12.45	0.01	93.10
	1123A_7H-3_48-50_6	4.09	3.13	2.08	68.68	0.22	0.02	1.03	0.13	12.56	0.00	91.94
	1123A_7H-3_48-50_8	4.62	3.09	2.20	70.39	0.19	0.05	1.03	0.04	12.79	0.02	94.42
	1123A_7H-3_48-50_7	4.70	3.55	2.40	70.48	0.17	0.05	0.73	0.05	12.06	0.02	94.21
	1123A_7H-3_48-50_9	4.82	3.27	2.12	70.01	0.24	0.06	1.02	0.04	12.76	0.00	94.35
	1123A_7H-3_48-50_1	4.63	3.28	2.13	69.19	0.21	0.06	1.05	0.07	12.55	0.04	93.21
	1123A_7H-3_48-50_2	4.70	3.18	2.05	68.96	0.27	0.10	1.01	0.06	12.46	0.01	92.79
	1123A_7H-3_48-50_3	4.42	3.20	2.24	69.99	0.22	0.10	1.04	0.09	12.50	0.01	93.81
	1123A_7H-3_48-50_4	4.16	3.15	2.20	69.81	0.19	0.02	1.04	0.10	12.55	0.00	93.22
	1123A_7H-3_48-50_10	4.87	3.19	1.96	70.79	0.24	0.03	1.03	0.16	12.86	0.02	95.14
	1123A_7H-3_108-110_1	4.81	3.10	2.11	70.79	0.18	0.14	1.10	0.04	12.64	0.01	94.93
	1123A_7H-3_108-110_2	5.03	3.02	2.34	70.86	0.19	0.14	1.09	0.10	12.60	0.00	95.37
	1123A_7H-3_108-110_3	5.01	3.05	2.22	70.94	0.18	0.11	1.11	0.12	12.83	0.05	95.61
	1123A_7H-3_108-110_4	4.73	3.05	2.24	70.23	0.17	0.10	1.09	0.15	12.78	0.04	94.58
	1123A_7H-3_108-110_5	4.77	3.05	2.46	70.81	0.19	0.12	1.12	0.07	12.87	0.01	95.47
	1123A_7H-3_108-110_6	4.93	3.21	2.20	71.07	0.17	0.11	1.10	0.05	12.73	0.01	95.57
	1123A_7H-3_108-110_7	4.99	3.02	2.42	71.31	0.15	0.13	1.16	0.07	12.78	0.03	96.06
	1123A_7H-3_108-110_8	4.72	3.27	2.09	71.74	0.14	0.08	0.90	0.03	12.33	0.00	95.30
	1123A_7H-3_108-110_9	4.91	2.90	2.23	70.53	0.17	0.09	1.10	0.11	12.46	0.00	94.49
	1123A_7H-3_108-110_10	4.70	3.00	2.22	71.31	0.15	0.12	1.08	0.08	12.90	0.00	95.57
	1123A_7H-3_108-110_11	4.91	3.24	2.27	70.97	0.17	0.10	1.11	0.06	12.77	0.02	95.62
	1123A_7H-3_108-110_12	4.74	3.07	2.27	70.76	0.18	0.12	1.12	0.14	12.51	0.02	94.93
	1123A_7H-3_108-110_13	4.92	2.99	2.33	70.09	0.19	0.14	1.16	0.23	12.67	0.00	94.72
	1123A_7H-3_108-110_14	5.00	3.04	2.18	70.20	0.16	0.14	1.13	0.11	12.58	0.01	94.55
	1123A_7H-3_108-110_15	4.70	2.07	5.50	61.88	1.09	1.59	4.19	0.14	14.89	0.29	96.34
	1123A_7H-3_108-110_16	5.01	3.09	2.13	70.57	0.16	0.08	1.13	0.05	12.64	0.00	94.86
	1123A_7H-3_108-110_17	5.14	3.08	2.13	70.51	0.18	0.14	1.09	0.11	12.80	0.03	95.21
	1123A_7H-3_108-110_18	4.93	2.96	2.29	71.03	0.16	0.13	1.08	0.05	12.74	0.00	95.37
	1123A_7H-3_108-110_19	4.78	3.04	2.34	70.46	0.18	0.11	1.11	0.10	12.56	0.00	94.68
	1123A_7H-3_108-110_20	5.01	3.06	2.16	70.95	0.15	0.13	1.11	0.06	12.79	0.05	95.47
	1123A_7H-3_108-110_2	4.91	2.98	2.39	70.96	0.25	0.13	1.11	0.10	12.78	0.01	95.61
	1123A_7H-3_108-110_3	4.73	2.99	2.24	71.31	0.21	0.10	1.12	0.15	12.86	0.02	95.73
	1123A_7H-3_108-110_4	4.30	3.09	2.26	70.61	0.22	0.11	1.08	0.09	12.85	0.00	94.60
	1123A_7H-3_108-110_6	4.19	3.05	2.37	70.84	0.22	0.11	1.10	0.04	12.95	0.02	94.89
	1123A_7H-3_108-110_7	4.81	2.93	2.16	70.53	0.21	0.10	1.08	0.04	12.60	0.00	94.47
	1123A_7H-3_108-110_1	4.63	3.01	2.11	70.18	0.23	0.11	1.08	0.07	12.89	0.00	94.31
	1123A_7H-3_108-110_5	4.64	3.04	2.17	70.67	0.25	0.15	1.11	0.07	12.94	0.00	95.04
	1123A_7H-3_108-110_8	4.74	2.97	2.17	71.22	0.21	0.12	1.12	0.06	12.74	0.04	95.40
	1123A_7H-3_108-110_9	4.48	3.09	2.18	70.77	0.25	0.12	1.09	0.11	12.95	0.02	95.06
	1123A_7H-3_108-110_10	4.46	3.06	2.31	71.06	0.23	0.07	1.09	0.05	12.82	0.00	95.16
s82	1123A_7H-4_108-110_1	3.63	3.71	0.87	72.28	0.03	0.07	0.82	0.05	11.74	0.00	93.20
	1123A_7H-4_108-110_2	3.60	4.16	0.79	72.26	0.01	0.04	0.62	0.06	11.76	0.01	93.30
	1123A_7H-4_108-110_3	3.57	3.83	1.04	72.17	0.06	0.09	0.88	0.07	11.80	0.02	93.52
	1123A_7H-4_108-110_4	3.72	4.14	0.85	73.09	0.01	0.04	0.65	0.08	11.98	0.01	94.56
	1123A_7H-4_108-110_5	3.83	4.20	0.80	72.41	0.01	0.02	0.61	0.10	11.93	0.00	93.90
	1123A_7H-4_108-110_6	3.58	4.15	0.92	72.68	0.05	0.01	0.72	0.02	11.97	0.00	94.10
	1123A_7H-4_108-110_7	3.74	3.77	0.91	73.82	0.08	0.05	0.84	0.09	11.92	0.00	95.21
	1123A_7H-4_108-110_8	3.52	3.86	0.83	73.44	0.06	0.04	0.85	0.00	11.81	0.00	94.42
	1123A_7H-4_108-110_9	3.64	3.72	0.85	72.29	0.03	0.05	0.84	0.05	11.73	0.00	93.20
	1123A_7H-4_108-110_10	3.41	3.97	0.91	73.73	0.04	0.06	0.86	0.07	12.26	0.03	95.33
	1123A_7H-4_108-110_11	3.58	3.87	0.83	73.27	0.03	0.06	0.81	0.05	11.90	0.02	94.42
	1123A_7H-4_108-110_12	3.54	3.81	0.84	73.65	0.05	0.08	0.94	0.00	11.93	0.00	94.85
	1123A_7H-4_108-110_13	3.46	3.90	0.96	73.46	0.06	0.09	0.85	0.02	11.88	0.02	94.69
	1123A_7H-4_108-110_14	3.86	3.72	0.97	73.64	0.05	0.05	0.85	0.10	11.97	0.03	95.24
	1123A_7H-4_108-110_15	3.56	3.55	1.14	73.10	0.07	0.06	1.05	0.02	11.79	0.03	94.37
	1123A_7H-4_108-110_16	3.54	4.14	0.87	72.83	0.03	0.06	0.70	0.03	12.00	0.02	94.22
	1123A_7H-4_108-110_17	3.68	3.53	1.20	73.14	0.09	0.11	1.05	0.03	12.05	0.00	94.88
	1123A_7H-4_108-110_18	3.60	3.99	0.79	72.78	0.03	0.05	0.79	0.07	11.75	0.03	93.87
	1123A_7H-4_108-110_19	3.65	3.48	1.15	73.03	0.06	0.09	1.04	0.00	12.00	0.00	94.49
	1123A_7H-4_108-110_20	3.71	3.60	0.95	72.63	0.04	0.03	0.86	0.03	12.03	0.00	93.88

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s83	1123A_7H-5_33-35_1	4.44	3.33	2.42	69.39	0.15	0.15	1.21	0.01	13.24	0.02	94.36
	1123A_7H-5_33-35_3	4.51	3.36	2.02	70.19	0.16	0.11	1.13	0.14	12.45	0.02	94.09
	1123A_7H-5_33-35_4	4.27	3.59	1.77	70.14	0.16	0.17	1.20	0.06	12.81	0.02	94.18
	1123A_7H-5_33-35_5	4.67	3.25	2.31	69.82	0.16	0.14	1.19	0.00	13.02	0.00	94.57
	1123A_7H-5_33-35_6	4.82	3.24	2.15	69.90	0.17	0.12	1.18	0.10	13.03	0.01	94.72
	1123A_7H-5_33-35_7	4.57	3.36	2.18	70.96	0.18	0.10	1.17	0.07	13.03	0.00	95.62
	1123A_7H-5_33-35_8	4.64	3.31	2.11	70.83	0.14	0.08	1.03	0.06	12.83	0.06	95.10
	1123A_7H-5_33-35_9	4.33	3.46	1.92	71.14	0.11	0.10	0.96	0.04	12.47	0.03	94.56
	1123A_7H-5_33-35_10	4.59	3.44	2.12	71.13	0.17	0.11	1.20	0.05	13.08	0.01	95.89
	1123A_7H-5_33-35_11	4.64	3.22	2.00	69.62	0.19	0.12	1.16	0.06	12.79	0.04	93.85
	1123A_7H-5_33-35_12	4.59	3.23	2.26	70.31	0.17	0.13	1.22	0.08	12.88	0.00	94.86
	1123A_7H-5_33-35_13	4.96	3.15	2.08	70.83	0.19	0.13	1.22	0.07	13.14	0.02	95.79
	1123A_7H-5_33-35_14	4.61	3.46	2.02	71.16	0.15	0.07	1.12	0.10	12.92	0.00	95.62
	1123A_7H-5_33-35_15	4.59	3.34	2.06	70.74	0.14	0.11	1.06	0.06	12.71	0.01	94.83
	1123A_7H-5_33-35_16	4.64	3.43	1.91	70.88	0.15	0.08	0.93	0.08	12.25	0.02	94.37
	1123A_7H-5_33-35_17	4.94	3.28	2.30	70.67	0.18	0.14	1.18	0.13	13.11	0.04	95.97
	1123A_7H-5_33-35_18	4.59	3.35	2.07	70.98	0.14	0.11	1.05	0.01	12.74	0.01	95.05
	1123A_7H-5_33-35_20	4.54	3.24	2.29	70.09	0.17	0.13	1.22	0.08	12.88	0.02	94.66
s85	1123A_7H-5_125-127_1	4.51	3.40	2.09	69.75	0.17	0.14	1.30	0.05	12.91	0.03	94.35
	1123A_7H-5_125-127_2	4.52	3.59	2.29	70.28	0.17	0.05	1.11	0.07	12.50	0.03	94.60
	1123A_7H-5_125-127_3	4.48	3.43	2.36	70.47	0.17	0.14	1.29	0.08	13.02	0.00	95.44
	1123A_7H-5_125-127_4	4.61	3.17	2.60	66.59	0.22	0.17	1.51	0.11	13.27	0.03	92.28
	1123A_7H-5_125-127_5	4.20	3.32	2.22	69.40	0.19	0.16	1.24	0.07	12.83	0.04	93.67
	1123A_7H-5_125-127_6	4.24	3.53	2.18	70.14	0.17	0.10	1.13	0.09	12.61	0.01	94.20
	1123A_7H-5_125-127_7	4.19	3.41	2.31	69.71	0.19	0.12	1.19	0.05	12.89	0.00	94.07
	1123A_7H-5_125-127_8	4.58	3.31	2.28	69.58	0.21	0.14	1.31	0.04	12.65	0.05	94.16
	1123A_7H-5_125-127_9	4.26	3.55	2.16	68.19	0.19	0.13	1.29	0.03	12.67	0.00	92.48
	1123A_7H-5_125-127_10	4.27	3.36	2.14	69.25	0.21	0.20	1.23	0.01	12.77	0.03	93.46
	1123A_7H-5_125-127_11	4.12	3.62	2.19	69.69	0.18	0.10	1.16	0.07	12.44	0.04	93.61
	1123A_7H-5_125-127_12	4.32	3.42	2.06	69.34	0.20	0.11	1.20	0.05	12.80	0.02	93.52
	1123A_7H-5_125-127_13	4.30	3.29	2.26	69.34	0.18	0.14	1.23	0.11	12.84	0.00	93.69
	1123A_7H-5_125-127_14	4.35	3.37	2.14	69.06	0.17	0.11	1.21	0.05	12.73	0.03	93.22
	1123A_7H-5_125-127_15	4.58	3.48	2.17	69.37	0.17	0.13	1.18	0.05	12.50	0.03	93.66
	1123A_7H-5_125-127_16	4.32	3.54	2.33	70.17	0.19	0.12	1.17	0.07	12.81	0.01	94.73
	1123A_7H-5_125-127_17	4.27	3.59	2.07	70.76	0.18	0.12	1.10	0.03	12.59	0.03	94.74
	1123A_7H-5_125-127_18	4.61	3.34	2.17	69.17	0.19	0.14	1.14	0.08	12.96	0.04	93.84
	1123A_7H-5_125-127_19	4.70	3.38	2.01	69.19	0.21	0.16	1.32	0.05	13.02	0.02	94.06
	1123A_7H-5_125-127_20	4.53	3.38	2.21	69.70	0.19	0.16	1.28	0.03	12.95	0.01	94.44
s90	1123A_9H-5_99-101_1	4.39	3.50	2.25	70.89	0.26	0.15	1.23	0.00	12.82	0.04	95.52
	1123A_9H-5_99-101_2	4.23	3.46	2.27	70.99	0.28	0.12	1.23	0.06	12.90	0.04	95.59
	1123A_9H-5_99-101_3	4.32	3.33	2.31	70.83	0.25	0.11	1.25	0.06	12.95	0.01	95.41
	1123A_9H-5_99-101_4	4.21	3.48	2.08	71.18	0.27	0.12	1.25	0.02	12.94	0.03	95.58
	1123A_9H-5_99-101_5	4.12	3.41	2.28	70.71	0.29	0.14	1.24	0.08	12.78	0.03	95.08
	1123A_9H-5_99-101_6	3.96	3.41	2.32	69.54	0.25	0.20	1.30	0.07	12.85	0.01	93.92
	1123A_9H-5_99-101_7	4.37	3.50	2.32	71.07	0.19	0.15	1.18	0.07	12.88	0.00	95.73
	1123A_9H-5_99-101_8	4.15	3.38	2.21	70.39	0.27	0.18	1.17	0.05	12.86	0.02	94.67
	1123A_9H-5_99-101_9	4.71	3.39	2.40	71.02	0.23	0.12	1.22	0.06	12.86	0.06	96.08
	1123A_9H-5_99-101_10	4.10	3.54	2.20	70.89	0.24	0.12	1.25	0.06	12.72	0.00	95.12
	1123A_9H-5_99-101_11	3.96	3.13	1.60	71.72	0.18	0.20	1.39	0.02	12.73	0.03	94.96
	1123A_9H-5_99-101_12	3.69	3.16	1.60	71.35	0.11	0.10	1.15	0.00	12.17	0.04	93.38
	1123A_9H-5_99-101_13	3.66	3.19	1.54	70.03	0.17	0.20	1.33	0.10	12.65	0.03	92.89
	1123A_9H-5_99-101_14	3.67	3.50	1.50	72.32	0.13	0.07	1.05	0.03	12.03	0.01	94.30
	1123A_9H-5_99-101_15	3.61	3.16	1.38	71.61	0.17	0.19	1.37	0.01	12.71	0.05	94.25
	1123A_9H-5_99-101_16	3.65	3.08	1.57	71.02	0.19	0.21	1.37	0.00	12.70	0.01	93.80
	1123A_9H-5_99-101_17	3.67	3.17	1.47	71.07	0.18	0.23	1.38	0.04	12.79	0.00	94.00
	1123A_9H-5_99-101_18	3.72	3.04	1.53	71.07	0.16	0.19	1.32	0.04	12.76	0.00	93.84
	1123A_9H-5_99-101_19	3.30	3.51	1.07	72.63	0.15	0.15	1.05	0.08	12.07	0.06	94.07
	1123A_9H-5_99-101_20	3.55	3.06	1.83	71.21	0.13	0.10	1.18	0.04	12.32	0.04	93.47
s90	1123A_9H-5_99-101_1	3.38	3.14	1.56	71.26	0.15	0.22	1.37	0.06	12.57	0.01	93.71
	1123A_9H-5_99-101_2	3.40	3.01	1.55	70.71	0.16	0.19	1.32	0.02	12.52	0.05	92.93
	1123A_9H-5_99-101_3	3.44	3.13	1.83	71.55	0.14	0.11	1.20	0.00	12.35	0.01	93.76
	1123A_9H-5_99-101_4	3.93	3.06	1.43	71.03	0.17	0.19	1.32	0.10	12.56	0.01	93.81
s90	1123A_9H-5_99-101_5	4.09	2.54	3.08	66.74	0.41	0.63	2.75	0.08	14.44	0.09	94.84
	1123A_9H-5_99-101_6	3.90	3.06	1.67	71.02	0.16	0.20	1.38	0.05	12.78	0.04	94.27
	1123A_9H-5_99-101_7	3.40	3.20	1.59	71.43	0.17	0.19	1.34	0.07	12.71	0.00	94.10
	1123A_9H-5_99-101_8	3.79	3.21	1.81	72.10	0.12	0.12	1.22	0.07	12.20	0.02	94.66
s90	1123A_9H-5_99-101_9	3.35	3.13	1.58	70.60	0.19	0.23	1.39	0.04	12.86	0.05	93.42
	1123A_9H-5_99-101_10	4.01	2.87	2.43	69.21	0.20	0.17	1.79	0.02	13.11	0.04	93.85
	1123A_9H-5_99-101_11	3.95	3.13	1.80	71.24	0.17	0.11	1.27	0.08	12.29	0.01	94.05
	1123A_9H-5_99-101_12	3.87	3.14	1.31	71.60	0.23	0.16	1.27	0.01	12.52	0.01	94.11

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s94	1123A_9H-5_99-101_4	3.78	3.29	1.88	71.50	0.23	0.09	1.29	0.07	12.26	0.02	94.41
	1123A_9H-5_99-101_7	3.84	3.21	1.48	71.11	0.23	0.17	1.30	0.07	12.82	0.03	94.26
	1123A_9H-5_99-101_9	4.16	2.91	1.68	71.13	0.21	0.18	1.40	0.03	12.75	0.00	94.46
	1123A_9H-5_99-101_3	3.91	3.11	1.69	70.80	0.20	0.16	1.19	0.09	12.16	0.01	93.32
	1123A_9H-5_99-101_8	4.16	3.18	1.31	70.72	0.20	0.21	1.37	0.03	12.48	0.00	93.66
	1123A_9H-5_99-101_10	4.22	3.04	1.54	71.25	0.24	0.15	1.31	0.05	12.54	0.02	94.35
	1123A_9H-5_141-143_1	3.81	2.90	1.93	71.97	0.20	0.20	1.43	0.02	12.40	0.00	94.86
	1123A_9H-5_141-143_2	3.81	2.76	1.71	71.95	0.18	0.17	1.38	0.11	12.47	0.01	94.56
	1123A_9H-5_141-143_3	4.13	3.15	1.63	71.20	0.20	0.28	1.55	0.06	12.69	0.04	94.92
	1123A_9H-5_141-143_4	4.04	2.85	1.76	72.09	0.19	0.20	1.40	0.04	12.68	0.03	95.29
	1123A_9H-5_141-143_5	3.87	2.61	1.69	70.98	0.20	0.22	1.33	0.02	11.83	0.03	92.78
	1123A_9H-5_141-143_6	3.77	2.94	1.79	71.34	0.22	0.21	1.65	0.08	12.35	0.02	94.38
	1123A_9H-5_141-143_8	4.08	2.74	1.84	71.54	0.22	0.23	1.44	0.09	12.69	0.03	94.89
	1123A_9H-5_141-143_9	4.06	2.74	1.79	71.55	0.20	0.17	1.41	0.08	12.32	0.00	94.32
	1123A_9H-5_141-143_10	3.24	3.48	1.49	71.54	0.14	0.14	1.27	0.02	11.95	0.01	93.28
	1123A_9H-5_141-143_11	3.93	2.83	1.79	72.09	0.20	0.17	1.39	0.04	12.52	0.04	94.99
	1123A_9H-5_141-143_12	3.87	2.59	1.66	71.65	0.18	0.19	1.40	0.06	12.62	0.00	94.23
	1123A_9H-5_141-143_13	3.46	3.31	1.47	73.17	0.15	0.14	1.15	0.00	12.25	0.02	95.12
	1123A_9H-5_141-143_14	3.82	2.76	1.56	71.71	0.20	0.21	1.45	0.11	12.67	0.02	94.50
	1123A_9H-5_141-143_15	4.02	2.59	1.73	71.71	0.21	0.14	1.39	0.00	12.37	0.03	94.19
	1123A_9H-5_141-143_16	3.95	2.73	1.90	71.69	0.20	0.19	1.41	0.00	12.68	0.03	94.78
	1123A_9H-5_141-143_17	3.99	2.92	1.81	71.76	0.19	0.20	1.38	0.14	12.48	0.00	94.88
	1123A_9H-5_141-143_18	3.89	2.75	1.76	71.82	0.21	0.21	1.36	0.01	12.58	0.03	94.62
	1123A_9H-5_141-143_20	3.67	2.85	1.59	71.31	0.16	0.12	1.15	0.03	11.74	0.02	92.65
	1123A_9H-5_141-143_2	4.08	2.65	1.66	71.90	0.28	0.15	1.41	0.05	12.45	0.01	94.65
	1123A_9H-5_141-143_9	4.11	2.68	1.81	70.39	0.28	0.17	1.36	0.05	12.33	0.01	93.19
	1123A_9H-5_141-143_10	4.11	2.64	1.79	70.41	0.29	0.17	1.39	0.00	12.33	0.00	93.13
	1123A_9H-5_141-143_1	4.15	2.77	1.80	71.67	0.24	0.19	1.41	0.04	12.56	0.00	94.83
	1123A_9H-5_141-143_7	4.12	2.67	1.85	71.46	0.25	0.14	1.39	0.02	12.46	0.04	94.40
s95	1123A_9H-6_58-60_1	4.11	3.04	1.49	72.74	0.13	0.14	1.14	0.03	11.97	0.00	94.79
	1123A_9H-6_58-60_2	4.39	2.93	1.78	71.44	0.20	0.18	1.45	0.02	12.28	0.00	94.67
	1123A_9H-6_58-60_3	4.00	2.99	2.05	71.09	0.18	0.17	1.42	0.03	12.40	0.01	94.34
	1123A_9H-6_58-60_4	4.04	3.19	1.78	71.93	0.11	0.04	1.08	0.00	11.94	0.01	94.13
	1123A_9H-6_58-60_5	4.26	3.01	1.94	71.85	0.21	0.20	1.51	0.03	12.27	0.02	95.30
	1123A_9H-6_58-60_6	4.44	2.82	2.30	69.57	0.29	0.25	1.76	0.05	13.17	0.05	94.70
	1123A_9H-6_58-60_7	4.18	2.88	1.81	71.68	0.22	0.19	1.45	0.00	12.29	0.05	94.75
	1123A_9H-6_58-60_8	4.08	2.97	1.80	71.92	0.18	0.23	1.48	0.03	12.23	0.01	94.93
	1123A_9H-6_58-60_9	4.38	3.13	1.71	72.33	0.11	0.10	1.10	0.06	12.28	0.00	95.20
	1123A_9H-6_58-60_10	4.48	3.12	1.54	72.32	0.11	0.09	1.08	0.04	12.35	0.01	95.15
	1123A_9H-6_58-60_11	4.10	2.99	1.89	71.34	0.20	0.18	1.46	0.07	12.28	0.00	94.52
	1123A_9H-6_58-60_12	4.27	2.81	1.98	70.44	0.24	0.27	1.67	0.02	12.75	0.05	94.50
	1123A_9H-6_58-60_13	4.39	2.95	1.43	72.17	0.13	0.11	1.18	0.10	12.05	0.01	94.53
	1123A_9H-6_58-60_14	4.33	3.10	1.78	71.81	0.11	0.07	1.11	0.08	12.23	0.02	94.64
	1123A_9H-6_58-60_15	4.00	2.94	1.87	72.23	0.23	0.22	1.48	0.00	12.27	0.02	95.26
	1123A_9H-6_58-60_16	3.94	3.46	1.61	71.92	0.12	0.11	1.08	0.04	12.18	0.01	94.47
	1123A_9H-6_58-60_17	4.25	2.84	1.88	71.37	0.18	0.19	1.43	0.00	12.30	0.02	94.47
	1123A_9H-6_58-60_18	3.93	2.93	1.97	71.59	0.20	0.15	1.45	0.03	12.39	0.00	94.64
	1123A_9H-6_58-60_19	4.00	3.03	2.05	71.81	0.18	0.20	1.46	0.00	12.38	0.03	95.14
	1123A_9H-6_58-60_20	3.83	3.00	1.88	71.63	0.20	0.22	1.38	0.00	12.46	0.03	94.63
s96	1123A_9H-7_7-9_1	3.31	3.77	1.11	72.82	0.10	0.10	0.93	0.01	11.70	0.00	93.86
	1123A_9H-7_7-9_2	3.61	3.64	1.04	73.33	0.06	0.11	0.91	0.00	11.78	0.04	94.52
	1123A_9H-7_7-9_3	3.54	3.52	1.00	73.59	0.11	0.09	1.06	0.02	11.76	0.02	94.72
	1123A_9H-7_7-9_4	3.50	3.31	1.30	74.35	0.15	0.14	1.13	0.09	11.42	0.03	95.42
	1123A_9H-7_7-9_5	3.46	3.51	0.99	72.85	0.07	0.13	0.98	0.00	11.60	0.01	93.61
	1123A_9H-7_7-9_6	3.71	3.60	1.02	73.44	0.12	0.15	1.04	0.03	11.78	0.00	94.88
	1123A_9H-7_7-9_7	3.84	2.99	1.48	73.31	0.25	0.21	1.40	0.05	11.78	0.05	95.37
	1123A_9H-7_7-9_8	3.57	2.90	1.49	73.49	0.22	0.23	1.38	0.00	11.64	0.03	94.95
	1123A_9H-7_7-9_9	3.80	2.98	1.34	73.53	0.23	0.23	1.42	0.00	11.87	0.01	95.41
	1123A_9H-7_7-9_10	3.54	3.74	1.05	73.59	0.10	0.09	1.04	0.00	11.83	0.02	95.00
	1123A_9H-7_7-9_11	3.62	3.01	1.41	74.05	0.23	0.22	1.48	0.03	11.71	0.01	95.77
	1123A_9H-7_7-9_12	3.43	2.86	1.40	72.29	0.23	0.19	1.41	0.07	11.42	0.03	93.34
	1123A_9H-7_7-9_13	3.63	2.98	1.46	73.90	0.22	0.22	1.42	0.00	11.81	0.02	95.66
	1123A_9H-7_7-9_14	3.60	3.59	1.12	73.85	0.12	0.09	1.01	0.14	11.84	0.05	95.41
	1123A_9H-7_7-9_15	3.75	3.67	1.06	73.50	0.11	0.06	0.92	0.02	11.83	0.02	94.93
	1123A_9H-7_7-9_16	3.73	2.85	1.44	72.81	0.23	0.24	1.45	0.01	11.53	0.00	94.29
	1123A_9H-7_7-9_17	3.69	2.86	1.28	72.82	0.22	0.25	1.46	0.05	11.41	0.01	94.05
	1123A_9H-7_7-9_18	3.75	3.40	1.14	72.76	0.08	0.12	1.03	0.00	11.66	0.01	93.96
	1123A_9H-7_7-9_19	3.09	3.66	1.27	71.83	0.11	0.12	1.04	0.00	11.37	0.00	92.49
	1123A_9H-7_7-9_20	3.57	3.82	1.05	72.55	0.03	0.05	0.85	0.03	11.60	0.00	93.56
	1123A_9H-7_7-9_1	3.77	2.81	1.54	69.46	0.35	0.24	1.43	0.00	11.55	0.04	91.19

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s10	1123A_9H-7_7-9_3	3.27	3.03	1.46	70.49	0.32	0.23	1.33	0.00	11.13	0.04	91.30
	1123A_9H-7_7-9_5	3.38	2.92	1.48	72.16	0.31	0.22	1.38	0.10	11.41	0.00	93.36
	1123A_9H-7_7-9_7	3.53	2.84	1.51	70.46	0.37	0.22	1.39	0.05	11.80	0.00	92.17
	1123A_9H-7_7-9_2	3.55	3.44	1.19	72.81	0.11	0.10	0.97	0.06	11.70	0.00	93.93
	1123A_9H-7_7-9_6	3.68	4.13	0.71	72.59	0.03	0.05	0.65	0.01	11.85	0.00	93.70
	1123A_9H-7_7-9_10	3.38	2.88	1.58	71.19	0.29	0.20	1.49	0.09	11.30	0.01	92.41
	1123B_1H-2_5-7_1	3.35	3.62	1.31	73.51	0.07	0.09	1.04	0.11	11.81	0.03	94.94
	1123B_1H-2_5-7_2	3.50	4.32	0.91	73.96	0.02	0.03	0.61	0.00	11.78	0.02	95.15
	1123B_1H-2_5-7_3	3.67	3.75	0.91	73.05	0.03	0.02	0.85	0.10	11.63	0.01	94.02
	1123B_1H-2_5-7_4	3.86	3.49	1.07	72.62	0.06	0.09	0.98	0.04	11.77	0.03	94.01
	1123B_1H-2_5-7_5	3.52	3.75	0.92	72.86	0.05	0.06	0.86	0.09	11.76	0.00	93.87
	1123B_1H-2_5-7_6	3.56	4.12	0.87	72.52	0.03	0.04	0.68	0.06	11.89	0.01	93.77
	1123B_1H-2_5-7_7	3.37	3.84	1.05	73.73	0.03	0.04	0.85	0.06	11.71	0.00	94.68
	1123B_1H-2_5-7_8	3.61	3.51	1.15	73.19	0.07	0.09	1.05	0.00	11.92	0.01	94.60
	1123B_1H-2_5-7_9	3.12	4.61	0.78	72.77	0.03	0.03	0.66	0.08	11.60	0.01	93.69
	1123B_1H-2_5-7_10	4.41	3.51	2.06	70.56	0.13	0.09	1.03	0.11	12.49	0.01	94.40
	1123B_1H-2_5-7_11	3.69	3.28	1.19	72.94	0.05	0.08	1.06	0.00	11.62	0.00	93.92
	1123B_1H-2_5-7_12	3.64	3.50	1.08	73.58	0.06	0.09	1.15	0.05	11.91	0.00	95.05
	1123B_1H-2_5-7_13	3.53	3.57	0.87	73.37	0.04	0.08	0.96	0.05	11.92	0.00	94.39
	1123B_1H-2_5-7_14	3.74	3.43	1.13	73.36	0.07	0.12	1.09	0.06	11.85	0.04	94.88
	1123B_1H-2_5-7_15	3.73	3.54	1.04	74.43	0.05	0.07	1.05	0.00	11.99	0.00	95.89
	1123B_1H-2_5-7_16	3.38	3.86	0.76	73.70	0.04	0.02	0.85	0.00	11.51	0.03	94.16
	1123B_1H-2_5-7_17	3.76	3.44	1.04	73.35	0.10	0.07	1.06	0.07	11.79	0.00	94.68
	1123B_1H-2_5-7_18	3.31	3.63	1.05	73.93	0.07	0.09	1.05	0.02	11.89	0.00	95.04
	1123B_1H-2_5-7_19	3.75	3.51	0.96	73.40	0.08	0.09	1.05	0.01	11.84	0.00	94.70
	1123B_1H-2_5-7_20	3.42	3.55	0.89	73.07	0.07	0.08	1.10	0.05	11.81	0.00	94.05
	1123B_1H-2_5-7_2	4.41	2.59	1.25	74.96	0.18	0.15	1.08	0.13	12.38	0.02	97.16
	1123B_1H-2_5-7_5	4.52	2.58	1.23	74.88	0.21	0.16	1.05	0.03	12.22	0.02	96.89
	1123B_1H-2_5-7_6	4.40	2.56	1.01	74.52	0.24	0.16	1.03	0.10	12.41	0.00	96.43
	1123B_1H-2_5-7_7	4.38	2.69	1.17	73.89	0.21	0.15	1.07	0.11	12.32	0.03	96.02
	1123B_1H-2_5-7_10	4.35	2.63	1.02	73.86	0.20	0.14	1.02	0.10	12.22	0.00	95.54
	1123B_1H-2_5-7_1	4.28	2.60	1.24	73.55	0.19	0.13	1.02	0.08	12.41	0.00	95.50
	1123B_1H-2_5-7_3	4.57	2.51	1.07	73.51	0.21	0.17	1.06	0.09	12.07	0.00	95.26
	1123B_1H-2_5-7_4	4.37	2.77	1.16	74.79	0.25	0.16	1.02	0.08	12.38	0.03	97.01
	1123B_1H-2_5-7_8	4.41	2.60	1.19	74.19	0.25	0.13	1.07	0.10	12.36	0.04	96.34
	1123B_1H-2_5-7_9	3.63	2.66	1.18	71.95	0.20	0.19	1.06	0.09	12.02	0.02	93.00
s14	1123B_2H-6_91-93_1	4.21	3.53	1.31	74.68	0.06	0.02	0.71	0.05	11.77	0.00	96.34
	1123B_2H-6_91-93_2	4.12	3.28	1.10	74.30	0.09	0.03	0.69	0.07	11.45	0.00	95.13
	1123B_2H-6_91-93_3	4.28	3.39	1.26	74.20	0.12	0.04	0.78	0.01	11.47	0.00	95.55
	1123B_2H-6_91-93_4	4.52	3.38	1.48	74.51	0.11	0.04	0.84	0.10	11.73	0.00	96.71
	1123B_2H-6_91-93_5	4.19	3.47	1.13	74.16	0.11	0.04	0.68	0.07	11.60	0.02	95.47
	1123B_2H-6_91-93_6	3.85	3.24	1.29	74.42	0.13	0.08	0.69	0.02	11.41	0.00	95.13
	1123B_2H-6_91-93_7	4.36	3.38	1.46	74.28	0.06	0.06	0.81	0.04	11.87	0.00	96.33
	1123B_2H-6_91-93_8	4.18	3.36	1.31	74.70	0.12	0.07	0.61	0.06	11.35	0.01	95.78
	1123B_2H-6_91-93_9	3.89	3.63	1.28	75.19	0.09	0.04	0.65	0.11	11.56	0.00	96.44
	1123B_2H-6_91-93_10	4.44	3.45	1.40	74.33	0.10	0.06	0.69	0.05	11.46	0.04	96.02
	1123B_2H-6_91-93_11	3.94	3.34	1.19	73.89	0.08	0.06	0.71	0.05	11.45	0.01	94.73
	1123B_2H-6_91-93_12	4.08	3.42	1.50	74.07	0.10	0.06	0.81	0.07	11.71	0.00	95.82
	1123B_2H-6_91-93_13	4.30	3.36	1.45	74.29	0.12	0.04	0.83	0.04	11.76	0.00	96.18
	1123B_2H-6_91-93_14	4.37	3.40	1.40	74.44	0.09	0.07	0.71	0.07	11.66	0.01	96.22
	1123B_2H-6_91-93_15	4.33	3.52	1.44	74.40	0.10	0.07	0.78	0.03	11.83	0.00	96.51
	1123B_2H-6_91-93_16	3.94	3.57	1.20	75.34	0.12	0.04	0.66	0.05	11.40	0.02	96.34
	1123B_2H-6_91-93_17	4.18	3.33	1.33	74.38	0.08	0.05	0.68	0.09	11.38	0.01	95.51
	1123B_2H-6_91-93_18	4.52	3.25	1.43	73.93	0.11	0.04	0.75	0.07	11.75	0.00	95.85
	1123B_2H-6_91-93_19	4.05	3.38	1.23	73.65	0.10	0.04	0.69	0.01	11.52	0.00	94.67
	1123B_2H-6_91-93_20	4.20	3.25	1.44	73.45	0.11	0.03	0.78	0.09	11.64	0.00	95.00
s43	1123B_5H-3_3-5_1	3.86	3.33	1.51	72.42	0.20	0.13	1.05	0.00	12.15	0.03	94.68
	1123B_5H-3_3-5_2	3.99	3.43	0.96	73.33	0.16	0.12	0.87	0.07	12.06	0.01	95.02
	1123B_5H-3_3-5_3	4.16	3.14	1.81	70.24	0.25	0.27	1.45	0.04	13.02	0.06	94.44
	1123B_5H-3_3-5_4	4.13	3.20	1.81	70.79	0.26	0.25	1.38	0.13	12.66	0.05	94.66
	1123B_5H-3_3-5_5	4.17	3.24	1.87	71.02	0.26	0.29	1.53	0.05	12.90	0.06	95.39
	1123B_5H-3_3-5_6	3.93	3.33	1.46	71.63	0.21	0.20	1.14	0.07	12.51	0.01	94.48
	1123B_5H-3_3-5_7	3.62	3.51	1.15	73.55	0.12	0.08	0.85	0.02	11.94	0.01	94.84
	1123B_5H-3_3-5_8	4.16	3.15	1.87	71.09	0.26	0.29	1.45	0.07	12.98	0.02	95.34
	1123B_5H-3_3-5_9	3.83	3.40	1.36	72.62	0.18	0.15	1.10	0.02	12.20	0.02	94.88
	1123B_5H-3_3-5_10	3.60	3.09	1.86	67.79	0.26	0.25	1.51	0.06	12.96	0.05	91.42
	1123B_5H-3_3-5_11	4.32	3.25	1.75	71.15	0.23	0.24	1.35	0.05	12.85	0.06	95.25
	1123B_5H-3_3-5_12	4.17	3.47	1.41	72.58	0.18	0.13	1.05	0.03	12.48	0.02	95.52
	1123B_5H-3_3-5_13	3.82	3.50	1.13	73.76	0.10	0.14	0.92	0.11	12.27	0.01	95.78
	1123B_5H-3_3-5_14	3.98	3.26	1.57	71.87	0.23	0.16	1.27	0.05	12.72	0.02	95.14

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1123B_5H-3_3-5_15	4.03	3.28	1.62	71.24	0.22	0.21	1.24	0.05	12.81	0.00	94.70
	1123B_5H-3_3-5_16	3.97	3.03	1.95	70.54	0.26	0.26	1.48	0.05	13.26	0.08	94.87
	1123B_5H-3_3-5_17	3.94	3.32	1.73	71.90	0.23	0.20	1.22	0.01	12.70	0.03	95.28
	1123B_5H-3_3-5_18	4.01	3.22	1.72	70.90	0.27	0.29	1.41	0.00	12.93	0.07	94.82
	1123B_5H-3_3-5_19	4.16	3.06	1.72	70.78	0.23	0.26	1.42	0.06	13.06	0.01	94.77
	1123B_5H-3_3-5_20	3.83	3.39	1.26	72.94	0.16	0.12	0.97	0.04	12.29	0.02	95.01
	1123B_5H-3_3-5_1	4.35	3.17	1.86	70.32	0.33	0.27	1.34	0.09	12.91	0.02	94.66
	1123B_5H-3_3-5_2	4.04	3.28	1.66	70.20	0.27	0.18	1.20	0.10	12.60	0.03	93.56
	1123B_5H-3_3-5_6	4.37	3.20	1.82	70.66	0.33	0.23	1.43	0.10	12.99	0.03	95.16
	1123B_5H-3_3-5_8	4.15	2.95	2.18	68.83	0.28	0.31	1.60	0.03	13.10	0.04	93.47
	1123B_5H-3_3-5_10	4.23	3.18	1.64	71.61	0.24	0.20	1.22	0.13	12.61	0.04	95.11
	1123B_5H-3_3-5_3	4.52	3.31	1.89	70.34	0.36	0.22	1.30	0.10	12.73	0.04	94.81
	1123B_5H-3_3-5_4	2.77	4.44	1.66	69.17	0.25	0.14	1.10	0.07	12.16	0.00	91.76
	1123B_5H-3_3-5_5	4.14	3.35	1.75	70.86	0.33	0.17	1.31	0.09	12.74	0.01	94.74
	1123B_5H-3_3-5_7	4.24	3.17	1.79	70.65	0.36	0.26	1.49	0.01	12.91	0.06	94.93
	1123B_5H-3_3-5_9	4.13	3.17	1.54	71.43	0.31	0.16	1.21	0.05	12.57	0.04	94.60
	1123B_6H-6_6-8_1	4.76	2.99	2.03	72.33	0.16	0.09	1.00	0.01	12.33	0.03	95.72
	1123B_6H-6_6-8_2	4.54	3.04	2.02	71.81	0.16	0.08	1.00	0.05	12.17	0.04	94.91
	1123B_6H-6_6-8_3	4.52	3.17	1.93	71.66	0.16	0.09	0.99	0.13	12.25	0.03	94.94
	1123B_6H-6_6-8_4	4.66	3.04	2.06	71.41	0.19	0.07	1.00	0.16	12.13	0.00	94.71
	1123B_6H-6_6-8_5	4.46	3.12	1.97	72.24	0.18	0.10	1.02	0.07	12.29	0.05	95.50
	1123B_6H-6_6-8_6	4.65	2.94	1.98	72.39	0.18	0.06	0.97	0.05	12.03	0.00	95.24
	1123B_6H-6_6-8_7	4.16	3.68	2.15	71.40	0.16	0.08	0.97	0.07	12.17	0.01	94.84
	1123B_6H-6_6-8_8	4.67	2.96	1.95	72.20	0.17	0.08	1.00	0.07	12.38	0.02	95.50
	1123B_6H-6_6-8_9	4.14	3.31	1.64	71.35	0.21	0.14	1.25	0.11	12.36	0.03	94.53
	1123B_6H-6_6-8_10	4.52	3.07	2.03	72.12	0.18	0.09	1.00	0.04	12.47	0.00	95.52
	1123B_6H-6_6-8_11	4.46	3.00	2.14	71.06	0.16	0.07	1.02	0.10	12.09	0.01	94.10
	1123B_6H-6_6-8_12	4.33	3.00	1.92	71.80	0.15	0.09	0.96	0.08	12.30	0.05	94.69
	1123B_6H-6_6-8_13	4.25	3.39	1.42	74.42	0.08	0.01	0.64	0.05	11.42	0.00	95.69
	1123B_6H-6_6-8_14	4.64	2.97	1.94	72.28	0.18	0.13	1.00	0.09	12.13	0.01	95.37
	1123B_6H-6_6-8_15	3.74	3.66	1.52	71.81	0.08	0.03	0.80	0.01	11.71	0.01	93.38
	1123B_6H-6_6-8_16	4.88	2.96	1.92	71.96	0.16	0.10	1.03	0.08	12.16	0.04	95.28
	1123B_6H-6_6-8_17	4.52	3.08	2.12	72.61	0.16	0.08	1.03	0.09	12.13	0.05	95.87
	1123B_6H-6_6-8_18	4.69	2.98	1.88	73.35	0.18	0.12	0.98	0.11	12.40	0.01	96.69
	1123B_6H-6_6-8_19	4.53	2.98	1.95	72.57	0.17	0.07	1.00	0.07	12.26	0.00	95.61
	1123B_6H-6_6-8_20	4.74	2.82	1.92	71.12	0.14	0.09	0.98	0.01	11.96	0.03	93.83
	1123B_6H-6_22-24_1	4.04	2.99	1.85	71.64	0.16	0.09	1.00	0.02	12.01	0.01	93.81
	1123B_6H-6_22-24_2	4.51	3.09	1.98	72.22	0.13	0.07	1.03	0.07	12.57	0.02	95.69
	1123B_6H-6_22-24_3	4.48	2.94	1.95	72.20	0.18	0.11	1.06	0.09	12.19	0.02	95.22
	1123B_6H-6_22-24_4	4.48	3.00	2.07	72.54	0.16	0.08	0.97	0.08	12.32	0.01	95.71
	1123B_6H-6_22-24_5	4.31	2.91	1.93	72.16	0.13	0.11	1.05	0.14	12.41	0.03	95.18
	1123B_6H-6_22-24_6	4.34	3.11	2.06	72.34	0.16	0.11	1.03	0.02	12.31	0.01	95.50
	1123B_6H-6_22-24_7	3.72	3.28	1.44	73.39	0.11	0.03	0.61	0.01	11.49	0.00	94.09
	1123B_6H-6_22-24_8	4.36	3.12	2.00	72.19	0.15	0.10	1.03	0.15	12.34	0.00	95.45
	1123B_6H-6_22-24_9	4.10	2.92	2.03	71.50	0.17	0.09	1.00	0.08	12.04	0.00	93.93
	1123B_6H-6_22-24_10	4.15	3.12	1.92	72.22	0.16	0.12	1.03	0.07	12.29	0.00	95.08
	1123B_6H-6_22-24_11	4.22	2.98	2.07	72.00	0.17	0.08	1.02	0.06	12.31	0.07	94.97
	1123B_6H-6_22-24_12	4.20	2.97	1.86	71.37	0.16	0.11	0.98	0.09	12.18	0.01	93.94
	1123B_6H-6_22-24_13	4.22	2.96	1.87	71.85	0.15	0.10	1.00	0.14	12.14	0.03	94.46
	1123B_6H-6_22-24_14	4.18	3.01	1.90	71.79	0.17	0.07	1.06	0.07	12.28	0.02	94.55
	1123B_6H-6_22-24_15	3.79	3.16	1.48	73.02	0.12	0.03	0.64	0.00	11.48	0.00	93.72
	1123B_6H-6_22-24_16	4.26	2.90	2.03	71.40	0.18	0.06	0.96	0.08	12.16	0.03	94.07
	1123B_6H-6_22-24_17	4.32	2.98	1.86	72.32	0.15	0.11	0.97	0.06	12.41	0.00	95.18
	1123B_6H-6_22-24_18	4.57	2.97	1.94	71.91	0.15	0.07	1.01	0.05	12.25	0.03	94.95
	1123B_6H-6_22-24_19	4.42	3.00	2.01	72.45	0.17	0.10	0.99	0.13	12.29	0.00	95.57
	1123B_6H-6_22-24_20	4.32	2.95	2.06	71.97	0.17	0.06	0.96	0.11	12.31	0.00	94.91
	1123B_6H-6_46-48_1	4.12	3.00	1.93	72.08	0.15	0.07	0.98	0.02	12.51	0.00	94.87
	1123B_6H-6_46-48_2	4.14	3.21	1.94	73.01	0.16	0.14	1.02	0.07	12.48	0.00	96.17
	1123B_6H-6_46-48_3	4.40	2.97	1.77	71.67	0.17	0.08	0.97	0.06	12.36	0.00	94.45
	1123B_6H-6_46-48_4	2.49	4.09	1.34	70.48	0.07	0.03	0.82	0.05	11.56	0.00	90.93
	1123B_6H-6_46-48_5	4.27	2.99	1.86	72.25	0.16	0.12	0.99	0.09	12.43	0.02	95.18
	1123B_6H-6_46-48_6	4.36	3.01	1.98	72.22	0.16	0.08	1.00	0.00	12.34	0.01	95.16
	1123B_6H-6_46-48_7	4.20	2.99	1.85	72.00	0.17	0.08	1.01	0.06	12.40	0.04	94.80
	1123B_6H-6_46-48_8	4.10	2.90	1.92	71.43	0.17	0.09	1.02	0.09	12.28	0.00	94.00
	1123B_6H-6_46-48_9	4.32	2.99	1.93	71.83	0.19	0.09	1.08	0.00	12.37	0.00	94.80
	1123B_6H-6_46-48_10	3.76	3.42	1.25	73.61	0.07	0.06	0.60	0.02	11.42	0.04	94.25
	1123B_6H-6_46-48_11	4.08	3.00	1.94	71.95	0.15	0.10	0.98	0.09	12.60	0.03	94.93
	1123B_6H-6_46-48_12	4.27	3.03	1.70	72.16	0.15	0.11	1.00	0.14	12.44	0.01	95.00
	1123B_6H-6_46-48_13	4.36	3.00	1.91	72.09	0.15	0.09	0.99	0.07	12.35	0.03	95.04
	1123B_6H-6_46-48_14	4.44	3.07	1.94	72.24	0.19	0.11	1.02	0.14	12.60	0.01	95.76

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s62	1123B_6H-6_46-48_15	4.07	3.34	1.45	73.72	0.09	0.03	0.64	0.11	11.65	0.05	95.15
	1123B_6H-6_46-48_16	4.25	3.01	1.82	72.04	0.17	0.12	1.05	0.07	12.38	0.00	94.90
	1123B_6H-6_46-48_17	4.22	3.03	1.97	71.90	0.15	0.10	1.01	0.13	12.59	0.00	95.10
	1123B_6H-6_46-48_18	4.12	2.99	2.00	71.43	0.17	0.13	1.02	0.13	12.16	0.01	94.16
	1123B_6H-6_46-48_19	4.25	2.84	1.89	72.22	0.16	0.06	1.07	0.15	12.44	0.02	95.10
	1123B_6H-6_46-48_20	4.07	2.66	2.13	69.55	0.20	0.18	1.45	0.01	12.87	0.01	93.14
	1123B_6H-6_50-52_1	4.14	3.07	1.93	71.56	0.17	0.10	1.00	0.02	12.21	0.01	94.22
	1123B_6H-6_50-52_2	4.28	2.92	2.00	71.81	0.16	0.09	1.00	0.11	12.33	0.01	94.70
	1123B_6H-6_50-52_3	4.22	2.94	1.88	71.80	0.16	0.12	1.03	0.08	12.07	0.03	94.34
	1123B_6H-6_50-52_4	4.30	2.99	1.74	72.55	0.14	0.12	0.98	0.09	12.39	0.05	95.36
	1123B_6H-6_50-52_5	3.25	3.60	1.24	73.44	0.12	0.06	0.84	0.04	11.53	0.00	94.13
	1123B_6H-6_50-52_6	4.17	3.01	1.97	72.01	0.16	0.09	1.00	0.09	12.55	0.02	95.07
	1123B_6H-6_50-52_7	4.03	2.92	1.99	71.20	0.14	0.08	1.01	0.06	12.01	0.03	93.48
	1123B_6H-6_50-52_8	4.17	2.98	1.86	71.85	0.20	0.13	1.04	0.15	12.15	0.01	94.54
	1123B_6H-6_50-52_9	4.18	3.08	1.98	72.20	0.13	0.13	0.98	0.15	12.29	0.00	95.12
	1123B_6H-6_50-52_10	4.36	2.99	2.01	71.74	0.18	0.12	1.01	0.06	12.30	0.00	94.77
	1123B_6H-6_50-52_11	4.27	2.94	1.99	71.88	0.16	0.11	0.98	0.10	12.26	0.03	94.72
	1123B_6H-6_50-52_12	4.29	3.00	1.95	72.30	0.13	0.11	1.06	0.08	12.28	0.05	95.25
	1123B_6H-6_50-52_13	4.39	2.86	2.13	71.74	0.17	0.11	1.02	0.07	12.38	0.01	94.88
	1123B_6H-6_50-52_14	3.62	3.61	1.26	74.14	0.07	0.08	0.81	0.00	11.52	0.00	95.11
	1123B_6H-6_50-52_15	4.01	3.15	1.97	71.66	0.15	0.09	1.08	0.07	12.23	0.01	94.42
	1123B_6H-6_50-52_16	4.27	2.96	1.90	72.35	0.17	0.10	1.05	0.13	12.35	0.00	95.28
	1123B_6H-6_50-52_17	4.16	3.02	1.92	72.16	0.12	0.10	1.07	0.00	12.37	0.02	94.94
	1123B_6H-6_50-52_18	3.60	3.60	1.07	73.93	0.13	0.07	0.84	0.02	11.82	0.00	95.07
	1123B_6H-6_50-52_19	4.06	3.06	1.85	72.13	0.17	0.10	1.03	0.08	12.13	0.01	94.62
	1123B_6H-6_50-52_20	4.26	2.97	1.91	71.84	0.15	0.13	1.04	0.07	12.28	0.01	94.66
	1123B_6H-6_50-52_2	4.52	2.99	1.81	70.14	0.18	0.10	0.97	0.09	12.31	0.02	93.13
	1123B_6H-6_50-52_3	4.65	2.89	2.00	69.79	0.14	0.12	1.00	0.10	12.25	0.02	92.96
	1123B_6H-6_50-52_4	3.62	3.41	1.64	69.50	0.10	0.08	1.04	0.00	12.14	0.02	91.55
	1123B_6H-6_50-52_10	4.16	3.18	1.98	69.13	0.19	0.08	0.97	0.08	12.38	0.03	92.18
	1123B_6H-6_50-52_12	4.32	2.99	2.01	70.01	0.17	0.10	0.98	0.07	12.27	0.04	92.96
	1123B_6H-6_50-52_6	4.49	3.06	2.01	70.15	0.18	0.09	1.04	0.02	12.02	0.02	93.08
	1123B_6H-6_50-52_7	4.46	3.04	1.88	71.12	0.17	0.09	1.07	0.09	12.60	0.01	94.53
	1123B_6H-6_50-52_8	4.56	3.01	1.99	70.63	0.18	0.13	0.99	0.07	12.15	0.03	93.74
	1123B_6H-6_50-52_9	4.08	2.98	2.12	70.34	0.17	0.10	1.04	0.10	12.20	0.00	93.14
	1123B_6H-6_59-61_1	3.48	3.31	1.94	67.39	0.24	0.26	1.61	0.04	12.49	0.00	90.77
	1123B_6H-6_59-61_2	4.02	2.97	1.87	69.96	0.25	0.24	1.71	0.05	12.54	0.03	93.64
	1123B_6H-6_59-61_3	4.02	3.18	1.52	71.84	0.09	0.04	1.07	0.06	11.99	0.05	93.86
	1123B_6H-6_59-61_4	4.02	3.59	1.29	73.36	0.10	0.11	0.87	0.00	11.50	0.03	94.86
	1123B_6H-6_59-61_5	4.02	3.16	1.54	69.11	0.18	0.19	1.31	0.04	11.67	0.01	91.22
	1123B_6H-6_59-61_6	4.06	3.28	1.49	72.80	0.16	0.14	1.21	0.01	12.24	0.01	95.40
	1123B_6H-6_59-61_7	3.54	3.80	1.34	73.89	0.14	0.09	0.85	0.00	11.59	0.00	95.24
	1123B_6H-6_59-61_8	4.18	3.15	1.93	70.94	0.23	0.28	1.57	0.08	12.62	0.03	95.01
	1123B_6H-6_59-61_9	4.10	3.35	1.56	71.97	0.12	0.05	1.08	0.00	12.36	0.02	94.61
	1123B_6H-6_59-61_10	4.10	2.92	2.06	69.63	0.25	0.29	1.72	0.09	12.96	0.05	94.06
	1123B_6H-6_59-61_11	4.30	3.43	1.59	73.25	0.09	0.08	0.93	0.03	11.98	0.02	95.70
	1123B_6H-6_59-61_12	4.42	3.06	1.75	69.91	0.22	0.26	1.70	0.01	12.86	0.03	94.22
	1123B_6H-6_59-61_13	3.83	3.21	1.54	71.08	0.17	0.18	1.27	0.09	12.16	0.03	93.56
	1123B_6H-6_59-61_14	3.99	3.81	1.09	73.45	0.10	0.10	0.93	0.01	11.79	0.00	95.28
	1123B_6H-6_59-61_15	3.74	3.80	1.23	72.84	0.11	0.11	0.84	0.00	11.80	0.00	94.47
	1123B_6H-6_59-61_16	3.90	3.61	1.11	73.83	0.11	0.08	0.99	0.08	11.55	0.02	95.29
	1123B_6H-6_59-61_17	3.84	3.79	1.63	73.56	0.10	0.11	0.89	0.07	11.61	0.03	95.63
	1123B_6H-6_59-61_18	4.32	2.94	1.94	69.71	0.24	0.26	1.68	0.04	12.72	0.05	93.90
	1123B_6H-6_59-61_19	3.63	3.76	1.19	73.41	0.12	0.07	0.94	0.02	11.41	0.02	94.56
	1123B_6H-6_59-61_20	3.70	3.64	1.03	73.52	0.10	0.05	0.89	0.05	11.44	0.01	94.44
s63	1123B_6H-6_137-139_1	4.41	3.11	1.99	70.30	0.27	0.32	1.66	0.03	13.22	0.08	95.38
	1123B_6H-6_137-139_2	4.44	2.97	1.88	70.50	0.18	0.21	1.56	0.07	13.13	0.04	94.99
	1123B_6H-6_137-139_3	4.02	2.96	1.87	67.38	0.24	0.22	1.53	0.00	12.54	0.01	90.78
	1123B_6H-6_137-139_4	4.22	2.98	1.93	70.77	0.28	0.27	1.66	0.00	12.73	0.04	94.87
	1123B_6H-6_137-139_5	4.24	3.07	2.08	71.07	0.22	0.21	1.52	0.07	13.03	0.03	95.54
	1123B_6H-6_137-139_6	4.14	2.93	2.09	70.25	0.23	0.28	1.66	0.08	12.91	0.02	94.59
	1123B_6H-6_137-139_7	4.40	2.91	2.02	71.07	0.25	0.27	1.65	0.03	13.12	0.00	95.72
	1123B_6H-6_137-139_8	4.22	2.92	2.09	70.58	0.24	0.27	1.65	0.08	13.06	0.02	95.13
	1123B_6H-6_137-139_9	4.21	2.96	1.72	70.50	0.21	0.24	1.49	0.08	12.73	0.05	94.20
	1123B_6H-6_137-139_10	4.11	3.08	2.09	70.74	0.22	0.27	1.68	0.02	13.06	0.04	95.32
	1123B_6H-6_137-139_11	4.45	2.98	1.98	71.43	0.23	0.23	1.66	0.06	13.27	0.03	96.32
	1123B_6H-6_137-139_12	4.37	3.04	2.10	70.54	0.24	0.24	1.64	0.00	12.96	0.01	95.13
	1123B_6H-6_137-139_13	4.11	3.09	1.96	69.64	0.24	0.28	1.65	0.03	13.03	0.02	94.06
	1123B_6H-6_137-139_14	4.34	3.00	1.89	70.04	0.27	0.28	1.67	0.03	12.80	0.03	94.35
	1123B_6H-6_137-139_15	4.13	3.00	2.01	70.37	0.25	0.23	1.64	0.01	12.99	0.02	94.65

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s70	1123B_6H-6_137-139_16	4.39	2.93	1.97	70.40	0.21	0.28	1.59	0.07	13.10	0.03	94.97
	1123B_6H-6_137-139_17	4.40	3.11	1.94	70.08	0.27	0.30	1.64	0.05	12.89	0.04	94.71
	1123B_6H-6_137-139_18	4.29	3.00	1.89	69.97	0.26	0.29	1.73	0.02	12.75	0.03	94.23
	1123B_6H-6_137-139_19	4.20	3.06	1.98	69.15	0.26	0.27	1.72	0.02	12.94	0.02	93.61
	1123B_6H-6_137-139_20	4.39	3.00	1.87	68.25	0.23	0.30	1.67	0.09	12.78	0.03	92.61
	1123B_6H-6_137-139_3	3.92	3.20	1.77	68.52	0.22	0.22	1.52	0.05	12.83	0.00	92.24
	1123B_6H-6_137-139_4	4.17	3.15	1.81	69.07	0.23	0.25	1.58	0.03	12.64	0.02	92.96
	1123B_6H-6_137-139_6	4.00	3.06	2.03	69.08	0.25	0.27	1.75	0.10	13.22	0.05	93.80
	1123B_6H-6_137-139_7	4.29	2.99	1.96	69.74	0.22	0.27	1.67	0.04	13.39	0.04	94.61
	1123B_6H-6_137-139_5	3.96	3.16	1.96	69.93	0.21	0.21	1.56	0.09	12.83	0.01	93.93
	1123B_6H-6_137-139_8	4.05	2.97	2.06	68.71	0.25	0.27	1.72	0.05	13.15	0.03	93.26
	1123B_6H-6_137-139_9	3.73	2.94	1.86	67.27	0.24	0.25	1.57	0.04	13.08	0.00	90.98
	1123B_6H-6_137-139_10	3.93	2.97	2.16	68.09	0.24	0.32	1.67	0.00	13.20	0.07	92.65
	1123B_6H-6_137-139_11	4.14	2.95	2.04	68.41	0.26	0.27	1.65	0.03	12.95	0.06	92.76
	1123B_7H-1_129-131_1	4.24	3.31	1.63	72.62	0.13	0.11	1.03	0.01	12.32	0.01	95.41
	1123B_7H-1_129-131_2	4.18	3.38	1.50	72.72	0.12	0.04	0.97	0.02	12.27	0.00	95.20
	1123B_7H-1_129-131_3	4.45	3.21	1.49	71.75	0.13	0.12	1.03	0.00	12.12	0.01	94.31
	1123B_7H-1_129-131_4	4.06	3.36	1.54	72.38	0.09	0.07	0.99	0.11	12.05	0.01	94.65
	1123B_7H-1_129-131_5	4.70	3.08	1.94	71.41	0.15	0.13	1.23	0.14	12.69	0.02	95.50
	1123B_7H-1_129-131_6	3.92	3.40	1.23	74.26	0.16	0.11	0.89	0.01	11.39	0.03	95.40
	1123B_7H-1_129-131_7	4.16	3.25	1.75	72.68	0.09	0.11	1.03	0.04	12.22	0.02	95.36
	1123B_7H-1_129-131_8	3.70	3.71	1.27	71.23	0.08	0.08	0.87	0.00	11.90	0.01	92.85
	1123B_7H-1_129-131_9	4.17	3.35	1.66	72.89	0.10	0.10	0.98	0.03	12.10	0.00	95.37
	1123B_7H-1_129-131_10	4.39	3.40	1.55	73.09	0.09	0.07	0.92	0.06	12.20	0.04	95.81
	1123B_7H-1_129-131_11	4.55	3.27	1.62	71.92	0.10	0.08	1.00	0.06	12.12	0.03	94.74
	1123B_7H-1_129-131_12	4.15	3.36	1.48	72.71	0.08	0.06	0.94	0.01	12.04	0.02	94.85
	1123B_7H-1_129-131_13	4.42	3.24	1.85	72.69	0.11	0.06	1.00	0.06	12.19	0.00	95.62
	1123B_7H-1_129-131_14	4.04	3.39	1.59	72.35	0.13	0.08	0.96	0.05	12.30	0.00	94.90
	1123B_7H-1_129-131_15	4.24	3.38	1.76	72.33	0.12	0.09	1.04	0.05	12.18	0.01	95.19
	1123B_7H-1_129-131_16	4.31	3.37	1.60	72.39	0.09	0.05	1.00	0.08	12.22	0.00	95.11
	1123B_7H-1_129-131_17	4.40	3.30	1.79	71.61	0.10	0.04	1.02	0.00	12.33	0.04	94.62
	1123B_7H-1_129-131_18	4.24	3.33	1.66	72.47	0.13	0.09	1.02	0.11	12.28	0.00	95.33
	1123B_7H-1_129-131_19	4.27	3.22	1.68	71.96	0.10	0.07	1.07	0.06	12.20	0.01	94.63
	1123B_7H-1_129-131_20	4.41	3.45	1.37	73.33	0.07	0.09	0.87	0.04	11.95	0.04	95.61
s72*	1123B_7H-1_129-131_1	4.11	3.36	1.58	71.33	0.19	0.07	1.02	0.04	12.23	0.01	93.95
	1123B_7H-1_129-131_2	4.33	3.33	1.61	70.90	0.17	0.08	0.99	0.10	12.19	0.00	93.70
	1123B_7H-1_129-131_3	3.96	3.39	1.58	72.22	0.09	0.09	0.91	0.08	12.00	0.00	94.31
	1123B_7H-1_129-131_7	4.05	3.47	1.57	72.70	0.16	0.04	0.89	0.00	12.17	0.02	95.06
	1123B_7H-1_129-131_10	4.01	3.37	1.59	70.45	0.09	0.07	0.93	0.04	11.89	0.03	92.47
	1123B_7H-1_129-131_4	3.98	3.23	1.76	70.24	0.16	0.11	1.03	0.00	12.19	0.04	92.74
	1123B_7H-1_129-131_5	3.90	3.29	1.49	71.52	0.13	0.03	0.92	0.09	11.74	0.03	93.14
	1123B_7H-1_129-131_6	4.02	3.36	1.76	71.67	0.19	0.05	1.06	0.02	12.38	0.00	94.52
	1123B_7H-1_129-131_8	3.86	3.28	1.57	71.58	0.14	0.06	0.93	0.00	11.96	0.00	93.38
	1123B_7H-1_129-131_9	3.91	3.24	1.67	70.86	0.16	0.09	1.01	0.03	12.20	0.02	93.20
	1123B_7H-2_38-40_1	3.92	3.29	1.54	71.79	0.15	0.18	1.14	0.04	12.27	0.01	94.33
	1123B_7H-2_38-40_2	3.99	3.13	1.46	72.29	0.19	0.13	1.19	0.04	12.35	0.04	94.80
	1123B_7H-2_38-40_3	3.88	2.98	1.91	68.78	0.23	0.28	1.69	0.06	12.93	0.00	92.74
	1123B_7H-2_38-40_4	3.89	3.31	1.60	72.42	0.20	0.16	1.22	0.10	12.41	0.02	95.33
	1123B_7H-2_38-40_5	3.89	3.26	1.64	72.02	0.17	0.15	1.19	0.11	12.53	0.02	94.98
	1123B_7H-2_38-40_6	3.80	2.92	1.85	69.87	0.20	0.27	1.70	0.02	12.93	0.04	93.60
	1123B_7H-2_38-40_7	3.87	3.00	1.98	70.03	0.25	0.28	1.71	0.04	12.78	0.05	93.98
	1123B_7H-2_38-40_8	3.83	3.11	1.48	72.09	0.15	0.17	1.19	0.01	12.38	0.02	94.43
	1123B_7H-2_38-40_9	3.36	3.66	1.13	73.92	0.11	0.10	0.86	0.03	11.35	0.00	94.53
	1123B_7H-2_38-40_10	3.76	3.20	1.60	71.94	0.17	0.13	1.18	0.04	12.16	0.00	94.18
	1123B_7H-2_38-40_11	3.60	2.88	1.96	68.59	0.25	0.28	1.64	0.13	12.87	0.03	92.23
	1123B_7H-2_38-40_12	3.88	3.03	2.16	68.74	0.24	0.30	1.70	0.04	13.01	0.01	93.11
	1123B_7H-2_38-40_13	3.87	2.97	1.87	69.01	0.24	0.29	1.68	0.05	12.91	0.03	92.93
	1123B_7H-2_38-40_14	3.92	3.05	2.05	69.73	0.21	0.25	1.67	0.10	12.72	0.02	93.72
	1123B_7H-2_38-40_15	3.74	3.38	1.68	72.74	0.16	0.22	1.21	0.15	12.26	0.01	95.55
	1123B_7H-2_38-40_16	4.12	3.21	1.68	71.47	0.17	0.16	1.20	0.09	12.36	0.00	94.46
	1123B_7H-2_38-40_17	3.78	3.19	1.85	69.51	0.25	0.26	1.64	0.04	12.68	0.01	93.22
	1123B_7H-2_38-40_18	3.98	3.17	1.66	71.66	0.14	0.17	1.19	0.04	12.28	0.01	94.30
	1123B_7H-2_38-40_19	3.71	3.57	1.61	72.16	0.17	0.16	1.16	0.06	12.47	0.00	95.06
	1123B_7H-2_38-40_20	3.79	2.96	2.22	70.57	0.25	0.25	1.69	0.04	12.99	0.03	94.80
	1123B_7H-2_38-40_1	4.02	2.87	2.06	68.26	0.32	0.26	1.66	0.05	12.78	0.01	92.29
	1123B_7H-2_38-40_8	3.86	2.93	1.81	69.40	0.30	0.20	1.52	0.01	12.54	0.02	92.59
	1123B_7H-2_38-40_9	4.21	2.92	2.02	70.00	0.37	0.31	1.68	0.10	13.12	0.04	94.76
	1123B_7H-2_38-40_6	3.96	3.04	1.56	70.13	0.27	0.19	1.24	0.05	12.25	0.01	92.69
	1123B_7H-2_38-40_7	3.88	3.29	1.57	70.97	0.24	0.09	1.18	0.01	12.18	0.07	93.48
	1123B_7H-2_38-40_4	4.05	3.08	1.45	71.18	0.26	0.17	1.24	0.06	12.33	0.00	93.82

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s74	1123B_7H-2_38-40_3	4.20	3.14	1.94	69.94	0.33	0.28	1.71	0.02	12.98	0.06	94.60
	1123B_7H-2_38-40_5	4.01	2.97	2.11	69.83	0.36	0.26	1.74	0.05	12.96	0.05	94.34
	1123B_7H-2_38-40_10	4.25	3.00	1.92	69.60	0.36	0.28	1.71	0.10	13.07	0.03	94.32
	1123B_7H-2_88-90_1	3.64	3.76	1.32	73.41	0.10	0.09	0.84	0.01	12.01	0.02	95.20
	1123B_7H-2_88-90_2	3.81	3.65	1.28	72.78	0.09	0.10	0.84	0.07	11.64	0.02	94.29
	1123B_7H-2_88-90_3	3.60	3.49	1.26	73.31	0.11	0.11	0.90	0.01	11.55	0.01	94.35
	1123B_7H-2_88-90_4	3.71	3.77	1.44	73.16	0.12	0.12	0.86	0.02	11.70	0.00	94.91
	1123B_7H-2_88-90_5	3.24	3.84	1.22	72.25	0.12	0.10	0.93	0.00	11.57	0.01	93.27
	1123B_7H-2_88-90_6	3.49	3.69	1.10	73.40	0.12	0.08	0.89	0.03	11.84	0.01	94.65
	1123B_7H-2_88-90_7	3.35	3.77	1.36	73.39	0.08	0.10	0.94	0.04	11.64	0.01	94.69
	1123B_7H-2_88-90_8	3.56	3.66	1.31	74.20	0.12	0.11	0.93	0.00	11.68	0.00	95.56
	1123B_7H-2_88-90_9	3.57	3.57	1.13	73.56	0.13	0.09	0.89	0.04	11.68	0.00	94.66
	1123B_7H-2_88-90_10	3.49	3.77	1.19	73.44	0.10	0.07	0.85	0.03	11.72	0.00	94.66
	1123B_7H-2_88-90_11	3.44	3.34	1.19	73.07	0.14	0.11	0.92	0.02	11.57	0.02	93.82
	1123B_7H-2_88-90_12	3.63	3.64	1.21	73.21	0.12	0.11	0.89	0.03	11.63	0.00	94.47
	1123B_7H-2_88-90_13	3.34	3.42	1.18	73.20	0.12	0.07	0.84	0.08	11.64	0.00	93.90
	1123B_7H-2_88-90_14	3.96	3.69	1.10	72.92	0.12	0.07	0.81	0.01	11.85	0.00	94.53
	1123B_7H-2_88-90_15	3.68	3.36	1.22	73.69	0.08	0.14	0.93	0.00	11.61	0.00	94.72
	1123B_7H-2_88-90_16	3.65	3.82	1.36	73.43	0.11	0.10	0.84	0.03	11.80	0.02	95.14
	1123B_7H-2_88-90_17	3.74	3.70	1.22	73.32	0.13	0.10	0.93	0.00	11.66	0.01	94.80
s78	1123B_7H-2_88-90_18	3.42	3.67	1.30	72.77	0.10	0.09	0.82	0.05	11.69	0.02	93.93
	1123B_7H-2_88-90_19	3.40	3.92	1.23	72.67	0.11	0.06	0.79	0.07	11.87	0.02	94.15
	1123B_7H-2_88-90_20	3.51	3.37	1.36	72.95	0.12	0.09	0.94	0.02	11.56	0.04	93.96
	1123B_7H-4_93-95_1	4.66	3.17	1.95	71.27	0.14	0.07	0.97	0.07	12.42	0.01	94.73
	1123B_7H-4_93-95_2	4.68	3.24	2.02	70.51	0.18	0.09	1.00	0.11	12.41	0.00	94.23
	1123B_7H-4_93-95_3	4.41	3.25	2.00	70.51	0.16	0.05	1.00	0.02	12.27	0.00	93.68
	1123B_7H-4_93-95_4	4.73	3.33	2.25	71.98	0.18	0.06	1.00	0.02	12.73	0.03	96.30
	1123B_7H-4_93-95_5	4.69	3.34	2.07	70.68	0.18	0.07	1.03	0.01	12.55	0.00	94.62
	1123B_7H-4_93-95_6	4.73	3.29	2.18	70.09	0.15	0.08	1.02	0.16	12.50	0.02	94.21
	1123B_7H-4_93-95_7	4.77	3.28	2.16	71.18	0.17	0.10	0.97	0.03	12.61	0.00	95.27
	1123B_7H-4_93-95_8	4.69	3.29	2.19	70.57	0.15	0.09	0.99	0.06	12.39	0.02	94.44
	1123B_7H-4_93-95_9	4.60	3.25	2.09	70.43	0.14	0.10	1.01	0.10	12.45	0.01	94.18
	1123B_7H-4_93-95_10	2.04	3.07	2.26	71.12	0.17	0.12	1.25	0.08	12.99	0.03	93.12
	1123B_7H-4_93-95_11	4.79	3.10	2.15	70.02	0.14	0.09	0.95	0.03	12.43	0.02	93.71
	1123B_7H-4_93-95_12	4.62	3.10	1.97	69.92	0.15	0.07	1.03	0.01	12.47	0.04	93.38
	1123B_7H-4_93-95_13	4.62	3.11	2.02	70.26	0.15	0.08	1.05	0.05	12.33	0.00	93.67
	1123B_7H-4_93-95_14	4.96	3.13	1.99	70.48	0.15	0.08	1.07	0.07	12.46	0.01	94.40
	1123B_7H-4_93-95_15	4.85	3.35	2.30	70.64	0.15	0.07	1.00	0.15	12.53	0.04	95.08
	1123B_7H-4_93-95_16	4.93	3.05	2.15	69.84	0.15	0.08	0.99	0.06	12.61	0.04	93.90
	1123B_7H-4_93-95_17	4.84	3.13	2.09	70.31	0.15	0.10	1.04	0.05	12.31	0.03	94.04
s79	1123B_7H-4_93-95_18	4.47	3.25	2.07	70.79	0.15	0.11	1.04	0.03	12.28	0.00	94.19
	1123B_7H-4_93-95_19	4.46	3.40	2.17	70.41	0.16	0.10	1.03	0.00	12.49	0.00	94.23
	1123B_7H-4_93-95_20	4.81	3.32	2.03	70.82	0.16	0.04	1.04	0.07	12.55	0.01	94.86
	1123B_7H-4_145-147_1	4.43	3.11	2.21	70.73	0.18	0.12	1.13	0.09	12.73	0.01	94.73
	1123B_7H-4_145-147_2	4.43	3.14	2.33	70.90	0.17	0.11	1.13	0.05	12.77	0.01	95.04
	1123B_7H-4_145-147_3	4.45	2.98	2.19	70.18	0.19	0.13	1.14	0.03	12.72	0.01	94.01
	1123B_7H-4_145-147_4	4.21	2.90	2.27	70.43	0.16	0.17	1.17	0.07	12.73	0.00	94.11
	1123B_7H-4_145-147_5	4.40	3.09	2.11	70.94	0.16	0.15	1.13	0.14	12.78	0.03	94.93
	1123B_7H-4_145-147_6	4.45	3.02	2.23	70.03	0.17	0.13	1.13	0.09	12.59	0.00	93.83
	1123B_7H-4_145-147_7	4.20	3.00	2.28	69.82	0.16	0.11	1.17	0.08	13.00	0.05	93.87
	1123B_7H-4_145-147_8	4.29	2.97	2.15	70.12	0.17	0.13	1.09	0.10	12.78	0.01	93.81
	1123B_7H-4_145-147_9	4.56	3.16	2.25	70.53	0.16	0.10	1.12	0.06	13.02	0.00	94.97
	1123B_7H-4_145-147_10	4.52	3.12	2.22	69.79	0.17	0.10	1.13	0.11	12.48	0.03	93.67
	1123B_7H-4_145-147_11	4.13	3.04	2.15	69.74	0.16	0.10	1.12	0.12	12.80	0.00	93.36
	1123B_7H-4_145-147_12	4.18	3.10	2.13	70.08	0.15	0.13	1.09	0.09	12.78	0.01	93.73
	1123B_7H-4_145-147_13	4.31	3.17	2.28	70.81	0.14	0.09	1.16	0.09	12.73	0.06	94.84
	1123B_7H-4_145-147_14	3.92	3.42	2.03	70.60	0.14	0.08	1.01	0.10	12.60	0.03	93.93
	1123B_7H-4_145-147_15	4.47	3.08	2.22	70.96	0.18	0.09	1.13	0.14	12.93	0.01	95.21
	1123B_7H-4_145-147_16	4.29	3.03	2.32	70.15	0.16	0.14	1.10	0.10	12.75	0.00	94.05
	1123B_7H-4_145-147_17	4.14	2.95	2.15	69.96	0.16	0.13	1.13	0.07	12.52	0.02	93.25
	1123B_7H-4_145-147_18	4.18	3.20	2.08	71.17	0.18	0.09	1.12	0.11	12.94	0.00	95.07
	1123B_7H-4_145-147_19	4.07	3.02	2.09	70.23	0.15	0.08	1.12	0.07	12.72	0.02	93.57
	1123B_7H-4_145-147_20	4.22	2.96	2.24	70.29	0.17	0.11	1.12	0.04	12.61	0.04	93.80
	1123B_7H-5_75-77_1	4.32	3.28	1.85	71.82	0.15	0.09	1.08	0.11	12.49	0.04	95.24
	1123B_7H-5_75-77_2	4.25	3.29	1.94	70.78	0.14	0.11	1.08	0.05	12.54	0.00	94.18
	1123B_7H-5_75-77_3	4.44	3.33	2.00	71.45	0.14	0.09	1.02	0.10	12.44	0.03	95.04
	1123B_7H-5_75-77_4	3.86	3.29	2.14	70.95	0.11	0.04	1.11	0.05	12.34	0.02	93.89
	1123B_7H-5_75-77_5	4.52	3.36	2.04	71.40	0.16	0.06	1.09	0.16	12.50	0.01	95.30
	1123B_7H-5_75-77_6	3.56	4.19	1.84	70.78	0.14	0.09	1.04	0.04	12.54	0.02	94.24
	1123B_7H-5_75-77_7	4.21	3.19	1.96	70.55	0.13	0.08	1.05	0.07	12.45	0.01	93.71

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s81	1123B_7H-5_75-77_8	4.36	3.21	1.96	71.12	0.17	0.10	1.08	0.02	12.40	0.04	94.47
	1123B_7H-5_75-77_10	4.10	3.31	2.18	71.78	0.15	0.10	0.98	0.09	12.66	0.03	95.39
	1123B_7H-5_75-77_11	4.48	3.32	1.96	71.02	0.17	0.06	1.09	0.06	12.65	0.00	94.80
	1123B_7H-5_75-77_12	4.19	3.23	1.94	70.58	0.18	0.09	1.04	0.05	12.58	0.02	93.91
	1123B_7H-5_75-77_13	4.14	3.33	2.05	71.02	0.14	0.08	1.06	0.07	12.40	0.06	94.35
	1123B_7H-5_75-77_14	4.09	3.32	2.12	71.07	0.16	0.06	1.00	0.06	12.60	0.03	94.50
	1123B_7H-5_75-77_15	4.19	3.26	2.10	70.85	0.14	0.12	1.03	0.10	12.36	0.04	94.18
	1123B_7H-5_75-77_16	4.20	3.36	2.16	71.04	0.16	0.13	1.05	0.08	12.45	0.01	94.65
	1123B_7H-5_75-77_17	4.27	3.37	2.05	71.43	0.13	0.10	1.02	0.08	12.65	0.00	95.10
	1123B_7H-5_75-77_18	4.18	3.28	1.99	71.13	0.15	0.07	1.04	0.04	12.43	0.01	94.32
	1123B_7H-5_75-77_19	4.11	3.34	1.99	69.93	0.14	0.10	1.03	0.12	12.45	0.03	93.25
	1123B_7H-5_75-77_20	4.30	3.11	2.13	70.69	0.14	0.08	1.01	0.09	12.45	0.00	94.01
	1123B_7H-5_115-117_1	4.04	3.34	1.96	69.91	0.11	0.10	0.95	0.05	12.71	0.03	93.20
	1123B_7H-5_115-117_2	4.50	3.24	1.96	71.09	0.13	0.07	0.98	0.03	12.68	0.03	94.71
	1123B_7H-5_115-117_3	4.21	3.32	2.05	70.46	0.16	0.06	0.98	0.02	12.65	0.00	93.91
	1123B_7H-5_115-117_4	4.22	3.17	1.89	70.66	0.15	0.09	0.99	0.07	12.63	0.00	93.87
	1123B_7H-5_115-117_5	4.05	3.30	2.09	70.10	0.15	0.06	0.96	0.06	12.81	0.01	93.60
	1123B_7H-5_115-117_6	4.24	3.14	2.06	70.52	0.13	0.08	0.92	0.08	12.77	0.03	93.98
	1123B_7H-5_115-117_7	4.23	3.22	1.94	70.07	0.13	0.09	1.00	0.07	12.46	0.03	93.24
	1123B_7H-5_115-117_8	4.12	3.04	1.99	69.09	0.12	0.07	0.95	0.10	12.66	0.03	92.16
	1123B_7H-5_115-117_9	4.14	3.32	1.89	69.78	0.16	0.07	0.97	0.08	12.58	0.00	92.98
s82	1123B_7H-5_115-117_10	4.42	3.23	2.02	70.72	0.15	0.11	0.99	0.09	12.68	0.01	94.40
	1123B_7H-5_115-117_11	4.25	3.25	2.16	70.82	0.15	0.06	1.00	0.04	12.50	0.03	94.25
	1123B_7H-5_115-117_12	4.23	3.32	2.03	70.77	0.12	0.09	1.02	0.03	12.75	0.01	94.38
	1123B_7H-5_115-117_13	4.46	3.21	2.03	70.92	0.13	0.12	1.00	0.09	12.69	0.03	94.68
	1123B_7H-5_115-117_14	4.01	3.26	1.89	69.86	0.12	0.08	0.95	0.01	12.62	0.00	92.79
	1123B_7H-5_115-117_15	4.25	3.49	1.88	70.92	0.16	0.10	1.00	0.04	12.54	0.02	94.40
	1123B_7H-5_115-117_16	4.13	3.26	1.79	70.06	0.13	0.08	0.97	0.11	12.52	0.00	93.05
	1123B_7H-5_115-117_17	4.25	3.16	2.04	70.18	0.13	0.10	1.00	0.15	12.52	0.02	93.55
	1123B_7H-5_115-117_18	4.36	3.28	2.17	70.33	0.12	0.09	0.94	0.07	12.55	0.01	93.92
	1123B_7H-5_115-117_19	4.64	3.19	2.01	69.77	0.12	0.09	0.94	0.09	12.26	0.02	93.13
	1123B_7H-5_115-117_20	4.25	3.10	2.04	69.92	0.14	0.06	0.99	0.09	12.39	0.01	92.99
	1123B_7H-6_13-15_1	3.81	3.39	1.05	73.37	0.08	0.06	1.10	0.03	12.07	0.00	94.96
	1123B_7H-6_13-15_2	3.68	3.40	1.02	72.81	0.07	0.08	1.03	0.07	11.73	0.03	93.91
	1123B_7H-6_13-15_3	3.73	4.17	0.87	73.85	0.00	0.05	0.63	0.05	11.73	0.00	95.08
	1123B_7H-6_13-15_4	3.50	3.41	1.07	73.80	0.08	0.10	1.04	0.03	11.95	0.01	94.99
	1123B_7H-6_13-15_5	3.59	3.67	1.06	73.44	0.07	0.05	1.06	0.07	12.16	0.00	95.17
	1123B_7H-6_13-15_6	3.60	3.72	0.86	73.37	0.05	0.05	0.84	0.07	11.78	0.02	94.35
	1123B_7H-6_13-15_7	3.81	3.76	1.00	72.84	0.04	0.01	0.85	0.00	11.82	0.02	94.15
	1123B_7H-6_13-15_8	3.63	3.68	1.00	74.04	0.04	0.08	0.90	0.00	11.90	0.03	95.30
	1123B_7H-6_13-15_9	3.77	3.45	1.18	73.26	0.03	0.08	1.08	0.00	12.04	0.04	94.93
	1123B_7H-6_13-15_10	3.62	3.83	0.87	73.98	0.05	0.03	0.86	0.02	11.97	0.02	95.25
s83	1123B_7H-6_13-15_11	4.74	3.18	2.15	70.60	0.17	0.08	1.01	0.11	12.50	0.00	94.55
	1123B_7H-6_13-15_12	3.53	4.10	0.92	73.41	0.01	0.02	0.74	0.08	11.87	0.00	94.67
	1123B_7H-6_13-15_13	3.56	3.57	1.13	73.70	0.09	0.09	1.10	0.07	11.78	0.00	95.08
	1123B_7H-6_13-15_14	3.71	3.79	0.84	73.98	0.02	0.05	0.84	0.02	11.89	0.00	95.14
	1123B_7H-6_13-15_15	3.55	3.95	0.82	73.93	0.01	0.04	0.87	0.03	11.77	0.03	95.00
	1123B_7H-6_13-15_16	3.77	3.86	0.73	73.85	0.06	0.05	0.82	0.01	11.90	0.00	95.05
	1123B_7H-6_13-15_17	3.53	3.47	1.06	74.01	0.08	0.09	1.02	0.02	12.09	0.00	95.37
	1123B_7H-6_13-15_18	3.63	3.75	0.90	73.30	0.03	0.06	0.83	0.00	11.88	0.00	94.39
	1123B_7H-6_13-15_19	3.63	3.76	0.97	73.35	0.02	0.08	0.83	0.04	11.79	0.00	94.47
	1123B_7H-6_13-15_20	3.76	3.47	1.06	74.13	0.04	0.07	1.06	0.00	11.96	0.01	95.58
	1123B_7H-6_13-15_5	3.47	3.16	1.14	70.82	0.09	0.07	1.08	0.05	11.75	0.01	91.65
	1123B_7H-6_13-15_7	3.51	3.49	1.13	72.89	0.08	0.08	1.09	0.03	12.15	0.00	94.45
	1123B_7H-6_13-15_9	3.51	3.21	1.15	71.64	0.14	0.07	1.07	0.11	11.89	0.00	92.78
	1123B_7H-6_13-15_1	3.60	4.19	0.82	71.32	0.04	0.06	0.64	0.07	11.92	0.00	92.66
	1123B_7H-6_13-15_2	2.79	4.62	0.93	71.77	0.04	0.05	0.84	0.00	11.62	0.00	92.66
	1123B_7H-6_13-15_3	3.41	3.68	1.05	72.17	0.06	0.05	0.84	0.00	11.71	0.00	92.98
	1123B_7H-6_13-15_10	3.62	3.60	0.94	72.13	0.04	0.06	0.85	0.00	11.88	0.03	93.16
	1123B_7H-6_87-89_1	4.42	3.14	2.57	68.86	0.26	0.32	1.72	0.11	13.24	0.07	94.71
	1123B_7H-6_87-89_2	4.58	3.57	1.86	71.36	0.13	0.08	0.91	0.08	12.62	0.01	95.19
	1123B_7H-6_87-89_3	4.50	3.87	1.69	70.51	0.13	0.04	0.90	0.00	12.24	0.01	93.89
	1123B_7H-6_87-89_4	4.81	3.37	2.37	70.28	0.15	0.10	1.17	0.06	13.10	0.04	95.45
	1123B_7H-6_87-89_5	4.54	3.33	2.16	69.71	0.16	0.12	1.18	0.11	12.83	0.03	94.18
	1123B_7H-6_87-89_6	4.64	3.37	2.34	70.53	0.18	0.13	1.19	0.08	12.89	0.00	95.36
	1123B_7H-6_87-89_7	4.54	3.19	2.08	69.43	0.16	0.12	1.12	0.04	12.71	0.02	93.42
	1123B_7H-6_87-89_8	4.68	3.23	2.11	69.73	0.18	0.13	1.19	0.09	12.82	0.02	94.19
	1123B_7H-6_87-89_9	4.49	3.42	2.15	70.74	0.20	0.13	1.14	0.11	12.68	0.00	95.07
	1123B_7H-6_87-89_10	4.66	3.41	2.29	70.71	0.18	0.14	1.20	0.05	13.14	0.06	95.84
	1123B_7H-6_87-89_11	4.72	3.30	2.11	69.24	0.18	0.11	1.18	0.05	13.00	0.05	93.95

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s94	1123B_7H-6_87-89_12	4.75	3.37	2.19	70.03	0.18	0.10	1.18	0.12	13.21	0.03	95.17
	1123B_7H-6_87-89_13	4.49	3.16	2.03	69.09	0.12	0.12	1.12	0.04	12.78	0.02	92.99
	1123B_7H-6_87-89_14	4.38	3.41	1.97	69.75	0.13	0.09	1.09	0.05	12.79	0.00	93.68
	1123B_7H-6_87-89_15	4.74	3.26	2.05	68.81	0.17	0.15	1.20	0.04	12.69	0.02	93.13
	1123B_7H-6_87-89_17	4.86	3.30	2.19	69.62	0.16	0.14	1.20	0.04	12.89	0.03	94.43
	1123B_7H-6_87-89_18	4.44	3.42	1.88	70.23	0.11	0.08	1.09	0.05	12.96	0.00	94.27
	1123B_7H-6_87-89_19	4.80	3.34	2.22	69.69	0.20	0.12	1.19	0.12	13.05	0.03	94.76
	1123B_7H-6_87-89_20	4.55	3.42	1.79	71.11	0.13	0.10	1.04	0.07	12.55	0.00	94.77
	1123B_10H-1_36-38_2	4.17	2.86	1.90	71.81	0.17	0.18	1.39	0.09	12.36	0.01	94.94
	1123B_10H-1_36-38_3	3.80	2.85	1.71	71.99	0.20	0.18	1.45	0.04	12.42	0.02	94.66
	1123B_10H-1_36-38_4	4.06	2.73	1.93	71.56	0.22	0.18	1.44	0.05	12.40	0.02	94.59
	1123B_10H-1_36-38_5	4.01	3.02	2.23	69.36	0.29	0.36	1.80	0.01	12.89	0.04	94.00
	1123B_10H-1_36-38_6	3.58	2.73	1.86	71.77	0.21	0.20	1.46	0.06	12.38	0.04	94.29
	1123B_10H-1_36-38_7	3.87	3.17	0.35	73.30	0.12	0.06	1.05	0.04	12.47	0.02	94.44
	1123B_10H-1_36-38_8	4.16	2.83	1.66	73.45	0.17	0.09	1.16	0.07	12.17	0.00	95.76
	1123B_10H-1_36-38_9	3.81	3.16	1.38	74.19	0.06	0.03	1.00	0.00	12.02	0.00	95.65
	1123B_10H-1_36-38_10	3.77	3.25	1.79	73.19	0.15	0.12	1.32	0.03	12.05	0.03	95.70
	1123B_10H-1_36-38_11	3.90	2.81	1.94	72.17	0.20	0.20	1.43	0.02	12.62	0.00	95.29
	1123B_10H-1_36-38_13	4.11	2.71	1.79	72.01	0.18	0.18	1.43	0.00	12.68	0.01	95.10
	1123B_10H-1_36-38_14	3.89	2.82	1.92	71.82	0.21	0.21	1.45	0.06	12.54	0.03	94.95
s95	1123B_10H-1_36-38_15	3.77	3.22	2.01	71.89	0.24	0.19	1.61	0.05	12.93	0.01	95.92
	1123B_10H-1_36-38_16	3.79	3.17	2.38	70.30	0.30	0.34	1.79	0.04	13.09	0.03	95.24
	1123B_10H-1_36-38_17	3.66	3.33	1.37	73.22	0.18	0.15	1.17	0.01	11.90	0.00	95.00
	1123B_10H-1_36-38_18	4.09	2.68	1.77	71.77	0.20	0.20	1.40	0.10	12.36	0.01	94.58
	1123B_10H-1_36-38_19	4.06	2.75	1.87	71.48	0.18	0.17	1.44	0.07	12.46	0.03	94.51
	1123B_10H-1_36-38_20	3.57	3.23	1.59	71.81	0.18	0.20	1.42	0.02	12.24	0.00	94.27
	1123B_10H-1_97-99_1	4.36	3.26	1.82	73.31	0.10	0.10	1.10	0.08	12.30	0.00	96.43
	1123B_10H-1_97-99_2	4.42	2.87	1.83	72.24	0.23	0.18	1.48	0.00	12.34	0.02	95.61
	1123B_10H-1_97-99_3	4.44	3.13	1.49	72.89	0.13	0.06	1.11	0.09	12.25	0.00	95.59
	1123B_10H-1_97-99_4	4.06	3.03	1.92	72.16	0.21	0.22	1.46	0.10	12.25	0.02	95.43
	1123B_10H-1_97-99_5	4.15	3.12	1.68	72.79	0.12	0.10	1.09	0.00	12.12	0.00	95.16
	1123B_10H-1_97-99_6	4.26	3.12	1.78	72.14	0.14	0.06	1.13	0.05	12.19	0.02	94.88
	1123B_10H-1_97-99_7	4.14	2.89	1.82	72.31	0.20	0.19	1.47	0.01	12.61	0.05	95.69
	1123B_10H-1_97-99_8	4.46	3.09	1.71	72.70	0.10	0.07	1.13	0.02	12.37	0.04	95.69
	1123B_10H-1_97-99_9	4.24	3.16	1.66	72.73	0.14	0.08	1.11	0.01	12.27	0.00	95.40
	1123B_10H-1_97-99_10	4.49	3.03	1.80	72.03	0.18	0.23	1.41	0.08	12.86	0.02	96.14
	1123B_10H-1_97-99_11	4.44	2.79	2.22	70.52	0.33	0.44	1.94	0.05	13.48	0.05	96.26
	1123B_10H-1_97-99_12	4.03	3.02	1.66	71.93	0.20	0.23	1.43	0.06	12.42	0.03	95.01
	1123B_10H-1_97-99_13	4.33	2.90	2.08	70.51	0.26	0.27	1.62	0.04	12.85	0.01	94.87
	1123B_10H-1_97-99_14	4.34	2.80	1.90	71.91	0.19	0.22	1.44	0.00	12.64	0.00	95.45
s96	1123B_10H-1_97-99_15	4.20	2.94	1.92	71.63	0.21	0.23	1.49	0.01	12.54	0.04	95.22
	1123B_10H-1_97-99_17	4.17	2.87	1.95	71.72	0.21	0.22	1.45	0.14	12.42	0.03	95.18
	1123B_10H-1_97-99_18	4.42	2.90	1.89	71.68	0.20	0.17	1.51	0.04	12.33	0.02	95.16
	1123B_10H-1_97-99_19	4.23	2.88	1.84	71.72	0.18	0.14	1.42	0.06	12.36	0.02	94.84
	1123B_10H-1_97-99_20	4.24	3.01	1.87	73.17	0.24	0.16	1.45	0.03	12.43	0.04	96.64
	1123B_10H-2_32-34_1	3.12	3.10	1.36	72.88	0.24	0.24	1.45	0.02	11.39	0.04	93.84
	1123B_10H-2_32-34_2	3.39	2.98	1.61	73.16	0.25	0.25	1.49	0.00	11.73	0.01	94.87
	1123B_10H-2_32-34_3	3.36	2.82	1.46	73.60	0.25	0.19	1.49	0.01	11.59	0.01	94.77
	1123B_10H-2_32-34_4	3.28	2.78	1.51	71.35	0.26	0.20	1.47	0.06	11.21	0.02	92.15
	1123B_10H-2_32-34_5	3.11	3.63	1.09	73.43	0.13	0.16	1.02	0.02	11.78	0.01	94.38
	1123B_10H-2_32-34_6	3.06	3.06	1.45	73.19	0.24	0.21	1.51	0.00	11.38	0.02	94.12
	1123B_10H-2_32-34_7	3.26	3.10	1.44	73.65	0.22	0.23	1.49	0.02	11.82	0.01	95.23
	1123B_10H-2_32-34_8	3.16	2.98	1.39	73.01	0.24	0.25	1.48	0.01	11.66	0.01	94.19
	1123B_10H-2_32-34_9	3.29	3.45	1.18	73.42	0.15	0.14	1.07	0.06	11.71	0.01	94.47
	1123B_10H-2_32-34_10	3.39	3.52	1.11	73.68	0.10	0.12	1.11	0.08	11.75	0.00	94.87
	1123B_10H-2_32-34_11	3.32	2.98	1.51	73.23	0.25	0.18	1.47	0.01	11.79	0.04	94.78
	1123B_10H-2_32-34_12	3.30	3.58	1.20	73.79	0.12	0.13	1.08	0.02	11.63	0.04	94.90
	1123B_10H-2_32-34_13	3.41	3.55	1.00	73.91	0.11	0.16	1.09	0.04	11.81	0.00	95.07
	1123B_10H-2_32-34_14	3.43	2.93	1.62	72.85	0.21	0.23	1.47	0.04	11.78	0.04	94.60
	1123B_10H-2_32-34_15	3.34	3.49	1.05	73.39	0.07	0.06	1.00	0.04	11.80	0.03	94.27
s10	1123B_10H-2_32-34_16	3.50	3.01	1.44	73.34	0.24	0.24	1.47	0.08	11.74	0.01	95.06
	1123B_10H-2_32-34_17	3.43	2.90	1.45	73.07	0.25	0.18	1.44	0.07	11.52	0.02	94.33
	1123B_10H-2_32-34_18	2.98	3.42	1.45	72.73	0.23	0.20	1.46	0.07	11.45	0.03	94.03
	1123B_10H-2_32-34_19	3.24	2.94	1.44	73.44	0.25	0.25	1.53	0.00	11.52	0.02	94.64
	1123B_10H-2_32-34_20	3.27	2.87	1.43	72.84	0.25	0.25	1.44	0.04	11.59	0.02	94.00
s10	1123C_1H-1_148-150_1	4.68	2.60	1.09	74.09	0.18	0.17	1.06	0.05	12.36	0.03	96.30
	1123C_1H-1_148-150_2	4.73	2.68	1.28	73.11	0.14	0.20	1.02	0.00	12.08	0.04	95.28
	1123C_1H-1_148-150_3	4.43	2.68	1.13	74.06	0.17	0.17	1.02	0.03	12.15	0.04	95.87
	1123C_1H-1_148-150_4	4.48	2.73	1.09	74.10	0.15	0.16	1.05	0.09	12.20	0.03	96.09
	1123C_1H-1_148-150_5	4.44	2.83	1.23	73.85	0.17	0.14	1.06	0.09	12.24	0.01	96.05

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s11	1123C_1H-1_148-150_6	4.71	2.69	1.12	73.25	0.13	0.15	1.04	0.04	11.97	0.01	95.11
	1123C_1H-1_148-150_7	4.54	2.85	1.12	75.14	0.13	0.12	0.88	0.03	11.88	0.03	96.71
	1123C_1H-1_148-150_8	4.52	2.58	1.25	72.04	0.18	0.22	1.13	0.00	12.21	0.00	94.13
	1123C_1H-1_148-150_9	4.48	2.68	1.11	73.48	0.15	0.19	0.99	0.02	12.26	0.04	95.40
	1123C_1H-1_148-150_10	4.62	2.74	1.30	75.53	0.16	0.15	1.00	0.08	12.51	0.01	98.09
	1123C_1H-1_148-150_11	4.47	2.57	1.28	73.27	0.15	0.11	1.05	0.08	12.19	0.02	95.19
	1123C_1H-1_148-150_12	4.87	2.78	1.16	74.69	0.19	0.22	1.07	0.06	12.61	0.02	97.67
	1123C_1H-1_148-150_13	4.36	2.67	1.19	72.74	0.19	0.19	1.00	0.05	12.10	0.04	94.53
	1123C_1H-1_148-150_14	4.60	2.74	1.28	73.37	0.13	0.16	1.02	0.07	12.29	0.00	95.66
	1123C_1H-1_148-150_15	4.60	2.71	1.09	73.42	0.14	0.16	1.01	0.05	12.23	0.00	95.42
	1123C_1H-1_148-150_16	4.77	2.71	1.15	73.83	0.15	0.18	1.11	0.05	12.40	0.01	96.36
	1123C_1H-1_148-150_17	4.59	2.74	1.25	74.64	0.15	0.16	1.03	0.11	12.10	0.00	96.78
	1123C_1H-1_148-150_18	4.74	2.69	1.25	73.32	0.13	0.18	1.00	0.03	12.26	0.02	95.62
	1123C_1H-1_148-150_19	4.62	2.69	1.20	75.20	0.15	0.17	1.04	0.11	12.52	0.04	97.75
	1123C_1H-1_148-150_20	4.34	2.78	1.17	74.65	0.10	0.11	0.85	0.05	12.04	0.00	96.09
	1123C_1H-1_148-150_2	4.40	2.66	1.08	69.79	0.21	0.15	1.02	0.09	12.38	0.00	91.79
	1123C_1H-1_148-150_3	4.62	2.60	1.26	69.46	0.23	0.15	1.02	0.02	12.04	0.04	91.44
	1123C_1H-1_148-150_4	4.42	2.66	1.26	73.14	0.22	0.15	0.99	0.13	12.42	0.04	95.43
	1123C_1H-1_148-150_9	4.23	2.62	1.14	72.50	0.20	0.14	1.06	0.09	12.21	0.01	94.18
	1123C_1H-1_148-150_6	4.38	2.62	1.01	73.06	0.20	0.14	1.10	0.10	12.13	0.00	94.74
	1123C_1H-1_148-150_7	4.27	2.55	1.11	72.47	0.22	0.14	1.04	0.02	12.11	0.02	93.96
	1123C_1H-1_148-150_8	4.21	2.69	1.09	73.26	0.24	0.17	1.02	0.07	12.17	0.05	94.98
	1123C_1H-1_148-150_10	4.32	2.60	1.34	72.17	0.28	0.19	1.01	0.08	12.09	0.00	94.07
	1123C_1H-2_69-71_1	3.82	3.07	0.90	74.90	0.10	0.11	0.87	0.10	11.90	0.02	95.80
	1123C_1H-2_69-71_2	3.76	2.92	0.79	74.27	0.10	0.12	0.83	0.02	11.70	0.01	94.52
	1123C_1H-2_69-71_3	3.58	2.93	0.91	74.27	0.11	0.12	0.94	0.00	11.71	0.00	94.58
	1123C_1H-2_69-71_4	3.85	3.05	0.91	75.30	0.11	0.10	0.84	0.12	11.71	0.00	96.00
	1123C_1H-2_69-71_5	3.96	2.78	0.98	74.53	0.13	0.14	0.94	0.14	11.67	0.00	95.27
	1123C_1H-2_69-71_6	3.80	2.84	0.89	73.69	0.12	0.13	0.89	0.05	11.41	0.02	93.83
	1123C_1H-2_69-71_7	3.90	2.94	0.90	74.16	0.12	0.16	0.85	0.12	11.72	0.00	94.86
	1123C_1H-2_69-71_8	4.09	2.97	0.94	74.46	0.11	0.12	0.93	0.02	11.72	0.00	95.35
	1123C_1H-2_69-71_9	3.95	2.86	0.84	74.28	0.12	0.09	0.81	0.08	11.77	0.04	94.84
	1123C_1H-2_69-71_10	3.95	2.84	0.87	74.30	0.09	0.17	0.88	0.13	11.85	0.01	95.08
	1123C_1H-2_69-71_11	3.87	2.81	0.78	74.50	0.11	0.14	0.89	0.03	11.61	0.02	94.75
	1123C_1H-2_69-71_12	3.67	2.92	1.00	73.76	0.15	0.15	0.92	0.03	11.61	0.02	94.23
	1123C_1H-2_69-71_13	3.99	2.80	0.85	74.33	0.11	0.12	0.87	0.07	11.77	0.03	94.94
	1123C_1H-2_69-71_14	3.85	2.85	0.89	74.53	0.10	0.09	0.87	0.09	11.72	0.02	95.02
	1123C_1H-2_69-71_15	3.88	2.96	0.89	76.10	0.15	0.13	0.87	0.06	11.79	0.00	96.83
	1123C_1H-2_69-71_16	3.93	2.96	0.82	74.85	0.13	0.14	0.87	0.07	11.69	0.00	95.46
	1123C_1H-2_69-71_17	3.57	2.95	0.84	67.75	0.10	0.11	0.73	0.06	10.70	0.02	86.84
	1123C_1H-2_69-71_18	4.25	2.86	1.00	75.37	0.14	0.14	0.89	0.02	11.72	0.02	96.42
	1123C_1H-2_69-71_19	3.75	2.90	0.80	73.89	0.15	0.15	0.84	0.05	11.53	0.01	94.07
	1123C_1H-2_69-71_20	3.82	2.96	0.81	74.93	0.13	0.13	0.87	0.04	11.91	0.03	95.61
	1123C_1H-2_69-71_1	4.03	2.79	0.76	73.15	0.17	0.12	0.90	0.06	11.54	0.02	93.55
	1123C_1H-2_69-71_10	3.77	2.82	0.95	72.90	0.22	0.10	0.88	0.12	11.49	0.04	93.28
	1123C_1H-2_69-71_6	4.14	3.03	0.80	73.32	0.18	0.13	0.83	0.13	11.46	0.02	94.05
	1123C_1H-2_69-71_7	3.90	3.10	0.79	74.67	0.17	0.12	0.98	0.01	11.74	0.02	95.51
	1123C_1H-2_69-71_3	3.72	2.99	0.93	73.58	0.20	0.13	0.89	0.08	11.65	0.03	94.19
	1123C_1H-2_69-71_4	3.94	2.95	0.78	73.33	0.20	0.12	0.87	0.06	11.67	0.00	93.91
	1123C_1H-2_69-71_5	3.73	2.83	0.83	73.20	0.16	0.10	0.84	0.02	11.68	0.01	93.40
	1123C_1H-2_69-71_9	4.15	3.12	0.77	74.25	0.12	0.08	0.84	0.13	11.74	0.02	95.22
	1123C_2H-2_90-94_1	4.05	3.33	1.49	73.41	0.11	0.07	0.85	0.05	11.82	0.02	95.20
	1123C_2H-2_90-94_2	4.06	3.14	1.47	73.52	0.08	0.09	0.85	0.08	11.81	0.00	95.09
	1123C_2H-2_90-94_3	3.98	3.35	1.38	73.77	0.10	0.05	0.81	0.05	11.94	0.01	95.44
	1123C_2H-2_90-94_4	3.61	3.48	1.23	74.60	0.10	0.08	0.67	0.08	11.70	0.00	95.55
	1123C_2H-2_90-94_5	3.69	3.52	1.20	74.33	0.12	0.08	0.69	0.03	11.49	0.00	95.14
	1123C_2H-2_90-94_6	3.80	3.40	1.25	74.22	0.09	0.06	0.74	0.05	11.64	0.06	95.31
	1123C_2H-2_90-94_7	3.74	3.41	1.33	74.83	0.13	0.03	0.73	0.07	11.69	0.04	95.99
	1123C_2H-2_90-94_8	3.93	3.41	1.35	73.90	0.10	0.08	0.81	0.05	11.76	0.00	95.39
	1123C_2H-2_90-94_9	3.95	3.28	1.37	74.18	0.09	0.02	0.84	0.04	11.83	0.03	95.63
	1123C_2H-2_90-94_10	3.80	3.50	1.34	74.13	0.12	0.06	0.81	0.03	11.87	0.00	95.68
	1123C_2H-2_90-94_11	3.80	3.33	1.54	74.48	0.12	0.06	0.82	0.02	11.76	0.00	95.93
	1123C_2H-2_90-94_12	3.92	3.24	1.39	74.01	0.12	0.02	0.84	0.05	11.77	0.00	95.36
	1123C_2H-2_90-94_13	3.73	3.41	1.23	74.21	0.09	0.02	0.69	0.01	11.48	0.00	94.87
	1123C_2H-2_90-94_14	3.85	3.23	1.30	73.85	0.09	0.06	0.71	0.02	11.44	0.03	94.58
	1123C_2H-2_90-94_15	3.81	3.53	1.21	74.44	0.10	0.07	0.72	0.05	11.33	0.01	95.27
	1123C_2H-2_90-94_16	3.72	3.38	1.31	73.64	0.10	0.08	0.84	0.07	11.70	0.00	94.85
	1123C_2H-2_90-94_17	3.67	3.18	1.27	73.68	0.09	0.05	0.71	0.00	11.37	0.00	94.02
	1123C_2H-2_90-94_18	4.09	3.27	1.44	73.73	0.09	0.04	0.81	0.09	11.62	0.00	95.18
	1123C_2H-2_90-94_19	3.62	3.29	1.56	73.55	0.08	0.06	0.83	0.06	11.76	0.00	94.81

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
sl4	1123C_2H-2_90-94_20	3.76	3.52	1.47	73.67	0.08	0.03	0.81	0.08	11.75	0.00	95.16
	1123C_2H-2_104-109_1	4.00	3.95	1.56	74.31	0.12	0.08	0.51	0.03	11.43	0.00	95.99
	1123C_2H-2_104-109_2	4.45	3.18	1.47	73.85	0.08	0.06	0.79	0.00	11.72	0.02	95.63
	1123C_2H-2_104-109_3	4.04	3.40	1.44	74.41	0.12	0.04	0.80	0.03	11.71	0.02	95.99
	1123C_2H-2_104-109_4	4.28	3.24	1.38	73.42	0.10	0.06	0.78	0.06	11.73	0.04	95.09
	1123C_2H-2_104-109_5	4.19	3.51	1.26	74.40	0.11	0.03	0.68	0.09	11.64	0.01	95.92
	1123C_2H-2_104-109_6	4.31	3.45	1.17	74.28	0.12	0.03	0.62	0.06	11.47	0.00	95.51
	1123C_2H-2_104-109_7	4.27	3.23	1.39	74.17	0.11	0.09	0.84	0.05	11.60	0.01	95.76
	1123C_2H-2_104-109_8	4.24	3.26	1.46	74.00	0.12	0.03	0.79	0.08	11.69	0.00	95.67
	1123C_2H-2_104-109_9	3.77	3.57	1.29	75.33	0.09	0.06	0.74	0.07	11.69	0.01	96.62
	1123C_2H-2_104-109_10	4.24	3.26	1.30	74.78	0.10	0.08	0.71	0.03	11.44	0.00	95.94
	1123C_2H-2_104-109_11	4.35	3.26	1.34	73.71	0.08	0.05	0.79	0.09	11.94	0.00	95.60
	1123C_2H-2_104-109_12	4.45	3.23	1.43	73.62	0.12	0.06	0.82	0.08	11.47	0.00	95.28
	1123C_2H-2_104-109_14	4.46	3.29	1.52	73.87	0.08	0.07	0.85	0.08	11.86	0.00	96.08
	1123C_2H-2_104-109_15	4.45	2.96	1.94	72.15	0.15	0.05	1.03	0.05	11.91	0.01	94.70
	1123C_2H-2_104-109_16	4.16	3.38	1.33	74.55	0.10	0.05	0.83	0.03	12.08	0.03	96.54
	1123C_2H-2_104-109_17	4.05	3.62	1.26	75.68	0.10	0.08	0.69	0.05	11.63	0.02	97.19
	1123C_2H-2_104-109_18	4.07	3.41	1.29	75.13	0.09	0.05	0.71	0.05	11.75	0.00	96.55
	1123C_2H-2_104-109_19	4.51	3.24	1.29	74.07	0.12	0.04	0.82	0.07	11.87	0.02	96.04
	1123C_2H-2_104-109_20	4.26	3.29	1.20	73.95	0.11	0.06	0.84	0.00	11.93	0.00	95.64
	1123C_2H-2_104-109_1	3.42	3.22	1.51	73.02	0.17	0.05	0.82	0.03	11.87	0.04	94.13
	1123C_2H-2_104-109_3	3.79	3.26	1.39	72.63	0.12	0.01	0.82	0.03	11.82	0.04	93.91
	1123C_2H-2_104-109_7	3.58	3.45	1.18	72.90	0.13	0.02	0.67	0.05	11.44	0.00	93.42
	1123C_2H-2_104-109_9	4.05	3.24	1.30	73.85	0.15	0.08	0.85	0.08	11.89	0.00	95.49
	1123C_2H-2_104-109_10	4.09	3.51	1.56	73.22	0.15	0.04	0.85	0.02	11.75	0.00	95.20
	1123C_2H-2_104-109_4	3.74	3.32	1.38	73.15	0.17	0.03	0.81	0.14	11.96	0.00	94.71
	1123C_2H-2_104-109_5	4.22	3.10	1.32	72.81	0.19	0.03	0.81	0.07	11.83	0.01	94.38
	1123C_2H-2_104-109_6	3.86	3.53	1.42	73.28	0.19	0.03	0.71	0.00	11.53	0.01	94.56
	1123C_2H-2_104-109_8	3.91	3.28	1.21	73.41	0.14	0.04	0.72	0.04	11.55	0.00	94.30
sl5	1123C_2H-3_69-71_1	3.72	3.51	1.42	74.89	0.16	0.08	0.93	0.09	11.80	0.01	96.62
	1123C_2H-3_69-71_2	3.65	3.30	1.51	72.44	0.14	0.12	1.04	0.00	12.18	0.00	94.38
	1123C_2H-3_69-71_3	3.69	3.09	1.02	74.10	0.16	0.14	0.98	0.02	11.74	0.00	94.95
	1123C_2H-3_69-71_4	3.81	3.36	1.33	73.90	0.12	0.10	1.01	0.05	12.06	0.01	95.75
	1123C_2H-3_69-71_5	3.36	3.33	1.30	72.54	0.15	0.11	1.00	0.05	11.94	0.03	93.82
	1123C_2H-3_69-71_6	3.41	3.41	1.04	72.59	0.16	0.11	0.92	0.15	11.33	0.00	93.12
	1123C_2H-3_69-71_7	3.75	3.64	1.04	74.69	0.16	0.15	0.95	0.06	11.90	0.00	96.35
	1123C_2H-3_69-71_8	3.73	3.31	1.27	73.35	0.13	0.12	1.00	0.04	11.82	0.02	94.79
	1123C_2H-3_69-71_9	3.76	3.30	1.45	72.09	0.13	0.09	1.08	0.05	11.98	0.03	93.96
	1123C_2H-3_69-71_10	3.65	3.50	0.95	73.58	0.14	0.09	0.82	0.11	11.72	0.00	94.56
	1123C_2H-3_69-71_11	3.89	3.30	1.35	72.94	0.13	0.10	1.01	0.02	11.76	0.06	94.56
	1123C_2H-3_69-71_12	3.57	3.27	1.28	73.13	0.14	0.08	1.01	0.02	11.77	0.02	94.29
	1123C_2H-3_69-71_13	3.17	3.21	1.03	73.11	0.17	0.15	0.99	0.04	11.59	0.02	93.48
	1123C_2H-3_69-71_14	3.73	3.35	1.31	73.03	0.13	0.08	0.94	0.09	11.81	0.00	94.46
	1123C_2H-3_69-71_15	3.84	3.21	1.40	73.30	0.14	0.09	1.04	0.07	12.02	0.02	95.13
	1123C_2H-3_69-71_16	3.23	2.95	1.06	72.41	0.14	0.12	0.94	0.02	11.18	0.03	92.08
	1123C_2H-3_69-71_17	3.70	3.25	1.35	72.67	0.14	0.13	0.99	0.00	11.95	0.03	94.20
	1123C_2H-3_69-71_18	3.41	3.26	1.28	72.16	0.11	0.10	1.06	0.06	11.86	0.01	93.30
	1123C_2H-3_69-71_19	3.73	3.31	1.58	72.73	0.12	0.07	1.05	0.03	12.17	0.02	94.81
	1123C_2H-3_69-71_20	3.31	4.33	1.20	74.57	0.14	0.11	0.78	0.03	11.82	0.01	96.31
	1123C_2H-3_69-71_1	4.01	3.16	1.36	70.98	0.19	0.13	1.00	0.03	11.87	0.01	92.74
	1123C_2H-3_69-71_2	4.11	3.49	1.32	72.31	0.19	0.08	0.86	0.06	11.62	0.01	94.05
	1123C_2H-3_69-71_3	3.79	3.22	1.37	71.00	0.19	0.13	1.04	0.04	11.84	0.01	92.64
	1123C_2H-3_69-71_5	4.05	3.30	1.15	72.26	0.20	0.09	0.91	0.01	11.85	0.04	93.86
	1123C_2H-3_69-71_6	3.63	3.45	1.24	72.41	0.20	0.07	0.88	0.00	11.72	0.00	93.61
	1123C_2H-3_69-71_4	3.70	3.29	1.27	72.30	0.19	0.05	0.91	0.07	11.87	0.03	93.67
	1123C_2H-3_69-71_7	3.93	3.22	1.37	71.73	0.16	0.06	0.99	0.10	11.76	0.03	93.34
	1123C_2H-3_69-71_8	3.67	3.54	1.01	73.22	0.20	0.15	0.87	0.01	11.67	0.03	94.36
	1123C_2H-3_69-71_9	4.08	3.26	1.30	71.19	0.18	0.10	1.01	0.02	11.97	0.03	93.15
	1123C_2H-3_69-71_10	3.90	3.25	1.58	70.37	0.22	0.08	1.09	0.00	11.83	0.00	92.32
sl6	1123C_2H-3_132-134_1	3.98	3.24	1.07	73.07	0.12	0.12	0.89	0.08	11.77	0.00	94.34
	1123C_2H-3_132-134_2	4.18	3.13	1.16	72.32	0.11	0.08	0.93	0.02	11.74	0.00	93.68
	1123C_2H-3_132-134_3	3.95	3.35	1.10	72.86	0.10	0.08	0.76	0.05	11.69	0.00	93.93
	1123C_2H-3_132-134_4	3.85	3.12	1.36	73.00	0.14	0.14	1.01	0.00	11.76	0.01	94.38
	1123C_2H-3_132-134_5	3.87	3.15	1.33	72.89	0.08	0.06	0.96	0.06	11.69	0.02	94.11
	1123C_2H-3_132-134_6	4.03	3.09	1.18	72.96	0.10	0.08	0.97	0.02	11.72	0.02	94.17
	1123C_2H-3_132-134_7	3.96	3.27	1.25	73.24	0.09	0.06	0.87	0.13	11.59	0.00	94.46
	1123C_2H-3_132-134_8	3.75	3.23	1.27	73.12	0.09	0.11	0.92	0.06	11.53	0.00	94.09
	1123C_2H-3_132-134_9	4.03	3.28	1.00	73.14	0.09	0.03	0.82	0.02	11.65	0.00	94.05
	1123C_2H-3_132-134_10	4.05	3.09	1.29	72.88	0.14	0.08	0.98	0.00	11.65	0.00	94.16
	1123C_2H-3_132-134_11	4.20	2.93	1.37	71.71	0.17	0.11	1.09	0.09	12.10	0.03	93.79

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s26	1123C_2H-3_132-134_12	3.96	3.07	1.19	72.00	0.12	0.10	1.02	0.00	11.87	0.05	93.38
	1123C_2H-3_132-134_13	4.01	3.14	1.16	72.83	0.12	0.09	0.85	0.03	11.69	0.00	93.92
	1123C_2H-3_132-134_14	3.93	3.06	1.15	71.92	0.09	0.07	0.86	0.05	11.73	0.00	92.86
	1123C_2H-3_132-134_15	4.19	3.21	1.29	72.72	0.14	0.13	1.12	0.08	12.09	0.01	94.98
	1123C_2H-3_132-134_16	3.91	3.15	1.20	72.60	0.09	0.09	0.93	0.02	11.86	0.04	93.90
	1123C_2H-3_132-134_17	4.01	3.18	1.34	72.56	0.09	0.11	0.97	0.03	11.93	0.02	94.23
	1123C_2H-3_132-134_18	4.28	2.93	1.24	71.08	0.16	0.12	1.15	0.03	12.40	0.00	93.39
	1123C_2H-3_132-134_19	4.18	3.12	1.30	72.89	0.10	0.12	1.01	0.06	11.75	0.00	94.53
	1123C_2H-3_132-134_20	3.87	3.23	1.15	72.82	0.14	0.11	0.87	0.01	11.45	0.00	93.64
	1123C_3H-4_84-86_1	3.40	3.19	1.09	74.07	0.10	0.11	1.01	0.03	11.41	0.00	94.42
	1123C_3H-4_84-86_2	3.47	3.05	1.11	73.57	0.13	0.18	1.23	0.02	11.54	0.03	94.32
	1123C_3H-4_84-86_3	3.54	2.99	0.99	73.87	0.13	0.17	1.31	0.07	11.67	0.02	94.76
	1123C_3H-4_84-86_4	3.45	3.43	1.14	73.67	0.09	0.13	1.00	0.00	11.61	0.04	94.57
	1123C_3H-4_84-86_5	3.43	3.06	1.03	73.57	0.12	0.16	1.14	0.05	11.59	0.03	94.18
	1123C_3H-4_84-86_6	3.29	3.09	1.12	73.87	0.11	0.20	1.29	0.07	11.71	0.02	94.76
	1123C_3H-4_84-86_7	3.35	3.30	0.91	73.95	0.14	0.13	1.03	0.07	11.57	0.00	94.45
	1123C_3H-4_84-86_8	3.48	3.21	1.29	72.44	0.17	0.17	1.33	0.03	12.20	0.01	94.33
	1123C_3H-4_84-86_9	3.42	2.98	1.08	73.46	0.16	0.15	1.22	0.04	11.60	0.01	94.12
	1123C_3H-4_84-86_10	3.34	2.97	1.21	73.79	0.13	0.16	1.32	0.04	11.53	0.01	94.51
	1123C_3H-4_84-86_11	3.26	3.05	1.17	73.31	0.14	0.12	1.22	0.06	11.61	0.00	93.94
s39	1123C_3H-4_84-86_12	3.30	3.23	1.06	73.83	0.14	0.17	1.15	0.06	11.60	0.00	94.53
	1123C_3H-4_84-86_13	3.24	3.04	1.22	73.89	0.17	0.18	1.31	0.00	11.82	0.00	94.87
	1123C_3H-4_84-86_14	3.46	3.03	0.93	74.11	0.17	0.17	1.23	0.07	11.72	0.00	94.89
	1123C_3H-4_84-86_15	3.42	2.79	1.74	70.35	0.29	0.42	2.02	0.00	12.75	0.06	93.84
	1123C_3H-4_84-86_16	3.43	3.22	0.99	73.89	0.11	0.14	0.99	0.00	11.96	0.02	94.75
	1123C_3H-4_84-86_17	3.22	3.27	0.94	74.18	0.12	0.14	1.04	0.02	11.88	0.00	94.80
	1123C_3H-4_84-86_18	3.53	3.14	1.08	74.17	0.12	0.10	1.05	0.05	11.48	0.00	94.73
	1123C_3H-4_84-86_19	3.42	3.07	1.08	73.82	0.16	0.17	1.27	0.03	11.81	0.04	94.87
	1123C_3H-4_84-86_20	3.42	2.95	1.16	73.27	0.16	0.17	1.27	0.09	11.69	0.04	94.23
	1123C_3H-4_84-86_1	3.88	3.16	1.17	73.37	0.20	0.12	1.04	0.05	11.66	0.00	94.65
	1123C_3H-4_84-86_2	3.71	3.07	1.05	73.27	0.15	0.15	1.22	0.06	11.68	0.02	94.37
	1123C_3H-4_84-86_3	3.45	3.00	1.07	73.28	0.17	0.16	1.22	0.09	11.64	0.02	94.09
	1123C_3H-4_84-86_6	3.69	3.11	0.95	73.08	0.13	0.11	0.99	0.07	11.76	0.00	93.89
	1123C_3H-4_84-86_9	3.58	3.15	0.95	72.71	0.15	0.10	0.98	0.04	11.64	0.02	93.31
	1123C_3H-4_84-86_4	3.54	3.17	1.26	73.65	0.15	0.11	1.05	0.09	11.78	0.00	94.79
	1123C_3H-4_84-86_5	3.47	2.99	1.03	72.49	0.15	0.13	1.17	0.10	11.44	0.00	92.96
	1123C_3H-4_84-86_8	3.46	2.96	0.99	73.28	0.20	0.13	1.25	0.10	11.85	0.01	94.25
	1123C_3H-4_84-86_10	3.32	3.08	1.10	72.57	0.22	0.19	1.27	0.07	11.55	0.00	93.36
	1123C_4H-6_68-70_1	4.10	3.00	2.08	70.98	0.29	0.26	1.46	0.08	13.04	0.02	95.32
	1123C_4H-6_68-70_2	4.44	2.82	2.07	71.90	0.32	0.26	1.49	0.07	12.97	0.08	96.41
s43	1123C_4H-6_68-70_3	3.88	2.86	1.83	70.21	0.29	0.26	1.36	0.05	12.94	0.04	93.72
	1123C_4H-6_68-70_4	4.11	2.70	1.87	69.81	0.35	0.26	1.37	0.00	12.64	0.01	93.12
	1123C_4H-6_68-70_5	3.79	2.98	1.85	71.30	0.34	0.18	1.17	0.04	12.38	0.04	94.06
	1123C_4H-6_68-70_6	4.25	2.74	2.30	70.30	0.39	0.35	1.64	0.12	13.18	0.09	95.35
	1123C_4H-6_68-70_7	4.07	2.81	2.02	70.03	0.31	0.28	1.42	0.02	12.74	0.00	93.71
	1123C_4H-6_68-70_8	4.25	2.99	1.88	71.39	0.28	0.27	1.45	0.04	12.95	0.04	95.54
	1123C_4H-6_68-70_9	4.23	2.74	2.15	68.67	0.47	0.34	1.84	0.06	13.58	0.14	94.22
	1123C_4H-6_68-70_10	4.09	2.80	1.93	70.38	0.33	0.30	1.53	0.07	12.89	0.04	94.36
	1123C_4H-6_68-70_12	4.23	2.91	2.07	70.75	0.29	0.28	1.43	0.11	12.87	0.03	94.98
	1123C_4H-6_68-70_13	3.89	2.88	2.10	70.56	0.30	0.33	1.48	0.12	12.80	0.02	94.48
	1123C_4H-6_68-70_14	3.88	3.00	1.61	71.53	0.24	0.23	1.18	0.04	12.29	0.01	94.00
	1123C_4H-6_68-70_15	3.98	2.97	1.98	70.39	0.32	0.31	1.44	0.08	13.04	0.07	94.57
	1123C_4H-6_68-70_16	4.17	2.89	2.01	70.87	0.28	0.29	1.51	0.15	12.88	0.03	95.09
	1123C_4H-6_68-70_17	3.94	2.76	2.00	70.61	0.30	0.26	1.53	0.08	12.69	0.06	94.23
	1123C_4H-6_68-70_18	4.18	2.94	1.77	71.42	0.34	0.31	1.49	0.05	13.01	0.07	95.58
	1123C_4H-6_68-70_19	3.87	3.09	1.34	71.85	0.22	0.16	1.07	0.03	12.08	0.00	93.71
	1123C_4H-6_68-70_20	4.27	2.87	2.35	70.04	0.41	0.37	1.61	0.07	13.11	0.06	95.16
	1123C_4H-6_68-70_1	3.98	2.99	1.55	71.87	0.36	0.13	1.18	0.11	12.49	0.04	94.70
	1123C_4H-6_68-70_10	4.42	2.99	2.14	68.02	0.47	0.25	1.44	0.02	12.86	0.00	92.61
	1123C_4H-6_68-70_2	4.19	2.84	1.51	71.92	0.32	0.19	1.10	0.08	12.18	0.04	94.37
	1123C_4H-6_68-70_4	4.06	3.00	1.64	70.20	0.35	0.23	1.29	0.04	12.20	0.03	93.05
s43	1123C_4H-6_68-70_8	4.08	2.99	1.34	71.68	0.34	0.19	1.10	0.11	12.23	0.01	94.06
	1123C_4H-6_68-70_5	4.27	2.77	1.97	69.10	0.51	0.31	1.53	0.05	12.64	0.03	93.18
	1123C_4H-6_68-70_9	4.21	2.92	1.43	70.91	0.31	0.17	1.19	0.04	12.36	0.00	93.54
	1123C_5H-1_90-92_1	4.32	3.10	2.04	70.08	0.27	0.27	1.46	0.04	12.87	0.02	94.48
	1123C_5H-1_90-92_2	3.83	3.45	1.52	71.92	0.17	0.16	1.11	0.00	12.34	0.02	94.52
	1123C_5H-1_90-92_3	4.07	3.29	1.53	72.36	0.16	0.15	1.08	0.00	12.16	0.00	94.80
s43	1123C_5H-1_90-92_4	3.98	3.37	1.63	71.13	0.21	0.19	1.23	0.06	12.60	0.00	94.40
	1123C_5H-1_90-92_5	3.88	3.48	1.17	72.95	0.13	0.14	0.87	0.02	11.89	0.00	94.53
	1123C_5H-1_90-92_6	2.61	4.34	1.06	70.56	0.13	0.06	0.87	0.07	11.56	0.03	91.29

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s54	1123C_5H-1_90-92_7	4.07	3.21	1.69	72.19	0.21	0.19	1.20	0.09	12.67	0.01	95.54
	1123C_5H-1_90-92_8	3.88	3.16	1.83	71.99	0.25	0.17	1.23	0.07	12.84	0.02	95.45
	1123C_5H-1_90-92_9	4.14	3.29	1.89	70.61	0.28	0.27	1.45	0.08	13.07	0.02	95.10
	1123C_5H-1_90-92_10	3.33	3.85	1.53	70.35	0.18	0.16	1.02	0.05	12.04	0.02	92.53
	1123C_5H-1_90-92_11	4.19	3.36	1.47	71.80	0.20	0.20	1.25	0.03	12.55	0.06	95.11
	1123C_5H-1_90-92_12	4.23	3.07	1.56	70.85	0.21	0.23	1.21	0.05	12.58	0.04	94.02
	1123C_5H-1_90-92_13	4.21	3.14	1.92	70.01	0.25	0.30	1.57	0.06	13.11	0.00	94.57
	1123C_5H-1_90-92_14	3.92	3.17	1.54	71.42	0.21	0.15	1.22	0.03	12.49	0.04	94.19
	1123C_5H-1_90-92_15	3.83	3.26	1.51	71.70	0.23	0.20	1.23	0.03	12.50	0.03	94.52
	1123C_5H-1_90-92_16	3.78	3.29	1.36	71.72	0.17	0.12	1.01	0.02	12.16	0.01	93.64
	1123C_5H-1_90-92_17	4.23	3.11	2.05	70.81	0.27	0.26	1.53	0.00	13.22	0.05	95.53
	1123C_5H-1_90-92_18	3.70	3.14	1.62	70.23	0.21	0.17	1.20	0.04	12.59	0.03	92.93
	1123C_5H-1_90-92_19	4.07	3.19	1.75	70.99	0.23	0.29	1.33	0.00	12.77	0.02	94.63
	1123C_5H-1_90-92_20	4.00	3.57	1.06	73.57	0.14	0.13	0.74	0.07	12.03	0.02	95.33
	1123C_5H-1_90-92_6	4.43	3.08	1.64	70.59	0.36	0.29	1.52	0.06	12.96	0.03	94.96
	1123C_5H-1_90-92_7	4.41	3.15	1.79	67.86	0.34	0.17	1.28	0.04	12.76	0.02	91.83
	1123C_5H-1_90-92_8	3.88	3.17	1.86	63.02	0.28	0.20	1.39	0.06	12.84	0.00	86.70
	1123C_5H-1_90-92_10	4.25	3.34	1.45	71.41	0.23	0.13	1.09	0.11	12.38	0.01	94.40
	1123C_5H-1_90-92_1	4.14	3.38	1.29	72.28	0.19	0.10	1.05	0.03	12.12	0.03	94.61
	1123C_5H-1_90-92_2	3.95	3.18	1.82	70.56	0.34	0.26	1.47	0.06	13.07	0.01	94.72
	1123C_5H-1_90-92_4	4.22	3.19	1.95	66.32	0.34	0.24	1.38	0.00	13.10	0.02	90.77
	1123C_5H-1_90-92_5	4.14	3.24	1.41	66.84	0.25	0.13	1.06	0.09	11.90	0.00	89.07
	1123C_5H-1_90-92_9	3.71	3.32	1.87	62.53	0.31	0.23	1.35	0.04	12.34	0.00	85.71
	1123C_5H-5_121-123_1	3.87	3.07	2.01	70.40	0.19	0.23	1.47	0.00	12.65	0.03	93.92
	1123C_5H-5_121-123_2	3.64	3.04	2.16	70.41	0.22	0.26	1.74	0.00	12.93	0.07	94.47
	1123C_5H-5_121-123_3	4.04	3.10	1.98	70.86	0.23	0.28	1.52	0.02	12.73	0.02	94.78
	1123C_5H-5_121-123_4	3.89	3.00	2.00	69.88	0.21	0.20	1.59	0.02	12.89	0.01	93.69
	1123C_5H-5_121-123_6	4.00	3.09	1.72	71.78	0.21	0.18	1.28	0.03	12.48	0.01	94.77
	1123C_5H-5_121-123_7	3.87	3.06	1.89	70.62	0.24	0.23	1.63	0.08	12.67	0.03	94.32
	1123C_5H-5_121-123_8	4.25	3.03	2.11	70.78	0.23	0.28	1.62	0.02	12.96	0.00	95.28
	1123C_5H-5_121-123_9	4.11	3.00	2.01	69.97	0.26	0.24	1.73	0.10	12.85	0.04	94.31
	1123C_5H-5_121-123_10	4.00	3.00	2.13	70.79	0.23	0.32	1.83	0.09	12.89	0.01	95.29
	1123C_5H-5_121-123_11	4.08	3.17	1.61	71.91	0.17	0.16	1.25	0.04	12.07	0.01	94.48
	1123C_5H-5_121-123_12	4.08	3.02	1.94	70.55	0.25	0.22	1.62	0.07	12.91	0.01	94.67
	1123C_5H-5_121-123_13	3.94	3.14	1.80	70.93	0.21	0.25	1.50	0.01	12.68	0.00	94.46
	1123C_5H-5_121-123_14	3.94	3.11	2.11	70.83	0.25	0.26	1.77	0.01	12.82	0.02	95.12
	1123C_5H-5_121-123_15	3.83	3.06	2.20	70.40	0.26	0.27	1.65	0.07	13.07	0.03	94.84
	1123C_5H-5_121-123_16	4.79	2.84	2.34	70.45	0.19	0.14	1.09	0.10	12.65	0.02	94.61
	1123C_5H-5_121-123_17	3.76	2.91	2.05	69.72	0.25	0.22	1.61	0.13	12.57	0.04	93.26
	1123C_5H-5_121-123_18	3.72	3.17	1.63	71.37	0.14	0.18	1.17	0.00	12.27	0.04	93.68
	1123C_5H-5_121-123_19	3.47	2.85	2.25	68.17	0.23	0.26	1.79	0.04	13.31	0.01	92.38
	1123C_5H-5_121-123_20	4.08	2.97	1.98	69.56	0.24	0.27	1.73	0.05	12.95	0.04	93.87
	1123C_5H-5_121-123_4	4.00	3.00	1.94	70.20	0.34	0.26	1.50	0.08	12.87	0.03	94.22
	1123C_5H-5_121-123_5	3.90	2.92	1.84	69.22	0.34	0.21	1.55	0.10	12.79	0.03	92.90
	1123C_5H-5_121-123_8	4.20	2.99	1.94	69.92	0.39	0.27	1.70	0.00	13.10	0.06	94.57
	1123C_5H-5_121-123_9	3.95	3.15	1.67	71.03	0.25	0.22	1.31	0.05	12.59	0.03	94.24
	1123C_5H-5_121-123_2	4.04	2.84	1.81	68.80	0.27	0.20	1.49	0.00	13.23	0.02	92.71
	1123C_5H-5_121-123_3	4.02	3.33	1.57	71.31	0.26	0.14	1.26	0.08	12.42	0.00	94.38
	1123C_5H-5_121-123_6	4.05	3.08	1.83	70.00	0.33	0.26	1.57	0.00	13.03	0.00	94.15
	1123C_5H-5_121-123_7	4.16	2.96	1.86	70.09	0.37	0.25	1.56	0.08	12.68	0.03	94.04
s62	1123C_6H-1_77-79_1	4.34	3.02	1.73	71.61	0.12	0.11	1.17	0.07	12.39	0.00	94.56
	1123C_6H-1_77-79_2	4.35	2.88	1.76	71.52	0.21	0.23	1.46	0.09	12.37	0.00	94.88
	1123C_6H-1_77-79_3	4.35	2.87	1.70	70.51	0.21	0.18	1.52	0.05	12.54	0.02	93.96
	1123C_6H-1_77-79_4	4.45	2.87	1.72	71.05	0.26	0.20	1.45	0.04	12.40	0.05	94.49
	1123C_6H-1_77-79_5	4.19	2.97	1.95	70.88	0.20	0.18	1.53	0.02	12.34	0.03	94.29
	1123C_6H-1_77-79_6	4.38	3.11	1.83	70.82	0.12	0.09	1.21	0.00	12.55	0.04	94.14
	1123C_6H-1_77-79_7	4.46	2.93	2.03	70.42	0.22	0.19	1.53	0.00	12.63	0.02	94.43
	1123C_6H-1_77-79_8	4.37	2.93	1.68	71.07	0.22	0.19	1.53	0.00	12.38	0.05	94.41
	1123C_6H-1_77-79_9	4.54	3.16	1.65	71.83	0.14	0.13	1.12	0.00	12.23	0.00	94.80
	1123C_6H-1_77-79_10	4.14	2.93	1.87	72.53	0.20	0.19	1.45	0.00	12.66	0.01	95.99
	1123C_6H-1_77-79_11	4.10	2.94	1.89	71.95	0.21	0.21	1.48	0.10	12.24	0.01	95.13
	1123C_6H-1_77-79_12	4.19	3.06	1.56	72.80	0.12	0.08	1.23	0.06	12.37	0.03	95.50
	1123C_6H-1_77-79_13	3.62	3.60	0.91	72.88	0.07	0.07	0.94	0.00	11.91	0.01	94.01
	1123C_6H-1_77-79_14	4.07	2.99	1.76	71.51	0.22	0.22	1.46	0.08	12.34	0.03	94.69
	1123C_6H-1_77-79_15	4.43	3.23	1.65	72.57	0.12	0.05	1.14	0.10	12.25	0.03	95.56
	1123C_6H-1_77-79_16	4.29	2.94	1.85	71.69	0.19	0.21	1.38	0.10	12.41	0.02	95.09
	1123C_6H-1_77-79_17	4.43	2.86	1.90	70.98	0.21	0.20	1.53	0.02	12.47	0.01	94.62
	1123C_6H-1_77-79_18	4.01	2.95	1.88	71.77	0.21	0.22	1.47	0.05	12.68	0.06	95.30
	1123C_6H-1_77-79_19	1.96	2.92	1.98	72.98	0.21	0.22	1.47	0.03	12.48	0.03	94.28
	1123C_6H-1_77-79_20	4.17	2.83	2.06	71.05	0.13	0.32	1.53	0.08	13.07	0.01	95.25

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s63	1123C_6H-3_128-130_1	4.76	3.07	2.28	70.24	0.19	0.11	1.09	0.15	12.78	0.03	94.70
	1123C_6H-3_128-130_2	3.79	3.52	1.27	74.40	0.07	0.05	0.94	0.02	11.74	0.03	95.82
	1123C_6H-3_128-130_3	3.40	4.66	2.34	70.36	0.31	0.13	0.74	0.04	11.40	0.01	93.40
	1123C_6H-3_128-130_4	4.78	2.94	2.37	70.08	0.15	0.13	1.09	0.18	12.80	0.02	94.53
	1123C_6H-3_128-130_5	3.88	3.33	1.32	73.57	0.05	0.03	0.90	0.00	11.80	0.02	94.91
	1123C_6H-3_128-130_6	4.98	3.09	2.11	70.90	0.16	0.13	1.11	0.05	12.90	0.03	95.46
	1123C_6H-3_128-130_7	4.63	2.92	2.20	70.95	0.16	0.10	1.16	0.12	12.90	0.01	95.15
	1123C_6H-3_128-130_8	4.84	3.01	2.19	70.14	0.14	0.10	1.19	0.09	12.92	0.03	94.65
	1123C_6H-3_128-130_9	4.78	3.08	2.14	71.48	0.19	0.08	1.13	0.13	13.06	0.00	96.06
	1123C_6H-3_128-130_10	5.07	3.03	2.31	70.61	0.20	0.13	1.11	0.09	12.70	0.02	95.28
	1123C_6H-3_128-130_11	4.81	3.07	2.25	72.08	0.17	0.13	1.19	0.03	12.83	0.03	96.59
	1123C_6H-3_128-130_12	5.03	3.09	2.21	71.23	0.16	0.11	1.13	0.14	12.89	0.03	96.02
	1123C_6H-3_128-130_13	4.83	3.31	2.28	68.59	0.20	0.07	1.17	0.15	12.68	0.03	93.31
	1123C_6H-3_128-130_14	5.13	3.06	2.34	70.80	0.16	0.14	1.15	0.08	13.13	0.03	96.03
	1123C_6H-3_128-130_15	4.68	3.01	2.15	70.06	0.15	0.11	1.11	0.09	12.79	0.02	94.17
	1123C_6H-3_128-130_16	4.64	2.97	2.45	70.30	0.21	0.12	1.13	0.09	13.04	0.00	94.95
	1123C_6H-3_128-130_17	5.03	3.00	2.17	70.77	0.14	0.10	1.18	0.08	12.87	0.04	95.39
	1123C_6H-3_128-130_18	4.66	3.02	2.14	70.66	0.21	0.09	1.17	0.00	12.74	0.04	94.73
	1123C_6H-3_128-130_19	5.07	3.11	2.17	71.16	0.17	0.10	1.11	0.12	12.76	0.01	95.78
	1123C_6H-3_128-130_20	4.73	2.97	2.45	69.92	0.16	0.11	1.11	0.05	12.81	0.02	94.34
	1123C_6H-3_128-130_1	4.44	2.93	2.35	70.03	0.22	0.10	1.24	0.11	12.79	0.04	94.25
	1123C_6H-3_128-130_4	4.33	2.91	2.07	68.86	0.20	0.14	1.09	0.02	12.82	0.02	92.46
	1123C_6H-3_128-130_6	4.31	2.87	2.26	68.79	0.24	0.12	1.11	0.00	12.71	0.02	92.43
	1123C_6H-3_128-130_8	4.39	3.06	2.08	69.54	0.28	0.09	1.10	0.13	12.61	0.03	93.31
	1123C_6H-3_128-130_10	4.58	2.92	2.18	69.40	0.23	0.16	1.12	0.00	12.77	0.03	93.40
	1123C_6H-3_128-130_3	4.58	2.99	2.19	69.72	0.20	0.10	1.10	0.03	12.65	0.03	93.60
	1123C_6H-3_128-130_5	4.50	3.32	2.23	69.18	0.27	0.08	1.22	0.00	12.83	0.03	93.66
s64	1123C_6H-4_62-64_1	3.93	3.16	2.14	71.78	0.16	0.11	1.14	0.08	12.65	0.00	95.15
	1123C_6H-4_62-64_2	4.02	3.32	1.97	71.57	0.16	0.10	0.99	0.07	12.67	0.01	94.87
	1123C_6H-4_62-64_3	4.62	3.01	1.99	71.49	0.11	0.07	1.02	0.09	12.79	0.03	95.23
	1123C_6H-4_62-64_4	3.79	3.94	2.18	70.49	0.14	0.09	1.02	0.07	12.64	0.00	94.36
	1123C_6H-4_62-64_5	4.40	3.25	2.21	72.00	0.16	0.05	1.04	0.00	12.73	0.02	95.86
	1123C_6H-4_62-64_6	4.09	3.41	1.97	71.40	0.15	0.09	1.01	0.09	12.61	0.01	94.83
	1123C_6H-4_62-64_7	3.83	3.33	2.23	71.37	0.15	0.03	1.00	0.04	12.62	0.00	94.60
	1123C_6H-4_62-64_8	4.53	3.38	1.85	71.71	0.17	0.08	1.04	0.00	12.81	0.00	95.56
	1123C_6H-4_62-64_9	4.33	3.21	2.36	71.66	0.14	0.08	0.98	0.03	12.67	0.01	95.47
	1123C_6H-4_62-64_10	4.26	3.17	2.17	71.40	0.14	0.08	1.01	0.11	12.80	0.00	95.15
	1123C_6H-4_62-64_11	4.34	3.17	1.98	71.35	0.16	0.09	0.97	0.10	12.96	0.00	95.12
	1123C_6H-4_62-64_12	4.28	3.20	2.04	71.99	0.17	0.05	0.89	0.01	12.60	0.02	95.24
	1123C_6H-4_62-64_13	4.15	3.22	2.10	71.77	0.16	0.05	1.02	0.07	12.76	0.04	95.34
	1123C_6H-4_62-64_14	4.00	3.14	2.04	71.36	0.16	0.11	1.10	0.12	12.81	0.00	94.85
	1123C_6H-4_62-64_15	4.27	3.18	2.08	71.35	0.16	0.12	1.05	0.06	12.99	0.01	95.27
	1123C_6H-4_62-64_16	4.26	3.10	2.26	71.45	0.17	0.09	1.08	0.08	12.81	0.01	95.30
	1123C_6H-4_62-64_17	4.55	3.17	2.49	72.41	0.15	0.10	1.07	0.04	12.77	0.03	96.79
	1123C_6H-4_62-64_18	3.98	3.09	2.35	70.16	0.17	0.09	1.00	0.04	12.54	0.00	93.42
	1123C_6H-4_62-64_19	4.30	3.28	2.07	71.88	0.14	0.09	1.06	0.10	12.78	0.02	95.72
	1123C_6H-4_62-64_20	4.37	3.29	1.93	71.70	0.13	0.06	0.95	0.02	12.46	0.00	94.91
	1123C_6H-4_62-64_2	4.61	3.20	2.15	70.69	0.21	0.06	1.01	0.07	12.65	0.00	94.65
	1123C_6H-4_62-64_4	4.37	3.18	2.25	71.59	0.24	0.07	1.00	0.12	12.69	0.00	95.51
	1123C_6H-4_62-64_5	4.53	3.20	2.12	71.57	0.19	0.09	1.05	0.08	12.76	0.01	95.60
	1123C_6H-4_62-64_9	4.55	3.06	2.30	71.08	0.21	0.07	1.04	0.09	12.66	0.02	95.08
	1123C_6H-4_62-64_10	4.53	3.19	1.94	71.46	0.21	0.09	1.02	0.06	12.57	0.00	95.07
	1123C_6H-4_62-64_1	4.39	3.20	2.17	71.68	0.23	0.11	1.04	0.11	12.78	0.02	95.73
	1123C_6H-4_62-64_3	4.54	3.35	2.33	71.74	0.25	0.09	1.05	0.11	12.86	0.00	96.32
	1123C_6H-4_62-64_6	4.60	3.11	2.13	70.91	0.22	0.10	0.99	0.08	12.40	0.04	94.58
	1123C_6H-4_62-64_8	4.75	3.19	2.07	71.66	0.20	0.08	0.99	0.14	12.50	0.02	95.60
s65	1123C_6H-4_93-95_1	5.15	3.01	2.45	70.72	0.18	0.12	1.09	0.12	12.71	0.00	95.54
	1123C_6H-4_93-95_2	4.83	3.15	2.09	70.83	0.17	0.09	1.14	0.12	12.67	0.00	95.09
	1123C_6H-4_93-95_3	4.79	2.97	2.29	70.25	0.16	0.11	1.07	0.06	12.79	0.01	94.50
	1123C_6H-4_93-95_4	4.28	3.64	2.18	69.43	0.20	0.15	1.08	0.11	12.34	0.00	93.40
	1123C_6H-4_93-95_5	4.90	3.11	2.13	70.98	0.16	0.07	1.05	0.09	12.80	0.04	95.33
	1123C_6H-4_93-95_7	4.79	3.05	2.05	70.40	0.18	0.06	1.11	0.04	12.91	0.02	94.61
	1123C_6H-4_93-95_8	4.89	3.13	2.15	69.49	0.15	0.11	1.06	0.00	12.49	0.06	93.53
	1123C_6H-4_93-95_9	4.79	2.92	2.07	69.77	0.14	0.10	1.06	0.08	12.60	0.01	93.55
	1123C_6H-4_93-95_10	4.73	2.90	2.17	70.22	0.14	0.13	1.09	0.10	12.77	0.02	94.27
	1123C_6H-4_93-95_11	4.69	3.00	2.26	70.57	0.15	0.12	1.06	0.09	12.81	0.00	94.75
	1123C_6H-4_93-95_12	5.06	3.01	2.15	70.14	0.16	0.13	1.12	0.10	13.02	0.07	94.96
	1123C_6H-4_93-95_13	4.87	2.96	2.02	69.68	0.17	0.12	1.09	0.11	12.70	0.00	93.73
	1123C_6H-4_93-95_14	5.01	3.04	2.19	70.76	0.17	0.13	1.13	0.05	12.78	0.03	95.30
	1123C_6H-4_93-95_15	4.87	3.06	2.28	69.48	0.17	0.09	1.09	0.07	12.87	0.02	94.00

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s68	1123C_6H-4_93-95_16	5.10	2.96	2.34	69.94	0.17	0.13	1.11	0.05	12.80	0.00	94.59
	1123C_6H-4_93-95_17	4.80	3.01	2.22	69.35	0.17	0.10	1.08	0.11	12.66	0.01	93.51
	1123C_6H-4_93-95_18	4.66	3.04	2.12	69.05	0.15	0.11	1.09	0.09	12.87	0.00	93.18
	1123C_6H-4_93-95_19	4.69	3.13	2.11	67.58	0.18	0.11	1.08	0.11	12.64	0.01	91.63
	1123C_6H-4_93-95_20	4.74	3.02	2.13	68.57	0.17	0.11	1.08	0.12	12.52	0.01	92.47
	1123C_6H-4_93-95_3	4.23	2.88	1.96	69.49	0.24	0.12	1.10	0.09	12.67	0.00	92.78
	1123C_6H-4_93-95_4	4.50	3.21	2.30	67.67	0.23	0.09	1.17	0.04	12.98	0.01	92.20
	1123C_6H-4_93-95_6	4.66	3.05	2.21	69.48	0.26	0.13	1.06	0.01	12.78	0.00	93.65
	1123C_6H-4_93-95_8	4.66	2.95	2.18	66.83	0.25	0.11	1.09	0.09	12.93	0.00	91.09
	1123C_6H-4_93-95_10	4.06	2.95	2.19	69.87	0.25	0.07	1.11	0.14	12.83	0.06	93.54
	1123C_6H-4_93-95_1	4.64	2.97	2.23	67.46	0.00	0.11	1.12	0.08	13.02	0.00	91.63
	1123C_6H-4_93-95_2	4.28	3.06	1.48	67.38	0.00	0.10	1.13	0.07	12.81	0.00	90.31
	1123C_6H-4_93-95_5	4.53	2.98	2.07	69.04	0.24	0.17	1.14	0.03	12.80	0.05	93.06
	1123C_6H-4_93-95_7	4.59	2.83	2.21	67.22	0.23	0.10	1.06	0.08	12.78	0.03	91.14
	1123C_6H-4_93-95_9	4.33	3.35	2.44	68.89	0.27	0.20	1.31	0.09	13.09	0.02	94.00
	1123C_6H-5_10-12_1	4.75	3.26	2.02	70.72	0.13	0.11	1.13	0.08	12.78	0.00	94.99
	1123C_6H-5_10-12_2	4.67	3.37	2.39	70.38	0.18	0.14	1.36	0.13	13.11	0.03	95.77
	1123C_6H-5_10-12_3	4.74	3.48	2.23	71.35	0.16	0.15	1.25	0.02	12.97	0.00	96.35
	1123C_6H-5_10-12_4	3.87	3.34	1.16	73.32	0.08	0.00	0.86	0.04	11.80	0.02	94.49
	1123C_6H-5_10-12_5	4.88	3.54	1.94	71.61	0.15	0.11	1.11	0.10	13.17	0.00	96.61
	1123C_6H-5_10-12_6	4.69	3.46	2.15	71.85	0.16	0.09	1.14	0.10	12.90	0.05	96.59
	1123C_6H-5_10-12_7	4.84	3.29	2.27	70.54	0.17	0.10	1.33	0.09	13.12	0.02	95.77
	1123C_6H-5_10-12_8	4.56	3.43	2.42	71.21	0.15	0.09	1.18	0.05	12.85	0.00	95.96
	1123C_6H-5_10-12_9	4.82	3.45	2.12	71.06	0.15	0.12	1.22	0.00	13.11	0.00	96.06
	1123C_6H-5_10-12_10	4.68	3.37	2.29	70.90	0.15	0.12	1.28	0.04	13.04	0.02	95.89
	1123C_6H-5_10-12_11	4.59	3.41	1.97	72.06	0.14	0.08	0.97	0.10	12.82	0.04	96.17
	1123C_6H-5_10-12_12	4.29	3.65	1.50	71.99	0.11	0.05	0.91	0.18	12.31	0.00	95.00
	1123C_6H-5_10-12_13	4.62	3.47	1.86	72.16	0.13	0.08	1.00	0.03	12.80	0.01	96.17
	1123C_6H-5_10-12_14	4.64	3.28	2.27	71.59	0.14	0.11	1.24	0.08	13.31	0.01	96.67
	1123C_6H-5_10-12_15	4.05	3.40	1.37	73.53	0.11	0.05	0.87	0.03	11.83	0.00	95.24
	1123C_6H-5_10-12_16	2.18	3.37	1.85	71.44	0.12	0.09	1.23	0.11	12.79	0.00	93.19
	1123C_6H-5_10-12_17	4.46	3.15	2.26	69.37	0.16	0.13	1.24	0.12	12.91	0.01	93.81
	1123C_6H-5_10-12_18	4.49	3.35	2.42	71.03	0.16	0.12	1.35	0.06	13.57	0.01	96.56
	1123C_6H-5_10-12_19	4.84	3.29	2.01	71.10	0.15	0.12	1.22	0.05	13.00	0.00	95.77
	1123C_6H-5_10-12_20	4.59	3.33	2.29	70.62	0.19	0.16	1.27	0.08	12.81	0.03	95.37
	1123C_6H-5_110-112_1	4.11	3.46	2.06	70.82	0.18	0.11	1.14	0.08	13.19	0.03	95.19
	1123C_6H-5_110-112_2	4.41	3.29	2.29	69.50	0.22	0.12	1.23	0.11	13.07	0.05	94.30
	1123C_6H-5_110-112_3	4.45	3.34	2.24	70.61	0.17	0.11	1.23	0.09	13.11	0.00	95.35
	1123C_6H-5_110-112_4	4.27	3.37	2.26	70.42	0.15	0.13	1.18	0.10	13.25	0.02	95.16
	1123C_6H-5_110-112_5	4.06	3.22	2.37	69.06	0.24	0.20	1.32	0.12	13.47	0.00	94.05
	1123C_6H-5_110-112_6	3.86	3.45	2.02	70.43	0.14	0.15	1.15	0.05	12.78	0.01	94.03
	1123C_6H-5_110-112_7	4.21	3.25	2.15	69.70	0.14	0.12	1.19	0.04	13.36	0.02	94.17
	1123C_6H-5_110-112_8	4.36	3.28	2.09	69.76	0.20	0.13	1.21	0.12	13.24	0.00	94.39
	1123C_6H-5_110-112_9	4.75	3.15	1.61	69.60	0.10	0.05	1.82	0.08	14.54	0.03	95.73
	1123C_6H-5_110-112_10	4.30	3.39	2.37	69.86	0.15	0.11	1.25	0.09	13.26	0.04	94.82
	1123C_6H-5_110-112_11	4.14	3.31	2.15	70.21	0.16	0.15	1.20	0.07	13.10	0.04	94.53
	1123C_6H-5_110-112_12	4.02	3.28	2.04	69.88	0.17	0.08	1.17	0.14	12.98	0.00	93.75
	1123C_6H-5_110-112_13	4.10	3.35	2.25	70.38	0.16	0.14	1.19	0.10	13.16	0.02	94.86
	1123C_6H-5_110-112_14	3.87	3.45	1.82	70.45	0.14	0.09	0.93	0.07	12.58	0.00	93.41
	1123C_6H-5_110-112_15	4.10	3.26	1.95	69.78	0.19	0.14	1.18	0.10	13.45	0.04	94.19
	1123C_6H-5_110-112_16	4.51	3.26	2.34	69.82	0.17	0.13	1.23	0.06	13.23	0.01	94.75
	1123C_6H-5_110-112_17	4.12	3.31	2.27	69.92	0.17	0.15	1.22	0.08	13.28	0.00	94.52
	1123C_6H-5_110-112_18	4.20	3.42	2.11	69.78	0.14	0.09	1.20	0.08	13.24	0.04	94.31
	1123C_6H-5_110-112_19	4.21	3.70	1.80	71.60	0.09	0.06	0.82	0.00	12.50	0.00	94.78
	1123C_6H-5_110-112_20	4.19	3.25	2.24	69.77	0.15	0.12	1.24	0.09	13.06	0.02	94.13
	1123C_6H-5_110-112_2	4.66	3.35	2.25	66.62	0.25	0.13	1.23	0.01	12.91	0.00	91.42
	1123C_6H-5_110-112_4	4.52	3.23	2.26	69.26	0.22	0.10	1.20	0.00	13.12	0.04	93.96
	1123C_6H-5_110-112_5	4.31	3.18	2.21	69.90	0.23	0.13	1.21	0.09	12.97	0.03	94.26
	1123C_6H-5_110-112_6	4.68	3.35	2.04	71.12	0.26	0.14	1.18	0.14	13.28	0.04	96.24
	1123C_6H-5_110-112_7	4.36	3.33	2.35	67.77	0.26	0.12	1.22	0.02	12.92	0.00	92.35
	1123C_6H-5_110-112_1	4.29	3.31	2.29	69.85	0.23	0.13	1.23	0.09	13.02	0.03	94.46
	1123C_6H-5_110-112_3	4.70	3.20	1.88	69.91	0.26	0.09	1.19	0.08	13.19	0.01	94.50
	1123C_6H-5_110-112_8	4.28	3.29	2.21	70.01	0.27	0.17	1.20	0.01	13.15	0.01	94.60
	1123C_6H-5_110-112_9	4.36	3.19	2.27	69.51	0.21	0.09	1.20	0.01	12.94	0.02	93.80
	1123C_6H-5_110-112_10	4.43	3.30	1.95	66.89	0.23	0.10	1.06	0.00	12.63	0.00	90.59
s69	1123C_6H-5_123-125_1	3.42	3.44	0.91	71.70	0.05	0.10	1.05	0.04	11.90	0.02	92.63
	1123C_6H-5_123-125_2	3.34	3.83	0.87	71.64	0.02	0.08	0.88	0.02	12.12	0.00	92.79
	1123C_6H-5_123-125_3	3.38	3.42	1.03	72.34	0.08	0.06	1.06	0.00	11.97	0.01	93.35
	1123C_6H-5_123-125_4	3.35	3.65	1.10	72.03	0.06	0.08	1.06	0.01	12.01	0.00	93.35
	1123C_6H-5_123-125_5	3.29	3.75	0.83	73.75	0.06	0.04	0.88	0.01	11.88	0.02	94.52

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s70	1123C_6H-5_123-125_6	3.34	3.81	0.86	73.33	0.01	0.05	0.84	0.01	11.89	0.00	94.15
	1123C_6H-5_123-125_7	3.54	4.19	0.83	73.62	0.03	0.03	0.74	0.04	11.86	0.04	94.91
	1123C_6H-5_123-125_8	3.35	3.58	1.21	73.47	0.07	0.06	1.06	0.01	12.14	0.00	94.96
	1123C_6H-5_123-125_9	3.36	4.18	0.84	73.35	0.02	0.08	0.69	0.02	11.86	0.00	94.40
	1123C_6H-5_123-125_10	3.50	3.65	1.53	71.68	0.08	0.06	0.87	0.07	11.70	0.00	93.14
	1123C_6H-5_123-125_11	3.20	3.87	0.86	72.82	0.02	0.06	0.84	0.00	11.91	0.00	93.58
	1123C_6H-5_123-125_12	3.28	3.43	1.07	72.69	0.06	0.06	1.06	0.10	12.04	0.00	93.78
	1123C_6H-5_123-125_13	3.41	3.35	1.03	73.02	0.07	0.07	1.03	0.00	12.04	0.02	94.05
	1123C_6H-5_123-125_14	3.25	3.86	0.92	73.73	0.02	0.03	0.85	0.00	12.07	0.03	94.76
	1123C_6H-5_123-125_15	3.26	3.84	0.83	73.34	0.02	0.02	0.90	0.02	12.00	0.01	94.23
	1123C_6H-5_123-125_16	3.34	3.35	1.05	73.73	0.06	0.06	1.08	0.07	12.07	0.04	94.84
	1123C_6H-5_123-125_17	3.54	4.10	0.82	73.44	0.02	0.04	0.72	0.03	11.99	0.00	94.70
	1123C_6H-5_123-125_18	3.45	3.73	0.94	73.67	0.02	0.05	0.91	0.06	12.06	0.00	94.89
	1123C_6H-5_123-125_19	3.31	4.28	0.83	73.65	0.03	0.05	0.62	0.02	11.92	0.00	94.71
	1123C_6H-5_123-125_20	3.34	3.30	1.06	73.35	0.06	0.08	1.06	0.01	11.95	0.01	94.22
	1123C_6H-6_118-120_1	3.99	3.32	1.43	72.66	0.08	0.06	0.95	0.00	12.09	0.03	94.60
	1123C_6H-6_118-120_2	3.98	3.31	1.64	72.46	0.12	0.01	1.04	0.03	12.35	0.00	94.94
	1123C_6H-6_118-120_3	3.99	3.28	1.53	72.35	0.11	0.08	1.03	0.03	12.31	0.01	94.73
	1123C_6H-6_118-120_4	3.95	3.34	1.79	72.35	0.10	0.06	1.01	0.05	12.30	0.00	94.95
	1123C_6H-6_118-120_5	3.93	3.48	1.55	72.36	0.12	0.08	0.94	0.05	12.14	0.00	94.64
s72*	1123C_6H-6_118-120_6	3.88	3.26	1.90	72.12	0.12	0.07	0.97	0.05	12.23	0.01	94.61
	1123C_6H-6_118-120_7	3.96	3.22	1.58	72.04	0.12	0.04	1.03	0.08	12.23	0.04	94.34
	1123C_6H-6_118-120_8	4.01	3.14	1.57	71.97	0.13	0.08	1.02	0.06	12.22	0.01	94.22
	1123C_6H-6_118-120_9	4.11	3.31	1.71	72.49	0.10	0.04	1.07	0.04	12.23	0.00	95.11
	1123C_6H-6_118-120_10	3.72	3.38	1.58	71.96	0.11	0.09	0.96	0.07	12.20	0.04	94.11
	1123C_6H-6_118-120_11	3.99	3.49	1.53	72.51	0.13	0.07	0.99	0.04	12.36	0.01	95.12
	1123C_6H-6_118-120_12	4.06	3.20	1.50	72.38	0.11	0.08	1.03	0.05	12.21	0.00	94.61
	1123C_6H-6_118-120_13	4.07	3.41	1.50	72.55	0.11	0.08	0.92	0.12	12.13	0.01	94.91
	1123C_6H-6_118-120_14	4.00	2.81	1.97	71.45	0.17	0.10	1.23	0.05	12.48	0.04	94.30
	1123C_6H-6_118-120_15	4.18	3.44	1.65	72.20	0.12	0.07	1.08	0.05	12.28	0.02	95.08
	1123C_6H-6_118-120_16	4.12	3.51	1.67	72.89	0.10	0.07	1.01	0.02	12.38	0.01	95.78
	1123C_6H-6_118-120_17	4.16	3.38	1.74	72.39	0.09	0.06	0.93	0.00	12.30	0.02	95.07
	1123C_6H-6_118-120_18	3.95	3.32	1.58	72.67	0.13	0.08	1.02	0.01	12.27	0.00	95.03
	1123C_6H-6_118-120_19	4.02	3.27	1.74	72.48	0.14	0.07	1.08	0.08	12.27	0.01	95.16
	1123C_6H-6_118-120_20	3.87	3.39	1.58	73.01	0.12	0.07	0.92	0.00	12.06	0.01	95.03
	1123C_6H-6_118-120_3	3.99	3.25	1.59	70.98	0.13	0.10	1.01	0.03	11.97	0.03	93.08
	1123C_6H-6_118-120_4	4.14	3.31	1.64	72.51	0.18	0.04	0.90	0.08	11.99	0.00	94.79
	1123C_6H-6_118-120_6	4.01	3.28	1.65	70.52	0.15	0.05	1.03	0.02	12.03	0.01	92.74
	1123C_6H-6_118-120_7	4.11	3.19	1.70	71.04	0.18	0.09	1.06	0.06	12.22	0.01	93.66
	1123C_6H-6_118-120_10	4.14	3.41	1.59	71.68	0.15	0.01	0.86	0.07	12.05	0.02	93.98
s74	1123C_6H-7_14-16_1	3.93	3.37	1.86	71.01	0.16	0.09	1.01	0.07	12.25	0.00	93.74
	1123C_6H-7_14-16_2	4.13	3.18	1.79	71.11	0.15	0.05	1.02	0.00	12.09	0.00	93.51
	1123C_6H-6_118-120_5	3.96	3.80	1.65	71.72	0.18	0.05	1.03	0.06	12.36	0.01	94.83
	1123C_6H-6_118-120_8	4.16	3.25	1.64	71.89	0.13	0.05	1.02	0.07	12.15	0.00	94.36
	1123C_6H-6_118-120_9	4.18	3.41	1.74	71.64	0.16	0.09	1.04	0.00	12.36	0.03	94.65
	1123C_6H-7_14-16_1	4.05	3.00	2.13	70.08	0.26	0.30	1.69	0.08	12.81	0.03	94.43
	1123C_6H-7_14-16_2	4.02	3.23	1.69	71.19	0.18	0.18	1.17	0.06	12.37	0.00	94.08
	1123C_6H-7_14-16_3	3.85	3.11	1.91	71.03	0.24	0.27	1.66	0.04	13.10	0.04	95.25
	1123C_6H-7_14-16_4	4.01	3.22	1.53	71.84	0.17	0.14	1.21	0.04	12.40	0.03	94.59
	1123C_6H-7_14-16_5	4.05	3.04	1.76	71.04	0.19	0.25	1.51	0.06	12.85	0.01	94.76
	1123C_6H-7_14-16_6	3.75	3.10	1.81	70.68	0.20	0.22	1.60	0.05	12.92	0.05	94.38
	1123C_6H-7_14-16_7	3.84	3.30	1.59	71.61	0.17	0.18	1.17	0.00	12.26	0.04	94.16
	1123C_6H-7_14-16_8	3.68	3.07	1.86	70.82	0.26	0.27	1.59	0.07	12.85	0.00	94.46
	1123C_6H-7_14-16_9	3.85	3.18	1.98	70.92	0.22	0.22	1.60	0.08	13.11	0.00	95.16
	1123C_6H-7_14-16_10	3.91	3.02	2.12	70.64	0.23	0.27	1.67	0.08	13.11	0.02	95.08
	1123C_6H-7_14-16_11	3.89	3.11	2.04	70.31	0.25	0.27	1.64	0.04	13.08	0.02	94.65
	1123C_6H-7_14-16_12	3.63	3.00	1.90	70.52	0.25	0.29	1.70	0.12	13.02	0.03	94.45
	1123C_6H-7_14-16_13	3.96	3.21	1.64	71.68	0.17	0.17	1.21	0.09	12.19	0.00	94.32
	1123C_6H-7_14-16_14	4.24	3.00	1.87	69.79	0.27	0.24	1.73	0.08	12.92	0.04	94.18
	1123C_6H-7_14-16_15	3.47	3.03	1.78	68.01	0.23	0.29	1.67	0.02	12.88	0.02	91.40
	1123C_6H-7_14-16_16	3.96	3.06	2.04	69.14	0.21	0.27	1.71	0.06	12.91	0.07	93.44
s74	1123C_6H-7_14-16_17	3.85	3.22	1.44	72.12	0.16	0.18	1.19	0.00	12.56	0.04	94.76
	1123C_6H-7_14-16_18	3.94	3.18	1.74	72.33	0.17	0.14	1.24	0.04	12.34	0.00	95.13
	1123C_6H-7_14-16_19	3.77	3.19	1.59	72.13	0.17	0.14	1.19	0.06	12.37	0.05	94.65
	1123C_6H-7_14-16_20	3.85	3.02	1.79	70.04	0.23	0.26	1.60	0.07	12.81	0.03	93.71
	1123C_6H-7_64-66_1	3.68	3.54	1.20	73.76	0.13	0.10	0.90	0.00	11.78	0.04	95.13
s74	1123C_6H-7_64-66_2	3.81	3.81	1.43	73.45	0.11	0.08	0.90	0.07	11.69	0.02	95.36
	1123C_6H-7_64-66_3	3.64	3.84	1.25	72.63	0.11	0.09	0.83	0.01	11.75	0.00	94.15
	1123C_6H-7_64-66_4	3.81	3.72	1.42	73.72	0.12	0.09	0.88	0.05	11.72	0.06	95.59
	1123C_6H-7_64-66_5	3.63	3.48	1.19	73.27	0.08	0.09	0.87	0.02	11.54	0.00	94.18

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s78	1123C_6H-7_64-66_6	3.60	3.72	1.33	73.86	0.12	0.11	0.84	0.02	11.67	0.00	95.27
	1123C_6H-7_64-66_7	3.64	3.75	1.19	73.40	0.14	0.11	0.82	0.05	11.87	0.04	95.00
	1123C_6H-7_64-66_8	3.65	3.72	1.34	73.94	0.13	0.12	0.83	0.00	11.72	0.00	95.45
	1123C_6H-7_64-66_9	3.57	3.65	1.19	73.43	0.11	0.11	0.88	0.07	11.56	0.01	94.58
	1123C_6H-7_64-66_10	3.66	3.49	1.30	73.54	0.12	0.08	0.81	0.09	11.97	0.00	95.05
	1123C_6H-7_64-66_11	3.72	3.82	1.38	73.40	0.13	0.10	0.86	0.00	12.09	0.01	95.51
	1123C_6H-7_64-66_12	3.37	3.49	1.10	74.10	0.10	0.06	0.80	0.08	11.51	0.02	94.62
	1123C_6H-7_64-66_13	3.37	3.64	1.23	73.53	0.14	0.12	0.90	0.00	11.94	0.01	94.89
	1123C_6H-7_64-66_14	3.67	3.72	1.32	74.07	0.10	0.11	0.82	0.00	11.90	0.00	95.71
	1123C_6H-7_64-66_15	3.73	3.80	1.21	74.02	0.14	0.08	0.82	0.08	11.71	0.04	95.63
	1123C_6H-7_64-66_16	3.41	3.69	1.18	74.33	0.10	0.07	0.84	0.00	11.38	0.01	95.02
	1123C_6H-7_64-66_17	3.66	3.74	1.26	73.21	0.12	0.08	0.88	0.02	11.65	0.03	94.65
	1123C_6H-7_64-66_18	3.92	3.73	1.11	72.96	0.12	0.06	0.86	0.04	11.83	0.00	94.64
	1123C_6H-7_64-66_19	3.70	3.68	1.25	74.11	0.11	0.08	0.87	0.04	11.88	0.02	95.74
	1123C_6H-7_64-66_20	3.63	3.45	1.37	73.74	0.12	0.09	0.89	0.00	11.70	0.00	95.00
	1123C_7H-2_62-64_1	4.63	3.11	2.08	70.75	0.12	0.07	1.03	0.08	12.58	0.02	94.48
	1123C_7H-2_62-64_2	4.49	3.21	2.10	70.91	0.15	0.05	1.05	0.05	12.55	0.00	94.56
	1123C_7H-2_62-64_3	4.69	2.99	2.00	71.62	0.14	0.08	0.97	0.10	12.71	0.00	95.30
	1123C_7H-2_62-64_4	4.89	3.18	2.08	71.15	0.15	0.09	1.00	0.12	12.72	0.00	95.37
	1123C_7H-2_62-64_5	4.83	3.24	2.28	71.06	0.12	0.08	1.01	0.03	12.69	0.00	95.33
s79	1123C_7H-2_62-64_6	4.71	3.17	2.22	70.44	0.16	0.06	1.04	0.01	12.70	0.03	94.55
	1123C_7H-2_62-64_7	4.87	3.21	2.19	70.88	0.15	0.07	0.96	0.05	12.51	0.01	94.91
	1123C_7H-2_62-64_8	4.70	3.18	2.27	70.82	0.13	0.06	0.96	0.12	12.63	0.00	94.86
	1123C_7H-2_62-64_9	4.31	3.23	1.98	71.55	0.16	0.06	1.01	0.03	12.65	0.02	95.00
	1123C_7H-2_62-64_10	4.89	3.20	2.09	71.11	0.16	0.08	1.01	0.09	12.56	0.05	95.23
	1123C_7H-2_62-64_12	4.76	3.24	2.18	70.89	0.13	0.08	1.01	0.09	12.69	0.01	95.08
	1123C_7H-2_62-64_13	4.54	3.14	2.10	69.64	0.16	0.09	0.97	0.07	12.38	0.02	93.11
	1123C_7H-2_62-64_14	4.99	3.16	2.13	70.83	0.14	0.07	1.04	0.02	12.55	0.00	94.93
	1123C_7H-2_62-64_15	4.49	3.04	2.09	71.31	0.16	0.05	1.01	0.11	12.75	0.02	95.03
	1123C_7H-2_62-64_16	4.63	3.20	2.28	71.55	0.15	0.08	0.99	0.05	12.67	0.01	95.61
	1123C_7H-2_62-64_17	4.72	3.18	2.07	70.90	0.13	0.08	1.00	0.06	12.82	0.00	94.95
	1123C_7H-2_62-64_18	4.97	3.26	2.01	71.09	0.16	0.09	1.01	0.08	12.69	0.01	95.36
	1123C_7H-2_62-64_19	4.76	3.24	2.08	71.33	0.15	0.09	1.05	0.07	12.64	0.02	95.42
	1123C_7H-2_62-64_20	4.77	3.18	2.20	71.53	0.19	0.12	1.02	0.11	12.88	0.02	96.02
	1123C_7H-2_120-122_1	4.41	2.92	2.10	69.78	0.16	0.12	1.07	0.09	12.68	0.02	93.35
	1123C_7H-2_120-122_2	4.67	3.07	2.08	70.47	0.18	0.09	1.07	0.07	12.62	0.04	94.36
	1123C_7H-2_120-122_3	4.88	3.01	2.17	70.60	0.17	0.07	1.07	0.02	12.82	0.00	94.80
	1123C_7H-2_120-122_4	4.99	3.01	2.11	70.13	0.18	0.11	1.15	0.06	12.78	0.05	94.56
	1123C_7H-2_120-122_5	4.93	2.97	2.18	70.69	0.17	0.10	1.09	0.07	12.80	0.02	95.02
	1123C_7H-2_120-122_6	5.03	3.06	2.37	70.65	0.16	0.07	1.05	0.07	12.72	0.01	95.19
s82	1123C_7H-2_120-122_7	4.88	3.04	2.38	70.91	0.17	0.12	1.09	0.11	12.87	0.00	95.58
	1123C_7H-2_120-122_8	4.55	3.06	2.13	70.06	0.16	0.09	1.13	0.15	12.60	0.00	93.93
	1123C_7H-2_120-122_9	4.63	3.08	2.26	70.29	0.18	0.11	1.11	0.06	12.81	0.05	94.59
	1123C_7H-2_120-122_10	4.88	3.14	2.23	70.72	0.20	0.11	1.14	0.05	12.95	0.00	95.42
	1123C_7H-2_120-122_11	4.81	3.16	2.11	70.68	0.16	0.09	0.99	0.09	12.51	0.03	94.63
	1123C_7H-2_120-122_12	4.90	3.11	2.04	70.76	0.18	0.10	1.07	0.04	12.60	0.03	94.83
	1123C_7H-2_120-122_13	4.92	3.00	2.36	70.64	0.15	0.11	1.11	0.19	12.95	0.02	95.45
	1123C_7H-2_120-122_14	4.96	2.99	2.12	70.42	0.17	0.08	1.07	0.08	13.04	0.00	94.94
	1123C_7H-2_120-122_15	4.73	3.02	2.17	70.66	0.21	0.09	1.05	0.08	12.86	0.01	94.88
	1123C_7H-2_120-122_16	4.91	3.05	2.17	70.78	0.20	0.10	1.06	0.04	12.77	0.00	95.07
	1123C_7H-2_120-122_17	4.96	3.10	2.14	70.49	0.19	0.10	1.10	0.07	12.78	0.00	94.93
	1123C_7H-2_120-122_18	5.01	3.00	2.34	70.74	0.16	0.11	1.09	0.09	12.92	0.00	95.46
	1123C_7H-2_120-122_19	4.95	3.07	2.15	70.80	0.14	0.09	1.08	0.16	12.83	0.02	95.29
	1123C_7H-2_120-122_20	4.89	2.99	2.24	70.38	0.18	0.09	1.06	0.12	12.72	0.02	94.69
	1123C_7H-3_132-134_1	3.52	3.54	1.01	73.20	0.04	0.06	1.00	0.03	11.98	0.03	94.41
	1123C_7H-3_132-134_2	3.34	3.66	0.87	72.75	0.08	0.05	0.86	0.06	11.87	0.00	93.54
	1123C_7H-3_132-134_3	4.21	3.27	2.24	71.66	0.16	0.05	1.07	0.07	12.75	0.01	95.49
	1123C_7H-3_132-134_4	3.17	3.87	0.88	73.16	0.05	0.04	0.86	0.07	11.97	0.00	94.06
	1123C_7H-3_132-134_5	3.38	3.47	1.08	73.15	0.07	0.07	1.09	0.04	11.89	0.00	94.24
	1123C_7H-3_132-134_6	3.41	3.33	1.13	73.42	0.07	0.07	1.10	0.15	11.95	0.01	94.63
	1123C_7H-3_132-134_7	3.23	4.33	0.82	73.09	0.04	0.02	0.65	0.02	11.93	0.00	94.13
	1123C_7H-3_132-134_8	3.35	3.76	0.85	73.07	0.03	0.06	0.87	0.06	11.91	0.01	93.96
	1123C_7H-3_132-134_9	3.42	3.84	0.89	73.03	0.02	0.06	0.88	0.04	11.95	0.00	94.13
	1123C_7H-3_132-134_10	3.43	3.47	1.15	73.47	0.06	0.06	1.05	0.06	11.71	0.02	94.48
	1123C_7H-3_132-134_11	3.40	4.05	0.91	73.32	0.04	0.04	0.70	0.10	11.89	0.00	94.44
	1123C_7H-3_132-134_12	3.45	3.73	0.95	73.12	0.05	0.06	0.88	0.03	11.91	0.00	94.18
	1123C_7H-3_132-134_14	2.83	3.93	1.00	68.51	0.04	0.02	0.95	0.03	11.08	0.00	88.39
	1123C_7H-3_132-134_15	3.35	4.00	0.87	72.94	0.03	0.02	0.83	0.09	11.95	0.01	94.10
	1123C_7H-3_132-134_16	3.41	4.16	0.82	73.18	0.02	0.05	0.73	0.04	11.85	0.00	94.25
	1123C_7H-3_132-134_17	3.14	4.07	0.90	72.74	0.02	0.04	0.71	0.04	11.87	0.00	93.54

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s83	1123C_7H-3_132-134_18	3.15	4.24	0.83	72.85	0.05	0.07	0.67	0.07	11.61	0.00	93.54
	1123C_7H-3_132-134_19	3.50	3.67	0.87	73.04	0.03	0.04	0.84	0.03	11.69	0.00	93.70
	1123C_7H-3_132-134_20	3.38	3.87	0.86	73.23	0.04	0.03	0.86	0.04	11.83	0.00	94.14
	1123C_7H-3_132-134_1	3.58	3.61	0.86	71.89	0.07	0.05	0.86	0.05	11.72	0.02	92.70
	1123C_7H-3_132-134_4	3.59	3.85	1.11	72.97	0.07	0.03	0.86	0.02	11.99	0.00	94.49
	1123C_7H-3_132-134_6	3.60	3.76	0.89	73.28	0.04	0.02	0.85	0.06	12.15	0.00	94.65
	1123C_7H-3_132-134_10	3.30	4.33	1.04	73.07	0.04	0.03	0.89	0.11	11.95	0.00	94.75
	1123C_7H-3_132-134_2	3.36	4.17	0.62	72.20	0.05	0.01	0.67	0.03	11.89	0.00	93.00
	1123C_7H-3_132-134_3	3.60	3.75	0.96	71.71	0.02	0.08	0.90	0.03	11.82	0.01	92.88
	1123C_7H-3_132-134_7	3.63	3.78	1.08	73.02	0.08	0.03	0.91	0.08	11.83	0.00	94.43
	1123C_7H-4_60-62_1	4.34	3.41	1.89	70.82	0.17	0.09	1.07	0.02	12.84	0.00	94.65
	1123C_7H-4_60-62_2	4.09	3.51	1.85	71.19	0.11	0.10	0.94	0.02	12.84	0.02	94.67
	1123C_7H-4_60-62_3	4.00	3.38	2.28	69.77	0.18	0.15	1.21	0.08	13.25	0.00	94.29
	1123C_7H-4_60-62_4	4.20	3.42	2.08	70.56	0.19	0.12	1.12	0.04	12.89	0.02	94.63
	1123C_7H-4_60-62_5	4.10	3.35	2.00	70.31	0.20	0.17	1.25	0.05	13.02	0.04	94.49
	1123C_7H-4_60-62_6	4.15	3.54	2.27	70.46	0.16	0.14	1.08	0.06	12.89	0.01	94.76
	1123C_7H-4_60-62_7	4.00	3.36	2.22	70.81	0.19	0.16	1.20	0.11	13.07	0.05	95.17
	1123C_7H-4_60-62_8	4.10	3.41	1.86	71.37	0.15	0.05	0.97	0.07	12.46	0.03	94.47
	1123C_7H-4_60-62_9	4.35	3.25	2.30	70.17	0.16	0.15	1.21	0.06	13.08	0.01	94.76
	1123C_7H-4_60-62_10	4.04	3.32	2.20	68.89	0.16	0.14	1.20	0.11	12.89	0.01	92.95
	1123C_7H-4_60-62_11	3.87	3.59	2.24	69.12	0.15	0.07	1.09	0.11	12.70	0.04	92.98
	1123C_7H-4_60-62_12	4.46	3.32	2.31	70.28	0.18	0.16	1.23	0.14	12.93	0.06	95.07
	1123C_7H-4_60-62_13	4.00	3.40	1.90	70.36	0.12	0.08	1.02	0.13	12.81	0.01	93.84
	1123C_7H-4_60-62_14	4.16	3.35	2.12	69.68	0.17	0.09	1.09	0.05	12.79	0.02	93.52
	1123C_7H-4_60-62_15	4.21	3.39	2.30	69.92	0.18	0.15	1.23	0.12	13.16	0.01	94.69
	1123C_7H-4_60-62_16	4.03	3.70	1.72	72.04	0.09	0.06	0.74	0.05	12.34	0.00	94.77
	1123C_7H-4_60-62_17	4.06	3.29	2.30	69.14	0.20	0.12	1.20	0.13	12.91	0.02	93.37
	1123C_7H-4_60-62_18	4.18	3.46	1.97	70.27	0.14	0.07	1.09	0.10	12.64	0.00	93.92
s85	1123C_7H-4_60-62_19	4.17	3.33	1.95	68.70	0.16	0.13	1.11	0.05	12.83	0.02	92.45
	1123C_7H-4_60-62_20	4.02	3.21	2.19	69.80	0.19	0.18	1.20	0.07	13.04	0.04	93.94
	1123C_7H-4_60-62_3	4.37	3.60	1.93	71.04	0.13	0.06	1.05	0.04	12.75	0.01	94.98
	1123C_7H-4_60-62_4	4.58	3.23	2.19	69.71	0.23	0.17	1.21	0.06	12.91	0.06	94.37
	1123C_7H-4_60-62_5	4.43	3.41	1.87	71.09	0.19	0.05	0.94	0.00	12.53	0.00	94.52
	1123C_7H-4_60-62_7	4.76	3.38	2.37	70.57	0.25	0.11	1.18	0.05	13.18	0.04	95.89
	1123C_7H-4_60-62_10	4.38	3.52	2.14	71.28	0.21	0.12	1.09	0.05	12.94	0.05	95.79
	1123C_7H-4_60-62_1	4.57	3.16	2.16	70.01	0.20	0.14	1.24	0.13	13.10	0.03	94.75
	1123C_7H-4_60-62_2	4.60	3.45	2.06	70.11	0.22	0.11	1.09	0.05	12.89	0.02	94.60
	1123C_7H-4_60-62_6	4.30	3.23	1.90	69.78	0.19	0.09	1.11	0.06	12.99	0.00	93.65
	1123C_7H-4_60-62_8	4.45	3.49	1.72	70.94	0.19	0.10	0.95	0.01	12.70	0.03	94.59
	1123C_7H-5_11-13_1	4.50	3.36	2.16	69.98	0.21	0.10	1.18	0.10	12.77	0.04	94.39
	1123C_7H-5_11-13_2	4.42	3.40	2.18	70.15	0.17	0.13	1.22	0.08	12.77	0.00	94.53
	1123C_7H-5_11-13_3	4.38	3.43	2.25	70.10	0.17	0.13	1.18	0.07	12.67	0.00	94.37
	1123C_7H-5_11-13_4	4.28	3.55	2.09	70.14	0.17	0.16	1.22	0.10	12.87	0.03	94.61
	1123C_7H-5_11-13_5	4.53	3.35	2.11	69.99	0.16	0.14	1.21	0.12	12.91	0.00	94.54
	1123C_7H-5_11-13_6	4.33	3.50	2.16	70.38	0.20	0.13	1.15	0.07	12.43	0.01	94.35
	1123C_7H-5_11-13_7	4.35	3.49	2.23	68.00	0.16	0.19	1.18	0.11	12.05	0.03	91.78
	1123C_7H-5_11-13_8	4.32	3.28	2.03	68.60	0.19	0.15	1.20	0.09	12.50	0.00	92.36
	1123C_7H-5_11-13_9	4.09	3.54	2.18	70.11	0.19	0.12	1.14	0.06	12.84	0.01	94.28
	1123C_7H-5_11-13_10	4.22	3.40	2.16	70.22	0.20	0.22	1.31	0.06	12.84	0.00	94.63
	1123C_7H-5_11-13_11	4.29	3.50	2.15	69.71	0.17	0.14	1.22	0.10	12.64	0.05	93.97
	1123C_7H-5_11-13_12	4.26	3.50	2.03	69.83	0.17	0.12	1.21	0.02	12.62	0.04	93.80
	1123C_7H-5_11-13_14	4.30	3.31	2.17	69.54	0.20	0.16	1.24	0.06	13.05	0.03	94.05
	1123C_7H-5_11-13_15	4.37	3.38	2.36	69.31	0.23	0.15	1.30	0.11	12.91	0.00	94.12
	1123C_7H-5_11-13_16	4.38	3.29	2.31	69.20	0.23	0.17	1.33	0.06	13.14	0.00	94.10
	1123C_7H-5_11-13_17	4.13	3.54	2.24	70.69	0.18	0.13	1.17	0.01	12.93	0.02	95.03
	1123C_7H-5_11-13_18	4.57	3.37	2.44	69.55	0.19	0.16	1.30	0.04	12.99	0.00	94.60
	1123C_7H-5_11-13_19	4.56	3.47	2.11	69.70	0.17	0.18	1.17	0.03	12.88	0.01	94.28
	1123C_7H-5_11-13_20	4.28	3.47	2.16	69.84	0.21	0.15	1.23	0.03	12.73	0.03	94.13
s94	1123C_7H-5_11-13_1	4.20	3.54	2.18	70.18	0.19	0.16	1.23	0.08	13.02	0.03	94.80
	1123C_7H-5_11-13_4	4.24	3.42	2.35	70.10	0.20	0.10	1.28	0.05	13.07	0.03	94.84
	1123C_7H-5_11-13_6	4.11	3.41	2.35	70.55	0.20	0.12	1.29	0.07	12.98	0.03	95.11
	1123C_7H-5_11-13_8	4.10	3.42	2.25	69.89	0.23	0.16	1.33	0.07	12.67	0.03	94.15
s94	1123C_7H-5_11-13_10	3.98	3.63	2.31	70.54	0.18	0.10	1.12	0.05	12.50	0.00	94.41
	1123C_7H-5_11-13_2	4.12	3.50	2.24	70.47	0.19	0.17	1.29	0.02	13.30	0.01	95.31
	1123C_7H-5_11-13_5	4.21	3.46	1.97	70.75	0.21	0.14	1.11	0.02	12.68	0.03	94.58
	1123C_7H-5_11-13_7	4.01	3.37	2.35	70.40	0.23	0.16	1.29	0.00	13.22	0.02	95.05
s94	1123C_7H-5_11-13_9	4.31	3.36	2.35	69.46	0.17	0.20	1.32	0.03	13.05	0.01	94.25
	1123C_7H-5_11-13_11	4.09	3.46	2.36	70.60	0.18	0.13	1.19	0.12	13.00	0.00	95.14
s94	1123C_9H-5_33-35_1	3.62	3.25	1.69	71.37	0.19	0.18	1.37	0.00	11.95	0.02	93.64
	1123C_9H-5_33-35_2	4.41	2.86	2.16	71.63	0.23	0.20	1.47	0.05	12.59	0.01	95.61

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1123C_9H-5_33-35_3	4.08	2.91	1.32	73.55	0.13	0.12	1.01	0.02	11.84	0.00	94.99
	1123C_9H-5_33-35_4	4.40	2.68	1.69	71.41	0.18	0.19	1.36	0.06	12.42	0.06	94.45
	1123C_9H-5_33-35_5	3.84	2.86	1.74	70.26	0.18	0.20	1.35	0.12	12.13	0.02	92.69
	1123C_9H-5_33-35_6	4.18	2.82	1.80	71.88	0.23	0.23	1.56	0.08	12.31	0.00	95.09
	1123C_9H-5_33-35_7	4.40	2.66	1.64	70.95	0.17	0.14	1.39	0.05	12.17	0.00	93.58
	1123C_9H-5_33-35_8	4.32	2.92	1.77	72.15	0.18	0.21	1.40	0.07	12.39	0.04	95.44
	1123C_9H-5_33-35_9	3.96	2.95	1.57	72.92	0.14	0.11	1.07	0.04	11.84	0.04	94.64
	1123C_9H-5_33-35_10	4.14	3.06	2.41	69.68	0.34	0.34	1.98	0.01	12.95	0.04	94.95
	1123C_9H-5_33-35_11	4.55	2.72	1.91	71.65	0.20	0.18	1.48	0.06	12.42	0.00	95.17
	1123C_9H-5_33-35_12	4.30	2.76	1.83	71.58	0.19	0.20	1.40	0.03	12.33	0.01	94.63
	1123C_9H-5_33-35_13	4.22	2.85	1.70	71.70	0.21	0.20	1.39	0.06	12.23	0.02	94.59
	1123C_9H-5_33-35_14	3.87	3.32	1.46	72.26	0.21	0.13	1.29	0.05	12.04	0.01	94.65
	1123C_9H-5_33-35_15	4.20	3.61	1.54	74.56	0.10	0.04	0.91	0.02	11.96	0.01	96.95
	1123C_9H-5_33-35_16	4.57	2.70	1.79	71.77	0.19	0.19	1.37	0.09	12.02	0.03	94.72
	1123C_9H-5_33-35_17	4.22	2.77	1.89	71.55	0.20	0.19	1.38	0.00	12.65	0.02	94.87
	1123C_9H-5_33-35_18	4.10	3.01	1.94	72.06	0.22	0.19	1.44	0.01	12.10	0.01	95.07
	1123C_9H-5_33-35_19	3.97	3.32	1.59	72.73	0.17	0.18	1.23	0.00	12.13	0.02	95.35
	1123C_9H-5_33-35_20	4.44	2.84	1.73	71.69	0.21	0.20	1.43	0.01	12.55	0.00	95.10
	1123C_9H-5_33-35_3	4.18	2.70	1.58	71.03	0.30	0.18	1.38	0.04	12.53	0.01	93.93
	1123C_9H-5_33-35_4	4.32	2.64	1.86	71.64	0.25	0.20	1.32	0.09	12.47	0.05	94.84
	1123C_9H-5_33-35_5	4.06	2.62	1.81	71.30	0.25	0.19	1.37	0.01	12.62	0.00	94.23
	1123C_9H-5_33-35_7	4.14	2.85	1.79	72.34	0.23	0.17	1.42	0.06	12.59	0.00	95.59
	1123C_9H-5_33-35_1	4.22	2.63	1.88	72.26	0.27	0.16	1.42	0.11	12.54	0.00	95.49
	1123C_9H-5_33-35_6	4.08	2.73	1.84	71.69	0.23	0.22	1.44	0.00	12.20	0.00	94.43
	1123C_9H-5_33-35_9	4.39	2.88	1.78	72.45	0.28	0.18	1.44	0.06	12.59	0.03	96.09
	1123C_9H-5_33-35_10	4.19	2.70	1.99	72.22	0.28	0.23	1.41	0.07	12.59	0.04	95.71
s95	1123C_9H-5_99-101_1	4.14	2.93	1.86	72.63	0.23	0.18	1.50	0.05	12.62	0.05	96.20
	1123C_9H-5_99-101_2	4.27	2.53	2.70	68.79	0.40	0.54	2.50	0.06	14.01	0.09	95.89
	1123C_9H-5_99-101_3	3.82	2.92	1.95	70.74	0.18	0.20	1.51	0.06	12.75	0.06	94.19
	1123C_9H-5_99-101_4	3.76	2.81	1.64	71.24	0.21	0.22	1.44	0.08	12.55	0.02	93.97
	1123C_9H-5_99-101_5	3.97	3.00	1.75	72.65	0.21	0.23	1.42	0.09	12.48	0.03	95.84
	1123C_9H-5_99-101_6	3.80	2.92	2.01	72.29	0.22	0.17	1.45	0.03	12.68	0.04	95.61
	1123C_9H-5_99-101_7	3.89	2.99	1.87	72.14	0.19	0.17	1.45	0.05	12.54	0.05	95.34
	1123C_9H-5_99-101_8	3.97	3.13	1.76	72.90	0.12	0.10	1.06	0.00	12.43	0.00	95.48
	1123C_9H-5_99-101_9	4.04	2.60	2.87	68.76	0.39	0.59	2.50	0.00	14.21	0.11	96.07
	1123C_9H-5_99-101_10	3.60	2.81	1.93	71.76	0.23	0.18	1.49	0.06	12.35	0.00	94.42
	1123C_9H-5_99-101_11	3.66	2.97	1.72	71.43	0.20	0.19	1.48	0.05	12.53	0.01	94.24
	1123C_9H-5_99-101_12	3.88	3.03	1.91	71.76	0.20	0.20	1.46	0.05	12.53	0.03	95.06
	1123C_9H-5_99-101_13	3.69	3.07	1.56	71.26	0.14	0.10	1.17	0.02	12.45	0.01	93.46
	1123C_9H-5_99-101_14	3.99	3.03	1.46	71.94	0.09	0.11	1.09	0.03	12.53	0.02	94.29
	1123C_9H-5_99-101_15	3.84	2.99	1.80	72.13	0.22	0.20	1.45	0.02	12.58	0.03	95.25
	1123C_9H-5_99-101_16	4.13	3.09	1.77	73.05	0.12	0.10	1.13	0.07	12.47	0.01	95.95
	1123C_9H-5_99-101_17	3.98	3.07	1.78	72.61	0.13	0.10	1.15	0.07	12.45	0.00	95.35
	1123C_9H-5_99-101_18	3.55	3.13	1.50	73.82	0.14	0.10	1.16	0.04	12.29	0.00	95.74
	1123C_9H-5_99-101_19	3.69	2.99	1.33	72.89	0.14	0.11	1.13	0.06	11.92	0.00	94.26
	1123C_9H-5_99-101_20	3.64	2.86	1.89	71.70	0.21	0.20	1.54	0.04	12.70	0.02	94.80
	1123C_9H-5_99-101_1	4.14	3.05	1.63	72.10	0.22	0.20	1.45	0.04	12.45	0.04	95.31
	1123C_9H-5_99-101_3	4.16	3.17	1.67	72.38	0.11	0.10	1.12	0.00	12.51	0.00	95.23
	1123C_9H-5_99-101_4	4.14	3.12	1.65	72.55	0.12	0.09	1.09	0.02	12.48	0.01	95.26
	1123C_9H-5_99-101_10	3.88	2.99	1.81	71.83	0.21	0.20	1.45	0.03	12.47	0.02	94.89
	1123C_9H-5_99-101_12	4.27	2.99	1.66	72.27	0.23	0.16	1.49	0.05	12.44	0.01	95.56
	1123C_9H-5_99-101_2	3.87	2.97	1.82	72.13	0.20	0.21	1.39	0.08	12.35	0.02	95.04
	1123C_9H-5_99-101_5	3.82	2.83	1.79	72.33	0.19	0.18	1.51	0.10	12.33	0.06	95.14
	1123C_9H-5_99-101_6	3.77	2.97	1.72	71.78	0.19	0.23	1.51	0.02	12.40	0.03	94.62
	1123C_9H-5_99-101_7	4.26	2.98	1.88	71.94	0.21	0.19	1.48	0.11	12.25	0.02	95.32
	1123C_9H-5_99-101_8	3.94	2.89	1.75	71.48	0.21	0.16	1.46	0.00	12.25	0.03	94.17
	1123C_9H-5_99-101_9	3.96	2.94	1.85	72.01	0.22	0.19	1.44	0.01	12.33	0.00	94.95
	1123C_9H-5_99-101_11	3.98	3.03	1.82	72.27	0.23	0.20	1.47	0.00	12.50	0.02	95.52
	1123C_9H-5_99-101_13	4.09	2.90	1.93	72.83	0.20	0.21	1.42	0.08	12.94	0.03	96.63
	1123C_9H-5_99-101_14	4.01	3.24	1.50	72.79	0.10	0.12	1.15	0.03	12.58	0.00	95.53

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1123A_4H-5_71-73_1	43.85	5.58	2.57	0.83	126.16	63.50	14.14	97.99	7.10	6.38	689.88	18.35	40.48	3.69	12.48
1123A_4H-5_71-73_4	19.64	2.94	1.97	0.50	73.29	52.46	9.69	60.72	3.57	3.49	405.19	11.66	22.86	2.305	8.08
1123A_4H-5_71-73_5	14.51	1.93	1.01	0.41	41.49	47.92	5.78	35.85	2.21	2.08	250.23	6.79	13.39	1.425	4.8
1123A_4H-5_71-73_8	19.97	2.46	1.22	0.48	55.71	44.27	7.04	42.99	3.06	3.11	331.33	8.98	18.41	1.919	6.05
1123A_4H-5_71-73_9	39.64	5.09	2.87	0.67	127.40	74.42	15.70	98.53	6.42	6.29	698.42	18.78	39.73	3.91	12.91
1123A_5H-2_98-100_1	30.02	8.29	3.78	0.67	124.77	50.73	26.66	128.87	7.96	6.07	711.23	24.8	51.47	5.94	22.79
1123A_5H-2_98-100_3	38.22	9.96	2.68	1.40	117.70	125.07	27.77	297.38	9.87	5.34	696.77	24.68	55.28	6.33	24.25
1123A_5H-2_98-100_4	32.77	9.16	2.75	1.01	130.60	84.30	28.66	206.51	8.35	5.70	719.97	25.01	55.75	6.44	23.91
1123A_5H-2_98-100_5	33.58	8.31	2.74	1.14	102.95	111.36	23.57	205.32	7.54	4.77	653.55	22.32	45.89	5.07	19.07
1123A_5H-2_98-100_7	39.84	9.57	2.74	1.26	113.26	99.79	25.85	238.45	9.06	5.49	731.42	24.3	51.7	6.05	20.7
1123A_5H-3_66-68_1	46.67	7.77	3.04	0.83	134.35	72.48	22.73	111.12	7.92	6.58	803.79	25.16	54.97	5.82	22.23
1123A_5H-3_66-68_5	47.14	8.33	2.71	0.85	133.55	70.64	22.81	109.56	8.88	6.44	774.02	23.73	50.17	5.47	19.4
1123A_5H-3_66-68_7	46.88	6.08	3.15	0.52	139.29	51.40	20.32	82.70	7.36	7.08	779.34	23.92	49.34	5.09	18.5
1123A_6H-4_131-133_1	41.49	11.43	2.76	0.41	114.13	67.04	34.89	269.40	10.38	5.93	764.97	26.92	60.44	7.02	26.78
1123A_6H-4_131-133_5	29.91	11.60	5.03	0.50	120.40	72.05	37.75	280.86	10.82	6.17	787.72	28.72	61.05	7.16	29.4
1123A_6H-4_131-133_2	38.46	11.86	4.43	0.52	125.44	72.47	36.48	280.08	11.21	6.42	811.86	29.08	61.73	7.38	28.28
1123A_6H-4_131-133_6	35.54	10.52	2.60	0.32	108.03	65.48	32.23	243.83	9.80	5.38	720.27	25.84	57.14	6.48	25.96
1123A_6H-4_131-133_10	39.42	10.51	3.22	0.34	112.72	62.74	33.29	256.82	10.94	5.81	721.12	25.88	57.14	6.59	26.74
1123A_6H-5_18-20_5	34.41	11.24	1.99	0.41	95.24	69.39	28.35	213.67	8.56	4.81	633.77	23.48	49.94	6.61	22.92
1123A_6H-5_18-20_6	34.80	12.93	41.30	0.57	100.67	85.46	33.67	257.23	9.49	5.33	719.79	26.55	56.74	6.75	27.65
1123A_6H-5_18-20_7	42.22	13.46	12.62	0.99	107.44	85.18	34.40	266.30	10.38	5.54	759.70	27.2	59.63	7.2	28.54
1123A_6H-5_18-20_8	40.49	13.59	17.08	0.37	109.87	85.29	34.51	267.26	10.34	5.63	779.36	29.27	61.53	6.92	28.73
1123A_6H-5_18-20_9	37.88	13.72	4.78	0.50	112.34	87.22	35.65	268.45	10.37	5.91	779.47	28.71	61.48	7.47	28.95
1123A_6H-6_125-127_1	77.16	4.89	2.91	0.37	162.45	55.13	18.60	62.76	5.10	9.94	749.21	23.47	50.78	4.91	16.87
1123A_6H-6_125-127_2	72.55	4.54	3.95	0.53	153.92	51.45	17.07	57.23	4.50	8.76	717.62	21.82	45.02	4.44	15.19
1123A_6H-6_125-127_3	59.60	4.26	3.60	0.69	161.46	85.32	16.35	70.34	5.44	8.09	805.62	25	50.51	5.42	18.44
1123A_6H-6_125-127_6	68.72	4.73	4.30	0.34	163.03	57.74	18.94	62.30	5.05	9.60	750.97	23.81	48.52	5.06	17.73
1123A_6H-6_125-127_10	65.96	4.46	3.31	0.51	149.45	78.00	15.78	66.69	5.27	8.65	781.15	25		5.2	16.83
1123A_7H-1_52-54_1	51.04	7.16	2.61	0.89	150.92	50.94	32.20	121.82	9.54	7.91	839.37	28.78	62.2	6.56	23.89
1123A_7H-1_52-54_4	50.80	7.28	2.85	0.77	136.62	57.34	29.83	116.33	8.61	7.10	777.34	26.83	55.97	6.44	22.7
1123A_7H-1_52-54_6	33.82	6.41	3.14	0.88	123.01	41.90	27.94	110.90	8.08	6.33	684.58	25.27	50.81	5.27	20.14
1123A_7H-1_52-54_7	49.13	8.05	3.60	0.83	150.36	59.63	31.09	121.81	9.02	7.92	839.36	28.45	60.29	6.53	24.53
1123A_7H-1_52-54_10	49.88	7.33	3.07	0.62	148.71	52.15	31.96	124.39	9.43	8.33	881.60	30.29	62.16	6.67	24.55
1123A_7H-3_48-50_5	42.26	12.67	2.45	0.30	118.09	67.92	35.37	268.20	11.06	6.30	787.44	28.19	62.76	7.11	28.95
1123A_7H-3_48-50_6	43.50	12.99	3.21	0.33	127.99	70.75	36.98	282.18	11.35	6.49	820.41	30.47	64.86	7.57	29.94
1123A_7H-3_48-50_8	39.71	12.17	2.48	0.28	118.27	69.07	34.63	267.30	11.03	6.24	769.84	27.76	62.58	7.33	29.06
1123A_7H-3_48-50_7	40.14	10.50	2.52	0.36	123.17	44.07	34.12	221.57	10.25	5.98	755.45	28.05	62.62	6.9	26.59
1123A_7H-3_48-50_9	46.01	11.96	2.56	0.26	117.29	68.06	34.08	260.47	10.82	5.77	730.95	26.56	61.24	7.05	27.03
1123A_7H-3_108-110_2	48.27	11.93	4.65	0.41	121.64	82.16	34.23	266.36	11.31	6.28	764.32	27.5	62	7.1	27
1123A_7H-3_108-110_3	42.55	12.55	3.55	0.30	111.97	77.19	30.54	228.39	11.08	7.18	777.07	26.6	59.82	6.51	24.68
1123A_7H-3_108-110_4	34.98	12.09	3.40	0.58	120.78	83.76	32.62	256.97	11.65	6.26	739.75	25.99	60.49	6.69	26.04
1123A_7H-3_108-110_6	43.52	11.65	3.24	0.26	118.24	84.80	32.99	256.82	11.00	6.12	756.97	26.15	61.3	6.76	26.61
1123A_7H-3_108-110_7	44.17	12.26	3.51	0.33	123.28	81.00	33.92	262.42	11.20	6.55	747.37	26.97	61.12	6.81	26.88
1123A_7H-5_125-127_1	44.42	10.57	4.05	1.18	142.10	93.06	32.55	270.42	10.46	7.51	777.47	28.26	61.73	6.99	26.96
1123A_7H-5_125-127_3	45.99	10.21	3.32	0.92	138.69	91.57	31.50	265.31	10.86	7.65	770.46	26.82	60.42	6.82	25.9
1123A_7H-5_125-127_5	42.01	9.05	3.07	1.44	109.22	74.35	24.72	238.99	9.69	6.32	637.56	23.13	51.55	5.35	20.66
1123A_7H-5_125-127_8	43.70	10.82	2.87	1.09	137.33	99.94	33.20	272.76	10.35	7.37	790.27	28.93	64.68	7.23	27.97
1123A_7H-5_125-127_10	42.40	9.90	149.25	0.97	140.47	89.81	31.04	262.02	10.47	7.70	758.38	26.96	59.18	6.81	26.21
1123A_9H-5_99-101_1	45.73	10.65	3.66	0.95	131.10	85.46	28.83	173.73	7.22	6.78	849.25	24.62	52.12	5.88	23.41
1123A_9H-5_99-101_2	35.34	6.08	3.25	1.94	106.56	93.61	18.06	126.69	5.99	5.16	666.62	19.28	39.04	4.31	15.99
1123A_9H-5_99-101_4	41.62	8.78	2.04	0.79	107.22	86.35	25.00	158.58	6.02	5.49	709.19	20.95	47.65	4.82	20.78
1123A_9H-5_99-101_7	42.55	6.25	2.59	0.75	121.43	109.92	19.14	146.81	7.12	5.57	777.31	21.83	44.12	4.77	16.88
1123A_9H-5_99-101_9	51.53	5.94	2.71	0.82	123.54	118.99	20.48	163.75	8.07	5.94	805.51	23.3	47.36	5.37	19.14
1123A_9H-5_141-143_2	45.98	12.53	2.94	1.20	108.19	94.13	27.41	191.85	7.06	5.70	722.38	20.81	46.74	5.45	21.11
1123A_9H-5_141-143_9	43.41	12.13	2.49	1.16	104.51	90.99	25.65	184.41	6.85	5.26	704.08	20.09	44.24	5.05	19.54
1123A_9H-5_141-143_10	39.10	12.81	3.30	1.48	121.20	98.67	28.18	194.91	7.51	5.61	746.30	21.73	49	5.57	21.21
1123A_9H-7_7-9_1	44.30	9.22	4.15	2.98	126.92	88.86	18.12	155.93	6.19	6.69	805.42	19.59	40.28	4.35	15.59
1123A_9H-7_7-9_3	33.41	8.21	4.70	2.01	117.31	83.47	17.85	154.19	5.90	6.17	755.73	19.08	37.12	4.03	14.73
1123A_9H-7_7-9_5	42.75	8.12	2.19	1.81	112.43	78.55	16.21	143.47	5.99	6.13	725.95	17	36.36	3.77	13.74
1123A_9H-7_7-9_7	42.18	8.93	2.50	2.00	118.53	81.23	16.76	148.46	6.14	6.21	773.60	18.09	38.33	3.9	14.59
1123B_1H-2_5-7_2	31.08	8.71	3.30	0.30	90.98	99.04	31.36	136.71	8.04	3.42	772.39	23.64	51.33	5.87	23.84
1123B_1H-2_5-7_5	33.46	8.76	3.69	0.33	101.09	103.26	31.77	140.86	9.14	3.60	844.98	24.9	55.57	6.29	25.32
1123B_1H-2_5-7_6	33.24	8.75	3.58	0.33	93.55	92.32	29.37	132.68	8.30	3.43	779.54	23.37	51.69	5.98	22.08
1123B_1H-2_5-7_7	34.47	9.25	3.58	0.22	101.16	104.26	33.10	150.55	9.12	3.71	820.71	25.66	54.37	6.34	24.64
1123B_1H-2_5-7_10	31.85	8.25	3.49	0.32	92.09	89.94	28.83	131.07	8.35	3.39	741.61	22.35	49.49	5.54	22.39
1123B_5H-3_3-5_1	31.37	10.54	3.52	1.09	110.55	102.03	24.69	225.94	7.96	5.10	668.66	22.77	48.12	5.4	20.12
1123B_5H-3_3-5_2	30.23	9.89	3.65	1.29	103.11	81.79	23.32	202.61	8.78	6.21	816.02	25.88	50.93	5.58	20.55
1123B_5H-3_3-5_6	24.66	8.67	3.89	0.93	98.03	115.09	19.40	174.14	6.12	4.30	546.17	18.96	39.3	4.45	16.74
1123B_5H-3_3-5_8	25.85	13.04	2.28												

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1123A_4H-5_71-73_1	2.75	0.44	2.05	0.33	2.35	0.45	1.50	0.26	1.80	0.32	3.51	0.498	15.22	10.22	2.71
1123A_4H-5_71-73_4	1.56	0.22	1.30	0.24	1.46	0.30	0.91	0.15	1.10	0.19	1.67	0.298	8.51	6.11	1.534
1123A_4H-5_71-73_5	0.87	0.14	0.93	0.15	0.88	0.18	0.62	0.09	0.71	0.11	1.02	0.185	5.25	3.68	0.909
1123A_4H-5_71-73_8	1.26	0.19	1.15	0.16	1.31	0.23	0.85	0.13	0.80	0.10	1.16	0.284	7.38	4.92	1.285
1123A_4H-5_71-73_9	2.74	0.42	2.20	0.36	2.35	0.58	1.48	0.27	1.94	0.31	2.88	0.536	15.1	10.84	2.74
1123A_5H-2_98-100_1	4.30	0.61	4.12	0.72	4.49	0.89	2.63	0.44	2.73	0.41	3.98	0.623	15.87	11.44	2.77
1123A_5H-2_98-100_3	6.09	0.87	4.99	0.80	4.98	0.95	2.82	0.53	2.84	0.49	7.12	0.779	17.08	10.92	3.12
1123A_5H-2_98-100_4	4.58	0.73	4.76	0.77	4.26	1.04	2.77	0.44	3.15	0.49	5.37	0.594	17.25	12.43	3.11
1123A_5H-2_98-100_5	4.22	0.76	3.52	0.59	4.13	0.84	2.59	0.41	2.70	0.45	5.34	0.596	14.93	9.77	2.41
1123A_5H-2_98-100_7	4.79	0.89	3.88	0.68	4.17	0.94	2.75	0.45	2.78	0.49	6.63	0.724	16.57	10.79	2.67
1123A_5H-3_66-68_1	3.70	0.48	3.98	0.50	3.52	0.78	2.61	0.30	2.92	0.46	3.23	0.747	18.74	12.65	3.08
1123A_5H-3_66-68_5	3.87	0.50	3.68	0.46	3.56	0.72	2.29	0.30	2.39	0.40	3.12	0.523	16.72	11.02	2.9
1123A_5H-3_66-68_7	3.60	0.48	3.14	0.44	3.20	0.64	2.01	0.30	2.09	0.34	2.61	0.553	16.82	11.85	2.85
1123A_6H-4_131-133_1	6.26	0.86	5.03	0.90	5.42	1.14	3.58	0.48	3.90	0.66	7.02	0.712	19.39	11.13	2.94
1123A_6H-4_131-133_5	6.60	0.94	6.05	0.95	6.28	1.43	4.08	0.58	3.63	0.54	6.72	0.632	20.21	11.66	6.41
1123A_6H-4_131-133_2	6.56	1.04	5.51	0.96	6.03	1.25	3.88	0.53	4.08	0.66	7.27	0.729	19.97	11.95	3.01
1123A_6H-4_131-133_6	5.45	0.91	5.20	0.82	5.30	1.21	3.57	0.49	3.46	0.52	6.29	0.714	16.5	10.83	2.5
1123A_6H-4_131-133_10	5.71	0.95	5.22	0.81	5.54	1.17	3.49	0.51	3.62	0.55	6.34	0.698	18.05	10.88	2.73
1123A_6H-5_18-20_5	4.77	0.82	4.75	0.76	4.86	1.02	3.00	0.48	3.24	0.49	5.61	0.574	17.2	9.74	3.06
1123A_6H-5_18-20_6	5.69	0.97	6.36	0.95	6.02	1.22	3.53	0.56	3.78	0.56	6.82	0.653	16.5	11.49	2.59
1123A_6H-5_18-20_7	5.57	1.08	6.45	0.93	6.04	1.25	3.43	0.56	3.93	0.64	7.06	0.737	17.86	11.6	2.76
1123A_6H-5_18-20_8	6.83	1.07	6.08	0.99	6.56	1.34	3.78	0.56	4.01	0.59	7.17	0.702	17.32	12.61	2.62
1123A_6H-5_18-20_9	6.40	1.08	6.15	0.91	6.37	1.27	3.82	0.56	4.02	0.61	6.89	0.724	17.94	12.06	2.65
1123A_6H-6_125-127_1	3.19	0.32	2.42	0.44	2.75	0.68	1.85	0.32	2.42	0.33	2.66	0.672	20.89	16.33	3.96
1123A_6H-6_125-127_2	2.92	0.28	2.74	0.40	3.11	0.61	1.59	0.29	2.11	0.29	2.52	0.65	19.44	14.92	3.55
1123A_6H-6_125-127_3	2.71	0.46	2.13	0.40	2.73	0.62	1.68	0.28	2.16	0.36	2.89	0.686	18.49	14.45	3.12
1123A_6H-6_125-127_6	3.16	0.31	2.78	0.43	2.96	0.64	1.91	0.29	2.13	0.32	2.56	0.587	21.07	16.02	4.01
1123A_6H-6_125-127_10	2.95	0.44	2.63	0.38	2.35	0.53	1.63	0.27	1.97	0.32	2.41	0.577	19.54	13.79	3.3
1123A_7H-1_52-54_1	4.54	0.44	4.44	0.84	4.78	1.05	3.16	0.49	3.57	0.59	3.77	0.785	19.73	14.28	3.28
1123A_7H-1_52-54_4	4.99	0.45	3.46	0.65	4.60	1.01	2.93	0.45	3.58	0.46	3.79	0.66	17.43	12.87	3.06
1123A_7H-1_52-54_6	4.93	0.61	4.11	0.59	4.11	0.96	2.85	0.35	2.78	0.42	2.75	0.71	18.85	11.34	2.56
1123A_7H-1_52-54_7	5.22	0.47	4.78	0.75	4.98	1.10	3.42	0.47	3.66	0.53	3.81	0.73	20.53	13.36	3.29
1123A_7H-1_52-54_10	5.59	0.52	4.81	0.81	5.27	1.09	3.31	0.54	3.71	0.54	4.10	0.77	18.5	13.98	2.97
1123A_7H-3_48-50_5	6.45	1.03	5.41	0.95	6.03	1.20	3.99	0.56	3.85	0.56	7.39	0.769	19.56	11.79	2.82
1123A_7H-3_48-50_6	6.49	0.97	6.15	1.03	6.35	1.37	4.05	0.54	4.12	0.57	7.29	0.752	20.74	12.43	3.01
1123A_7H-3_48-50_8	5.94	1.10	5.87	0.95	6.03	1.25	3.68	0.52	3.90	0.63	7.17	0.789	19.32	11.69	2.96
1123A_7H-3_48-50_7	6.17	0.78	4.88	0.89	6.35	1.24	3.62	0.55	3.41	0.56	5.53	0.761	19.78	11.91	2.9
1123A_7H-3_48-50_9	6.25	0.92	5.33	0.87	5.35	1.27	3.58	0.51	3.47	0.63	6.62	0.715	19.47	11.39	2.94
1123A_7H-3_108-110_2	6.11	1.09	5.26	0.87	5.41	1.16	3.61	0.51	3.73	0.54	6.54	0.732	18.88	11.07	2.81
1123A_7H-3_108-110_3	5.76	1.05	4.78	0.80	5.52	0.94	3.53	0.48	3.36	0.43	6.72	0.768	21.04	9.54	2.85
1123A_7H-3_108-110_4	5.51	1.04	5.48	0.82	5.46	1.16	3.51	0.54	3.66	0.49	6.09	0.667	19.11	10.46	2.87
1123A_7H-3_108-110_6	5.85	1.06	5.20	0.87	5.61	1.21	3.72	0.50	3.47	0.53	6.28	0.72	19.41	10.45	2.82
1123A_7H-3_108-110_7	5.82	1.06	5.88	0.87	5.58	1.18	3.70	0.50	3.64	0.54	6.26	0.688	19.4	10.72	2.77
1123A_7H-5_125-127_1	5.81	0.89	5.28	0.83	5.54	1.09	3.57	0.49	3.22	0.53	6.76	0.726	21.86	12.56	3.19
1123A_7H-5_125-127_3	5.82	1.05	5.19	0.82	5.46	1.10	3.29	0.48	3.39	0.52	6.72	0.737	21.8	12.35	3.09
1123A_7H-5_125-127_5	4.63	1.01	3.76	0.71	3.80	1.01	2.54	0.38	2.77	0.46	5.70	0.728	17.53	10.75	2.7
1123A_7H-5_125-127_8	5.68	0.95	5.44	0.82	6.21	1.19	3.50	0.49	3.79	0.53	6.84	0.743	21.45	13.16	3.18
1123A_7H-5_125-127_10	5.59	0.90	5.33	0.84	5.24	0.98	3.18	0.50	3.20	0.52	6.56	0.719	20.98	12.23	3.22
1123A_9H-5_99-101_1	5.20	0.81	4.57	0.77	4.72	0.98	3.13	0.49	3.18	0.49	4.87	0.551	20.65	11.1	2.62
1123A_9H-5_99-101_2	3.25	0.46	2.96	0.46	3.05	0.62	1.88	0.29	2.11	0.32	3.58	0.431	14.81	9.25	2.254
1123A_9H-5_99-101_4	4.41	0.71	4.08	0.93	3.68	0.97	2.68	0.36	2.31	0.49	4.19	0.455	16.16	9.99	2.04
1123A_9H-5_99-101_7	3.31	0.68	2.96	0.43	3.16	0.66	1.74	0.36	2.20	0.33	4.37	0.616	15.65	10.96	2.73
1123A_9H-5_99-101_9	3.36	0.72	2.84	0.53	3.19	0.72	2.50	0.41	2.38	0.29	4.14	0.578	16.59	12.35	3.06
1123A_9H-5_141-143_2	4.87	1.00	4.11	0.75	4.65	0.99	3.18	0.44	3.35	0.44	5.41	0.458	19.83	9.52	2.42
1123A_9H-5_141-143_9	4.36	0.86	4.06	0.74	4.46	1.01	2.72	0.42	3.00	0.43	5.22	0.536	18.72	9.18	2.3
1123A_9H-5_141-143_10	4.52	0.91	4.64	0.81	4.52	1.03	2.91	0.43	3.21	0.44	5.30	0.478	21.49	9.81	2.49
1123A_9H-7_7-9_1	3.34	0.56	3.16	0.44	2.91	0.65	1.82	0.32	2.09	0.33	4.47	0.49	18.56	10.56	2.59
1123A_9H-7_7-9_3	2.38	0.52	2.53	0.41	2.74	0.61	1.85	0.26	1.92	0.30	4.27	0.48	14.57	9.97	2.27
1123A_9H-7_7-9_5	3.44	0.44	2.46	0.44	2.67	0.59	1.75	0.24	1.91	0.28	4.12	0.491	14.14	9.2	2.46
1123A_9H-7_7-9_7	2.58	0.55	2.67	0.47	2.59	0.57	1.92	0.32	2.01	0.29	4.40	0.497	16.79	9.76	2.61
1123B_1H-2_5-7_2	4.75	0.91	4.69	0.76	4.89	1.19	3.30	0.40	3.12	0.49	3.81	0.573	13.42	8.12	1.79
1123B_1H-2_5-7_5	5.50	1.10	4.79	0.78	5.31	1.04	3.43	0.52	3.49	0.52	4.03	0.624	15.66	8.34	2.08
1123B_1H-2_5-7_6	5.23	0.92	4.43	0.80	4.53	1.04	3.06	0.45	3.34	0.47	3.94	0.539	14.19	7.83	1.97
1123B_1H-2_5-7_7	5.21	1.08	4.80	0.83	5.39	1.09	3.57	0.49	3.71	0.50	4.05	0.637	14.52	8.5	2.11
1123B_1H-2_5-7_10	4.39	0.99	4.41	0.71	4.67	1.03	2.86	0.44	3.00	0.45	3.73	0.606	13.91	7.37	1.98
1123B_5H-3_3-5_1	3.72	0.76	4.16	0.71	3.90	0.89	2.54	0.46	2.62	0.44	5.37	0.559	15.81	10.15	2.54
1123B_5H-3_3-5_2	4.49	0.80	5.32	0.82	5.04	0.96	2.86	0.41	3.82	0.53	5.09	0.597	17.63	10.85	2.37
1123B_5H-3_3-5_6	3.52	0.71	3.34	0.47	3.08	0.69	1.95	0.27	2.02	0.32	4.61	0.447	13.1	7.75	1.96
1123B_5H-3_3-5_8	4.73	1.00	3.99	0.64	4.23	0.86	2.48	0.41	2.80	0.45	6.64	0.575	19.72	8.6	2.67
1123B_5H-3_3-5_10	5.23	1.17	5.20	0.69	4.83	0.90	2.85	0.46	2.34	0.46	5.09	0.547	16.52	11.68	2.68

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1123B_6H-6_50-52_6	41.37	14.63	1.98	0.35	106.72	75.42	35.28	255.75	9.83	5.52	773.34	28.97	60.75	7.31	28.2
1123B_6H-6_50-52_7	46.60	13.74	2.25	0.36	113.53	80.29	37.35	271.60	10.30	6.03	828.19	31.14	63.88	7.73	31.32
1123B_6H-6_50-52_8	39.47	12.13	1.86	0.48	105.46	78.77	34.16	247.47	9.25	5.36	750.32	28.06	59.42	7.17	27.94
1123B_6H-6_50-52_9	45.13	13.26	2.22	0.43	112.51	77.11	36.02	262.82	10.37	5.86	785.00	29.23	61.03	7.4	29.15
1123B_6H-6_137-139_3	44.17	9.69	11.17	1.58	111.15	105.93	28.66	228.38	6.92	5.69	744.86	25.45	52.29	6.13	24.22
1123B_6H-6_137-139_4	44.34	10.25	2.33	1.54	115.71	118.24	29.01	226.80	7.43	6.04	765.02	25.76	54.15	6.55	24.01
1123B_6H-6_137-139_6	46.04	11.22	2.74	2.38	127.62	127.51	29.02	237.60	7.96	6.62	770.62	25.9	54.08	6.26	23.78
1123B_6H-6_137-139_7	44.52	10.12	2.13	1.79	112.15	118.55	28.60	228.39	7.59	5.67	742.29	25.12	52.27	5.83	22.52
1123B_7H-1_129-131_1	46.85	7.96	2.31	0.64	103.28	64.28	29.46	156.77	9.01	5.92	695.87	22.55	51.96	6.31	25.2
1123B_7H-1_129-131_2	55.84	9.13	2.72	0.55	168.58	86.96	37.80	176.61	10.02	6.94	843.58	31.22	80.61	9.44	36.99
1123B_7H-1_129-131_3	34.52	8.85	3.94	1.15	119.23	69.53	30.24	150.22	8.15	6.25	750.37	26.38	56.39	6.48	26.11
1123B_7H-1_129-131_7	47.38	9.98	4.19	0.68	140.18	61.35	35.82	163.27	10.53	6.93	870.09	31.93	67.53	7.66	29.62
1123B_7H-1_129-131_10	48.71	8.56	2.61	0.68	125.54	58.92	28.22	132.84	8.74	6.49	780.14	26.6	60.72	6.38	24.73
1123B_7H-2_38-40_1	49.60	10.19	2.69	2.45	119.19	120.65	25.71	217.10	7.66	6.10	753.07	22.88	54.13	5.67	20.1
1123B_7H-2_38-40_8	50.76	10.75	2.96	1.52	137.08	110.04	28.35	232.72	8.53	7.11	829.48	25.06	57.93	6.38	23.75
1123B_7H-2_38-40_9	46.99	9.41	2.26	2.08	112.65	118.09	25.76	210.76	7.68	5.87	738.06	23.96	52.39	5.72	22.62
1123B_7H-2_38-40_6	51.58	9.35	3.15	1.57	129.20	89.60	29.04	193.86	7.89	6.42	813.81	26.17	55.88	6.28	24.21
1123B_7H-2_38-40_7	47.74	9.43	2.56	1.02	133.34	80.84	27.31	210.82	8.22	6.95	813.38	25.37	56.18	6.09	22.32
1123B_7H-6_13-15_5	84.00	5.01	3.12	0.44	152.33	79.30	15.86	68.72	6.17	8.85	773.60	25.34	55.15	5.16	17.81
1123B_7H-6_13-15_7	65.72	4.61	2.80	0.65	157.64	75.87	14.75	63.43	5.57	8.53	765.77	26.17	53.72	5.01	17.51
1123B_7H-6_13-15_9	79.84	5.03	3.49	0.50	156.36	78.73	15.68	67.41	5.91	8.80	781.58	25.95	53.17	5.24	16.99
1123C_1H-1_148-150_2	38.85	8.26	3.86	0.21	101.16	102.14	31.92	130.73	8.78	3.80	895.83	26.27	59.44	6.81	25.25
1123C_1H-1_148-150_3	28.04	7.50	4.35	0.28	92.63	86.16	25.30	106.38	7.47	3.84	813.74	22.5	50.87	5.25	20.94
1123C_1H-1_148-150_4	38.72	7.67	3.22	0.26	105.16	108.10	30.93	132.71	9.11	3.52	831.25	25.27	60.46	6.67	23.24
1123C_1H-1_148-150_9	30.89	7.95	3.98	0.20	99.25	99.27	30.95	131.98	8.44	3.78	856.01	31.23	54.19	6.3	23.48
1123C_1H-2_69-71_1	48.98	10.60	2.91	0.48	96.87	65.20	20.25	86.59	7.70	3.97	1010.61	23.14	46.74	5.04	18.25
1123C_1H-2_69-71_10	46.97	9.78	3.45	0.52	103.19	65.99	20.53	83.15	7.93	4.23	1082.81	24.22	50.61	5.21	17.8
1123C_1H-2_69-71_6	38.01	9.74	3.10	0.49	97.46	61.21	19.87	82.84	7.16	3.87	990.01	22.82	44.21	4.89	17.7
1123C_1H-2_69-71_7	46.71	10.18	3.44	0.52	97.62	66.21	21.12	87.19	7.55	3.87	1039.04	23.77	48.18	4.96	18.76
1123C_2H-2_104-109_1	43.96	12.03	2.95	0.35	128.46	62.69	30.76	150.40	8.87	5.57	796.50	29.1	58.11	6.54	25.31
1123C_2H-2_104-109_3	47.69	11.17	4.04	0.30	128.70	61.35	31.19	152.95	9.23	5.59	740.48	28.06	60.09	6.71	27.19
1123C_2H-2_104-109_7	38.35	9.35	2.46	0.23	134.40	49.36	31.44	123.61	8.78	5.55	751.19	27.93	61.33	6.73	25.1
1123C_2H-2_104-109_9	45.38	11.59	3.20	0.38	130.95	62.84	31.80	159.23	9.49	5.94	792.84	28.72	60.69	7	25.77
1123C_2H-2_104-109_10	39.90	11.69	3.20	0.41	146.38	71.30	33.62	160.96	9.02	5.92	825.44	31.88	67.86	7.41	26.33
1123C_2H-3_69-71_1	45.75	10.49	3.58	0.63	143.70	90.05	26.44	154.95	9.15	5.73	763.88	26.22	57.56	6.33	22.93
1123C_2H-3_69-71_2	36.72	9.01	3.46	0.53	125.90	67.86	22.38	125.62	7.34	5.46	692.69	22.59	48.01	5.04	19.39
1123C_2H-3_69-71_3	41.29	10.49	3.45	0.73	136.08	85.45	26.50	151.29	8.68	5.64	738.59	25.19	56.12	6.03	22.23
1123C_2H-3_69-71_5	36.82	8.41	3.10	0.50	117.44	68.36	23.36	124.41	7.33	4.85	653.18	22.31	48.84	5.44	21.13
1123C_2H-3_69-71_6	38.85	9.39	2.70	0.39	123.32	63.52	23.72	119.82	7.89	5.30	695.44	22.5	49.56	5.55	21.07
1123C_3H-4_84-86_1	45.03	7.51	2.90	0.58	119.57	84.95	14.55	89.66	5.77	5.75	784.48	19.66	38.87	3.94	13.39
1123C_3H-4_84-86_2	46.55	7.52	2.62	0.94	122.52	103.86	13.50	102.74	5.94	5.67	818.76	19.83	38.3	3.71	12.79
1123C_3H-4_84-86_3	46.13	8.10	2.63	0.60	116.41	102.84	13.01	103.95	5.40	5.72	807.43	20.59	37.38	3.71	13.15
1123C_3H-4_84-86_6	53.64	7.09	2.63	0.60	119.12	80.09	15.03	84.04	5.64	5.90	791.33	19.68	38.92	3.99	14.33
1123C_3H-4_84-86_9	45.98	6.76	2.23	0.66	113.69	75.36	13.83	79.39	5.27	5.47	744.81	19	36.67	3.84	13.47
1123C_4H-6_68-70_1	38.89	10.50	3.89	0.80	112.26	87.52	27.66	231.43	8.82	5.65	734.07	23.68	50.54	5.69	21.91
1123C_4H-6_68-70_10	34.38	12.06	3.07	1.39	120.78	120.86	29.87	242.53	9.20	4.88	824.78	26.25	55.78	6.03	23.28
1123C_4H-6_68-70_2	39.40	9.84	2.96	0.74	109.73	80.35	27.52	208.22	8.93	5.39	732.05	22.99	50.5	5.81	20.69
1123C_4H-6_68-70_4	45.20	12.18	3.13	1.35	143.17	107.70	31.48	259.41	10.26	7.28	851.71	26.82	70.63	7.36	25.22
1123C_4H-6_68-70_8	42.12	10.83	2.41	0.93	120.55	79.62	27.77	204.27	9.32	6.23	817.41	24.89	53.67	5.83	22.14
1123C_5H-1_90-92_6	37.02	9.82	2.94	1.51	121.11	131.25	29.78	312.08	9.72	5.27	780.35	28.18	56.74	6.42	26.67
1123C_5H-1_90-92_7	40.95	9.00	3.02	1.45	119.34	100.60	28.17	244.15	8.69	5.71	749.05	26.68	54.2	6.15	24.05
1123C_5H-1_90-92_8	15.08	8.26	2.72	0.87	109.43	109.68	25.37	292.93	9.26	5.32	727.44	25.47	51.81	5.81	21.95
1123C_5H-1_90-92_10	45.10	9.71	3.17	2.70	125.41	92.51	26.79	203.21	8.72	5.51	751.18	27.31	55.64	6.35	22.05
1123C_5H-5_121-123_4	44.72	9.67	3.07	1.55	123.40	106.69	27.56	222.94	7.48	6.33	770.49	24.7	53.73	6.05	22.6
1123C_5H-5_121-123_5	51.01	10.03	2.60	1.68	118.47	109.62	27.25	226.17	7.83	6.36	764.64	24.56	53.44	5.99	22.81
1123C_5H-5_121-123_8	45.49	9.13	4.41	1.21	122.17	113.83	24.20	200.87	8.22	4.96	777.79	23.49	53.55	5.88	22.25
1123C_5H-5_121-123_9	52.27	9.34	2.74	1.31	131.95	88.31	27.72	195.91	8.13	6.91	829.09	25.75	57.14	6.08	23.99
1123C_6H-3_128-130_1	36.47	13.26	2.66	0.46	120.86	91.42	36.33	267.56	11.46	6.29	937.90	33.36	67.34	7.47	30.01
1123C_6H-3_128-130_4	42.60	12.44	2.94	0.31	118.37	81.45	34.82	269.71	11.00	6.24	768.84	27.94	60.67	7.17	28.49
1123C_6H-3_128-130_6	33.10	12.92	2.86	0.28	106.00	77.71	35.04	264.99	10.84	5.92	783.79	27.85	57.63	6.8	27.88
1123C_6H-3_128-130_8	25.31	8.42	5.76	0.53	76.24	69.08	23.99	185.67	7.32	4.31	535.54	19.43	40.51	4.61	19.68
1123C_6H-3_128-130_10	46.16	12.29	2.55	0.30	122.03	94.12	38.68	289.44	11.44	6.20	797.53	29.65	70.17	8.2	32.27
1123C_6H-4_62-64_2	40.34	12.63	3.04	0.31	115.74	68.70	35.63	273.02	11.89	5.92	786.50	28.76	61.12	7.1	26.13
1123C_6H-4_62-64_4	35.27	11.48	2.88	0.35	112.74	64.10	33.53	257.59	10.62	5.81	748.17	26.37	56.82	6.51	25.12
1123C_6H-4_62-64_5	38.62	12.50	3.31	0.43	124.11	74.88	38.66	292.63	13.69	6.31	846.52	30.87	66.92	7.6	29.66
1123C_6H-4_62-64_9	45.91	13.09	3.48	0.27	123.79	71.83	38.54	294.30	11.53	6.27	805.61	29.92	63.43	7.38	29.83
1123C_6H-4_62-64_10	44.89	12.15	2.61	0.24	119.91	76.37	35.98	269.29	11.29	6.14	759.77	28.09	61.95	7.1	27.34
1123C_6H-4_93-95_3	36.04	12.05	3.09	0.44	107.66	79.89	33.42	256.68	9.45	5.83	750.18	26.52	57.35	7	28.94

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1123B_6H-6_50-52_6	6.14	1.09	6.26	1.04	5.99	1.35	3.84	0.65	3.86	0.55	6.86	0.732	17.05	10.98	2.68
1123B_6H-6_50-52_7	6.59	1.07	7.16	0.96	6.66	1.51	4.12	0.62	3.77	0.64	7.69	0.598	18.8	12.08	2.61
1123B_6H-6_50-52_8	5.57	1.05	5.91	1.03	5.89	1.14	3.85	0.55	3.87	0.62	6.95	0.762	19.36	11.04	2.7
1123B_6H-6_50-52_9	6.42	1.15	5.94	0.95	6.43	1.34	4.12	0.60	3.98	0.64	7.13	0.78	18.17	11.75	2.82
1123B_6H-6_137-139_3	5.35	0.87	4.75	0.70	5.01	1.07	3.25	0.57	3.11	0.54	5.99	0.471	17.45	11.57	2.69
1123B_6H-6_137-139_4	5.81	0.79	5.18	0.73	4.67	0.97	2.98	0.56	3.80	0.56	6.46	0.572	19.09	12.23	3.22
1123B_6H-6_137-139_6	4.81	0.98	4.63	0.79	5.11	1.01	3.05	0.49	3.23	0.50	6.46	0.617	20.76	11.78	2.88
1123B_6H-6_137-139_7	5.00	0.96	4.80	0.78	4.77	1.02	3.17	0.45	2.96	0.53	6.29	0.63	18.28	11.46	2.64
1123B_7H-1_129-131_1	5.16	0.85	4.84	0.69	4.03	0.92	3.06	0.54	3.58	0.50	4.11	0.557	17.36	9.77	2.9
1123B_7H-1_129-131_2	6.89	0.84	5.15	0.96	6.51	1.34	3.87	0.65	4.20	0.55	5.14	0.752	29.61	16.05	4.52
1123B_7H-1_129-131_3	5.37	0.77	5.46	0.90	5.09	1.02	3.07	0.44	2.80	0.48	4.56	0.561	21.88	11.59	2.81
1123B_7H-1_129-131_7	6.55	0.86	6.33	1.02	6.01	1.26	3.79	0.56	4.12	0.57	5.49	0.648	23.81	13.77	3.03
1123B_7H-1_129-131_10	5.27	0.77	4.75	0.80	5.24	1.07	2.90	0.46	3.01	0.47	4.56	0.692	21.99	11.72	2.99
1123B_7H-2_38-40_1	5.03	0.92	4.31	0.70	4.64	0.82	2.78	0.49	3.34	0.44	5.48	0.524	17.72	10.51	2.62
1123B_7H-2_38-40_8	5.21	0.97	4.44	0.85	5.10	1.08	3.03	0.52	3.41	0.50	6.70	0.619	23.27	11.95	3.19
1123B_7H-2_38-40_9	4.62	0.83	4.42	0.69	4.43	1.04	2.80	0.41	2.87	0.46	5.94	0.588	19	10.63	2.96
1123B_7H-2_38-40_6	4.91	0.88	4.92	0.77	4.90	1.08	3.20	0.45	3.34	0.53	5.74	0.669	18.93	12.25	2.98
1123B_7H-2_38-40_7	5.15	0.79	4.29	0.67	4.75	1.05	3.19	0.47	2.92	0.39	5.62	0.652	19.27	11.83	3.05
1123B_7H-6_13-15_5	2.95	0.45	2.44	0.38	2.29	0.53	1.60	0.24	2.06	0.32	2.33	0.673	21.81	13.91	3.68
1123B_7H-6_13-15_7	2.87	0.37	2.73	0.39	2.37	0.53	1.72	0.32	1.86	0.31	2.79	0.675	21.09	13.8	3.59
1123B_7H-6_13-15_9	3.10	0.47	2.54	0.35	2.29	0.47	1.56	0.25	1.99	0.28	2.42	0.611	21.48	13.86	3.75
1123C_1H-1_148-150_2	5.58	1.20	4.71	0.82	5.20	1.12	3.80	0.51	3.55	0.54	4.50	0.672	15.91	8.91	2.4
1123C_1H-1_148-150_3	4.62	0.99	4.85	0.66	4.39	0.87	2.60	0.38	2.65	0.33	4.02	0.585	15.58	7.09	1.89
1123C_1H-1_148-150_4	5.57	0.97	5.34	0.79	5.56	1.18	3.34	0.44	3.59	0.47	4.20	0.644	17.74	9.44	2.44
1123C_1H-1_148-150_9	4.95	1.06	5.10	0.87	5.40	1.17	3.28	0.45	3.58	0.55	4.25	0.617	16.05	8.77	2.17
1123C_1H-2_69-71_1	3.53	0.69	3.08	0.47	3.61	0.61	2.06	0.38	2.54	0.39	3.03	0.594	11.84	9.23	2.27
1123C_1H-2_69-71_10	3.54	0.47	3.25	0.52	3.22	0.64	2.09	0.33	2.48	0.41	2.91	0.611	13.09	9.52	2.43
1123C_1H-2_69-71_6	3.22	0.50	2.88	0.57	3.16	0.65	2.02	0.31	2.58	0.40	2.51	0.564	11.18	8.79	2.14
1123C_1H-2_69-71_7	3.28	0.61	2.69	0.52	3.30	0.78	2.16	0.34	2.16	0.36	2.92	0.6	11.87	9.31	2.3
1123C_2H-2_104-109_1	5.23	0.86	4.99	0.88	5.47	1.26	3.56	0.47	3.74	0.52	4.73	0.795	22.37	12.08	2.93
1123C_2H-2_104-109_3	5.34	0.83	5.18	0.84	5.32	1.13	3.31	0.51	3.40	0.49	4.75	0.724	21.76	12.55	2.9
1123C_2H-2_104-109_7	5.22	0.72	4.75	0.72	4.78	1.04	3.53	0.44	3.21	0.56	4.50	0.764	21.71	12.78	3.3
1123C_2H-2_104-109_9	5.91	0.84	4.94	0.94	5.88	1.00	3.53	0.59	3.28	0.52	5.18	0.633	21.24	12.2	2.95
1123C_2H-2_104-109_10	5.88	0.90	5.81	1.04	6.14	1.37	3.02	0.53	3.92	0.62	5.62	0.802	24.21	13.97	3.14
1123C_2H-3_69-71_1	5.08	0.81	4.11	0.66	4.60	0.96	2.73	0.46	3.04	0.46	4.51	0.74	21.85	11.83	3.12
1123C_2H-3_69-71_2	3.82	0.65	3.87	0.57	3.88	0.76	2.54	0.32	2.50	0.35	3.77	0.651	17.13	11	2.69
1123C_2H-3_69-71_3	4.96	0.73	3.91	0.65	4.37	0.94	2.64	0.43	2.97	0.36	4.34	0.678	22.46	11.44	3.12
1123C_2H-3_69-71_5	4.19	0.66	3.84	0.63	3.91	0.78	2.44	0.37	2.58	0.36	3.81	0.607	18.39	10.45	2.67
1123C_2H-3_69-71_6	4.06	0.68	3.58	0.65	3.93	0.84	2.33	0.37	2.58	0.42	4.20	0.597	19	10.8	2.86
1123C_3H-4_84-86_1	2.78	0.45	2.20	0.33	2.33	0.47	1.71	0.25	1.72	0.26	3.03	0.556	14.29	11.46	2.39
1123C_3H-4_84-86_2	2.44	0.54	2.00	0.34	2.35	0.51	1.75	0.21	1.69	0.28	3.16	0.576	14.72	11.91	2.64
1123C_3H-4_84-86_3	2.35	0.59	1.95	0.35	2.02	0.43	1.56	0.27	1.68	0.30	3.02	0.512	14.5	12.04	2.68
1123C_3H-4_84-86_6	2.48	0.50	2.43	0.37	2.33	0.47	1.56	0.28	1.70	0.26	3.08	0.509	14.02	11.56	2.55
1123C_3H-4_84-86_9	2.39	0.57	2.11	0.31	2.28	0.52	1.43	0.23	1.59	0.26	2.88	0.48	13.15	10.76	2.55
1123C_4H-6_68-70_1	4.79	0.96	4.49	0.75	4.82	0.94	3.06	0.42	3.22	0.51	6.13	0.6	15.63	10.19	2.56
1123C_4H-6_68-70_10	4.83	1.03	4.61	0.81	5.45	1.22	3.59	0.54	3.15	0.50	6.07	0.842	16.53	10.68	2.66
1123C_4H-6_68-70_2	4.41	0.83	4.18	0.71	4.51	0.98	2.91	0.45	2.97	0.47	5.58	0.62	15.25	10.06	2.5
1123C_4H-6_68-70_4	5.01	1.07	5.81	0.91	5.24	1.19	3.47	0.46	3.89	0.50	7.76	0.788	20.77	11.94	3.45
1123C_4H-6_68-70_8	4.93	1.01	4.72	0.74	4.73	1.10	3.08	0.52	3.12	0.51	5.87	0.75	17.73	10.61	2.71
1123C_5H-1_90-92_6	5.46	0.92	5.08	0.94	5.15	1.13	3.31	0.47	3.20	0.62	8.41	0.777	17.13	11.81	3.04
1123C_5H-1_90-92_7	4.77	0.82	4.80	0.79	4.75	1.09	3.06	0.46	3.00	0.47	6.15	0.655	18.47	12.36	2.89
1123C_5H-1_90-92_8	4.25	0.85	3.58	0.70	3.93	1.00	2.62	0.39	2.74	0.49	6.95	0.596	15.62	10.91	2.53
1123C_5H-1_90-92_10	4.34	0.79	4.13	0.68	4.49	1.05	3.05	0.45	3.16	0.50	5.69	0.609	17.89	12.16	2.95
1123C_5H-5_121-123_4	4.68	0.82	4.40	0.68	4.55	0.97	3.10	0.43	3.26	0.43	5.83	0.624	18.32	11.44	2.84
1123C_5H-5_121-123_5	5.10	0.87	4.41	0.73	4.75	1.03	2.96	0.46	3.10	0.45	6.37	0.586	18.2	11.51	2.97
1123C_5H-5_121-123_8	4.17	0.86	4.69	0.66	5.23	1.12	3.17	0.26	2.60	0.42	5.08	0.7	22.06	11.67	3.18
1123C_5H-5_121-123_9	4.70	0.82	4.48	0.76	4.82	0.96	3.07	0.43	3.04	0.46	5.64	0.646	20.22	12.13	3.54
1123C_6H-3_128-130_1	6.16	1.35	7.23	1.15	7.51	1.49	4.01	0.58	4.55	0.95	8.42	0.861	21.97	13.09	3.15
1123C_6H-3_128-130_4	6.01	1.16	5.89	0.95	6.33	1.32	3.81	0.59	3.85	0.59	6.98	0.749	20.02	11.55	2.93
1123C_6H-3_128-130_6	6.62	1.19	5.88	1.12	6.13	1.45	3.76	0.55	4.15	0.59	7.57	0.76	17.77	11.04	2.41
1123C_6H-3_128-130_8	4.23	0.79	3.90	0.71	4.18	0.89	2.59	0.39	2.72	0.44	4.92	0.508	12.61	7.79	1.844
1123C_6H-3_128-130_10	6.98	1.21	5.98	1.03	6.71	1.41	4.61	0.60	3.97	0.63	6.89	0.789	21.5	13.27	3.39
1123C_6H-4_62-64_2	6.15	1.07	5.71	0.88	6.03	1.37	4.09	0.53	3.93	0.54	6.67	0.753	19.08	11.77	2.87
1123C_6H-4_62-64_4	5.69	1.03	5.32	0.91	5.54	1.15	3.37	0.55	3.45	0.56	6.65	0.64	16.95	10.79	2.42
1123C_6H-4_62-64_5	7.20	1.04	7.06	1.05	5.99	1.45	4.09	0.59	4.88	0.70	7.06	0.86	19.74	12.79	2.8
1123C_6H-4_62-64_9	7.00	1.01	5.73	1.04	6.42	1.40	4.06	0.58	4.35	0.64	7.72	0.817	19.63	12.15	2.85
1123C_6H-4_62-64_10	6.22	1.04	5.48	0.82	5.89	1.30	3.78	0.55	3.80	0.64	6.78	0.687	19.43	11.84	2.88
1123C_6H-4_93-95_3	5.84	1.04	5.44	0.85	5.81	1.17	3.52	0.43	4.21	0.59	6.69	0.675	17.34	11.01	2.87
1123C_6H-4_93-95_4	7.13	1.33	5.69	1.06	6.59	1.30	4.46	0.55	3.87	0.75	7.67	0.735	19.82	12.81	3.18
1123C_6H-4_93-95_6	5.98	1.13	5.04	0.94	5.61	1.14	3.36	0.51	3.67	0.55	6.81	0.747	18.69	11.06	2.98

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

Sample name	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1123C_6H-4_93-95_8	43.89	12.18	4.00	0.68	116.53	83.61	34.73	266.91	10.73	6.33	770.18	27.74	60.27	7.07	27.57
1123C_6H-4_93-95_10	37.97	11.78	3.64	0.50	114.01	83.71	34.05	259.08	10.77	6.04	752.16	26.88	60.46	7	26.88
1123C_6H-5_110-112_2	38.69	12.00	3.26	0.73	122.50	91.62	32.05	255.26	10.19	6.37	763.77	27.84	59.15	6.93	27.17
1123C_6H-5_110-112_4	39.10	11.90	2.89	0.53	134.98	93.93	33.12	260.43	10.58	7.08	787.02	29.13	63.69	7.16	26.6
1123C_6H-5_110-112_5	43.43	11.79	3.19	0.72	128.71	88.51	31.42	254.22	10.54	7.02	755.28	27.48	57.95	6.67	26.24
1123C_6H-5_110-112_6	43.98	12.27	2.55	0.63	125.86	87.35	33.19	252.83	10.92	6.92	793.63	28.82	61.54	7.1	27.35
1123C_6H-5_110-112_7	37.86	12.25	3.09	0.76	120.06	101.69	33.09	258.71	10.10	6.13	749.32	27.41	58.65	6.7	25.48
1123C_6H-6_118-120_3	42.49	11.64	2.33	0.69	119.03	71.95	31.27	168.46	8.91	6.07	803.22	27.84	60.48	6.76	26.89
1123C_6H-6_118-120_4	40.89	12.24	5.35	1.30	145.25	67.52	33.35	145.46	9.69	6.65	835.69	28.55	70.28	6.95	26.5
1123C_6H-6_118-120_6	48.15	12.74	2.42	0.65	124.18	73.10	30.06	160.71	9.33	6.39	781.73	27.75	61.34	6.7	24.88
1123C_6H-6_118-120_7	43.75	12.68	2.98	0.65	129.22	78.51	33.00	171.25	8.92	6.43	819.07	29.04	62.49	7.04	27.01
1123C_6H-6_118-120_10	46.45	11.45	2.43	0.78	134.86	61.67	31.81	130.22	8.84	6.54	802.82	28.52	62.69	6.7	26.3
1123C_7H-3_132-134_1	81.26	5.65	3.53	0.25	150.50	52.49	18.18	62.11	4.77	9.52	699.88	23.54	46.12	4.76	16.97
1123C_7H-3_132-134_4	68.72	5.31	7.35	0.35	155.38	55.62	19.07	60.53	4.50	10.11	724.08	24.23	45.59	4.72	16.52
1123C_7H-3_132-134_6	70.80	4.99	3.17	0.34	155.63	56.42	19.53	63.63	4.76	9.74	754.77	25.27	50.5	5.3	16.71
1123C_7H-3_132-134_10	84.26	6.11	2.63	0.20	162.02	59.51	21.37	70.78	5.33	10.35	778.61	26.07	51.46	5.46	18.74
1123C_7H-4_60-62_3	49.50	12.63	2.55	0.58	155.97	80.08	35.75	218.69	12.81	7.84	886.19	30.69	71.66	7.65	31.88
1123C_7H-4_60-62_4	40.72	10.89	2.63	0.77	125.88	87.83	30.74	248.41	10.97	6.93	780.02	27.62	61.54	6.9	26.11
1123C_7H-4_60-62_5	49.10	11.20	3.19	0.40	143.48	67.34	33.00	204.71	11.20	7.62	810.14	29.56	66.45	7.48	27.75
1123C_7H-4_60-62_7	47.09	11.23	2.58	0.56	124.74	87.71	29.63	238.30	10.59	6.74	753.05	26.58	60.58	6.66	25.24
1123C_7H-4_60-62_10	32.54	9.47	2.22	0.59	111.52	79.72	31.23	223.55	9.47	5.94	760.68	28.34	61.75	6.57	25.28
1123C_7H-5_11-13_2	40.48	10.75	6.89	2.12	125.20	102.26	32.36	284.25	9.45	6.89	748.38	27.53	57.57	6.71	27.33
1123C_7H-5_11-13_5	42.40	10.23	2.47	0.88	118.05	86.47	30.71	257.73	9.41	6.51	725.16	26.19	55.63	6.69	27.19
1123C_7H-5_11-13_7	47.89	10.38	2.00	0.95	116.87	100.07	31.16	277.62	9.65	6.74	743.51	26.63	58.25	6.78	26.6
1123C_7H-5_11-13_9	48.39	11.23	4.46	1.15	134.11	110.19	32.93	298.78	10.56	7.53	798.62	28.93	62.13	7.14	28.06
1123C_7H-5_11-13_11	47.38	9.54	2.78	0.81	118.10	89.01	32.20	265.13	9.76	6.90	756.90	26.41	61.39	6.99	25.2
1123C_9H-5_33-35_3	39.78	11.53	3.12	1.38	108.56	92.52	26.83	193.35	7.09	4.98	680.89	19.93	44.62	4.92	19.45
1123C_9H-5_33-35_4	41.13	10.49	3.57	1.27	101.58	89.94	25.22	180.21	6.69	4.96	665.56	19.53	42.01	4.72	18.17
1123C_9H-5_33-35_5	37.57	10.80	3.11	1.39	102.98	89.35	25.99	189.22	7.36	5.19	667.51	20.16	42.84	4.79	19
1123C_9H-5_33-35_7	37.68	11.33	2.90	1.24	108.78	93.06	26.56	191.37	7.22	5.04	714.37	20.6	45.03	5.13	19.59
1123C_9H-5_99-101_1	44.55	9.91	4.62	1.30	109.76	92.19	26.54	184.82	6.56	5.42	740.35	22.19	46.87	5.36	19.05
1123C_9H-5_99-101_3	43.60	9.97	3.71	0.74	111.04	78.23	25.50	159.39	6.81	5.65	759.30	22.26	46.59	5.16	20.22
1123C_9H-5_99-101_4	41.96	9.85	5.09	0.81	113.76	77.98	25.50	150.19	7.17	5.79	759.25	22.84	47.17	5.22	20.71
1123C_9H-5_99-101_10	38.61	10.04	66.68	1.72	106.22	90.01	25.87	184.08	6.45	5.69	731.07	21.94	45.68	4.97	19.21
1123C_9H-5_99-101_12	46.26	10.40	29.15	1.43	107.94	87.60	22.98	168.02	6.24	5.56	709.57	20.43	44.71	4.81	16.81

Appendix A

Supplementary Table S14: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1123.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1123C_6H-4_93-95_8	6.02	1.10	5.95	0.95	6.07	1.33	3.80	0.58	3.94	0.61	6.90	0.753	19.59	11.52	3.26
1123C_6H-4_93-95_10	6.03	1.05	5.10	0.84	5.72	1.26	3.83	0.51	3.37	0.55	6.59	0.798	19.28	11.22	2.86
1123C_6H-5_110-112_2	6.17	0.96	5.13	0.84	6.06	1.22	3.70	0.54	3.64	0.55	6.60	0.69	19.31	12.14	2.92
1123C_6H-5_110-112_4	5.99	1.04	5.51	0.93	6.04	1.25	3.48	0.52	3.69	0.64	7.10	0.774	21.99	13.5	3.44
1123C_6H-5_110-112_5	5.66	0.97	5.27	0.81	5.13	1.12	3.40	0.43	3.72	0.51	6.51	0.754	20.42	12.59	3.23
1123C_6H-5_110-112_6	6.77	1.07	5.57	0.84	5.56	1.14	3.21	0.52	4.21	0.51	6.50	0.763	20.3	13.02	3.25
1123C_6H-5_110-112_7	6.15	0.89	4.89	0.89	5.84	1.14	3.53	0.50	3.66	0.52	6.52	0.677	19.39	12.66	3.26
1123C_6H-6_118-120_3	5.73	0.96	5.84	0.93	5.56	1.10	3.18	0.42	3.52	0.53	4.91	0.667	20.35	12.08	2.83
1123C_6H-6_118-120_4	5.31	0.67	4.89	0.88	4.94	1.12	3.61	0.31	3.57	0.53	4.04	0.558	23.83	11.78	3.23
1123C_6H-6_118-120_6	5.61	0.88	5.25	0.82	5.61	1.08	3.25	0.45	3.33	0.45	4.83	0.639	22.29	11.75	2.94
1123C_6H-6_118-120_7	5.87	0.88	6.07	0.91	5.84	1.13	3.49	0.48	3.43	0.53	5.21	0.655	21.3	12.49	2.96
1123C_6H-6_118-120_10	5.62	0.88	5.38	0.83	5.77	1.12	3.48	0.48	3.32	0.53	4.29	0.684	21.59	12.17	2.99
1123C_7H-3_132-134_1	3.18	0.37	2.76	0.42	2.87	0.64	1.82	0.32	2.28	0.35	2.68	0.615	20.69	16.12	3.78
1123C_7H-3_132-134_4	3.27	0.40	2.82	0.52	3.56	0.55	1.99	0.28	2.35	0.38	2.97	0.604	18.47	15.17	3.51
1123C_7H-3_132-134_6	2.80	0.36	2.63	0.48	3.26	0.59	2.12	0.33	2.39	0.41	2.74	0.784	21.58	16.26	4.15
1123C_7H-3_132-134_10	3.58	0.44	3.12	0.55	3.15	0.73	2.28	0.33	2.57	0.45	2.70	0.72	22.18	17.81	4.23
1123C_7H-4_60-62_3	5.62	0.97	4.37	0.93	5.85	1.19	3.71	0.57	4.20	0.60	6.62	0.869	23.64	14.25	3.64
1123C_7H-4_60-62_4	5.63	1.03	4.84	0.83	5.84	1.11	3.56	0.50	3.52	0.58	6.54	0.683	20.45	12.85	3.17
1123C_7H-4_60-62_5	6.07	0.84	5.64	0.88	5.76	1.22	3.45	0.53	3.89	0.56	6.06	0.842	22.12	14.34	3.35
1123C_7H-4_60-62_7	5.37	0.99	5.01	0.75	5.41	1.09	3.21	0.51	3.24	0.51	6.42	0.804	21.1	13.1	3.43
1123C_7H-4_60-62_10	5.92	0.84	4.93	0.91	6.68	1.21	4.20	0.53	3.88	0.63	6.38	0.86	17.86	13.83	3.09
1123C_7H-5_11-13_2	5.45	0.99	5.03	0.88	5.58	1.13	3.52	0.49	3.86	0.56	7.15	0.661	18.51	12.8	3
1123C_7H-5_11-13_5	5.40	1.05	4.97	0.81	5.19	1.13	3.22	0.53	3.61	0.54	6.63	0.63	18.88	12.63	3.29
1123C_7H-5_11-13_7	6.13	1.00	4.88	0.93	5.29	1.06	3.49	0.56	3.55	0.46	6.99	0.677	19.89	13.3	3.48
1123C_7H-5_11-13_9	6.35	1.13	5.80	0.89	5.96	1.28	3.33	0.59	3.69	0.54	8.19	0.781	21.55	14.22	3.24
1123C_7H-5_11-13_11	4.60	0.94	5.48	0.85	4.74	1.20	3.85	0.62	4.24	0.54	7.01	0.76	19.12	13.83	3.24
1123C_9H-5_33-35_3	4.28	0.68	4.06	0.64	4.32	0.96	2.58	0.42	2.48	0.44	4.89	0.512	18.94	8.51	2.17
1123C_9H-5_33-35_4	3.77	0.74	3.88	0.57	4.23	0.90	2.56	0.36	2.66	0.42	4.97	0.464	16.9	8.08	1.94
1123C_9H-5_33-35_5	4.10	0.78	4.33	0.65	4.21	0.97	2.70	0.39	2.74	0.45	4.59	0.451	18.18	8.01	2.083
1123C_9H-5_33-35_7	4.28	0.79	4.08	0.72	4.32	0.90	2.67	0.43	2.70	0.43	4.74	0.507	17.98	8.27	2.15
1123C_9H-5_99-101_1	3.70	0.67	4.59	0.66	3.70	1.03	2.88	0.42	2.74	0.45	4.94	0.576	17.12	10.59	2.43
1123C_9H-5_99-101_3	4.58	0.74	3.99	0.73	4.72	0.99	2.95	0.37	3.04	0.43	4.69	0.554	15.65	10.33	2.37
1123C_9H-5_99-101_4	5.24	0.76	4.45	0.69	4.48	0.93	2.68	0.33	2.96	0.44	5.09	0.617	16.7	10.3	2.41
1123C_9H-5_99-101_10	4.11	0.68	4.17	0.78	4.22	0.98	2.70	0.45	2.85	0.43	5.35	0.392	16.9	10.61	2.5
1123C_9H-5_99-101_12	3.96	0.72	4.39	0.63	4.06	0.76	2.70	0.35	2.81	0.39	4.82	0.65	16.74	9.52	2.22

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s11	1124A_1H-1_58-60_12	3.68	3.33	0.00	72.26	0.00	0.06	0.81	0.02	11.40	0.00	91.56
	1124A_1H-1_58-60_13	3.95	3.30	1.06	73.62	0.00	0.09	0.82	0.07	11.55	0.00	94.47
	1124A_1H-1_58-60_14	4.03	3.33	0.82	72.78	0.00	0.09	0.86	0.04	11.24	0.00	93.20
	1124A_1H-1_58-60_15	3.80	3.25	1.06	73.14	0.00	0.07	0.85	0.01	11.47	0.00	93.65
	1124A_1H-1_58-60_16	4.01	3.38	0.94	73.12	0.06	0.07	0.84	0.03	11.10	0.00	93.55
	1124A_1H-1_58-60_17	3.77	3.21	1.12	73.84	0.09	0.07	0.79	0.02	11.45	0.02	94.37
	1124A_1H-1_58-60_18	4.05	3.26	0.93	74.08	0.04	0.11	0.76	0.04	11.14	0.01	94.42
	1124A_1H-1_58-60_19	3.62	3.54	1.03	72.93	0.07	0.07	0.80	0.06	11.37	0.00	93.50
	1124A_1H-1_58-60_20	3.67	3.18	1.00	73.84	0.09	0.04	0.79	0.00	11.21	0.02	93.84
	1124A_1H-1_71-73_1	4.27	2.88	0.80	72.46	0.14	0.13	0.85	0.09	11.66	0.00	93.27
	1124A_1H-1_71-73_2	4.19	2.98	0.97	75.32	0.12	0.18	0.82	0.08	11.95	0.01	96.62
	1124A_1H-1_71-73_3	4.16	2.87	0.80	74.17	0.13	0.16	0.79	0.07	11.62	0.00	94.76
	1124A_1H-1_71-73_4	4.32	2.94	1.00	73.94	0.13	0.13	0.80	0.07	11.57	0.00	94.91
	1124A_1H-1_71-73_5	3.99	2.94	0.73	74.48	0.13	0.13	0.81	0.06	11.76	0.01	95.05
	1124A_1H-1_71-73_6	3.89	2.92	0.80	73.65	0.10	0.18	0.84	0.02	11.40	0.03	93.83
	1124A_1H-1_71-73_7	4.32	2.68	0.76	74.17	0.12	0.13	0.81	0.08	11.49	0.00	94.56
	1124A_1H-1_71-73_8	4.05	2.93	0.88	74.40	0.11	0.12	0.83	0.06	11.58	0.02	94.98
	1124A_1H-1_71-73_9	4.12	3.00	0.85	73.69	0.11	0.13	0.80	0.09	11.36	0.04	94.18
	1124A_1H-1_71-73_10	3.99	2.72	0.74	72.59	0.12	0.10	0.81	0.06	11.45	0.00	92.58
	1124A_1H-1_71-73_11	4.29	2.90	0.84	74.74	0.12	0.14	0.82	0.05	11.86	0.01	95.75
	1124A_1H-1_71-73_12	4.03	2.85	0.83	74.28	0.11	0.12	0.82	0.09	11.75	0.00	94.88
	1124A_1H-1_71-73_13	4.24	3.04	0.89	74.53	0.12	0.13	0.88	0.09	11.70	0.00	95.62
	1124A_1H-1_71-73_14	4.38	2.96	0.89	74.31	0.15	0.10	0.82	0.01	11.68	0.04	95.35
	1124A_1H-1_71-73_15	4.13	3.21	1.02	74.40	0.12	0.12	0.81	0.00	11.59	0.01	95.40
	1124A_1H-1_71-73_16	4.03	2.96	0.82	74.03	0.10	0.08	0.81	0.05	11.75	0.02	94.65
	1124A_1H-1_71-73_17	3.89	2.76	0.79	73.75	0.13	0.12	0.83	0.04	11.58	0.00	93.89
	1124A_1H-1_71-73_18	3.82	3.00	0.91	73.96	0.14	0.08	0.80	0.00	11.70	0.00	94.41
	1124A_1H-1_71-73_19	4.22	2.84	0.74	73.47	0.12	0.08	0.80	0.01	11.39	0.00	93.66
	1124A_1H-1_71-73_20	3.93	2.96	0.80	74.45	0.10	0.16	0.83	0.09	11.72	0.00	95.03
	1124A_1H-1_71-73_1	3.71	3.56	1.04	74.17	0.09	0.13	0.80	0.10	11.68	0.02	95.30
	1124A_1H-1_71-73_8	3.84	2.95	0.93	75.74	0.12	0.12	0.82	0.02	11.74	0.00	96.29
	1124A_1H-1_71-73_2	3.68	2.97	0.69	73.52	0.11	0.15	0.81	0.12	11.84	0.00	93.89
	1124A_1H-1_71-73_3	3.82	3.00	0.89	75.53	0.13	0.11	0.81	0.03	11.95	0.00	96.27
	1124A_1H-1_71-73_5	3.69	3.25	1.02	74.54	0.12	0.10	0.79	0.09	11.82	0.01	95.44
	1124A_1H-1_71-73_7	3.99	3.00	0.84	74.99	0.12	0.13	0.83	0.06	11.91	0.00	95.86
	1124A_1H-1_71-73_11	4.08	2.87	0.79	75.25	0.11	0.13	0.83	0.00	12.05	0.02	96.11
	1124A_1H-1_85-87_1	4.20	2.90	0.79	73.33	0.11	0.10	0.82	0.02	11.35	0.02	93.65
	1124A_1H-1_85-87_2	3.84	2.81	0.83	73.45	0.12	0.14	0.82	0.07	11.86	0.01	93.96
	1124A_1H-1_85-87_3	4.24	3.03	0.91	75.91	0.16	0.11	0.83	0.03	12.18	0.03	97.43
	1124A_1H-1_85-87_4	4.17	2.94	0.98	74.45	0.12	0.12	0.87	0.04	11.68	0.02	95.39
	1124A_1H-1_85-87_5	4.14	2.94	0.93	73.78	0.14	0.14	0.83	0.11	11.56	0.03	94.60
	1124A_1H-1_85-87_6	3.92	3.00	0.84	73.97	0.10	0.08	0.81	0.01	11.55	0.02	94.30
	1124A_1H-1_85-87_7	3.91	3.01	0.95	74.36	0.12	0.12	0.79	0.08	11.75	0.02	95.10
	1124A_1H-1_85-87_8	4.31	2.92	0.87	73.54	0.12	0.15	0.83	0.05	11.59	0.05	94.44
	1124A_1H-1_85-87_9	4.22	2.92	0.86	74.37	0.11	0.10	0.83	0.14	11.58	0.02	95.17
	1124A_1H-1_85-87_10	3.88	2.88	0.88	73.57	0.14	0.12	0.80	0.03	11.64	0.04	93.99
	1124A_1H-1_85-87_11	4.26	2.83	0.91	73.64	0.11	0.09	0.81	0.03	11.37	0.01	94.06
	1124A_1H-1_85-87_12	4.20	2.86	0.94	73.67	0.12	0.11	0.80	0.06	11.50	0.02	94.28
	1124A_1H-1_85-87_13	4.13	2.94	0.86	74.45	0.13	0.12	0.82	0.05	11.79	0.02	95.30
	1124A_1H-1_85-87_14	3.92	3.00	0.75	72.89	0.12	0.12	0.79	0.06	11.45	0.00	93.10
	1124A_1H-1_85-87_15	4.24	2.82	0.73	74.04	0.14	0.13	0.85	0.07	11.86	0.00	94.88
	1124A_1H-1_85-87_16	4.32	2.94	0.82	76.13	0.15	0.10	0.84	0.10	12.09	0.01	97.50
	1124A_1H-1_85-87_17	4.21	2.80	0.82	73.38	0.13	0.14	0.86	0.06	11.57	0.03	94.01
	1124A_1H-1_85-87_18	4.07	2.75	0.69	72.67	0.12	0.15	0.85	0.05	11.48	0.02	92.84
	1124A_1H-1_85-87_19	3.93	2.79	0.83	73.16	0.08	0.09	0.84	0.04	11.58	0.03	93.37
	1124A_1H-1_85-87_20	4.00	2.89	0.85	74.71	0.10	0.07	0.84	0.08	11.58	0.01	95.14
u5	1124A_1H-3_35-37_1	4.42	2.90	2.53	70.47	0.15	0.15	1.80	0.07	12.93	0.07	95.48
	1124A_1H-3_35-37_2	4.23	2.96	2.47	70.63	0.22	0.18	1.81	0.13	13.14	0.02	95.79
	1124A_1H-3_35-37_3	4.43	2.92	2.36	71.01	0.22	0.19	1.84	0.10	13.01	0.04	96.12
	1124A_1H-3_35-37_4	4.33	2.89	2.60	71.68	0.24	0.17	1.99	0.12	13.44	0.01	97.46
	1124A_1H-3_35-37_5	4.27	2.82	2.68	70.08	0.21	0.20	1.92	0.06	13.21	0.02	95.46
	1124A_1H-3_35-37_6	4.38	2.86	2.72	71.18	0.21	0.16	1.93	0.00	13.23	0.00	96.67
	1124A_1H-3_35-37_7	4.49	2.90	2.91	72.17	0.23	0.21	2.02	0.09	13.78	0.03	98.82
	1124A_1H-3_35-37_8	4.28	2.95	2.57	71.45	0.20	0.18	1.88	0.08	13.40	0.03	97.03
	1124A_1H-3_35-37_9	3.87	2.92	2.53	70.15	0.20	0.19	1.78	0.13	13.15	0.05	94.97
	1124A_1H-3_35-37_10	4.34	2.96	2.57	71.82	0.23	0.18	1.85	0.04	13.38	0.02	97.40
	1124A_1H-3_35-37_11	4.36	2.94	2.61	71.85	0.22	0.26	1.82	0.00	13.34	0.00	97.40
	1124A_1H-3_35-37_12	4.23	2.90	2.84	72.39	0.18	0.21	1.93	0.01	13.71	0.03	98.43
	1124A_1H-3_35-37_13	4.36	2.94	2.74	72.00	0.20	0.20	1.82	0.14	13.29	0.05	97.73
	1124A_1H-3_35-37_14	4.13	2.90	2.50	70.09	0.23	0.18	1.82	0.06	13.01	0.01	94.93

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u15	1124A_1H-3_35-37_15	4.13	2.87	2.59	69.81	0.22	0.21	1.96	0.10	12.88	0.06	94.81
	1124A_1H-3_35-37_16	4.13	2.89	2.61	68.52	0.22	0.18	1.81	0.10	13.03	0.07	93.57
	1124A_1H-3_35-37_17	4.24	2.96	2.47	70.57	0.21	0.20	1.87	0.10	13.18	0.00	95.80
	1124A_1H-3_35-37_18	3.93	2.87	2.33	69.97	0.20	0.14	1.83	0.06	13.22	0.00	94.55
	1124A_1H-3_35-37_19	4.32	3.00	2.73	72.39	0.23	0.22	1.95	0.11	13.87	0.04	98.86
	1124A_1H-3_35-37_20	4.43	2.97	2.66	70.36	0.22	0.23	1.91	0.04	13.12	0.04	95.98
	1124A_1H-3_35-37_3	4.05	3.06	2.72	71.07	0.24	0.20	1.90	0.04	14.01	0.02	97.30
	1124A_1H-3_35-37_4	3.99	3.01	2.90	71.52	0.23	0.18	2.08	0.09	13.90	0.04	97.94
	1124A_1H-3_35-37_5	4.07	2.81	2.69	69.75	0.17	0.20	1.88	0.06	12.89	0.01	94.54
	1124A_1H-3_35-37_8	4.24	3.00	2.69	72.83	0.25	0.21	1.95	0.00	13.46	0.05	98.68
	1124A_1H-3_35-37_1	4.34	2.99	3.05	71.60	0.19	0.18	1.95	0.03	13.52	0.05	97.89
	1124A_1H-3_35-37_2	4.02	2.94	2.61	72.10	0.21	0.20	1.93	0.04	13.50	0.01	97.56
	1124A_1H-3_35-37_6	3.78	3.04	2.83	71.23	0.19	0.16	1.93	0.04	13.53	0.01	96.75
	1124A_1H-3_35-37_9	4.32	2.97	2.86	72.04	0.23	0.21	2.00	0.08	13.44	0.01	98.16
	1124A_1H-6_144-146_1	4.05	3.26	1.07	74.05	0.12	0.05	0.63	0.07	11.57	0.00	94.87
	1124A_1H-6_144-146_2	3.78	3.93	0.86	72.71	0.10	0.02	0.42	0.09	11.70	0.00	93.61
	1124A_1H-6_144-146_3	4.28	3.39	0.98	74.76	0.10	0.08	0.68	0.03	11.55	0.00	95.85
	1124A_1H-6_144-146_7	4.50	3.25	1.15	73.76	0.13	0.04	0.64	0.04	11.35	0.00	94.86
	1124A_1H-6_144-146_9	4.11	3.10	1.13	73.16	0.11	0.10	0.68	0.07	11.33	0.00	93.79
	1124A_1H-6_144-146_10	4.33	3.27	1.01	73.34	0.10	0.02	0.64	0.02	11.24	0.01	93.98
	1124A_1H-6_144-146_11	4.19	3.21	1.30	73.09	0.10	0.08	0.64	0.09	11.54	0.00	94.24
	1124A_1H-6_144-146_12	3.88	3.36	1.23	73.97	0.12	0.07	0.78	0.09	11.64	0.02	95.16
	1124A_1H-6_144-146_13	3.88	3.33	0.89	73.60	0.14	0.04	0.64	0.04	11.53	0.01	94.10
	1124A_1H-6_144-146_14	4.30	3.28	0.95	73.70	0.12	0.06	0.74	0.07	11.38	0.03	94.63
	1124A_1H-6_144-146_15	4.09	3.47	1.22	73.71	0.13	0.09	0.67	0.02	11.50	0.00	94.89
	1124A_1H-6_144-146_16	4.59	3.26	1.06	72.41	0.14	0.05	0.69	0.07	11.45	0.02	93.73
	1124A_1H-6_144-146_17	3.97	3.24	1.14	74.32	0.08	0.13	0.69	0.05	11.45	0.05	95.13
	1124A_1H-6_144-146_18	4.26	3.10	1.04	73.51	0.11	0.10	0.69	0.10	11.34	0.00	94.25
	1124A_1H-6_144-146_19	4.15	3.21	1.08	73.49	0.14	0.10	0.74	0.09	11.36	0.01	94.36
	1124A_1H-6_144-146_20	4.46	3.17	1.06	72.82	0.12	0.06	0.70	0.06	11.47	0.00	93.92
	1124A_1H-7_25-27_1	4.05	3.30	1.15	73.83	0.12	0.07	0.66	0.01	11.29	0.02	94.50
	1124A_1H-7_25-27_2	4.26	3.16	1.08	73.56	0.11	0.06	0.69	0.03	11.41	0.00	94.36
	1124A_1H-7_25-27_3	4.19	3.20	1.18	73.26	0.15	0.05	0.73	0.05	11.66	0.02	94.49
	1124A_1H-7_25-27_4	4.01	3.21	1.08	74.03	0.12	0.05	0.67	0.05	11.43	0.00	94.66
	1124A_1H-7_25-27_5	4.19	3.22	1.13	73.69	0.11	0.04	0.73	0.08	11.42	0.00	94.61
	1124A_1H-7_25-27_6	3.92	3.78	0.91	73.46	0.09	0.01	0.47	0.04	11.32	0.03	94.04
	1124A_1H-7_25-27_7	4.43	3.25	1.11	73.97	0.12	0.04	0.66	0.01	11.52	0.01	95.12
	1124A_1H-7_25-27_8	4.18	3.29	1.07	73.77	0.10	0.06	0.67	0.12	11.45	0.01	94.71
	1124A_1H-7_25-27_9	4.29	3.18	1.06	73.50	0.12	0.07	0.69	0.02	11.34	0.03	94.30
	1124A_1H-7_25-27_10	3.61	4.28	0.98	73.59	0.12	0.05	0.52	0.10	11.37	0.02	94.65
	1124A_1H-7_25-27_11	3.97	3.51	0.86	73.43	0.07	0.04	0.47	0.00	11.26	0.00	93.62
	1124A_1H-7_25-27_12	4.20	3.12	1.27	73.15	0.15	0.07	0.83	0.09	11.75	0.01	94.64
	1124A_1H-7_25-27_13	3.92	3.44	1.05	74.85	0.08	0.06	0.68	0.00	11.48	0.01	95.57
	1124A_1H-7_25-27_14	4.39	3.28	1.08	74.17	0.09	0.06	0.66	0.05	11.24	0.00	95.02
	1124A_1H-7_25-27_15	3.81	3.25	1.19	74.05	0.14	0.05	0.64	0.08	11.35	0.00	94.56
	1124A_1H-7_25-27_16	4.22	3.17	1.25	73.77	0.10	0.04	0.67	0.00	11.50	0.00	94.71
	1124A_1H-7_25-27_17	4.05	3.32	1.08	73.98	0.11	0.10	0.65	0.07	11.61	0.02	94.99
	1124A_1H-7_25-27_18	4.23	3.28	1.07	74.29	0.11	0.08	0.64	0.04	11.44	0.03	95.21
	1124A_1H-7_25-27_19	4.08	3.15	1.14	74.12	0.12	0.07	0.66	0.03	11.19	0.00	94.58
	1124A_1H-7_25-27_20	4.18	3.11	1.30	72.74	0.18	0.15	0.87	0.09	11.75	0.05	94.42
s10	1124B_1H-2_43-45_1	4.36	2.62	1.17	73.62	0.15	0.14	1.02	0.03	12.06	0.00	95.19
	1124B_1H-2_43-45_2	4.48	2.68	1.14	74.04	0.15	0.12	1.07	0.13	11.98	0.03	95.81
	1124B_1H-2_43-45_3	4.38	2.53	0.96	73.36	0.17	0.14	1.01	0.08	11.98	0.04	94.64
	1124B_1H-2_43-45_4	4.49	2.59	1.01	74.78	0.13	0.16	1.03	0.09	12.10	0.00	96.39
	1124B_1H-2_43-45_5	4.83	2.62	0.95	73.38	0.15	0.12	0.99	0.12	11.76	0.02	94.95
	1124B_1H-2_43-45_6	4.65	2.59	1.10	73.53	0.17	0.12	1.03	0.11	11.87	0.03	95.20
	1124B_1H-2_43-45_7	4.67	2.59	1.26	74.66	0.16	0.15	1.03	0.00	12.06	0.01	96.59
	1124B_1H-2_43-45_8	4.44	2.74	1.05	73.43	0.13	0.14	1.04	0.07	11.92	0.06	95.00
	1124B_1H-2_43-45_9	4.80	2.56	1.16	74.10	0.15	0.15	1.03	0.09	12.21	0.00	96.25
	1124B_1H-2_43-45_10	4.28	2.60	1.25	73.45	0.16	0.13	1.03	0.11	12.17	0.00	95.19
	1124B_1H-2_43-45_11	4.59	2.64	1.11	74.37	0.18	0.17	1.12	0.08	11.97	0.00	96.23
	1124B_1H-2_43-45_12	4.79	2.64	1.15	75.15	0.15	0.17	1.05	0.00	12.49	0.04	97.62
	1124B_1H-2_43-45_13	4.20	2.56	0.93	72.04	0.18	0.18	1.06	0.04	11.67	0.01	92.86
	1124B_1H-2_43-45_14	4.70	2.60	1.17	74.58	0.14	0.17	1.01	0.05	12.13	0.00	96.56
	1124B_1H-2_43-45_15	4.42	2.62	1.21	74.81	0.13	0.15	1.05	0.10	12.29	0.05	96.82
	1124B_1H-2_43-45_16	4.55	2.59	1.12	74.09	0.15	0.14	1.05	0.02	12.19	0.03	95.93
	1124B_1H-2_43-45_17	4.55	2.63	1.29	74.65	0.15	0.11	1.05	0.06	12.08	0.01	96.57
	1124B_1H-2_43-45_18	4.38	2.52	1.12	72.92	0.16	0.13	1.02	0.04	11.64	0.05	93.97
	1124B_1H-2_43-45_19	4.43	2.64	1.05	73.74	0.16	0.19	1.05	0.08	12.12	0.00	95.45
	1124B_1H-2_43-45_20	4.44	2.61	1.21	74.03	0.16	0.12	1.09	0.16	11.95	0.02	95.79

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s11	1124B_1H-2_43-45_1	4.00	2.57	1.22	71.65	0.17	0.13	1.15	0.12	12.09	0.05	93.15
	1124B_1H-2_43-45_3	4.13	2.62	1.14	72.98	0.16	0.18	1.03	0.04	11.94	0.06	94.28
	1124B_1H-2_43-45_5	4.02	2.79	1.21	72.98	0.13	0.12	1.01	0.19	11.92	0.01	94.38
	1124B_1H-2_43-45_7	4.30	2.62	1.27	73.31	0.15	0.17	1.04	0.01	12.28	0.01	95.16
	1124B_1H-2_43-45_10	4.44	2.79	1.39	75.83	0.18	0.19	1.13	0.12	12.25	0.02	98.33
	1124B_1H-2_43-45_2	4.09	2.72	1.05	73.30	0.12	0.18	1.07	0.04	12.37	0.01	94.95
	1124B_1H-2_43-45_4	4.22	2.74	1.19	73.82	0.15	0.15	1.03	0.02	12.13	0.02	95.47
	1124B_1H-2_43-45_6	4.20	2.66	1.18	72.29	0.16	0.15	1.03	0.06	12.32	0.00	94.05
	1124B_1H-2_43-45_8	4.19	2.68	1.13	73.22	0.15	0.13	1.00	0.02	12.12	0.04	94.67
	1124B_1H-2_43-45_9	4.26	2.60	1.30	74.18	0.20	0.19	1.02	0.12	11.93	0.05	95.84
	1124B_1H-2_72-74_1	4.55	2.59	1.30	74.54	0.18	0.14	1.14	0.14	12.86	0.02	97.46
	1124B_1H-2_72-74_2	4.49	2.60	1.16	74.34	0.19	0.24	1.16	0.07	12.66	0.02	96.94
	1124B_1H-2_72-74_3	4.42	2.62	1.13	73.81	0.17	0.16	1.18	0.09	12.47	0.04	96.10
	1124B_1H-2_72-74_4	4.73	2.69	1.13	75.01	0.21	0.22	1.22	0.11	12.49	0.00	97.81
	1124B_1H-2_72-74_5	4.72	2.51	1.13	74.01	0.16	0.18	1.18	0.09	12.28	0.03	96.28
	1124B_1H-2_72-74_6	4.22	2.62	1.04	73.12	0.15	0.13	1.08	0.06	12.14	0.02	94.57
	1124B_1H-2_72-74_7	4.38	2.62	1.13	73.46	0.15	0.17	1.11	0.11	12.19	0.02	95.35
	1124B_1H-2_72-74_8	4.24	2.62	1.05	72.52	0.18	0.18	1.05	0.16	12.06	0.02	94.09
	1124B_1H-2_72-74_9	4.45	2.71	1.12	73.43	0.16	0.13	1.05	0.10	12.23	0.04	95.43
	1124B_1H-2_72-74_10	4.14	2.69	1.05	73.90	0.17	0.16	1.04	0.03	12.11	0.00	95.29
	1124B_1H-2_72-74_11	4.29	2.56	1.22	71.67	0.15	0.21	1.05	0.04	11.82	0.05	93.07
	1124B_1H-2_72-74_12	4.24	2.58	1.15	72.73	0.17	0.22	1.14	0.10	12.12	0.03	94.48
	1124B_1H-2_72-74_13	4.55	2.65	1.15	72.94	0.19	0.19	1.12	0.09	12.07	0.01	94.97
	1124B_1H-2_72-74_14	4.31	2.68	1.09	73.11	0.16	0.15	1.09	0.10	12.21	0.00	94.90
	1124B_1H-2_72-74_15	4.57	2.60	1.18	75.05	0.19	0.14	1.09	0.10	12.16	0.02	97.10
	1124B_1H-2_72-74_16	4.44	2.63	1.09	73.95	0.16	0.18	1.16	0.12	12.35	0.00	96.08
	1124B_1H-2_72-74_17	4.19	2.85	1.05	73.50	0.18	0.18	1.11	0.07	12.20	0.00	95.33
	1124B_1H-2_72-74_18	4.58	2.49	1.26	73.34	0.20	0.15	1.31	0.15	12.90	0.03	96.41
	1124B_1H-2_72-74_19	4.82	2.50	1.38	73.70	0.23	0.20	1.29	0.12	12.76	0.03	97.03
	1124B_1H-2_72-74_20	5.07	2.53	1.32	74.12	0.19	0.27	1.27	0.07	12.77	0.01	97.62
	1124B_1H-2_72-74_1	4.20	2.63	1.22	74.61	0.19	0.17	1.07	0.05	12.72	0.02	96.88
	1124B_1H-2_72-74_2	4.32	2.62	1.30	75.31	0.18	0.20	1.13	0.06	12.93	0.00	98.04
	1124B_1H-2_72-74_4	4.13	2.61	1.03	74.52	0.20	0.21	1.12	0.13	12.42	0.03	96.41
	1124B_1H-2_72-74_5	4.20	2.64	1.13	75.02	0.17	0.14	1.10	0.07	12.45	0.04	96.95
	1124B_1H-2_72-74_9	4.64	2.58	1.12	75.61	0.14	0.17	1.14	0.11	12.50	0.02	98.03
	1124B_1H-2_72-74_3	4.29	2.71	1.18	74.77	0.16	0.14	1.12	0.10	12.59	0.03	97.09
	1124B_1H-2_72-74_6	4.10	2.64	1.24	75.14	0.16	0.17	1.13	0.08	12.59	0.05	97.30
	1124B_1H-2_72-74_7	4.40	2.48	1.12	74.62	0.16	0.17	1.12	0.06	12.49	0.04	96.66
	1124B_1H-2_72-74_8	4.19	2.58	1.45	74.64	0.16	0.18	1.11	0.10	12.89	0.06	97.36
	1124B_1H-2_72-74_10	4.54	2.61	1.27	75.58	0.20	0.16	1.20	0.05	12.57	0.02	98.19
	1124B_1H-3_3-5_1	4.37	2.94	0.82	74.00	0.13	0.12	0.84	0.01	11.54	0.02	94.79
	1124B_1H-3_3-5_2	4.25	2.89	0.99	74.19	0.12	0.14	0.84	0.00	11.60	0.03	95.05
	1124B_1H-3_3-5_3	4.47	3.13	0.86	74.61	0.11	0.09	0.80	0.04	11.69	0.01	95.82
	1124B_1H-3_3-5_4	4.02	3.09	0.89	74.80	0.12	0.14	0.83	0.02	11.56	0.00	95.48
	1124B_1H-3_3-5_5	4.31	2.89	0.85	74.41	0.13	0.15	0.83	0.08	11.37	0.03	95.05
	1124B_1H-3_3-5_6	3.94	2.90	0.92	73.49	0.10	0.11	0.84	0.02	11.16	0.04	93.52
	1124B_1H-3_3-5_7	4.21	2.91	0.92	74.00	0.11	0.11	0.85	0.02	11.39	0.04	94.56
	1124B_1H-3_3-5_8	4.20	2.93	0.76	74.44	0.13	0.13	0.80	0.03	11.54	0.07	95.02
	1124B_1H-3_3-5_9	4.09	3.03	1.10	74.42	0.15	0.15	0.86	0.12	11.55	0.02	95.48
	1124B_1H-3_3-5_10	3.93	3.03	0.91	73.11	0.11	0.10	0.75	0.01	11.38	0.03	93.36
	1124B_1H-3_3-5_11	4.02	2.95	0.97	74.23	0.12	0.12	0.86	0.00	11.43	0.03	94.73
	1124B_1H-3_3-5_12	3.94	2.91	0.90	73.46	0.12	0.10	0.83	0.05	11.46	0.03	93.80
	1124B_1H-3_3-5_13	4.05	3.05	1.00	73.75	0.12	0.14	0.83	0.07	11.44	0.01	94.47
	1124B_1H-3_3-5_14	4.37	2.95	0.91	73.51	0.14	0.09	0.78	0.09	11.39	0.00	94.23
	1124B_1H-3_3-5_15	4.03	2.92	0.93	73.20	0.13	0.14	0.85	0.05	11.47	0.04	93.76
	1124B_1H-3_3-5_16	4.19	2.95	0.87	74.16	0.09	0.09	0.81	0.02	11.40	0.02	94.60
	1124B_1H-3_3-5_17	4.17	2.69	0.99	72.76	0.17	0.18	1.01	0.06	11.85	0.00	93.89
	1124B_1H-3_3-5_18	3.93	2.94	0.71	74.23	0.12	0.10	0.83	0.04	11.45	0.00	94.34
	1124B_1H-3_3-5_19	4.37	2.68	1.11	73.65	0.16	0.10	1.05	0.06	11.87	0.02	95.06
	1124B_1H-3_3-5_20	4.33	2.92	0.83	73.45	0.10	0.08	0.80	0.04	11.35	0.02	93.93
	1124B_1H-3_15-17_1	4.24	2.86	0.83	75.68	0.12	0.13	0.84	0.10	12.06	0.00	96.87
	1124B_1H-3_15-17_2	4.05	3.03	0.79	73.54	0.10	0.11	0.82	0.01	11.53	0.02	94.00
	1124B_1H-3_15-17_3	4.06	3.05	0.92	74.59	0.15	0.12	0.81	0.06	11.68	0.00	95.43
	1124B_1H-3_15-17_13	4.55	2.87	0.87	74.74	0.11	0.14	0.83	0.10	11.52	0.02	95.74
	1124B_1H-3_15-17_14	4.10	2.90	0.91	73.24	0.09	0.13	0.80	0.09	11.28	0.03	93.57
	1124B_1H-3_15-17_15	4.33	3.05	1.04	76.00	0.12	0.15	0.84	0.05	11.71	0.00	97.29
	1124B_1H-3_15-17_16	3.21	4.22	1.02	72.34	0.13	0.08	0.85	0.08	11.34	0.01	93.28
	1124B_1H-3_15-17_17	4.22	2.90	0.82	73.90	0.09	0.14	0.87	0.10	11.53	0.02	94.58
	1124B_1H-3_15-17_19	4.00	2.86	0.85	73.29	0.12	0.11	0.82	0.06	11.57	0.03	93.71
	1124B_1H-3_15-17_20	4.22	2.84	0.92	73.20	0.10	0.13	0.82	0.05	11.55	0.05	93.88

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s14	1124B_1H-3_15-17_1	3.87	3.10	0.98	74.19	0.14	0.11	0.74	0.00	11.60	0.00	94.73
	1124B_1H-3_15-17_2	3.74	2.97	1.04	76.06	0.12	0.12	0.81	0.04	12.02	0.00	96.92
	1124B_1H-3_15-17_4	4.18	2.88	1.01	75.13	0.11	0.11	0.81	0.10	12.39	0.00	96.73
	1124B_1H-3_15-17_5	3.70	3.03	0.86	74.70	0.09	0.13	0.86	0.03	11.88	0.01	95.29
	1124B_1H-3_15-17_6	3.77	2.77	0.80	74.45	0.11	0.10	0.83	0.07	11.60	0.04	94.55
	1124B_1H-3_15-17_7	3.91	2.83	0.91	74.36	0.12	0.10	0.83	0.09	11.73	0.00	94.88
	1124B_1H-3_15-17_8	3.95	2.87	0.76	74.36	0.09	0.10	0.80	0.03	11.64	0.01	94.62
	1124B_1H-3_15-17_9	3.99	2.98	0.85	74.64	0.10	0.14	0.79	0.06	11.94	0.00	95.49
	1124B_1H-3_15-17_10	3.95	3.05	0.77	74.76	0.11	0.10	0.89	0.03	11.77	0.02	95.45
	1124B_1H-3_15-17_11	4.05	2.92	0.87	74.86	0.11	0.16	0.86	0.18	12.03	0.00	96.05
	1124B_1H-3_15-17_12	3.88	2.85	0.81	74.27	0.10	0.12	0.85	0.01	11.67	0.03	94.59
	1124C_1X-1_65-67_1	3.77	3.47	1.07	74.34	0.14	0.05	0.67	0.07	11.43	0.00	95.02
	1124C_1X-1_65-67_2	4.00	3.23	1.14	74.05	0.14	0.04	0.67	0.08	11.29	0.00	94.64
	1124C_1X-1_65-67_3	4.08	3.21	1.01	74.74	0.15	0.03	0.65	0.03	11.34	0.03	95.26
	1124C_1X-1_65-67_4	4.38	3.27	1.07	74.00	0.12	0.08	0.71	0.02	11.58	0.01	95.25
	1124C_1X-1_65-67_5	4.12	3.49	0.99	74.49	0.13	0.07	0.67	0.01	11.20	0.00	95.17
	1124C_1X-1_65-67_6	4.25	3.32	1.16	74.10	0.11	0.04	0.69	0.14	11.50	0.04	95.35
	1124C_1X-1_65-67_7	3.93	3.82	0.94	74.10	0.11	0.05	0.54	0.06	11.56	0.00	95.11
	1124C_1X-1_65-67_8	4.35	3.05	1.21	72.75	0.15	0.14	0.84	0.05	11.88	0.03	94.45
	1124C_1X-1_65-67_9	3.88	3.23	1.13	74.05	0.09	0.07	0.62	0.04	11.09	0.00	94.20
	1124C_1X-1_65-67_10	3.96	3.25	1.10	73.15	0.10	0.04	0.62	0.13	11.23	0.00	93.58
	1124C_1X-1_65-67_11	4.40	3.26	1.21	74.27	0.10	0.07	0.68	0.10	11.46	0.01	95.56
	1124C_1X-1_65-67_12	4.15	3.19	1.00	73.31	0.12	0.04	0.67	0.00	11.29	0.00	93.77
	1124C_1X-1_65-67_13	4.20	3.24	1.03	73.67	0.11	0.04	0.63	0.02	11.16	0.01	94.12
	1124C_1X-1_65-67_18	3.75	3.70	1.02	73.27	0.08	0.06	0.49	0.05	11.30	0.02	93.74
	1124C_1X-1_65-67_19	4.06	3.11	1.17	72.56	0.12	0.09	0.75	0.08	11.36	0.00	93.30
	1124C_1X-1_65-67_20	4.04	3.62	0.96	73.95	0.06	0.03	0.48	0.06	11.47	0.01	94.67
	1124C_1X-1_80-82_1	4.12	3.13	0.93	73.30	0.00	0.08	0.65	0.04	11.39	0.01	93.64
	1124C_1X-1_80-82_2	4.07	3.43	0.99	74.05	0.05	0.04	0.56	0.09	11.72	0.00	95.00
	1124C_1X-1_80-82_3	4.44	3.21	1.24	73.21	0.11	0.09	0.65	0.06	11.39	0.00	94.41
	1124C_1X-1_80-82_4	4.16	3.30	0.97	73.80	0.09	0.03	0.59	0.03	11.29	0.00	94.27
	1124C_1X-1_80-82_5	4.25	3.43	1.27	73.98	0.11	0.08	0.65	0.06	11.43	0.00	95.26
	1124C_1X-1_80-82_6	4.17	3.02	1.35	72.29	0.13	0.11	0.85	0.10	11.81	0.00	93.82
	1124C_1X-1_80-82_7	4.23	3.30	1.26	73.34	0.18	0.09	0.89	0.08	11.88	0.04	95.28
	1124C_1X-1_80-82_8	4.22	3.16	1.21	73.73	0.13	0.05	0.63	0.08	11.47	0.03	94.71
	1124C_1X-1_80-82_9	4.08	3.44	1.07	73.79	0.12	0.06	0.67	0.05	11.66	0.00	94.94
	1124C_1X-1_80-82_10	4.08	3.22	1.05	73.92	0.12	0.10	0.75	0.12	11.63	0.00	94.99
	1124C_1X-1_80-82_11	4.20	3.27	1.02	73.91	0.10	0.07	0.65	0.04	11.41	0.00	94.67
	1124C_1X-1_80-82_12	4.07	3.59	0.90	74.01	0.08	0.06	0.57	0.07	11.56	0.01	94.92
	1124C_1X-1_80-82_13	4.27	3.54	1.11	73.12	0.08	0.02	0.52	0.03	11.52	0.03	94.23
	1124C_1X-1_80-82_14	4.10	3.25	1.07	73.89	0.13	0.11	0.64	0.06	11.54	0.03	94.82
	1124C_1X-1_80-82_15	4.05	3.21	0.95	73.25	0.12	0.08	0.64	0.07	11.29	0.00	93.66
	1124C_1X-1_80-82_16	4.23	3.14	1.28	73.52	0.12	0.05	0.62	0.05	11.74	0.00	94.74
	1124C_1X-1_80-82_17	3.91	3.56	1.19	73.84	0.11	0.11	0.65	0.05	11.47	0.00	94.89
	1124C_1X-1_80-82_18	3.87	3.24	1.03	73.90	0.09	0.07	0.67	0.04	11.48	0.01	94.41
	1124C_1X-1_80-82_19	4.12	3.16	1.17	73.68	0.11	0.10	0.68	0.00	11.47	0.01	94.49
	1124C_1X-1_80-82_20	4.12	3.33	1.03	74.28	0.12	0.07	0.64	0.13	11.47	0.00	95.20
s29	1124C_1X-1_80-82_3	4.21	3.29	0.98	75.53	0.10	0.06	0.65	0.06	11.61	0.05	96.53
	1124C_1X-1_80-82_5	3.69	3.48	1.21	74.53	0.08	0.08	0.62	0.02	11.33	0.00	95.04
	1124C_1X-1_80-82_7	3.82	3.22	1.04	74.89	0.13	0.04	0.77	0.00	11.74	0.03	95.69
	1124C_1X-1_80-82_8	3.83	3.33	0.95	75.11	0.10	0.08	0.62	0.08	11.84	0.00	95.95
	1124C_1X-1_80-82_9	4.05	3.14	1.09	74.56	0.10	0.09	0.64	0.04	11.59	0.00	95.31
	1124C_1X-1_80-82_1	3.98	3.13	1.21	75.29	0.11	0.03	0.66	0.06	11.73	0.00	96.19
	1124C_1X-1_80-82_2	3.77	3.06	1.10	74.87	0.11	0.05	0.72	0.02	11.68	0.03	95.41
	1124C_1X-1_80-82_4	4.01	3.15	1.20	74.95	0.14	0.07	0.70	0.03	11.78	0.00	96.03
	1124C_1X-1_80-82_6	3.72	3.49	1.04	74.72	0.11	0.06	0.64	0.05	11.55	0.01	95.39
	1124C_1X-1_80-82_10	3.27	3.33	1.07	76.04	0.08	0.04	0.61	0.00	11.67	0.02	96.13
	1124C-2X-6_53-55-1	3.91	3.17	1.18	73.91	0.08	0.09	0.97	0.05	11.52	0.05	94.92
	1124C-2X-6_53-55-2	3.95	3.30	1.66	72.73	0.21	0.21	1.37	0.05	12.79	0.02	96.28
	1124C-2X-6_53-55-3	3.62	3.53	1.07	73.78	0.10	0.13	0.83	0.07	11.77	0.00	94.90
	1124C-2X-6_53-55-4	3.69	3.97	1.13	74.56	0.13	0.10	0.75	0.07	11.79	0.03	96.23
	1124C-2X-6_53-55-5	4.01	3.00	1.34	72.36	0.27	0.24	1.13	0.03	11.80	0.08	94.26
	1124C-2X-6_53-55-6	3.74	3.96	1.11	74.54	0.11	0.08	0.68	0.11	11.54	0.00	95.86
	1124C-2X-6_53-55-7	3.99	3.39	1.15	73.95	0.09	0.06	0.81	0.02	11.49	0.05	94.98
	1124C-2X-6_53-55-8	4.06	3.30	1.08	73.60	0.11	0.10	0.86	0.01	11.45	0.03	94.60
	1124C-2X-6_53-55-9	4.20	3.16	1.55	71.52	0.16	0.19	1.30	0.08	12.30	0.03	94.49
	1124C-2X-6_53-55-10	4.17	3.17	1.47	72.01	0.18	0.19	1.39	0.05	12.09	0.02	94.74
	1124C-2X-6_53-55-11	3.85	3.45	0.98	73.61	0.12	0.12	0.92	0.04	11.46	0.00	94.55
	1124C-2X-6_53-55-12	4.05	3.13	0.91	74.55	0.15	0.12	0.96	0.02	11.46	0.06	95.42
	1124C-2X-6_53-55-13	3.77	3.28	0.99	73.74	0.10	0.10	0.84	0.07	11.63	0.01	94.54

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1124C-2X-6_53-55-16	4.03	2.05	1.55	71.50	0.19	0.18	0.89	0.08	12.39	0.05	92.90
	1124C-2X-6_53-55-17	3.83	3.18	1.26	72.37	0.14	0.11	1.13	0.03	11.80	0.01	93.87
	1124C-2X-6_53-55-18	3.89	3.26	1.08	73.19	0.10	0.07	0.87	0.07	11.48	0.04	94.04
	1124C-2X-6_53-55-19	3.82	3.08	1.07	72.85	0.15	0.16	1.21	0.05	11.33	0.01	93.73
	1124C-2X-6_53-55-20	4.36	3.11	1.74	71.49	0.18	0.16	1.30	0.04	12.47	0.03	94.89
	1124C_2X-6_53-55_2	3.47	4.17	1.06	74.05	0.14	0.07	0.80	0.03	11.76	0.05	95.62
	1124C_2X-6_53-55_8	4.15	3.24	1.62	72.07	0.26	0.20	1.29	0.02	12.49	0.04	95.38
	1124C_2X-6_53-55_6	3.65	3.08	0.97	73.86	0.20	0.15	1.02	0.07	11.62	0.00	94.62
	1124C_2X-6_53-55_9	3.91	3.41	1.02	74.58	0.17	0.07	0.87	0.05	11.56	0.05	95.69
	1124C_2X-6_53-55_10	3.71	3.24	1.08	74.04	0.15	0.06	0.80	0.06	11.69	0.00	94.83
	1124C_2X-6_53-55_1	3.57	3.95	1.20	73.92	0.16	0.13	0.76	0.07	11.61	0.01	95.38
	1124C_2X-6_53-55_3	3.43	4.02	1.08	74.17	0.19	0.11	0.84	0.05	11.61	0.01	95.51
	1124C_2X-6_53-55_4	3.63	3.71	0.89	74.83	0.10	0.03	0.87	0.04	11.95	0.00	96.04
	1124C_2X-6_53-55_7	4.23	3.20	1.01	74.81	0.16	0.07	0.84	0.02	11.88	0.02	96.23
	1124C_2X-6_66-68_1	3.79	3.09	0.85	73.01	0.09	0.07	1.00	0.02	11.43	0.00	93.36
	1124C_2X-6_66-68_2	3.73	3.20	0.94	73.70	0.09	0.09	1.05	0.11	11.55	0.00	94.47
	1124C_2X-6_66-68_3	3.64	3.26	1.09	73.38	0.13	0.12	1.01	0.03	11.38	0.03	94.07
	1124C_2X-6_66-68_4	3.18	2.98	1.11	73.14	0.14	0.15	1.26	0.01	11.24	0.00	93.22
	1124C_2X-6_66-68_5	4.01	3.08	1.10	73.24	0.15	0.18	1.25	0.09	11.44	0.00	94.54
	1124C_2X-6_66-68_6	3.63	3.25	1.08	72.95	0.13	0.20	1.03	0.10	11.52	0.03	93.93
	1124C_2X-6_66-68_7	3.58	3.19	1.02	72.88	0.11	0.15	1.04	0.01	11.38	0.00	93.36
	1124C_2X-6_66-68_8	3.59	3.20	0.94	72.59	0.12	0.11	0.99	0.03	11.48	0.03	93.09
	1124C_2X-6_66-68_9	3.83	3.22	1.07	73.09	0.13	0.09	0.94	0.03	11.47	0.02	93.89
	1124C_2X-6_66-68_10	3.63	3.11	0.98	73.87	0.09	0.10	1.01	0.00	11.37	0.00	94.16
	1124C_2X-6_66-68_11	3.67	3.05	1.05	73.39	0.13	0.10	1.27	0.02	11.41	0.00	94.09
	1124C_2X-6_66-68_12	3.55	3.26	1.10	73.57	0.09	0.13	1.03	0.03	11.61	0.02	94.39
	1124C_2X-6_66-68_13	3.65	3.47	1.13	73.57	0.09	0.09	0.85	0.06	11.60	0.05	94.56
	1124C_2X-6_66-68_14	3.52	3.33	0.96	73.49	0.09	0.12	1.00	0.00	11.19	0.00	93.71
	1124C_2X-6_66-68_15	3.65	3.22	0.93	72.72	0.11	0.14	1.01	0.08	11.45	0.00	93.31
	1124C_2X-6_66-68_16	3.89	3.28	0.94	72.59	0.13	0.09	0.96	0.06	11.49	0.00	93.43
	1124C_2X-6_66-68_17	3.59	3.07	1.09	73.66	0.17	0.13	1.23	0.00	11.22	0.01	94.17
	1124C_2X-6_66-68_18	3.69	2.94	1.11	73.79	0.15	0.15	1.24	0.04	11.53	0.02	94.67
	1124C_2X-6_66-68_19	4.09	2.92	1.56	70.57	0.26	0.30	1.78	0.11	12.29	0.01	93.89
	1124C_2X-6_66-68_20	3.78	3.22	1.15	73.32	0.12	0.13	1.04	0.03	11.32	0.00	94.11
	1124C_2X-6_72-74_1	3.26	3.05	1.16	73.66	0.15	0.15	1.26	0.01	11.83	0.01	94.54
	1124C_2X-6_72-74_2	3.46	3.11	0.95	72.65	0.12	0.15	1.03	0.00	11.57	0.00	93.03
	1124C_2X-6_72-74_3	3.74	3.20	0.93	73.35	0.09	0.15	1.00	0.00	11.93	0.02	94.41
	1124C_2X-6_72-74_4	3.48	3.29	1.09	73.16	0.09	0.08	0.99	0.02	11.75	0.00	93.95
	1124C_2X-6_72-74_5	3.73	3.21	1.03	73.59	0.09	0.09	0.93	0.02	11.75	0.06	94.50
	1124C_2X-6_72-74_6	3.64	3.31	0.96	73.04	0.14	0.09	1.04	0.05	11.88	0.04	94.20
	1124C_2X-6_72-74_7	3.65	2.99	1.09	72.14	0.21	0.18	1.42	0.05	12.05	0.01	93.79
	1124C_2X-6_72-74_8	3.69	2.94	1.03	72.87	0.15	0.18	1.29	0.04	11.61	0.04	93.85
	1124C_2X-6_72-74_9	3.75	3.30	1.05	73.15	0.12	0.10	1.01	0.04	11.64	0.00	94.16
	1124C_2X-6_72-74_10	3.30	3.08	1.11	72.97	0.11	0.16	1.19	0.09	11.74	0.00	93.75
	1124C_2X-6_72-74_16	3.47	3.07	1.23	73.26	0.13	0.16	1.25	0.06	11.81	0.00	94.46
	1124C_2X-6_72-74_17	3.59	3.00	1.09	72.70	0.14	0.15	1.25	0.05	11.77	0.00	93.74
	1124C_2X-6_72-74_18	3.82	3.11	1.00	73.10	0.15	0.12	1.01	0.11	11.92	0.02	94.36
	1124C_2X-6_72-74_20	3.64	3.11	1.04	72.74	0.13	0.09	1.05	0.06	11.91	0.00	93.77
s31	1124C_3H-1_85-87_1	3.39	3.54	0.97	73.20	0.14	0.11	0.95	0.09	11.98	0.00	94.37
	1124C_3H-1_85-87_2	3.45	3.68	1.03	72.83	0.13	0.13	0.99	0.08	11.96	0.00	94.28
	1124C_3H-1_85-87_3	3.66	3.63	1.04	73.17	0.15	0.15	0.98	0.03	12.24	0.02	95.06
	1124C_3H-1_85-87_4	3.31	3.48	1.22	73.77	0.16	0.09	0.97	0.00	12.02	0.01	95.02
	1124C_3H-1_85-87_5	3.17	3.59	1.01	72.79	0.12	0.10	0.96	0.08	11.92	0.02	93.76
	1124C_3H-1_85-87_6	3.75	3.41	1.03	73.50	0.08	0.10	1.11	0.05	12.28	0.02	95.32
	1124C_3H-1_85-87_7	3.43	3.55	1.08	74.50	0.10	0.09	1.04	0.10	12.22	0.00	96.11
	1124C_3H-1_85-87_8	3.55	3.72	0.99	74.30	0.11	0.13	1.00	0.00	12.14	0.00	95.95
	1124C_3H-1_85-87_9	3.42	3.53	1.05	74.44	0.09	0.12	0.96	0.10	11.98	0.04	95.74
	1124C_3H-1_85-87_10	3.47	3.66	1.03	74.61	0.13	0.12	1.08	0.06	12.21	0.00	96.38
	1124C_3H-1_85-87_11	3.52	3.52	1.13	74.17	0.10	0.15	1.09	0.06	12.53	0.01	96.28
	1124C_3H-1_85-87_12	3.59	3.48	1.10	73.62	0.08	0.13	0.97	0.00	12.02	0.00	94.98
	1124C_3H-1_85-87_13	3.74	3.57	1.00	74.31	0.13	0.10	0.98	0.09	12.23	0.00	96.15
	1124C_3H-1_85-87_14	3.66	3.55	0.87	73.59	0.13	0.14	0.98	0.06	12.10	0.01	95.09
	1124C_3H-1_85-87_15	3.69	3.53	0.92	73.19	0.12	0.10	1.01	0.06	11.94	0.00	94.56
	1124C_3H-1_85-87_16	3.45	3.57	1.02	73.58	0.12	0.12	0.92	0.05	11.94	0.00	94.77
	1124C_3H-1_85-87_17	3.54	3.53	1.03	73.44	0.08	0.11	0.99	0.09	11.84	0.03	94.68
	1124C_3H-1_85-87_18	3.45	3.52	0.96	73.44	0.13	0.14	0.97	0.09	11.97	0.00	94.67
	1124C_3H-1_85-87_19	3.50	3.54	1.04	74.01	0.10	0.14	0.94	0.06	11.86	0.00	95.20
	1124C_3H-1_85-87_20	3.41	3.54	1.08	74.24	0.12	0.13	0.99	0.01	12.08	0.01	95.61
	1124C_3H-1_85-87_1	3.23	3.73	1.05	74.71	0.12	0.08	1.01	0.07	11.99	0.01	96.01
	1124C_3H-1_85-87_2	3.34	3.93	1.03	74.97	0.12	0.14	0.96	0.07	12.36	0.01	96.93

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s35*	1124C_3H-1_85-87_3	3.37	3.76	1.18	73.25	0.14	0.12	0.95	0.01	11.97	0.03	94.78
	1124C_3H-1_85-87_5	3.24	3.80	1.00	74.38	0.12	0.12	1.00	0.03	11.93	0.00	95.62
	1124C_3H-1_85-87_6	3.41	3.57	0.94	73.87	0.13	0.13	0.93	0.07	11.76	0.01	94.82
	1124C_3H-1_85-87_4	3.27	3.77	1.05	73.72	0.11	0.14	0.96	0.05	11.93	0.00	95.00
	1124C_3H-3_54-56_1	4.59	2.92	1.85	70.84	0.27	0.24	1.25	0.06	12.66	0.02	94.69
	1124C_3H-3_54-56_2	4.50	2.95	1.80	70.93	0.30	0.21	1.23	0.12	12.39	0.05	94.47
	1124C_3H-3_54-56_3	4.63	3.01	2.07	70.30	0.37	0.26	1.38	0.06	12.76	0.02	94.86
	1124C_3H-3_54-56_4	4.54	2.98	1.93	70.01	0.30	0.23	1.31	0.03	12.58	0.01	93.92
	1124C_3H-3_54-56_5	4.34	3.17	1.56	71.79	0.17	0.18	1.02	0.10	12.29	0.03	94.64
	1124C_3H-3_54-56_6	4.54	2.89	1.88	70.68	0.32	0.23	1.25	0.01	12.28	0.02	94.10
	1124C_3H-3_54-56_7	4.42	2.93	2.10	70.17	0.31	0.22	1.23	0.07	12.44	0.02	93.91
	1124C_3H-3_54-56_8	4.49	3.05	1.69	70.80	0.27	0.24	1.23	0.08	12.46	0.00	94.32
	1124C_3H-3_54-56_9	4.41	3.18	1.49	71.90	0.21	0.10	0.92	0.01	12.20	0.00	94.42
	1124C_3H-3_54-56_10	4.83	2.89	1.91	70.28	0.30	0.26	1.28	0.09	12.52	0.00	94.36
	1124C_3H-3_54-56_11	4.81	2.83	1.72	70.61	0.28	0.24	1.28	0.07	12.49	0.06	94.39
	1124C_3H-3_54-56_12	4.67	2.99	1.69	70.86	0.30	0.18	1.28	0.05	12.60	0.03	94.65
	1124C_3H-3_54-56_13	4.50	2.92	1.74	70.53	0.30	0.26	1.35	0.11	12.88	0.07	94.65
	1124C_3H-3_54-56_14	4.59	2.99	1.67	70.88	0.30	0.23	1.26	0.05	12.44	0.06	94.47
	1124C_3H-3_54-56_15	4.72	2.85	2.07	70.03	0.35	0.34	1.50	0.12	12.89	0.08	94.96
	1124C_3H-3_54-56_16	4.46	3.00	1.81	70.22	0.30	0.22	1.31	0.13	12.60	0.02	94.07
	1124C_3H-3_54-56_17	4.78	2.65	1.80	71.05	0.30	0.23	1.19	0.12	12.57	0.03	94.72
	1124C_3H-3_54-56_1	4.03	2.89	1.85	68.54	0.30	0.26	1.22	0.00	12.25	0.04	91.39
	1124C_3H-3_54-56_4	4.31	3.01	1.90	69.93	0.30	0.27	1.27	0.07	12.70	0.03	93.79
	1124C_3H-3_54-56_6	4.36	3.08	1.92	69.30	0.29	0.24	1.30	0.05	12.83	0.01	93.38
	1124C_3H-3_54-56_8	4.46	3.20	1.45	70.86	0.20	0.13	1.01	0.09	12.62	0.00	94.02
	1124C_3H-3_54-56_10	4.40	2.98	1.81	69.26	0.31	0.21	1.30	0.08	12.70	0.03	93.08
	1124C_3H-3_54-56_2	4.53	2.93	1.96	68.98	0.26	0.24	1.27	0.06	12.73	0.04	93.01
	1124C_3H-3_54-56_5	4.58	3.10	1.69	69.65	0.22	0.21	1.20	0.09	12.55	0.00	93.30
	1124C_3H-3_54-56_7	4.40	2.85	1.60	68.43	0.30	0.25	1.26	0.03	12.26	0.04	91.43
	1124C_3H-3_54-56_11	4.42	3.15	1.99	70.08	0.32	0.27	1.28	0.11	12.69	0.04	94.36
	1124C_3H-3_139-141_1	4.07	3.09	1.25	72.95	0.13	0.07	0.90	0.10	11.64	0.00	94.21
	1124C_3H-3_139-141_2	4.24	3.16	1.21	73.18	0.13	0.07	0.92	0.07	11.68	0.02	94.67
	1124C_3H-3_139-141_3	4.04	3.19	1.20	72.47	0.14	0.05	0.87	0.06	11.65	0.00	93.67
	1124C_3H-3_139-141_4	4.11	3.16	1.33	72.83	0.10	0.11	0.90	0.15	11.60	0.00	94.29
	1124C_3H-3_139-141_5	4.42	3.17	1.34	73.31	0.15	0.09	0.89	0.00	11.47	0.02	94.86
	1124C_3H-3_139-141_6	4.36	3.24	1.50	73.16	0.14	0.06	0.94	0.05	11.61	0.01	95.07
	1124C_3H-3_139-141_7	4.20	3.14	1.31	73.15	0.17	0.12	0.92	0.07	11.50	0.00	94.58
	1124C_3H-3_139-141_8	3.98	3.18	1.34	73.38	0.17	0.11	0.88	0.07	11.55	0.02	94.68
	1124C_3H-3_139-141_9	4.13	3.21	1.43	73.27	0.11	0.10	0.89	0.09	11.76	0.00	94.98
	1124C_3H-3_139-141_10	4.15	3.10	1.27	72.77	0.12	0.11	0.89	0.01	11.48	0.00	93.90
	1124C_3H-3_139-141_11	4.02	3.22	1.34	73.32	0.16	0.10	0.90	0.05	11.51	0.03	94.65
	1124C_3H-3_139-141_12	4.25	3.15	1.41	72.73	0.10	0.07	0.88	0.05	11.74	0.05	94.43
	1124C_3H-3_139-141_13	4.13	3.33	1.28	73.69	0.09	0.05	0.78	0.01	11.34	0.00	94.70
	1124C_3H-3_139-141_14	3.95	3.31	1.28	73.14	0.14	0.06	0.96	0.05	11.73	0.01	94.63
	1124C_3H-3_139-141_15	4.16	3.22	1.18	72.87	0.13	0.11	0.85	0.00	11.64	0.02	94.17
	1124C_3H-3_139-141_16	4.14	3.27	1.31	73.39	0.16	0.07	0.91	0.07	11.75	0.04	95.11
	1124C_3H-3_139-141_17	4.19	3.23	1.26	72.03	0.14	0.06	0.92	0.03	11.71	0.03	93.59
	1124C_3H-3_139-141_18	4.42	3.07	1.29	72.14	0.13	0.12	0.86	0.01	11.68	0.03	93.76
	1124C_3H-3_139-141_19	4.04	3.10	1.31	72.77	0.13	0.08	0.93	0.08	11.47	0.00	93.90
	1124C_3H-3_139-141_20	4.16	3.12	1.49	72.79	0.13	0.08	0.89	0.00	11.55	0.00	94.21
u30	1124C_3H-4_50-52_1	4.00	3.16	1.38	72.56	0.15	0.07	0.87	0.08	11.51	0.00	93.78
	1124C_3H-4_50-52_2	4.33	3.05	1.30	72.34	0.17	0.10	0.88	0.03	11.50	0.00	93.71
	1124C_3H-4_50-52_3	3.96	3.25	1.22	71.86	0.15	0.12	0.90	0.05	11.36	0.00	92.87
	1124C_3H-4_50-52_4	4.18	3.21	1.14	72.67	0.12	0.06	0.76	0.01	11.02	0.02	93.19
	1124C_3H-4_50-52_5	4.20	3.22	1.35	72.59	0.10	0.08	0.93	0.02	11.57	0.02	94.09
	1124C_3H-4_50-52_6	3.96	3.18	1.27	71.66	0.13	0.09	0.88	0.08	11.50	0.01	92.76
	1124C_3H-4_50-52_7	4.20	3.15	1.33	72.92	0.14	0.12	0.90	0.01	11.75	0.04	94.56
	1124C_3H-4_50-52_8	4.48	3.15	1.29	72.84	0.10	0.09	0.89	0.06	11.53	0.00	94.43
	1124C_3H-4_50-52_9	4.34	3.12	1.35	72.38	0.13	0.10	0.89	0.09	11.63	0.01	94.03
	1124C_3H-4_50-52_10	4.08	3.19	1.25	72.47	0.14	0.07	0.92	0.05	11.64	0.01	93.82
	1124C_3H-4_50-52_11	3.94	3.26	1.22	72.39	0.15	0.10	0.81	0.00	11.31	0.02	93.19
	1124C_3H-4_50-52_12	4.11	3.14	1.22	72.73	0.11	0.07	0.96	0.02	11.52	0.00	93.88
	1124C_3H-4_50-52_13	4.21	3.11	1.38	72.49	0.10	0.09	0.87	0.07	11.72	0.01	94.06
	1124C_3H-4_50-52_14	4.28	3.18	1.36	73.26	0.11	0.16	0.91	0.03	11.67	0.03	95.00
	1124C_3H-4_50-52_15	4.22	3.24	1.34	72.84	0.11	0.11	0.91	0.02	11.67	0.02	94.48
	1124C_3H-4_50-52_16	4.24	3.15	1.19	72.08	0.14	0.11	0.91	0.03	11.47	0.00	93.33
	1124C_3H-4_50-52_17	4.13	3.07	1.36	72.89	0.16	0.07	0.92	0.05	11.65	0.02	94.33
	1124C_3H-4_50-52_18	4.21	3.10	1.59	72.37	0.17	0.09	0.87	0.04	11.83	0.01	94.28
	1124C_3H-4_50-52_19	4.32	3.10	1.21	72.02	0.13	0.11	0.88	0.04	11.65	0.01	93.47
	1124C_3H-4_50-52_20	4.09	3.08	1.51	72.27	0.15	0.07	0.94	0.07	11.75	0.00	93.93

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s36	1124C_3H-4_50-52_2	3.99	3.11	1.36	73.62	0.14	0.07	0.86	0.06	11.95	0.02	95.19
	1124C_3H-4_50-52_3	4.13	3.15	1.37	73.49	0.12	0.08	0.89	0.06	11.90	0.07	95.26
	1124C_3H-4_50-52_4	4.07	3.19	1.58	73.75	0.14	0.09	0.90	0.07	12.24	0.00	96.04
	1124C_3H-4_50-52_5	4.06	3.27	1.33	73.29	0.12	0.10	0.91	0.02	12.18	0.00	95.27
	1124C_3H-4_50-52_8	4.05	3.17	1.62	73.78	0.12	0.11	0.88	0.07	12.26	0.00	96.06
	1124C_3H-4_50-52_1	4.14	3.26	1.51	74.35	0.13	0.08	0.91	0.03	12.04	0.02	96.47
	1124C_3H-4_50-52_6	4.08	3.23	1.39	73.25	0.17	0.07	0.92	0.00	11.95	0.01	95.08
	1124C_3H-4_50-52_7	3.82	3.15	1.20	73.37	0.12	0.04	0.88	0.05	12.08	0.00	94.71
	1124C_3H-4_50-52_9	4.11	3.17	1.35	73.69	0.15	0.11	0.93	0.01	11.90	0.00	95.41
	1124C_3H-4_50-52_10	3.94	3.27	1.50	73.35	0.15	0.11	0.89	0.02	11.84	0.00	95.06
	1124C_3H-4_107-109_1	3.78	3.37	1.47	72.57	0.15	0.14	0.78	0.01	11.50	0.01	93.79
	1124C_3H-4_107-109_2	4.23	3.40	1.44	72.89	0.15	0.12	0.84	0.10	11.56	0.00	94.73
	1124C_3H-4_107-109_3	3.95	3.33	1.42	73.20	0.14	0.12	0.80	0.01	11.32	0.02	94.31
	1124C_3H-4_107-109_4	3.92	3.38	1.52	72.97	0.18	0.09	0.85	0.04	11.49	0.00	94.44
	1124C_3H-4_107-109_5	4.11	3.25	1.32	73.07	0.17	0.11	0.78	0.04	11.51	0.01	94.37
	1124C_3H-4_107-109_6	4.01	3.29	1.41	73.02	0.17	0.06	0.80	0.06	11.59	0.00	94.41
	1124C_3H-4_107-109_7	3.73	3.38	1.30	72.62	0.18	0.08	0.81	0.05	11.45	0.00	93.59
	1124C_3H-4_107-109_8	4.56	3.27	1.42	72.66	0.12	0.09	0.86	0.01	11.93	0.03	94.96
	1124C_3H-4_107-109_9	3.83	3.22	1.40	72.41	0.15	0.13	0.80	0.00	11.38	0.02	93.34
	1124C_3H-4_107-109_10	4.07	3.18	1.20	73.34	0.18	0.11	0.79	0.05	11.29	0.00	94.21
	1124C_3H-4_107-109_11	3.98	3.37	1.46	73.00	0.21	0.07	0.83	0.10	11.30	0.00	94.31
s38	1124C_3H-4_107-109_12	4.07	3.17	1.42	72.54	0.17	0.09	0.82	0.05	11.52	0.02	93.88
	1124C_3H-4_107-109_13	4.01	3.34	1.51	72.87	0.21	0.11	0.80	0.02	11.64	0.02	94.54
	1124C_3H-4_107-109_14	3.78	3.30	1.55	73.32	0.17	0.09	0.78	0.05	11.34	0.02	94.40
	1124C_3H-4_107-109_15	4.05	3.32	1.23	72.11	0.19	0.07	0.83	0.08	11.53	0.00	93.42
	1124C_3H-4_107-109_16	3.79	3.38	1.56	73.19	0.18	0.09	0.81	0.01	11.61	0.00	94.62
	1124C_3H-4_107-109_17	4.01	3.39	1.28	73.01	0.16	0.12	0.81	0.11	11.65	0.02	94.56
	1124C_3H-4_107-109_19	4.01	3.30	1.30	72.51	0.17	0.09	0.79	0.12	11.22	0.00	93.52
	1124C_3H-4_107-109_20	4.08	3.32	1.46	73.12	0.16	0.14	0.84	0.06	11.46	0.00	94.65
	1124C_3H-5_56-58_1	4.03	3.26	1.18	72.65	0.15	0.16	1.01	0.07	11.84	0.00	94.34
	1124C_3H-5_56-58_2	4.18	3.28	1.31	72.84	0.16	0.09	0.92	0.01	11.80	0.00	94.60
	1124C_3H-5_56-58_3	4.15	3.35	1.11	72.28	0.16	0.13	1.02	0.04	11.92	0.00	94.15
	1124C_3H-5_56-58_4	3.79	3.50	1.08	72.83	0.17	0.12	1.06	0.05	11.71	0.03	94.34
	1124C_3H-5_56-58_5	4.13	3.20	1.43	72.96	0.15	0.09	0.88	0.04	11.47	0.02	94.38
	1124C_3H-5_56-58_6	4.27	3.25	1.34	73.08	0.15	0.07	0.88	0.07	11.64	0.02	94.77
	1124C_3H-5_56-58_7	4.01	3.10	1.27	72.44	0.14	0.06	0.87	0.03	11.32	0.00	93.23
	1124C_3H-5_56-58_8	3.87	3.40	1.08	72.30	0.18	0.10	1.01	0.13	12.00	0.00	94.07
	1124C_3H-5_56-58_9	4.10	3.45	1.23	72.31	0.13	0.15	1.02	0.05	11.62	0.01	94.06
	1124C_3H-5_56-58_10	3.76	3.35	1.15	71.94	0.19	0.18	1.00	0.08	11.82	0.01	93.48
	1124C_3H-5_56-58_11	3.76	3.44	1.16	72.68	0.14	0.12	1.00	0.06	11.66	0.00	94.02
	1124C_3H-5_56-58_12	3.81	3.48	1.19	72.05	0.12	0.15	1.05	0.01	11.73	0.01	93.60
	1124C_3H-5_56-58_13	4.01	3.36	1.18	71.92	0.19	0.14	1.07	0.04	11.67	0.02	93.60
u31	1124C_3H-5_56-58_14	4.04	3.16	1.35	72.87	0.12	0.07	0.92	0.07	11.51	0.00	94.10
	1124C_3H-5_56-58_15	3.85	3.40	1.21	71.85	0.14	0.10	1.03	0.08	11.84	0.01	93.51
	1124C_3H-5_56-58_16	3.84	3.31	1.10	71.86	0.17	0.13	1.04	0.07	11.68	0.03	93.23
	1124C_3H-5_56-58_17	4.00	3.38	1.28	71.74	0.14	0.15	1.00	0.00	11.57	0.04	93.30
	1124C_3H-5_56-58_18	3.91	3.35	1.15	71.91	0.18	0.14	1.03	0.03	11.79	0.03	93.52
	1124C_3H-5_56-58_19	4.06	3.38	1.32	72.15	0.14	0.14	1.04	0.00	11.85	0.05	94.13
	1124C_3H-5_56-58_20	3.82	3.45	1.27	72.29	0.16	0.13	1.03	0.06	11.72	0.00	93.93
	1124C_3H-5_56-58_1	3.88	3.44	1.26	69.97	0.16	0.15	1.04	0.04	11.75	0.00	91.68
	1124C_3H-5_56-58_4	3.55	3.23	1.34	70.06	0.14	0.13	0.89	0.02	11.83	0.00	91.19
	1124C_3H-5_56-58_6	3.99	3.25	1.31	73.03	0.10	0.05	0.88	0.06	11.95	0.00	94.64
	1124C_3H-5_56-58_7	3.71	3.51	1.28	73.44	0.17	0.13	1.02	0.03	11.62	0.00	94.92
	1124C_3H-5_56-58_8	3.73	3.47	1.14	72.21	0.17	0.15	1.04	0.03	12.08	0.02	94.05
	1124C_3H-5_56-58_2	3.58	3.51	1.21	70.03	0.17	0.14	1.06	0.05	11.81	0.00	91.56
	1124C_3H-5_56-58_3	3.71	3.48	1.11	69.95	0.15	0.15	0.99	0.01	12.13	0.02	91.71
	1124C_3H-5_56-58_5	3.52	3.51	1.13	70.84	0.18	0.11	1.04	0.00	11.93	0.01	92.26
	1124C_3H-5_56-58_9	3.82	3.49	1.21	72.95	0.17	0.13	1.02	0.05	12.12	0.03	94.99
	1124C_3H-5_56-58_10	3.70	3.44	1.28	73.19	0.14	0.21	1.01	0.01	11.93	0.02	94.93
	1124C_3H-5_90-92_1	4.30	3.22	1.37	73.26	0.12	0.10	0.89	0.04	11.83	0.00	95.13
	1124C_3H-5_90-92_2	4.10	3.11	1.31	73.44	0.11	0.10	0.90	0.02	11.69	0.01	94.80
	1124C_3H-5_90-92_3	4.16	2.94	2.02	70.72	0.43	0.32	1.46	0.03	11.79	0.03	93.90
	1124C_3H-5_90-92_4	4.07	3.19	1.22	72.88	0.15	0.12	0.90	0.08	11.55	0.04	94.20
	1124C_3H-5_90-92_5	3.90	3.24	1.29	72.13	0.17	0.11	1.11	0.08	11.92	0.00	93.96
	1124C_3H-5_90-92_6	4.36	3.00	1.66	72.26	0.14	0.11	0.98	0.08	11.90	0.00	94.49
	1124C_3H-5_90-92_7	3.75	3.35	1.32	72.11	0.19	0.17	1.23	0.04	12.11	0.02	94.29
	1124C_3H-5_90-92_8	3.69	3.21	1.39	71.82	0.18	0.14	1.22	0.06	11.83	0.01	93.54
	1124C_3H-5_90-92_9	3.89	3.29	1.17	72.34	0.19	0.22	1.18	0.07	12.04	0.03	94.41
	1124C_3H-5_90-92_10	4.08	3.20	1.39	73.53	0.13	0.09	0.89	0.00	11.62	0.03	94.96
	1124C_3H-5_90-92_11	3.78	3.26	1.23	71.90	0.15	0.11	1.16	0.07	11.75	0.05	93.46

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1124C_3H-5_90-92_12	4.21	3.25	1.27	73.88	0.13	0.08	0.88	0.05	11.92	0.00	95.67
	1124C_3H-5_90-92_13	4.27	3.22	1.40	73.22	0.16	0.04	0.94	0.01	11.74	0.03	95.04
	1124C_3H-5_90-92_14	4.04	3.34	1.20	73.84	0.13	0.04	0.78	0.04	11.49	0.00	94.89
	1124C_3H-5_90-92_15	3.96	3.25	1.28	72.70	0.17	0.14	1.14	0.11	12.08	0.04	94.87
	1124C_3H-5_90-92_16	4.31	3.15	1.16	72.62	0.15	0.12	0.90	0.08	11.61	0.00	94.11
	1124C_3H-5_90-92_17	4.30	3.09	1.52	72.78	0.15	0.04	0.89	0.07	11.39	0.01	94.24
	1124C_3H-5_90-92_18	3.84	3.24	1.16	72.75	0.18	0.16	1.20	0.05	12.14	0.01	94.72
	1124C_3H-5_90-92_19	4.25	3.17	1.36	72.93	0.14	0.08	0.90	0.03	11.67	0.05	94.57
	1124C_3H-5W_90-92_1	3.94	3.21	1.18	71.78	0.16	0.17	1.22	0.06	11.97	0.02	93.72
	1124C_3H-5W_90-92_2	4.05	3.34	1.31	72.94	0.12	0.10	0.89	0.00	11.63	0.02	94.41
	1124C_3H-5W_90-92_3	4.14	3.18	1.56	73.19	0.12	0.09	0.91	0.07	11.96	0.01	95.22
	1124C_3H-5W_90-92_4	4.10	3.28	1.41	71.37	0.17	0.17	1.18	0.09	12.01	0.00	93.78
	1124C_3H-5W_90-92_5	3.96	3.36	1.22	71.52	0.18	0.19	1.19	0.06	12.06	0.00	93.72
	1124C_3H-5W_90-92_6	4.04	3.27	1.36	71.77	0.21	0.19	1.18	0.03	12.28	0.01	94.34
	1124C_3H-5W_90-92_7	4.06	3.21	1.27	72.94	0.13	0.12	0.90	0.00	11.62	0.00	94.25
	1124C_3H-5W_90-92_8	4.07	2.95	2.06	70.91	0.46	0.33	1.44	0.09	12.00	0.04	94.35
	1124C_3H-5W_90-92_9	3.98	3.22	1.24	72.16	0.14	0.14	1.21	0.07	12.04	0.00	94.19
	1124C_3H-5W_90-92_10	4.00	3.27	1.14	71.95	0.16	0.15	1.18	0.02	12.16	0.01	94.04
	1124C_3H-5W_90-92_11	4.11	3.21	1.24	72.76	0.14	0.08	0.92	0.05	11.55	0.00	94.07
	1124C_3H-5W_90-92_12	4.26	3.27	1.40	72.89	0.12	0.08	0.96	0.02	11.89	0.02	94.91
	1124C_3H-5W_90-92_13	3.94	3.20	1.26	71.56	0.20	0.19	1.30	0.00	11.92	0.01	93.58
	1124C_3H-5W_90-92_14	4.26	3.15	1.25	73.12	0.13	0.11	0.89	0.03	11.83	0.00	94.76
	1124C_3H-5W_90-92_15	4.37	3.27	2.09	71.25	0.49	0.32	1.37	0.09	12.10	0.05	95.40
	1124C_3H-5W_90-92_16	4.22	3.16	1.10	72.24	0.15	0.15	1.21	0.02	11.96	0.00	94.21
	1124C_3H-5W_90-92_17	3.84	3.29	1.27	72.06	0.21	0.15	1.18	0.08	12.21	0.03	94.32
	1124C_3H-5W_90-92_18	4.15	3.23	1.32	72.86	0.13	0.07	0.89	0.03	11.75	0.00	94.44
	1124C_3H-5W_90-92_19	4.31	3.34	1.31	73.07	0.15	0.08	0.89	0.06	11.76	0.00	94.97
	1124C_3H-5W_90-92_20	3.81	3.20	1.16	71.67	0.18	0.16	1.14	0.04	11.90	0.02	93.28
	1124C_3H-5_90-92_20	4.07	3.24	1.43	73.17	0.16	0.07	0.89	0.08	11.72	0.04	94.86
	s39 1124C_3H-5_141-143_1	4.10	2.76	1.96	70.19	0.46	0.37	1.71	0.06	12.29	0.07	93.97
	1124C_3H-5_141-143_2	4.13	2.81	1.98	71.45	0.36	0.25	1.54	0.06	12.37	0.00	94.95
	1124C_3H-5_141-143_3	4.11	2.81	1.98	71.66	0.35	0.30	1.57	0.11	12.46	0.06	95.41
	1124C_3H-5_141-143_4	3.68	3.30	1.05	73.12	0.13	0.10	0.87	0.04	11.58	0.00	93.86
	1124C_3H-5_141-143_5	4.13	2.86	1.88	71.10	0.35	0.33	1.56	0.05	12.25	0.01	94.52
	1124C_3H-5_141-143_6	4.17	3.02	1.40	72.40	0.22	0.13	1.22	0.07	11.87	0.02	94.52
	1124C_3H-5_141-143_7	3.95	2.87	1.99	70.74	0.34	0.31	1.54	0.03	12.26	0.02	94.04
	1124C_3H-5_141-143_8	4.16	2.83	1.84	71.40	0.35	0.28	1.52	0.09	12.28	0.01	94.77
	1124C_3H-5_141-143_9	3.74	3.33	1.11	73.22	0.11	0.10	0.93	0.00	11.53	0.02	94.10
	1124C_3H-5_141-143_10	4.14	2.88	2.16	71.42	0.39	0.31	1.59	0.05	12.36	0.03	95.33
	1124C_3H-5_141-143_11	4.04	2.94	1.90	71.11	0.36	0.32	1.59	0.05	12.05	0.05	94.41
	1124C_3H-5_141-143_12	4.34	2.82	1.97	71.11	0.33	0.26	1.50	0.01	12.09	0.00	94.43
	1124C_3H-5_141-143_13	4.21	2.77	1.92	70.81	0.33	0.32	1.61	0.04	12.25	0.01	94.27
	1124C_3H-5_141-143_14	4.48	2.73	2.02	70.66	0.37	0.36	1.62	0.00	12.43	0.03	94.70
	1124C_3H-5_141-143_15	4.05	2.82	1.96	70.94	0.32	0.30	1.45	0.08	12.30	0.07	94.29
	1124C_3H-5_141-143_16	4.27	2.80	2.10	70.49	0.36	0.29	1.61	0.13	12.32	0.04	94.41
	1124C_3H-5_141-143_17	4.02	3.33	1.24	73.74	0.12	0.07	0.78	0.00	11.16	0.03	94.49
	1124C_3H-5_141-143_18	3.77	3.35	1.08	73.07	0.09	0.10	0.96	0.00	11.32	0.00	93.73
	1124C_3H-5_141-143_19	4.21	2.81	2.05	71.21	0.36	0.36	1.54	0.07	12.09	0.05	94.75
	1124C_3H-5_141-143_20	3.80	3.02	1.34	72.63	0.21	0.19	1.27	0.09	11.94	0.03	94.52
s40	1124C_3H-6_61-63_1	3.78	3.29	1.03	73.19	0.13	0.14	0.93	0.00	11.55	0.00	94.04
	1124C_3H-6_61-63_2	3.41	3.68	1.10	71.31	0.14	0.10	1.10	0.04	11.29	0.04	92.22
	1124C_3H-6_61-63_3	3.93	3.29	1.03	74.22	0.15	0.13	0.95	0.05	11.77	0.00	95.53
	1124C_3H-6_61-63_4	4.12	3.37	1.06	73.62	0.15	0.15	0.96	0.05	11.64	0.00	95.12
	1124C_3H-6_61-63_5	3.91	3.33	1.12	73.56	0.11	0.09	0.89	0.08	11.52	0.03	94.64
	1124C_3H-6_61-63_6	3.74	3.45	1.15	73.72	0.12	0.12	0.95	0.02	11.73	0.00	95.00
	1124C_3H-6_61-63_7	4.10	3.31	1.18	73.68	0.13	0.12	0.96	0.07	11.84	0.01	95.40
	1124C_3H-6_61-63_8	3.94	3.39	1.07	73.89	0.13	0.16	0.97	0.07	11.60	0.00	95.23
	1124C_3H-6_61-63_9	3.65	3.34	1.18	73.56	0.12	0.12	0.93	0.08	11.52	0.05	94.55
	1124C_3H-6_61-63_10	3.82	3.34	1.03	74.27	0.16	0.12	0.94	0.03	11.59	0.04	95.34
	1124C_3H-6_61-63_11	4.17	3.38	1.06	73.47	0.12	0.09	0.98	0.12	11.76	0.00	95.17
	1124C_3H-6_61-63_12	3.85	3.31	1.12	73.69	0.14	0.13	0.92	0.12	11.67	0.01	94.97
	1124C_3H-6_61-63_13	3.63	3.69	1.01	73.77	0.11	0.10	0.94	0.05	11.53	0.01	94.84
	1124C_3H-6_61-63_14	3.93	3.45	1.11	73.95	0.15	0.12	0.93	0.06	11.86	0.03	95.58
	1124C_3H-6_61-63_15	3.70	3.25	1.05	73.08	0.12	0.13	0.89	0.06	11.59	0.00	93.87
	1124C_3H-6_61-63_16	3.74	3.31	0.99	73.70	0.12	0.14	0.98	0.07	11.71	0.00	94.76
	1124C_3H-6_61-63_17	3.92	3.86	0.85	73.10	0.11	0.08	0.76	0.08	11.70	0.03	94.50
	1124C_3H-6_61-63_18	3.92	3.52	1.01	74.23	0.12	0.08	0.88	0.05	11.60	0.00	95.40
	1124C_3H-6_61-63_19	3.97	3.20	0.86	73.23	0.14	0.13	0.92	0.10	11.39	0.01	93.96
	1124C_3H-6_61-63_20	3.50	3.97	0.90	72.69	0.10	0.06	0.78	0.04	11.36	0.03	93.45
s45	1124C_4H-1_26-28_1	4.28	3.21	1.12	72.29	0.12	0.10	0.78	0.07	11.48	0.00	93.46

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s48	1124C_4H-1_26-28_2	4.19	3.21	0.98	71.54	0.14	0.12	0.82	0.03	11.69	0.02	92.75
	1124C_4H-1_26-28_3	4.14	3.27	1.07	71.34	0.12	0.08	0.78	0.00	11.56	0.05	92.42
	1124C_4H-1_26-28_4	4.07	3.31	1.12	71.03	0.14	0.10	0.77	0.03	11.60	0.00	92.18
	1124C_4H-1_26-28_5	4.09	3.30	1.08	73.39	0.14	0.11	0.83	0.00	11.63	0.00	94.57
	1124C_4H-1_26-28_6	4.27	3.40	1.15	71.79	0.12	0.09	0.81	0.06	11.67	0.01	93.37
	1124C_4H-1_26-28_7	4.27	3.32	1.05	73.66	0.12	0.08	0.80	0.02	11.77	0.00	95.09
	1124C_4H-1_26-28_8	4.19	3.26	1.14	74.05	0.10	0.10	0.76	0.08	11.82	0.00	95.50
	1124C_4H-1_26-28_9	4.15	3.27	1.19	73.76	0.13	0.09	0.77	0.00	11.62	0.04	95.02
	1124C_4H-1_26-28_10	4.20	3.33	1.26	73.81	0.12	0.10	0.78	0.05	11.43	0.00	95.09
	1124C_4H-1_26-28_11	4.22	3.49	1.21	73.58	0.11	0.11	0.79	0.00	11.60	0.01	95.13
	1124C_4H-1_26-28_12	4.16	3.08	1.20	72.76	0.14	0.08	0.77	0.00	11.36	0.00	93.55
	1124C_4H-1_26-28_13	4.28	3.20	1.15	74.64	0.12	0.11	0.76	0.09	11.77	0.00	96.12
	1124C_4H-1_26-28_14	4.21	3.07	1.20	73.76	0.11	0.05	0.74	0.08	11.56	0.01	94.79
	1124C_4H-1_26-28_15	4.42	3.30	1.18	73.57	0.14	0.11	0.81	0.05	11.57	0.01	95.15
	1124C_4H-1_26-28_16	4.24	3.33	1.10	74.19	0.13	0.06	0.80	0.10	11.52	0.03	95.49
	1124C_4H-1_26-28_17	4.12	3.29	1.21	73.99	0.13	0.08	0.77	0.01	11.70	0.00	95.30
	1124C_4H-1_26-28_18	4.20	3.26	1.16	74.18	0.13	0.11	0.77	0.00	11.79	0.00	95.60
	1124C_4H-1_26-28_19	4.00	3.23	1.20	73.68	0.12	0.15	0.74	0.06	11.67	0.00	94.85
	1124C_4H-1_26-28_20	4.17	3.26	1.11	73.50	0.10	0.08	0.74	0.01	11.35	0.03	94.36
	1124C_4H-1_26-28_1	4.13	3.27	1.09	75.80	0.14	0.08	0.79	0.05	12.07	0.01	97.43
	1124C_4H-1_26-28_3	3.73	3.10	1.03	74.84	0.12	0.12	0.78	0.03	11.83	0.00	95.58
	1124C_4H-1_26-28_4	3.93	3.31	1.05	74.43	0.11	0.08	0.80	0.04	11.89	0.03	95.66
	1124C_4H-1_26-28_5	3.80	3.28	1.10	74.81	0.14	0.13	0.81	0.10	11.83	0.03	96.02
	1124C_4H-1_26-28_6	3.85	3.41	1.18	74.94	0.13	0.08	0.81	0.10	11.63	0.00	96.14
	1124C_4H-1_26-28_2	3.65	3.27	1.11	74.51	0.12	0.08	0.75	0.00	11.65	0.04	95.19
	1124C_4H-1_26-28_7	3.73	3.22	1.16	74.26	0.14	0.09	0.81	0.05	11.30	0.03	94.80
	1124C_4H-1_26-28_8	3.93	3.49	1.08	74.99	0.12	0.08	0.82	0.04	12.10	0.00	96.65
	1124C_4H-1_26-28_9	3.82	3.31	1.22	73.46	0.12	0.09	0.79	0.03	12.01	0.04	94.89
	1124C_4H-1_26-28_10	3.80	3.44	1.22	74.65	0.14	0.11	0.77	0.06	11.83	0.00	96.02
	1124C_4H-2_17-19_1	4.25	3.38	1.31	72.34	0.16	0.12	0.77	0.06	11.80	0.02	94.21
	1124C_4H-2_17-19_2	4.26	3.37	1.21	73.44	0.14	0.11	0.67	0.06	11.29	0.00	94.56
	1124C_4H-2_17-19_3	4.77	2.91	1.88	69.65	0.28	0.30	1.52	0.08	13.08	0.05	94.53
	1124C_4H-2_17-19_4	4.21	3.44	1.17	73.44	0.14	0.10	0.70	0.02	11.54	0.00	94.75
	1124C_4H-2_17-19_5	5.09	2.98	2.29	69.92	0.28	0.32	1.48	0.13	13.52	0.02	96.03
	1124C_4H-2_17-19_6	4.73	2.98	2.27	69.97	0.31	0.29	1.50	0.08	13.30	0.04	95.47
	1124C_4H-2_17-19_7	4.83	2.87	2.15	70.39	0.28	0.31	1.50	0.07	13.44	0.00	95.85
	1124C_4H-2_17-19_8	4.31	3.37	1.29	71.91	0.16	0.14	0.76	0.02	11.72	0.02	93.69
	1124C_4H-2_17-19_9	4.55	3.50	1.31	73.92	0.13	0.11	0.73	0.05	11.86	0.01	96.18
	1124C_4H-2_17-19_10	4.45	3.25	1.20	73.05	0.17	0.11	0.73	0.04	11.87	0.00	94.86
	1124C_4H-2_17-19_11	4.78	2.90	1.84	70.31	0.28	0.28	1.45	0.08	13.40	0.03	95.34
	1124C_4H-2_17-19_12	4.33	3.29	1.35	73.82	0.11	0.11	0.70	0.03	11.57	0.00	95.30
	1124C_4H-2_17-19_13	4.29	3.44	1.18	72.97	0.15	0.11	0.77	0.03	12.06	0.01	95.00
	1124C_4H-2_17-19_14	4.44	3.39	1.33	72.52	0.16	0.17	0.77	0.04	11.86	0.00	94.68
	1124C_4H-2_17-19_15	4.29	3.43	1.28	73.73	0.18	0.09	0.78	0.10	11.88	0.05	95.81
	1124C_4H-2_17-19_16	4.22	3.50	1.31	73.74	0.16	0.08	0.78	0.13	11.85	0.00	95.77
	1124C_4H-2_17-19_17	4.27	3.47	1.18	73.46	0.14	0.12	0.81	0.01	11.93	0.00	95.40
	1124C_4H-2_17-19_18	4.35	3.01	1.95	68.46	0.34	0.29	1.49	0.07	12.99	0.02	92.98
	1124C_4H-2_17-19_19	4.24	3.38	1.47	73.90	0.13	0.12	0.80	0.08	12.09	0.06	96.26
	1124C_4H-2_17-19_20	4.11	3.41	1.16	73.11	0.16	0.13	0.78	0.04	11.87	0.05	94.81
s49	1124C_4H-2_17-19_1	3.94	2.89	1.87	70.72	0.19	0.17	1.16	0.12	12.82	0.03	93.92
	1124C_4H-2_17-19_2	4.39	2.98	1.88	71.27	0.19	0.17	1.14	0.10	12.76	0.01	94.89
	1124C_4H-2_17-19_3	4.36	2.92	1.77	71.81	0.22	0.12	1.14	0.11	12.91	0.00	95.35
	1124C_4H-2_17-19_4	4.51	2.94	1.71	71.86	0.20	0.15	1.15	0.04	12.81	0.00	95.36
	1124C_4H-2_17-19_5	4.44	2.88	1.84	71.16	0.21	0.18	1.08	0.10	12.67	0.03	94.59
	1124C_4H-2_17-19_6	4.07	2.90	1.65	71.34	0.25	0.20	1.09	0.09	12.97	0.00	94.55
	1124C_4H-2_17-19_7	4.07	2.98	1.76	71.15	0.22	0.16	1.10	0.12	12.76	0.02	94.34
	1124C_4H-2_17-19_8	4.49	2.98	1.70	71.85	0.20	0.16	1.15	0.12	12.68	0.08	95.41
	1124C_4H-2_17-19_9	4.42	3.04	1.91	72.94	0.20	0.18	1.14	0.12	13.14	0.00	97.09
	1124C_4H-2_17-19_10	4.25	2.98	1.87	70.64	0.21	0.18	1.12	0.09	12.87	0.06	94.27
	1124C_4H-2_17-19_11	4.13	2.98	1.77	70.15	0.20	0.22	1.11	0.06	12.68	0.00	93.30
	1124C_4H-2_81-83_1	4.04	3.11	1.43	72.28	0.15	0.14	1.05	0.06	12.09	0.04	94.39
	1124C_4H-2_81-83_2	4.20	3.05	1.48	72.67	0.15	0.12	1.07	0.02	12.32	0.04	95.12
	1124C_4H-2_81-83_3	3.85	3.17	1.40	71.98	0.17	0.13	1.00	0.00	12.30	0.00	94.01
	1124C_4H-2_81-83_4	4.36	2.99	1.52	72.14	0.20	0.15	1.26	0.08	12.59	0.04	95.33
	1124C_4H-2_81-83_5	4.29	3.08	1.44	72.53	0.17	0.10	1.02	0.02	12.35	0.00	95.00
	1124C_4H-2_81-83_6	4.44	2.98	1.58	72.39	0.19	0.12	1.01	0.08	12.50	0.04	95.34
	1124C_4H-2_81-83_7	4.29	3.04	1.63	71.88	0.17	0.15	1.24	0.10	12.48	0.01	94.99
	1124C_4H-2_81-83_8	4.15	2.98	1.59	71.67	0.19	0.14	1.20	0.09	12.34	0.02	94.37
	1124C_4H-2_81-83_9	4.52	2.77	1.97	71.09	0.21	0.20	1.12	0.03	12.79	0.02	94.72
	1124C_4H-2_81-83_10	3.48	3.77	1.61	71.27	0.20	0.19	1.25	0.08	12.54	0.00	94.38

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s50*	1124C_4H-2_81-83_11	4.28	3.16	1.49	72.58	0.14	0.10	1.07	0.05	12.21	0.01	95.09
	1124C_4H-2_81-83_12	4.08	3.20	1.38	72.18	0.16	0.12	1.08	0.07	12.46	0.02	94.75
	1124C_4H-2_81-83_13	4.10	2.94	1.56	72.25	0.20	0.17	1.23	0.03	12.56	0.04	95.08
	1124C_4H-2_81-83_14	3.74	3.14	1.50	71.19	0.15	0.14	1.05	0.06	12.11	0.01	93.09
	1124C_4H-2_81-83_15	4.09	2.96	1.56	70.48	0.16	0.21	1.30	0.08	12.66	0.04	93.54
	1124C_4H-2_81-83_16	3.82	3.07	1.35	71.71	0.17	0.09	1.08	0.00	11.97	0.00	93.26
	1124C_4H-2_81-83_17	4.12	3.08	1.35	72.01	0.13	0.10	1.08	0.04	12.26	0.00	94.16
	1124C_4H-2_81-83_18	4.11	2.92	1.64	71.06	0.20	0.19	1.22	0.00	12.53	0.01	93.87
	1124C_4H-2_81-83_19	4.02	2.86	1.61	70.80	0.21	0.19	1.20	0.01	12.70	0.01	93.60
	1124C_4H-2_81-83_20	3.78	3.08	1.39	71.72	0.17	0.13	1.07	0.00	12.05	0.02	93.41
	1124C_4H-2_81-83_1	3.95	3.24	1.43	72.95	0.16	0.14	1.04	0.01	12.21	0.00	95.13
	1124C_4H-2_81-83_2	4.02	3.13	1.59	72.18	0.15	0.07	1.05	0.10	11.94	0.04	94.27
	1124C_4H-2_81-83_3	4.09	3.40	1.59	73.47	0.18	0.14	0.97	0.09	12.64	0.02	96.59
	1124C_4H-2_81-83_4	4.12	3.05	1.56	71.43	0.17	0.12	1.13	0.05	12.09	0.02	93.75
	1124C_4H-2_81-83_5	3.99	2.98	1.54	70.65	0.21	0.15	1.23	0.03	12.53	0.03	93.35
	1124C_4H-2_81-83_6	4.02	3.33	1.50	71.39	0.16	0.11	1.02	0.02	12.32	0.01	93.88
	1124C_4H-2_81-83_8	3.93	3.03	1.72	70.68	0.15	0.16	1.23	0.05	12.49	0.03	93.47
	1124C_4H-2_81-83_9	3.90	2.97	1.65	71.59	0.15	0.16	1.25	0.09	12.61	0.05	94.43
	1124C_4H-2_81-83_10	3.83	3.25	1.65	73.48	0.17	0.14	1.08	0.02	12.62	0.02	96.27
	1124C_4H-2_118-120_1	4.06	3.22	1.25	73.41	0.12	0.10	0.78	0.00	11.86	0.02	94.82
	1124C_4H-2_118-120_2	4.45	3.08	1.70	71.85	0.16	0.09	0.94	0.05	12.34	0.00	94.66
	1124C_4H-2_118-120_3	4.39	3.14	1.60	72.34	0.17	0.12	0.98	0.09	12.45	0.00	95.27
	1124C_4H-2_118-120_4	4.56	2.87	1.93	71.13	0.23	0.17	1.14	0.12	12.71	0.00	94.85
	1124C_4H-2_118-120_5	4.54	2.96	1.89	71.14	0.23	0.19	1.09	0.08	12.55	0.00	94.66
	1124C_4H-2_118-120_6	4.66	3.20	1.68	72.27	0.17	0.08	0.95	0.06	12.56	0.03	95.66
	1124C_4H-2_118-120_7	4.40	3.19	1.55	72.20	0.13	0.13	0.95	0.08	12.30	0.00	94.93
	1124C_4H-2_118-120_8	4.57	3.14	1.50	72.43	0.14	0.14	0.96	0.04	12.25	0.01	95.17
	1124C_4H-2_118-120_9	4.36	3.20	1.50	71.68	0.16	0.10	0.97	0.08	12.39	0.00	94.44
	1124C_4H-2_118-120_10	4.82	2.94	1.87	71.72	0.22	0.19	1.16	0.06	12.58	0.00	95.56
	1124C_4H-2_118-120_11	4.37	3.13	1.65	72.11	0.16	0.16	1.01	0.06	12.40	0.03	95.08
	1124C_4H-2_118-120_12	4.33	3.16	1.70	72.78	0.15	0.12	1.01	0.13	12.60	0.05	96.02
	1124C_4H-2_118-120_13	4.26	3.17	1.67	72.54	0.17	0.13	0.98	0.01	12.18	0.00	95.11
	1124C_4H-2_118-120_14	4.41	3.00	1.57	71.18	0.17	0.16	1.00	0.08	12.36	0.02	93.96
	1124C_4H-2_118-120_15	4.53	3.21	1.60	72.07	0.17	0.11	0.94	0.03	12.56	0.00	95.22
	1124C_4H-2_118-120_16	4.51	3.02	1.83	72.42	0.16	0.15	1.05	0.08	12.64	0.00	95.87
	1124C_4H-2_118-120_17	4.40	3.01	1.34	70.93	0.17	0.14	0.92	0.07	12.27	0.04	93.29
	1124C_4H-2_118-120_18	4.57	3.17	1.54	72.07	0.13	0.14	0.98	0.02	12.41	0.04	95.08
	1124C_4H-2_118-120_19	4.56	3.23	1.60	72.44	0.14	0.16	0.97	0.13	12.44	0.00	95.67
	1124C_4H-2_118-120_20	4.02	3.40	1.08	74.10	0.14	0.10	0.79	0.09	11.78	0.01	95.52
s51	1124C_4H-2_118-120_3	4.82	3.26	1.54	72.27	0.19	0.16	0.98	0.03	12.37	0.00	95.61
	1124C_4H-2_118-120_6	4.49	3.18	1.58	70.86	0.13	0.10	1.01	0.12	12.19	0.01	93.67
	1124C_4H-2_118-120_7	4.51	3.12	1.71	71.35	0.17	0.14	0.98	0.06	11.99	0.02	94.05
	1124C_4H-2_118-120_8	4.38	3.34	1.66	71.30	0.17	0.13	0.99	0.07	12.53	0.05	94.61
	1124C_4H-2_118-120_2	4.37	3.19	1.40	71.29	0.14	0.14	1.02	0.00	12.36	0.02	93.93
	1124C_4H-2_118-120_4	4.47	3.29	1.50	72.31	0.17	0.14	1.04	0.01	13.06	0.01	96.01
	1124C_4H-2_118-120_5	4.80	2.99	1.73	71.43	0.20	0.19	1.12	0.08	12.90	0.04	95.47
	1124C_4H-2_118-120_9	4.36	3.28	1.51	71.90	0.17	0.09	0.94	0.01	12.50	0.02	94.77
	1124C_4H-2_118-120_10	4.47	3.08	1.55	70.91	0.16	0.11	1.02	0.07	12.41	0.00	93.78
	1124C_4H-3_48-50_1	3.77	3.49	1.10	71.56	0.09	0.05	0.75	0.03	11.49	0.00	92.33
	1124C_4H-3_48-50_2	4.03	3.32	1.16	71.97	0.08	0.04	0.74	0.04	11.49	0.00	92.87
	1124C_4H-3_48-50_3	4.13	3.30	1.07	70.56	0.10	0.05	0.72	0.02	11.27	0.00	91.23
	1124C_4H-3_48-50_4	4.12	3.43	1.02	72.19	0.12	0.07	0.71	0.02	11.38	0.00	93.05
	1124C_4H-3_48-50_5	4.22	3.00	1.49	71.49	0.23	0.17	1.04	0.00	11.74	0.05	93.43
	1124C_4H-3_48-50_6	4.21	3.13	1.34	72.14	0.17	0.14	0.94	0.09	11.75	0.00	93.91
	1124C_4H-3_48-50_7	3.88	3.39	1.23	73.41	0.09	0.09	0.77	0.00	11.47	0.00	94.34
	1124C_4H-3_48-50_8	4.17	3.21	1.18	72.81	0.13	0.10	0.81	0.11	11.48	0.01	94.01
	1124C_4H-3_48-50_9	3.89	3.42	1.02	72.84	0.10	0.07	0.72	0.05	11.63	0.02	93.76
	1124C_4H-3_48-50_10	4.43	3.17	1.59	71.94	0.12	0.08	0.98	0.08	12.33	0.04	94.76
	1124C_4H-3_48-50_11	4.14	3.48	1.05	73.02	0.08	0.06	0.70	0.08	11.67	0.02	94.30
	1124C_4H-3_48-50_12	3.79	3.47	1.10	73.31	0.08	0.10	0.76	0.05	11.84	0.07	94.58
u38	1124C_4H-3_48-50_13	3.94	3.55	1.32	73.09	0.10	0.06	0.71	0.00	11.67	0.01	94.45
	1124C_4H-3_48-50_14	4.04	3.43	1.29	73.31	0.10	0.09	0.76	0.02	11.67	0.01	94.72
	1124C_4H-3_48-50_15	4.28	3.48	1.24	73.81	0.10	0.11	0.72	0.05	11.70	0.01	95.49
	1124C_4H-3_48-50_16	3.78	3.50	1.19	73.61	0.14	0.07	0.73	0.00	11.59	0.02	94.63
	1124C_4H-3_48-50_17	4.03	3.38	1.21	72.89	0.10	0.05	0.75	0.01	11.38	0.03	93.84
	1124C_4H-3_48-50_18	4.09	3.20	1.29	72.58	0.14	0.08	0.98	0.00	12.15	0.00	94.51
	1124C_4H-3_48-50_19	4.10	3.29	1.03	73.16	0.10	0.07	0.76	0.07	11.53	0.00	94.12
	1124C_4H-3_48-50_20	4.11	3.34	1.33	73.96	0.15	0.08	0.80	0.00	11.62	0.02	95.40
	1124C_4H-3_121-123_1	4.01	3.52	1.45	73.05	0.16	0.14	1.09	0.04	12.10	0.04	95.61
	1124C_4H-3_121-123_2	4.44	3.14	1.60	71.23	0.22	0.17	1.35	0.04	12.51	0.06	94.76

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u39	1124C_4H-3_121-123_3	4.09	3.28	1.52	71.14	0.20	0.15	1.23	0.10	12.45	0.05	94.20
	1124C_4H-3_121-123_4	4.42	3.39	1.27	73.50	0.17	0.12	1.08	0.07	12.15	0.04	96.20
	1124C_4H-3_121-123_5	4.15	3.22	1.82	69.93	0.25	0.18	1.29	0.00	12.65	0.02	93.52
	1124C_4H-3_121-123_6	3.88	3.44	1.08	72.44	0.12	0.06	0.82	0.01	11.81	0.00	93.66
	1124C_4H-3_121-123_7	4.07	3.39	1.01	73.22	0.12	0.14	0.87	0.00	11.82	0.00	94.64
	1124C_4H-3_121-123_8	4.92	2.90	1.96	71.10	0.19	0.15	1.16	0.08	12.37	0.02	94.85
	1124C_4H-3_121-123_9	4.43	3.12	1.59	71.93	0.21	0.17	1.20	0.09	12.47	0.00	95.21
	1124C_4H-3_121-123_10	4.08	3.16	1.43	70.20	0.17	0.10	1.04	0.05	12.10	0.01	92.34
	1124C_4H-3_121-123_11	4.41	3.36	1.35	72.66	0.18	0.13	1.06	0.08	12.01	0.00	95.25
	1124C_4H-3_121-123_12	3.98	3.30	1.17	72.07	0.15	0.11	1.02	0.00	12.12	0.05	93.97
	1124C_4H-3_121-123_13	4.70	3.10	1.55	71.75	0.20	0.22	1.18	0.06	12.70	0.03	95.48
	1124C_4H-3_121-123_14	4.07	3.07	1.67	71.33	0.22	0.20	1.24	0.00	12.32	0.00	94.12
	1124C_4H-3_121-123_15	4.20	3.30	1.52	71.45	0.20	0.16	1.18	0.02	12.42	0.03	94.47
	1124C_4H-3_121-123_16	4.12	3.60	1.16	72.40	0.10	0.11	0.79	0.01	11.75	0.01	94.04
	1124C_4H-3_121-123_17	4.06	3.27	1.64	72.20	0.19	0.18	1.22	0.04	12.42	0.00	95.22
	1124C_4H-3_121-123_18	4.16	3.33	1.64	71.41	0.18	0.11	1.16	0.10	12.27	0.01	94.37
	1124C_4H-3_121-123_19	4.23	3.38	0.98	73.31	0.15	0.14	0.80	0.04	11.67	0.05	94.75
	1124C_4H-3_121-123_20	4.14	3.22	1.91	69.46	0.30	0.27	1.40	0.03	12.63	0.03	93.39
	1124C_4H-3_142-144_1	4.75	3.01	1.93	72.33	0.15	0.19	1.16	0.13	12.75	0.02	96.43
	1124C_4H-3_142-144_2	3.98	3.31	1.30	72.28	0.13	0.14	1.05	0.06	12.39	0.05	94.68
	1124C_4H-3_142-144_3	4.20	3.53	1.24	71.89	0.16	0.12	0.88	0.07	12.04	0.02	94.14
	1124C_4H-3_142-144_4	4.12	3.30	1.44	71.12	0.18	0.14	1.01	0.00	12.19	0.01	93.51
	1124C_4H-3_142-144_5	4.13	3.40	1.44	71.77	0.12	0.11	1.00	0.03	12.05	0.00	94.04
	1124C_4H-3_142-144_6	4.32	3.37	1.28	73.31	0.15	0.10	0.84	0.05	11.97	0.05	95.44
	1124C_4H-3_142-144_7	3.67	3.54	1.32	72.68	0.13	0.08	0.92	0.10	12.07	0.04	94.55
	1124C_4H-3_142-144_8	4.30	3.07	1.67	70.75	0.21	0.18	1.25	0.00	12.88	0.02	94.33
	1124C_4H-3_142-144_9	3.90	3.50	1.15	73.16	0.14	0.09	0.82	0.09	11.91	0.00	94.76
	1124C_4H-3_142-144_10	4.26	3.31	1.47	71.27	0.16	0.15	1.02	0.07	12.22	0.00	93.92
	1124C_4H-3_142-144_11	4.19	3.25	1.67	71.56	0.19	0.15	1.14	0.00	12.46	0.01	94.63
	1124C_4H-3_142-144_12	4.45	2.94	2.20	69.16	0.29	0.31	1.65	0.12	13.47	0.00	94.60
	1124C_4H-3_142-144_13	3.91	3.49	1.27	72.57	0.11	0.09	0.84	0.11	12.12	0.01	94.52
	1124C_4H-3_142-144_14	4.40	3.38	1.32	72.51	0.12	0.12	0.96	0.00	12.27	0.00	95.08
	1124C_4H-3_142-144_15	4.25	3.24	1.19	71.09	0.09	0.06	0.85	0.10	11.59	0.05	92.50
	1124C_4H-3_142-144_16	4.18	3.36	1.32	71.51	0.11	0.11	0.87	0.03	11.75	0.01	93.24
	1124C_4H-3_142-144_17	4.06	3.15	1.95	69.83	0.22	0.16	1.30	0.08	12.89	0.02	93.67
	1124C_4H-3_142-144_18	4.42	3.34	1.33	72.15	0.14	0.12	1.00	0.02	12.25	0.02	94.80
	1124C_4H-3_142-144_19	4.15	3.29	1.23	71.64	0.12	0.08	0.87	0.14	12.23	0.00	93.76
	1124C_4H-3_142-144_20	4.17	3.39	1.23	72.06	0.14	0.14	0.94	0.03	11.98	0.03	94.11
	1124C_4H-3_142-144_1	3.73	3.22	1.50	70.65	0.12	0.12	1.08	0.05	12.52	0.02	93.02
	1124C_4H-3_142-144_2	3.84	3.58	1.07	72.56	0.10	0.05	0.74	0.02	12.19	0.00	94.15
	1124C_4H-3_142-144_3	3.81	3.53	1.24	72.29	0.11	0.04	0.81	0.12	12.22	0.00	94.17
	1124C_4H-3_142-144_4	3.98	3.46	1.34	72.01	0.13	0.06	0.86	0.08	11.92	0.00	93.84
	1124C_4H-3_142-144_7	4.21	2.94	1.66	70.25	0.17	0.17	1.12	0.07	12.79	0.04	93.42
	1124C_4H-3_142-144_10	3.85	3.57	1.23	73.23	0.12	0.12	0.90	0.03	11.87	0.03	94.95
	1124C_4H-3_142-144_5	3.85	3.54	1.27	73.42	0.10	0.09	0.84	0.04	12.03	0.02	95.20
	1124C_4H-3_142-144_6	3.99	3.34	1.21	68.60	0.16	0.12	1.00	0.06	12.69	0.00	91.17
	1124C_4H-3_142-144_8	3.77	3.40	1.08	70.29	0.13	0.12	0.97	0.08	12.38	0.03	92.25
	1124C_4H-3_142-144_9	3.89	3.40	1.51	72.34	0.13	0.12	1.02	0.04	12.49	0.01	94.95
	1124C_4H-3_142-144_11	3.96	3.23	1.48	69.32	0.12	0.15	1.14	0.06	12.40	0.04	91.90
s52	1124C_4H-4_81-83_1	4.17	3.18	1.23	72.79	0.12	0.08	1.03	0.00	11.62	0.00	94.22
	1124C_4H-4_81-83_2	3.96	3.22	1.24	73.21	0.11	0.09	1.02	0.00	11.71	0.00	94.56
	1124C_4H-4_81-83_3	3.96	3.29	1.09	73.43	0.13	0.11	0.93	0.12	11.39	0.02	94.47
	1124C_4H-4_81-83_4	3.83	3.27	1.14	73.22	0.11	0.10	1.01	0.01	11.57	0.00	94.26
	1124C_4H-4_81-83_5	3.88	3.31	1.12	73.46	0.10	0.10	0.87	0.04	11.37	0.00	94.25
	1124C_4H-4_81-83_6	3.74	3.27	1.31	73.22	0.11	0.14	1.03	0.04	11.49	0.01	94.34
	1124C_4H-4_81-83_7	3.95	3.48	1.12	73.80	0.11	0.08	0.93	0.07	11.59	0.00	95.14
	1124C_4H-4_81-83_8	4.01	3.15	1.22	72.76	0.10	0.11	1.06	0.08	11.79	0.03	94.31
	1124C_4H-4_81-83_9	3.87	3.26	0.91	72.90	0.11	0.09	0.92	0.05	11.40	0.05	93.55
	1124C_4H-4_81-83_10	3.65	3.29	1.15	72.99	0.11	0.10	1.02	0.10	11.59	0.00	94.00
	1124C_4H-4_81-83_11	3.78	3.33	1.10	73.81	0.12	0.05	0.92	0.08	11.46	0.03	94.67
	1124C_4H-4_81-83_12	3.66	3.14	1.30	73.37	0.13	0.09	1.04	0.03	11.39	0.02	94.16
	1124C_4H-4_81-83_13	4.08	3.18	1.23	73.03	0.12	0.12	1.02	0.06	11.72	0.03	94.59
	1124C_4H-4_81-83_14	3.60	3.31	0.87	73.44	0.12	0.08	0.96	0.02	11.34	0.00	93.75
	1124C_4H-4_81-83_15	3.96	3.12	1.27	73.28	0.12	0.09	1.02	0.06	11.58	0.01	94.52
	1124C_4H-4_81-83_16	3.89	3.30	1.16	73.33	0.10	0.08	0.90	0.01	11.47	0.03	94.28
	1124C_4H-4_81-83_17	3.82	3.38	1.29	73.79	0.10	0.11	1.03	0.03	11.43	0.01	94.99
	1124C_4H-4_81-83_18	3.63	3.56	1.03	74.01	0.12	0.05	0.83	0.01	11.57	0.00	94.82
	1124C_4H-4_81-83_19	3.73	3.24	1.26	72.64	0.11	0.10	1.02	0.05	11.64	0.02	93.81
	1124C_4H-4_81-83_20	4.27	3.30	1.16	72.26	0.16	0.09	0.85	0.11	11.77	0.00	93.97
s53	1124C_4H-4_111-113_1	3.64	3.46	1.18	73.92	0.09	0.08	0.86	0.00	11.78	0.01	95.02

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
ss5	1124C_4H-4_111-113_2	3.75	2.86	1.47	74.23	0.19	0.22	1.50	0.03	11.86	0.02	96.13
	1124C_4H-4_111-113_3	3.75	2.83	1.33	73.74	0.19	0.18	1.51	0.01	11.76	0.04	95.33
	1124C_4H-4_111-113_4	3.97	2.94	1.57	73.88	0.16	0.20	1.49	0.01	11.99	0.00	96.22
	1124C_4H-4_111-113_5	3.57	2.95	1.41	73.85	0.16	0.22	1.43	0.07	11.50	0.02	95.18
	1124C_4H-4_111-113_6	3.87	2.88	1.55	74.20	0.16	0.17	1.45	0.00	11.88	0.00	96.16
	1124C_4H-4_111-113_7	3.78	2.89	1.52	73.23	0.15	0.18	1.49	0.02	11.77	0.00	95.03
	1124C_4H-4_111-113_8	3.80	2.87	1.42	74.13	0.17	0.20	1.47	0.05	11.83	0.05	95.99
	1124C_4H-4_111-113_9	3.91	3.36	1.28	74.92	0.15	0.08	0.96	0.00	11.91	0.00	96.57
	1124C_4H-4_111-113_10	3.96	2.86	1.42	73.93	0.20	0.20	1.43	0.11	11.78	0.02	95.92
	1124C_4H-4_111-113_11	3.35	2.82	1.36	73.24	0.18	0.17	1.49	0.01	11.94	0.01	94.57
	1124C_4H-4_111-113_12	3.80	3.35	1.41	74.47	0.11	0.10	1.00	0.09	11.92	0.02	96.27
	1124C_4H-4_111-113_13	3.71	2.83	1.41	74.35	0.16	0.19	1.48	0.00	12.23	0.00	96.36
	1124C_4H-4_111-113_14	3.92	3.45	1.20	74.12	0.11	0.11	0.95	0.05	11.85	0.03	95.78
	1124C_4H-4_111-113_15	3.77	2.99	1.50	74.56	0.15	0.19	1.57	0.02	11.96	0.02	96.74
	1124C_4H-4_111-113_16	3.86	3.36	1.16	74.64	0.11	0.11	0.99	0.08	11.73	0.00	96.04
	1124C_4H-4_111-113_17	3.80	3.19	1.27	73.95	0.10	0.09	0.96	0.08	11.69	0.03	95.14
	1124C_4H-4_111-113_18	3.70	2.99	1.34	73.86	0.15	0.16	1.52	0.06	11.82	0.04	95.65
	1124C_4H-4_111-113_19	3.88	2.90	1.42	73.44	0.20	0.20	1.49	0.03	11.86	0.03	95.45
	1124C_4H-4_111-113_20	4.15	3.26	1.21	74.08	0.11	0.11	0.98	0.02	11.81	0.01	95.75
	1124C_5H-1_91-93_1	4.49	2.93	2.04	71.18	0.13	0.13	0.99	0.11	12.22	0.03	94.25
	1124C_5H-1_91-93_2	4.67	3.01	1.97	72.02	0.18	0.10	0.97	0.03	12.52	0.03	95.50
	1124C_5H-1_91-93_3	4.80	2.97	2.06	71.98	0.16	0.09	0.96	0.07	12.42	0.02	95.54
	1124C_5H-1_91-93_4	4.46	2.94	1.89	72.12	0.18	0.10	0.98	0.11	12.58	0.01	95.38
	1124C_5H-1_91-93_5	4.77	3.03	2.07	71.46	0.18	0.11	0.97	0.08	12.49	0.03	95.19
	1124C_5H-1_91-93_6	4.60	2.96	2.09	71.82	0.18	0.12	0.96	0.08	12.20	0.00	95.01
	1124C_5H-1_91-93_7	4.54	2.91	1.93	71.49	0.16	0.13	1.00	0.10	12.38	0.00	94.64
	1124C_5H-1_91-93_8	4.43	2.98	1.85	71.68	0.15	0.12	0.94	0.04	12.04	0.03	94.25
	1124C_5H-1_91-93_9	4.73	3.06	1.89	71.82	0.14	0.11	0.96	0.05	12.15	0.02	94.93
	1124C_5H-1_91-93_10	4.45	2.95	1.75	70.66	0.16	0.12	0.96	0.07	12.05	0.01	93.17
	1124C_5H-1_91-93_11	4.53	2.93	2.14	70.41	0.12	0.09	0.97	0.08	12.18	0.04	93.50
	1124C_5H-1_91-93_12	4.52	3.34	2.20	71.84	0.16	0.14	1.18	0.08	13.04	0.02	96.51
	1124C_5H-1_91-93_13	4.57	3.00	2.38	71.99	0.15	0.10	0.97	0.16	12.71	0.01	96.04
	1124C_5H-1_91-93_14	4.51	2.84	1.99	70.09	0.16	0.09	0.94	0.07	12.10	0.04	92.83
	1124C_5H-1_91-93_15	4.11	2.85	1.83	70.03	0.16	0.08	1.01	0.09	11.93	0.03	92.12
	1124C_5H-1_91-93_16	4.47	2.90	1.83	70.50	0.15	0.10	0.94	0.08	12.13	0.01	93.12
	1124C_5H-1_91-93_17	4.65	2.92	2.02	71.84	0.15	0.07	0.97	0.08	12.49	0.00	95.19
	1124C_5H-1_91-93_18	4.19	3.31	1.67	69.58	0.13	0.10	0.97	0.00	12.43	0.01	92.38
	1124C_5H-1_91-93_19	4.68	3.01	2.06	72.14	0.18	0.09	1.01	0.09	12.52	0.01	95.79
	1124C_5H-1_91-93_20	4.61	2.84	2.10	70.10	0.17	0.10	1.03	0.08	12.21	0.04	93.28
u43	1124C_5H-1_91-93_1	4.39	3.02	1.94	70.91	0.18	0.11	0.99	0.05	11.74	0.02	93.36
	1124C_5H-1_91-93_2	4.37	3.02	1.93	71.25	0.17	0.11	1.06	0.06	11.83	0.00	93.80
	1124C_5H-1_91-93_4	4.43	2.97	1.73	70.27	0.17	0.11	1.01	0.12	11.17	0.00	91.98
	1124C_5H-1_91-93_6	4.45	2.97	1.85	70.15	0.15	0.10	0.99	0.06	11.47	0.00	92.19
	1124C_5H-1_91-93_8	4.42	3.03	1.93	70.43	0.16	0.14	0.94	0.17	11.62	0.00	92.84
	1124C_5H-1_91-93_3	4.45	2.98	1.79	70.74	0.16	0.09	0.95	0.11	11.29	0.00	92.56
	1124C_5H-1_91-93_5	4.51	2.99	1.83	71.01	0.16	0.11	1.00	0.08	11.69	0.01	93.40
	1124C_5H-1_91-93_7	3.58	3.55	1.95	68.28	0.15	0.14	1.23	0.00	11.65	0.05	90.59
	1124C_5H-1_91-93_9	4.20	3.04	1.75	70.94	0.15	0.10	0.97	0.04	11.82	0.00	93.00
	1124C_5H-1_91-93_10	4.59	2.94	2.09	70.77	0.21	0.16	1.29	0.11	12.21	0.05	94.42
	1124C_5H-2_5-7_1	4.63	2.78	2.21	69.92	0.20	0.15	1.32	0.03	12.80	0.02	94.07
	1124C_5H-2_5-7_2	4.99	2.72	2.35	69.85	0.27	0.19	1.40	0.08	12.89	0.05	94.78
	1124C_5H-2_5-7_3	4.90	2.73	2.19	70.43	0.23	0.19	1.38	0.05	12.86	0.00	94.95
	1124C_5H-2_5-7_4	4.59	3.02	1.84	71.28	0.15	0.07	1.01	0.05	12.62	0.01	94.64
	1124C_5H-2_5-7_5	4.78	2.95	2.13	70.82	0.20	0.17	1.13	0.12	12.47	0.05	94.82
	1124C_5H-2_5-7_6	4.72	3.05	1.83	72.06	0.16	0.07	1.02	0.05	12.32	0.01	95.29
	1124C_5H-2_5-7_7	4.89	2.72	2.42	69.88	0.20	0.18	1.37	0.08	12.64	0.01	94.40
	1124C_5H-2_5-7_8	4.85	2.70	2.17	70.15	0.24	0.18	1.48	0.05	12.79	0.05	94.66
	1124C_5H-2_5-7_9	4.88	2.92	2.29	70.44	0.25	0.21	1.42	0.05	13.25	0.01	95.72
	1124C_5H-2_5-7_10	4.78	2.97	2.17	70.64	0.18	0.11	1.15	0.09	12.53	0.04	94.66
	1124C_5H-2_5-7_11	4.96	3.06	1.97	71.09	0.13	0.06	1.00	0.13	12.40	0.05	94.84
	1124C_5H-2_5-7_12	4.60	2.66	2.16	70.26	0.22	0.19	1.33	0.13	12.76	0.02	94.33
	1124C_5H-2_5-7_13	4.71	2.90	2.28	70.29	0.26	0.26	1.50	0.13	13.18	0.01	95.53
	1124C_5H-2_5-7_14	4.42	2.70	2.08	70.11	0.25	0.20	1.39	0.17	12.68	0.00	94.00
	1124C_5H-2_5-7_15	4.70	2.77	2.11	70.23	0.20	0.21	1.37	0.04	13.07	0.06	94.76
	1124C_5H-2_5-7_16	4.70	2.72	2.07	70.03	0.20	0.21	1.35	0.06	12.78	0.05	94.18
	1124C_5H-2_5-7_17	4.85	3.04	1.95	71.71	0.11	0.07	0.90	0.14	12.23	0.03	95.02
	1124C_5H-2_5-7_18	4.88	2.72	2.23	69.83	0.20	0.19	1.35	0.13	12.76	0.04	94.34
	1124C_5H-2_5-7_19	4.69	3.08	1.90	71.04	0.13	0.08	0.95	0.07	12.21	0.01	94.16
	1124C_5H-2_5-7_20	4.50	2.86	2.10	69.92	0.18	0.14	1.18	0.12	12.45	0.05	93.50
	1124C_5H-2_5-7_3	4.45	3.08	1.99	72.05	0.27	0.09	1.08	0.03	12.37	0.06	95.46

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s56*	1124C_SH-2_5-7_4	4.20	2.88	2.06	71.62	0.23	0.14	1.07	0.00	12.29	0.01	94.50
	1124C_SH-2_5-7_6	4.56	2.98	2.03	71.86	0.19	0.10	1.04	0.04	12.20	0.00	95.00
	1124C_SH-2_5-7_9	4.43	3.03	2.01	72.56	0.19	0.10	0.94	0.06	12.29	0.00	95.61
	1124C_SH-2_5-7_1	4.43	3.01	1.89	72.24	0.21	0.09	0.97	0.10	12.15	0.01	95.09
	1124C_SH-2_5-7_2	4.51	2.92	1.96	71.28	0.22	0.06	0.99	0.11	12.18	0.06	94.29
	1124C_SH-2_5-7_5	4.47	3.07	1.97	72.63	0.21	0.06	0.99	0.02	12.50	0.02	95.95
	1124C_SH-2_5-7_7	4.39	3.00	1.94	72.08	0.21	0.08	0.93	0.04	12.19	0.03	94.90
	1124C_SH-2_5-7_8	4.33	2.92	1.88	71.85	0.23	0.08	1.00	0.06	12.13	0.01	94.48
	1124C_SH-2_45-47_1	4.31	2.88	2.29	69.55	0.20	0.16	1.34	0.08	12.18	0.01	93.00
	1124C_SH-2_45-47_2	4.37	2.94	2.18	70.15	0.21	0.18	1.36	0.06	12.36	0.02	93.84
	1124C_SH-2_45-47_3	4.47	2.99	2.17	70.15	0.20	0.16	1.32	0.12	12.55	0.04	94.16
	1124C_SH-2_45-47_4	4.58	2.94	2.41	70.19	0.21	0.16	1.38	0.04	12.49	0.00	94.41
	1124C_SH-2_45-47_5	4.46	2.99	1.88	70.24	0.17	0.07	1.23	0.00	12.26	0.00	93.31
	1124C_SH-2_45-47_6	4.41	2.88	1.92	70.26	0.17	0.10	1.26	0.07	12.31	0.03	93.40
	1124C_SH-2_45-47_7	4.00	3.12	1.88	71.19	0.13	0.05	0.82	0.00	11.77	0.04	93.00
	1124C_SH-2_45-47_8	4.45	3.42	1.59	71.59	0.12	0.05	0.78	0.12	11.49	0.00	93.61
	1124C_SH-2_45-47_9	4.95	2.63	2.65	68.49	0.23	0.22	1.76	0.00	13.07	0.00	94.00
	1124C_SH-2_45-47_10	4.50	3.02	2.37	70.11	0.23	0.16	1.32	0.03	12.65	0.06	94.45
	1124C_SH-2_45-47_11	4.27	3.24	1.64	71.37	0.18	0.09	1.15	0.03	12.60	0.03	94.60
	1124C_SH-2_45-47_12	4.46	3.05	2.05	69.79	0.18	0.10	1.21	0.07	12.22	0.00	93.13
	1124C_SH-2_45-47_13	3.28	4.12	1.58	69.87	0.10	0.07	0.75	0.13	11.51	0.00	91.41
	1124C_SH-2_45-47_14	4.53	2.91	2.23	70.89	0.23	0.16	1.34	0.09	12.72	0.06	95.16
	1124C_SH-2_45-47_15	4.17	2.93	2.28	69.88	0.19	0.19	1.37	0.07	12.58	0.02	93.67
	1124C_SH-2_45-47_16	4.38	3.40	1.65	70.93	0.11	0.06	0.75	0.06	11.57	0.00	92.91
	1124C_SH-2_65-67_1	4.53	2.86	2.46	70.13	0.18	0.16	1.26	0.12	13.03	0.00	94.73
	1124C_SH-2_65-67_2	4.81	2.79	2.04	70.87	0.20	0.11	1.27	0.00	13.29	0.00	95.38
	1124C_SH-2_65-67_3	4.60	2.82	2.28	69.64	0.18	0.13	1.25	0.09	12.92	0.03	93.93
	1124C_SH-2_65-67_4	4.41	2.84	2.09	69.79	0.13	0.11	1.27	0.09	13.06	0.00	93.79
	1124C_SH-2_65-67_5	4.33	2.83	1.98	69.35	0.10	0.17	1.26	0.06	13.07	0.01	93.17
	1124C_SH-2_65-67_6	4.62	2.78	2.33	69.76	0.14	0.17	1.29	0.08	12.99	0.04	94.20
	1124C_SH-2_65-67_7	4.30	2.77	2.33	70.71	0.14	0.17	1.25	0.11	13.14	0.00	94.91
	1124C_SH-2_65-67_8	4.52	2.80	2.03	68.89	0.17	0.09	1.23	0.06	13.16	0.00	92.95
	1124C_SH-2_65-67_9	4.64	2.76	2.09	70.03	0.18	0.14	1.26	0.10	13.01	0.03	94.24
	1124C_SH-2_65-67_10	4.43	2.86	2.33	70.36	0.17	0.14	1.29	0.02	13.07	0.01	94.68
	1124C_SH-2_65-67_11	4.40	2.84	2.20	69.38	0.18	0.10	1.26	0.08	13.09	0.03	93.57
	1124C_SH-2_65-67_12	4.18	2.83	2.19	69.85	0.16	0.13	1.28	0.02	13.22	0.00	93.86
	1124C_SH-2_65-67_13	4.50	2.75	2.27	69.08	0.16	0.09	1.30	0.06	12.93	0.04	93.18
	1124C_SH-2_65-67_14	4.78	2.78	2.13	70.34	0.15	0.12	1.32	0.10	13.07	0.02	94.80
	1124C_SH-2_65-67_15	4.58	2.85	2.28	70.66	0.19	0.10	1.31	0.13	12.93	0.03	95.06
	1124C_SH-2_65-67_16	4.44	3.05	1.87	70.48	0.22	0.12	1.19	0.07	13.05	0.02	94.50
	1124C_SH-2_65-67_17	4.60	2.79	2.16	69.78	0.18	0.12	1.25	0.08	13.17	0.01	94.14
	1124C_SH-2_65-67_18	4.48	2.77	2.12	70.00	0.19	0.16	1.23	0.04	13.00	0.03	94.02
s57	1124C_SH-2_110-112_1	4.18	3.43	1.74	73.24	0.11	0.10	0.90	0.10	12.27	0.02	96.10
	1124C_SH-2_110-112_2	4.40	3.26	1.83	72.23	0.12	0.11	0.98	0.06	12.63	0.05	95.67
	1124C_SH-2_110-112_3	4.25	3.31	1.64	72.13	0.09	0.06	0.86	0.05	12.41	0.04	94.84
	1124C_SH-2_110-112_4	4.45	3.15	1.95	71.41	0.10	0.09	0.97	0.00	12.47	0.03	94.62
	1124C_SH-2_110-112_5	4.76	3.11	1.88	71.23	0.11	0.08	0.98	0.05	12.56	0.02	94.78
	1124C_SH-2_110-112_6	4.58	3.16	2.01	71.27	0.13	0.07	0.99	0.06	12.46	0.05	94.78
	1124C_SH-2_110-112_7	4.26	3.17	1.64	72.13	0.12	0.06	0.86	0.12	12.25	0.00	94.61
	1124C_SH-2_110-112_8	4.99	3.19	2.17	71.03	0.15	0.06	1.20	0.08	12.94	0.00	95.81
	1124C_SH-2_110-112_9	4.52	3.13	1.86	71.92	0.10	0.07	1.02	0.09	12.46	0.02	95.19
	1124C_SH-2_110-112_10	4.21	3.22	1.63	71.96	0.12	0.06	0.87	0.11	12.21	0.02	94.40
	1124C_SH-2_110-112_11	4.50	3.36	1.70	72.24	0.08	0.08	0.93	0.01	12.46	0.02	95.38
	1124C_SH-2_110-112_12	4.47	3.16	1.84	72.19	0.12	0.06	0.98	0.00	12.58	0.00	95.40
	1124C_SH-2_110-112_13	4.34	3.27	1.65	72.10	0.11	0.02	0.93	0.08	12.21	0.04	94.75
	1124C_SH-2_110-112_14	4.57	3.20	1.75	72.36	0.09	0.07	0.92	0.07	12.30	0.00	95.32
	1124C_SH-2_110-112_15	4.43	3.14	1.77	72.22	0.11	0.07	0.97	0.02	12.47	0.05	95.25
	1124C_SH-2_110-112_16	4.64	3.23	1.62	72.53	0.07	0.05	0.86	0.05	12.31	0.04	95.40
	1124C_SH-2_110-112_17	4.57	3.26	1.53	72.47	0.09	0.09	0.89	0.12	12.22	0.01	95.25
	1124C_SH-2_110-112_18	4.37	3.40	1.63	72.58	0.09	0.05	0.88	0.07	12.26	0.01	95.32
	1124C_SH-2_110-112_19	4.32	3.52	1.73	71.18	0.11	0.06	0.83	0.10	12.41	0.00	94.25
	1124C_SH-2_110-112_20	4.49	3.22	1.97	71.61	0.13	0.07	0.96	0.11	12.57	0.00	95.12
	1124C_SH-2_110-112_1	4.17	3.45	1.45	72.05	0.12	0.08	0.88	0.04	11.39	0.03	93.66
	1124C_SH-2_110-112_2	4.11	3.48	1.53	71.87	0.12	0.04	0.86	0.03	11.80	0.01	93.84
	1124C_SH-2_110-112_3	4.30	3.11	1.79	69.73	0.10	0.07	1.01	0.08	12.12	0.00	92.31
	1124C_SH-2_110-112_7	4.53	3.25	1.74	72.56	0.07	0.07	1.04	0.01	12.00	0.04	95.30
	1124C_SH-2_110-112_8	4.04	3.19	1.47	71.69	0.09	0.07	0.90	0.00	11.53	0.00	92.99
	1124C_SH-2_110-112_4	3.77	3.24	1.58	72.34	0.12	0.04	1.00	0.02	12.02	0.01	94.15
	1124C_SH-2_110-112_5	4.17	3.33	1.70	70.61	0.12	0.06	1.04	0.03	12.22	0.03	93.31
	1124C_SH-2_110-112_6	4.10	3.38	1.68	71.73	0.13	0.05	0.94	0.05	11.75	0.02	93.82

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s59	1124C_SH-2_110-112_9	4.24	3.21	1.75	71.11	0.16	0.07	0.99	0.02	11.91	0.01	93.47
	1124C_SH-2_110-112_10	4.09	3.39	1.73	71.59	0.14	0.05	1.02	0.03	12.21	0.00	94.25
	1124C_SH-3_13-15_1	4.17	3.40	1.43	72.00	0.10	0.08	0.92	0.07	11.89	0.01	94.08
	1124C_SH-3_13-15_2	4.23	3.19	1.65	70.31	0.10	0.09	1.01	0.03	11.98	0.01	92.60
	1124C_SH-3_13-15_3	4.38	3.17	1.66	70.74	0.11	0.09	1.01	0.04	12.20	0.04	93.44
	1124C_SH-3_13-15_4	4.42	3.25	1.79	70.87	0.13	0.07	1.07	0.05	11.94	0.02	93.61
	1124C_SH-3_13-15_5	4.37	3.35	1.50	71.10	0.09	0.06	0.89	0.01	12.09	0.00	93.45
	1124C_SH-3_13-15_6	4.32	3.24	1.67	71.11	0.10	0.04	1.04	0.06	12.05	0.00	93.63
	1124C_SH-3_13-15_7	3.88	3.48	1.82	69.72	0.12	0.12	1.11	0.05	12.00	0.02	92.33
	1124C_SH-3_13-15_8	4.09	3.46	1.73	72.05	0.12	0.04	0.90	0.08	12.06	0.00	94.53
	1124C_SH-3_13-15_9	4.38	3.24	1.58	70.70	0.13	0.08	1.02	0.02	11.97	0.01	93.13
	1124C_SH-3_13-15_10	4.24	3.26	1.68	71.47	0.11	0.07	1.04	0.09	12.22	0.02	94.21
	1124C_SH-3_13-15_11	3.94	3.31	1.44	69.57	0.11	0.07	0.91	0.03	11.68	0.01	91.07
	1124C_SH-3_13-15_12	3.91	3.38	1.36	71.80	0.14	0.06	0.88	0.10	11.74	0.02	93.40
	1124C_SH-3_13-15_13	4.26	3.24	1.73	70.98	0.11	0.07	1.05	0.06	12.07	0.03	93.59
	1124C_SH-3_13-15_14	3.96	3.32	1.61	71.19	0.11	0.05	1.00	0.00	11.95	0.01	93.19
	1124C_SH-3_13-15_15	4.39	3.23	1.66	70.35	0.13	0.05	0.93	0.03	11.79	0.00	92.56
	1124C_SH-3_13-15_16	4.34	3.26	1.61	70.57	0.12	0.09	1.03	0.04	12.03	0.07	93.16
	1124C_SH-3_13-15_17	3.81	3.36	1.25	71.13	0.09	0.10	1.07	0.08	12.23	0.00	93.12
	1124C_SH-3_13-15_18	4.41	3.28	1.60	71.35	0.12	0.05	0.88	0.16	11.80	0.01	93.66
s60	1124C_SH-3_13-15_19	4.35	3.19	1.74	70.66	0.11	0.06	1.08	0.06	12.14	0.00	93.40
	1124C_SH-3_13-15_20	4.31	3.33	1.38	71.36	0.10	0.04	0.91	0.09	12.02	0.01	93.56
	1124C_SH-3_107-109_1	4.33	2.91	2.05	69.78	0.25	0.28	1.69	0.00	12.92	0.04	94.25
	1124C_SH-3_107-109_2	4.14	3.01	1.97	70.06	0.22	0.27	1.62	0.08	12.85	0.03	94.26
	1124C_SH-3_107-109_3	4.19	3.20	2.34	69.68	0.26	0.28	1.66	0.03	12.92	0.05	94.61
	1124C_SH-3_107-109_4	3.97	3.15	1.28	71.27	0.12	0.14	1.17	0.05	12.17	0.02	93.34
	1124C_SH-3_107-109_5	4.39	2.96	1.86	69.51	0.27	0.28	1.67	0.06	12.97	0.05	94.02
	1124C_SH-3_107-109_6	4.30	2.97	1.91	70.18	0.20	0.20	1.56	0.04	12.60	0.04	94.00
	1124C_SH-3_107-109_7	4.18	3.07	2.06	69.78	0.27	0.28	1.71	0.03	12.94	0.02	94.34
	1124C_SH-3_107-109_8	4.15	3.01	1.84	70.14	0.24	0.31	1.77	0.00	12.54	0.03	94.02
	1124C_SH-3_107-109_9	4.41	2.93	1.99	70.04	0.27	0.27	1.69	0.09	12.92	0.05	94.65
	1124C_SH-3_107-109_10	4.36	3.05	2.18	69.70	0.23	0.29	1.75	0.05	13.10	0.03	94.74
	1124C_SH-3_107-109_11	4.13	2.95	2.00	70.09	0.29	0.31	1.71	0.10	12.88	0.03	94.49
	1124C_SH-3_107-109_12	4.50	2.88	2.11	70.12	0.25	0.23	1.63	0.01	12.83	0.06	94.63
	1124C_SH-3_107-109_13	4.31	3.00	1.87	70.23	0.23	0.23	1.48	0.09	12.54	0.02	94.00
	1124C_SH-3_107-109_14	4.43	3.03	2.16	70.34	0.24	0.25	1.59	0.12	12.78	0.01	94.95
	1124C_SH-3_107-109_15	3.66	3.18	1.93	68.38	0.25	0.25	1.63	0.06	12.73	0.01	92.09
	1124C_SH-3_107-109_16	4.22	2.83	1.85	70.13	0.25	0.25	1.63	0.07	13.17	0.00	94.39
	1124C_SH-3_107-109_17	4.11	2.98	1.90	69.89	0.28	0.29	1.73	0.05	12.92	0.04	94.19
	1124C_SH-3_107-109_18	3.97	3.10	1.72	70.21	0.27	0.31	1.71	0.03	12.93	0.00	94.25
s61	1124C_SH-3_107-109_19	4.15	3.02	1.99	69.25	0.24	0.27	1.76	0.06	12.98	0.03	93.75
	1124C_SH-3_107-109_20	4.39	2.53	1.80	69.14	0.21	0.21	2.62	0.02	14.33	0.04	95.29
	1124C_SH-3_107-109_2	4.02	2.90	1.91	70.63	0.23	0.26	1.74	0.03	13.68	0.04	95.44
	1124C_SH-3_107-109_4	4.06	3.04	2.17	71.06	0.25	0.26	1.69	0.03	13.21	0.05	95.81
	1124C_SH-3_107-109_7	3.91	2.98	1.94	70.77	0.20	0.23	1.57	0.04	12.78	0.02	94.44
	1124C_SH-3_107-109_8	4.12	3.00	1.84	71.03	0.28	0.30	1.67	0.04	13.26	0.04	95.57
	1124C_SH-3_107-109_9	4.06	2.97	2.07	70.88	0.24	0.31	1.71	0.00	12.87	0.05	95.16
	1124C_SH-3_107-109_5	3.99	3.15	1.85	71.45	0.19	0.23	1.51	0.00	13.26	0.00	95.63
	1124C_SH-3_107-109_6	3.93	3.05	2.11	70.50	0.25	0.27	1.61	0.00	13.37	0.04	95.13
	1124C_SH-4_9-11_1	4.00	3.49	1.33	73.53	0.12	0.11	0.91	0.02	11.27	0.00	94.78
	1124C_SH-4_9-11_2	3.92	3.45	1.22	72.91	0.09	0.10	0.80	0.00	11.51	0.01	94.01
	1124C_SH-4_9-11_3	3.68	3.85	1.19	73.11	0.11	0.08	0.83	0.04	11.35	0.00	94.24
	1124C_SH-4_9-11_4	3.94	3.42	1.05	73.48	0.12	0.07	0.85	0.00	11.30	0.00	94.23
	1124C_SH-4_9-11_5	3.67	3.47	1.28	73.72	0.08	0.09	0.91	0.06	11.15	0.00	94.43
	1124C_SH-4_9-11_6	3.81	3.74	1.24	73.30	0.11	0.05	0.82	0.00	11.63	0.08	94.79
	1124C_SH-4_9-11_7	3.89	3.74	1.22	73.82	0.11	0.07	0.89	0.03	11.41	0.04	95.22
	1124C_SH-4_9-11_8	3.65	3.61	1.34	73.90	0.12	0.08	0.95	0.00	11.26	0.01	94.92
	1124C_SH-4_9-11_9	3.65	3.43	1.18	72.03	0.11	0.14	0.91	0.02	11.60	0.00	93.07
	1124C_SH-4_9-11_10	4.07	3.42	1.25	73.74	0.12	0.05	0.95	0.00	11.36	0.00	94.95
	1124C_SH-4_9-11_11	3.78	3.79	1.29	72.49	0.12	0.08	0.81	0.00	11.46	0.02	93.83
	1124C_SH-4_9-11_12	3.66	3.73	1.31	71.69	0.10	0.07	0.73	0.03	11.49	0.00	92.80
	1124C_SH-4_9-11_13	3.93	3.44	1.14	72.72	0.14	0.08	0.95	0.05	11.44	0.00	93.88
	1124C_SH-4_9-11_14	4.00	3.66	1.17	73.19	0.13	0.06	0.92	0.00	11.34	0.00	94.46
	1124C_SH-4_9-11_15	3.74	3.58	1.25	73.68	0.18	0.09	0.92	0.03	11.39	0.03	94.89
	1124C_SH-4_9-11_16	3.74	3.55	1.15	73.76	0.11	0.12	0.93	0.01	11.48	0.03	94.88
	1124C_SH-4_9-11_17	3.77	3.62	1.16	73.28	0.13	0.05	0.82	0.06	11.60	0.00	94.50
	1124C_SH-4_9-11_18	3.93	3.51	1.23	73.60	0.12	0.07	0.83	0.08	11.25	0.01	94.62
	1124C_SH-4_9-11_19	3.78	3.52	1.10	73.59	0.13	0.09	0.94	0.07	11.02	0.03	94.27
	1124C_SH-4_9-11_20	3.95	3.27	1.11	73.49	0.12	0.09	0.92	0.03	11.33	0.01	94.32
	1124C_SH-4_9-11_1	3.43	3.69	1.38	72.17	0.14	0.14	0.96	0.09	11.73	0.00	93.73

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s64	1124C_SH-4_9-11_2	3.52	3.62	0.91	71.33	0.11	0.08	0.83	0.00	11.76	0.00	92.16
	1124C_SH-4_9-11_3	3.41	3.80	1.28	70.76	0.09	0.09	0.82	0.01	12.06	0.01	92.32
	1124C_SH-4_9-11_6	3.52	3.84	1.29	72.49	0.11	0.10	0.81	0.07	11.84	0.00	94.07
	1124C_SH-4_9-11_9	3.59	3.56	1.39	71.97	0.14	0.11	0.91	0.05	11.72	0.00	93.45
	1124C_SH-4_9-11_4	3.75	3.79	1.07	72.55	0.13	0.09	0.82	0.03	11.60	0.00	93.84
	1124C_SH-4_9-11_5	3.84	3.61	1.35	72.78	0.12	0.12	0.94	0.00	11.74	0.00	94.50
	1124C_SH-4_9-11_8	3.64	3.60	1.44	73.17	0.09	0.12	0.91	0.05	11.83	0.01	94.87
	1124C_SH-4_9-11_10	3.51	3.34	1.25	71.55	0.11	0.10	0.90	0.07	11.17	0.00	92.00
	1124C_SH-6_50-52_1	4.84	3.29	2.33	71.72	0.15	0.06	1.03	0.03	12.52	0.02	95.98
	1124C_SH-6_50-52_2	4.64	3.20	1.93	70.60	0.16	0.08	0.98	0.07	12.41	0.02	94.09
	1124C_SH-6_50-52_3	4.54	3.12	1.94	71.41	0.12	0.05	1.03	0.04	12.43	0.02	94.71
	1124C_SH-6_50-52_4	4.87	3.23	2.25	71.66	0.14	0.10	0.98	0.09	12.69	0.06	96.07
	1124C_SH-6_50-52_5	4.55	3.17	2.20	71.22	0.15	0.10	0.99	0.08	12.23	0.00	94.70
	1124C_SH-6_50-52_6	4.77	3.02	2.03	70.82	0.16	0.11	0.99	0.08	12.08	0.01	94.06
	1124C_SH-6_50-52_7	4.64	3.12	2.11	70.80	0.16	0.04	1.00	0.10	12.33	0.01	94.30
	1124C_SH-6_50-52_8	4.85	3.01	2.16	70.50	0.13	0.08	0.99	0.05	12.28	0.01	94.05
	1124C_SH-6_50-52_9	4.38	3.15	1.99	70.60	0.16	0.10	0.98	0.12	12.52	0.02	94.03
	1124C_SH-6_50-52_10	4.62	3.28	2.01	71.33	0.18	0.05	1.07	0.03	12.53	0.00	95.09
	1124C_SH-6_50-52_11	4.78	3.10	2.11	70.56	0.15	0.09	1.06	0.14	12.20	0.01	94.22
	1124C_SH-6_50-52_12	4.36	3.17	2.03	70.39	0.18	0.02	1.00	0.10	12.20	0.03	93.48
	1124C_SH-6_50-52_13	4.83	3.16	2.07	71.18	0.15	0.05	1.03	0.04	12.40	0.02	94.93
	1124C_SH-6_50-52_14	4.73	3.26	2.10	71.19	0.14	0.08	1.00	0.08	12.59	0.01	95.19
	1124C_SH-6_50-52_15	4.61	3.27	2.07	71.25	0.15	0.06	1.01	0.12	12.42	0.00	94.97
	1124C_SH-6_50-52_16	4.52	3.09	1.98	71.37	0.15	0.05	1.00	0.06	12.63	0.02	94.88
	1124C_SH-6_50-52_17	3.18	3.06	2.07	71.45	0.14	0.07	0.95	0.09	12.27	0.06	93.34
	1124C_SH-6_50-52_18	4.58	3.17	2.21	69.98	0.13	0.08	0.98	0.04	12.22	0.02	93.41
	1124C_SH-6_50-52_19	4.53	3.19	1.94	70.92	0.15	0.08	1.00	0.08	12.25	0.00	94.14
	1124C_SH-6_50-52_20	4.72	3.09	2.02	70.10	0.16	0.05	0.98	0.06	12.18	0.00	93.37
	1124C_SH-6_57-59_1	4.93	3.23	1.95	71.02	0.14	0.08	1.02	0.06	12.69	0.00	95.12
	1124C_SH-6_57-59_2	5.01	3.09	2.19	70.97	0.14	0.08	1.01	0.03	12.50	0.03	95.05
	1124C_SH-6_57-59_4	4.87	3.22	2.13	71.02	0.15	0.11	1.02	0.07	12.56	0.00	95.15
	1124C_SH-6_57-59_5	4.96	3.38	2.09	71.13	0.14	0.04	1.00	0.06	12.51	0.02	95.33
	1124C_SH-6_57-59_6	4.95	3.39	2.28	71.24	0.16	0.11	1.02	0.14	12.60	0.06	95.94
	1124C_SH-6_57-59_7	4.87	3.26	1.99	70.89	0.16	0.09	0.99	0.08	12.69	0.00	95.02
	1124C_SH-6_57-59_8	4.84	3.22	2.14	71.66	0.14	0.07	0.99	0.06	12.65	0.03	95.80
	1124C_SH-6_57-59_9	4.88	3.23	2.19	70.97	0.15	0.13	0.98	0.10	12.52	0.04	95.20
	1124C_SH-6_57-59_10	4.85	3.17	2.18	71.48	0.15	0.10	1.00	0.08	12.50	0.02	95.53
	1124C_SH-6_57-59_11	4.76	3.18	2.14	70.97	0.17	0.07	0.99	0.04	12.69	0.00	95.01
	1124C_SH-6_57-59_12	4.60	3.40	2.13	71.93	0.14	0.10	1.01	0.07	12.66	0.00	96.04
	1124C_SH-6_57-59_13	4.83	3.02	2.37	71.44	0.13	0.07	0.97	0.15	12.47	0.02	95.47
	1124C_SH-6_57-59_14	4.50	3.24	2.30	70.59	0.14	0.07	1.03	0.05	12.58	0.01	94.51
	1124C_SH-6_57-59_15	4.65	3.24	2.29	71.85	0.14	0.10	1.01	0.11	12.86	0.00	96.25
	1124C_SH-6_57-59_16	4.94	3.28	2.41	71.47	0.13	0.09	0.94	0.05	12.68	0.01	96.01
	1124C_SH-6_57-59_17	4.94	3.28	2.12	70.54	0.15	0.12	1.01	0.10	12.51	0.02	94.79
	1124C_SH-6_57-59_18	4.84	3.29	2.15	71.57	0.15	0.07	1.01	0.02	12.74	0.04	95.88
	1124C_SH-6_57-59_20	4.84	3.05	2.43	70.97	0.16	0.08	1.04	0.04	12.62	0.02	95.24
	1124C_SH-6_57-59_5	4.73	3.18	2.35	70.84	0.23	0.08	1.02	0.14	12.67	0.04	95.28
	1124C_SH-6_57-59_5	4.34	3.09	2.39	68.10	0.23	0.09	1.23	0.10	12.79	0.02	92.39
	1124C_SH-6_57-59_8	4.61	3.03	2.20	70.30	0.20	0.07	0.99	0.11	12.40	0.00	93.91
	1124C_SH-6_57-59_9	4.01	3.64	2.03	69.15	0.21	0.05	0.87	0.11	12.33	0.00	92.41
	1124C_SH-6_57-59_10	4.37	3.10	2.15	70.57	0.21	0.09	1.09	0.11	12.52	0.03	94.23
	1124C_SH-6_57-59_2	4.32	3.41	1.97	70.84	0.20	0.11	1.02	0.16	12.86	0.02	94.91
	1124C_SH-6_57-59_3	4.24	2.97	1.96	70.91	0.22	0.07	1.02	0.05	12.38	0.00	93.83
	1124C_SH-6_57-59_4	4.34	3.33	2.39	70.79	0.23	0.06	1.04	0.05	12.72	0.01	94.96
	1124C_SH-6_57-59_6	4.34	3.11	2.09	68.69	0.21	0.08	0.96	0.04	12.43	0.03	91.98
	1124C_SH-6_57-59_7	4.34	3.03	2.05	70.17	0.24	0.09	0.99	0.07	12.45	0.02	93.46
s66*	1124C_SH-6_131-133_1	4.89	2.97	2.16	70.29	0.16	0.12	1.08	0.08	12.66	0.00	94.42
	1124C_SH-6_131-133_2	4.73	3.15	2.47	69.58	0.19	0.18	1.13	0.14	12.62	0.04	94.24
	1124C_SH-6_131-133_3	4.96	3.15	2.21	70.80	0.13	0.12	1.05	0.09	12.73	0.05	95.31
	1124C_SH-6_131-133_4	4.65	3.08	2.31	70.35	0.15	0.11	1.05	0.03	12.65	0.00	94.39
	1124C_SH-6_131-133_5	5.07	2.96	2.22	70.81	0.19	0.11	1.08	0.04	12.78	0.05	95.30
	1124C_SH-6_131-133_6	5.03	2.98	2.31	69.98	0.19	0.15	1.12	0.10	12.54	0.03	94.42
	1124C_SH-6_131-133_7	4.86	3.08	2.24	70.84	0.14	0.09	0.98	0.14	12.43	0.00	94.80
	1124C_SH-6_131-133_8	5.07	3.18	2.11	71.42	0.14	0.11	0.98	0.05	12.45	0.04	95.55
	1124C_SH-6_131-133_9	4.97	3.03	2.45	69.70	0.24	0.20	1.22	0.14	12.71	0.02	94.68
	1124C_SH-6_131-133_10	5.26	3.00	2.26	70.68	0.17	0.11	1.07	0.04	12.80	0.03	95.41
	1124C_SH-6_131-133_11	5.15	3.01	2.56	67.99	0.29	0.18	1.33	0.12	12.59	0.08	93.30
	1124C_SH-6_131-133_12	3.24	3.33	2.10	70.38	0.13	0.07	0.94	0.09	12.39	0.03	92.71
	1124C_SH-6_131-133_13	5.14	2.96	2.33	70.23	0.15	0.15	1.06	0.07	12.47	0.03	94.60
	1124C_SH-6_131-133_14	5.02	2.96	2.24	69.99	0.19	0.10	1.14	0.11	12.70	0.00	94.46

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s67*	1124C_SH-6_131-133_15	5.03	3.07	2.28	69.94	0.18	0.12	1.08	0.11	12.64	0.00	94.45
	1124C_SH-6_131-133_16	4.86	2.93	2.55	69.19	0.18	0.14	1.34	0.10	12.89	0.05	94.24
	1124C_SH-6_131-133_17	4.74	3.07	2.39	69.69	0.18	0.14	1.33	0.07	13.10	0.04	94.75
	1124C_SH-6_131-133_19	4.86	2.95	2.12	70.12	0.18	0.13	1.04	0.16	12.63	0.05	94.23
	1124C_SH-6_131-133_20	4.64	3.15	2.41	71.56	0.14	0.08	1.03	0.04	12.85	0.02	95.93
	1124C_SH-6_131-133_1	4.62	3.06	2.14	71.12	0.17	0.11	1.14	0.09	12.89	0.01	95.35
	1124C_SH-6_131-133_2	4.39	2.95	2.13	69.90	0.17	0.12	1.04	0.11	12.61	0.04	93.46
	1124C_SH-6_131-133_3	4.58	3.00	2.34	71.47	0.20	0.07	1.12	0.06	12.86	0.00	95.71
	1124C_SH-6_131-133_4	4.53	3.04	2.06	70.43	0.16	0.13	1.13	0.03	12.88	0.00	94.39
	1124C_SH-6_131-133_8	4.29	3.05	2.09	71.30	0.17	0.10	1.15	0.09	12.98	0.01	95.22
	1124C_SH-6_131-133_5	4.33	3.21	2.20	71.62	0.13	0.06	0.94	0.11	12.63	0.04	95.26
	1124C_SH-6_131-133_6	4.73	3.09	2.15	71.39	0.18	0.07	1.15	0.03	13.27	0.00	96.06
	1124C_SH-6_131-133_7	4.24	3.07	2.21	71.00	0.16	0.11	1.10	0.13	12.97	0.02	95.01
	1124C_SH-6_131-133_9	4.66	3.09	2.33	71.44	0.16	0.11	1.12	0.12	13.52	0.02	96.58
	1124C_SH-6_131-133_10	4.50	3.21	2.18	71.42	0.20	0.10	1.13	0.04	13.18	0.00	95.97
	1124C_SH-7_60-62_1	3.64	3.51	1.20	72.20	0.06	0.01	0.80	0.04	11.57	0.00	93.03
	1124C_SH-7_60-62_2	3.97	3.45	1.17	72.72	0.04	0.07	0.80	0.00	11.87	0.00	94.09
	1124C_SH-7_60-62_4	3.97	3.21	1.14	71.23	0.05	0.06	0.87	0.06	11.55	0.00	92.14
	1124C_SH-7_60-62_5	3.90	3.41	1.31	71.82	0.07	0.04	0.88	0.00	11.58	0.01	93.03
	1124C_SH-7_60-62_6	3.76	3.44	1.25	72.37	0.08	0.03	0.91	0.00	11.62	0.00	93.46
	1124C_SH-7_60-62_7	3.75	3.34	1.07	72.86	0.07	0.02	0.89	0.08	11.95	0.02	94.05
	1124C_SH-7_60-62_8	3.93	3.43	1.12	72.80	0.06	0.00	0.83	0.03	11.77	0.02	93.99
	1124C_SH-7_60-62_9	3.89	3.44	1.11	73.36	0.07	0.03	0.80	0.00	11.84	0.01	94.55
	1124C_SH-7_60-62_10	3.92	3.27	1.26	72.12	0.06	0.05	0.91	0.02	11.94	0.00	93.55
	1124C_SH-7_60-62_11	4.65	3.19	1.75	70.19	0.17	0.07	0.93	0.07	12.60	0.03	93.65
	1124C_SH-7_60-62_12	3.84	3.40	1.23	72.80	0.08	0.05	0.85	0.05	11.80	0.00	94.10
	1124C_SH-7_60-62_13	4.15	3.38	1.02	72.75	0.05	0.03	0.85	0.04	11.90	0.02	94.18
	1124C_SH-7_60-62_14	3.80	3.25	1.28	72.88	0.04	0.03	0.84	0.05	11.75	0.00	93.91
	1124C_SH-7_60-62_15	3.69	3.57	1.07	72.87	0.08	0.04	0.78	0.04	11.65	0.00	93.79
	1124C_SH-7_60-62_17	3.98	3.54	1.27	72.16	0.05	0.02	0.88	0.07	11.83	0.05	93.85
	1124C_SH-7_60-62_18	3.73	3.42	1.38	72.60	0.10	0.03	0.93	0.01	11.81	0.00	94.01
	1124C_SH-7_60-62_19	3.85	3.31	1.32	70.74	0.05	0.06	0.89	0.01	11.85	0.00	92.08
	1124C_SH-7_60-62_20	3.98	3.34	1.32	71.04	0.06	0.02	0.90	0.11	11.92	0.02	92.70
	1124C_SH-7_60-62_6	3.79	3.42	1.03	73.99	0.06	0.05	0.83	0.00	11.82	0.03	95.01
	1124C_SH-7_60-62_8	3.41	3.61	1.17	72.99	0.06	0.04	0.81	0.03	11.73	0.00	93.86
	1124C_SH-7_60-62_9	3.68	3.55	1.14	73.18	0.05	0.05	0.77	0.00	11.99	0.00	94.40
	1124C_SH-7_60-62_10	3.54	3.53	1.11	73.95	0.03	0.04	0.82	0.04	12.18	0.02	95.26
	1124C_SH-7_60-62_1	3.55	3.33	1.26	72.40	0.02	0.00	0.90	0.05	11.93	0.02	93.46
s68	1124C_SH-7_60-62_4	3.58	3.41	1.26	73.86	0.06	0.03	0.91	0.04	11.92	0.00	95.06
	1124C_SH-7_60-62_7	3.64	3.39	1.19	73.62	0.05	0.03	0.86	0.02	11.98	0.02	94.81
	1124C_SH-CC-10-12_1	4.21	3.30	1.95	69.90	0.15	0.11	1.03	0.10	12.75	0.03	93.52
	1124C_SH-CC-10-12_2	4.38	3.19	2.10	69.94	0.15	0.10	0.98	0.00	12.94	0.03	93.81
	1124C_SH-CC-10-12_3	4.45	3.34	2.08	70.79	0.13	0.09	1.02	0.04	12.99	0.02	94.96
	1124C_SH-CC-10-12_4	4.53	3.27	1.84	70.40	0.14	0.10	0.93	0.02	12.82	0.04	94.09
	1124C_SH-CC-10-12_5	4.37	3.20	2.03	69.94	0.16	0.07	1.05	0.07	12.79	0.04	93.71
	1124C_SH-CC-10-12_6	4.49	3.19	1.89	69.93	0.14	0.10	0.97	0.04	12.91	0.00	93.66
	1124C_SH-CC-10-12_7	4.46	3.20	2.05	70.54	0.13	0.06	1.05	0.02	12.94	0.02	94.48
	1124C_SH-CC-10-12_8	4.44	3.19	1.98	71.44	0.14	0.09	1.05	0.08	12.99	0.01	95.40
	1124C_SH-CC-10-12_9	4.60	3.08	2.06	70.14	0.13	0.08	1.00	0.11	12.56	0.03	93.79
	1124C_SH-CC-10-12_10	4.24	3.35	2.00	71.94	0.16	0.08	1.05	0.07	12.93	0.02	95.84
	1124C_SH-CC-10-12_11	4.44	3.26	1.89	70.80	0.14	0.08	1.03	0.07	12.96	0.02	94.69
	1124C_SH-CC-10-12_12	4.57	3.25	1.88	70.59	0.14	0.13	1.02	0.07	12.78	0.04	94.46
	1124C_SH-CC-10-12_13	4.41	3.21	2.01	70.62	0.15	0.10	1.00	0.13	12.84	0.01	94.50
	1124C_SH-CC-10-12_14	4.51	3.22	2.07	70.07	0.14	0.04	0.99	0.00	12.71	0.01	93.75
	1124C_SH-CC-10-12_15	4.44	3.15	1.96	70.82	0.13	0.08	1.05	0.05	12.88	0.00	94.56
	1124C_SH-CC-10-12_16	4.66	3.21	2.17	69.02	0.16	0.10	1.02	0.09	12.81	0.00	93.24
	1124C_SH-CC-10-12_17	4.68	3.19	1.93	69.90	0.12	0.07	1.02	0.02	12.81	0.00	93.74
	1124C_SH-CC-10-12_18	4.50	3.26	2.05	70.10	0.14	0.09	1.01	0.07	12.65	0.01	93.87
	1124C_SH-CC-10-12_19	4.75	3.08	1.96	69.07	0.19	0.10	1.00	0.15	12.73	0.00	93.04
s69	1124C_SH-CC-10-12_20	4.62	3.23	1.83	71.45	0.14	0.06	1.01	0.10	12.84	0.02	95.29
	1124C_6H-1_26-28_1	3.39	3.84	0.91	74.22	0.02	0.06	0.88	0.12	12.34	0.02	95.80
	1124C_6H-1_26-28_2	3.66	3.72	0.94	73.64	0.05	0.05	0.88	0.06	12.19	0.00	95.18
	1124C_6H-1_26-28_3	3.37	4.21	0.90	73.90	0.06	0.04	0.61	0.01	12.49	0.02	95.60
	1124C_6H-1_26-28_4	3.54	4.16	0.93	74.18	0.02	0.04	0.64	0.00	12.46	0.02	96.00
	1124C_6H-1_26-28_5	3.51	3.75	0.88	74.03	0.03	0.04	0.87	0.06	12.33	0.01	95.51
	1124C_6H-1_26-28_6	3.45	3.83	0.97	73.99	0.05	0.03	0.89	0.00	12.35	0.01	95.57
	1124C_6H-1_26-28_7	3.75	3.28	1.12	74.20	0.08	0.08	1.09	0.00	12.43	0.01	96.05
	1124C_6H-1_26-28_8	3.59	4.18	0.82	74.08	0.02	0.03	0.64	0.09	12.40	0.04	95.88
	1124C_6H-1_26-28_9	3.51	4.13	0.78	74.25	0.03	0.01	0.68	0.06	12.18	0.00	95.64
	1124C_6H-1_26-28_10	3.60	3.83	0.96	74.62	0.06	0.07	0.89	0.04	12.49	0.00	96.55

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s71*	1124C_6H-1_26-28_11	3.60	4.04	0.85	73.43	0.02	0.04	0.67	0.00	12.33	0.00	94.97
	1124C_6H-1_26-28_12	3.70	4.16	0.96	73.09	0.00	0.00	0.62	0.00	12.19	0.00	94.72
	1124C_6H-1_26-28_13	3.42	3.30	1.03	73.72	0.05	0.09	1.03	0.03	12.09	0.00	94.76
	1124C_6H-1_26-28_14	3.49	3.47	1.12	73.83	0.06	0.06	1.03	0.03	12.09	0.01	95.19
	1124C_6H-1_26-28_15	3.37	3.71	0.81	72.69	0.02	0.05	0.88	0.02	12.17	0.00	93.72
	1124C_6H-1_26-28_16	3.43	3.81	0.91	73.80	0.03	0.07	0.88	0.08	12.03	0.02	95.06
	1124C_6H-1_26-28_17	3.66	4.00	0.90	74.00	0.05	0.04	0.72	0.07	12.19	0.03	95.65
	1124C_6H-1_26-28_18	3.39	3.61	0.81	72.60	0.02	0.04	0.85	0.05	12.16	0.00	93.51
	1124C_6H-1_26-28_19	3.51	4.10	0.75	73.07	0.02	0.02	0.63	0.02	12.05	0.02	94.19
	1124C_6H-1_26-28_20	3.64	3.70	1.02	72.85	0.04	0.05	0.87	0.04	12.10	0.03	94.35
	1124C_6H-1_26-28_2	3.35	4.31	0.87	73.47	0.01	0.04	0.64	0.04	11.86	0.00	94.58
	1124C_6H-1_26-28_7	3.45	3.34	1.17	72.27	0.08	0.04	1.05	0.00	11.82	0.02	93.23
	1124C_6H-1_26-28_8	3.51	4.23	0.99	73.44	0.03	0.03	0.67	0.07	11.99	0.00	94.96
	1124C_6H-1_26-28_9	3.26	3.32	1.20	72.65	0.06	0.07	1.06	0.03	11.89	0.02	93.56
	1124C_6H-1_26-28_10	3.34	4.08	0.78	72.61	0.01	0.04	0.70	0.02	11.94	0.01	93.52
	1124C_6H-1_26-28_1	3.45	4.21	0.88	73.83	0.06	0.02	0.61	0.05	11.86	0.00	94.97
	1124C_6H-1_26-28_3	3.47	3.96	0.81	73.33	0.03	0.03	0.85	0.06	11.82	0.00	94.36
	1124C_6H-1_26-28_4	3.61	3.89	1.05	73.99	0.04	0.04	0.84	0.05	12.14	0.01	95.66
	1124C_6H-1_26-28_5	3.53	3.80	1.09	74.02	0.07	0.08	1.02	0.04	12.25	0.04	95.94
	1124C_6H-1_26-28_6	3.34	3.76	0.97	73.73	0.04	0.06	0.86	0.08	12.12	0.01	94.97
	1124C_6H-1_37-39_1	4.49	3.27	2.03	71.20	0.17	0.06	1.11	0.03	12.30	0.01	94.68
	1124C_6H-1_37-39_2	4.60	3.20	2.12	70.93	0.17	0.04	1.04	0.18	12.39	0.02	94.69
	1124C_6H-1_37-39_3	4.57	3.41	1.90	71.14	0.17	0.09	0.92	0.11	12.02	0.01	94.34
	1124C_6H-1_37-39_4	4.10	3.70	1.47	72.45	0.10	0.08	0.71	0.12	11.83	0.04	94.61
	1124C_6H-1_37-39_5	4.84	3.11	2.08	71.06	0.16	0.09	1.07	0.08	12.62	0.00	95.11
	1124C_6H-1_37-39_6	4.28	3.28	1.99	71.43	0.18	0.06	0.99	0.10	12.40	0.00	94.70
	1124C_6H-1_37-39_7	3.91	3.47	1.36	73.38	0.07	0.00	0.85	0.06	11.61	0.06	94.78
	1124C_6H-1_37-39_8	4.59	3.13	2.10	70.19	0.15	0.10	1.02	0.01	12.52	0.01	93.82
	1124C_6H-1_37-39_9	4.08	3.52	1.47	72.50	0.10	0.07	0.69	0.10	11.67	0.00	94.21
	1124C_6H-1_37-39_10	4.67	3.23	2.01	70.94	0.14	0.06	0.97	0.00	12.35	0.00	94.37
	1124C_6H-1_37-39_11	4.29	3.22	1.86	71.10	0.11	0.04	1.04	0.03	12.45	0.02	94.17
	1124C_6H-1_37-39_12	4.03	3.71	1.32	74.02	0.10	0.05	0.68	0.07	11.68	0.00	95.65
	1124C_6H-1_37-39_13	3.34	3.08	2.16	71.14	0.16	0.04	1.02	0.05	12.22	0.05	93.26
	1124C_6H-1_37-39_14	3.48	3.52	1.45	72.82	0.08	0.02	0.70	0.03	11.72	0.02	93.84
	1124C_6H-1_37-39_15	4.80	3.29	2.16	71.79	0.17	0.06	1.04	0.10	12.67	0.05	96.12
	1124C_6H-1_37-39_16	3.45	3.19	2.03	70.21	0.17	0.09	1.01	0.07	12.37	0.00	92.59
	1124C_6H-1_37-39_5	4.17	3.20	1.91	70.28	0.14	0.11	1.04	0.09	12.69	0.02	93.64
	1124C_6H-1_37-39_6	4.22	3.51	2.00	72.32	0.14	0.09	0.92	0.06	12.44	0.00	95.70
	1124C_6H-1_37-39_9	4.44	3.36	1.89	71.53	0.15	0.06	0.94	0.12	13.08	0.00	95.56
	1124C_6H-1_37-39_10	4.17	3.45	1.88	70.39	0.15	0.08	1.01	0.06	12.72	0.00	93.91
	1124C_6H-1_37-39_1	3.84	3.73	1.61	73.02	0.08	0.04	0.70	0.00	12.24	0.05	95.31
	1124C_6H-1_37-39_3	3.88	3.63	1.36	72.75	0.10	0.03	0.68	0.04	12.06	0.01	94.54
	1124C_6H-1_37-39_7	4.13	3.66	1.47	72.45	0.11	0.06	0.74	0.11	12.09	0.00	94.82
	1124C_6H-1_37-39_8	3.80	3.44	1.53	71.48	0.10	0.06	0.82	0.09	12.09	0.02	93.43
	1124C_6H-1_37-39_2	4.16	3.40	1.99	70.53	0.13	0.10	1.04	0.07	13.24	0.02	94.69
u53	1124C_6H-1_37-39_4	3.98	3.38	1.96	71.65	0.14	0.07	0.96	0.04	12.41	0.01	94.61
	1124C_6H-1_118-120_1	4.62	3.43	1.94	72.51	0.15	0.11	0.99	0.09	12.65	0.01	96.51
	1124C_6H-1_118-120_2	4.53	3.38	1.96	71.36	0.15	0.07	1.04	0.03	12.49	0.02	95.03
	1124C_6H-1_118-120_3	4.32	3.43	1.95	71.96	0.16	0.14	1.05	0.06	12.69	0.00	95.75
	1124C_6H-1_118-120_5	4.25	3.69	2.19	72.17	0.16	0.09	1.07	0.09	12.59	0.01	96.30
	1124C_6H-1_118-120_6	4.45	3.46	2.10	72.04	0.15	0.12	1.01	0.06	12.54	0.01	95.95
	1124C_6H-1_118-120_7	4.84	3.34	2.07	71.61	0.15	0.10	0.98	0.10	12.58	0.03	95.80
	1124C_6H-1_118-120_8	4.37	3.49	2.15	71.57	0.14	0.11	1.00	0.03	12.50	0.01	95.37
	1124C_6H-1_118-120_9	4.50	3.52	2.09	72.48	0.15	0.09	1.02	0.02	12.79	0.04	96.71
	1124C_6H-1_118-120_10	4.45	3.39	1.95	71.67	0.13	0.09	1.01	0.03	12.54	0.00	95.26
	1124C_6H-1_118-120_11	4.69	3.46	2.05	71.59	0.14	0.06	0.99	0.09	12.45	0.00	95.53
	1124C_6H-1_118-120_12	4.36	3.40	1.98	71.67	0.16	0.10	1.04	0.09	12.49	0.00	95.29
	1124C_6H-1_118-120_13	4.73	3.43	2.20	71.25	0.10	0.10	0.99	0.07	12.51	0.00	95.39
	1124C_6H-1_118-120_14	4.70	3.43	2.11	71.87	0.17	0.08	0.98	0.03	12.30	0.00	95.66
	1124C_6H-1_118-120_15	4.44	3.42	1.99	71.52	0.14	0.08	0.99	0.01	12.60	0.02	95.19
	1124C_6H-1_118-120_16	4.65	3.49	2.17	72.04	0.15	0.09	1.04	0.06	12.48	0.00	96.17
	1124C_6H-1_118-120_17	4.76	3.47	2.09	72.64	0.15	0.09	1.00	0.00	12.76	0.00	96.96
	1124C_6H-1_118-120_18	4.92	3.46	1.99	72.55	0.18	0.12	1.01	0.09	12.75	0.00	97.07
	1124C_6H-1_118-120_19	4.45	3.50	2.17	72.95	0.16	0.09	1.02	0.09	12.76	0.00	97.19
	1124C_6H-1_118-120_20	4.30	3.37	2.27	71.99	0.18	0.13	1.05	0.03	13.07	0.03	96.43
s76*	1124C_6H-1_118-120_2	4.07	3.27	1.73	68.84	0.16	0.10	0.96	0.02	12.71	0.00	91.86
	1124C_6H-1_118-120_8	4.14	3.48	2.00	71.83	0.18	0.06	1.01	0.07	12.71	0.04	95.52
	1124C_6H-1_118-120_11	4.15	3.41	2.04	70.23	0.14	0.10	1.00	0.09	12.77	0.00	93.93
	1124C_6H-2_27-29_1	4.37	3.47	1.61	71.21	0.15	0.06	0.93	0.12	12.49	0.02	94.43
	1124C_6H-2_27-29_2	4.43	3.38	2.06	71.61	0.16	0.06	0.97	0.07	12.73	0.06	95.52

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1124C_6H-2_27-29_3	4.83	3.34	2.19	70.93	0.15	0.14	1.25	0.11	13.05	0.05	96.04
	1124C_6H-2_27-29_4	4.57	3.30	2.22	70.89	0.18	0.09	1.24	0.02	12.73	0.01	95.26
	1124C_6H-2_27-29_5	4.72	3.31	2.28	70.24	0.17	0.11	1.22	0.13	12.87	0.01	95.05
	1124C_6H-2_27-29_6	4.84	3.10	2.14	70.47	0.16	0.15	1.22	0.07	13.05	0.00	95.21
	1124C_6H-2_27-29_7	4.53	3.26	2.17	70.12	0.17	0.12	1.23	0.09	12.82	0.05	94.57
	1124C_6H-2_27-29_8	4.47	3.48	1.84	71.28	0.12	0.07	0.90	0.07	12.61	0.01	94.84
	1124C_6H-2_27-29_9	4.68	3.36	1.78	71.63	0.13	0.07	0.94	0.05	12.34	0.00	94.97
	1124C_6H-2_27-29_10	4.56	3.29	2.11	70.64	0.15	0.12	1.19	0.05	12.83	0.04	94.97
	1124C_6H-2_27-29_11	4.47	3.30	1.98	70.63	0.15	0.10	1.07	0.03	12.53	0.00	94.26
	1124C_6H-2_27-29_12	4.44	3.26	2.22	70.77	0.17	0.15	1.28	0.08	12.87	0.03	95.26
	1124C_6H-2_27-29_13	4.44	3.28	2.07	70.54	0.15	0.10	1.21	0.03	12.94	0.03	94.79
	1124C_6H-2_27-29_14	4.40	3.46	1.67	71.67	0.12	0.03	0.91	0.09	12.30	0.01	94.66
	1124C_6H-2_27-29_15	4.56	3.31	2.23	70.18	0.19	0.15	1.22	0.02	12.84	0.06	94.75
	1124C_6H-2_27-29_16	4.39	3.32	1.84	70.67	0.13	0.10	1.05	0.12	12.80	0.02	94.44
	1124C_6H-2_27-29_17	4.61	3.23	2.22	69.99	0.17	0.10	1.24	0.11	12.83	0.04	94.53
	1124C_6H-2_27-29_18	4.25	3.46	1.81	71.43	0.14	0.08	0.92	0.05	12.46	0.00	94.60
	1124C_6H-2_27-29_19	4.66	3.13	2.25	70.36	0.14	0.09	1.20	0.05	12.84	0.03	94.75
	1124C_6H-2_27-29_20	4.36	3.54	1.74	71.53	0.13	0.06	0.97	0.05	12.57	0.04	95.00
	1124C_6H-2_27-29_1	4.40	3.37	2.06	71.10	0.15	0.12	1.07	0.03	13.09	0.03	95.42
	1124C_6H-2_27-29_4	4.21	3.39	2.33	70.58	0.18	0.12	1.19	0.06	13.08	0.00	95.14
	1124C_6H-2_27-29_7	4.23	3.43	2.00	70.61	0.16	0.13	1.23	0.06	13.10	0.02	94.97
	1124C_6H-2_27-29_8	4.39	3.52	2.03	72.13	0.13	0.10	1.06	0.10	13.20	0.01	96.67
	1124C_6H-2_27-29_6	4.23	3.40	1.84	71.87	0.12	0.08	0.90	0.06	12.89	0.05	95.43
	1124C_6H-2_27-29_2	4.33	3.42	1.85	71.42	0.17	0.12	0.95	0.09	13.05	0.00	95.40
	1124C_6H-2_27-29_5	4.22	3.56	1.79	71.98	0.16	0.12	0.94	0.10	12.84	0.03	95.75
	1124C_6H-2_27-29_9	4.32	3.51	1.75	71.91	0.15	0.07	0.90	0.04	13.03	0.05	95.73
	1124C_6H-2_27-29_3	4.32	3.22	2.27	70.33	0.17	0.10	1.22	0.13	13.08	0.03	94.87
	1124C_6H-2_27-29_10	4.41	3.25	2.26	70.43	0.18	0.11	1.25	0.15	13.73	0.00	95.78
s77	1124C_6H-2_127-129_1	4.27	3.39	2.14	70.02	0.20	0.12	1.21	0.09	12.88	0.01	94.32
	1124C_6H-2_127-129_2	4.12	3.46	2.18	70.12	0.19	0.11	1.25	0.10	12.90	0.00	94.43
	1124C_6H-2_127-129_3	4.46	3.24	2.26	71.34	0.21	0.11	1.24	0.05	13.00	0.01	95.91
	1124C_6H-2_127-129_4	4.30	3.46	2.23	70.99	0.19	0.13	1.23	0.05	12.88	0.00	95.45
	1124C_6H-2_127-129_5	4.33	3.47	2.11	71.18	0.17	0.09	1.24	0.09	13.21	0.03	95.92
	1124C_6H-2_127-129_7	4.34	3.43	1.98	71.19	0.20	0.13	1.22	0.06	13.05	0.04	95.64
	1124C_6H-2_127-129_8	4.10	3.45	2.12	71.08	0.17	0.15	1.23	0.00	13.48	0.00	95.77
	1124C_6H-2_127-129_9	4.40	3.39	2.15	70.92	0.20	0.14	1.23	0.03	13.25	0.02	95.72
	1124C_6H-2_127-129_10	3.99	3.40	2.11	70.09	0.21	0.14	1.22	0.12	13.25	0.01	94.54
	1124C_6H-2_127-129_11	3.94	3.35	2.12	70.44	0.22	0.15	1.20	0.01	13.23	0.03	94.69
	1124C_6H-2_127-129_12	4.18	3.39	2.08	70.93	0.18	0.13	1.19	0.13	13.18	0.00	95.39
	1124C_6H-2_127-129_13	4.07	3.52	2.37	71.07	0.19	0.12	1.24	0.05	13.28	0.01	95.92
	1124C_6H-2_127-129_14	4.30	3.44	2.37	71.22	0.19	0.16	1.20	0.09	13.13	0.00	96.11
	1124C_6H-2_127-129_15	4.24	3.26	2.18	71.63	0.21	0.14	1.21	0.04	12.99	0.01	95.92
	1124C_6H-2_127-129_16	4.33	3.41	2.07	70.70	0.20	0.12	1.18	0.00	13.10	0.02	95.13
	1124C_6H-2_127-129_17	4.31	3.34	1.98	70.55	0.18	0.12	1.20	0.04	13.04	0.01	94.77
	1124C_6H-2_127-129_18	4.03	3.45	2.24	70.42	0.15	0.10	1.21	0.06	13.31	0.00	94.98
	1124C_6H-2_127-129_19	3.97	3.43	2.22	71.29	0.18	0.14	1.23	0.07	13.04	0.01	95.58
	1124C_6H-2_127-129_20	4.53	3.43	2.26	71.19	0.19	0.08	1.17	0.11	12.96	0.00	95.92
	1124C_6H-3_55-57_1	4.20	3.82	1.72	70.31	0.16	0.04	0.86	0.06	12.65	0.00	93.82
	1124C_6H-3_55-57_2	4.52	3.81	1.59	71.44	0.11	0.04	0.90	0.08	12.63	0.02	95.13
	1124C_6H-3_55-57_3	4.03	3.97	1.55	70.73	0.12	0.06	0.84	0.06	12.54	0.04	93.94
	1124C_6H-3_55-57_4	4.17	3.67	1.51	69.55	0.10	0.05	0.88	0.03	12.47	0.00	92.43
	1124C_6H-3_55-57_5	4.14	3.76	1.67	70.78	0.13	0.05	0.87	0.08	12.59	0.00	94.06
	1124C_6H-3_55-57_6	3.88	4.00	1.74	71.12	0.18	0.08	0.86	0.00	12.05	0.01	93.92
	1124C_6H-3_55-57_7	4.04	3.79	1.63	70.63	0.13	0.04	0.81	0.11	12.10	0.06	93.34
	1124C_6H-3_55-57_8	4.21	3.86	1.68	71.89	0.09	0.07	0.91	0.03	12.33	0.00	95.07
	1124C_6H-3_55-57_9	3.94	3.79	1.62	69.43	0.09	0.01	0.80	0.06	12.44	0.01	92.19
	1124C_6H-3_55-57_10	4.23	3.78	1.59	69.99	0.10	0.04	0.85	0.05	12.42	0.03	93.09
	1124C_6H-3_55-57_11	4.14	3.77	1.75	69.16	0.10	0.06	0.88	0.00	12.55	0.00	92.41
	1124C_6H-3_55-57_12	3.96	3.99	1.72	68.80	0.12	0.05	0.88	0.01	12.40	0.01	91.94
	1124C_6H-3_55-57_13	3.81	4.23	1.91	69.27	0.16	0.10	0.87	0.10	12.15	0.01	92.61
	1124C_6H-3_55-57_14	4.46	3.51	2.62	66.25	0.20	0.26	1.63	0.09	13.81	0.06	92.88
	1124C_6H-3_55-57_15	4.33	3.86	1.71	71.97	0.12	0.06	0.88	0.09	12.50	0.00	95.52
	1124C_6H-3_55-57_16	4.22	3.92	1.49	71.66	0.11	0.05	0.79	0.05	12.19	0.05	94.53
	1124C_6H-3_55-57_17	4.01	3.68	1.64	70.65	0.12	0.06	0.95	0.02	12.42	0.02	93.57
	1124C_6H-3_55-57_18	4.09	3.85	1.33	70.71	0.09	0.06	0.75	0.05	12.23	0.00	93.16
	1124C_6H-3_55-57_19	4.43	3.86	1.59	71.37	0.07	0.09	0.86	0.03	12.38	0.00	94.68
s80	1124C_6H-3_55-57_20	4.33	3.88	1.59	71.28	0.10	0.05	0.83	0.06	12.33	0.02	94.46
	1124C_6H-3_90-92_1	4.03	4.05	1.98	70.99	0.15	0.08	0.82	0.07	12.29	0.02	94.48
	1124C_6H-3_90-92_2	3.88	4.10	1.76	70.53	0.15	0.08	0.86	0.04	12.23	0.01	93.64
	1124C_6H-3_90-92_3	3.90	4.01	1.91	71.22	0.15	0.10	0.80	0.00	12.37	0.04	94.50

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s86	1124C_6H-3_90-92_4	3.83	4.04	1.75	70.64	0.14	0.10	0.84	0.01	12.34	0.02	93.70
	1124C_6H-3_90-92_5	4.00	4.04	1.73	70.68	0.17	0.08	0.86	0.09	12.27	0.01	93.93
	1124C_6H-3_90-92_6	4.29	4.08	1.89	70.15	0.15	0.08	0.88	0.04	12.23	0.00	93.79
	1124C_6H-3_90-92_7	4.03	4.17	1.81	69.74	0.16	0.13	0.85	0.09	12.24	0.02	93.24
	1124C_6H-3_90-92_8	3.81	4.25	1.77	70.44	0.14	0.08	0.85	0.05	12.22	0.02	93.63
	1124C_6H-3_90-92_9	3.98	4.12	1.77	70.24	0.12	0.07	0.82	0.01	12.14	0.05	93.33
	1124C_6H-3_90-92_10	4.04	4.22	1.82	70.46	0.14	0.09	0.86	0.07	12.14	0.01	93.85
	1124C_6H-3_90-92_11	3.94	4.22	1.99	70.57	0.14	0.10	0.87	0.07	12.29	0.00	94.19
	1124C_6H-3_90-92_12	3.93	4.18	1.90	70.69	0.14	0.09	0.88	0.03	12.25	0.03	94.12
	1124C_6H-3_90-92_13	3.94	4.19	1.88	70.19	0.15	0.09	0.85	0.02	12.04	0.03	93.38
	1124C_6H-3_90-92_14	3.86	4.12	1.81	70.39	0.16	0.10	0.90	0.02	12.30	0.02	93.68
	1124C_6H-3_90-92_15	4.16	4.12	1.75	69.95	0.18	0.09	0.85	0.00	12.22	0.01	93.33
	1124C_6H-3_90-92_16	4.07	3.98	1.85	69.94	0.17	0.09	0.86	0.13	12.28	0.00	93.37
	1124C_6H-3_90-92_17	3.97	4.22	1.82	70.51	0.16	0.05	0.85	0.09	12.13	0.00	93.79
	1124C_6H-3_90-92_18	4.25	4.25	1.93	70.68	0.17	0.07	0.85	0.03	12.40	0.00	94.63
	1124C_6H-3_90-92_19	4.07	4.26	2.00	71.03	0.16	0.08	0.83	0.06	12.58	0.00	95.07
	1124C_6H-3_90-92_20	3.95	4.13	1.78	70.42	0.14	0.10	0.85	0.06	12.15	0.03	93.61
	1124C_6H-3_90-92_2	3.69	4.27	1.80	72.20	0.14	0.07	0.85	0.03	12.80	0.00	95.84
	1124C_6H-3_90-92_5	3.68	4.26	1.79	71.97	0.16	0.09	0.86	0.01	12.63	0.01	95.46
	1124C_6H-3_90-92_6	3.68	4.05	1.73	72.52	0.17	0.11	0.83	0.06	12.49	0.01	95.65
	1124C_6H-3_90-92_8	3.91	4.06	1.90	72.33	0.18	0.09	0.84	0.09	12.35	0.04	95.79
	1124C_6H-3_90-92_9	3.72	4.10	1.91	72.00	0.18	0.06	0.85	0.00	12.55	0.05	95.42
	1124C_6H-3_90-92_1	3.73	4.18	1.91	71.90	0.14	0.03	0.80	0.09	12.34	0.04	95.16
	1124C_6H-3_90-92_3	3.77	4.26	1.85	72.38	0.14	0.06	0.88	0.08	12.64	0.00	96.06
	1124C_6H-3_90-92_4	3.74	4.19	1.70	72.09	0.16	0.09	0.90	0.04	12.21	0.00	95.12
	1124C_6H-3_90-92_7	3.98	4.18	1.75	72.30	0.19	0.11	0.89	0.05	12.36	0.03	95.84
	1124C_6H-3_90-92_10	3.92	4.20	1.85	73.40	0.18	0.07	0.91	0.00	12.60	0.00	97.14
	1124C_6H-4_52-54_1	4.24	4.20	2.02	67.42	0.13	0.08	0.93	0.11	12.80	0.03	91.96
	1124C_6H-4_52-54_2	3.86	4.14	1.89	67.40	0.14	0.09	0.89	0.01	12.65	0.01	91.08
	1124C_6H-4_52-54_3	4.13	4.15	1.83	71.36	0.11	0.11	0.94	0.02	12.83	0.02	95.49
	1124C_6H-4_52-54_4	4.12	4.18	1.77	69.01	0.11	0.08	0.92	0.08	12.56	0.00	92.84
	1124C_6H-4_52-54_5	4.05	4.30	1.83	71.49	0.09	0.05	0.93	0.04	12.82	0.01	95.61
	1124C_6H-4_52-54_6	4.10	4.26	1.77	70.09	0.13	0.10	0.90	0.03	12.62	0.00	94.00
	1124C_6H-4_52-54_7	3.94	4.47	1.82	71.94	0.13	0.07	0.94	0.08	12.99	0.01	96.39
	1124C_6H-4_52-54_8	4.02	4.43	1.94	71.18	0.13	0.05	0.89	0.11	12.73	0.00	95.48
	1124C_6H-4_52-54_9	4.12	4.23	1.87	70.92	0.13	0.09	0.92	0.04	12.84	0.00	95.16
	1124C_6H-4_52-54_10	4.12	4.32	1.78	71.10	0.11	0.11	0.91	0.06	12.84	0.02	95.38
	1124C_6H-4_52-54_11	4.20	4.29	1.84	70.43	0.13	0.03	0.95	0.07	12.53	0.00	94.46
	1124C_6H-4_52-54_12	3.83	4.36	1.85	71.73	0.11	0.09	0.91	0.06	12.82	0.00	95.76
	1124C_6H-4_52-54_13	4.31	4.24	2.06	70.81	0.13	0.04	0.92	0.08	12.66	0.00	95.24
	1124C_6H-4_52-54_14	3.95	4.37	1.85	70.95	0.12	0.09	0.90	0.09	12.69	0.01	95.01
	1124C_6H-4_52-54_15	3.86	4.40	1.78	71.02	0.14	0.09	0.92	0.00	12.68	0.00	94.88
	1124C_6H-4_52-54_16	4.14	4.11	1.83	70.23	0.16	0.06	0.91	0.00	12.49	0.02	93.94
	1124C_6H-4_52-54_17	4.10	4.31	1.88	70.79	0.16	0.10	0.93	0.11	12.61	0.00	94.98
	1124C_6H-4_52-54_18	3.90	4.23	1.78	70.92	0.15	0.08	0.90	0.06	12.72	0.01	94.75
	1124C_6H-4_52-54_19	3.88	4.51	1.64	71.31	0.11	0.06	0.92	0.11	12.81	0.00	95.36
	1124C_6H-4_52-54_20	3.97	4.34	1.89	70.67	0.16	0.04	0.89	0.09	12.81	0.00	94.86
	1124C_6H-4_52-54_1	3.84	4.12	1.80	68.66	0.13	0.07	0.89	0.06	12.02	0.00	91.59
	1124C_6H-4_52-54_2	3.83	4.20	1.69	69.07	0.13	0.06	0.94	0.07	12.42	0.05	92.45
	1124C_6H-4_52-54_6	3.13	4.32	1.79	70.76	0.14	0.06	0.90	0.00	12.41	0.00	93.51
	1124C_6H-4_52-54_7	4.03	4.30	1.89	69.74	0.14	0.05	0.97	0.02	12.82	0.00	93.97
	1124C_6H-4_52-54_10	3.23	4.12	1.72	70.35	0.12	0.05	0.93	0.00	12.65	0.01	93.18
	1124C_6H-4_52-54_8	4.18	4.12	1.81	69.31	0.10	0.06	0.89	0.03	12.59	0.00	93.09
	1124C_6H-4_52-54_9	2.63	4.31	1.83	69.79	0.09	0.07	0.88	0.11	12.33	0.04	92.08
u58	1124C_6H-5_20-22_1	3.83	2.95	2.58	66.63	0.24	0.33	1.70	0.09	13.66	0.08	92.09
	1124C_6H-5_20-22_2	3.91	3.06	2.32	67.56	0.22	0.35	1.76	0.07	13.61	0.06	92.92
	1124C_6H-5_20-22_3	4.19	3.01	2.37	66.66	0.29	0.36	1.79	0.13	13.66	0.03	92.50
	1124C_6H-5_20-22_4	4.04	3.03	2.26	68.23	0.25	0.32	1.76	0.06	13.63	0.08	93.66
	1124C_6H-5_20-22_5	4.10	2.96	2.66	67.96	0.27	0.30	1.86	0.10	13.67	0.06	93.94
	1124C_6H-5_20-22_6	4.16	3.06	2.31	68.27	0.24	0.35	1.75	0.17	13.84	0.04	94.19
	1124C_6H-5_20-22_7	4.18	2.90	2.36	66.66	0.27	0.32	1.80	0.12	13.53	0.06	92.20
	1124C_6H-5_20-22_8	4.19	3.07	2.36	68.27	0.24	0.29	1.76	0.07	13.50	0.04	93.79
	1124C_6H-5_20-22_9	4.20	2.63	3.62	66.64	0.39	0.62	3.05	0.09	15.26	0.06	96.56
	1124C_6H-5_20-22_10	3.87	3.02	2.36	69.23	0.27	0.34	1.74	0.06	13.58	0.06	94.54
	1124C_6H-5_20-22_11	3.72	2.54	2.80	58.80	0.26	0.45	2.17	0.12	12.58	0.06	83.50
	1124C_6H-5_20-22_12	4.23	2.48	3.67	62.35	0.44	0.69	3.02	0.02	14.09	0.10	91.09
	1124C_6H-5_20-22_13	3.98	3.04	2.39	69.11	0.27	0.29	1.76	0.15	13.56	0.07	94.62
	1124C_6H-5_20-22_14	4.18	2.95	2.48	68.94	0.27	0.37	1.83	0.09	13.72	0.02	94.85
	1124C_6H-5_20-22_15	4.06	2.97	2.24	68.97	0.23	0.33	1.73	0.11	13.49	0.03	94.16
	1124C_6H-5_20-22_17	4.11	3.05	2.52	69.01	0.25	0.30	1.73	0.05	13.47	0.04	94.54

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s87	1124C_6H-5_20-22_18	4.16	2.95	2.30	68.67	0.24	0.35	1.80	0.02	13.42	0.08	93.99
	1124C_6H-5_20-22_19	3.89	2.69	3.33	66.49	0.34	0.63	2.70	0.09	14.59	0.03	94.77
	1124C_6H-5_20-22_20	4.15	3.03	2.32	69.21	0.24	0.34	1.82	0.07	13.73	0.03	94.93
	1124C_6H-5_20-22_1	3.87	3.12	2.36	69.32	0.24	0.28	1.84	0.14	13.18	0.06	94.42
	1124C_6H-5_20-22_4	3.87	3.09	2.42	68.98	0.25	0.34	1.79	0.04	12.96	0.06	93.80
	1124C_6H-5_20-22_7	3.93	3.06	2.29	68.25	0.24	0.33	1.78	0.12	12.55	0.03	92.57
	1124C_6H-5_20-22_8	3.91	3.06	2.27	69.24	0.26	0.35	1.84	0.10	12.72	0.00	93.75
	1124C_6H-5_20-22_2	4.01	3.02	2.43	68.80	0.21	0.32	1.85	0.16	12.99	0.08	93.86
	1124C_6H-5_20-22_3	4.05	2.97	2.30	68.84	0.25	0.38	1.89	0.07	13.17	0.02	93.95
	1124C_6H-5_20-22_5	4.11	3.01	2.39	68.25	0.25	0.31	1.78	0.12	12.60	0.06	92.88
	1124C_6H-5_20-22_9	3.71	3.05	2.22	68.81	0.26	0.29	1.83	0.10	13.27	0.05	93.59
	1124C_6H-5_20-22_10	3.86	2.94	2.14	68.28	0.26	0.34	1.81	0.00	12.79	0.09	92.51
	1124C_6H-5_37-39_1	3.72	2.98	1.04	72.19	0.20	0.22	1.40	0.03	12.03	0.00	93.81
	1124C_6H-5_37-39_2	3.71	2.99	0.99	73.11	0.16	0.19	1.30	0.04	11.79	0.01	94.30
	1124C_6H-5_37-39_3	3.41	3.00	0.88	72.68	0.14	0.16	1.24	0.02	11.57	0.02	93.13
	1124C_6H-5_37-39_4	3.63	2.93	1.41	71.91	0.17	0.36	1.66	0.04	12.16	0.07	94.35
	1124C_6H-5_37-39_5	3.56	3.02	1.28	72.38	0.20	0.24	1.41	0.02	11.89	0.00	94.00
	1124C_6H-5_37-39_6	3.50	2.89	1.19	72.09	0.18	0.27	1.42	0.01	11.75	0.06	93.35
	1124C_6H-5_37-39_7	3.33	3.06	1.00	73.11	0.17	0.20	1.31	0.06	11.82	0.01	94.07
	1124C_6H-5_37-39_8	3.70	2.94	1.23	71.61	0.20	0.24	1.49	0.04	12.16	0.02	93.63
	1124C_6H-5_37-39_9	3.45	2.98	1.11	73.00	0.15	0.20	1.33	0.03	11.73	0.01	93.99
	1124C_6H-5_37-39_10	3.56	3.00	1.26	72.42	0.19	0.19	1.47	0.08	12.10	0.07	94.34
	1124C_6H-5_37-39_11	3.52	2.97	1.11	72.41	0.15	0.23	1.39	0.06	11.92	0.02	93.78
	1124C_6H-5_37-39_12	3.64	2.95	1.00	73.01	0.17	0.17	1.28	0.02	11.88	0.03	94.15
	1124C_6H-5_37-39_13	3.32	3.45	1.05	72.36	0.14	0.08	1.06	0.09	11.64	0.00	93.20
	1124C_6H-5_37-39_14	3.59	2.89	1.18	72.98	0.20	0.22	1.42	0.04	12.02	0.04	94.57
	1124C_6H-5_37-39_15	3.65	2.96	1.03	72.64	0.19	0.25	1.43	0.07	12.26	0.04	94.52
	1124C_6H-5_37-39_16	3.44	3.00	0.90	72.67	0.20	0.15	1.39	0.05	12.08	0.03	93.91
	1124C_6H-5_37-39_17	3.25	3.60	0.87	73.95	0.10	0.11	1.07	0.03	11.67	0.03	94.68
	1124C_6H-5_37-39_19	3.48	3.00	1.09	73.16	0.17	0.19	1.40	0.05	11.76	0.00	94.31
	1124C_6H-5_37-39_20	3.69	2.97	0.96	73.19	0.18	0.18	1.38	0.02	11.84	0.02	94.42
	1124C_6H-5_37-39cm_7	3.35	3.02	1.16	74.19	0.15	0.23	1.39	0.04	12.39	0.04	95.95
	1124C_6H-5_37-39cm_1	3.54	4.44	1.92	72.31	0.11	0.11	0.90	0.05	12.72	0.06	96.15
	1124C_6H-5_37-39cm_3	3.26	3.70	1.02	74.40	0.08	0.12	1.04	0.02	11.85	0.01	95.50
	1124C_6H-5_37-39cm_5	3.57	4.40	1.70	72.62	0.15	0.08	0.88	0.00	12.80	0.00	96.19
	1124C_6H-5_37-39cm_6	3.52	4.30	1.68	72.04	0.14	0.09	0.85	0.06	12.63	0.00	95.31
	1124C_6H-5_37-39cm_8	3.24	3.13	1.01	68.64	0.17	0.21	1.27	0.07	11.53	0.00	89.26
	1124C_7H-3_70-72_1	4.08	3.14	1.40	73.26	0.07	0.08	0.83	0.01	11.44	0.00	94.31
	1124C_7H-3_70-72_2	4.28	2.91	1.40	72.29	0.13	0.10	1.07	0.03	11.71	0.00	93.92
	1124C_7H-3_70-72_3	4.25	3.08	1.51	73.56	0.13	0.12	1.07	0.06	11.91	0.00	95.69
	1124C_7H-3_70-72_4	4.28	3.13	1.59	73.01	0.16	0.10	1.10	0.00	11.93	0.01	95.31
	1124C_7H-3_70-72_5	4.22	3.11	1.62	72.50	0.12	0.07	1.06	0.02	11.83	0.02	94.56
	1124C_7H-3_70-72_6	4.04	3.21	1.20	73.02	0.08	0.03	0.85	0.04	11.50	0.00	93.98
	1124C_7H-3_70-72_7	4.08	3.04	1.42	72.84	0.15	0.13	1.05	0.05	11.71	0.01	94.49
	1124C_7H-3_70-72_8	4.15	3.13	1.25	73.69	0.06	0.05	0.87	0.06	11.53	0.00	94.80
	1124C_7H-3_70-72_9	4.58	2.84	1.63	71.56	0.16	0.10	1.20	0.00	12.29	0.03	94.39
	1124C_7H-3_70-72_10	4.08	3.40	1.31	73.78	0.06	0.02	0.82	0.09	11.43	0.00	95.00
	1124C_7H-3_70-72_11	4.22	3.16	1.21	73.28	0.07	0.04	0.84	0.00	11.29	0.03	94.14
	1124C_7H-3_70-72_12	3.96	3.05	1.45	72.96	0.12	0.09	1.12	0.08	12.01	0.00	94.83
	1124C_7H-3_70-72_13	4.18	3.07	1.28	72.85	0.08	0.04	0.91	0.04	11.51	0.00	93.96
	1124C_7H-3_70-72_14	4.31	2.98	1.53	72.75	0.12	0.12	1.15	0.09	12.52	0.00	95.58
	1124C_7H-3_70-72_15	3.98	3.21	1.31	73.34	0.11	0.05	0.86	0.10	11.39	0.03	94.38
	1124C_7H-3_70-72_16	4.10	3.08	1.15	73.75	0.11	0.05	0.84	0.02	11.44	0.05	94.59
	1124C_7H-3_70-72_17	4.10	3.24	1.25	74.20	0.09	0.04	0.86	0.00	11.49	0.01	95.29
	1124C_7H-3_70-72_18	4.01	3.16	1.23	74.10	0.09	0.07	0.88	0.04	11.36	0.00	94.95
	1124C_7H-3_70-72_19	4.15	3.06	1.74	73.09	0.15	0.14	1.08	0.03	12.13	0.03	95.61
	1124C_7H-3_70-72_20	4.24	2.97	1.53	72.24	0.12	0.09	1.03	0.06	11.86	0.02	94.17
s89*	1124C_7H-3_117-119_3	3.81	3.58	1.23	74.60	0.03	0.04	0.78	0.03	11.88	0.00	95.99
	1124C_7H-3_117-119_4	3.74	3.61	1.17	72.72	0.05	0.07	0.74	0.02	11.45	0.00	93.58
	1124C_7H-3_117-119_5	3.70	3.54	1.19	73.23	0.07	0.07	0.81	0.01	11.46	0.02	94.10
	1124C_7H-3_117-119_6	4.01	3.05	1.21	73.17	0.07	0.08	0.88	0.07	11.63	0.02	94.19
	1124C_7H-3_117-119_7	4.16	3.13	1.42	74.16	0.07	0.09	0.85	0.03	11.49	0.02	95.41
	1124C_7H-3_117-119_8	3.98	3.17	1.52	74.02	0.06	0.05	0.91	0.07	11.46	0.00	95.25
	1124C_7H-3_117-119_9	3.83	3.42	1.18	74.14	0.08	0.02	0.77	0.00	11.66	0.04	95.14
	1124C_7H-3_117-119_10	4.02	3.48	1.20	73.79	0.11	0.05	0.75	0.02	11.55	0.00	94.98
	1124C_7H-3_117-119_11	4.13	3.16	1.34	74.40	0.07	0.03	0.89	0.11	11.55	0.03	95.71
	1124C_7H-3_117-119_12	3.99	3.12	1.54	74.17	0.06	0.03	0.87	0.00	11.60	0.00	95.38
	1124C_7H-3_117-119_13	4.16	3.33	1.41	73.91	0.05	0.03	0.79	0.01	11.48	0.00	95.17
	1124C_7H-3_117-119_14	3.91	3.14	1.45	74.25	0.06	0.03	0.87	0.04	11.46	0.01	95.22
	1124C_7H-3_117-119_15	3.80	3.34	1.21	73.61	0.09	0.06	0.77	0.00	11.52	0.00	94.40

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s92	1124C_7H-3_117-119_16	3.88	3.48	1.46	74.06	0.07	0.04	0.75	0.04	11.63	0.03	95.45
	1124C_7H-3_117-119_17	3.94	3.17	1.44	74.00	0.11	0.03	0.87	0.08	11.40	0.04	95.07
	1124C_7H-3_117-119_18	3.73	3.63	1.12	73.52	0.07	0.07	0.78	0.10	11.52	0.01	94.56
	1124C_7H-3_117-119_19	3.82	3.45	1.14	72.44	0.06	0.07	0.74	0.00	11.45	0.00	93.18
	1124C_7H-3_117-119_20	3.99	3.33	1.35	73.49	0.07	0.01	0.79	0.10	11.45	0.00	94.59
	1124C_7H-3_117-119_3	3.73	3.12	1.51	72.72	0.09	0.06	0.89	0.01	10.88	0.00	93.01
	1124C_7H-3_117-119_4	4.20	3.03	1.41	71.51	0.08	0.08	0.90	0.07	11.07	0.00	92.35
	1124C_7H-3_117-119_6	3.75	3.24	1.14	72.03	0.03	0.02	0.77	0.00	10.97	0.03	91.99
	1124C_7H-3_117-119_7	3.67	3.52	1.20	73.08	0.07	0.05	0.82	0.02	11.29	0.01	93.74
	1124C_7H-3_117-119_9	3.87	3.35	1.08	72.83	0.09	0.05	0.81	0.02	11.06	0.02	93.17
	1124C_7H-3_117-119_1	3.96	3.55	1.25	73.35	0.08	0.03	0.82	0.04	11.20	0.00	94.28
	1124C_7H-3_117-119_2	3.83	3.54	1.21	72.44	0.04	0.04	0.79	0.05	10.66	0.01	92.62
	1124C_7H-3_117-119_5	3.73	3.44	0.02	72.51	0.00	0.05	0.75	0.00	11.12	0.00	91.62
	1124C_7H-3_117-119_8	3.80	3.26	1.57	72.72	0.03	0.10	0.91	0.00	11.10	0.00	93.49
	1124C_7H-3_117-119_10	3.89	3.21	1.34	73.02	0.12	0.03	0.92	0.03	11.17	0.00	93.73
	1124C_7H-4_60-62_1	3.78	3.46	1.27	74.03	0.13	0.12	1.10	0.00	11.86	0.01	95.75
	1124C_7H-4_60-62_2	3.62	3.55	1.05	73.54	0.09	0.08	0.97	0.07	11.76	0.02	94.76
	1124C_7H-4_60-62_3	3.75	3.42	0.99	73.35	0.07	0.11	1.03	0.03	11.72	0.00	94.47
	1124C_7H-4_60-62_4	3.85	3.41	1.18	72.46	0.09	0.10	1.08	0.05	11.61	0.00	93.83
	1124C_7H-4_60-62_5	3.74	3.48	1.13	73.95	0.09	0.11	1.02	0.04	11.76	0.00	95.32
	1124C_7H-4_60-62_6	3.96	3.37	1.29	73.18	0.07	0.11	1.08	0.00	11.65	0.01	94.70
	1124C_7H-4_60-62_7	4.23	3.01	1.36	73.71	0.12	0.12	1.04	0.01	11.81	0.01	95.41
	1124C_7H-4_60-62_8	3.78	3.41	1.10	73.15	0.10	0.07	1.07	0.09	11.88	0.00	94.66
	1124C_7H-4_60-62_9	3.66	3.32	1.20	73.97	0.09	0.10	1.08	0.10	12.24	0.00	95.75
	1124C_7H-4_60-62_10	3.89	3.41	1.14	73.61	0.08	0.10	1.02	0.00	11.72	0.00	94.98
	1124C_7H-4_60-62_11	3.75	3.42	1.29	74.25	0.09	0.07	0.94	0.00	11.69	0.03	95.52
	1124C_7H-4_60-62_12	3.68	3.32	1.26	73.47	0.14	0.14	1.06	0.00	11.83	0.00	94.90
	1124C_7H-4_60-62_13	3.87	3.24	1.23	73.71	0.11	0.10	1.02	0.02	11.63	0.01	94.95
	1124C_7H-4_60-62_14	3.93	3.38	1.21	73.49	0.10	0.07	1.10	0.02	11.71	0.00	95.01
	1124C_7H-4_60-62_15	3.70	3.27	1.13	73.40	0.09	0.07	1.08	0.07	11.88	0.01	94.70
	1124C_7H-4_60-62_16	3.67	3.32	1.23	73.40	0.09	0.09	1.08	0.05	11.74	0.00	94.68
	1124C_7H-4_60-62_17	3.83	3.33	1.33	73.43	0.10	0.12	1.06	0.00	11.73	0.00	94.93
	1124C_7H-4_60-62_18	3.87	3.57	0.98	73.31	0.06	0.05	0.82	0.06	11.76	0.00	94.50
	1124C_7H-4_60-62_19	3.75	3.42	1.32	73.86	0.14	0.09	1.09	0.01	11.62	0.00	95.30
	1124C_7H-4_60-62_20	3.64	3.52	0.98	73.70	0.06	0.07	0.82	0.03	11.61	0.01	94.44
u65	1124C_7H-4_85-87_1	4.43	2.94	2.62	71.02	0.20	0.12	1.53	0.09	12.42	0.07	95.43
	1124C_7H-4_85-87_2	4.26	2.98	2.48	71.24	0.17	0.12	1.50	0.03	12.45	0.02	95.25
	1124C_7H-4_85-87_3	4.11	2.99	2.54	71.28	0.15	0.13	1.54	0.10	12.62	0.02	95.49
	1124C_7H-4_85-87_4	4.17	2.88	2.46	70.96	0.18	0.10	1.49	0.08	12.62	0.01	94.94
	1124C_7H-4_85-87_5	4.36	3.01	2.47	70.88	0.18	0.12	1.43	0.11	12.54	0.02	95.11
	1124C_7H-4_85-87_6	4.15	2.96	2.45	71.62	0.17	0.13	1.52	0.03	12.77	0.01	95.82
	1124C_7H-4_85-87_7	4.15	2.97	2.56	71.48	0.17	0.08	1.47	0.08	12.55	0.01	95.53
	1124C_7H-4_85-87_8	4.33	2.89	2.28	71.37	0.19	0.12	1.50	0.04	12.72	0.03	95.47
	1124C_7H-4_85-87_9	4.11	3.00	2.46	71.36	0.17	0.15	1.51	0.05	12.86	0.00	95.67
	1124C_7H-4_85-87_11	4.35	2.86	2.25	71.16	0.17	0.16	1.54	0.03	12.58	0.02	95.12
	1124C_7H-4_85-87_12	4.43	2.93	2.55	71.26	0.15	0.10	1.49	0.09	12.69	0.03	95.72
	1124C_7H-4_85-87_13	4.34	3.00	2.28	71.25	0.15	0.13	1.51	0.06	12.59	0.05	95.36
	1124C_7H-4_85-87_14	4.26	2.99	2.75	71.28	0.19	0.12	1.53	0.05	12.67	0.04	95.88
	1124C_7H-4_85-87_15	4.12	2.91	2.54	71.10	0.14	0.16	1.49	0.03	12.60	0.01	95.10
	1124C_7H-4_85-87_16	4.40	2.95	2.52	71.56	0.17	0.14	1.50	0.10	12.68	0.02	96.04
	1124C_7H-4_85-87_17	4.30	2.81	2.74	70.17	0.18	0.15	1.77	0.08	12.99	0.04	95.23
	1124C_7H-4_85-87_18	4.15	2.89	2.89	70.47	0.19	0.14	1.67	0.10	12.69	0.05	95.23
	1124C_7H-4_85-87_2	4.13	2.88	2.30	69.73	0.16	0.13	1.50	0.02	11.79	0.04	92.69
	1124C_7H-4_85-87_4	4.07	2.92	2.24	69.40	0.17	0.16	1.56	0.08	11.69	0.01	92.30
	1124C_7H-4_85-87_5	4.24	2.88	2.19	69.09	0.18	0.12	1.48	0.06	11.86	0.02	92.12
u66	1124C_7H-4_85-87_10	4.24	2.94	2.81	68.53	0.21	0.16	1.84	0.08	12.10	0.02	92.93
	1124C_7H-4_85-87_3	4.16	2.91	2.16	69.98	0.16	0.15	1.52	0.07	12.19	0.00	93.30
	1124C_7H-4_85-87_6	4.12	2.96	2.51	69.79	0.16	0.15	1.50	0.05	12.05	0.04	93.32
	1124C_7H-5_15-17_1	3.48	3.33	1.01	73.46	0.10	0.08	0.95	0.04	11.88	0.00	94.33
	1124C_7H-5_15-17_2	3.50	3.46	1.00	73.62	0.11	0.10	0.90	0.05	11.53	0.03	94.30
	1124C_7H-5_15-17_3	3.24	3.70	0.95	72.96	0.05	0.12	0.95	0.01	11.41	0.01	93.39
	1124C_7H-5_15-17_4	3.52	3.58	0.99	74.04	0.11	0.12	0.96	0.00	11.72	0.02	95.06
	1124C_7H-5_15-17_5	3.53	3.37	1.13	74.63	0.08	0.12	0.98	0.04	12.02	0.01	95.90
	1124C_7H-5_15-17_7	3.67	3.25	0.98	73.49	0.06	0.09	0.92	0.06	11.68	0.05	94.24
	1124C_7H-5_15-17_8	3.84	3.31	1.05	73.95	0.07	0.10	0.99	0.02	11.66	0.03	95.03
	1124C_7H-5_15-17_9	3.48	3.44	1.06	73.77	0.06	0.11	0.97	0.03	11.70	0.00	94.62
	1124C_7H-5_15-17_10	3.41	3.59	1.03	73.78	0.08	0.08	0.95	0.02	11.68	0.02	94.64
	1124C_7H-5_15-17_11	3.49	3.52	1.12	74.18	0.08	0.12	0.96	0.00	11.78	0.00	95.25
	1124C_7H-5_15-17_12	3.68	3.47	1.15	73.93	0.10	0.11	0.97	0.00	11.94	0.00	95.35
	1124C_7H-5_15-17_13	3.60	3.47	0.97	73.25	0.07	0.11	0.95	0.00	11.73	0.01	94.17

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s93*	1124C_7H-5_15-17_14	5.87	1.99	2.42	70.25	0.25	0.16	1.14	0.17	12.69	0.04	94.98
	1124C_7H-5_15-17_15	3.57	3.34	1.10	73.29	0.09	0.12	0.94	0.09	11.72	0.01	94.28
	1124C_7H-5_15-17_16	3.53	3.49	1.06	73.52	0.11	0.09	0.98	0.03	11.71	0.00	94.52
	1124C_7H-5_15-17_17	3.30	3.59	1.00	73.36	0.09	0.09	0.99	0.00	11.71	0.03	94.17
	1124C_7H-5_15-17_18	3.57	3.39	1.20	73.43	0.11	0.11	1.01	0.02	11.47	0.00	94.31
	1124C_7H-5_15-17_19	3.46	3.37	1.09	73.23	0.12	0.10	0.97	0.01	11.77	0.00	94.12
	1124C_7H-5_15-17_20	3.66	3.44	1.10	72.85	0.09	0.10	0.95	0.06	11.54	0.02	93.81
	1124C_7H-5_15-17_1	3.65	3.35	0.97	72.51	0.11	0.08	0.98	0.02	11.08	0.00	92.75
	1124C_7H-5_15-17_7	3.47	3.41	0.97	71.61	0.05	0.13	0.95	0.04	10.91	0.00	91.54
	1124C_7H-5_15-17_9	3.39	3.31	1.04	71.99	0.08	0.12	0.97	0.07	10.69	0.01	91.66
	1124C_7H-5_15-17_3	3.40	3.59	1.14	72.44	0.11	0.10	0.96	0.10	11.01	0.01	92.86
	1124C_7H-5_15-17_4	3.43	3.31	0.94	73.36	0.08	0.08	0.99	0.02	11.11	0.04	93.35
	1124C_7H-5_15-17_6	3.35	3.39	0.93	72.22	0.09	0.09	0.93	0.09	11.08	0.00	92.18
	1124C_7H-5_15-17_8	3.17	3.33	0.91	72.24	0.08	0.11	0.97	0.08	11.10	0.00	92.00
	1124C_7H-5_92-94_1	3.43	2.96	1.22	74.04	0.16	0.13	1.25	0.08	11.30	0.00	94.58
	1124C_7H-5_92-94_2	3.52	3.84	1.01	74.45	0.07	0.09	0.90	0.08	12.04	0.03	96.04
	1124C_7H-5_92-94_3	3.36	3.70	1.12	72.94	0.09	0.10	0.90	0.00	11.70	0.03	93.94
	1124C_7H-5_92-94_4	3.59	2.91	1.39	73.49	0.20	0.17	1.30	0.12	11.28	0.02	94.48
	1124C_7H-5_92-94_5	3.67	3.79	1.18	73.29	0.10	0.07	0.95	0.02	11.71	0.01	94.79
	1124C_7H-5_92-94_6	3.57	3.06	1.33	73.58	0.18	0.16	1.30	0.00	11.52	0.00	94.70
	1124C_7H-5_92-94_7	3.83	2.93	1.40	72.61	0.17	0.21	1.33	0.00	11.51	0.01	94.00
	1124C_7H-5_92-94_8	3.84	2.96	1.34	72.41	0.14	0.10	1.32	0.05	11.41	0.00	93.57
	1124C_7H-5_92-94_9	3.40	3.74	1.04	71.83	0.11	0.08	0.91	0.06	11.56	0.02	92.73
	1124C_7H-5_92-94_10	3.67	3.91	1.01	72.11	0.10	0.09	0.90	0.01	11.79	0.01	93.60
	1124C_7H-5_92-94_11	3.50	3.07	1.33	73.49	0.16	0.19	1.31	0.04	11.71	0.01	94.81
	1124C_7H-5_92-94_12	3.61	3.71	1.02	73.17	0.08	0.08	0.88	0.04	11.79	0.02	94.41
	1124C_7H-5_92-94_13	3.06	4.24	1.13	72.42	0.09	0.08	0.89	0.04	11.66	0.00	93.63
	1124C_7H-5_92-94_14	3.41	3.79	1.12	73.23	0.09	0.10	0.87	0.00	11.75	0.00	94.36
	1124C_7H-5_92-94_15	3.52	3.61	1.07	71.22	0.08	0.08	0.89	0.03	11.52	0.01	92.04
	1124C_7H-5_92-94_16	3.47	3.77	1.01	72.78	0.06	0.04	0.87	0.01	11.40	0.01	93.42
	1124C_7H-5_92-94_17	3.31	3.65	1.19	71.27	0.10	0.10	0.88	0.07	11.75	0.00	92.32
	1124C_7H-5_92-94_18	3.46	2.88	1.39	73.21	0.15	0.18	1.32	0.07	11.32	0.00	93.98
	1124C_7H-5_92-94_19	3.58	3.59	1.20	73.12	0.08	0.08	0.87	0.03	11.69	0.03	94.27
	1124C_7H-5_92-94_20	3.50	3.86	1.10	73.22	0.09	0.07	0.90	0.07	11.68	0.00	94.49
s95	1124C_7H-5_92-94_1	3.35	3.16	1.45	74.88	0.19	0.18	1.34	0.08	11.93	0.00	96.57
	1124C_7H-5_92-94_5	3.28	2.91	1.32	73.80	0.14	0.15	1.28	0.00	11.91	0.01	94.80
	1124C_7H-5_92-94_2	3.18	3.78	1.12	73.98	0.13	0.08	0.89	0.00	11.75	0.01	94.91
	1124C_7H-5_92-94_3	3.22	3.88	1.13	74.72	0.08	0.05	0.91	0.04	11.76	0.01	95.81
	1124C_7H-5_92-94_8	3.31	3.70	1.04	73.55	0.12	0.11	0.88	0.01	11.78	0.00	94.50
	1124C_7H-5_92-94_11	3.37	3.74	1.05	74.02	0.09	0.08	0.94	0.09	11.94	0.00	95.33
	1124C_7H-5_92-94_4	3.43	3.85	0.96	74.23	0.06	0.06	0.91	0.03	11.99	0.02	95.55
	1124C_7H-5_92-94_6	3.48	3.80	1.04	74.52	0.07	0.04	0.90	0.10	12.00	0.05	96.00
	1124C_7H-5_92-94_7	3.40	3.69	1.12	73.77	0.09	0.08	0.93	0.05	11.65	0.04	94.82
	1124C_7H-5_92-94_10	3.24	3.01	1.27	72.19	0.18	0.13	1.32	0.05	11.50	0.01	92.90
	1124C_7H-5_92-94_9	3.29	3.73	1.27	74.55	0.08	0.08	0.90	0.03	11.86	0.02	95.82
	1124C_7H-6_135-137_1	4.07	3.28	1.44	73.39	0.09	0.04	0.84	0.01	12.08	0.00	95.24
	1124C_7H-6_135-137_2	4.26	2.98	1.65	71.98	0.09	0.12	1.16	0.05	12.81	0.00	95.12
	1124C_7H-6_135-137_3	3.94	3.34	1.47	73.12	0.13	0.09	1.01	0.00	12.49	0.02	95.60
	1124C_7H-6_135-137_4	4.02	3.14	1.89	72.22	0.15	0.08	1.20	0.04	12.48	0.02	95.23
	1124C_7H-6_135-137_5	4.13	3.14	1.80	71.90	0.12	0.10	1.14	0.00	12.60	0.01	94.95
	1124C_7H-6_135-137_6	3.99	3.32	1.35	74.05	0.11	0.04	0.89	0.09	12.06	0.00	95.90
	1124C_7H-6_135-137_7	4.08	3.24	1.43	72.20	0.13	0.06	1.01	0.04	12.29	0.00	94.48
	1124C_7H-6_135-137_8	4.27	3.09	1.76	72.40	0.17	0.12	1.18	0.00	12.68	0.00	95.66
	1124C_7H-6_135-137_10	3.98	3.25	1.26	73.09	0.12	0.08	0.90	0.01	12.11	0.02	94.82
	1124C_7H-6_135-137_11	4.05	3.02	1.63	71.07	0.14	0.12	1.20	0.09	12.67	0.03	94.03
	1124C_7H-6_135-137_12	3.83	3.23	1.64	72.67	0.13	0.09	1.00	0.00	12.05	0.00	94.65
	1124C_7H-6_135-137_13	3.97	3.15	1.74	72.12	0.12	0.08	1.22	0.04	12.61	0.00	95.05
	1124C_7H-6_135-137_14	4.23	3.20	1.46	73.47	0.12	0.05	1.08	0.07	12.53	0.00	96.21
	1124C_7H-6_135-137_15	4.18	3.07	1.47	72.50	0.10	0.09	1.02	0.04	12.09	0.00	94.56
	1124C_7H-6_135-137_16	4.26	2.87	1.83	71.24	0.17	0.11	1.43	0.06	13.26	0.02	95.25
	1124C_7H-6_135-137_17	4.01	3.32	1.50	73.04	0.10	0.07	1.01	0.06	12.37	0.00	95.48
	1124C_7H-6_135-137_18	3.89	3.28	1.50	72.56	0.11	0.11	0.98	0.07	12.47	0.00	94.98
	1124C_7H-6_135-137_19	4.08	3.23	1.53	72.53	0.12	0.07	1.03	0.02	12.14	0.04	94.79
	1124C_7H-6_135-137_20	4.11	3.30	1.54	72.97	0.08	0.11	1.04	0.07	12.34	0.03	95.59
	1124C_7H-6_143-145_2	4.23	3.17	1.59	72.57	0.12	0.20	1.26	0.07	12.54	0.00	95.74
	1124C_7H-6_143-145_3	4.15	3.35	1.68	72.15	0.15	0.16	1.30	0.06	12.62	0.00	95.62
	1124C_7H-6_143-145_4	4.13	3.11	1.63	72.48	0.15	0.17	1.34	0.00	12.73	0.01	95.76
	1124C_7H-6_143-145_5	4.20	3.19	1.50	71.78	0.15	0.17	1.28	0.00	12.71	0.01	94.98
	1124C_7H-6_143-145_6	4.20	3.11	1.50	72.06	0.10	0.12	1.16	0.01	12.14	0.00	94.40
	1124C_7H-6_143-145_7	4.32	3.18	1.81	71.61	0.18	0.17	1.32	0.04	12.57	0.02	95.22

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s96	1124C_7H-6_143-145_8	4.08	3.23	1.65	72.00	0.12	0.18	1.31	0.04	12.95	0.00	95.56
	1124C_7H-6_143-145_9	4.22	3.28	1.71	71.53	0.12	0.09	1.18	0.03	12.36	0.01	94.53
	1124C_7H-6_143-145_10	4.07	3.15	1.71	71.54	0.15	0.21	1.27	0.06	12.89	0.05	95.10
	1124C_7H-6_143-145_11	4.14	3.12	1.44	71.96	0.16	0.21	1.24	0.12	12.71	0.03	95.13
	1124C_7H-6_143-145_12	4.23	3.35	1.52	72.58	0.14	0.16	1.31	0.07	12.60	0.04	96.00
	1124C_7H-6_143-145_13	4.25	3.13	1.52	72.21	0.17	0.17	1.28	0.07	12.63	0.00	95.43
	1124C_7H-6_143-145_14	4.26	3.20	1.35	72.65	0.14	0.18	1.30	0.00	12.75	0.00	95.83
	1124C_7H-6_143-145_15	4.25	3.39	1.58	72.79	0.14	0.08	1.19	0.07	12.28	0.02	95.80
	1124C_7H-6_143-145_16	4.07	3.17	1.46	72.36	0.13	0.19	1.33	0.11	13.08	0.01	95.92
	1124C_7H-6_143-145_17	4.06	3.22	1.59	72.22	0.18	0.20	1.31	0.06	12.66	0.01	95.51
	1124C_7H-6_143-145_18	4.11	3.37	1.51	73.69	0.14	0.06	1.14	0.03	12.44	0.00	96.49
	1124C_7H-6_143-145_19	3.71	3.78	1.46	74.84	0.25	0.17	0.64	0.00	11.62	0.00	96.47
	1124C_7H-6_143-145_20	4.27	3.14	1.84	73.03	0.11	0.08	1.18	0.08	12.46	0.03	96.21
	1124C_7H-6_143-145_2	3.79	3.21	1.48	71.57	0.18	0.18	1.33	0.08	12.58	0.05	94.44
	1124C_7H-6_143-145_3	3.76	3.14	1.35	71.17	0.14	0.21	1.30	0.07	13.03	0.06	94.23
	1124C_7H-6_143-145_4	4.01	3.22	1.51	72.04	0.17	0.18	1.28	0.02	12.61	0.00	95.04
	1124C_7H-6_143-145_5	3.97	3.29	1.41	72.37	0.11	0.12	1.12	0.02	12.32	0.04	94.76
	1124C_7H-6_143-145_10	4.16	3.16	1.41	71.83	0.19	0.17	1.29	0.00	12.77	0.02	95.00
	1124C_7H-6_143-145_1	3.89	3.29	1.60	72.13	0.16	0.20	1.35	0.03	12.81	0.02	95.48
	1124C_7H-6_143-145_7	3.91	3.24	1.54	72.43	0.12	0.08	1.14	0.03	12.28	0.00	94.77
	1124C_7H-6_143-145_8	3.76	3.22	1.49	72.22	0.15	0.22	1.30	0.08	12.71	0.03	95.18
	1124C_7H-6_143-145_9	3.77	3.23	1.73	71.84	0.16	0.21	1.26	0.08	12.28	0.02	94.58
	1124C_7H-6_143-145_11	3.85	3.04	1.30	71.55	0.15	0.20	1.28	0.06	12.68	0.06	94.16
	1124C_8H-1_104-106_1	3.36	3.05	1.41	71.38	0.25	0.22	1.47	0.02	11.64	0.01	92.81
	1124C_8H-1_104-106_2	3.47	2.91	1.70	70.91	0.29	0.21	1.42	0.02	11.62	0.04	92.59
	1124C_8H-1_104-106_3	3.54	2.95	1.47	73.28	0.21	0.22	1.48	0.05	11.55	0.07	94.82
	1124C_8H-1_104-106_4	3.54	3.67	1.02	71.92	0.12	0.09	0.99	0.08	11.88	0.00	93.31
	1124C_8H-1_104-106_5	3.59	3.24	1.19	70.95	0.10	0.10	1.12	0.00	11.95	0.03	92.27
	1124C_8H-1_104-106_6	3.56	3.01	1.39	71.74	0.23	0.21	1.43	0.07	11.52	0.01	93.17
	1124C_8H-1_104-106_7	3.42	3.03	1.27	71.75	0.21	0.22	1.52	0.06	11.69	0.00	93.17
	1124C_8H-1_104-106_8	3.64	3.37	1.10	71.89	0.14	0.10	1.06	0.01	11.68	0.00	92.98
	1124C_8H-1_104-106_9	3.56	3.49	1.06	70.54	0.12	0.13	1.00	0.00	11.75	0.00	91.66
	1124C_8H-1_104-106_10	3.76	3.45	0.98	71.39	0.10	0.08	1.04	0.00	11.89	0.04	92.73
	1124C_8H-1_104-106_11	3.72	2.92	1.37	72.88	0.26	0.20	1.46	0.00	11.39	0.09	94.30
	1124C_8H-1_104-106_12	3.82	4.32	0.76	71.52	0.06	0.00	0.57	0.02	11.75	0.00	92.83
	1124C_8H-1_104-106_13	3.46	3.52	1.07	71.05	0.11	0.10	1.07	0.07	11.78	0.02	92.26
	1124C_8H-1_104-106_14	3.43	2.83	1.34	72.97	0.22	0.20	1.44	0.04	11.55	0.00	94.02
	1124C_8H-1_104-106_15	3.37	2.90	1.21	72.78	0.23	0.21	1.42	0.07	11.56	0.02	93.76
	1124C_8H-1_104-106_16	3.30	3.62	0.95	73.14	0.10	0.13	1.04	0.02	11.75	0.02	94.08
	1124C_8H-1_104-106_17	3.61	2.99	1.41	71.83	0.23	0.24	1.42	0.06	11.69	0.03	93.52
	1124C_8H-1_104-106_18	3.65	4.16	0.77	71.43	0.04	0.04	0.61	0.02	11.88	0.01	92.62
	1124C_8H-1_104-106_19	3.36	2.86	1.40	70.53	0.25	0.25	1.44	0.05	11.41	0.01	91.56
	1124C_8H-1_104-106_20	3.48	3.01	1.39	73.45	0.24	0.21	1.43	0.00	11.86	0.01	95.08
	1124C_8H-1_104-106_1	3.39	2.98	1.51	72.58	0.19	0.22	1.47	0.04	11.50	0.02	93.89
	1124C_8H-1_104-106_8	3.59	3.51	1.01	73.11	0.14	0.15	0.98	0.05	11.74	0.01	94.28
	1124C_8H-1_104-106_10	3.21	3.12	1.73	72.51	0.25	0.25	1.41	0.00	11.69	0.01	94.18
	1124C_8H-1_104-106_2	3.46	3.49	1.16	72.92	0.09	0.09	1.01	0.08	11.89	0.00	94.19
	1124C_8H-1_104-106_4	3.47	3.00	1.52	73.80	0.23	0.25	1.44	0.07	11.68	0.00	95.46
	1124C_8H-1_104-106_5	3.04	2.95	1.44	72.04	0.19	0.23	1.44	0.06	11.62	0.01	93.02
	1124C_8H-1_104-106_6	3.38	3.36	0.99	73.74	0.11	0.12	1.03	0.02	11.79	0.04	94.57
	1124C_8H-1_104-106_7	3.05	3.76	1.00	73.57	0.10	0.13	1.06	0.02	11.58	0.05	94.31
s24*	1124D_1H-2_70-72_1	3.81	3.37	1.41	70.43	0.18	0.17	1.27	0.03	12.27	0.02	92.96
	1124D_1H-2_70-72_2	4.07	3.22	1.73	71.99	0.16	0.16	1.28	0.08	12.70	0.06	95.45
	1124D_1H-2_70-72_3	3.87	3.30	1.51	71.40	0.15	0.14	1.23	0.08	12.23	0.00	93.92
	1124D_1H-2_70-72_4	3.80	3.39	1.53	70.96	0.18	0.17	1.33	0.07	12.47	0.00	93.91
	1124D_1H-2_70-72_5	3.73	3.23	1.56	71.97	0.14	0.25	1.30	0.04	12.59	0.03	94.85
	1124D_1H-2_70-72_6	4.02	3.19	1.54	71.30	0.17	0.17	1.29	0.05	12.40	0.01	94.14
	1124D_1H-2_70-72_7	3.93	3.23	1.51	71.75	0.14	0.16	1.32	0.09	12.46	0.00	94.59
	1124D_1H-2_70-72_8	4.10	3.28	1.54	71.82	0.18	0.19	1.29	0.07	12.48	0.00	94.94
	1124D_1H-2_70-72_9	4.26	3.27	1.58	71.93	0.14	0.13	1.34	0.04	12.44	0.02	95.15
	1124D_1H-2_70-72_10	4.12	3.27	1.52	71.63	0.17	0.16	1.27	0.06	12.43	0.01	94.63
	1124D_1H-2_70-72_11	4.22	3.30	1.51	71.29	0.16	0.15	1.21	0.08	12.51	0.07	94.49
	1124D_1H-2_70-72_12	4.39	3.14	1.49	71.47	0.17	0.19	1.31	0.02	12.32	0.00	94.50
	1124D_1H-2_70-72_13	4.15	3.19	1.55	71.42	0.19	0.20	1.24	0.00	12.31	0.02	94.28
	1124D_1H-2_70-72_14	4.06	3.24	1.56	71.76	0.16	0.22	1.24	0.02	12.48	0.05	94.79
	1124D_1H-2_70-72_15	4.17	3.27	1.83	71.74	0.18	0.15	1.27	0.02	12.33	0.00	94.96
	1124D_1H-2_70-72_16	3.90	3.17	1.53	71.59	0.18	0.19	1.30	0.13	12.42	0.00	94.40
	1124D_1H-2_70-72_17	4.27	3.26	1.41	71.50	0.16	0.22	1.28	0.07	12.50	0.00	94.67
	1124D_1H-2_70-72_18	3.85	3.26	1.56	71.33	0.18	0.19	1.29	0.10	12.35	0.02	94.12
	1124D_1H-2_70-72_19	4.28	3.25	1.55	70.42	0.17	0.18	1.26	0.10	12.33	0.03	93.57

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s26	1124D_1H-2_70-72_20	4.11	3.23	1.60	70.75	0.13	0.18	1.27	0.06	12.28	0.01	93.62
	1124D_1H-2_148-150_1	3.70	3.20	0.86	73.80	0.14	0.15	0.97	0.05	11.66	0.00	94.53
	1124D_1H-2_148-150_2	3.56	2.95	1.11	73.75	0.17	0.17	1.27	0.02	11.72	0.05	94.76
	1124D_1H-2_148-150_3	3.53	3.35	1.07	73.74	0.11	0.10	1.00	0.02	11.77	0.00	94.70
	1124D_1H-2_148-150_4	3.66	3.22	1.06	73.67	0.13	0.12	1.01	0.03	11.63	0.00	94.53
	1124D_1H-2_148-150_5	3.41	3.02	1.02	73.62	0.13	0.16	1.21	0.09	11.54	0.00	94.20
	1124D_1H-2_148-150_6	3.49	3.00	1.13	73.10	0.12	0.15	1.20	0.00	11.75	0.05	93.99
	1124D_1H-2_148-150_7	3.64	3.19	0.91	73.80	0.13	0.14	1.05	0.00	11.59	0.01	94.46
	1124D_1H-2_148-150_8	3.41	2.91	1.15	73.40	0.16	0.18	1.28	0.07	11.73	0.01	94.31
	1124D_1H-2_148-150_9	3.76	2.98	1.15	73.04	0.17	0.14	1.38	0.03	11.88	0.01	94.54
	1124D_1H-2_148-150_10	3.65	2.90	1.49	71.23	0.23	0.27	1.69	0.05	12.53	0.03	94.07
	1124D_1H-2_148-150_11	3.64	3.24	1.05	73.10	0.13	0.09	1.02	0.00	11.94	0.02	94.23
	1124D_1H-2_148-150_12	3.60	3.09	1.06	73.66	0.13	0.12	1.19	0.03	11.61	0.02	94.51
	1124D_1H-2_148-150_13	3.72	3.38	1.03	73.92	0.12	0.11	1.03	0.03	11.81	0.01	95.15
	1124D_1H-2_148-150_14	3.75	3.19	1.00	73.98	0.13	0.06	1.00	0.05	11.86	0.02	95.05
	1124D_1H-2_148-150_15	3.75	3.05	1.41	72.66	0.18	0.20	1.42	0.05	12.19	0.04	94.95
	1124D_1H-2_148-150_16	3.67	3.60	0.81	74.01	0.11	0.09	0.88	0.01	11.86	0.01	95.05
	1124D_1H-2_148-150_17	3.62	3.37	0.97	73.49	0.11	0.12	1.01	0.02	11.67	0.02	94.40
	1124D_1H-2_148-150_18	3.55	3.30	1.06	73.65	0.09	0.12	1.01	0.00	11.67	0.00	94.46
	1124D_1H-2_148-150_19	3.73	3.24	1.01	73.86	0.11	0.11	1.01	0.05	11.70	0.01	94.82
	1124D_1H-2_148-150_20	3.63	2.89	0.98	73.73	0.16	0.18	1.22	0.00	11.68	0.00	94.47
	1124D_1H-2_148-150_1	3.37	3.17	1.18	73.71	0.13	0.18	1.22	0.04	11.46	0.04	94.51
	1124D_1H-2_148-150_2	3.61	3.02	1.06	74.07	0.12	0.15	1.21	0.00	11.82	0.00	95.06
	1124D_1H-2_148-150_6	3.23	3.42	1.02	73.55	0.10	0.10	1.04	0.11	11.86	0.05	94.48
	1124D_1H-2_148-150_7	3.54	3.35	1.13	73.32	0.12	0.10	1.03	0.07	11.36	0.00	94.02
	1124D_1H-2_148-150_9	3.43	3.07	1.20	73.75	0.15	0.13	1.29	0.03	12.04	0.03	95.11
	1124D_1H-2_148-150_3	2.85	3.30	1.12	74.39	0.10	0.14	1.01	0.00	11.46	0.00	94.38
	1124D_1H-2_148-150_4	3.42	3.31	1.03	73.00	0.11	0.08	0.99	0.00	11.81	0.01	93.76
	1124D_1H-2_148-150_5	3.30	3.81	0.86	74.25	0.07	0.10	0.80	0.00	11.57	0.02	94.78
	1124D_1H-2_148-150_8	3.32	3.58	0.92	72.55	0.09	0.05	0.88	0.01	11.32	0.05	92.77
	1124D_1H-2_148-150_10	3.60	3.30	1.10	73.49	0.13	0.09	0.95	0.01	11.84	0.00	94.52
	1124D_1H-3W_2-4_1	3.62	3.22	0.95	73.69	0.10	0.14	1.00	0.05	11.55	0.01	94.34
	1124D_1H-3W_2-4_2	3.78	3.13	0.94	72.97	0.12	0.09	1.02	0.01	11.53	0.01	93.58
	1124D_1H-3W_2-4_3	3.53	3.03	0.98	73.77	0.12	0.18	1.22	0.02	11.53	0.02	94.40
	1124D_1H-3W_2-4_4	3.46	2.97	1.09	73.30	0.13	0.13	1.24	0.06	11.32	0.01	93.70
	1124D_1H-3W_2-4_5	3.89	3.04	1.02	73.28	0.09	0.10	1.02	0.01	11.31	0.01	93.77
	1124D_1H-3W_2-4_6	3.60	2.92	1.04	72.65	0.14	0.19	1.22	0.04	11.37	0.01	93.18
	1124D_1H-3W_2-4_7	3.82	3.04	0.99	73.27	0.11	0.15	0.98	0.01	11.55	0.00	93.92
	1124D_1H-3W_2-4_8	3.70	3.19	1.01	73.38	0.10	0.07	0.98	0.10	11.44	0.05	94.02
	1124D_1H-3W_2-4_9	3.60	3.25	1.02	73.10	0.10	0.13	0.97	0.03	11.60	0.02	93.83
	1124D_1H-3W_2-4_10	3.71	2.95	1.04	73.89	0.17	0.18	1.30	0.08	11.57	0.00	94.88
	1124D_1H-3W_2-4_11	3.77	3.28	1.01	73.76	0.07	0.15	0.98	0.02	11.35	0.00	94.39
	1124D_1H-3W_2-4_12	3.66	3.30	0.98	73.36	0.13	0.08	1.01	0.07	11.29	0.04	93.92
	1124D_1H-3W_2-4_13	3.81	3.19	0.92	73.46	0.11	0.09	1.03	0.10	11.52	0.00	94.23
	1124D_1H-3W_2-4_14	3.61	2.91	1.18	73.18	0.11	0.16	1.22	0.08	11.37	0.03	93.86
	1124D_1H-3W_2-4_15	3.71	3.21	0.98	73.69	0.12	0.09	0.99	0.02	11.80	0.01	94.62
	1124D_1H-3W_2-4_16	3.58	3.14	0.94	73.05	0.12	0.11	1.01	0.04	11.56	0.00	93.55
	1124D_1H-3W_2-4_17	3.65	3.14	1.01	73.21	0.10	0.10	1.02	0.05	11.62	0.02	93.92
	1124D_1H-3W_2-4_18	3.47	2.98	1.12	74.10	0.13	0.13	1.28	0.05	11.31	0.01	94.58
	1124D_1H-3W_2-4_19	3.68	3.22	1.11	73.76	0.11	0.09	1.02	0.02	11.59	0.00	94.59
	1124D_1H-3W_2-4_20	3.38	3.20	0.92	73.73	0.10	0.08	0.91	0.05	11.33	0.01	93.72
s29	1124D_1H-3_50-52_1	3.46	3.10	1.04	72.81	0.15	0.13	1.24	0.06	11.52	0.02	93.52
	1124D_1H-3_50-52_2	3.14	3.66	0.87	73.29	0.12	0.11	0.94	0.02	11.36	0.00	93.52
	1124D_1H-3_50-52_3	3.55	3.59	1.00	73.80	0.12	0.14	1.01	0.05	11.57	0.02	94.85
	1124D_1H-3_50-52_4	3.42	3.19	1.02	73.46	0.16	0.18	1.29	0.03	11.55	0.00	94.29
	1124D_1H-3_50-52_5	3.40	3.29	1.15	74.16	0.18	0.17	1.29	0.10	11.73	0.00	95.49
	1124D_1H-3_50-52_6	3.79	3.45	0.87	73.98	0.12	0.13	1.01	0.03	11.54	0.02	94.92
	1124D_1H-3_50-52_7	3.52	3.36	1.22	73.80	0.14	0.12	1.25	0.12	11.70	0.04	95.27
	1124D_1H-3_50-52_8	3.35	3.56	1.13	73.27	0.14	0.12	1.03	0.05	11.52	0.04	94.21
	1124D_1H-3_50-52_9	3.44	3.38	1.11	73.79	0.17	0.13	1.22	0.07	11.53	0.01	94.84
	1124D_1H-3_50-52_10	3.24	3.51	1.04	73.20	0.13	0.12	1.01	0.00	11.38	0.00	93.63
	1124D_1H-3_50-52_11	3.46	3.50	0.94	73.01	0.11	0.10	1.03	0.00	11.31	0.03	93.49
	1124D_1H-3_50-52_12	3.19	3.56	0.91	74.33	0.10	0.14	0.99	0.07	11.46	0.00	94.74
	1124D_1H-3_50-52_13	3.22	3.67	0.82	73.36	0.10	0.10	0.99	0.07	11.34	0.03	93.70
	1124D_1H-3_50-52_14	3.38	3.47	0.95	73.10	0.10	0.12	1.02	0.05	11.53	0.01	93.73
	1124D_1H-3_50-52_15	3.47	3.21	1.06	73.20	0.14	0.17	1.15	0.06	11.56	0.05	94.06
	1124D_1H-3_50-52_16	3.38	3.21	1.11	73.59	0.15	0.10	1.35	0.05	11.37	0.01	94.32
	1124D_1H-3_50-52_17	3.33	3.49	0.89	73.32	0.14	0.10	1.09	0.10	11.37	0.01	93.84
	1124D_1H-3_50-52_18	3.28	3.20	1.05	73.58	0.17	0.17	1.28	0.02	11.20	0.02	93.98
	1124D_1H-3_50-52_19	3.38	3.30	1.08	73.27	0.14	0.15	1.25	0.01	11.53	0.01	94.12

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s30	1124D_1H-3_50-52_20	3.26	3.24	1.04	73.85	0.16	0.17	1.28	0.02	11.36	0.00	94.38
	1124D_1H-3_50-52_1	3.36	3.53	1.02	73.22	0.09	0.12	1.00	0.07	10.77	0.02	93.19
	1124D_1H-3_50-52_2	3.22	3.48	1.14	73.25	0.13	0.14	1.19	0.07	11.07	0.02	93.72
	1124D_1H-3_50-52_3	3.25	3.31	1.15	73.16	0.14	0.13	1.30	0.07	11.44	0.02	93.97
	1124D_1H-3_50-52_4	3.21	3.29	1.10	70.80	0.11	0.12	1.17	0.01	11.45	0.03	91.29
	1124D_1H-3_50-52_5	3.30	3.30	1.11	73.47	0.15	0.12	1.24	0.04	11.65	0.00	94.38
	1124D_1H-3_50-52_6	3.23	3.53	1.03	74.09	0.14	0.13	0.94	0.07	11.46	0.05	94.67
	1124D_1H-3_50-52_7	3.15	3.23	1.11	71.09	0.13	0.09	1.15	0.05	11.04	0.03	91.07
	1124D_1H-3_50-52_8	3.27	3.34	1.22	75.64	0.17	0.11	1.32	0.06	11.84	0.01	96.99
	1124D_1H-3_50-52_9	3.02	3.48	0.86	72.56	0.10	0.09	1.01	0.04	11.49	0.02	92.68
	1124D_1H-3_50-52_10	3.31	3.41	1.04	73.63	0.13	0.15	1.13	0.06	11.55	0.01	94.42
	1124D-1H-4_49-51-1	3.71	3.88	0.94	73.60	0.09	0.07	0.77	0.05	11.52	0.03	94.66
	1124D-1H-4_49-51-2	3.66	3.91	1.13	73.88	0.13	0.11	0.78	0.00	11.78	0.03	95.40
	1124D-1H-4_49-51-3	3.57	4.02	0.98	74.34	0.14	0.13	0.81	0.03	12.02	0.00	96.05
	1124D-1H-4_49-51-4	3.88	3.85	1.09	74.19	0.10	0.11	0.74	0.00	11.60	0.01	95.56
	1124D-1H-4_49-51-5	3.83	3.92	0.95	73.93	0.10	0.09	0.72	0.03	11.62	0.00	95.19
	1124D-1H-4_49-51-6	3.92	3.78	0.92	73.69	0.15	0.12	0.79	0.07	11.46	0.02	94.91
	1124D-1H-4_49-51-7	3.50	4.10	1.10	74.08	0.09	0.13	0.78	0.03	11.71	0.00	95.53
	1124D-1H-4_49-51-8	3.74	3.94	0.93	73.50	0.12	0.09	0.78	0.00	11.46	0.00	94.56
	1124D-1H-4_49-51-9	3.59	3.83	0.92	73.79	0.12	0.09	0.75	0.00	11.58	0.03	94.70
	1124D-1H-4_49-51-10	3.60	3.92	1.05	73.75	0.12	0.14	0.79	0.04	11.60	0.00	95.01
	1124D-1H-4_49-51-11	3.85	3.99	1.02	74.40	0.13	0.11	0.71	0.07	11.76	0.00	96.04
	1124D-1H-4_49-51-12	3.83	4.00	1.04	74.14	0.14	0.08	0.74	0.01	11.89	0.03	95.91
	1124D-1H-4_49-51-13	3.51	4.00	1.11	73.93	0.11	0.11	0.75	0.08	11.62	0.00	95.23
	1124D-1H-4_49-51-14	3.78	3.80	0.81	73.56	0.13	0.09	0.75	0.08	11.94	0.00	94.95
	1124D-1H-4_49-51-15	3.88	3.86	1.02	73.83	0.10	0.10	0.73	0.08	11.42	0.00	95.04
	1124D-1H-4_49-51-16	3.66	3.91	0.97	74.03	0.14	0.12	0.76	0.03	11.61	0.01	95.24
	1124D-1H-4_49-51-17	3.98	3.89	1.08	73.38	0.10	0.11	0.77	0.03	11.44	0.03	94.82
	1124D-1H-4_49-51-18	3.67	4.24	1.12	73.14	0.12	0.08	0.75	0.04	11.36	0.04	94.56
	1124D-1H-4_49-51-19	3.80	3.77	0.89	74.04	0.11	0.10	0.75	0.07	11.71	0.00	95.24
	1124D-1H-4_49-51-20	3.77	3.65	0.98	71.93	0.10	0.12	0.82	0.01	11.34	0.02	92.73
	1124D_1H-4_86-88_1	3.50	3.87	1.01	74.19	0.11	0.07	0.79	0.05	11.65	0.01	95.25
	1124D_1H-4_86-88_2	3.63	3.85	0.95	73.95	0.14	0.07	0.75	0.00	11.67	0.02	95.04
	1124D_1H-4_86-88_3	3.68	3.77	0.98	73.27	0.13	0.09	0.77	0.05	11.88	0.02	94.63
	1124D_1H-4_86-88_4	3.50	3.85	1.08	73.88	0.13	0.11	0.83	0.09	12.00	0.00	95.45
	1124D_1H-4_86-88_5	3.51	3.94	1.01	74.87	0.11	0.14	0.78	0.02	12.01	0.00	96.40
	1124D_1H-4_86-88_6	3.61	3.98	1.03	74.34	0.15	0.11	0.76	0.03	11.90	0.01	95.92
	1124D_1H-4_86-88_7	3.57	3.88	0.86	73.75	0.12	0.08	0.79	0.06	11.77	0.02	94.90
	1124D_1H-4_86-88_8	3.82	3.71	1.08	73.63	0.10	0.10	0.77	0.04	11.87	0.00	95.12
	1124D_1H-4_86-88_9	3.63	3.84	0.88	73.38	0.13	0.11	0.72	0.04	11.51	0.00	94.25
	1124D_1H-4_86-88_10	3.79	3.89	0.96	73.54	0.12	0.07	0.77	0.05	11.77	0.00	94.98
	1124D_1H-4_86-88_11	3.54	3.80	1.04	73.00	0.13	0.14	0.74	0.01	11.61	0.01	94.02
	1124D_1H-4_86-88_12	3.58	3.71	0.97	73.64	0.13	0.09	0.71	0.08	11.78	0.00	94.70
	1124D_1H-4_86-88_13	3.67	3.84	1.07	73.91	0.16	0.11	0.76	0.00	11.89	0.01	95.43
	1124D_1H-4_86-88_14	3.52	3.84	0.93	74.00	0.13	0.11	0.79	0.07	11.84	0.04	95.27
	1124D_1H-4_86-88_15	3.75	3.85	0.96	73.50	0.14	0.07	0.78	0.00	11.75	0.00	94.80
	1124D_1H-4_86-88_16	3.63	4.00	0.94	74.57	0.11	0.06	0.76	0.00	11.79	0.01	95.87
	1124D_1H-4_86-88_17	3.70	3.86	1.06	72.98	0.12	0.10	0.78	0.06	11.62	0.01	94.29
	1124D_1H-4_86-88_18	3.95	3.84	1.04	73.79	0.11	0.07	0.79	0.08	11.81	0.00	95.48
	1124D_1H-4_86-88_19	3.51	3.96	1.01	73.94	0.10	0.11	0.91	0.03	12.02	0.01	95.59
	1124D_1H-4_86-88_20	3.75	3.85	0.92	73.02	0.11	0.08	0.77	0.04	11.52	0.00	94.06
s31	1124D_1H-5_79-81_1	3.35	3.58	0.94	73.38	0.13	0.11	0.94	0.03	11.57	0.00	94.02
	1124D_1H-5_79-81_2	3.42	3.63	1.02	73.98	0.14	0.12	0.96	0.08	11.17	0.03	94.55
	1124D_1H-5_79-81_3	3.46	3.58	1.02	73.65	0.13	0.10	1.06	0.08	11.78	0.01	94.88
	1124D_1H-5_79-81_4	3.62	3.44	1.10	72.91	0.12	0.07	0.99	0.07	11.46	0.03	93.81
	1124D_1H-5_79-81_5	3.60	3.53	0.97	73.38	0.15	0.10	0.94	0.06	11.42	0.01	94.16
	1124D_1H-5_79-81_6	3.40	3.66	0.91	73.87	0.16	0.08	0.99	0.05	11.57	0.01	94.71
	1124D_1H-5_79-81_7	3.77	3.64	0.96	74.00	0.14	0.10	1.02	0.02	11.67	0.02	95.35
	1124D_1H-5_79-81_8	3.50	3.58	1.08	73.18	0.11	0.11	0.96	0.04	11.41	0.03	94.00
	1124D_1H-5_79-81_9	3.43	3.66	1.04	73.89	0.08	0.11	1.10	0.03	11.81	0.00	95.15
	1124D_1H-5_79-81_10	3.33	3.74	1.09	73.53	0.14	0.15	0.95	0.05	11.50	0.04	94.51
	1124D_1H-5_79-81_11	3.49	3.63	1.08	73.36	0.13	0.14	0.95	0.03	11.33	0.00	94.15
	1124D_1H-5_79-81_12	3.31	3.71	1.00	73.93	0.11	0.10	1.00	0.01	11.54	0.03	94.74
	1124D_1H-5_79-81_13	3.53	3.67	1.00	72.96	0.13	0.13	1.00	0.12	11.47	0.03	94.03
	1124D_1H-5_79-81_14	3.54	3.68	0.96	73.84	0.12	0.09	1.01	0.00	11.61	0.05	94.91
	1124D_1H-5_79-81_15	3.57	3.70	1.06	73.90	0.13	0.08	0.98	0.04	11.67	0.03	95.16
	1124D_1H-5_79-81_16	3.56	3.55	1.04	73.63	0.12	0.12	1.00	0.01	11.28	0.00	94.31
	1124D_1H-5_79-81_17	3.48	3.66	1.06	74.43	0.14	0.10	0.97	0.03	11.33	0.01	95.20
	1124D_1H-5_79-81_18	3.75	3.70	1.01	73.77	0.12	0.11	0.97	0.04	11.54	0.01	95.02
	1124D_1H-5_79-81_19	3.46	3.65	1.14	73.15	0.13	0.15	0.98	0.00	11.33	0.05	94.05

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s35*	1124D_1H-5_79-81_20	3.37	3.59	1.13	73.39	0.09	0.09	0.98	0.00	11.34	0.00	93.99
	1124D_1H-5_79-81_1	3.38	3.78	1.16	72.57	0.11	0.11	0.93	0.06	11.78	0.00	93.88
	1124D_1H-5_79-81_4	3.02	3.93	1.10	74.93	0.14	0.12	0.96	0.04	11.98	0.01	96.23
	1124D_1H-5_79-81_5	3.18	3.77	0.99	75.03	0.14	0.10	0.96	0.06	11.84	0.04	96.11
	1124D_1H-5_79-81_7	3.58	3.80	0.92	73.46	0.13	0.13	0.93	0.04	11.63	0.02	94.65
	1124D_1H-5_79-81_8	3.45	3.72	0.96	73.91	0.09	0.14	0.95	0.00	11.73	0.01	94.96
	1124D_1H-5_79-81_3	3.37	3.80	1.03	72.04	0.10	0.11	0.98	0.07	11.69	0.00	93.19
	1124D_1H-5_79-81_6	3.34	3.78	1.02	74.07	0.13	0.11	0.99	0.06	11.89	0.01	95.41
	1124D_1H-5_79-81_9	3.48	3.53	0.95	73.06	0.13	0.11	0.93	0.01	12.11	0.03	94.34
	1124D_1H-5_79-81_10	3.25	3.68	1.08	73.53	0.14	0.14	0.94	0.04	12.02	0.03	94.83
	1124D_1H-5_79-81_2	3.33	3.76	0.74	71.68	0.09	0.14	0.97	0.07	11.52	0.02	92.31
	1124D_1H-7_24-26_1	4.70	3.02	1.87	70.87	0.33	0.20	1.25	0.06	12.61	0.03	94.94
	1124D_1H-7_24-26_2	4.60	3.03	1.93	71.18	0.33	0.23	1.34	0.06	12.51	0.04	95.26
	1124D_1H-7_24-26_3	4.21	3.27	1.24	72.52	0.14	0.04	0.75	0.02	11.95	0.01	94.15
	1124D_1H-7_24-26_4	4.51	2.99	1.94	70.89	0.35	0.28	1.35	0.08	12.71	0.09	95.17
	1124D_1H-7_24-26_5	4.60	2.92	2.06	71.02	0.34	0.29	1.36	0.07	12.61	0.03	95.30
	1124D_1H-7_24-26_6	4.66	2.81	1.94	70.94	0.31	0.23	1.27	0.06	12.77	0.07	95.06
	1124D_1H-7_24-26_7	4.62	2.96	1.83	71.13	0.30	0.23	1.27	0.10	12.65	0.04	95.12
	1124D_1H-7_24-26_8	4.64	2.96	1.84	70.44	0.34	0.25	1.28	0.04	12.39	0.01	94.19
	1124D_1H-7_24-26_9	4.52	3.20	1.53	72.13	0.17	0.11	0.91	0.04	12.22	0.00	94.83
	1124D_1H-7_24-26_10	4.76	3.00	1.76	71.37	0.25	0.13	1.09	0.08	12.51	0.00	94.94
	1124D_1H-7_24-26_11	4.66	3.05	1.72	70.86	0.31	0.22	1.35	0.15	12.46	0.04	94.81
	1124D_1H-7_24-26_12	4.31	3.17	1.55	71.67	0.18	0.18	1.04	0.05	12.10	0.04	94.29
	1124D_1H-7_24-26_13	4.41	3.09	1.50	72.33	0.19	0.14	0.99	0.00	12.22	0.02	94.89
	1124D_1H-7_24-26_14	4.29	3.22	1.45	72.28	0.18	0.12	1.00	0.10	12.38	0.05	95.07
	1124D_1H-7_24-26_15	4.52	2.88	2.00	70.26	0.31	0.20	1.26	0.08	12.52	0.03	94.06
	1124D_1H-7_24-26_16	4.21	2.97	2.17	71.14	0.31	0.25	1.33	0.00	12.62	0.05	95.05
	1124D_1H-7_24-26_17	4.72	3.13	1.70	71.79	0.27	0.19	1.10	0.11	12.48	0.03	95.51
	1124D_1H-7_24-26_18	4.42	2.91	1.85	70.80	0.31	0.20	1.27	0.08	12.55	0.03	94.41
	1124D_1H-7_24-26_19	4.22	2.92	1.83	70.33	0.28	0.21	1.27	0.09	12.43	0.02	93.60
	1124D_1H-7_24-26_20	4.64	3.00	1.94	70.33	0.34	0.29	1.56	0.08	13.05	0.05	95.27
	1124D_1H-7_24-26_3	4.28	3.21	1.46	71.74	0.18	0.14	0.96	0.11	12.38	0.09	94.54
	1124D_1H-7_24-26_2	4.39	3.01	1.86	70.83	0.31	0.26	1.39	0.06	12.43	0.09	94.63
	1124D_1H-7_24-26_4	4.43	3.07	2.06	70.56	0.32	0.24	1.37	0.09	12.29	0.00	94.43
	1124D_1H-7_24-26_5	4.19	3.05	2.05	71.42	0.30	0.24	1.25	0.03	12.63	0.03	95.19
	1124D_1H-7_24-26_10	4.30	3.11	1.92	70.37	0.30	0.24	1.23	0.03	12.69	0.03	94.22
	1124D_1H-7_24-26_1	4.48	3.02	1.90	70.96	0.34	0.26	1.30	0.05	12.70	0.02	95.03
	1124D_1H-7_24-26_8	4.27	3.19	1.65	71.62	0.23	0.14	1.10	0.00	12.81	0.03	95.06
	1124D_1H-7_24-26_9	4.22	3.13	1.83	71.36	0.33	0.22	1.21	0.01	12.11	0.05	94.46
	1124D_1H-7_24-26_7	4.39	2.79	2.75	68.44	0.50	0.51	2.05	0.16	13.56	0.06	95.21
s36	1124D_2H-1_42-44_1	3.83	3.31	1.37	73.20	0.16	0.11	0.86	0.07	11.43	0.01	94.35
	1124D_2H-1_42-44_3	3.99	3.37	1.32	73.33	0.19	0.16	0.82	0.01	11.34	0.02	94.54
	1124D_2H-1_42-44_6	3.96	3.30	1.41	73.20	0.18	0.10	0.83	0.00	11.46	0.00	94.45
	1124D_2H-1_42-44_7	3.90	3.36	1.35	74.15	0.16	0.09	0.80	0.05	11.68	0.02	95.56
	1124D_2H-1_42-44_8	4.14	2.89	1.84	71.64	0.29	0.27	1.53	0.07	12.29	0.05	95.01
	1124D_2H-1_42-44_9	4.17	3.30	1.50	73.40	0.19	0.14	0.82	0.01	11.28	0.05	94.87
	1124D_2H-1_42-44_10	3.91	3.36	1.21	73.16	0.17	0.09	0.83	0.11	11.47	0.00	94.31
	1124D_2H-1_42-44_11	4.05	3.33	1.35	73.44	0.20	0.13	0.79	0.04	11.34	0.04	94.71
	1124D_2H-1_42-44_12	3.97	3.27	1.43	73.45	0.17	0.10	0.82	0.07	11.16	0.03	94.46
	1124D_2H-1_42-44_13	4.07	3.34	1.49	73.84	0.19	0.10	0.83	0.01	11.64	0.00	95.51
	1124D_2H-1_42-44_14	4.09	3.27	1.25	72.75	0.16	0.12	0.81	0.01	11.39	0.02	93.86
	1124D_2H-1_42-44_15	4.14	3.29	1.48	73.95	0.16	0.11	0.81	0.05	11.73	0.03	95.76
	1124D_2H-1_42-44_16	4.29	3.26	1.28	72.81	0.19	0.11	0.83	0.10	11.32	0.01	94.21
	1124D_2H-1_42-44_17	3.98	3.38	1.37	73.08	0.16	0.08	0.87	0.05	11.25	0.00	94.22
	1124D_2H-1_42-44_18	3.97	3.32	1.39	73.69	0.16	0.11	0.82	0.03	11.35	0.05	94.88
	1124D_2H-1_42-44_19	4.11	3.33	1.49	72.78	0.19	0.13	0.93	0.06	11.43	0.03	94.48
	1124D_2H-1_42-44_20	4.11	3.33	1.38	73.51	0.18	0.12	0.78	0.02	11.46	0.01	94.89
s38	1124D_2H-1_128-130_1	3.96	3.36	1.14	72.58	0.17	0.17	1.05	0.09	12.10	0.00	94.61
	1124D_2H-1_128-130_2	3.86	3.43	1.18	72.89	0.16	0.17	1.04	0.04	12.04	0.03	94.85
	1124D_2H-1_128-130_3	3.91	3.39	1.13	72.96	0.17	0.21	1.04	0.03	11.93	0.01	94.78
	1124D_2H-1_128-130_4	3.79	3.41	1.09	72.13	0.15	0.14	1.06	0.00	11.74	0.09	93.59
	1124D_2H-1_128-130_5	3.92	3.44	1.16	72.46	0.16	0.13	1.02	0.04	11.99	0.00	94.32
	1124D_2H-1_128-130_6	3.68	3.55	1.19	72.57	0.21	0.12	1.02	0.04	12.10	0.00	94.48
	1124D_2H-1_128-130_7	3.92	3.41	1.09	72.93	0.19	0.13	1.02	0.06	12.20	0.03	94.97
	1124D_2H-1_128-130_8	4.07	3.30	1.10	72.61	0.17	0.12	1.01	0.08	12.00	0.01	94.48
	1124D_2H-1_128-130_9	3.85	3.46	1.18	72.84	0.17	0.13	1.04	0.06	11.90	0.02	94.64
	1124D_2H-1_128-130_10	3.77	3.38	1.02	72.90	0.15	0.16	1.01	0.11	11.99	0.03	94.52
	1124D_2H-1_128-130_11	3.86	3.39	1.16	72.27	0.21	0.12	1.00	0.02	12.11	0.00	94.14
	1124D_2H-1_128-130_12	4.01	3.34	1.12	72.29	0.13	0.13	1.00	0.02	12.13	0.03	94.19
	1124D_2H-1_128-130_13	3.71	3.43	1.15	72.57	0.18	0.10	1.01	0.09	11.87	0.00	94.11

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s39	1124D_2H-1_128-130_14	3.69	3.35	1.27	72.07	0.14	0.12	1.06	0.00	11.82	0.02	93.53
	1124D_2H-1_128-130_15	3.66	3.37	1.02	72.70	0.17	0.08	1.03	0.04	11.96	0.00	94.04
	1124D_2H-1_128-130_16	3.90	3.55	1.14	72.83	0.16	0.12	1.04	0.03	11.96	0.06	94.78
	1124D_2H-1_128-130_17	4.02	3.39	1.20	72.89	0.13	0.13	1.03	0.08	12.04	0.00	94.92
	1124D_2H-1_128-130_18	3.67	3.28	1.19	72.20	0.16	0.12	0.99	0.00	12.03	0.04	93.68
	1124D_2H-1_128-130_19	3.74	3.37	1.21	72.98	0.15	0.09	1.08	0.13	12.03	0.02	94.80
	1124D_2H-1_128-130_20	3.78	3.28	1.28	72.01	0.14	0.12	1.05	0.04	11.94	0.02	93.66
	1124D_2H-2_53-55_1	4.09	2.80	2.54	69.55	0.42	0.42	1.89	0.07	12.67	0.03	94.48
	1124D_2H-2_53-55_2	4.06	2.78	2.11	70.31	0.44	0.37	1.79	0.07	12.59	0.02	94.54
	1124D_2H-2_53-55_3	4.52	2.74	2.31	70.81	0.40	0.39	1.78	0.04	12.60	0.04	95.63
	1124D_2H-2_53-55_4	3.89	2.88	1.79	70.54	0.32	0.29	1.54	0.12	12.27	0.04	93.68
	1124D_2H-2_53-55_5	4.27	2.91	1.79	71.09	0.37	0.28	1.49	0.05	12.23	0.07	94.54
	1124D_2H-2_53-55_6	4.00	3.25	1.35	73.39	0.14	0.15	0.88	0.06	11.84	0.01	95.06
	1124D_2H-2_53-55_7	3.78	2.92	2.07	70.44	0.41	0.31	1.60	0.04	12.20	0.06	93.82
	1124D_2H-2_53-55_8	3.60	3.30	1.12	73.75	0.12	0.10	0.89	0.00	11.77	0.00	94.64
	1124D_2H-2_53-55_9	4.32	2.88	1.90	70.60	0.35	0.26	1.56	0.08	12.36	0.00	94.32
	1124D_2H-2_53-55_10	4.06	2.93	2.02	71.23	0.37	0.26	1.54	0.08	12.36	0.07	94.91
	1124D_2H-2_53-55_11	4.35	2.82	1.87	71.06	0.36	0.24	1.62	0.10	12.46	0.03	94.92
	1124D_2H-2_53-55_12	3.84	2.93	1.88	70.35	0.37	0.30	1.56	0.04	12.23	0.06	93.56
	1124D_2H-2_53-55_13	4.01	2.86	1.95	71.24	0.35	0.29	1.49	0.06	12.10	0.04	94.38
	1124D_2H-2_53-55_14	3.49	3.33	1.17	72.87	0.13	0.07	0.94	0.03	11.50	0.00	93.54
	1124D_2H-2_53-55_15	3.90	3.26	1.30	73.03	0.19	0.16	1.00	0.04	11.75	0.00	94.62
	1124D_2H-2_53-55_16	4.48	2.81	1.94	70.47	0.36	0.30	1.50	0.12	12.15	0.05	94.18
	1124D_2H-2_53-55_17	4.14	2.89	2.15	70.87	0.33	0.35	1.53	0.05	12.44	0.05	94.81
	1124D_2H-2_53-55_18	3.79	3.36	1.04	73.31	0.13	0.09	0.95	0.07	11.49	0.04	94.27
	1124D_2H-2_53-55_19	4.09	2.81	1.92	71.43	0.35	0.32	1.52	0.00	12.31	0.04	94.80
	1124D_2H-2_53-55_20	4.15	2.79	1.85	70.23	0.34	0.30	1.54	0.01	12.24	0.03	93.48
	1124D_2H-2_53-55_1	4.20	2.82	2.04	72.20	0.33	0.27	1.50	0.12	12.54	0.05	96.07
	1124D_2H-2_53-55_3	4.18	2.75	2.16	71.63	0.33	0.35	1.63	0.03	12.32	0.04	95.42
	1124D_2H-2_53-55_4	4.19	2.69	2.20	71.36	0.37	0.39	1.72	0.11	12.51	0.02	95.57
	1124D_2H-2_53-55_6	4.02	2.89	2.02	72.48	0.35	0.28	1.63	0.16	12.54	0.04	96.42
	1124D_2H-2_53-55_7	4.32	2.79	2.41	71.14	0.36	0.40	1.82	0.03	12.99	0.07	96.32
	1124D_2H-2_53-55_5	3.82	2.91	1.97	72.36	0.34	0.26	1.55	0.12	12.26	0.06	95.66
	1124D_2H-2_53-55_2	3.74	3.40	1.17	74.29	0.18	0.13	1.01	0.02	12.11	0.00	96.06
	1124D_2H-2_53-55_8	3.89	3.06	1.52	72.31	0.24	0.22	1.30	0.06	12.45	0.02	95.07
	1124D_2H-2_53-55_9	3.75	3.36	0.92	74.21	0.14	0.09	0.91	0.00	11.90	0.01	95.30
	1124D_2H-2_53-55_10	3.97	3.20	1.00	74.89	0.12	0.07	0.91	0.00	12.05	0.01	96.22
s40	1124D_2H-2_121-123_1	3.96	3.33	1.03	73.10	0.13	0.11	0.91	0.00	11.55	0.01	94.13
	1124D_2H-2_121-123_2	4.06	3.26	1.23	72.80	0.14	0.15	0.94	0.03	11.48	0.05	94.13
	1124D_2H-2_121-123_3	3.94	3.16	1.13	72.88	0.14	0.15	0.97	0.01	11.45	0.00	93.83
	1124D_2H-2_121-123_4	3.73	3.30	1.16	73.21	0.13	0.14	0.94	0.04	11.37	0.00	94.03
	1124D_2H-2_121-123_5	3.92	3.14	1.20	73.10	0.14	0.10	0.93	0.08	11.22	0.00	93.83
	1124D_2H-2_121-123_6	3.92	3.53	1.13	74.11	0.16	0.11	0.91	0.03	11.60	0.00	95.51
	1124D_2H-2_121-123_7	3.94	3.36	1.23	73.24	0.12	0.06	0.95	0.02	11.40	0.00	94.32
	1124D_2H-2_121-123_8	4.02	3.31	1.16	73.97	0.15	0.16	0.93	0.11	11.64	0.01	95.45
	1124D_2H-2_121-123_9	3.66	3.29	1.15	72.53	0.16	0.11	0.98	0.03	11.41	0.00	93.32
	1124D_2H-2_121-123_10	3.92	3.41	1.06	74.08	0.09	0.16	0.90	0.09	11.63	0.04	95.38
	1124D_2H-2_121-123_11	3.68	3.34	1.12	72.68	0.12	0.11	0.95	0.06	11.42	0.01	93.48
	1124D_2H-2_121-123_12	4.06	3.18	1.06	73.41	0.10	0.10	0.96	0.05	11.65	0.00	94.58
	1124D_2H-2_121-123_13	3.77	3.54	1.07	73.46	0.11	0.12	0.92	0.06	11.38	0.00	94.43
	1124D_2H-2_121-123_14	3.72	3.25	1.13	72.79	0.13	0.14	0.98	0.04	11.43	0.01	93.60
	1124D_2H-2_121-123_15	3.96	3.30	1.08	72.20	0.14	0.13	0.93	0.12	11.51	0.00	93.37
	1124D_2H-2_121-123_16	3.94	3.32	1.13	73.53	0.11	0.11	0.91	0.00	11.64	0.00	94.69
	1124D_2H-2_121-123_17	3.89	3.21	0.99	73.08	0.14	0.11	0.95	0.10	11.75	0.00	94.22
	1124D_2H-2_121-123_18	3.85	3.32	1.17	73.37	0.12	0.12	0.92	0.04	11.67	0.00	94.58
	1124D_2H-2_121-123_19	4.05	3.27	1.14	73.56	0.15	0.11	0.98	0.01	11.67	0.04	94.97
	1124D_2H-2_121-123_20	3.69	3.35	1.08	73.26	0.14	0.11	0.99	0.01	11.67	0.00	94.30
u34	1124D_2H-3_128-130_1	4.57	2.95	1.82	73.16	0.19	0.12	0.99	0.00	12.49	0.03	96.32
	1124D_2H-3_128-130_2	4.57	3.00	1.44	71.35	0.20	0.14	0.99	0.05	12.24	0.00	93.98
	1124D_2H-3_128-130_3	4.51	2.95	1.65	71.94	0.24	0.15	0.96	0.11	12.33	0.03	94.87
	1124D_2H-3_128-130_4	3.87	3.42	0.97	73.74	0.15	0.12	0.92	0.09	11.54	0.00	94.82
	1124D_2H-3_128-130_5	4.65	2.93	1.67	72.53	0.21	0.11	0.95	0.04	12.51	0.01	95.61
	1124D_2H-3_128-130_6	4.44	2.98	1.69	72.48	0.20	0.18	1.00	0.07	12.20	0.04	95.27
	1124D_2H-3_128-130_7	4.75	2.95	1.69	71.64	0.17	0.16	1.03	0.05	12.26	0.00	94.70
	1124D_2H-3_128-130_8	4.66	3.01	1.54	71.60	0.16	0.19	1.01	0.07	12.14	0.02	94.40
	1124D_2H-3_128-130_9	3.81	3.25	1.24	74.14	0.11	0.11	0.95	0.09	11.34	0.06	95.10
	1124D_2H-3_128-130_10	4.55	2.92	1.50	72.22	0.17	0.11	0.97	0.11	12.31	0.03	94.89
	1124D_2H-3_128-130_11	3.68	3.33	1.11	73.88	0.15	0.12	0.95	0.04	11.60	0.00	94.87
	1124D_2H-3_128-130_12	4.58	3.01	1.75	72.91	0.23	0.18	1.01	0.01	12.45	0.00	96.13
	1124D_2H-3_128-130_13	4.85	2.91	1.68	73.00	0.17	0.12	0.95	0.07	12.45	0.01	96.20

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s44	1124D_2H-3_128-130_14	4.59	2.93	1.56	72.51	0.22	0.13	0.99	0.12	12.13	0.00	95.18
	1124D_2H-3_128-130_15	4.97	2.97	1.58	72.18	0.18	0.14	0.99	0.00	12.22	0.02	95.24
	1124D_2H-3_128-130_16	4.48	3.03	1.68	72.97	0.18	0.15	0.99	0.04	12.06	0.00	95.59
	1124D_2H-3_128-130_17	4.47	2.95	1.48	73.62	0.22	0.16	1.01	0.09	12.35	0.00	96.35
	1124D_2H-3_128-130_18	3.94	3.19	1.47	73.16	0.17	0.11	0.81	0.07	11.34	0.00	94.26
	1124D_2H-3_128-130_19	4.58	2.88	1.73	72.41	0.20	0.18	1.01	0.08	12.38	0.02	95.47
	1124D_2H-3_128-130_20	4.56	2.96	1.74	71.47	0.21	0.12	0.96	0.01	12.24	0.01	94.27
	1124D_2H-4_76-78_1	4.48	2.85	1.82	70.69	0.22	0.12	1.11	0.05	12.54	0.03	93.91
	1124D_2H-4_76-78_2	4.08	3.32	1.18	72.22	0.12	0.07	0.74	0.05	11.71	0.02	93.52
	1124D_2H-4_76-78_3	4.53	3.07	1.70	71.72	0.19	0.10	0.94	0.15	12.18	0.00	94.58
	1124D_2H-4_76-78_4	4.22	3.08	1.49	71.10	0.19	0.04	0.86	0.11	11.97	0.02	93.09
	1124D_2H-4_76-78_5	4.66	3.11	1.64	71.37	0.13	0.13	0.92	0.09	12.30	0.06	94.42
	1124D_2H-4_76-78_6	4.40	2.98	1.50	70.23	0.23	0.20	1.13	0.10	12.50	0.05	93.32
	1124D_2H-4_76-78_7	4.66	2.83	1.82	70.45	0.22	0.17	1.17	0.06	12.37	0.03	93.77
	1124D_2H-4_76-78_8	4.64	2.92	1.90	70.36	0.22	0.19	1.17	0.07	12.47	0.02	93.97
	1124D_2H-4_76-78_9	4.37	2.92	1.88	70.27	0.21	0.12	1.13	0.02	12.60	0.01	93.53
	1124D_2H-4_76-78_10	4.41	2.82	1.70	70.03	0.19	0.16	1.14	0.08	12.48	0.02	93.03
	1124D_2H-4_76-78_11	4.47	3.01	1.85	70.22	0.20	0.20	1.18	0.00	12.67	0.00	93.80
	1124D_2H-4_76-78_12	4.18	2.86	1.80	70.21	0.22	0.16	1.14	0.17	12.49	0.05	93.29
	1124D_2H-4_76-78_13	4.44	3.05	1.45	71.05	0.15	0.11	0.87	0.03	12.13	0.01	93.30
	1124D_2H-4_76-78_14	4.28	3.03	1.83	70.56	0.19	0.16	1.14	0.04	12.45	0.02	93.71
	1124D_2H-4_76-78_15	4.46	3.01	1.84	70.36	0.20	0.17	1.13	0.07	12.39	0.01	93.64
	1124D_2H-4_76-78_16	4.45	2.90	1.80	70.39	0.24	0.18	1.13	0.03	12.33	0.01	93.45
	1124D_2H-4_76-78_17	4.56	3.01	1.71	70.78	0.25	0.20	1.18	0.08	12.61	0.00	94.37
	1124D_2H-4_76-78_18	4.55	2.83	1.73	70.96	0.19	0.17	1.17	0.12	12.55	0.03	94.30
	1124D_2H-4_76-78_19	4.50	2.88	1.85	70.54	0.23	0.17	1.15	0.06	12.55	0.01	93.94
	1124D_2H-4_76-78_20	4.19	2.92	1.67	70.47	0.23	0.17	1.14	0.08	12.47	0.02	93.36
	1124D_2H-4_88-90_1	4.47	2.98	1.83	70.08	0.24	0.17	1.14	0.09	12.46	0.03	93.49
	1124D_2H-4_88-90_2	4.76	2.93	1.92	71.17	0.23	0.18	1.16	0.08	12.58	0.05	95.07
	1124D_2H-4_88-90_3	4.14	3.25	1.51	71.78	0.17	0.14	1.05	0.08	12.29	0.03	94.45
	1124D_2H-4_88-90_4	4.47	2.92	1.94	70.27	0.22	0.20	1.12	0.05	12.38	0.00	93.58
	1124D_2H-4_88-90_5	4.31	3.06	2.13	70.75	0.25	0.13	1.14	0.12	12.56	0.03	94.48
	1124D_2H-4_88-90_6	4.52	2.88	2.03	71.00	0.23	0.19	1.16	0.11	12.72	0.02	94.87
	1124D_2H-4_88-90_7	4.33	2.89	1.66	70.70	0.24	0.18	1.13	0.10	12.37	0.02	93.61
	1124D_2H-4_88-90_8	4.78	3.05	1.92	71.18	0.24	0.17	1.18	0.05	12.70	0.00	95.26
	1124D_2H-4_88-90_9	4.43	2.90	1.63	70.46	0.21	0.11	1.15	0.09	12.54	0.03	93.55
	1124D_2H-4_88-90_10	4.37	2.85	1.84	69.84	0.22	0.16	1.12	0.13	12.66	0.04	93.23
	1124D_2H-4_88-90_11	4.29	2.89	1.65	70.78	0.21	0.18	1.15	0.07	12.68	0.04	93.95
	1124D_2H-4_88-90_12	4.76	2.83	1.80	71.25	0.24	0.15	1.13	0.06	12.77	0.04	95.02
	1124D_2H-4_88-90_13	4.64	2.91	1.81	70.38	0.19	0.18	1.12	0.02	12.60	0.01	93.87
	1124D_2H-4_88-90_14	4.55	3.00	2.04	71.15	0.21	0.16	1.14	0.11	12.48	0.05	94.89
	1124D_2H-4_88-90_15	4.63	2.95	1.83	71.57	0.23	0.18	1.14	0.08	12.46	0.04	95.10
	1124D_2H-4_88-90_16	4.59	2.84	1.83	70.70	0.23	0.17	1.17	0.08	12.47	0.06	94.14
	1124D_2H-4_88-90_17	4.40	3.01	1.90	70.84	0.20	0.17	1.17	0.04	12.31	0.00	94.04
	1124D_2H-4_88-90_18	4.48	3.08	1.84	71.63	0.23	0.16	1.14	0.08	12.39	0.05	95.08
	1124D_2H-4_88-90_19	4.50	2.81	1.88	70.50	0.18	0.16	1.15	0.09	12.52	0.03	93.82
	1124D_2H-4_88-90_20	4.33	2.93	1.77	69.92	0.22	0.15	1.13	0.09	12.11	0.02	92.66
	1124D_2H-4_146-148_1	4.12	3.08	1.35	69.80	0.16	0.14	1.02	0.11	12.06	0.02	91.85
	1124D_2H-4_146-148_2	3.85	3.20	1.37	71.42	0.16	0.14	1.01	0.03	12.11	0.00	93.28
	1124D_2H-4_146-148_3	4.21	3.13	1.54	72.23	0.13	0.12	1.02	0.13	12.13	0.03	94.67
	1124D_2H-4_146-148_4	4.44	3.04	1.53	70.17	0.20	0.17	1.21	0.07	12.36	0.00	93.18
	1124D_2H-4_146-148_5	4.42	3.40	1.82	71.56	0.14	0.11	0.98	0.04	12.48	0.00	94.95
	1124D_2H-4_146-148_6	4.08	3.12	1.55	71.53	0.15	0.14	1.04	0.05	12.22	0.01	93.89
	1124D_2H-4_146-148_7	4.07	3.10	1.72	70.26	0.18	0.19	1.18	0.06	12.39	0.02	93.17
	1124D_2H-4_146-148_8	3.99	3.21	1.49	72.00	0.15	0.14	0.98	0.00	11.80	0.03	93.79
	1124D_2H-4_146-148_9	4.25	3.17	1.90	68.12	0.25	0.22	1.33	0.02	12.56	0.06	91.87
	1124D_2H-4_146-148_10	4.55	3.02	1.88	70.60	0.19	0.23	1.43	0.07	12.94	0.01	94.92
	1124D_2H-4_146-148_11	4.40	3.23	1.37	73.21	0.17	0.13	1.04	0.05	12.11	0.00	95.71
	1124D_2H-4_146-148_12	4.11	3.03	1.79	69.31	0.19	0.18	1.16	0.12	12.40	0.01	92.29
	1124D_2H-4_146-148_13	4.43	3.02	1.57	70.22	0.20	0.16	1.19	0.04	12.52	0.03	93.38
	1124D_2H-4_146-148_14	4.29	3.04	1.68	69.83	0.17	0.18	1.18	0.03	12.22	0.00	92.62
	1124D_2H-4_146-148_15	4.20	3.05	1.66	69.62	0.17	0.12	1.16	0.02	12.39	0.00	92.39
	1124D_2H-4_146-148_16	4.51	3.07	1.89	70.57	0.17	0.19	1.29	0.12	12.46	0.00	94.27
	1124D_2H-4_146-148_17	3.52	3.70	0.92	72.26	0.09	0.17	0.93	0.00	11.85	0.00	93.44
	1124D_2H-4_146-148_18	4.04	3.46	1.28	72.12	0.14	0.09	0.69	0.05	11.78	0.02	93.68
	1124D_2H-4_146-148_19	4.63	2.90	1.75	70.56	0.15	0.18	1.19	0.08	12.59	0.02	94.06
	1124D_2H-4_146-148_20	4.38	3.07	1.66	69.46	0.19	0.18	1.16	0.07	12.38	0.04	92.59
	1124D_2H-5_47-49_1	4.41	2.81	1.94	69.92	0.30	0.29	1.38	0.00	12.48	0.01	93.54
	1124D_2H-5_47-49_2	4.44	2.74	1.94	70.24	0.29	0.28	1.37	0.11	12.54	0.05	94.00
	1124D_2H-5_47-49_3	4.39	2.81	1.95	69.71	0.31	0.31	1.44	0.04	12.64	0.00	93.59

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s46	1124D_2H-5_47-49_4	4.35	2.80	1.90	69.52	0.32	0.26	1.36	0.00	12.34	0.04	92.89
	1124D_2H-5_47-49_5	4.46	2.72	1.80	69.82	0.29	0.27	1.47	0.09	12.61	0.04	93.57
	1124D_2H-5_47-49_6	4.22	2.76	1.92	69.44	0.29	0.30	1.43	0.16	12.42	0.04	92.98
	1124D_2H-5_47-49_7	4.29	2.80	1.75	70.41	0.31	0.31	1.40	0.08	12.73	0.03	94.10
	1124D_2H-5_47-49_8	4.45	2.78	2.14	69.30	0.36	0.33	1.69	0.12	13.14	0.00	94.31
	1124D_2H-5_47-49_9	4.47	2.81	1.95	70.43	0.33	0.27	1.43	0.04	12.63	0.05	94.41
	1124D_2H-5_47-49_10	4.39	2.77	1.86	70.60	0.26	0.23	1.37	0.08	12.59	0.01	94.15
	1124D_2H-5_47-49_11	4.37	2.80	1.96	69.48	0.35	0.22	1.52	0.03	12.62	0.06	93.41
	1124D_2H-5_47-49_12	4.43	2.86	1.92	70.74	0.34	0.24	1.40	0.03	12.53	0.03	94.51
	1124D_2H-5_47-49_13	4.54	2.84	2.06	70.41	0.31	0.23	1.40	0.07	12.59	0.05	94.50
	1124D_2H-5_47-49_14	4.44	2.77	1.93	69.56	0.33	0.30	1.46	0.05	12.85	0.07	93.76
	1124D_2H-5_47-49_15	4.84	2.78	1.81	70.72	0.32	0.23	1.40	0.05	12.49	0.03	94.67
	1124D_2H-5_47-49_16	4.52	2.77	1.89	70.44	0.30	0.29	1.43	0.03	12.48	0.00	94.15
	1124D_2H-5_47-49_17	4.56	2.83	2.06	69.99	0.36	0.30	1.48	0.04	12.66	0.01	94.29
	1124D_2H-5_47-49_18	4.02	3.16	1.14	70.55	0.17	0.15	0.88	0.03	11.56	0.02	91.68
	1124D_2H-5_47-49_19	3.66	3.35	1.00	71.82	0.12	0.08	0.80	0.03	11.25	0.00	92.11
	1124D_2H-5_47-49_20	4.71	2.79	1.81	68.08	0.32	0.26	1.40	0.05	12.48	0.00	91.90
	1124D_2H-5_87-89_1	4.46	2.80	1.75	69.89	0.24	0.18	1.15	0.10	12.15	0.03	92.75
	1124D_2H-5_87-89_2	4.76	2.91	1.97	71.03	0.27	0.25	1.43	0.12	12.70	0.05	95.49
	1124D_2H-5_87-89_3	4.41	2.86	1.83	70.84	0.29	0.28	1.46	0.00	12.60	0.02	94.59
	1124D_2H-5_87-89_4	4.36	2.41	2.90	65.98	0.50	0.58	2.34	0.09	13.24	0.08	92.47
	1124D_2H-5_87-89_5	4.64	2.80	1.98	70.68	0.26	0.24	1.39	0.12	12.60	0.04	94.75
	1124D_2H-5_87-89_6	4.51	2.91	1.77	71.14	0.29	0.22	1.37	0.01	12.37	0.07	94.65
	1124D_2H-5_87-89_7	4.17	2.95	1.59	71.13	0.25	0.22	1.44	0.03	12.64	0.04	94.46
	1124D_2H-5_87-89_8	4.77	2.79	1.96	70.31	0.30	0.25	1.39	0.05	12.62	0.07	94.52
	1124D_2H-5_87-89_9	4.53	2.78	1.81	70.73	0.28	0.24	1.42	0.02	12.42	0.04	94.28
	1124D_2H-5_87-89_10	4.48	2.80	1.80	70.60	0.30	0.28	1.40	0.10	12.51	0.00	94.27
	1124D_2H-5_87-89_11	4.53	2.98	1.92	71.61	0.28	0.22	1.39	0.00	12.87	0.01	95.81
	1124D_2H-5_87-89_12	3.34	3.84	1.05	71.87	0.11	0.11	0.80	0.03	11.01	0.02	92.17
	1124D_2H-5_87-89_13	4.51	2.84	1.70	71.06	0.32	0.27	1.47	0.09	12.59	0.06	94.91
	1124D_2H-5_87-89_14	4.42	2.80	1.90	69.95	0.29	0.27	1.44	0.07	12.42	0.05	93.62
	1124D_2H-5_87-89_15	4.48	2.85	1.74	70.50	0.31	0.28	1.39	0.09	12.59	0.03	94.26
	1124D_2H-5_87-89_16	4.51	2.88	1.83	70.69	0.32	0.26	1.47	0.05	12.56	0.02	94.59
	1124D_2H-5_87-89_17	4.46	2.80	1.92	70.47	0.43	0.24	1.40	0.10	12.55	0.00	94.38
	1124D_2H-5_87-89_18	4.54	2.98	1.77	71.24	0.29	0.24	1.36	0.07	12.59	0.04	95.13
	1124D_2H-5_87-89_19	4.63	2.86	1.70	71.18	0.27	0.25	1.38	0.17	12.59	0.01	95.04
	1124D_2H-5_87-89_20	4.34	2.86	1.92	70.36	0.27	0.29	1.29	0.12	12.55	0.06	94.06
	1124D_2H-5_87-89_1	4.35	2.92	1.67	71.50	0.27	0.24	1.40	0.07	12.90	0.05	95.37
	1124D_2H-5_87-89_2	4.43	2.87	1.74	72.49	0.36	0.24	1.40	0.06	13.10	0.03	96.71
	1124D_2H-5_87-89_4	4.21	2.89	1.87	71.65	0.32	0.29	1.36	0.04	12.84	0.00	95.47
	1124D_2H-5_87-89_5	4.19	2.98	1.73	72.43	0.30	0.24	1.38	0.03	12.75	0.03	96.05
	1124D_2H-5_87-89_10	4.25	2.88	1.80	71.16	0.28	0.27	1.40	0.13	13.12	0.02	95.31
	1124D_2H-5_87-89_3	4.30	2.96	1.92	71.17	0.29	0.27	1.49	0.09	13.02	0.03	95.54
	1124D_2H-5_87-89_8	4.47	2.93	1.95	71.91	0.29	0.25	1.42	0.08	12.97	0.04	96.31
	1124D_2H-5_87-89_9	4.18	3.01	1.86	71.53	0.29	0.30	1.51	0.03	12.85	0.01	95.57
	1124D_2H-5_87-89_11	3.93	2.90	1.90	71.22	0.30	0.28	1.45	0.04	12.67	0.05	94.74
	1124D_2H-5_119-121_1	4.30	3.25	1.22	74.10	0.13	0.08	0.81	0.09	11.46	0.02	95.46
	1124D_2H-5_119-121_2	3.90	3.19	1.15	72.85	0.12	0.10	0.73	0.01	11.39	0.01	93.45
	1124D_2H-5_119-121_3	3.96	3.23	1.16	73.22	0.12	0.05	0.78	0.01	11.20	0.03	93.75
	1124D_2H-5_119-121_4	4.12	3.17	1.18	73.43	0.17	0.09	0.78	0.03	11.33	0.00	94.30
	1124D_2H-5_119-121_5	3.89	3.33	1.13	74.43	0.14	0.11	0.83	0.05	11.50	0.01	95.41
	1124D_2H-5_119-121_6	4.02	3.09	1.06	73.06	0.16	0.08	0.77	0.06	11.35	0.02	93.67
	1124D_2H-5_119-121_7	4.23	3.15	1.08	74.08	0.13	0.06	0.82	0.05	11.47	0.00	95.06
	1124D_2H-5_119-121_8	4.02	3.22	1.16	73.82	0.16	0.09	0.80	0.03	11.82	0.03	95.15
	1124D_2H-5_119-121_9	4.12	3.19	1.09	73.23	0.15	0.09	0.82	0.00	11.51	0.00	94.19
	1124D_2H-5_119-121_10	3.99	3.27	0.90	74.09	0.14	0.12	0.83	0.06	11.33	0.02	94.74
	1124D_2H-5_119-121_11	3.97	3.22	1.24	72.66	0.12	0.08	0.77	0.05	11.31	0.01	93.44
	1124D_2H-5_119-121_12	3.75	3.32	1.08	73.55	0.14	0.13	0.79	0.08	11.37	0.01	94.23
	1124D_2H-5_119-121_13	4.07	3.14	1.16	73.46	0.17	0.08	0.80	0.04	11.57	0.02	94.52
	1124D_2H-5_119-121_14	4.05	3.23	1.15	73.35	0.12	0.09	0.78	0.00	11.35	0.00	94.13
	1124D_2H-5_119-121_15	4.16	3.30	1.18	73.81	0.15	0.09	0.83	0.07	11.63	0.00	95.21
	1124D_2H-5_119-121_16	4.15	3.30	1.11	74.49	0.13	0.08	0.78	0.05	11.23	0.00	95.33
	1124D_2H-5_119-121_17	4.08	3.00	1.06	72.21	0.12	0.09	0.76	0.03	11.35	0.00	92.71
	1124D_2H-5_119-121_18	4.21	3.14	1.18	73.09	0.12	0.11	0.80	0.05	11.38	0.02	94.10
	1124D_2H-5_119-121_19	4.17	3.45	1.12	73.99	0.15	0.09	0.75	0.05	11.60	0.00	95.37
	1124D_2H-5_119-121_20	4.08	3.24	1.14	73.63	0.17	0.06	0.81	0.06	11.50	0.00	94.68
	1124D_2H-5_128-130_1	4.06	3.26	1.20	73.82	0.11	0.11	0.75	0.06	11.73	0.00	95.11
	1124D_2H-5_128-130_2	4.05	3.45	1.25	75.11	0.13	0.13	0.78	0.07	11.85	0.02	96.84
	1124D_2H-5_128-130_3	4.24	3.22	1.15	73.96	0.12	0.11	0.82	0.04	11.52	0.00	95.18
	1124D_2H-5_128-130_4	4.21	3.25	1.02	73.76	0.12	0.13	0.80	0.02	11.67	0.00	94.99

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1124D_2H-5_128-130_5	4.46	3.31	1.16	73.48	0.11	0.09	0.75	0.04	11.67	0.00	95.07
	1124D_2H-5_128-130_6	4.14	3.26	1.02	73.84	0.10	0.10	0.78	0.02	11.48	0.00	94.74
	1124D_2H-5_128-130_7	4.30	3.24	1.00	73.81	0.12	0.09	0.80	0.00	11.52	0.02	94.91
	1124D_2H-5_128-130_8	4.26	3.22	1.07	73.47	0.12	0.10	0.80	0.04	11.41	0.00	94.49
	1124D_2H-5_128-130_9	4.18	3.22	0.94	73.23	0.10	0.12	0.77	0.03	11.82	0.00	94.42
	1124D_2H-5_128-130_10	4.02	3.23	1.12	72.96	0.15	0.08	0.76	0.05	11.43	0.04	93.84
	1124D_2H-5_128-130_11	4.17	3.40	1.20	73.63	0.12	0.11	0.73	0.04	11.60	0.00	95.02
	1124D_2H-5_128-130_12	4.22	3.15	1.81	70.24	0.18	0.12	0.93	0.12	12.01	0.03	92.80
	1124D_2H-5_128-130_13	4.24	3.31	1.04	73.56	0.12	0.08	0.76	0.03	11.68	0.01	94.83
	1124D_2H-5_128-130_14	4.24	3.30	1.08	74.05	0.13	0.13	0.80	0.06	11.68	0.03	95.51
	1124D_2H-5_128-130_15	4.30	3.20	1.11	73.60	0.12	0.10	0.81	0.02	11.62	0.00	94.90
	1124D_2H-5_128-130_16	4.30	3.41	1.08	74.30	0.14	0.08	0.79	0.00	11.76	0.01	95.87
	1124D_2H-5_128-130_17	4.27	3.30	1.26	73.43	0.12	0.11	0.81	0.01	11.63	0.02	94.97
	1124D_2H-5_128-130_18	4.21	3.25	1.03	72.55	0.11	0.08	0.77	0.13	11.32	0.00	93.45
	1124D_2H-5_128-130_19	4.11	3.30	1.27	73.61	0.13	0.12	0.82	0.01	11.68	0.02	95.07
	1124D_2H-5_128-130_20	4.03	3.35	1.03	74.29	0.14	0.08	0.79	0.04	11.62	0.00	95.36
s50*	1124D_2H-CC_10-12_1	4.24	3.25	1.20	72.92	0.11	0.09	0.80	0.00	11.84	0.05	94.48
	1124D_2H-CC_10-12_2	4.00	3.24	1.33	73.21	0.16	0.09	0.84	0.00	11.75	0.01	94.64
	1124D_2H-CC_10-12_3	4.41	3.14	1.30	72.26	0.14	0.08	0.86	0.01	11.80	0.00	94.00
	1124D_2H-CC_10-12_4	3.86	3.50	1.46	73.16	0.12	0.09	0.84	0.02	11.90	0.01	94.97
	1124D_2H-CC_10-12_5	4.53	3.14	1.52	71.31	0.16	0.08	1.03	0.07	12.56	0.01	94.42
	1124D_2H-CC_10-12_6	4.27	3.26	1.26	72.04	0.13	0.12	0.85	0.05	11.69	0.02	93.69
	1124D_2H-CC_10-12_7	4.28	3.26	1.21	73.24	0.15	0.03	0.86	0.05	11.83	0.00	94.92
	1124D_2H-CC_10-12_8	3.86	3.65	1.14	73.18	0.14	0.05	0.82	0.08	11.89	0.01	94.82
	1124D_2H-CC_10-12_9	4.47	3.25	1.67	71.99	0.16	0.16	0.98	0.06	12.39	0.01	95.14
	1124D_2H-CC_10-12_10	4.30	3.01	1.56	71.04	0.16	0.13	1.00	0.07	12.21	0.03	93.52
	1124D_2H-CC_10-12_11	4.36	3.17	1.33	71.88	0.12	0.13	0.80	0.11	11.71	0.00	93.62
	1124D_2H-CC_10-12_12	4.26	2.92	1.60	71.32	0.15	0.11	0.98	0.02	12.17	0.02	93.54
	1124D_2H-CC_10-12_13	4.57	3.14	1.61	71.05	0.21	0.11	1.00	0.08	12.20	0.03	94.01
	1124D_2H-CC_10-12_14	4.03	3.28	1.29	72.24	0.13	0.11	0.83	0.04	11.63	0.01	93.59
	1124D_2H-CC_10-12_15	4.25	3.27	1.38	72.71	0.13	0.08	0.85	0.07	11.94	0.00	94.68
	1124D_2H-CC_10-12_16	4.18	3.29	1.34	72.89	0.14	0.07	0.83	0.09	11.85	0.02	94.69
	1124D_2H-CC_10-12_17	4.57	2.94	1.65	70.73	0.16	0.12	0.98	0.06	12.06	0.03	93.30
	1124D_2H-CC_10-12_18	4.24	3.22	1.43	72.17	0.18	0.07	0.86	0.05	12.05	0.05	94.32
	1124D_2H-CC_10-12_19	4.09	3.37	1.35	72.92	0.13	0.07	0.79	0.18	11.76	0.00	94.66
	1124D_2H-CC_10-12_20	3.93	3.13	1.29	72.20	0.11	0.12	0.85	0.10	11.98	0.00	93.72
s52	1124D_2H-CC_10-12_2	4.00	3.45	1.10	73.98	0.11	0.09	0.84	0.00	11.92	0.02	95.51
	1124D_2H-CC_10-12_4	3.80	3.24	1.32	71.40	0.11	0.09	0.87	0.03	12.07	0.02	92.95
	1124D_2H-CC_10-12_5	4.04	3.41	1.25	72.49	0.15	0.08	0.81	0.00	12.07	0.00	94.29
	1124D_2H-CC_10-12_7	3.94	3.36	1.25	72.59	0.12	0.12	0.86	0.04	12.18	0.00	94.45
	1124D_2H-CC_10-12_11	3.97	3.29	1.32	72.87	0.14	0.11	0.79	0.01	12.20	0.00	94.70
	1124D_2H-CC_10-12_12	3.88	3.43	1.15	73.11	0.13	0.09	0.87	0.04	12.10	0.03	94.84
	1124D_2H-CC_10-12_9	3.86	3.31	1.20	73.67	0.12	0.08	0.82	0.03	12.10	0.03	95.22
	1124D_2H-CC_10-12_10	3.72	3.49	1.16	74.53	0.09	0.06	0.74	0.01	11.96	0.00	95.76
	1124D_2H-CC_10-12_1	4.00	3.29	1.69	73.75	0.18	0.13	1.01	0.06	12.78	0.02	96.92
	1124D_2H-CC_10-12_3	4.00	3.21	1.74	72.29	0.19	0.10	0.99	0.09	12.39	0.01	95.00
	1124D_2H-CC_10-12_8	4.42	3.20	1.51	72.89	0.15	0.07	0.98	0.04	12.52	0.05	95.83
	1124D_2H-CC_10-12_6	4.11	3.27	1.49	71.95	0.14	0.09	0.88	0.07	12.11	0.00	94.11
	1124D_2H-CC_10-12_13	4.23	3.15	1.64	72.58	0.16	0.08	0.93	0.08	12.69	0.06	95.59
	1124D_2H-CC_10-12_14	4.57	3.04	1.77	72.55	0.19	0.15	0.96	0.06	12.67	0.04	96.01
	1124D_3H-1_3-5_1	3.75	3.33	1.02	73.30	0.11	0.09	0.96	0.07	11.68	0.01	94.33
	1124D_3H-1_3-5_2	3.69	3.42	1.11	73.20	0.14	0.09	0.94	0.00	11.66	0.00	94.26
	1124D_3H-1_3-5_3	3.82	3.34	0.98	73.72	0.11	0.06	0.93	0.03	11.62	0.00	94.62
	1124D_3H-1_3-5_4	3.67	3.39	1.11	73.48	0.11	0.11	0.93	0.03	11.71	0.00	94.53
	1124D_3H-1_3-5_5	4.08	3.25	1.34	73.23	0.14	0.09	1.06	0.04	11.69	0.03	94.94
	1124D_3H-1_3-5_6	3.63	3.28	1.18	73.35	0.13	0.06	0.95	0.07	11.62	0.00	94.27
	1124D_3H-1_3-5_7	3.66	3.70	0.80	73.38	0.09	0.08	0.76	0.04	11.58	0.02	94.10
	1124D_3H-1_3-5_8	3.77	3.46	1.23	73.66	0.08	0.09	0.95	0.01	11.48	0.04	94.77
	1124D_3H-1_3-5_9	3.72	3.46	1.07	73.85	0.10	0.15	0.95	0.03	11.86	0.02	95.20
	1124D_3H-1_3-5_10	3.79	3.30	1.39	73.61	0.10	0.08	0.98	0.06	11.60	0.03	94.95
	1124D_3H-1_3-5_11	3.86	3.30	1.00	73.40	0.13	0.09	0.92	0.00	11.79	0.00	94.50
	1124D_3H-1_3-5_12	3.75	3.35	1.03	73.25	0.11	0.07	0.95	0.08	11.74	0.01	94.33
	1124D_3H-1_3-5_13	3.77	3.28	1.09	73.50	0.12	0.07	1.00	0.01	11.78	0.00	94.62
	1124D_3H-1_3-5_14	4.06	3.06	1.17	72.84	0.11	0.10	1.03	0.04	11.83	0.02	94.26
	1124D_3H-1_3-5_15	3.92	3.18	1.10	73.59	0.16	0.08	0.95	0.02	11.49	0.01	94.49
	1124D_3H-1_3-5_16	3.91	3.23	0.97	73.16	0.12	0.10	0.93	0.03	11.70	0.02	94.17
	1124D_3H-1_3-5_17	3.61	3.35	1.24	73.08	0.11	0.08	0.89	0.09	11.81	0.01	94.26
	1124D_3H-1_3-5_18	3.67	3.20	1.27	73.12	0.12	0.08	1.05	0.00	11.78	0.00	94.29
	1124D_3H-1_3-5_19	4.03	3.19	1.13	73.23	0.12	0.11	1.01	0.01	11.97	0.02	94.81
	1124D_3H-1_3-5_20	3.62	3.30	1.08	73.15	0.11	0.11	1.00	0.07	11.49	0.00	93.93

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s53	1124D_3H-1_3-5_1	3.84	3.17	1.29	73.22	0.10	0.10	1.04	0.05	11.86	0.00	94.67
	1124D_3H-1_3-5_3	3.59	3.35	1.14	73.38	0.10	0.10	0.98	0.06	11.38	0.01	94.09
	1124D_3H-1_3-5_4	3.29	3.71	1.19	73.45	0.15	0.04	0.91	0.01	11.67	0.00	94.42
	1124D_3H-1_3-5_5	3.37	3.38	0.98	73.52	0.12	0.06	0.94	0.06	11.68	0.00	94.11
	1124D_3H-1_3-5_7	3.56	3.27	1.18	72.59	0.11	0.13	1.11	0.00	11.72	0.00	93.67
	1124D_3H-1_3-5_2	3.65	3.21	1.31	73.96	0.12	0.10	0.96	0.05	11.59	0.00	94.96
	1124D_3H-1_3-5_6	3.53	3.36	1.03	72.98	0.10	0.12	0.94	0.05	11.84	0.02	93.96
	1124D_3H-1_3-5_8	3.49	3.24	1.13	73.18	0.10	0.07	0.95	0.02	11.65	0.05	93.87
	1124D_3H-1_3-5_9	3.69	3.34	1.22	72.93	0.13	0.09	0.95	0.00	11.92	0.03	94.30
	1124D_3H-1_3-5_10	3.82	3.24	1.19	72.14	0.10	0.10	1.02	0.04	11.88	0.01	93.54
	1124D_3H-1_27-29_1	3.37	2.90	1.41	72.85	0.19	0.21	1.52	0.05	11.76	0.00	94.26
	1124D_3H-1_27-29_2	3.67	2.83	1.43	73.42	0.18	0.18	1.50	0.03	11.85	0.00	95.09
	1124D_3H-1_27-29_3	3.73	2.79	1.27	73.07	0.16	0.17	1.51	0.00	11.81	0.02	94.54
	1124D_3H-1_27-29_4	3.64	2.77	1.41	72.93	0.17	0.18	1.53	0.05	11.83	0.02	94.53
	1124D_3H-1_27-29_5	3.50	2.81	1.40	72.84	0.17	0.20	1.48	0.05	11.73	0.02	94.19
	1124D_3H-1_27-29_6	3.77	2.91	1.30	73.11	0.18	0.18	1.51	0.09	12.09	0.02	95.16
	1124D_3H-1_27-29_7	3.94	2.87	1.39	72.93	0.16	0.20	1.48	0.10	11.82	0.03	94.92
	1124D_3H-1_27-29_8	3.75	2.85	1.50	72.79	0.20	0.17	1.47	0.03	11.68	0.00	94.44
	1124D_3H-1_27-29_9	3.44	3.01	1.51	73.27	0.18	0.20	1.53	0.08	12.01	0.00	95.23
	1124D_3H-1_27-29_10	3.58	2.79	1.23	73.16	0.17	0.15	1.53	0.08	11.75	0.01	94.46
	1124D_3H-1_27-29_11	3.74	2.86	1.28	72.96	0.17	0.22	1.50	0.06	11.89	0.02	94.70
u42	1124D_3H-1_27-29_12	3.23	2.87	1.33	72.84	0.19	0.17	1.50	0.05	11.90	0.03	94.12
	1124D_3H-1_27-29_13	3.78	2.99	1.46	73.70	0.15	0.20	1.52	0.00	11.93	0.01	95.74
	1124D_3H-1_27-29_14	3.74	2.82	1.48	73.20	0.17	0.16	1.51	0.06	11.77	0.03	94.94
	1124D_3H-1_27-29_15	3.64	2.86	1.34	73.01	0.19	0.14	1.53	0.04	11.91	0.00	94.66
	1124D_3H-1_27-29_16	3.68	2.84	1.34	72.54	0.17	0.12	1.57	0.15	11.78	0.00	94.18
	1124D_3H-1_27-29_17	3.76	3.20	1.05	73.18	0.12	0.10	0.95	0.02	11.51	0.02	93.90
	1124D_3H-1_27-29_18	3.46	2.79	1.30	72.56	0.20	0.18	1.49	0.07	11.80	0.00	93.85
	1124D_3H-1_27-29_19	4.09	3.23	1.18	73.05	0.11	0.08	0.96	0.06	11.59	0.00	94.35
	1124D_3H-1_27-29_20	3.67	2.85	1.35	72.85	0.16	0.16	1.53	0.07	11.61	0.04	94.29
	1124D_3H-4_96-98_1	4.17	3.18	1.66	72.36	0.14	0.08	1.06	0.10	12.63	0.01	95.39
	1124D_3H-4_96-98_2	4.32	2.99	1.95	71.71	0.12	0.09	1.03	0.10	12.35	0.01	94.67
	1124D_3H-4_96-98_3	4.00	2.93	1.92	71.20	0.14	0.09	0.96	0.05	12.41	0.00	93.69
	1124D_3H-4_96-98_4	4.14	3.03	1.63	72.16	0.15	0.11	1.05	0.08	12.57	0.02	94.94
	1124D_3H-4_96-98_5	4.48	2.83	1.73	71.60	0.14	0.08	1.04	0.03	12.43	0.00	94.36
	1124D_3H-4_96-98_6	3.94	3.13	1.45	71.70	0.11	0.08	0.89	0.06	12.26	0.00	93.61
	1124D_3H-4_96-98_7	4.36	2.93	1.89	72.89	0.11	0.09	1.05	0.06	12.82	0.00	96.20
	1124D_3H-4_96-98_8	4.10	3.10	1.79	72.02	0.13	0.09	1.07	0.02	12.59	0.03	94.93
	1124D_3H-4_96-98_9	3.52	3.15	1.69	64.07	0.14	0.06	0.91	0.00	11.11	0.03	84.70
	1124D_3H-4_96-98_10	4.20	3.15	1.72	72.73	0.15	0.10	1.04	0.07	12.62	0.00	95.78
	1124D_3H-4_96-98_11	4.17	3.06	1.70	72.46	0.14	0.07	1.06	0.03	12.50	0.02	95.21
s55	1124D_3H-4_96-98_12	4.33	0.76	1.85	72.44	0.18	0.08	0.34	0.06	12.52	0.01	92.58
	1124D_3H-4_96-98_13	4.02	0.50	1.80	72.21	0.11	0.09	0.23	0.03	12.53	0.05	91.57
	1124D_3H-4_96-98_14	4.35	3.06	1.61	71.97	0.17	0.12	1.03	0.02	12.44	0.02	94.79
	1124D_3H-4_96-98_15	4.09	3.02	1.72	71.15	0.14	0.12	1.04	0.03	12.36	0.00	93.68
	1124D_3H-4_96-98_16	4.52	2.98	1.91	71.51	0.11	0.06	1.03	0.09	12.38	0.00	94.59
	1124D_3H-4_96-98_17	4.16	3.07	1.63	71.85	0.14	0.10	1.09	0.05	12.40	0.00	94.49
	1124D_3H-4_96-98_18	4.01	3.07	1.84	72.04	0.16	0.07	1.04	0.09	12.32	0.01	94.65
	1124D_3H-4_96-98_19	4.05	2.94	1.91	70.62	0.15	0.12	1.00	0.02	12.08	0.00	92.89
	1124D_3H-4_96-98_20	4.15	2.98	1.71	71.77	0.10	0.07	1.07	0.02	12.62	0.00	94.49
	1124D_3H-4_96-98_1	4.17	3.17	1.94	70.84	0.15	0.10	0.93	0.17	12.41	0.04	93.92
	1124D_3H-4_96-98_2	3.94	3.01	1.70	71.30	0.12	0.09	1.02	0.07	12.28	0.03	93.55
	1124D_3H-4_96-98_4	3.98	3.24	1.71	71.80	0.14	0.09	0.98	0.05	12.43	0.03	94.45
	1124D_3H-4_96-98_8	3.88	3.44	1.83	70.65	0.13	0.11	1.04	0.16	12.09	0.02	93.35
	1124D_3H-4_96-98_9	4.03	3.10	1.69	71.22	0.15	0.05	1.06	0.03	12.06	0.00	93.39
	1124D_3H-4_96-98_3	4.00	3.12	1.78	71.94	0.16	0.09	1.06	0.05	12.38	0.04	94.61
	1124D_3H-4_96-98_5	4.10	3.11	1.77	72.10	0.11	0.11	1.07	0.05	12.41	0.04	94.86
	1124D_3H-4_96-98_6	3.95	3.08	1.76	71.74	0.12	0.12	1.06	0.00	12.23	0.04	94.10
	1124D_3H-4_96-98_7	4.12	3.07	1.82	70.92	0.14	0.10	1.07	0.09	12.23	0.00	93.56
	1124D_3H-4_96-98_10	3.97	3.21	1.58	72.64	0.14	0.10	1.03	0.06	12.82	0.00	95.55
	1124D_3H-4_145-147_1	4.32	2.81	1.97	70.96	0.14	0.12	0.96	0.07	12.26	0.02	93.63
s55	1124D_3H-4_145-147_2	4.27	2.88	1.77	72.33	0.16	0.10	1.01	0.05	12.44	0.01	95.03
	1124D_3H-4_145-147_3	4.64	2.80	1.91	71.72	0.19	0.09	0.99	0.06	12.44	0.00	94.84
	1124D_3H-4_145-147_4	4.35	3.00	1.96	71.84	0.16	0.11	1.03	0.09	12.35	0.02	94.93
	1124D_3H-4_145-147_5	4.24	2.96	1.93	72.45	0.17	0.07	0.96	0.12	12.18	0.03	95.11
	1124D_3H-4_145-147_6	4.49	2.88	2.02	71.18	0.17	0.11	0.94	0.11	12.38	0.00	94.27
	1124D_3H-4_145-147_7	4.26	2.95	2.05	71.17	0.18	0.10	1.00	0.11	12.19	0.03	94.03
	1124D_3H-4_145-147_8	4.50	2.95	1.91	70.63	0.15	0.13	1.00	0.03	12.13	0.00	93.43
	1124D_3H-4_145-147_9	4.10	2.86	1.60	70.73	0.16	0.10	1.02	0.12	12.29	0.02	93.00
	1124D_3H-4_145-147_10	4.54	2.91	1.86	71.77	0.19	0.07	1.05	0.12	12.22	0.02	94.74

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s56*	1124D_3H-4_145-147_11	4.44	2.92	1.88	71.65	0.17	0.13	0.96	0.12	12.15	0.00	94.42
	1124D_3H-4_145-147_12	4.26	2.96	2.02	71.97	0.16	0.08	1.02	0.07	12.37	0.03	94.95
	1124D_3H-4_145-147_13	4.45	3.02	2.18	73.24	0.16	0.11	1.01	0.09	12.68	0.00	96.95
	1124D_3H-4_145-147_14	4.56	2.89	2.03	72.31	0.15	0.09	0.96	0.08	12.35	0.01	95.44
	1124D_3H-4_145-147_15	4.65	2.94	2.01	73.08	0.12	0.08	1.02	0.08	12.63	0.04	96.64
	1124D_3H-4_145-147_16	4.39	2.85	2.03	70.95	0.18	0.07	1.01	0.09	12.09	0.03	93.69
	1124D_3H-4_145-147_17	4.21	3.12	1.94	72.43	0.15	0.09	0.99	0.02	12.30	0.01	95.25
	1124D_3H-4_145-147_18	4.48	2.94	1.88	72.03	0.18	0.11	1.03	0.09	12.37	0.01	95.12
	1124D_3H-4_145-147_19	4.32	2.93	1.98	71.59	0.14	0.08	1.02	0.15	12.26	0.01	94.48
	1124D_3H-4_145-147_20	4.37	2.86	2.10	71.12	0.06	0.10	0.98	0.08	12.37	0.02	94.05
	1124C_10H-6_12-140_4	4.43	3.12	1.83	71.30	0.16	0.12	0.99	0.12	12.35	0.02	94.44
	1124C_10H-6_12-140_5	4.25	2.89	1.83	71.09	0.16	0.07	1.01	0.07	12.16	0.01	93.53
	1124C_10H-6_12-140_6	4.39	3.05	1.93	71.32	0.14	0.10	0.97	0.07	12.56	0.00	94.53
	1124C_10H-6_12-140_7	4.36	3.02	1.91	71.74	0.16	0.09	0.95	0.03	12.43	0.04	94.72
	1124C_10H-6_12-140_8	4.19	2.91	1.95	72.13	0.17	0.12	1.02	0.02	12.54	0.04	95.09
	1124C_10H-6_12-140_1	4.37	3.00	1.92	72.03	0.19	0.13	0.98	0.05	12.50	0.01	95.17
	1124C_10H-6_12-140_2	4.05	2.97	1.94	71.29	0.18	0.09	0.98	0.04	12.46	0.04	94.05
	1124C_10H-6_12-140_3	4.33	3.03	2.03	71.10	0.16	0.09	1.01	0.07	12.24	0.03	94.09
	1124C_10H-6_12-140_9	4.53	3.08	1.88	71.60	0.13	0.08	1.06	0.09	12.50	0.01	94.96
	1124C_10H-6_12-140_10	4.31	2.96	2.11	71.80	0.13	0.10	0.97	0.10	12.56	0.01	95.06
	1124D_3H-5_60-62_1	4.51	2.99	1.95	72.36	0.12	0.09	1.02	0.06	12.65	0.02	95.77
	1124D_3H-5_60-62_2	4.94	2.90	1.85	71.11	0.13	0.08	1.05	0.03	12.72	0.00	94.82
	1124D_3H-5_60-62_3	4.69	2.71	2.29	69.82	0.26	0.17	1.37	0.08	12.91	0.00	94.30
	1124D_3H-5_60-62_4	4.54	2.66	2.11	70.27	0.20	0.14	1.30	0.02	12.90	0.00	94.14
	1124D_3H-5_60-62_5	4.63	2.97	1.94	71.71	0.13	0.12	0.98	0.11	12.55	0.00	95.14
	1124D_3H-5_60-62_6	4.28	2.86	2.09	71.44	0.20	0.18	1.25	0.17	12.99	0.05	95.50
	1124D_3H-5_60-62_7	4.81	2.87	2.17	71.28	0.24	0.20	1.37	0.11	13.47	0.07	96.59
	1124D_3H-5_60-62_8	4.95	2.77	2.40	70.23	0.29	0.25	1.59	0.03	13.46	0.05	96.03
	1124D_3H-5_60-62_9	4.67	2.75	2.22	70.40	0.21	0.17	1.40	0.08	13.23	0.04	95.16
	1124D_3H-5_60-62_10	4.62	2.79	2.31	70.46	0.24	0.16	1.41	0.12	13.21	0.05	95.37
	1124D_3H-5_60-62_11	4.88	2.71	2.32	69.60	0.21	0.18	1.28	0.02	12.93	0.04	94.18
	1124D_3H-5_60-62_12	4.57	2.49	2.35	69.91	0.23	0.22	1.42	0.07	13.03	0.03	94.32
	1124D_3H-5_60-62_13	4.71	2.78	1.98	70.30	0.22	0.16	1.23	0.08	13.08	0.04	94.59
	1124D_3H-5_60-62_14	4.32	2.90	1.88	70.15	0.14	0.10	1.06	0.11	12.60	0.00	93.26
	1124D_3H-5_60-62_15	4.58	2.67	2.17	70.57	0.24	0.12	1.44	0.09	13.37	0.00	95.25
	1124D_3H-5_60-62_16	4.56	2.99	2.07	71.68	0.15	0.11	1.02	0.02	12.70	0.02	95.32
	1124D_3H-5_60-62_17	4.68	0.04	2.27	71.00	0.23	0.22	0.05	0.07	13.33	0.05	91.95
	1124D_3H-5_60-62_18	4.52	1.90	2.28	69.49	0.24	0.22	1.14	0.03	13.39	0.06	93.27
	1124D_3H-5_60-62_19	4.67	2.97	1.81	71.42	0.18	0.09	1.03	0.07	12.69	0.00	94.93
	1124D_3H-5_60-62_20	4.67	3.03	1.89	72.00	0.17	0.10	0.99	0.03	12.64	0.00	95.51
	1124D_3H-5_96-98_1	4.14	3.25	1.92	68.88	0.18	0.10	1.21	0.03	12.22	0.00	91.94
	1124D_3H-5_96-98_2	4.43	3.14	2.00	69.53	0.16	0.11	1.18	0.16	12.39	0.00	93.10
	1124D_3H-5_96-98_3	3.70	4.11	1.52	68.64	0.10	0.05	0.79	0.12	11.46	0.04	90.52
	1124D_3H-5_96-98_4	4.44	2.97	2.13	68.70	0.20	0.10	1.23	0.16	12.15	0.04	92.12
	1124D_3H-5_96-98_5	4.27	3.00	2.21	69.09	0.19	0.21	1.31	0.13	12.47	0.02	92.90
	1124D_3H-5_96-98_6	3.99	3.31	1.72	69.77	0.19	0.13	1.17	0.10	12.20	0.02	92.60
	1124D_3H-5_96-98_7	2.63	4.09	1.56	69.52	0.12	0.02	0.97	0.07	11.71	0.01	90.69
	1124D_3H-5_96-98_8	3.27	4.46	1.49	69.56	0.09	0.05	0.82	0.06	11.60	0.00	91.40
	1124D_3H-5_96-98_9	4.52	2.94	2.13	69.15	0.19	0.16	1.37	0.00	12.53	0.01	93.00
	1124D_3H-5_96-98_10	4.65	3.02	1.82	70.48	0.17	0.09	0.90	0.05	11.75	0.03	92.97
	1124D_3H-5_96-98_11	4.13	3.29	1.50	70.43	0.11	0.05	0.76	0.06	11.40	0.02	91.75
	1124D_3H-5_96-98_13	3.13	4.14	1.54	68.68	0.10	0.06	0.76	0.12	11.27	0.00	89.81
	1124D_3H-5_96-98_14	4.52	2.77	2.26	68.14	0.18	0.13	1.35	0.09	12.13	0.03	91.59
	1124D_3H-5_96-98_15	3.47	4.64	1.42	70.58	0.11	0.06	0.77	0.10	11.59	0.03	92.76
	1124D_3H-5_96-98_16	4.23	3.19	1.89	70.14	0.13	0.12	1.07	0.06	11.97	0.01	92.81
	1124D_3H-5_96-98_17	4.27	2.99	2.35	68.19	0.22	0.17	1.39	0.06	12.48	0.01	92.12
	1124D_3H-5_96-98_18	4.25	3.11	2.09	69.75	0.18	0.13	1.16	0.12	12.38	0.02	93.18
	1124D_3H-5_96-98_19	4.60	2.88	2.16	68.71	0.21	0.15	1.38	0.07	12.42	0.03	92.62
	1124D_3H-5_96-98_20	2.94	4.38	1.30	68.65	0.13	0.08	0.75	0.06	11.26	0.00	89.56
s57	1124D_3H-5_112-114_1	4.52	2.90	2.24	70.53	0.15	0.09	1.27	0.13	12.54	0.00	94.37
	1124D_3H-5_112-114_2	4.52	2.87	2.24	70.58	0.19	0.10	1.28	0.02	12.71	0.02	94.54
	1124D_3H-5_112-114_3	4.63	2.90	1.94	70.36	0.18	0.11	1.28	0.08	12.59	0.04	94.11
	1124D_3H-5_112-114_4	4.51	2.79	2.11	71.03	0.18	0.10	1.29	0.06	12.41	0.03	94.50
	1124D_3H-5_112-114_5	4.22	3.33	2.08	71.19	0.19	0.10	1.30	0.06	12.74	0.00	95.22
	1124D_3H-5_112-114_6	4.61	2.93	1.94	70.69	0.18	0.14	1.24	0.08	12.38	0.00	94.19
	1124D_3H-5_112-114_7	4.16	2.92	2.13	69.92	0.18	0.16	1.26	0.01	12.39	0.00	93.14
	1124D_3H-5_112-114_8	4.47	2.87	2.22	70.69	0.17	0.12	1.26	0.06	12.57	0.01	94.44
	1124D_3H-5_112-114_9	4.27	2.91	2.25	70.58	0.17	0.12	1.26	0.16	12.53	0.00	94.24
	1124D_3H-5_112-114_10	4.37	2.89	2.15	70.31	0.18	0.09	1.28	0.13	12.51	0.00	93.92
	1124D_3H-5_112-114_11	4.73	2.87	2.33	69.99	0.16	0.08	1.31	0.00	12.20	0.04	93.70

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1124D_3H-5_112-114_12	4.53	2.97	2.33	70.66	0.16	0.10	1.27	0.10	12.49	0.02	94.64
	1124D_3H-5_112-114_13	4.59	2.72	2.46	69.41	0.21	0.11	1.33	0.07	12.28	0.00	93.19
	1124D_3H-5_112-114_14	4.54	2.92	2.06	70.68	0.16	0.12	1.28	0.10	12.71	0.03	94.60
	1124D_3H-5_112-114_15	4.97	2.83	2.30	70.92	0.21	0.10	1.33	0.14	12.43	0.04	95.26
	1124D_3H-5_112-114_16	4.51	2.84	2.09	70.96	0.16	0.10	1.26	0.01	12.41	0.05	94.39
	1124D_3H-5_112-114_17	4.57	2.89	2.15	70.40	0.21	0.17	1.34	0.04	12.42	0.04	94.23
	1124D_3H-5_112-114_18	4.75	2.91	2.17	71.08	0.17	0.13	1.30	0.05	12.58	0.00	95.14
	1124D_3H-5_112-114_19	4.57	2.82	2.10	70.18	0.17	0.11	1.29	0.05	12.17	0.03	93.49
	1124D_3H-5_112-114_20	4.79	2.91	1.77	71.90	0.19	0.09	0.99	0.08	12.12	0.00	94.85
	1124D_3H-5_112-114_2	4.46	2.86	2.18	70.02	0.16	0.10	1.27	0.08	12.58	0.05	93.76
	1124D_3H-5_112-114_4	4.46	2.99	2.24	70.06	0.17	0.12	1.24	0.04	12.88	0.02	94.22
	1124D_3H-5_112-114_5	4.35	2.83	2.09	69.96	0.17	0.12	1.27	0.16	12.57	0.02	93.53
	1124D_3H-5_112-114_6	4.10	3.04	2.18	70.05	0.18	0.11	1.19	0.01	13.28	0.02	94.16
	1124D_3H-5_112-114_7	4.31	2.92	2.20	70.56	0.18	0.14	1.28	0.09	13.05	0.00	94.72
	1124D_3H-5_112-114_8	4.41	2.90	2.31	69.89	0.19	0.12	1.27	0.07	12.80	0.02	93.97
	1124D_3H-5_112-114_9	4.17	2.83	2.29	69.81	0.17	0.11	1.29	0.05	12.81	0.03	93.57
	1124D_3H-5_112-114_1	4.31	2.88	2.21	70.01	0.15	0.05	1.28	0.04	12.68	0.02	93.63
	1124D_3H-5_112-114_10	4.49	2.89	2.34	69.79	0.19	0.15	1.34	0.10	12.76	0.01	94.06
	1124D_3H-5_112-114_11	4.32	2.90	2.14	70.07	0.17	0.13	1.25	0.09	12.43	0.01	93.51
	1124D_3H-5_112-114_12	4.34	2.88	2.23	68.95	0.16	0.12	1.27	0.02	12.70	0.05	92.72
	1124D_3H-5_112-114_13	4.23	2.96	2.03	69.64	0.13	0.16	1.28	0.03	12.56	0.02	93.05
	1124D_3H-5_147-149_1	3.91	3.73	1.00	73.34	0.07	0.01	0.56	0.03	11.50	0.00	94.15
	1124D_3H-5_147-149_2	4.43	3.23	1.86	71.84	0.10	0.05	1.03	0.05	12.04	0.00	94.62
	1124D_3H-5_147-149_3	4.25	3.25	1.74	72.22	0.11	0.07	0.99	0.07	12.25	0.03	94.98
	1124D_3H-5_147-149_4	4.17	3.29	1.70	72.09	0.11	0.09	0.91	0.04	12.13	0.00	94.53
	1124D_3H-5_147-149_5	4.31	3.64	1.10	73.24	0.06	0.01	0.57	0.01	11.53	0.00	94.47
	1124D_3H-5_147-149_6	4.25	3.33	1.65	72.84	0.12	0.01	0.86	0.05	11.91	0.00	95.02
	1124D_3H-5_147-149_7	4.23	3.44	1.69	72.86	0.12	0.01	0.92	0.05	11.98	0.00	95.30
	1124D_3H-5_147-149_8	4.48	3.22	1.64	71.42	0.14	0.08	0.99	0.07	12.16	0.00	94.20
	1124D_3H-5_147-149_9	4.38	3.34	1.66	73.14	0.12	0.04	0.87	0.05	12.29	0.00	95.90
	1124D_3H-5_147-149_10	4.30	3.23	1.81	72.72	0.10	0.07	0.87	0.06	11.87	0.00	95.03
	1124D_3H-5_147-149_11	4.36	3.36	1.73	72.56	0.09	0.10	0.92	0.05	11.97	0.00	95.14
	1124D_3H-5_147-149_12	4.45	3.23	1.75	72.42	0.13	0.04	0.90	0.05	12.01	0.00	94.98
	1124D_3H-5_147-149_13	4.30	3.28	1.75	72.40	0.08	0.08	0.92	0.02	12.20	0.01	95.03
	1124D_3H-5_147-149_14	4.20	3.18	1.81	71.55	0.13	0.07	1.02	0.02	12.19	0.01	94.19
	1124D_3H-5_147-149_15	4.25	3.37	1.60	72.56	0.09	0.03	0.88	0.06	11.81	0.00	94.66
	1124D_3H-5_147-149_16	4.36	3.23	1.78	71.12	0.11	0.05	1.03	0.01	12.03	0.00	93.72
	1124D_3H-5_147-149_17	4.49	3.37	1.48	72.82	0.11	0.04	0.80	0.08	11.75	0.02	94.96
	1124D_3H-5_147-149_18	4.44	3.49	1.57	72.68	0.12	0.01	0.90	0.07	11.79	0.02	95.10
	1124D_3H-5_147-149_19	4.72	3.20	1.67	72.32	0.09	0.06	0.90	0.03	12.03	0.03	95.05
	1124D_3H-5_147-149_20	3.95	3.25	1.74	71.58	0.11	0.03	0.92	0.07	11.94	0.00	93.58
	1124D_3H-5_147-149_5	4.26	3.30	1.71	72.14	0.10	0.07	1.01	0.04	12.27	0.04	94.94
	1124D_3H-5_147-149_6	4.08	3.39	1.59	72.94	0.08	0.06	0.89	0.11	12.46	0.04	95.63
	1124D_3H-5_147-149_7	4.12	3.28	1.57	72.17	0.12	0.07	0.89	0.05	12.55	0.01	94.83
	1124D_3H-5_147-149_1	4.16	3.14	1.67	72.17	0.09	0.04	0.89	0.04	12.61	0.03	94.85
	1124D_3H-5_147-149_10	4.17	3.30	1.51	73.23	0.12	0.06	0.93	0.10	12.51	0.00	95.93
s58*	1124D_3H-6_5-7_1	4.27	3.46	1.57	72.14	0.09	0.04	0.84	0.08	12.12	0.02	94.63
	1124D_3H-6_5-7_2	4.26	3.21	1.62	70.85	0.12	0.06	0.90	0.10	12.08	0.02	93.21
	1124D_3H-6_5-7_3	4.10	3.20	1.54	69.59	0.12	0.06	0.91	0.11	12.00	0.00	91.62
	1124D_3H-6_5-7_4	4.19	3.25	1.49	71.68	0.11	0.02	0.89	0.02	11.91	0.01	93.57
	1124D_3H-6_5-7_5	4.42	3.04	1.81	70.61	0.11	0.06	1.02	0.01	12.33	0.01	93.42
	1124D_3H-6_5-7_6	4.48	3.06	1.76	70.33	0.09	0.06	1.01	0.02	12.44	0.03	93.28
	1124D_3H-6_5-7_7	4.44	3.09	1.71	70.45	0.14	0.02	0.98	0.08	12.58	0.06	93.54
	1124D_3H-6_5-7_8	4.28	3.05	1.85	70.52	0.11	0.06	1.01	0.10	12.31	0.03	93.32
	1124D_3H-6_5-7_9	4.27	3.05	1.76	70.95	0.08	0.07	0.97	0.07	12.30	0.00	93.52
	1124D_3H-6_5-7_10	4.43	3.08	1.82	69.99	0.08	0.08	1.05	0.06	12.24	0.01	92.84
	1124D_3H-6_5-7_11	4.59	3.22	1.59	71.44	0.13	0.06	0.89	0.00	12.10	0.00	94.02
	1124D_3H-6_5-7_12	4.21	3.22	1.52	69.97	0.09	0.06	0.88	0.09	11.70	0.01	91.75
	1124D_3H-6_5-7_13	4.48	3.03	1.88	71.56	0.14	0.08	1.06	0.02	12.24	0.03	94.52
	1124D_3H-6_5-7_14	4.64	3.04	1.97	69.83	0.15	0.08	1.06	0.07	12.56	0.00	93.40
	1124D_3H-6_5-7_15	4.23	3.05	1.69	70.47	0.09	0.08	1.03	0.01	12.46	0.03	93.14
	1124D_3H-6_5-7_16	4.44	2.99	1.92	70.49	0.13	0.04	0.99	0.15	12.08	0.00	93.23
	1124D_3H-6_5-7_17	4.50	3.03	1.63	71.08	0.15	0.09	1.00	0.09	12.22	0.00	93.79
	1124D_3H-6_5-7_18	4.36	3.22	1.53	72.01	0.10	0.03	0.81	0.11	11.96	0.00	94.13
	1124D_3H-6_5-7_19	4.56	3.07	1.67	71.00	0.14	0.03	1.05	0.00	12.34	0.01	93.87
	1124D_3H-6_5-7_20	4.27	3.04	1.62	70.70	0.11	0.06	1.06	0.08	12.12	0.01	93.07
	1124D_3H-5_147-149_3	4.20	3.15	1.70	72.12	0.12	0.05	0.99	0.08	12.52	0.03	94.97
	1124D_3H-5_147-149_8	4.17	3.11	1.80	71.09	0.11	0.04	0.97	0.04	12.42	0.01	93.77
	1124D_3H-5_147-149_2	4.19	3.30	1.87	71.99	0.11	0.07	1.00	0.00	12.35	0.02	94.91
	1124D_3H-5_147-149_4	4.43	3.27	1.84	72.36	0.12	0.07	1.07	0.05	12.40	0.00	95.61

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s59	1124D_3H-6_46-48_1	4.32	3.21	1.66	72.34	0.13	0.08	1.01	0.08	12.28	0.00	95.10
	1124D_3H-6_46-48_2	3.96	3.27	1.87	72.14	0.12	0.03	1.01	0.08	11.86	0.00	94.34
	1124D_3H-6_46-48_3	4.28	3.29	1.52	72.57	0.10	0.03	0.91	0.03	12.03	0.03	94.80
	1124D_3H-6_46-48_4	4.34	3.25	1.76	71.47	0.11	0.07	0.97	0.07	12.15	0.00	94.19
	1124D_3H-6_46-48_5	4.18	3.29	1.34	71.89	0.11	0.10	0.90	0.00	11.64	0.01	93.46
	1124D_3H-6_46-48_6	4.01	3.39	1.75	72.21	0.11	0.02	1.03	0.01	12.12	0.00	94.66
	1124D_3H-6_46-48_7	4.24	3.28	1.72	72.01	0.10	0.08	1.04	0.05	12.01	0.03	94.56
	1124D_3H-6_46-48_8	4.07	3.38	1.72	73.10	0.14	0.10	1.04	0.08	12.12	0.01	95.76
	1124D_3H-6_46-48_9	4.24	3.27	1.78	72.88	0.10	0.10	1.00	0.04	12.09	0.00	95.50
	1124D_3H-6_46-48_10	4.14	3.29	1.50	72.53	0.16	0.06	1.10	0.04	12.27	0.02	95.11
	1124D_3H-6_46-48_11	3.68	3.59	1.20	73.47	0.07	0.09	0.89	0.00	11.85	0.01	94.86
	1124D_3H-6_46-48_12	4.12	3.31	1.72	72.68	0.14	0.07	1.05	0.07	12.33	0.00	95.48
	1124D_3H-6_46-48_13	4.20	3.38	1.46	73.16	0.09	0.07	0.90	0.02	12.10	0.01	95.39
	1124D_3H-6_46-48_14	4.11	3.14	1.45	71.94	0.13	0.05	0.90	0.08	11.79	0.01	93.60
	1124D_3H-6_46-48_15	4.05	3.38	1.60	72.19	0.11	0.02	0.88	0.00	11.81	0.00	94.05
	1124D_3H-6_46-48_16	4.14	3.26	1.68	72.82	0.13	0.10	1.02	0.02	12.02	0.00	95.18
	1124D_3H-6_46-48_17	4.22	3.23	1.79	71.90	0.13	0.04	1.03	0.03	12.01	0.04	94.42
	1124D_3H-6_46-48_18	4.07	3.31	1.58	72.65	0.06	0.07	0.96	0.08	11.86	0.02	94.67
	1124D_3H-6_46-48_19	4.36	3.28	1.48	72.57	0.11	0.04	0.84	0.04	12.00	0.00	94.72
	1124D_3H-6_46-48_20	4.55	3.18	1.69	72.32	0.12	0.07	1.00	0.07	12.09	0.00	95.09
s60	1124D_3H-6_116-118_1	4.16	3.10	2.08	71.06	0.23	0.17	1.60	0.02	12.68	0.00	95.10
	1124D_3H-6_116-118_2	4.18	3.06	1.81	70.96	0.21	0.27	1.51	0.00	12.62	0.04	94.67
	1124D_3H-6_116-118_3	4.17	2.85	2.10	70.08	0.25	0.30	1.73	0.04	12.75	0.04	94.31
	1124D_3H-6_116-118_4	4.57	2.97	1.93	70.52	0.24	0.25	1.57	0.07	12.69	0.05	94.87
	1124D_3H-6_116-118_5	4.02	3.02	1.92	70.29	0.26	0.25	1.58	0.05	12.62	0.02	94.03
	1124D_3H-6_116-118_6	4.30	2.98	2.11	70.34	0.23	0.24	1.63	0.02	12.81	0.05	94.70
	1124D_3H-6_116-118_7	4.34	2.94	2.01	69.56	0.24	0.29	1.65	0.10	13.05	0.05	94.22
	1124D_3H-6_116-118_8	4.09	2.92	2.03	69.36	0.24	0.26	1.81	0.05	12.66	0.04	93.46
	1124D_3H-6_116-118_9	4.53	2.94	1.82	70.27	0.23	0.22	1.54	0.03	12.60	0.02	94.21
	1124D_3H-6_116-118_10	4.09	3.02	1.81	70.69	0.21	0.25	1.44	0.04	12.49	0.01	94.06
	1124D_3H-6_116-118_11	3.98	2.77	2.11	69.60	0.25	0.26	1.70	0.08	12.82	0.03	93.59
	1124D_3H-6_116-118_12	4.32	2.83	1.96	69.75	0.26	0.27	1.62	0.07	12.65	0.00	93.73
	1124D_3H-6_116-118_13	4.38	3.06	1.93	70.45	0.27	0.26	1.72	0.06	12.75	0.05	94.93
	1124D_3H-6_116-118_14	4.18	2.83	1.83	69.17	0.24	0.29	1.63	0.01	12.55	0.09	92.82
	1124D_3H-6_116-118_15	4.15	2.89	1.85	70.04	0.24	0.27	1.68	0.01	12.37	0.04	93.54
	1124D_3H-6_116-118_16	4.27	2.94	2.04	70.46	0.22	0.25	1.62	0.05	12.69	0.00	94.54
	1124D_3H-6_116-118_17	4.37	3.01	1.90	70.24	0.26	0.29	1.79	0.01	13.02	0.04	94.92
	1124D_3H-6_116-118_18	4.32	2.84	1.90	69.82	0.25	0.30	1.67	0.05	12.64	0.01	93.79
	1124D_3H-6_116-118_19	4.07	2.85	2.04	69.27	0.27	0.25	1.65	0.03	12.75	0.03	93.22
	1124D_3H-6_116-118_20	4.26	3.19	1.56	71.85	0.19	0.11	1.22	0.06	12.19	0.05	94.68
s64	1124D_4H-2_69-71_1	3.78	3.01	2.00	70.17	0.24	0.25	1.67	0.01	12.75	0.06	93.93
	1124D_4H-2_69-71_2	3.92	2.98	1.96	69.21	0.25	0.21	1.67	0.09	13.44	0.02	93.75
	1124D_4H-2_69-71_3	4.16	3.11	2.00	70.05	0.25	0.23	1.58	0.04	13.39	0.04	94.85
	1124D_4H-2_69-71_4	3.88	3.04	2.11	71.00	0.23	0.31	1.68	0.03	13.39	0.04	95.71
	1124D_4H-2_69-71_5	3.94	2.94	2.02	69.96	0.21	0.24	1.52	0.09	12.64	0.04	93.61
	1124D_4H-2_69-71_6	4.07	3.01	2.06	69.67	0.21	0.28	1.70	0.00	12.94	0.01	93.96
	1124D_4H-2_69-71_7	3.77	3.11	2.18	70.65	0.27	0.24	1.63	0.04	13.25	0.08	95.22
	1124D_4H-2_69-71_8	4.55	3.08	2.00	70.94	0.15	0.07	1.01	0.00	12.39	0.01	94.21
	1124D_4H-2_69-71_9	4.64	3.18	2.05	70.53	0.16	0.08	1.02	0.17	12.45	0.00	94.28
	1124D_4H-2_69-71_10	4.37	3.21	2.20	70.16	0.16	0.07	1.03	0.06	12.45	0.01	93.72
	1124D_4H-2_69-71_11	4.63	3.17	1.90	70.49	0.15	0.07	1.05	0.07	12.50	0.03	94.05
	1124D_4H-2_69-71_12	4.87	3.09	1.98	70.45	0.16	0.10	0.97	0.03	12.26	0.02	93.94
	1124D_4H-2_69-71_13	4.70	3.01	2.18	70.71	0.17	0.06	1.00	0.06	12.44	0.00	94.34
	1124D_4H-2_69-71_14	4.38	3.48	1.93	70.04	0.18	0.07	1.05	0.00	12.30	0.02	93.45
	1124D_4H-2_69-71_15	4.62	3.05	2.02	70.29	0.17	0.08	0.98	0.12	12.52	0.01	93.86
	1124D_4H-2_69-71_16	4.36	3.22	2.22	69.91	0.17	0.09	1.02	0.08	12.46	0.02	93.54
	1124D_4H-2_69-71_17	4.62	3.28	2.09	70.39	0.15	0.04	1.04	0.08	12.53	0.00	94.22
	1124D_4H-2_69-71_18	4.38	3.13	2.03	69.76	0.17	0.09	0.99	0.12	12.46	0.01	93.14
	1124D_4H-2_69-71_19	4.70	3.10	2.12	70.68	0.16	0.05	1.04	0.09	12.52	0.03	94.49
	1124D_4H-2_69-71_20	4.63	3.21	2.17	70.64	0.16	0.10	1.02	0.05	12.44	0.00	94.43
s65	1124D_4H-2_116-118_1	4.80	3.08	2.08	70.25	0.16	0.05	1.00	0.07	12.29	0.08	93.86
	1124D_4H-2_116-118_2	4.74	3.25	1.89	71.44	0.14	0.07	1.04	0.09	12.53	0.02	95.21
	1124D_4H-2_116-118_3	4.56	3.09	2.08	70.26	0.15	0.08	1.00	0.09	12.46	0.06	93.84

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1124D_4H-2_116-118_4	4.35	3.33	2.03	71.36	0.12	0.08	1.05	0.03	12.02	0.00	94.38
	1124D_4H-2_116-118_5	4.05	3.35	2.11	70.96	0.16	0.04	1.09	0.21	11.89	0.00	93.86
	1124D_4H-2_116-118_6	4.59	3.32	1.92	71.79	0.14	0.04	1.02	0.09	12.14	0.02	95.08
	1124D_4H-2_116-118_7	4.15	3.32	2.07	70.52	0.13	0.06	1.02	0.07	12.03	0.02	93.39
	1124D_4H-2_116-118_8	4.17	3.26	2.12	69.06	0.18	0.06	1.02	0.11	12.29	0.01	92.27
	1124D_4H-2_116-118_9	4.87	3.11	2.13	70.11	0.15	0.08	1.07	0.07	12.84	0.00	94.42
	1124D_4H-2_116-118_10	4.34	3.51	2.11	71.66	0.16	0.04	1.03	0.05	12.01	0.02	94.92
	1124D_4H-2_116-118_11	4.37	3.43	1.97	71.83	0.13	0.07	1.02	0.00	12.03	0.01	94.85
	1124D_4H-2_116-118_12	4.34	3.33	2.07	71.53	0.14	0.03	0.99	0.05	12.06	0.00	94.54
	1124D_4H-2_116-118_13	4.17	3.40	2.08	71.32	0.15	0.08	0.98	0.04	12.22	0.01	94.46
	1124D_4H-2_116-118_14	4.67	3.46	2.08	72.05	0.15	0.04	0.95	0.08	12.08	0.00	95.57
	1124D_4H-2_116-118_15	4.27	3.42	1.86	71.51	0.15	0.07	0.99	0.09	12.11	0.01	94.49
	1124D_4H-2_116-118_16	4.38	3.49	1.98	72.11	0.16	0.10	1.03	0.07	12.59	0.00	95.91
	1124D_4H-2_116-118_17	4.53	3.48	2.06	71.62	0.16	0.08	1.04	0.11	12.23	0.02	95.33
	1124D_4H-2_116-118_18	4.44	3.53	1.92	71.99	0.17	0.11	1.03	0.11	11.99	0.00	95.28
	1124D_4H-2_116-118_19	4.67	3.28	2.14	71.86	0.11	0.10	1.05	0.11	12.62	0.00	95.94
	1124D_4H-2_116-118_1	4.22	3.41	1.87	71.18	0.16	0.07	1.05	0.08	12.06	0.02	94.11
	1124D_4H-2_116-118_6	4.21	3.42	2.22	71.75	0.13	0.08	1.03	0.05	12.14	0.00	95.03
	1124D_4H-2_116-118_8	4.01	3.41	2.08	71.70	0.13	0.03	1.02	0.12	12.24	0.00	94.75
	1124D_4H-2_116-118_10	3.99	3.53	1.99	71.60	0.13	0.09	1.05	0.03	12.15	0.02	94.58
	1124D_4H-2_116-118_3	4.09	3.48	2.18	71.73	0.12	0.02	1.04	0.01	12.36	0.02	95.05
	1124D_4H-2_116-118_2	4.06	3.43	1.90	71.07	0.16	0.07	1.02	0.03	12.31	0.02	94.06
	1124D_4H-2_116-118_4	3.87	3.53	2.10	70.99	0.15	0.08	1.02	0.11	12.23	0.00	94.07
	1124D_4H-2_116-118_5	4.08	3.38	2.08	70.35	0.15	0.11	1.00	0.00	12.13	0.00	93.28
	1124D_4H-2_116-118_7	4.21	3.34	2.16	68.95	0.12	0.08	1.07	0.10	12.69	0.01	92.73
	1124D_4H-2_116-118_9	3.84	3.35	1.88	70.48	0.15	0.06	1.06	0.00	12.40	0.01	93.23
66°/s67	1124D_4H-2_137-139_1	4.60	3.02	2.07	70.82	0.17	0.10	1.11	0.09	12.81	0.03	94.83
	1124D_4H-2_137-139_2	4.14	3.33	1.09	73.33	0.08	0.06	0.82	0.07	11.75	0.02	94.69
	1124D_4H-2_137-139_3	3.86	3.37	1.23	73.34	0.06	0.02	0.88	0.06	11.92	0.00	94.73
	1124D_4H-2_137-139_4	4.79	2.96	1.94	70.33	0.17	0.10	1.12	0.04	12.68	0.04	94.16
	1124D_4H-2_137-139_5	4.95	2.96	2.25	69.69	0.21	0.13	1.09	0.05	12.84	0.01	94.18
	1124D_4H-2_137-139_6	4.04	3.71	1.04	72.85	0.04	0.03	0.75	0.02	12.11	0.03	94.62
	1124D_4H-2_137-139_7	4.76	2.90	2.47	68.55	0.15	0.06	1.06	0.07	12.70	0.00	92.72
	1124D_4H-2_137-139_8	4.77	3.00	2.12	69.24	0.15	0.11	1.09	0.10	12.69	0.01	93.28
	1124D_4H-2_137-139_9	4.83	2.94	2.12	70.09	0.15	0.10	1.12	0.11	13.15	0.00	94.60
	1124D_4H-2_137-139_10	3.85	3.57	1.19	73.00	0.08	0.06	0.78	0.02	11.69	0.02	94.26
	1124D_4H-2_137-139_11	4.82	3.01	2.01	70.25	0.18	0.13	1.09	0.12	13.02	0.00	94.64
	1124D_4H-2_137-139_12	5.08	2.99	2.12	69.07	0.19	0.13	1.00	0.09	12.89	0.02	93.58
	1124D_4H-2_137-139_13	4.77	2.97	2.27	69.20	0.17	0.09	1.10	0.14	12.70	0.01	93.42
	1124D_4H-2_137-139_14	4.20	3.37	1.17	72.67	0.05	0.02	0.86	0.03	11.74	0.01	94.11
	1124D_4H-2_137-139_15	4.99	2.96	2.15	69.17	0.15	0.11	1.07	0.07	12.70	0.00	93.38
	1124D_4H-2_137-139_16	3.92	3.36	1.30	72.10	0.07	0.05	0.82	0.05	11.81	0.00	93.49
	1124D_4H-2_137-139_17	4.75	3.08	2.09	70.13	0.17	0.11	1.10	0.09	12.91	0.00	94.42
	1124D_4H-2_137-139_18	4.92	3.12	2.08	69.79	0.19	0.10	1.11	0.12	12.85	0.03	94.31
	1124D_4H-2_137-139_19	4.57	3.06	2.29	68.81	0.17	0.07	1.05	0.14	12.96	0.04	93.15
	1124D_4H-2_137-139_20	4.88	3.05	2.14	68.86	0.14	0.10	1.06	0.07	12.92	0.01	93.22
	1124D_4H-2_137-139_2	4.44	3.12	2.21	70.36	0.15	0.12	1.14	0.03	12.77	0.00	94.33
	1124D_4H-2_137-139_9	4.37	3.19	1.96	68.91	0.15	0.09	0.94	0.07	12.53	0.03	92.24
	1124D_4H-2_137-139_6	4.66	3.05	2.13	70.38	0.17	0.13	1.12	0.00	13.21	0.01	94.87
	1124D_4H-2_137-139_8	4.42	3.09	2.09	70.71	0.14	0.12	1.13	0.16	13.08	0.00	94.94
	1124D_4H-2_137-139_10	4.50	3.05	2.09	70.10	0.17	0.17	1.15	0.04	13.13	0.04	94.44
	1124D_4H-2_137-139_1	3.78	3.36	1.27	73.30	0.09	0.04	0.86	0.00	11.57	0.02	94.29
	1124D_4H-2_137-139_5	3.64	3.50	1.27	73.87	0.05	0.02	0.85	0.05	11.87	0.01	95.13
	1124D_4H-2_137-139_7	3.63	3.53	1.23	72.78	0.05	0.05	0.81	0.00	12.17	0.01	94.27
	1124D_4H-2_137-139_3	3.24	4.25	0.92	74.83	0.04	0.04	0.74	0.10	12.13	0.00	96.28
	1124D_4H-2_137-139_4	3.36	4.28	0.82	73.02	0.03	0.05	0.75	0.05	11.77	0.00	94.13
	1124D_4H-3_11-13_1	3.75	3.34	1.17	73.20	0.06	0.04	0.90	0.02	11.64	0.03	94.15
	1124D_4H-3_11-13_2	3.63	3.30	1.28	72.64	0.05	0.03	0.87	0.01	11.75	0.01	93.56
	1124D_4H-3_11-13_3	3.64	3.40	0.96	72.72	0.04	0.00	0.83	0.03	11.46	0.00	93.09
	1124D_4H-3_11-13_4	3.80	3.43	1.13	72.77	0.05	0.03	0.81	0.09	11.60	0.00	93.72
	1124D_4H-3_11-13_5	3.84	3.39	1.45	72.80	0.06	0.06	0.89	0.03	11.35	0.00	93.87
	1124D_4H-3_11-13_6	3.71	3.41	1.14	72.63	0.04	0.07	0.80	0.02	11.57	0.02	93.43
	1124D_4H-3_11-13_7	3.75	3.26	1.23	72.92	0.07	0.06	0.85	0.04	11.45	0.04	93.67
	1124D_4H-3_11-13_8	3.64	3.35	1.16	73.05	0.09	0.05	0.89	0.01	11.47	0.02	93.73
	1124D_4H-3_11-13_9	3.98	3.35	1.08	73.32	0.08	0.04	0.92	0.02	11.64	0.02	94.44
	1124D_4H-3_11-13_10	3.68	3.30	1.15	73.23	0.07	0.03	0.88	0.01	11.68	0.05	94.07
	1124D_4H-3_11-13_11	3.66	3.43	1.13	72.90	0.06	0.02	0.88	0.00	11.34	0.01	93.43
	1124D_4H-3_11-13_12	3.75	3.32	1.14	72.19	0.07	0.04	0.78	0.01	11.48	0.00	92.77
	1124D_4H-3_11-13_13	4.12	3.35	1.35	72.77	0.06	0.03	0.91	0.04	11.72	0.02	94.38
	1124D_4H-3_11-13_14	4.07	3.34	1.33	73.69	0.07	0.06	0.83	0.00	11.72	0.00	95.11

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s69	1124D_4H-3_11-13_15	3.64	3.43	1.25	73.35	0.02	0.03	0.80	0.00	11.49	0.00	94.02
	1124D_4H-3_11-13_16	3.78	3.46	1.03	73.14	0.04	0.04	0.75	0.06	11.69	0.01	94.00
	1124D_4H-3_11-13_17	3.71	3.48	1.09	73.80	0.08	0.03	0.85	0.00	11.59	0.00	94.62
	1124D_4H-3_11-13_18	4.02	3.41	1.24	73.38	0.09	0.01	0.85	0.00	11.79	0.01	94.80
	1124D_4H-3_11-13_19	3.79	3.52	0.99	72.09	0.04	0.03	0.76	0.07	11.56	0.00	92.84
	1124D_4H-3_11-13_20	3.69	3.30	1.15	72.87	0.07	0.00	0.83	0.00	11.47	0.01	93.39
	1124D_4H-3_70-72_1	3.72	3.46	1.37	74.02	0.08	0.03	0.84	0.03	11.74	0.00	95.28
	1124D_4H-3_70-72_2	3.79	3.36	1.18	73.25	0.06	0.04	0.88	0.00	11.73	0.00	94.30
	1124D_4H-3_70-72_3	3.72	3.37	1.09	73.79	0.08	0.04	0.87	0.01	11.80	0.00	94.76
	1124D_4H-3_70-72_4	3.84	3.24	1.24	73.29	0.05	0.02	0.89	0.00	12.08	0.01	94.66
	1124D_4H-3_70-72_5	3.84	3.23	1.35	73.76	0.06	0.05	0.90	0.05	11.96	0.00	95.21
	1124D_4H-3_70-72_6	3.68	3.38	1.19	74.22	0.06	0.03	0.89	0.01	12.14	0.00	95.59
	1124D_4H-3_70-72_7	3.93	3.33	1.26	73.21	0.07	0.03	0.81	0.00	11.77	0.00	94.41
	1124D_4H-3_70-72_8	3.63	3.42	1.20	73.12	0.06	0.02	0.87	0.05	11.72	0.04	94.12
	1124D_4H-3_70-72_9	3.81	3.33	1.23	73.70	0.08	0.04	0.90	0.03	11.76	0.01	94.88
	1124D_4H-3_70-72_10	3.61	3.50	1.24	72.54	0.06	0.02	0.78	0.10	11.81	0.00	93.66
	1124D_4H-3_70-72_11	3.98	3.26	1.21	72.97	0.08	0.06	0.85	0.05	11.80	0.00	94.26
	1124D_4H-3_70-72_12	3.59	3.34	1.23	72.36	0.07	0.04	0.91	0.03	11.74	0.00	93.30
	1124D_4H-3_70-72_13	3.68	3.28	1.16	73.27	0.04	0.04	0.90	0.03	11.72	0.00	94.12
	1124D_4H-3_70-72_14	3.64	3.24	1.36	72.59	0.08	0.04	0.90	0.11	11.97	0.01	93.93
	1124D_4H-3_70-72_15	4.09	3.18	1.30	72.77	0.03	0.02	1.00	0.07	11.92	0.02	94.39
	1124D_4H-3_70-72_16	3.67	3.39	1.18	72.97	0.05	0.05	0.86	0.04	11.59	0.01	93.80
	1124D_4H-3_70-72_17	3.91	3.51	1.36	73.50	0.08	0.03	0.93	0.05	11.55	0.00	94.91
	1124D_4H-3_70-72_18	3.75	3.33	1.11	72.45	0.04	0.04	0.85	0.01	11.83	0.01	93.42
	1124D_4H-3_70-72_19	3.69	3.27	1.21	73.19	0.06	0.02	0.91	0.03	11.83	0.01	94.22
	1124D_4H-3_70-72_20	3.87	3.36	1.27	73.13	0.06	0.02	0.88	0.03	11.79	0.00	94.41
	1124D_4H-4_48-50_1	4.62	3.14	2.08	69.31	0.17	0.09	1.00	0.05	12.37	0.00	92.82
	1124D_4H-4_48-50_2	4.76	3.26	2.16	70.75	0.15	0.08	1.03	0.07	12.28	0.00	94.54
	1124D_4H-4_48-50_3	4.45	3.31	2.10	70.62	0.15	0.07	1.05	0.05	12.19	0.04	94.03
	1124D_4H-4_48-50_4	4.49	3.25	2.07	70.71	0.15	0.10	1.00	0.06	12.35	0.00	94.18
	1124D_4H-4_48-50_5	4.34	3.17	1.90	69.22	0.13	0.08	0.99	0.08	12.37	0.00	92.28
	1124D_4H-4_48-50_6	4.53	3.26	1.90	69.68	0.15	0.06	1.00	0.09	12.18	0.01	92.87
	1124D_4H-4_48-50_7	4.49	3.11	2.03	70.27	0.16	0.05	1.00	0.09	12.33	0.00	93.54
	1124D_4H-4_48-50_8	4.62	3.30	1.88	70.10	0.16	0.06	0.99	0.05	12.47	0.02	93.65
	1124D_4H-4_48-50_9	4.64	3.28	2.03	70.68	0.13	0.11	1.02	0.16	12.36	0.02	94.43
	1124D_4H-4_48-50_10	4.43	3.27	1.89	69.88	0.14	0.09	1.01	0.09	12.23	0.01	93.04
	1124D_4H-4_48-50_12	4.40	3.26	2.07	69.23	0.17	0.04	1.02	0.07	12.21	0.02	92.50
	1124D_4H-4_48-50_13	4.29	3.15	2.00	70.15	0.12	0.08	1.03	0.04	12.39	0.02	93.27
	1124D_4H-4_48-50_14	4.33	3.06	2.09	69.88	0.13	0.10	1.03	0.07	12.01	0.00	92.69
	1124D_4H-4_48-50_15	4.34	3.23	1.99	69.96	0.12	0.09	1.00	0.11	12.16	0.02	93.01
	1124D_4H-4_48-50_16	2.95	3.25	1.91	70.17	0.11	0.06	1.03	0.03	12.30	0.00	91.82
	1124D_4H-4_48-50_17	3.99	3.27	2.06	70.14	0.14	0.09	1.00	0.10	12.03	0.00	92.82
	1124D_4H-4_48-50_18	2.06	3.21	2.06	69.97	0.16	0.03	0.98	0.11	12.37	0.01	90.96
	1124D_4H-4_48-50_20	1.99	3.28	1.97	69.31	0.16	0.04	1.02	0.04	11.95	0.03	89.79
	1124D_4H-4_93-95_1	4.66	3.21	1.78	70.21	0.14	0.06	0.96	0.02	12.26	0.01	93.30
	1124D_4H-4_93-95_2	4.60	3.07	2.03	70.38	0.15	0.05	0.98	0.05	12.36	0.00	93.68
	1124D_4H-4_93-95_3	3.83	3.22	1.07	74.11	0.07	0.01	0.89	0.00	11.53	0.00	94.74
	1124D_4H-4_93-95_4	3.47	3.19	1.07	74.05	0.08	0.08	1.04	0.00	11.52	0.01	94.52
	1124D_4H-4_93-95_5	4.55	3.30	2.00	70.50	0.17	0.06	0.93	0.07	12.30	0.01	93.88
	1124D_4H-4_93-95_6	4.85	3.16	2.01	70.76	0.18	0.06	0.99	0.12	12.66	0.03	94.82
	1124D_4H-4_93-95_7	4.64	3.23	2.06	70.55	0.14	0.06	0.99	0.06	12.40	0.04	94.16
	1124D_4H-4_93-95_8	4.73	3.29	2.00	71.47	0.16	0.08	0.96	0.05	12.29	0.00	95.04
	1124D_4H-4_93-95_9	4.59	3.23	1.75	70.23	0.15	0.05	0.98	0.14	12.30	0.05	93.47
	1124D_4H-4_93-95_10	4.71	3.21	2.09	70.12	0.14	0.10	0.96	0.13	12.45	0.00	93.92
	1124D_4H-4_93-95_11	4.56	3.20	1.76	70.66	0.19	0.08	0.98	0.08	12.22	0.03	93.76
	1124D_4H-4_93-95_12	4.62	3.15	1.99	70.30	0.16	0.08	0.94	0.09	12.41	0.01	93.76
	1124D_4H-4_93-95_13	4.53	3.15	1.96	71.07	0.12	0.08	0.96	0.08	12.56	0.01	94.52
	1124D_4H-4_93-95_14	4.87	3.22	1.74	71.33	0.13	0.08	0.96	0.12	12.32	0.02	94.79
	1124D_4H-4_93-95_15	4.43	3.26	1.98	70.16	0.14	0.09	0.95	0.06	12.16	0.03	93.26
	1124D_4H-4_93-95_16	4.58	3.31	1.87	70.84	0.13	0.09	0.97	0.16	12.40	0.01	94.35
	1124D_4H-4_93-95_17	4.76	3.29	1.98	71.06	0.16	0.12	0.94	0.12	12.25	0.02	94.69
	1124D_4H-4_93-95_18	4.50	3.14	2.03	71.01	0.17	0.11	0.96	0.02	12.43	0.01	94.39
	1124D_4H-4_93-95_19	4.75	3.28	2.01	71.32	0.14	0.06	0.97	0.07	12.71	0.00	95.31
	1124D_4H-4_93-95_20	4.00	3.54	1.04	73.59	0.07	0.04	0.75	0.07	11.48	0.02	94.59
u51	1124D_4H-4_100-102_1	3.18	3.15	1.28	73.80	0.10	0.11	1.22	0.03	11.43	0.00	94.31
	1124D_4H-4_100-102_2	3.41	3.36	1.07	74.67	0.08	0.11	1.04	0.00	11.72	0.01	95.46
	1124D_4H-4_100-102_3	3.53	3.27	1.15	74.01	0.09	0.12	1.11	0.05	11.65	0.02	95.01
	1124D_4H-4_100-102_4	4.65	2.45	0.82	69.94	0.09	0.08	2.91	0.08	15.57	0.00	96.59
	1124D_4H-4_100-102_5	3.28	3.84	0.97	73.73	0.00	0.02	0.80	0.04	11.57	0.00	94.26
	1124D_4H-4_100-102_6	3.36	3.77	1.00	74.37	0.03	0.01	0.75	0.04	11.25	0.00	94.58

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1124D_4H-4_100-102_7	3.74	3.51	0.93	72.92	0.04	0.04	0.90	0.08	11.76	0.00	93.92
	1124D_4H-4_100-102_8	3.43	3.37	1.02	73.14	0.10	0.14	1.06	0.03	11.39	0.00	93.68
	1124D_4H-4_100-102_9	3.55	3.55	0.95	74.25	0.09	0.01	0.91	0.01	11.44	0.01	94.78
	1124D_4H-4_100-102_10	3.71	3.58	0.91	73.71	0.07	0.05	0.84	0.10	11.71	0.02	94.69
	1124D_4H-4_100-102_11	3.80	3.20	1.28	73.91	0.10	0.09	1.07	0.04	11.36	0.04	94.89
	1124D_4H-4_100-102_12	3.39	3.60	0.89	73.65	0.08	0.06	0.78	0.03	11.30	0.01	93.79
	1124D_4H-4_100-102_13	3.43	3.48	1.09	75.17	0.08	0.11	1.13	0.00	12.04	0.02	96.55
	1124D_4H-4_100-102_14	3.55	3.53	1.01	71.87	0.04	0.06	0.91	0.01	11.54	0.03	92.54
	1124D_4H-4_100-102_15	3.64	3.30	1.12	73.20	0.10	0.04	0.99	0.00	11.53	0.00	93.92
	1124D_4H-4_100-102_16	3.76	3.45	0.94	72.80	0.06	0.07	0.88	0.00	11.45	0.00	93.41
	1124D_4H-4_100-102_17	3.54	3.19	1.19	72.96	0.11	0.10	1.08	0.05	11.69	0.01	93.91
	1124D_4H-4_100-102_18	3.81	3.74	0.97	73.17	0.08	0.08	0.86	0.08	11.54	0.01	94.34
	1124D_4H-4_100-102_19	3.53	3.31	1.15	74.14	0.13	0.06	1.10	0.01	11.49	0.00	94.92
	1124D_4H-4_100-102_5	3.36	3.54	1.22	75.10	0.11	0.08	1.07	0.04	11.97	0.05	96.55
	1124D_4H-4_100-102_6	3.15	3.37	0.98	73.95	0.11	0.11	1.03	0.04	11.53	0.00	94.27
	1124D_4H-4_100-102_7	3.44	3.31	1.20	74.01	0.11	0.11	1.04	0.07	12.10	0.04	95.43
	1124D_4H-4_100-102_8	3.44	3.33	0.90	73.88	0.09	0.13	1.07	0.03	11.96	0.05	94.87
	1124D_4H-4_100-102_9	3.41	3.27	0.88	74.09	0.09	0.08	1.06	0.03	11.68	0.00	94.60
	1124D_4H-4_100-102_2	3.32	3.32	1.05	74.46	0.09	0.07	1.04	0.07	11.79	0.04	95.25
	1124D_4H-4_100-102_4	3.68	3.20	1.22	74.06	0.10	0.12	1.16	0.00	11.91	0.02	95.47
	1124D_4H-4_100-102_10	3.63	3.21	1.20	73.93	0.06	0.07	1.08	0.00	12.14	0.00	95.31
	1124D_4H-4_133-135_1	3.62	3.72	0.82	73.07	0.02	0.08	0.87	0.06	11.84	0.00	94.09
	1124D_4H-4_133-135_2	3.57	3.75	0.90	72.84	0.01	0.09	0.89	0.04	11.77	0.00	93.86
	1124D_4H-4_133-135_3	3.49	3.86	0.97	73.22	0.05	0.05	0.87	0.06	11.84	0.01	94.42
	1124D_4H-4_133-135_4	3.49	3.47	0.95	73.07	0.08	0.04	1.09	0.03	11.75	0.02	93.99
	1124D_4H-4_133-135_5	3.35	4.25	0.76	73.30	0.00	0.01	0.67	0.00	11.85	0.02	94.21
	1124D_4H-4_133-135_6	3.69	3.38	1.15	72.82	0.09	0.08	1.06	0.08	12.05	0.02	94.41
	1124D_4H-4_133-135_7	3.67	3.87	0.71	71.66	0.04	0.02	0.85	0.10	11.75	0.01	92.68
	1124D_4H-4_133-135_8	3.48	4.34	0.88	72.69	0.02	0.02	0.71	0.04	11.77	0.00	93.95
	1124D_4H-4_133-135_9	3.76	3.21	1.09	71.78	0.03	0.09	1.03	0.03	11.62	0.00	92.66
	1124D_4H-4_133-135_10	3.54	3.83	0.87	73.07	0.02	0.10	0.87	0.03	11.65	0.00	93.99
	1124D_4H-4_133-135_11	3.76	3.55	1.07	73.67	0.08	0.10	1.10	0.00	11.99	0.03	95.34
	1124D_4H-4_133-135_12	3.54	3.84	0.80	72.69	0.06	0.04	0.86	0.12	11.80	0.00	93.74
	1124D_4H-4_133-135_13	3.48	4.03	0.82	73.18	0.05	0.07	0.87	0.00	11.88	0.02	94.39
	1124D_4H-4_133-135_14	3.58	4.10	0.89	72.80	0.04	0.00	0.68	0.03	11.83	0.02	93.98
	1124D_4H-4_133-135_15	3.53	3.39	0.94	72.46	0.10	0.07	1.08	0.06	11.80	0.01	93.44
	1124D_4H-4_133-135_16	3.59	3.67	1.06	72.95	0.02	0.01	0.87	0.04	11.87	0.00	94.07
	1124D_4H-4_133-135_17	3.55	3.76	0.94	72.48	0.03	0.04	0.87	0.01	11.95	0.01	93.64
	1124D_4H-4_133-135_18	3.52	3.73	0.77	73.04	0.06	0.06	0.81	0.06	11.82	0.02	93.88
	1124D_4H-4_133-135_19	3.41	3.22	1.10	72.49	0.06	0.05	1.05	0.03	11.71	0.04	93.16
	1124D_4H-4_133-135_20	3.55	3.44	1.07	72.82	0.06	0.05	1.04	0.00	11.73	0.01	93.76
	1124D_4H-4_140-142_1	4.57	3.29	1.99	68.56	0.13	0.10	1.07	0.03	12.53	0.04	92.32
	1124D_4H-4_140-142_2	3.78	3.24	1.15	72.33	0.07	0.00	0.89	0.04	11.63	0.00	93.13
	1124D_4H-4_140-142_3	3.88	3.42	1.25	72.59	0.04	0.01	0.80	0.04	11.55	0.01	93.59
	1124D_4H-4_140-142_4	4.29	3.26	1.88	68.79	0.15	0.10	0.92	0.06	12.15	0.02	91.62
	1124D_4H-4_140-142_5	3.84	3.47	1.18	70.61	0.04	0.02	0.88	0.07	11.74	0.02	91.86
	1124D_4H-4_140-142_6	4.66	3.38	1.72	69.55	0.12	0.04	0.87	0.00	12.31	0.00	92.65
	1124D_4H-4_140-142_7	3.98	3.64	1.19	72.36	0.11	0.00	0.63	0.03	11.57	0.01	93.52
	1124D_4H-4_140-142_8	4.31	3.37	1.83	69.52	0.14	0.06	0.93	0.02	12.33	0.01	92.53
	1124D_4H-4_140-142_9	4.53	3.23	1.91	69.17	0.18	0.06	1.03	0.10	12.49	0.05	92.76
	1124D_4H-4_140-142_10	4.73	3.30	2.02	69.90	0.18	0.13	1.06	0.05	12.65	0.04	94.05
	1124D_4H-4_140-142_11	4.29	3.30	1.95	70.47	0.12	0.08	1.03	0.04	12.45	0.00	93.74
	1124D_4H-4_140-142_12	4.54	3.19	2.16	69.62	0.16	0.08	1.00	0.01	12.52	0.02	93.30
	1124D_4H-4_140-142_13	4.33	3.23	1.80	70.25	0.17	0.09	1.05	0.09	12.49	0.00	93.50
	1124D_4H-4_140-142_14	3.97	3.52	1.05	73.28	0.06	0.04	0.84	0.10	11.67	0.00	94.53
	1124D_4H-4_140-142_15	3.75	3.24	1.24	72.47	0.06	0.05	0.90	0.02	11.72	0.02	93.48
	1124D_4H-4_140-142_16	4.38	3.34	1.97	70.70	0.15	0.05	0.99	0.09	12.53	0.00	94.20
	1124D_4H-4_140-142_17	4.51	3.26	1.81	70.74	0.15	0.08	1.08	0.11	12.60	0.01	94.35
	1124D_4H-4_140-142_18	4.02	3.66	1.34	72.94	0.10	0.01	0.62	0.10	11.71	0.00	94.50
	1124D_4H-4_140-142_19	4.51	3.19	2.18	70.92	0.15	0.15	1.05	0.04	12.84	0.00	95.04
	1124D_4H-4_140-142_20	4.30	3.44	1.50	71.82	0.10	0.04	0.80	0.02	11.97	0.02	94.01
s73	1124D_4H-5_12-14_1	3.63	3.57	1.09	73.50	0.08	0.04	0.82	0.08	11.71	0.04	94.56
	1124D_4H-5_12-14_2	3.50	4.17	0.78	73.57	0.07	0.04	0.86	0.14	11.94	0.04	95.10
	1124D_4H-5_12-14_3	3.23	4.34	0.66	73.64	0.03	0.04	0.67	0.08	12.00	0.02	94.71
	1124D_4H-5_12-14_4	3.71	3.55	1.27	73.31	0.07	0.03	0.90	0.00	11.74	0.00	94.57
	1124D_4H-5_12-14_5	3.46	3.83	0.89	72.92	0.02	0.00	0.84	0.15	11.96	0.00	94.08
	1124D_4H-5_12-14_6	3.05	4.24	0.78	72.32	0.05	0.02	0.99	0.11	11.67	0.00	93.23
	1124D_4H-5_12-14_7	3.82	3.39	1.29	72.89	0.07	0.01	0.85	0.06	11.76	0.01	94.14
	1124D_4H-5_12-14_8	3.90	3.44	1.24	73.24	0.08	0.02	0.87	0.08	11.69	0.00	94.56
	1124D_4H-5_12-14_9	3.79	3.31	1.24	73.03	0.07	0.01	0.87	0.03	11.66	0.03	94.04

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s76*	1124D_4H-5_12-14_10	3.83	3.40	1.11	72.97	0.06	0.03	0.91	0.03	11.72	0.04	94.10
	1124D_4H-5_12-14_11	3.90	3.29	1.10	72.96	0.07	0.02	0.85	0.03	11.56	0.00	93.78
	1124D_4H-5_12-14_12	3.59	3.80	0.92	73.33	0.07	0.06	0.84	0.04	11.76	0.00	94.41
	1124D_4H-5_12-14_13	3.69	4.17	0.86	73.11	0.03	0.03	0.68	0.08	11.84	0.03	94.51
	1124D_4H-5_12-14_14	4.06	3.39	1.16	73.03	0.08	0.03	0.89	0.00	11.92	0.00	94.56
	1124D_4H-5_12-14_15	3.30	4.11	0.92	72.84	0.01	0.07	0.72	0.05	11.89	0.02	93.93
	1124D_4H-5_12-14_16	3.95	3.44	1.08	73.63	0.08	0.01	0.86	0.05	11.91	0.02	95.02
	1124D_4H-5_12-14_17	3.55	3.42	1.21	73.60	0.09	0.01	0.85	0.00	11.68	0.03	94.44
	1124D_4H-5_12-14_18	3.79	3.31	1.12	72.85	0.05	0.01	0.82	0.01	11.81	0.01	93.80
	1124D_4H-5_12-14_19	3.78	3.20	1.42	72.54	0.09	0.04	1.10	0.04	12.00	0.03	94.25
	1124D_4H-5_12-14_20	3.62	4.09	0.92	74.46	0.06	0.04	0.91	0.14	12.17	0.00	96.41
	1124D_4H-5_27-29_1	4.44	3.34	2.08	72.26	0.16	0.10	1.06	0.10	12.84	0.03	96.40
	1124D_4H-5_27-29_2	4.64	3.36	2.06	71.97	0.16	0.09	1.02	0.09	12.73	0.02	96.14
	1124D_4H-5_27-29_3	4.41	3.42	2.00	72.03	0.13	0.11	1.01	0.00	12.57	0.00	95.68
	1124D_4H-5_27-29_4	4.46	3.42	1.92	71.93	0.13	0.10	1.02	0.10	12.61	0.01	95.70
	1124D_4H-5_27-29_5	4.57	3.45	2.11	72.56	0.13	0.07	1.02	0.04	12.63	0.00	96.58
	1124D_4H-5_27-29_6	4.60	3.34	2.00	71.84	0.14	0.15	1.01	0.04	12.45	0.00	95.57
	1124D_4H-5_27-29_7	4.39	3.34	1.94	71.94	0.13	0.11	0.98	0.05	12.58	0.03	95.50
	1124D_4H-5_27-29_8	4.47	3.40	2.08	72.12	0.12	0.10	1.04	0.00	12.60	0.01	95.93
	1124D_4H-5_27-29_9	4.45	3.27	1.89	71.61	0.15	0.08	0.96	0.08	12.36	0.03	94.88
	1124D_4H-5_27-29_10	4.37	3.33	2.10	71.11	0.14	0.11	1.01	0.07	12.55	0.02	94.82
	1124D_4H-5_27-29_11	4.22	3.48	1.94	72.10	0.11	0.11	1.16	0.06	12.69	0.02	95.89
	1124D_4H-5_27-29_12	4.39	3.47	1.57	71.64	0.22	0.16	1.25	0.03	12.71	0.07	95.51
	1124D_4H-5_27-29_14	4.59	3.40	1.99	72.17	0.13	0.09	0.99	0.08	12.48	0.01	95.94
	1124D_4H-5_27-29_15	4.40	3.37	2.08	71.68	0.16	0.11	0.97	0.08	12.72	0.04	95.61
	1124D_4H-5_27-29_16	4.55	3.37	1.85	72.81	0.16	0.07	0.99	0.06	12.94	0.04	96.83
	1124D_4H-5_27-29_17	4.45	3.37	2.06	72.33	0.15	0.09	1.04	0.08	12.72	0.00	96.29
	1124D_4H-5_27-29_18	4.17	3.77	1.61	73.98	0.10	0.04	0.78	0.06	12.49	0.00	97.00
	1124D_4H-5_27-29_20	4.34	3.35	1.87	71.50	0.17	0.10	1.02	0.00	12.45	0.05	94.84
	1124D_4H-5_77-79_1	4.63	3.38	1.82	70.63	0.13	0.11	1.04	0.04	12.87	0.01	94.66
	1124D_4H-5_77-79_2	4.74	3.22	2.30	69.40	0.18	0.09	1.19	0.06	12.99	0.00	94.17
	1124D_4H-5_77-79_3	4.42	3.28	2.01	69.79	0.14	0.10	1.12	0.04	12.89	0.01	93.79
	1124D_4H-5_77-79_4	4.59	3.23	2.24	69.72	0.17	0.12	1.21	0.14	12.95	0.00	94.37
	1124D_4H-5_77-79_5	4.63	3.27	2.23	69.37	0.16	0.16	1.24	0.11	13.10	0.04	94.32
	1124D_4H-5_77-79_6	4.31	3.23	2.17	70.21	0.16	0.12	1.19	0.07	13.06	0.00	94.52
	1124D_4H-5_77-79_7	4.94	3.31	2.18	70.12	0.22	0.11	1.15	0.04	13.05	0.02	95.14
	1124D_4H-5_77-79_8	4.33	3.27	1.88	70.15	0.14	0.13	1.00	0.01	12.53	0.01	93.44
	1124D_4H-5_77-79_9	4.36	3.28	2.00	71.03	0.15	0.09	1.10	0.05	13.08	0.00	95.13
	1124D_4H-5_77-79_10	4.49	3.42	2.01	70.36	0.16	0.15	1.06	0.06	12.57	0.00	94.28
	1124D_4H-5_77-79_11	4.70	3.42	1.95	70.70	0.18	0.12	1.18	0.11	13.02	0.00	95.38
	1124D_4H-5_77-79_12	4.50	3.44	1.84	70.55	0.14	0.10	1.06	0.07	12.64	0.00	94.34
	1124D_4H-5_77-79_13	4.44	3.26	2.06	70.25	0.14	0.10	1.23	0.05	13.12	0.00	94.65
	1124D_4H-5_77-79_14	4.73	3.35	2.30	70.35	0.18	0.07	1.20	0.15	13.02	0.05	95.40
	1124D_4H-5_77-79_15	4.62	3.32	2.15	69.79	0.18	0.05	1.19	0.05	13.04	0.04	94.44
	1124D_4H-5_77-79_16	4.26	3.28	1.93	70.38	0.15	0.09	1.09	0.07	12.71	0.01	93.96
	1124D_4H-5_77-79_17	4.33	3.38	1.69	70.67	0.17	0.08	0.96	0.01	12.56	0.00	93.85
	1124D_4H-5_77-79_18	4.48	3.47	1.76	70.80	0.12	0.08	0.94	0.09	12.44	0.02	94.19
	1124D_4H-5_77-79_19	4.08	3.50	1.78	69.94	0.14	0.12	0.93	0.07	12.45	0.00	93.01
	1124D_4H-5_77-79_20	4.85	3.34	2.24	69.56	0.18	0.14	1.26	0.05	13.04	0.00	94.66
s77	1124D_4H-5_77-79_3	4.19	3.36	2.01	70.18	0.14	0.10	1.11	0.05	12.87	0.00	94.01
	1124D_4H-5_77-79_4	4.46	3.48	2.00	69.52	0.14	0.10	1.23	0.10	13.04	0.06	94.13
	1124D_4H-5_77-79_6	4.36	3.26	2.34	70.03	0.17	0.13	1.18	0.09	12.94	0.03	94.53
	1124D_4H-5_77-79_8	4.21	3.36	1.93	70.53	0.12	0.11	0.91	0.02	12.17	0.00	93.35
	1124D_4H-5_77-79_9	4.12	3.52	1.61	70.76	0.10	0.12	0.89	0.02	12.70	0.03	93.86
	1124D_4H-5_77-79_1	4.28	3.27	2.13	68.39	0.19	0.14	1.19	0.07	13.14	0.00	92.79
	1124D_4H-5_77-79_2	4.19	3.39	2.18	69.72	0.12	0.10	1.16	0.07	12.65	0.02	93.61
	1124D_4H-5_77-79_5	4.25	3.42	1.86	70.36	0.13	0.07	1.02	0.07	12.41	0.04	93.63
	1124D_4H-5_77-79_7	4.59	3.30	2.24	69.33	0.16	0.05	1.20	0.06	13.29	0.01	94.24
	1124D_4H-5_77-79_10	4.56	3.43	2.13	70.73	0.15	0.09	1.04	0.14	13.09	0.03	95.38
	1124D_4H-6_18-20_1	4.14	3.54	2.15	70.10	0.20	0.14	1.21	0.09	12.47	0.02	94.07
	1124D_4H-6_18-20_2	4.13	3.44	2.05	70.00	0.22	0.14	1.22	0.07	12.74	0.01	94.03
	1124D_4H-6_18-20_3	4.20	3.44	2.21	69.57	0.19	0.14	1.24	0.17	12.86	0.00	94.02
	1124D_4H-6_18-20_4	4.12	3.35	2.06	69.13	0.20	0.15	1.18	0.09	12.78	0.00	93.06
	1124D_4H-6_18-20_5	4.37	3.43	2.36	70.03	0.20	0.12	1.17	0.06	12.79	0.01	94.54
	1124D_4H-6_18-20_6	4.25	3.39	2.06	68.93	0.16	0.13	1.18	0.09	12.24	0.03	92.47
	1124D_4H-6_18-20_7	4.40	3.44	2.12	70.10	0.22	0.13	1.24	0.05	12.84	0.01	94.54
	1124D_4H-6_18-20_8	4.45	3.55	2.11	69.52	0.19	0.15	1.25	0.05	12.43	0.02	93.73
	1124D_4H-6_18-20_9	4.35	3.33	2.06	69.37	0.17	0.15	1.22	0.04	12.15	0.00	92.84
	1124D_4H-6_18-20_10	4.21	3.43	2.03	69.89	0.18	0.13	1.25	0.07	12.35	0.02	93.57
	1124D_4H-6_18-20_11	4.25	3.37	2.11	69.56	0.18	0.13	1.23	0.06	12.56	0.00	93.46

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
u56	1124D_4H-6_18-20_12	4.36	3.42	2.16	69.64	0.17	0.10	1.24	0.02	12.65	0.05	93.81
	1124D_4H-6_18-20_13	4.23	3.35	2.10	70.01	0.18	0.11	1.22	0.09	12.45	0.05	93.79
	1124D_4H-6_18-20_14	4.59	3.28	2.22	69.21	0.15	0.10	1.20	0.01	12.72	0.00	93.49
	1124D_4H-6_18-20_15	4.36	3.48	2.19	68.17	0.20	0.12	1.19	0.01	12.65	0.02	92.37
	1124D_4H-6_18-20_16	4.17	3.28	2.01	68.08	0.21	0.16	1.28	0.08	12.37	0.05	91.69
	1124D_4H-6_18-20_17	4.32	3.50	2.07	69.56	0.19	0.14	1.13	0.09	12.71	0.00	93.70
	1124D_4H-6_18-20_18	4.28	3.44	2.13	70.03	0.17	0.14	1.25	0.07	12.48	0.00	94.00
	1124D_4H-6_18-20_19	4.30	3.40	2.25	69.27	0.19	0.16	1.21	0.05	12.47	0.01	93.32
	1124D_4H-6_18-20_20	4.44	3.47	2.23	69.76	0.19	0.14	1.19	0.09	12.82	0.01	94.35
	1124D_4H-6_18-20_3	4.20	3.42	2.29	70.37	0.20	0.14	1.26	0.04	12.69	0.06	94.68
	1124D_4H-6_18-20_4	4.11	3.38	2.07	70.74	0.20	0.13	1.15	0.07	12.74	0.00	94.59
	1124D_4H-6_18-20_6	3.90	3.77	1.89	70.83	0.17	0.14	1.05	0.07	12.70	0.00	94.52
	1124D_4H-6_18-20_8	4.29	3.64	2.26	71.62	0.18	0.09	1.23	0.00	13.06	0.03	96.41
	1124D_4H-6_18-20_9	4.07	3.42	2.10	70.67	0.20	0.20	1.17	0.02	13.20	0.00	95.04
	1124D_4H-6_18-20_1	4.20	3.55	2.34	70.80	0.15	0.12	1.22	0.08	12.96	0.04	95.47
	1124D_4H-6_18-20_2	4.07	3.42	2.22	71.57	0.17	0.10	1.18	0.12	12.98	0.04	95.87
	1124D_4H-6_18-20_5	4.14	3.48	2.33	71.14	0.17	0.13	1.20	0.02	12.67	0.04	95.31
	1124D_4H-6_18-20_7	4.18	3.67	2.45	71.16	0.17	0.13	1.24	0.07	12.43	0.03	95.54
	1124D_4H-6_18-20_10	4.24	3.35	2.17	70.68	0.17	0.14	1.23	0.05	12.65	0.03	94.71
	1124D_4H-6_57-59_1	4.27	3.33	2.62	67.84	0.40	0.38	1.77	0.02	13.07	0.07	93.77
	1124D_4H-6_57-59_2	3.94	3.33	2.50	66.62	0.42	0.36	1.59	0.02	12.63	0.04	91.45
	1124D_4H-6_57-59_3	3.93	3.18	2.69	67.50	0.46	0.45	2.02	0.12	13.57	0.08	93.99
	1124D_4H-6_57-59_4	4.39	3.36	2.45	68.42	0.39	0.39	1.85	0.07	12.89	0.03	94.23
	1124D_4H-6_57-59_5	4.48	3.25	2.87	67.81	0.44	0.37	1.85	0.11	13.18	0.03	94.39
	1124D_4H-6_57-59_6	4.44	3.23	2.49	68.73	0.43	0.35	1.72	0.02	13.19	0.05	94.66
	1124D_4H-6_57-59_7	4.45	3.09	2.89	68.05	0.46	0.49	2.20	0.16	13.67	0.07	95.53
	1124D_4H-6_57-59_8	4.32	3.27	2.43	68.46	0.38	0.35	1.80	0.11	13.40	0.06	94.57
	1124D_4H-6_57-59_9	4.36	3.32	2.47	68.43	0.42	0.36	1.75	0.04	12.92	0.05	94.11
	1124D_4H-6_57-59_10	4.38	3.32	2.50	68.29	0.43	0.36	1.75	0.10	13.30	0.05	94.48
	1124D_4H-6_57-59_11	4.47	3.26	2.60	68.31	0.43	0.38	1.76	0.11	13.32	0.05	94.70
	1124D_4H-6_57-59_12	4.32	3.02	2.87	66.76	0.48	0.47	2.18	0.11	13.72	0.09	94.01
	1124D_4H-6_57-59_13	4.15	3.29	2.34	68.06	0.40	0.38	1.77	0.16	13.04	0.03	93.63
	1124D_4H-6_57-59_14	4.48	3.29	2.48	68.12	0.41	0.33	1.73	0.06	12.88	0.04	93.82
	1124D_4H-6_57-59_15	4.36	3.21	2.62	68.14	0.42	0.33	1.77	0.05	13.20	0.03	94.12
	1124D_4H-6_57-59_16	4.33	3.35	2.49	68.30	0.43	0.36	1.80	0.10	13.07	0.07	94.30
	1124D_4H-6_57-59_17	4.30	3.21	2.61	67.86	0.39	0.36	1.76	0.09	12.92	0.07	93.56
	1124D_4H-6_57-59_18	4.28	3.14	2.73	67.58	0.47	0.44	2.00	0.08	13.26	0.07	94.05
	1124D_4H-6_57-59_19	4.43	3.30	2.58	68.72	0.41	0.38	1.76	0.00	13.13	0.08	94.78
	1124D_4H-6_57-59_20	4.13	3.29	2.58	68.30	0.40	0.38	1.77	0.07	12.91	0.07	93.90
u57*	1124D_4H-6_57-59_2	4.23	3.29	3.15	67.80	0.44	0.48	2.05	0.04	14.07	0.07	95.61
	1124D_4H-6_57-59_4	4.16	3.39	2.30	69.00	0.40	0.37	1.77	0.01	13.38	0.05	94.82
	1124D_4H-6_57-59_8	4.15	3.33	2.68	69.09	0.39	0.36	1.80	0.07	13.11	0.04	95.01
	1124D_4H-6_57-59_9	4.29	3.31	2.53	69.08	0.45	0.41	1.80	0.10	13.61	0.04	95.61
	1124D_4H-6_57-59_1	4.16	3.31	2.57	68.95	0.37	0.38	1.75	0.09	13.06	0.06	94.70
	1124D_4H-6_57-59_3	4.08	3.25	2.81	68.54	0.42	0.47	2.02	0.04	13.68	0.07	95.38
	1124D_4H-6_57-59_6	4.17	3.16	2.96	68.85	0.46	0.43	2.05	0.07	13.82	0.06	96.02
	1124D_4H-6_57-59_7	4.20	3.10	2.79	68.23	0.42	0.48	2.06	0.12	13.64	0.08	95.12
	1124D_4H-6_57-59_10	4.19	3.37	2.51	69.49	0.39	0.37	1.77	0.02	13.29	0.01	95.41
	1124D_4H-6_86-88_1	4.35	3.61	2.49	68.94	0.20	0.17	1.46	0.03	13.23	0.01	94.50
	1124D_4H-6_86-88_2	4.38	3.82	1.79	71.18	0.13	0.04	0.92	0.04	12.56	0.00	94.86
	1124D_4H-6_86-88_3	4.27	3.69	1.66	70.65	0.12	0.05	0.95	0.10	12.45	0.03	93.96
	1124D_4H-6_86-88_4	4.29	3.76	1.88	70.64	0.12	0.04	1.01	0.11	12.73	0.03	94.60
	1124D_4H-6_86-88_5	4.41	3.93	1.55	71.67	0.10	0.10	0.91	0.06	12.53	0.01	95.27
	1124D_4H-6_86-88_6	4.07	3.68	1.52	70.76	0.08	0.03	0.85	0.05	12.41	0.01	93.46
	1124D_4H-6_86-88_7	4.16	3.86	1.40	70.65	0.10	0.06	0.86	0.07	12.36	0.02	93.54
	1124D_4H-6_86-88_8	4.26	3.69	2.24	69.30	0.15	0.15	1.24	0.00	13.13	0.03	94.19
	1124D_4H-6_86-88_9	4.32	3.66	2.35	69.14	0.22	0.16	1.44	0.07	13.32	0.02	94.70
	1124D_4H-6_86-88_10	3.60	3.96	1.60	71.17	0.09	0.01	0.88	0.05	12.27	0.01	93.64
	1124D_4H-6_86-88_11	4.51	3.81	1.72	71.04	0.09	0.02	0.90	0.07	12.64	0.05	94.84
	1124D_4H-6_86-88_12	4.49	3.75	1.67	70.94	0.09	0.05	0.89	0.05	12.75	0.01	94.69
	1124D_4H-6_86-88_13	4.11	3.78	1.58	70.56	0.08	0.02	0.88	0.05	12.44	0.04	93.54
	1124D_4H-6_86-88_14	4.17	3.74	2.29	68.79	0.21	0.20	1.51	0.05	13.48	0.02	94.45
	1124D_4H-6_86-88_15	3.95	4.17	1.20	72.17	0.09	0.03	0.70	0.07	11.80	0.00	94.19
	1124D_4H-6_86-88_16	4.48	3.60	2.38	68.98	0.19	0.13	1.37	0.07	13.24	0.03	94.47
	1124D_4H-6_86-88_17	3.91	4.11	1.66	71.23	0.10	0.05	0.89	0.07	12.38	0.02	94.41
	1124D_4H-6_86-88_18	4.36	3.47	2.25	69.24	0.18	0.11	1.23	0.03	13.03	0.01	93.90
	1124D_4H-6_86-88_19	4.29	3.75	1.64	70.16	0.10	0.09	0.94	0.11	12.37	0.00	93.45
	1124D_4H-6_86-88_20	4.49	3.79	1.45	70.73	0.12	0.04	0.90	0.10	12.43	0.00	94.05
	1124D_4H-6_86-88_1	3.85	3.89	1.78	72.00	0.09	0.10	0.93	0.04	12.81	0.00	95.49
	1124D_4H-6_86-88_3	4.11	3.92	1.54	72.93	0.11	0.08	0.83	0.04	12.84	0.00	96.40

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s80	1124D_4H-6_86-88_4	3.97	3.84	1.55	73.13	0.09	0.06	0.89	0.00	12.77	0.01	96.31
	1124D_4H-6_86-88_8	3.89	3.97	1.57	72.67	0.13	0.07	0.87	0.02	12.75	0.03	95.97
	1124D_4H-6_86-88_10	4.29	3.77	1.72	71.81	0.10	0.09	0.91	0.04	12.91	0.03	95.67
	1124D_4H-6_86-88_2	4.07	3.87	1.59	70.99	0.11	0.07	0.88	0.04	12.73	0.03	94.38
	1124D_4H-6_86-88_5	4.12	3.81	1.62	71.39	0.10	0.08	0.86	0.00	12.54	0.00	94.51
	1124D_4H-6_86-88_7	3.91	3.80	1.76	72.00	0.06	0.03	0.82	0.02	12.75	0.00	95.15
	1124D_4H-6_86-88_9	3.87	3.78	1.58	71.66	0.08	0.11	0.83	0.13	12.38	0.04	94.45
	1124D_4H-6_117-119_1	3.80	3.94	1.66	71.40	0.17	0.04	0.86	0.02	12.42	0.03	94.35
	1124D_4H-6_117-119_2	3.83	4.06	1.69	71.26	0.18	0.04	0.87	0.08	12.18	0.00	94.19
	1124D_4H-6_117-119_3	3.94	4.09	1.76	71.21	0.15	0.10	0.88	0.07	12.29	0.00	94.48
	1124D_4H-6_117-119_4	4.09	4.14	1.81	71.12	0.15	0.09	0.84	0.10	12.26	0.00	94.60
	1124D_4H-6_117-119_5	3.70	4.17	1.72	71.63	0.20	0.10	0.86	0.07	12.38	0.00	94.83
	1124D_4H-6_117-119_6	4.11	4.06	1.70	71.32	0.16	0.03	0.87	0.06	12.34	0.01	94.66
	1124D_4H-6_117-119_7	3.78	4.06	1.70	71.24	0.13	0.10	0.85	0.05	12.07	0.02	94.00
	1124D_4H-6_117-119_8	4.06	4.02	1.74	71.09	0.16	0.03	0.87	0.07	12.19	0.00	94.23
	1124D_4H-6_117-119_9	3.65	4.15	1.80	72.06	0.16	0.07	0.87	0.08	12.22	0.01	95.07
	1124D_4H-6_117-119_10	4.12	4.28	1.67	71.62	0.15	0.07	0.86	0.06	12.22	0.00	95.06
	1124D_4H-6_117-119_11	4.07	4.18	1.83	71.21	0.16	0.08	0.88	0.05	12.33	0.02	94.82
	1124D_4H-6_117-119_12	3.98	4.04	1.84	71.53	0.17	0.10	0.89	0.04	12.17	0.00	94.75
	1124D_4H-6_117-119_13	3.85	4.02	1.80	70.83	0.15	0.05	0.87	0.02	12.22	0.03	93.84
	1124D_4H-6_117-119_14	3.92	4.31	2.00	71.75	0.17	0.10	0.88	0.08	12.46	0.00	95.66
	1124D_4H-6_117-119_15	3.77	4.07	1.85	71.31	0.14	0.05	0.92	0.10	12.29	0.03	94.53
	1124D_4H-6_117-119_16	3.94	4.09	1.71	70.97	0.16	0.13	0.89	0.16	12.25	0.00	94.30
	1124D_4H-6_117-119_17	3.88	4.09	1.70	71.50	0.17	0.08	0.93	0.06	12.23	0.05	94.70
	1124D_4H-6_117-119_18	3.94	4.03	1.71	71.11	0.15	0.08	0.85	0.06	12.22	0.00	94.15
	1124D_4H-6_117-119_19	4.01	4.12	1.84	71.74	0.17	0.08	0.88	0.05	12.29	0.01	95.19
	1124D_4H-6_117-119_20	3.86	4.26	1.90	71.72	0.15	0.11	0.90	0.00	12.36	0.02	95.28
	1124D_4H-6_117-119_2	3.77	4.10	1.76	72.23	0.13	0.12	0.93	0.13	12.40	0.01	95.58
	1124D_4H-6_117-119_3	3.70	4.06	1.89	71.96	0.18	0.04	0.87	0.04	12.31	0.00	95.06
	1124D_4H-6_117-119_7	3.67	4.23	1.80	72.49	0.14	0.08	0.87	0.00	12.52	0.02	95.81
	1124D_4H-6_117-119_8	3.73	4.15	1.69	72.52	0.14	0.08	0.90	0.00	12.47	0.00	95.68
	1124D_4H-6_117-119_10	3.66	4.15	1.66	73.59	0.15	0.06	0.90	0.02	12.38	0.00	96.57
	1124D_4H-6_117-119_1	3.61	4.26	1.76	71.87	0.15	0.11	0.87	0.00	12.52	0.00	95.16
	1124D_4H-6_117-119_4	3.73	4.17	1.87	72.22	0.16	0.10	0.88	0.05	12.35	0.03	95.56
	1124D_4H-6_117-119_5	3.70	4.11	2.11	71.22	0.16	0.12	0.86	0.00	12.36	0.00	94.63
	1124D_4H-6_117-119_6	3.91	4.03	1.86	71.93	0.18	0.08	0.87	0.11	12.68	0.00	95.65
	1124D_4H-6_117-119_9	3.54	4.18	1.99	72.89	0.19	0.08	0.84	0.02	12.22	0.01	95.96
s89*	1124D_5H-7_12-14_1	3.91	3.14	1.38	73.27	0.07	0.00	0.88	0.03	11.49	0.00	94.18
	1124D_5H-7_12-14_2	3.88	3.44	1.26	73.16	0.07	0.05	0.82	0.00	11.53	0.02	94.24
	1124D_5H-7_12-14_3	3.98	3.18	1.51	73.11	0.07	0.01	0.91	0.10	11.57	0.01	94.45
	1124D_5H-7_12-14_4	4.10	3.12	1.47	73.18	0.08	0.02	0.87	0.00	11.72	0.00	94.56
	1124D_5H-7_12-14_5	3.92	3.10	1.48	73.16	0.08	0.03	0.92	0.03	11.67	0.01	94.41
	1124D_5H-7_12-14_6	4.10	3.40	1.17	73.10	0.07	0.03	0.79	0.03	11.51	0.00	94.20
	1124D_5H-7_12-14_7	3.90	3.16	1.27	71.56	0.09	0.02	0.88	0.05	11.40	0.03	92.36
	1124D_5H-7_12-14_8	3.70	3.65	1.20	73.43	0.09	0.06	0.77	0.07	11.65	0.01	94.63
	1124D_5H-7_12-14_9	3.90	3.40	1.08	73.23	0.08	0.06	0.75	0.04	11.66	0.00	94.22
	1124D_5H-7_12-14_10	4.01	3.00	1.40	72.41	0.08	0.03	0.93	0.05	11.59	0.01	93.50
	1124D_5H-7_12-14_11	4.04	3.06	1.44	71.77	0.10	0.03	0.86	0.11	11.50	0.01	92.92
	1124D_5H-7_12-14_12	3.79	3.31	1.10	72.45	0.07	0.08	0.83	0.01	11.57	0.00	93.21
	1124D_5H-7_12-14_13	4.05	3.15	1.44	72.37	0.08	0.03	0.88	0.10	11.69	0.01	93.81
	1124D_5H-7_12-14_14	3.97	2.97	1.51	72.31	0.09	0.04	0.90	0.04	11.36	0.01	93.20
	1124D_5H-7_12-14_15	3.88	3.37	1.28	72.71	0.08	0.04	0.77	0.04	11.21	0.00	93.39
	1124D_5H-7_12-14_16	4.04	2.98	1.35	73.20	0.09	0.05	0.91	0.01	11.70	0.00	94.33
	1124D_5H-7_12-14_17	4.30	3.09	1.32	73.36	0.09	0.00	0.90	0.05	11.56	0.05	94.72
	1124D_5H-7_12-14_18	3.68	3.47	1.14	72.82	0.05	0.02	0.77	0.03	11.39	0.00	93.37
	1124D_5H-7_12-14_19	3.88	3.20	1.43	73.00	0.07	0.03	0.91	0.04	11.58	0.00	94.15
	1124D_5H-7_12-14_20	3.93	3.14	1.39	73.34	0.08	0.10	0.91	0.00	11.72	0.00	94.60
	1124D_5H-7_12-14_2	3.79	3.07	1.41	70.51	0.10	0.07	0.91	0.01	11.58	0.00	91.46
	1124D_5H-7_12-14_5	3.92	3.15	1.44	71.07	0.09	0.00	0.89	0.01	11.46	0.01	92.04
	1124D_5H-7_12-14_6	3.83	3.24	1.50	71.11	0.09	0.05	0.91	0.02	11.52	0.05	92.32
	1124D_5H-7_12-14_9	3.72	3.26	1.55	71.32	0.09	0.01	0.91	0.06	11.81	0.00	92.73
	1124D_5H-7_12-14_11	3.75	3.19	1.18	71.16	0.07	0.06	0.86	0.02	11.54	0.02	91.85
	1124D_5H-7_12-14_7	3.74	3.38	1.14	71.21	0.06	0.04	0.83	0.00	11.65	0.00	92.06
	1124D_5H-7_12-14_8	3.80	3.42	1.47	70.52	0.09	0.06	0.81	0.00	11.41	0.00	91.58
	1124D_5H-7_12-14_10	3.76	3.27	0.98	69.87	0.09	0.02	0.83	0.00	11.44	0.03	90.29
	1124D_6H-1_72-74_1	4.01	3.00	2.99	67.85	0.33	0.29	2.04	0.07	13.57	0.09	94.24
	1124D_6H-1_72-74_2	3.54	3.40	1.01	74.67	0.06	0.11	1.10	0.04	12.06	0.00	95.99
	1124D_6H-1_72-74_3	3.62	3.39	1.12	74.41	0.08	0.10	1.05	0.11	11.92	0.00	95.81
	1124D_6H-1_72-74_4	3.33	3.46	1.03	74.55	0.09	0.09	1.08	0.05	12.03	0.00	95.71
	1124D_6H-1_72-74_5	3.53	4.39	1.22	73.32	0.15	0.08	0.57	0.05	11.79	0.03	95.13

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1124D_6H-1_72-74_7	3.35	3.61	1.10	74.82	0.10	0.03	1.09	0.05	11.85	0.02	96.02
	1124D_6H-1_72-74_8	3.38	3.53	1.11	73.22	0.08	0.09	1.08	0.02	11.80	0.00	94.32
	1124D_6H-1_72-74_9	3.65	3.48	1.25	72.42	0.18	0.16	1.12	0.08	12.25	0.00	94.59
	1124D_6H-1_72-74_10	3.56	3.34	1.23	73.94	0.07	0.11	1.05	0.01	12.08	0.03	95.40
	1124D_6H-1_72-74_11	3.71	3.44	1.00	74.41	0.10	0.12	1.04	0.00	12.02	0.01	95.84
	1124D_6H-1_72-74_12	3.64	3.34	1.04	72.81	0.11	0.10	1.02	0.01	11.84	0.02	93.93
	1124D_6H-1_72-74_13	3.63	3.39	1.03	74.09	0.08	0.10	1.08	0.08	12.21	0.05	95.74
	1124D_6H-1_72-74_14	4.38	2.74	2.40	69.81	0.27	0.31	2.23	0.00	14.33	0.04	96.51
	1124D_6H-1_72-74_16	4.17	2.73	2.81	69.02	0.35	0.42	2.33	0.02	14.45	0.05	96.35
	1124D_6H-1_72-74_17	3.92	3.00	1.79	72.97	0.15	0.20	1.53	0.05	12.69	0.02	96.33
	1124D_6H-1_72-74_18	4.10	2.51	3.65	68.86	0.41	0.60	2.92	0.10	14.84	0.08	98.07
	1124D_6H-1_72-74_19	3.51	3.46	1.02	74.92	0.08	0.13	1.08	0.02	12.13	0.00	96.36
	s93* 1124D_6H-1_142-144_1	3.62	3.62	1.15	72.78	0.08	0.06	0.88	0.07	11.71	0.03	94.00
	1124D_6H-1_142-144_2	3.56	3.39	1.08	72.86	0.09	0.06	1.01	0.02	11.55	0.02	93.64
	1124D_6H-1_142-144_3	3.35	3.92	0.86	73.05	0.08	0.06	0.94	0.08	11.58	0.01	93.93
	1124D_6H-1_142-144_4	3.67	3.76	1.11	73.38	0.06	0.11	0.89	0.00	11.49	0.00	94.47
	1124D_6H-1_142-144_5	3.59	3.67	1.07	72.48	0.07	0.04	0.92	0.06	11.97	0.02	93.88
	1124D_6H-1_142-144_6	3.79	2.89	1.17	73.29	0.18	0.15	1.28	0.06	11.40	0.01	94.22
	1124D_6H-1_142-144_7	3.83	2.87	1.30	73.43	0.16	0.15	1.28	0.00	11.41	0.02	94.45
	1124D_6H-1_142-144_8	4.07	2.95	2.18	69.86	0.14	0.09	1.57	0.04	12.44	0.01	93.35
	1124D_6H-1_142-144_9	3.56	3.73	1.08	72.59	0.06	0.08	0.91	0.01	11.57	0.00	93.59
	1124D_6H-1_142-144_10	3.42	3.69	1.04	72.94	0.05	0.08	0.88	0.03	11.56	0.03	93.73
	1124D_6H-1_142-144_11	3.62	3.65	1.00	72.57	0.09	0.05	0.93	0.00	11.49	0.01	93.40
	1124D_6H-1_142-144_12	3.74	2.90	1.21	73.22	0.18	0.14	1.35	0.03	11.44	0.02	94.23
	1124D_6H-1_142-144_13	3.71	2.90	1.24	73.62	0.16	0.19	1.27	0.06	11.42	0.00	94.58
	1124D_6H-1_142-144_14	3.84	2.94	1.36	73.57	0.19	0.13	1.31	0.00	11.56	0.00	94.91
	1124D_6H-1_142-144_15	3.54	3.76	1.11	73.22	0.11	0.08	0.90	0.01	11.58	0.02	94.31
	1124D_6H-1_142-144_16	3.42	3.67	1.17	73.33	0.08	0.09	0.92	0.06	11.49	0.01	94.24
	1124D_6H-1_142-144_17	3.32	3.83	1.15	73.35	0.12	0.09	0.85	0.06	11.79	0.00	94.57
	1124D_6H-1_142-144_18	3.73	2.87	1.23	72.46	0.14	0.17	1.35	0.01	11.28	0.00	93.25
	1124D_6H-1_142-144_19	3.68	3.72	1.15	73.39	0.09	0.10	0.86	0.08	11.45	0.03	94.54
	1124D_6H-1_142-144_20	3.43	3.62	1.15	73.23	0.08	0.08	0.91	0.04	11.58	0.01	94.14
	1124D_6H-1_142-144_1	3.63	3.09	1.33	74.07	0.13	0.15	1.35	0.02	11.80	0.02	95.60
	1124D_6H-1_142-144_4	3.61	3.13	1.58	73.69	0.22	0.16	1.31	0.07	11.72	0.01	95.50
	1124D_6H-1_142-144_10	3.59	3.24	1.19	73.52	0.10	0.09	1.10	0.05	11.96	0.00	94.84
	1124D_6H-1_142-144_2	3.37	3.75	1.05	73.63	0.08	0.01	0.92	0.02	11.85	0.00	94.69
	1124D_6H-1_142-144_5	3.29	3.76	1.27	74.22	0.06	0.09	1.06	0.00	12.05	0.00	95.81
	1124D_6H-1_142-144_8	3.57	3.77	1.10	74.42	0.12	0.05	0.90	0.04	12.14	0.00	96.10
	1124D_6H-1_142-144_3	3.61	3.72	1.02	74.09	0.11	0.01	0.87	0.05	12.17	0.01	95.66
	1124D_6H-1_142-144_6	3.46	3.83	1.09	73.83	0.08	0.07	0.90	0.09	11.58	0.00	94.92
	1124D_6H-1_142-144_7	3.43	3.70	1.05	74.23	0.09	0.06	0.91	0.01	11.99	0.02	95.48
	1124D_6H-1_142-144_9	3.35	3.68	1.12	74.66	0.07	0.09	0.92	0.05	11.87	0.03	95.83
	s95 1124D_6H-3_27-29_1	4.03	3.26	1.55	72.01	0.10	0.07	1.01	0.01	11.96	0.04	94.05
	1124D_6H-3_27-29_2	4.41	3.05	1.70	70.91	0.16	0.11	1.21	0.00	12.30	0.02	93.86
	1124D_6H-3_27-29_3	3.73	3.37	1.36	72.12	0.08	0.04	0.88	0.00	11.70	0.00	93.28
	1124D_6H-3_27-29_4	4.05	3.14	1.52	70.65	0.14	0.11	1.14	0.05	12.18	0.01	92.99
	1124D_6H-3_27-29_5	3.72	3.17	1.56	71.30	0.11	0.08	1.13	0.03	11.90	0.02	93.02
	1124D_6H-3_27-29_6	3.68	3.24	1.57	71.18	0.13	0.13	1.00	0.04	11.81	0.04	92.83
	1124D_6H-3_27-29_7	4.08	3.18	1.47	71.15	0.11	0.08	1.01	0.04	11.63	0.02	92.78
	1124D_6H-3_27-29_8	3.72	3.17	1.47	71.00	0.11	0.07	1.04	0.04	11.80	0.02	92.44
	1124D_6H-3_27-29_9	3.92	3.36	1.26	71.50	0.11	0.10	1.03	0.08	11.65	0.00	93.02
	1124D_6H-3_27-29_10	4.00	3.34	1.51	71.65	0.12	0.09	1.08	0.00	11.80	0.01	93.60
	1124D_6H-3_27-29_11	3.91	3.13	1.28	71.90	0.12	0.06	0.97	0.00	11.59	0.00	92.96
	1124D_6H-3_27-29_12	4.13	3.06	1.73	70.50	0.12	0.12	1.23	0.07	11.99	0.01	92.95
	1124D_6H-3_27-29_13	4.02	3.32	1.65	71.89	0.12	0.08	1.05	0.01	11.71	0.00	93.85
	1124D_6H-3_27-29_14	3.78	3.23	1.46	71.74	0.09	0.08	1.00	0.04	11.82	0.02	93.26
	1124D_6H-3_27-29_15	3.87	3.31	1.37	70.52	0.11	0.08	1.03	0.07	11.63	0.01	92.00
	1124D_6H-3_27-29_16	4.02	3.16	1.56	70.27	0.12	0.12	1.17	0.02	11.95	0.01	92.40
	1124D_6H-3_27-29_17	4.10	3.23	1.47	71.94	0.13	0.07	0.99	0.08	11.84	0.00	93.85
	1124D_6H-3_27-29_18	3.88	3.21	1.49	70.96	0.12	0.08	1.00	0.09	11.63	0.00	92.46
	1124D_6H-3_27-29_19	4.19	3.17	1.78	70.63	0.15	0.12	1.21	0.05	12.23	0.01	93.53
	1124D_6H-3_27-29_20	3.82	3.27	1.55	71.55	0.07	0.12	1.07	0.04	11.78	0.01	93.28
	u67 1124D_6H-3_70-72_1	3.99	2.82	1.77	71.38	0.22	0.20	1.40	0.00	12.23	0.08	94.09
	1124D_6H-3_70-72_2	4.06	2.71	1.56	71.83	0.22	0.22	1.41	0.06	12.27	0.05	94.38
	1124D_6H-3_70-72_3	4.38	2.83	1.67	71.02	0.19	0.17	1.39	0.06	12.32	0.02	94.05
	1124D_6H-3_70-72_4	3.85	2.85	1.30	72.68	0.14	0.14	1.06	0.00	11.72	0.01	93.75
	1124D_6H-3_70-72_5	3.67	2.92	1.53	71.41	0.18	0.20	1.38	0.07	11.91	0.05	93.32
	1124D_6H-3_70-72_6	4.16	2.74	1.71	71.39	0.17	0.19	1.41	0.08	12.41	0.00	94.26
	1124D_6H-3_70-72_7	4.28	2.61	1.67	70.98	0.19	0.18	1.40	0.06	12.24	0.05	93.66
	1124D_6H-3_70-72_8	3.86	3.57	1.24	74.23	0.06	0.02	0.73	0.01	11.37	0.01	95.11

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
	1124D_6H-3_70-72_9	4.44	2.62	1.86	71.07	0.20	0.22	1.40	0.09	12.15	0.05	94.11
	1124D_6H-3_70-72_10	4.32	2.76	1.72	71.50	0.20	0.22	1.46	0.06	12.32	0.01	94.56
	1124D_6H-3_70-72_11	4.39	2.66	1.97	71.30	0.19	0.17	1.41	0.03	12.32	0.01	94.44
	1124D_6H-3_70-72_12	3.98	2.72	1.78	71.69	0.19	0.18	1.47	0.04	12.15	0.01	94.20
	1124D_6H-3_70-72_13	3.94	2.99	1.38	72.43	0.15	0.09	1.04	0.05	11.82	0.00	93.88
	1124D_6H-3_70-72_14	4.00	3.25	1.49	72.67	0.09	0.06	1.11	0.09	12.08	0.00	94.85
	1124D_6H-3_70-72_15	4.35	2.71	1.82	71.88	0.18	0.17	1.36	0.02	12.33	0.04	94.87
	1124D_6H-3_70-72_16	4.45	2.70	1.58	70.95	0.18	0.14	1.40	0.04	12.43	0.03	93.90
	1124D_6H-3_70-72_17	4.03	3.05	1.82	72.83	0.20	0.16	1.40	0.09	12.33	0.01	95.91
	1124D_6H-3_70-72_18	4.40	2.76	1.76	71.88	0.20	0.20	1.40	0.07	12.34	0.00	95.01
	1124D_6H-3_70-72_19	4.02	3.03	1.79	72.09	0.22	0.20	1.33	0.11	12.19	0.05	95.02
	1124D_6H-3_70-72_20	4.44	2.68	1.82	71.53	0.20	0.17	1.44	0.06	12.45	0.04	94.83
	1124D_6H-3_120-122_1	3.88	3.23	1.56	71.57	0.11	0.07	1.12	0.02	11.99	0.00	93.55
	1124D_6H-3_120-122_2	4.08	3.34	1.67	72.08	0.12	0.09	1.16	0.10	12.50	0.00	95.14
	1124D_6H-3_120-122_3	3.99	3.38	1.54	72.76	0.10	0.07	1.09	0.05	12.06	0.02	95.06
	1124D_6H-3_120-122_4	3.89	3.37	1.54	72.20	0.10	0.04	0.98	0.03	11.78	0.00	93.92
	1124D_6H-3_120-122_5	4.21	3.28	1.59	71.96	0.11	0.08	1.13	0.01	12.15	0.00	94.52
	1124D_6H-3_120-122_6	4.05	3.28	1.61	71.74	0.11	0.09	1.07	0.10	11.83	0.01	93.90
	1124D_6H-3_120-122_7	4.17	2.64	3.01	67.53	0.22	0.31	2.31	0.05	13.12	0.05	93.41
	1124D_6H-3_120-122_9	4.47	3.30	1.51	72.48	0.06	0.05	1.09	0.04	11.92	0.00	94.92
	1124D_6H-3_120-122_10	4.22	3.32	1.46	72.04	0.07	0.04	1.09	0.00	11.87	0.00	94.12
	1124D_6H-3_120-122_11	4.10	3.28	1.60	71.99	0.11	0.09	1.10	0.00	11.97	0.02	94.26
	1124D_6H-3_120-122_12	4.19	3.22	1.58	71.80	0.08	0.10	1.13	0.00	11.85	0.03	93.98
	1124D_6H-3_120-122_13	3.28	3.67	0.78	72.93	0.13	0.10	1.00	0.03	11.44	0.03	93.39
	1124D_6H-3_120-122_14	4.17	3.32	1.61	71.92	0.10	0.05	1.09	0.04	11.77	0.00	94.06
	1124D_6H-3_120-122_15	4.21	3.20	1.51	71.24	0.10	0.07	1.10	0.07	11.86	0.02	93.38
	1124D_6H-3_120-122_16	4.18	3.20	1.56	72.29	0.11	0.08	1.08	0.00	12.12	0.01	94.64
	1124D_6H-3_120-122_17	4.03	3.31	1.74	71.98	0.09	0.07	1.11	0.02	12.27	0.01	94.62
	1124D_6H-3_120-122_18	3.99	3.39	1.32	72.09	0.09	0.04	0.95	0.00	11.51	0.01	93.39
	1124D_6H-3_120-122_19	4.00	3.21	1.47	71.76	0.11	0.08	1.08	0.08	12.00	0.00	93.79
	1124D_6H-3_120-122_20	3.91	3.35	1.77	72.28	0.10	0.07	1.12	0.03	12.19	0.01	94.83
s96	1124D_6H-4_29-31_1	3.31	2.89	1.46	72.93	0.22	0.23	1.46	0.00	11.47	0.03	94.01
	1124D_6H-4_29-31_2	3.61	2.98	1.47	73.47	0.25	0.21	1.46	0.03	11.53	0.01	95.03
	1124D_6H-4_29-31_3	3.64	3.26	1.02	72.69	0.08	0.12	0.93	0.00	11.63	0.00	93.38
	1124D_6H-4_29-31_4	3.55	3.04	1.53	73.42	0.22	0.22	1.47	0.08	11.62	0.08	95.23
	1124D_6H-4_29-31_5	3.51	3.46	1.03	73.43	0.10	0.13	1.04	0.04	11.65	0.01	94.40
	1124D_6H-4_29-31_6	3.65	2.97	1.61	73.26	0.23	0.19	1.49	0.04	11.41	0.03	94.88
	1124D_6H-4_29-31_7	3.66	2.99	1.35	73.27	0.23	0.24	1.40	0.00	11.40	0.02	94.56
	1124D_6H-4_29-31_8	3.73	2.95	1.37	72.68	0.22	0.26	1.50	0.00	11.62	0.00	94.33
	1124D_6H-4_29-31_9	3.58	2.86	1.43	73.14	0.23	0.25	1.42	0.04	11.32	0.01	94.29
	1124D_6H-4_29-31_10	3.54	3.37	1.05	73.20	0.11	0.14	1.05	0.00	11.64	0.03	94.13
	1124D_6H-4_29-31_11	3.37	3.59	0.99	73.51	0.11	0.14	1.07	0.05	11.56	0.02	94.40
	1124D_6H-4_29-31_12	3.60	2.92	1.43	73.06	0.23	0.24	1.43	0.09	11.70	0.02	94.72
	1124D_6H-4_29-31_13	3.57	2.98	1.36	72.86	0.24	0.19	1.46	0.06	11.35	0.03	94.10
	1124D_6H-4_29-31_14	3.54	2.88	1.51	72.50	0.26	0.21	1.47	0.04	11.45	0.03	93.89
	1124D_6H-4_29-31_15	3.39	2.97	1.39	72.89	0.22	0.21	1.44	0.00	11.41	0.01	93.93
	1124D_6H-4_29-31_16	3.60	2.75	1.40	72.85	0.23	0.20	1.47	0.03	11.49	0.05	94.07
	1124D_6H-4_29-31_17	3.33	3.09	1.38	72.98	0.24	0.20	1.39	0.06	11.16	0.06	93.88
	1124D_6H-4_29-31_18	3.67	2.97	1.39	73.17	0.21	0.22	1.46	0.03	11.35	0.02	94.50
	1124D_6H-4_29-31_20	3.40	3.05	1.45	73.40	0.22	0.15	1.45	0.00	11.48	0.04	94.65
	1124D_6H-4_29-31_4	3.45	3.11	1.63	73.20	0.23	0.23	1.47	0.03	11.92	0.02	95.30
	1124D_6H-4_29-31_6	3.36	3.12	1.60	73.25	0.24	0.23	1.48	0.03	11.73	0.03	95.06
	1124D_6H-4_29-31_9	2.95	3.27	1.33	72.82	0.23	0.20	1.40	0.01	11.68	0.01	93.90
	1124D_6H-4_29-31_10	3.38	2.96	1.44	73.22	0.23	0.21	1.41	0.01	11.53	0.00	94.39
	1124D_6H-4_29-31_8	3.39	3.45	1.15	72.63	0.10	0.09	1.08	0.00	11.51	0.01	93.41
	1124D_6H-4_29-31_1	3.25	2.93	1.38	72.54	0.19	0.24	1.46	0.01	11.45	0.02	93.47
	1124D_6H-4_29-31_2	3.30	4.18	0.95	73.66	0.06	0.04	0.79	0.05	11.72	0.00	94.76
	1124D_6H-4_29-31_3	3.26	3.67	1.14	73.24	0.12	0.11	1.03	0.02	11.71	0.06	94.36
	1124D_6H-4_29-31_5	3.46	2.91	1.28	71.49	0.24	0.23	1.48	0.00	11.27	0.01	92.37
	1124D_6H-4_29-31_7	3.41	3.03	1.31	73.28	0.23	0.23	1.49	0.00	11.43	0.01	94.41

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1124A_1H-1_71-73_2	37.36	5.45	2.76	0.46	94.75	61.34	18.61	79.49	6.90	3.49	937.27	21.77	42.86	4.63	17.16
1124A_1H-1_71-73_3	36.76	5.64	2.96	0.43	100.59	62.47	19.57	81.39	7.08	4.12	989.29	22.73	44.6	4.77	17.58
1124A_1H-1_71-73_5	35.78	5.69	2.23	0.82	123.60	59.26	19.63	82.86	7.15	6.18	977.61	23.18	45.7	4.8	17.92
1124A_1H-1_71-73_7	41.28	5.80	1.85	0.33	90.53	63.37	20.54	85.80	7.24	3.39	955.64	22.99	44.88	4.67	16.84
1124A_1H-1_71-73_11	38.80	6.14	2.05	0.53	89.80	60.34	19.37	81.67	7.12	3.57	944.72	22.19	44.31	4.66	17.12
1124A_1H-3_35-37_3	57.25	15.00	2.82	1.86	114.95	130.23	32.00	221.31	7.78	6.38	672.29	27.73	56.13	6.17	25.66
1124A_1H-3_35-37_4	56.67	15.97	2.29	1.81	129.57	140.65	32.95	234.57	8.58	7.30	723.95	28.49	61.61	7	26.76
1124A_1H-3_35-37_5	50.41	12.57	3.02	1.85	105.96	123.62	29.12	206.99	6.81	5.90	630.71	26.04	53.56	6.14	21.83
1124A_1H-3_35-37_8	52.58	14.18	2.19	1.78	118.31	125.62	31.69	227.87	7.57	6.44	678.26	27.72	58.1	6.58	26.55
1124B_1H-2_43-45_2	38.28	10.41	2.85	0.21	100.86	104.95	33.05	143.96	8.76	3.85	860.13	26.39	57.93	6.66	25.13
1124B_1H-2_43-45_4	36.08	9.18	3.21	0.24	94.56	98.62	31.86	139.29	8.63	3.54	819.98	25.33	54.06	6.44	24.93
1124B_1H-2_43-45_6	38.55	9.50	2.80	0.28	97.21	97.78	31.07	134.07	8.84	3.65	829.09	25.33	54.54	6.57	25.69
1124B_1H-2_43-45_8	33.55	9.25	2.52	0.24	87.29	91.94	28.25	124.24	7.66	3.37	747.57	23.01	50.68	5.78	22.69
1124B_1H-2_43-45_9	35.02	9.35	2.70	0.31	92.20	96.24	30.42	136.06	8.28	3.43	794.31	24.49	52.22	5.99	24.06
1124B_1H-2_72-74_3	33.38	11.18	3.74	0.38	96.82	110.13	30.69	145.17	9.21	3.41	886.71	26.4	55.01	6.46	24.49
1124B_1H-2_72-74_6	37.92	10.95	3.17	0.33	98.93	107.98	29.91	142.80	8.73	3.31	858.33	25.19	53.36	6.27	23.73
1124B_1H-2_72-74_7	33.96	10.23	2.06	0.17	86.13	107.72	29.49	146.03	8.41	3.12	821.62	24.34	52.15	5.98	24.08
1124B_1H-2_72-74_8	33.53	10.20	2.61	0.36	91.40	108.17	30.01	147.62	8.49	3.18	812.81	24.09	51.11	6.12	23.83
1124B_1H-2_72-74_10	34.58	10.55	1.77	0.21	84.34	116.01	31.40	154.09	8.84	2.93	817.02	24.57	53.64	6.31	24.87
1124B_1H-3_15-17_1	35.86	5.55	2.86	0.68	86.41	59.32	17.96	75.80	6.55	3.22	926.27	20.8	43.51	4.55	15.59
1124B_1H-3_15-17_2	47.29	5.47	2.95	0.47	93.33	60.97	18.81	79.20	7.21	3.66	977.32	22	45.07	4.92	17.01
1124B_1H-3_15-17_4	42.66	5.06	2.89	0.40	88.41	60.44	18.08	75.70	6.86	3.46	957.41	21.37	43.34	4.67	16.69
1124B_1H-3_15-17_5	47.09	6.11	3.01	0.52	103.52	65.48	19.82	86.39	7.67	3.94	1060.91	23.83	48.46	5.19	18.09
1124C_1X-1_80-82_1	42.46	9.26	1.75	0.37	113.47	43.02	35.93	136.84	9.19	5.21	737.69	27.47	59.73	7.05	28.3
1124C_1X-1_80-82_2	45.08	8.98	2.97	0.45	135.45	45.70	37.13	141.01	9.95	6.16	834.32	30.65	64.98	7.62	28.56
1124C_1X-1_80-82_4	47.79	9.62	1.98	0.51	126.59	46.88	39.64	144.03	9.86	5.66	809.13	31.93	66.87	7.68	31.5
1124C_1X-1_80-82_6	43.77	8.28	2.58	0.38	138.48	36.59	32.81	128.41	10.83	5.87	861.46	30.05	61.57	7.16	26.59
1124C_1X-1_80-82_10	37.48	8.09	3.86	0.43	113.19	34.03	34.97	124.62	8.67	5.06	719.28	27.28		6.83	26.86
1124C_2X-6_53-55_2	56.69	6.53	3.99	0.85	174.71	53.05	19.75	114.60	7.71	8.19	963.80	24.83	49.46	4.92	17.26
1124C_2X-6_53-55_8	42.77	6.43	3.75	0.77	125.59	106.87	18.40	170.94	7.36	5.63	731.16	21.36	42.14	4.42	16.94
1124C_2X-6_53-55_6	49.54	6.04	4.12	0.62	131.06	85.07	18.47	120.96	6.91	5.78	775.26	21.56	42.94	4.5	16.14
1124C_2X-6_53-55_9	61.05	7.71	4.52	0.42	148.05	75.61	24.18	92.98	8.18	6.86	974.25	26.73	54.79	5.8	21.39
1124C_2X-6_53-55_10	51.56	6.33	3.17	0.40	118.85	62.03	20.28	78.18	6.84	5.61	806.67	21.33	45.49	5.02	18.66
1124C_3H-1_85-87_1	41.06	5.08	1.91	1.39	114.85	60.64	14.17	78.31	5.08	5.84	782.46	18.43	36.71	3.51	12.66
1124C_3H-1_85-87_2	47.36	5.99	2.74	1.07	135.45	62.81	15.82	91.56	5.69	6.35	914.94	20.64	38.52	4	13.85
1124C_3H-1_85-87_3	57.04	5.62	2.06	0.94	143.00	65.66	16.32	93.08	5.79	6.63	924.90	21.19	41.52	4.47	14.19
1124C_3H-1_85-87_5	52.15	6.53	5.80	1.26	161.10	75.60	19.41	105.72	6.04	7.74	1059.06	23.76	44.8	4.49	16.89
1124C_3H-1_85-87_6	56.46	6.05	2.48	0.94	135.75	63.47	16.33	94.66	6.08	6.76	930.03	21.25	41.42	4.14	14.78
1124C_3H-3_54-56_1	33.46	12.09	2.51	1.24	109.68	100.64	31.27	275.94	9.38	5.20	717.90	24.85	55.1	6.29	27.14
1124C_3H-3_54-56_4	38.97	12.15	3.36	1.10	107.51	98.97	30.84	274.88	9.33	5.18	723.03	24.75	54.67	6.6	24.6
1124C_3H-3_54-56_6	31.20	13.19	8.98	1.02	125.09	108.34	34.57	298.70	9.86	5.25	767.05	28.14	59.36	6.81	26.57
1124C_3H-3_54-56_8	38.49	9.90	2.63	0.86	124.68	78.52	29.92	196.21	8.78	5.50	772.40	25.57	59.32	6.78	26.46
1124C_3H-3_54-56_10	38.98	12.03	2.06	1.02	111.56	103.92	31.18	275.97	9.46	5.24	749.15	25.15	57.24	6.56	26.15
1124C_3H-4_50-52_2	41.83	13.67	2.06	0.57	116.46	62.93	26.41	139.69	7.87	5.51	702.30	23.5	49.75	5.52	21.41
1124C_3H-4_50-52_3	45.57	13.90	2.35	0.67	119.68	66.25	28.04	146.65	7.87	6.00	743.12	24.24	52.4	5.95	22.12
1124C_3H-4_50-52_4	48.27	13.88	2.58	0.70	125.87	65.61	28.25	149.61	8.19	5.94	721.15	23.71	49.97	5.74	21.97
1124C_3H-4_50-52_5	44.47	14.00	2.49	0.69	131.41	68.67	29.36	155.87	8.00	6.10	769.02	25.18	53.52	6.1	23.06
1124C_3H-4_50-52_8	45.04	13.07	2.46	0.47	121.86	65.57	27.59	147.69	7.96	5.65	771.20	25.35	52.88	5.86	23.98
1124C_3H-5_56-58_1	37.41	4.45	2.15	0.79	132.90	82.63	18.62	137.51	7.20	6.23	750.04	22.09	42.03	4.68	15.53
1124C_3H-5_56-58_4	33.96	4.75	3.71	0.64	115.74	70.66	18.47	124.87	6.26	5.35	666.80	20.56	38.86	4.28	15.16
1124C_3H-5_56-58_6	40.35	7.83	3.64	0.58	109.66	64.55	28.18	147.95	7.23	5.39	719.29	24.89	49.52	5.81	20.23
1124C_3H-5_56-58_7	40.90	4.42	2.04	0.76	131.18	82.06	18.30	139.03	7.16	6.03	759.36	22.65	41.92	4.46	16.61
1124C_3H-5_56-58_8	39.64	4.63	2.01	0.71	128.92	83.20	18.71	144.90	7.08	6.44	757.94	22.89	43.13	4.47	16.02
1124C_4H-1_26-28_1	41.15	5.30	2.59	0.52	118.18	51.81	26.55	116.35	8.06	6.30	725.63	25.19	52.14	5.87	22.37
1124C_4H-1_26-28_3	45.67	5.46	2.46	0.38	121.89	52.08	27.09	118.39	8.58	6.51	734.85	25.81	53.48	6.19	22.11
1124C_4H-1_26-28_4	38.81	5.01	2.42	0.46	119.75	54.10	28.09	122.85	8.31	6.13	736.31	26.35	54	6.25	23.16
1124C_4H-1_26-28_5	41.34	5.36	2.36	0.55	128.08	55.27	28.65	123.55	8.91	6.58	763.76	26.3	55.19	6.02	22.8
1124C_4H-1_26-28_6	39.46	5.11	2.53	0.64	118.74	54.15	27.96	120.61	8.33	6.20	744.25	26.34	52.88	5.99	23.61
1124C_4H-2_17-19_1	44.33	11.86	7.42	1.99	121.70	104.06	34.61	266.07	11.08	6.25	783.38	27.96	60.26	7.36	27.59
1124C_4H-2_17-19_2	44.55	11.11	6.18	0.53	110.28	94.45	32.46	252.13	10.35	5.64	736.17	26.8	56.92	6.84	25.88
1124C_4H-2_17-19_3	44.80	11.66	3.10	0.59	115.36	96.93	33.15	255.37	10.71	5.87	753.62	26.94	58.62	7	26.83
1124C_4H-2_17-19_4	42.28	10.78	30.07	0.81	108.26	96.76	32.86	254.38	10.62	5.61	756.10	25.83	59.96	6.97	26.9
1124C_4H-2_17-19_5	41.00	10.01	2.41	0.46	105.13	89.35	30.20	242.28	10.11	5.59	705.31	25.47	55.21	6.47	25.92
1124C_4H-2_81-83_1	36.69	9.13	3.03	0.65	105.15	73.89	26.80	150.51	7.16	4.62	692.67	23.38	49.51	5.88	23.82
1124C_4H-2_81-83_2	45.67	9.84	2.39	0.69	116.75	79.26	30.09	164.52	8.43	5.55	759.34	26.58	53.43	6.17	22.87
1124C_4H-2_81-83_3	30.70	10.72	2.19	0.54	114.93	77.75	33.40	209.96	9.90	5.09	749.13	27.37	57.21	6.66	26.77
1124C_4H-2_81-83_4	37.34	9.58	3.71	0.97	106.94	82.23	28.46	168.29	7.66	4.68	723.32	26.05	51.85	5.88	22.76
1124C_4H-2_118-120_3	34.09	10.10	3.85	0.60	116.23	77.00	31.16	203.72	9.72	4.85	744.14	27.01	58.81	6.74	26.65
1124C_4H-2_118-120_6	30.98	9.78	2.51	1.05	125.99	78.63	31.87	208							

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1124A_1H-1_71-73_2	3.02	0.46	2.70	0.43	3.29	0.65	2.01	0.27	2.26	0.36	2.59	0.568	11.95	8.71	2.009
1124A_1H-1_71-73_3	3.08	0.50	3.26	0.52	3.02	0.68	1.92	0.33	2.60	0.35	2.80	0.629	12.15	9.08	2.08
1124A_1H-1_71-73_5	3.17	0.41	2.96	0.46	3.11	0.65	2.16	0.34	2.37	0.35	2.65	0.647	14.75	9.72	2.28
1124A_1H-1_71-73_7	3.11	0.53	2.74	0.52	3.14	0.73	1.91	0.36	2.80	0.55	2.61	0.676	12.1	9.3	2.12
1124A_1H-1_71-73_11	3.44	0.38	3.35	0.45	3.19	0.64	1.92	0.26	2.26	0.41	3.02	0.501	11.83	9.05	2.01
1124A_1H-3_35-37_3	6.16	1.04	4.60	0.97	5.80	1.10	3.63	0.54	3.80	0.50	6.84	0.541	16.28	11	2.46
1124A_1H-3_35-37_4	5.98	1.20	5.12	0.99	5.88	1.31	3.68	0.48	4.14	0.56	6.59	0.62	19.05	11.79	2.74
1124A_1H-3_35-37_5	5.92	1.01	4.82	0.85	5.12	1.10	3.01	0.46	2.96	0.51	7.00	0.74	17.22	10.32	2.28
1124A_1H-3_35-37_8	6.30	1.11	4.94	0.85	5.75	1.35	3.61	0.54	3.85	0.58	6.07	0.587	18.97	11.67	2.74
1124B_1H-2_43-45_2	6.24	1.18	5.40	0.79	5.48	1.11	3.79	0.56	3.81	0.56	4.51	0.694	16.65	9.68	2.35
1124B_1H-2_43-45_4	5.75	1.12	4.62	0.85	5.27	1.13	3.22	0.56	3.57	0.58	4.32	0.625	15.32	9.31	2.15
1124B_1H-2_43-45_6	5.36	1.10	4.84	0.85	5.15	1.15	3.51	0.49	3.43	0.51	4.57	0.655	16.23	9	2.25
1124B_1H-2_43-45_8	4.99	1.04	4.24	0.71	4.67	1.07	3.01	0.45	3.33	0.42	3.73	0.545	15.27	8.22	1.84
1124B_1H-2_43-45_9	4.95	1.15	5.09	0.77	5.03	1.02	3.36	0.48	3.62	0.55	4.35	0.542	14.52	8.58	2.068
1124B_1H-2_72-74_3	5.70	1.12	4.87	0.80	5.17	1.01	2.93	0.54	3.73	0.58	4.43	0.644	15.48	8.79	2.26
1124B_1H-2_72-74_6	5.15	1.10	4.78	0.81	5.01	1.05	3.07	0.48	3.73	0.48	4.66	0.608	16.06	8.71	2.19
1124B_1H-2_72-74_7	4.86	1.05	5.24	0.67	5.30	1.04	3.35	0.48	3.28	0.46	4.28	0.568	13.82	8.16	2.07
1124B_1H-2_72-74_8	4.79	1.08	4.88	0.80	4.74	1.07	3.20	0.46	3.49	0.52	4.39	0.584	14.68	8.31	2.08
1124B_1H-2_72-74_10	5.72	1.16	4.77	0.79	5.10	1.16	3.82	0.51	3.32	0.45	4.40	0.523	15.91	8.32	2.34
1124B_1H-3_15-17_1	4.07	0.39	2.37	0.43	2.96	0.53	1.88	0.29	2.68	0.41	3.09	0.58	10.25	8.72	1.8
1124B_1H-3_15-17_2	3.02	0.50	2.94	0.45	3.01	0.67	2.08	0.31	2.40	0.39	2.73	0.666	11.42	8.91	2.3
1124B_1H-3_15-17_4	2.80	0.45	2.97	0.42	2.78	0.60	1.93	0.27	2.47	0.33	2.54	0.539	11.4	8.3	2.02
1124B_1H-3_15-17_5	3.52	0.54	2.89	0.47	3.07	0.67	1.94	0.36	2.53	0.41	2.94	0.615	12.41	9.35	2.36
1124C_1X-1_80-82_1	6.22	0.62	6.47	0.92	6.28	1.32	4.06	0.58	4.43	0.67	4.76	0.775	18.29	11.82	2.72
1124C_1X-1_80-82_2	6.12	0.82	5.77	0.98	6.25	1.32	3.89	0.54	4.10	0.65	4.73	0.808	21.24	12.55	2.82
1124C_1X-1_80-82_4	6.66	0.91	6.32	1.05	7.48	1.53	5.22	0.68	5.06	0.68	5.16	0.899	20.36	13.43	2.95
1124C_1X-1_80-82_6	5.35	0.69	5.30	0.87	5.46	1.19	3.37	0.49	3.77	0.56	4.26	0.789	25.69	12.67	3.19
1124C_1X-1_80-82_10	5.32	0.59	5.07	0.81	5.61	1.05	3.52	0.65	4.47	0.67	4.05	0.586	17.07	11.33	2.62
1124C_2X-6_53-55_2	3.43	0.41	3.12	0.41	2.99	0.69	1.94	0.32	2.34	0.36	3.60	0.744	18.13	15.35	3.71
1124C_2X-6_53-55_8	3.11	0.66	3.00	0.48	3.01	0.70	2.11	0.33	2.13	0.37	4.59	0.667	26.1	11.02	2.8
1124C_2X-6_53-55_6	3.36	0.51	2.74	0.45	2.87	0.65	1.99	0.30	2.06	0.33	3.72	0.613	16.81	11.4	2.84
1124C_2X-6_53-55_9	3.94	0.68	3.70	0.58	3.86	0.82	2.59	0.37	2.73	0.43	3.18	0.697	18.79	13.35	3.21
1124C_2X-6_53-55_10	3.71	0.58	2.98	0.56	3.15	0.73	2.32	0.35	2.46	0.39	2.66	0.603	15.48	11.12	2.78
1124C_3H-1_85-87_1	2.32	0.31	2.37	0.42	2.32	0.56	1.69	0.23	1.56	0.32	2.84	0.504	14.6	11.23	2.28
1124C_3H-1_85-87_2	3.15	0.29	2.21	0.44	2.71	0.49	1.59	0.32	1.84	0.28	2.62	0.61	16.58	11.79	2.74
1124C_3H-1_85-87_3	3.15	0.34	2.57	0.32	2.48	0.54	1.78	0.26	1.88	0.34	3.30	0.565	15.91	12.87	2.83
1124C_3H-1_85-87_5	3.59	0.47	3.58	0.45	2.63	0.58	1.88	0.28	2.33	0.29	3.17	0.485	15.62	12.37	3.15
1124C_3H-1_85-87_6	2.82	0.40	2.16	0.38	2.48	0.63	1.75	0.26	1.93	0.31	3.10	0.559	16.06	12.72	2.94
1124C_3H-3_54-56_1	5.44	1.06	5.08	0.89	5.51	1.05	3.03	0.50	3.73	0.70	7.07	0.675	17.74	10.57	2.55
1124C_3H-3_54-56_4	5.89	1.05	4.72	0.83	5.53	1.05	3.46	0.53	3.77	0.49	6.88	0.639	17.01	10.16	2.74
1124C_3H-3_54-56_6	5.66	0.95	5.92	0.86	5.09	1.11	3.46	0.64	4.02	0.49	7.26	0.591	18.08	10.88	2.67
1124C_3H-3_54-56_8	5.66	0.86	4.93	0.84	5.12	1.13	3.67	0.50	3.54	0.53	5.24	0.514	20.15	11.07	2.72
1124C_3H-3_54-56_10	5.81	0.99	4.58	0.88	5.30	1.16	3.37	0.49	3.76	0.58	6.95	0.722	18.79	10.29	2.66
1124C_3H-4_50-52_2	4.46	0.73	4.06	0.57	3.99	1.04	2.94	0.44	3.13	0.45	4.05	0.613	16.7	10.52	2.53
1124C_3H-4_50-52_3	5.34	0.86	4.60	0.60	4.96	1.02	2.93	0.53	2.89	0.53	4.47	0.7	16.92	11.31	2.65
1124C_3H-4_50-52_4	4.37	0.78	4.49	0.73	4.34	0.96	2.70	0.39	3.15	0.48	4.81	0.534	17.61	11.52	2.74
1124C_3H-4_50-52_5	5.10	0.68	4.53	0.82	4.73	1.06	3.24	0.51	3.43	0.50	4.86	0.642	17.33	12.27	2.99
1124C_3H-4_50-52_8	5.12	0.89	5.58	0.84	4.75	0.98	3.20	0.48	3.06	0.56	5.27	0.627	19.09	12.55	2.7
1124C_3H-5_56-58_1	3.46	0.60	2.87	0.39	2.99	0.63	1.94	0.29	2.02	0.31	4.03	0.639	15.52	12.11	2.72
1124C_3H-5_56-58_4	2.92	0.49	2.81	0.47	3.29	0.66	2.03	0.28	1.99	0.28	3.66	0.563	14.43	10.62	2.54
1124C_3H-5_56-58_6	4.67	0.78	4.35	0.80	4.54	0.87	2.57	0.44	3.08	0.46	4.51	0.836	15.14	11.18	2.46
1124C_3H-5_56-58_7	3.39	0.56	2.93	0.51	3.03	0.75	1.78	0.29	2.23	0.31	4.41	0.692	15.6	12.33	3.13
1124C_3H-5_56-58_8	3.13	0.64	2.70	0.49	3.32	0.61	1.99	0.30	2.46	0.42	4.11	0.594	15.96	12.61	2.79
1124C_4H-1_26-28_1	4.49	0.49	4.29	0.66	4.43	0.95	2.91	0.45	3.16	0.50	3.70	0.683	17.26	11.76	2.7
1124C_4H-1_26-28_3	4.62	0.59	4.15	0.66	4.54	0.98	3.07	0.42	3.34	0.48	3.90	0.705	18.21	11.96	2.85
1124C_4H-1_26-28_4	4.51	0.57	4.01	0.63	4.39	1.14	3.02	0.46	3.21	0.49	4.20	0.773	16.42	11.55	2.92
1124C_4H-1_26-28_5	4.33	0.62	4.17	0.75	4.14	1.02	3.03	0.49	3.32	0.53	4.18	0.753	17.96	12.48	2.88
1124C_4H-1_26-28_6	4.60	0.60	3.74	0.75	4.94	1.04	3.07	0.42	3.39	0.50	4.18	0.66	17.25	12.34	2.63
1124C_4H-2_17-19_1	6.35	1.22	5.69	0.89	5.96	1.30	3.79	0.56	3.84	0.56	7.30	0.732	25.91	10.98	2.69
1124C_4H-2_17-19_2	6.08	1.13	5.52	0.88	5.59	1.13	3.55	0.55	3.62	0.56	6.65	0.76	17.65	10.71	2.6
1124C_4H-2_17-19_3	5.96	1.19	5.97	0.91	5.82	1.19	3.63	0.54	3.79	0.57	7.08	0.724	19.91	10.91	2.66
1124C_4H-2_17-19_4	5.99	1.10	5.20	0.86	5.39	1.25	3.67	0.54	4.59	0.61	6.94	0.648	17.99	10.76	2.73
1124C_4H-2_17-19_5	5.18	1.18	4.90	0.83	5.59	1.24	3.50	0.51	3.55	0.53	6.20	0.683	17.16	10.29	2.59
1124C_4H-2_81-83_1	4.96	1.00	4.94	0.65	4.78	1.09	3.02	0.31	3.11	0.39	4.64	0.699	16.08	10.66	2.15
1124C_4H-2_81-83_2	5.99	0.94	5.17	0.84	4.97	1.10	3.18	0.52	3.68	0.47	4.31	0.625	18.13	11.54	2.55
1124C_4H-2_81-83_3	6.36	1.04	6.05	0.83	5.16	1.18	3.73	0.41	3.89	0.45	5.53	0.635	17.88	12.19	2.68
1124C_4H-2_81-83_4	5.29	0.98	4.41	0.83	4.56	1.06	2.96	0.55	2.19	0.43	4.64	0.495	17.79	11.12	2.34
1124C_4H-2_118-120_3	5.62	0.72	6.30	0.93	5.25	1.31	3.90	0.47	3.21	0.51	5.47	0.821	19.92	11.55	2.71
1124C_4H-2_118-120_6	6.08	0.93	5.00	0.83	5.65	1.16	3.44	0.51	3.50	0.53	6.12	0.613	21.27	11.65	3.31
1124C_4H-2_118-120_7	6.08	1.04	5.35	0.92	6.25	1.15	3.59	0.47	4.02	0.55	6.10	0.846	20.06	12.08	2.9

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1124C_4H-2_118-120_8	32.68	9.82	2.89	0.69	118.98	79.48	32.17	203.22	9.40	5.59	764.87	28.13	57.42	6.64	27.37
1124C_4H-3_142-144_5	41.75	6.85	2.36	0.84	115.03	62.57	24.64	127.24	7.93	5.35	706.72	24.3	53.59	5.5	23.71
1124C_4H-3_142-144_6	42.10	7.47	4.72	0.88	120.89	70.07	24.85	152.72	8.34	6.03	729.05	24.8	52.78	5.87	21.68
1124C_4H-3_142-144_8	45.73	7.83	2.45	0.70	126.69	70.86	27.08	158.98	8.75	6.46	767.63	25.86	57.34	6.32	24.09
1124C_4H-3_142-144_9	41.11	8.32	2.85	0.87	133.72	73.25	27.85	165.46	9.18	6.42	785.34	26.96	56.82	6.35	23.96
1124C_4H-3_142-144_11	42.11	7.85	2.39	0.73	117.16	83.20	26.94	177.24	8.69	5.84	760.31	26.48	56.04	6.3	22.7
1124C_5H-1_91-93_1	41.94	11.97	3.07	0.69	102.76	75.08	34.66	244.13	10.25	5.20	766.74	27.51	58.15	6.82	26.56
1124C_5H-1_91-93_2	37.04	11.89	3.14	0.60	99.47	77.28	34.00	245.79	9.20	5.41	767.02	28.33	59.66	6.72	29.44
1124C_5H-1_91-93_4	39.34	12.04	2.12	0.37	107.38	75.47	34.93	255.89	10.43	5.68	768.70	28.79	62.89	6.97	29.17
1124C_5H-1_91-93_6	39.40	11.97	2.35	1.07	106.48	74.13	33.50	243.76	9.77	5.45	754.69	28.21	58.66	6.84	28.26
1124C_5H-1_91-93_8	38.95	11.16	2.01	0.91	109.70	71.31	31.80	236.15	9.68	5.65	732.87	25.97	56.22	6.59	26.23
1124C_5H-2_5-7_3	37.47	11.56	3.99	0.92	116.42	84.17	33.70	230.60	10.31	5.66	775.95	27.09	58.88	6.8	26.93
1124C_5H-2_5-7_4	38.07	10.53	3.95	0.63	106.90	81.57	33.12	227.96	9.46	5.19	741.19	26.51	55.66	6.48	26.1
1124C_5H-2_5-7_6	43.73	11.35	3.81	0.45	116.50	78.89	33.94	230.09	10.11	5.79	775.55	27.92	58.81	6.77	27.81
1124C_5H-2_5-7_9	43.27	10.98	3.44	0.40	111.71	70.76	33.24	218.41	10.34	5.54	751.14	26.49	57.11	6.66	26.54
1124C_5H-2_110-112_4	39.88	10.98	5.45	0.31	116.92	77.91	33.36	192.74	8.81	5.78	772.19	28.75	59.37	7.02	25.03
1124C_5H-2_110-112_5	46.27	12.67	3.08	0.49	137.52	80.58	34.66	199.81	10.64	6.63	871.58	31.62	66.36	7.72	30.13
1124C_5H-2_110-112_6	40.47	10.70	3.78	0.39	109.99	72.73	31.26	183.09	9.12	5.60	745.49	26.35	57	6.83	24.54
1124C_5H-2_110-112_9	45.65	12.06	3.55	0.41	132.99	76.02	33.01	188.10	9.84	6.66	826.99	28.87	61.42	7.29	27.94
1124C_5H-2_110-112_10	38.73	10.51	2.29	0.29	107.84	74.65	32.54	187.05	9.64	5.60	737.43	26.24	57.36	6.96	25.76
1124C_5H-3_107-109_2	46.30	8.86	2.27	2.44	108.50	122.75	28.61	230.99	7.71	5.40	751.59	25.39	52.17	6.07	22.84
1124C_5H-3_107-109_4	43.45	9.38	2.07	3.19	118.89	122.10	30.13	244.05	7.53	6.03	796.83	27.15	55.22	6.62	25.41
1124C_5H-3_107-109_7	40.15	9.02	2.16	3.12	113.28	113.75	28.05	233.97	7.58	5.94	765.64	25.93	52.2	5.92	22.86
1124C_5H-3_107-109_8	38.44	8.91	2.40	1.84	103.27	120.54	27.99	221.32	7.11	5.28	744.96	24.51	50.41	5.98	23.11
1124C_5H-3_107-109_9	38.92	9.24	1.97	2.08	110.19	124.58	29.36	230.86	7.47	5.56	755.63	25.48	52.97	6.23	24.01
1124C_5H-4_9-11_4	51.29	5.37	1.91	0.71	136.89	52.65	34.38	131.89	8.90	7.31	899.43	31.02	60.91	6.55	22.77
1124C_5H-4_9-11_5	48.97	5.25	2.40	0.86	132.13	59.93	31.91	118.76	8.50	6.72	813.78	29.12	57.15	6.49	24.36
1124C_5H-4_9-11_8	48.02	5.51	1.92	0.61	124.25	57.13	29.38	115.45	7.91	6.49	773.55	26.49	54.49	6.16	22.9
1124C_5H-4_9-11_10	51.54	5.04	1.98	0.72	119.30	55.44	29.92	117.15	8.33	6.51	771.69	26.86	54.72	6.39	21.84
1124C_5H-6_57-59_1	41.07	11.75	2.97	0.86	120.86	72.43	36.73	274.40	10.84	5.87	787.26	28.21	61.39	6.97	27.32
1124C_5H-6_57-59_5	32.47	12.20	3.62	1.93	118.91	95.35	33.28	292.36	10.80	6.07	790.30	28.24	60.24	6.82	26.32
1124C_5H-6_57-59_8	40.44	11.46	2.88	0.30	118.95	64.50	33.23	261.47	10.80	5.89	768.36	27.25	59.1	6.93	26.38
1124C_5H-6_57-59_9	35.39	10.32	3.34	0.35	108.91	60.32	31.05	241.37	9.50	5.60	698.31	25.48	53.86	6.23	24.46
1124C_5H-6_57-59_10	49.57	12.63	4.39	0.74	134.57	75.82	39.00	303.36	12.30	6.81	861.23	31.74	66.91	7.83	31.17
1124C_5H-6_131-133_1	48.10	11.04	2.60	0.65	119.70	91.45	39.53	291.35	11.17	6.47	848.99	30.6	67.17	8.33	30.48
1124C_5H-6_131-133_2	40.90	10.13	2.37	0.90	106.49	80.27	33.65	255.96	10.02	6.01	739.92	27.53	58.45	6.95	29.58
1124C_5H-6_131-133_3	43.27	10.43	2.21	0.35	108.06	83.95	36.03	270.24	10.24	5.88	783.95	28.97	63.14	6.94	28.52
1124C_5H-6_131-133_4	47.45	11.48	2.35	0.34	120.21	89.40	37.32	287.51	11.12	6.68	829.75	30.98	65.35	7.66	31.36
1124C_5H-6_131-133_8	34.67	10.52	1156.96	9.81	96.06	83.66	33.43	251.18	8.94	5.31	689.37	26.78	53.28	7.03	28.15
1124C_5H-7_60-62_6	52.41	7.47	2.09	0.50	138.62	56.06	27.24	83.78	6.70	7.58	905.98	28	56.01	6.2	23.09
1124C_5H-7_60-62_8	57.39	7.81	2.27	0.22	145.62	55.79	26.52	87.18	7.05	7.97	893.83	26.62	55.81	6.14	23.43
1124C_5H-7_60-62_9	39.23	5.82	1.64	0.61	101.08	41.04	20.67	65.09	5.04	5.78	663.39	20.22	41.42	4.78	17.79
1124C_5H-7_60-62_10	52.02	7.50	2.04	0.35	126.61	57.14	26.28	86.72	6.87	7.39	855.94	26.22	54.2	6.2	21.91
1124C_6H-1_26-28_2	29.63	5.13	2.21	1.00	158.08	34.23	16.25	57.17	5.08	10.50	470.11	19.16	37.43	3.68	14.02
1124C_6H-1_26-28_7	67.01	5.24	3.06	0.51	138.64	75.28	16.11	66.67	4.99	8.22	762.15	26.19	49.98	5.05	16.86
1124C_6H-1_26-28_8	53.02	4.54	1.40	0.41	127.00	38.27	15.73	44.69	3.73	7.98	589.44	16.69	33.01	3.2	11.29
1124C_6H-1_26-28_9	58.36	5.47	3.29	1.33	161.92	70.65	17.85	67.27	5.39	9.30	785.92	26.42	48.91	5.19	17.96
1124C_6H-1_26-28_10	72.14	5.69	2.26	0.32	169.43	40.62	20.19	57.14	5.23	10.66	761.27	20.8	41.59	4.5	15.4
1124C_6H-1_37-39_5	46.39	11.70	2.87	0.48	134.74	71.00	32.74	234.75	10.73	7.50	828.87	29.17	61.7	7.19	28.52
1124C_6H-1_37-39_6	45.51	11.39	3.51	0.67	130.47	62.66	32.66	231.30	10.87	7.05	799.06	28.96	61.01	7.17	28.06
1124C_6H-1_37-39_9	39.83	11.84	2.35	0.43	121.76	62.54	33.45	232.40	10.67	6.36	773.43	29.3	60.81	6.8	27.62
1124C_6H-1_37-39_10	37.46	11.12	2.21	0.43	113.85	72.60	31.66	234.46	10.01	5.81	750.53	26.72	55.98	6.04	25.33
1124C_6H-1_37-39_1	41.15	9.36	2.35	0.31	118.01	39.36	28.73	138.87	9.06	6.62	744.57	25.38	55.2	6.07	21.99
1124C_6H-1_118-120_2	46.65	10.03	13.11	0.65	120.83	68.71	31.08	232.07	10.44	6.59	749.88	27.83	57.81	7.04	26.19
1124C_6H-1_118-120_8	43.82	10.71	2.77	0.54	120.75	73.51	30.39	229.98	10.43	6.52	783.87	29.35	62.25	6.99	24.77
1124C_6H-1_118-120_11	41.63	9.91	2.90	1.39	122.70	73.61	28.58	219.20	9.62	6.75	731.65	25.91	55.71	6.36	23.51
1124C_6H-2_27-29_2	53.65	12.22	2.75	0.40	133.53	65.88	34.91	209.94	11.16	7.39	850.83	31.12	67.72	7.82	31.13
1124C_6H-2_27-29_5	47.62	11.98	2.55	0.33	137.88	66.09	35.34	210.52	11.36	7.73	858.24	32.42	68.23	7.84	30.67
1124C_6H-2_27-29_9	41.30	11.09	2.46	0.38	124.29	63.84	33.33	196.89	10.29	6.59	812.36	30.02	62.89	7.25	28.08
1124C_6H-2_27-29_3	55.92	13.31	2.59	0.63	134.22	96.28	35.00	280.71	11.52	7.57	861.29	31.95	69.3	8.16	30.56
1124C_6H-2_27-29_10	44.36	12.03	2.58	0.66	124.59	93.58	32.89	263.34	10.67	6.89	830.46	30.58	64.52	7.48	28
1124C_6H-3_90-92_2	52.22	10.97	2.62	0.97	167.76	58.80	33.93	230.77	10.69	9.89	850.10	31.96	68.18	7.66	29.37
1124C_6H-3_90-92_5	53.46	10.95	2.43	1.24	149.78	58.51	33.70	229.08	10.40	9.20	880.74	32.32	68.13	7.94	31.92
1124C_6H-3_90-92_6	50.32	10.01	2.25	0.67	153.42	55.40	31.26	214.09	9.86	8.90	795.12	29.89	64.73	7.28	28.69
1124C_6H-3_90-92_8	48.14	10.14	3.15	3.55	157.15	56.23	31.86	213.32	9.97	9.16	815.97	30.46	64.81	7.29	28.44
1124C_6H-3_90-92_9	50.76	10.50	2.47	0.81	168.27	57.37	33.44	227.39	10.62	9.75	844.05	31.96	68.57	7.89	29.72
1124C_6H-4_52-54_1	47.75	7.63	21.20	1.42	165.48	67.39	31.05	201.65	10.81	10.00	841.70	31.73	66.17	7.48	29.65
1124C_6H-4_52-54_2	49.36	8.09	8.76	0.99	173.26	66.22	31.00	207.00	10.71	9.87	847.82	31.23	66.56	7.44	28.6

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1124C_4H-2_118-120_8	5.89	1.01	5.43	0.78	5.26	1.15	3.35	0.49	3.40	0.46	5.42	0.623	18.1	11.15	2.56
1124C_4H-3_142-144_5	4.83	0.60	4.11	0.65	4.42	0.82	2.61	0.37	3.15	0.45	4.32	0.706	17.15	11.53	2.92
1124C_4H-3_142-144_6	4.56	0.67	4.37	0.70	4.25	0.92	2.41	0.38	2.81	0.40	4.64	0.607	18.62	11.67	2.87
1124C_4H-3_142-144_8	5.07	0.76	4.54	0.71	4.77	1.00	2.96	0.52	3.34	0.47	5.00	0.772	18.43	12.19	3.14
1124C_4H-3_142-144_9	5.05	0.79	5.01	0.70	4.84	1.01	2.95	0.41	3.19	0.45	5.36	0.714	17.7	12.42	3.07
1124C_4H-3_142-144_11	4.52	0.73	4.65	0.70	4.51	0.95	3.03	0.44	2.98	0.50	5.08	0.617	18.09	11.98	2.86
1124C_5H-1_91-93_1	6.33	1.02	5.83	0.92	5.61	1.25	4.21	0.60	4.04	0.62	6.48	0.502	16.71	10.95	2.56
1124C_5H-1_91-93_2	5.58	0.94	6.42	1.02	6.73	1.21	3.36	0.50	3.91	0.52	6.71	0.66	16.14	11.61	2.7
1124C_5H-1_91-93_4	6.99	1.21	5.88	0.94	6.50	1.28	3.98	0.59	3.83	0.66	7.12	0.717	19.41	11.74	2.74
1124C_5H-1_91-93_6	5.93	1.00	5.96	0.91	5.79	1.22	3.78	0.51	3.88	0.54	6.94	0.741	18.85	11.19	2.62
1124C_5H-1_91-93_8	5.98	1.03	5.39	0.84	5.82	1.07	3.52	0.54	3.38	0.58	6.30	0.658	17.96	10.5	2.61
1124C_5H-2_5-7_3	5.84	1.03	5.75	0.88	5.49	1.16	3.73	0.56	3.86	0.56	6.04	0.626	18.45	10.66	2.69
1124C_5H-2_5-7_4	5.48	1.05	5.59	0.85	5.51	1.15	3.32	0.48	3.75	0.54	5.95	0.633	16.45	10.44	2.45
1124C_5H-2_5-7_6	6.25	1.04	5.39	0.89	5.88	1.24	3.55	0.50	3.88	0.55	6.14	0.722	18.4	11.1	2.68
1124C_5H-2_5-7_9	5.90	0.98	5.67	0.89	5.48	1.23	3.59	0.52	3.66	0.50	5.65	0.649	18.34	10.56	2.63
1124C_5H-2_110-112_4	5.83	1.00	5.08	0.94	5.54	1.28	3.86	0.54	3.88	0.44	5.91	0.692	18.73	11.79	2.71
1124C_5H-2_110-112_5	6.38	1.23	6.27	0.96	6.15	1.38	3.74	0.53	3.84	0.61	6.09	0.722	23.19	12.97	2.91
1124C_5H-2_110-112_6	5.18	0.81	5.37	0.84	5.80	1.06	3.34	0.49	3.77	0.51	5.24	0.701	18.42	10.89	2.45
1124C_5H-2_110-112_9	5.91	0.98	5.83	1.03	5.47	1.15	3.27	0.49	3.66	0.48	5.91	0.641	21.48	12.01	2.85
1124C_5H-2_110-112_10	6.41	0.78	4.73	0.86	5.44	1.17	3.49	0.48	3.18	0.50	4.65	0.652	17.73	10.85	2.28
1124C_5H-3_107-109_2	4.77	0.87	4.59	0.80	5.15	1.02	2.57	0.52	3.46	0.49	6.09	0.637	18.57	11.2	2.64
1124C_5H-3_107-109_4	5.07	0.95	5.23	0.82	4.85	1.08	3.36	0.46	3.43	0.45	6.53	0.666	20.81	12.45	2.99
1124C_5H-3_107-109_7	4.89	0.90	4.31	0.69	5.07	1.07	3.19	0.45	3.17	0.49	6.47	0.652	18.49	11.9	2.72
1124C_5H-3_107-109_8	4.77	0.84	5.05	0.67	4.73	1.12	2.98	0.49	2.95	0.48	5.48	0.561	19.48	11.06	2.56
1124C_5H-3_107-109_9	5.10	1.07	5.12	0.77	5.19	0.97	3.20	0.43	2.99	0.44	6.51	0.644	17.66	11.28	2.74
1124C_5H-4_9-11_4	6.06	0.44	4.73	0.78	4.49	0.93	3.19	0.38	2.49	0.68	3.46	0.55	20.07	14.46	3.02
1124C_5H-4_9-11_5	4.44	0.56	4.18	0.70	5.69	1.09	2.96	0.37	4.05	0.41	3.99	0.637	19.26	14.06	2.9
1124C_5H-4_9-11_8	4.78	0.39	4.13	0.69	5.10	1.11	2.79	0.52	3.46	0.55	3.65	0.69	17.16	13.7	2.9
1124C_5H-4_9-11_10	5.56	0.54	4.30	0.59	4.25	1.02	3.40	0.43	3.06	0.61	3.37	0.551	17.09	12.75	2.81
1124C_5H-6_57-59_1	6.27	0.97	5.38	0.90	5.89	1.29	3.68	0.62	3.87	0.59	6.72	0.654	19.78	11.66	2.89
1124C_5H-6_57-59_5	5.36	1.09	5.17	0.85	5.67	1.28	3.64	0.53	3.41	0.61	7.60	0.717	19.69	11.3	2.77
1124C_5H-6_57-59_8	6.31	0.93	5.62	0.91	5.94	1.28	3.44	0.49	3.74	0.58	6.76	0.671	19.22	11.38	2.54
1124C_5H-6_57-59_9	5.53	0.84	5.03	0.83	5.19	1.09	3.37	0.47	3.62	0.53	5.91	0.633	17.88	10.27	2.45
1124C_5H-6_57-59_10	6.69	1.10	6.43	1.01	6.69	1.47	4.13	0.68	4.10	0.64	7.61	0.796	22.25	12.91	3.02
1124C_5H-6_131-133_1	6.97	1.26	6.73	1.06	7.21	1.58	4.25	0.68	4.25	0.72	8.33	0.743	21.69	12.71	3.1
1124C_5H-6_131-133_2	6.31	1.02	5.56	1.01	5.79	1.24	3.39	0.51	4.08	0.59	7.32	0.694	18.33	11.27	2.68
1124C_5H-6_131-133_3	6.03	1.24	4.84	0.95	5.94	1.29	3.47	0.55	4.09	0.73	7.47	0.692	18.91	12.17	2.71
1124C_5H-6_131-133_4	6.58	1.20	6.55	1.06	6.25	1.37	4.27	0.63	4.10	0.67	7.48	0.738	20.08	12.74	2.98
1124C_5H-6_131-133_8	5.04	1.11	4.10	0.64	6.70	1.17	3.66	0.52	3.60	0.82	6.59	0.9	25.87	10.35	3.05
1124C_5H-7_60-62_6	5.52	0.46	3.77	0.75	4.84	1.19	2.88	0.52	2.90	0.39	2.93	0.605	18.5	13.32	3.04
1124C_5H-7_60-62_8	5.26	0.50	4.43	0.78	4.82	1.03	3.08	0.41	2.85	0.42	3.31	0.644	19.76	13.3	3.08
1124C_5H-7_60-62_9	3.91	0.29	3.84	0.57	3.57	0.74	1.87	0.33	2.42	0.39	2.76	0.437	13.77	9.76	2.18
1124C_5H-7_60-62_10	5.25	0.57	4.14	0.77	4.19	1.02	2.95	0.42	3.20	0.42	3.55	0.594	17.97	12.7	2.93
1124C_6H-1_26-28_2	2.45	0.26	2.15	0.40	2.43	0.54	1.62	0.27	2.21	0.29	2.43	0.759	20.09	16.49	4.21
1124C_6H-1_26-28_7	2.79	0.52	2.16	0.45	2.67	0.62	1.81	0.26	2.12	0.33	2.81	0.531	19.31	13.82	3.08
1124C_6H-1_26-28_8	2.34	0.28	2.54	0.41	2.68	0.65	1.61	0.27	1.76	0.32	1.94	0.549	15.51	13.09	2.99
1124C_6H-1_26-28_9	3.12	0.35	2.39	0.43	2.51	0.63	1.65	0.36	2.19	0.40	2.52	0.615	20.83	14.88	3.39
1124C_6H-1_26-28_10	3.17	0.32	2.58	0.52	3.17	0.60	2.17	0.30	2.66	0.45	2.60	0.876	21.66	16.61	4.09
1124C_6H-1_37-39_5	6.04	0.93	5.74	0.90	6.07	1.28	3.68	0.53	3.67	0.53	6.66	0.768	21.9	13.43	3.17
1124C_6H-1_37-39_6	5.71	0.90	5.16	0.95	5.44	1.19	3.32	0.50	3.89	0.60	6.70	0.715	21.5	13.43	3.24
1124C_6H-1_37-39_9	6.79	1.01	5.76	0.83	5.30	1.18	3.25	0.60	3.93	0.42	6.75	0.78	21.46	13.96	2.99
1124C_6H-1_37-39_10	6.41	0.89	5.13	0.89	5.57	1.19	3.59	0.52	3.76	0.60	6.76	0.703	18.17	12.44	2.79
1124C_6H-1_37-39_1	5.68	0.65	4.00	0.62	4.92	1.16	3.04	0.42	3.38	0.40	3.90	0.74	17.79	12.53	2.94
1124C_6H-1_118-120_2	6.12	0.78	5.53	0.83	4.78	1.13	3.46	0.49	3.22	0.47	5.94	0.714	22.11	12.22	2.98
1124C_6H-1_118-120_8	5.92	0.96	4.91	0.93	5.97	1.08	3.14	0.47	3.68	0.43	6.47	0.848	19.9	12.67	3.06
1124C_6H-1_118-120_11	5.03	0.81	4.86	0.78	5.25	1.08	3.02	0.47	3.23	0.49	5.90	0.716	19.9	11.6	2.83
1124C_6H-2_27-29_2	6.86	0.88	6.64	1.05	6.48	1.32	3.77	0.64	4.05	0.68	5.99	0.743	25.02	14.91	3.48
1124C_6H-2_27-29_5	6.67	0.97	5.56	1.02	6.38	1.32	3.87	0.59	3.84	0.63	6.50	0.852	23.29	15.02	3.44
1124C_6H-2_27-29_9	6.11	0.86	5.80	0.93	5.17	1.15	3.70	0.60	3.89	0.48	5.80	0.812	21.36	13.37	3.14
1124C_6H-2_27-29_3	6.67	1.10	6.37	0.97	6.23	1.25	4.16	0.57	4.31	0.61	7.46	0.824	23.82	14.31	3.52
1124C_6H-2_27-29_10	6.32	1.02	6.23	0.94	5.58	1.29	3.80	0.50	3.84	0.52	7.07	0.792	21.5	13.6	2.97
1124C_6H-3_90-92_2	6.11	0.80	5.97	0.93	5.66	1.33	3.54	0.54	3.76	0.57	6.50	0.837	24.09	17.06	4.09
1124C_6H-3_90-92_5	5.46	0.74	5.70	0.91	6.25	1.10	3.98	0.56	4.27	0.70	7.32	0.95	24.87	17.64	4.1
1124C_6H-3_90-92_6	5.44	0.75	5.52	1.04	5.76	1.22	3.48	0.51	3.64	0.54	6.42	0.677	23.63	16.31	3.99
1124C_6H-3_90-92_8	5.71	0.75	5.76	0.76	5.61	1.15	3.47	0.56	3.53	0.52	6.40	0.813	23.77	15.96	3.98
1124C_6H-3_90-92_9	6.40	0.76	5.92	0.98	5.58	1.28	3.61	0.57	3.85	0.55	6.51	0.836	23.82	17.43	4.14
1124C_6H-4_52-54_1	6.29	0.86	5.22	0.81	5.12	1.09	3.14	0.47	3.32	0.50	6.13	0.836	23.16	17.82	4.14
1124C_6H-4_52-54_2	5.94	0.76	6.00	0.82	5.54	1.18	3.32	0.44	3.78	0.51	6.35	0.752	23	18.03	4.07
1124C_6H-4_52-54_6	5.99	0.80	4.75	0.79	4.78	1.09	3.71	0.50	3.40	0.58	6.02	0.868	22.11	18.22	4.04
1124C_6H-4_52-54_7	6.30	0.95	5.52	0.96	5.70	1.21	3.68	0.56	3.68	0.56	6.82	0.917	25.76	19.21	4.37

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1124C_6H-4_52-54_10	45.80	7.66	7.03	0.99	181.58	71.44	33.01	213.30	11.01	10.83	900.13	33.45	68.44	8.09	30.58
1124C_6H-5_20-22_2	44.34	8.89	6.81	1.88	113.28	136.03	19.70	134.29	7.06	6.87	681.56	20.46	42.37	4.69	14.82
1124C_6H-5_20-22_3	23.85	4.06	1.17	1.65	55.55	92.05	8.94	58.94	3.55	3.35	307.19	9.54	19.88	2.13	7.73
1124C_6H-5_20-22_5	42.91	8.25	2.48	1.88	112.51	131.17	18.97	130.15	6.70	6.08	631.08	20.03	39.69	4.67	17.07
1124C_6H-5_20-22_9	38.72	7.42	2.78	2.03	96.29	124.42	16.56	117.05	6.12	5.14	577.10	17.91	35.47	3.73	14.31
1124C_6H-5_20-22_10	57.97	9.02	2.46	2.12	129.74	137.85	19.70	139.78	7.53	7.42	687.56	21.58	43.41	4.83	17.29
1124C_6H-5_37-39cm_7	48.35	5.07	3.30	1.05	124.01	95.57	13.03	101.45	5.88	7.02	725.74	18.65	34.02	3.72	12.52
1124C_6H-5_37-39cm_1	48.82	7.53	3.32	0.88	164.85	64.60	28.87	191.03	10.10	9.32	805.63	29.47	62.05	7.02	28.04
1124C_6H-5_37-39cm_3	33.72	3.89	3.03	1.27	125.61	69.98	9.59	62.34	4.63	7.14	692.73	16.83	30.95	3.2	10.49
1124C_6H-5_37-39cm_5	22.19	3.48	1.17	0.76	75.10	46.70	13.69	89.46	4.88	4.44	388.63	14.52	30.05	3.15	13.04
1124C_6H-5_37-39cm_6	53.26	7.68	2.29	0.55	164.56	65.54	29.72	195.83	10.30	9.70	828.62	30.26	64.12	7.25	27.04
1124C_6H-5_37-39cm_8	27.91	4.88	11.68	2.02	144.80	88.89	13.78	87.30	5.71	7.79	799.70	20.24	36.66	3.78	12.45
1124C_7H-3_117-119_3	44.87	8.27	2.38	0.62	114.49	56.74	26.27	121.61	6.74	5.37	735.87	21.82	44.76	4.65	20.3
1124C_7H-3_117-119_4	53.10	8.66	3.25	0.66	139.16	58.18	27.96	121.55	7.13	6.68	803.82	24.26	48.39	5.59	22.38
1124C_7H-3_117-119_6	57.52	6.84	2.98	0.52	136.93	45.51	25.23	89.04	6.51	6.85	780.27	22.89	46.64	5.16	19.22
1124C_7H-3_117-119_7	53.91	8.06	2.22	1.23	135.76	50.82	28.24	97.94	7.18	6.56	817.85	24.58	51.65	5.76	20.42
1124C_7H-3_117-119_9	61.88	7.96	2.10	0.50	135.68	48.94	28.33	97.18	7.13	6.60	832.03	25.08	51.37	5.58	21.58
1124C_7H-4_85-87_2	51.98	15.10	2.63	1.18	108.06	111.52	30.92	242.99	7.93	5.78	730.21	24.41	52.96	6.07	23.32
1124C_7H-4_85-87_4	57.31	15.45	1.97	1.21	111.28	114.04	32.60	255.99	8.06	6.22	747.97	24.92	55.39	6.51	25.49
1124C_7H-4_85-87_5	55.76	14.66	1.87	1.07	103.38	106.31	30.07	235.45	7.57	5.85	713.79	23.58	52.86	5.9	22.91
1124C_7H-4_85-87_10	54.88	16.16	2.05	1.59	100.96	136.09	31.22	233.97	7.99	5.43	716.01	23.46	52.32	6.25	25.32
1124C_7H-5_15-17_1	24.01	4.15	1.82	1.27	123.40	68.82	12.85	73.75	5.47	6.25	727.41	19.42	36.39	3.79	12.76
1124C_7H-5_15-17_7	20.12	4.46	7.78	1.64	121.21	74.83	12.46	65.12	5.68	5.86	684.38	18.29	33.12	3.55	12.25
1124C_7H-5_15-17_9	37.68	4.56	4.70	0.66	134.63	71.77	14.11	76.83	6.02	7.16	800.12	22.04	40.27	3.96	14.09
1124C_7H-5_92-94_2	55.99	4.66	2.22	0.90	155.06	58.59	19.03	83.78	5.46	8.61	917.16	25.41	51.16	5.12	17.94
1124C_7H-5_92-94_3	49.33	5.01	2.23	0.71	155.23	59.37	19.68	83.86	5.04	8.77	942.79	25.23	51.72	5.27	19.12
1124C_7H-5_92-94_8	46.79	4.06	1.85	2.16	136.01	53.57	17.53	82.91	4.97	7.51	799.28	23.16	47.93	4.88	15.28
1124C_7H-5_92-94_11	51.11	4.25	2.25	0.57	142.83	60.10	19.62	82.33	5.05	7.99	866.14	24.97	49.03	4.93	18.06
1124C_7H-5_92-94_9	54.37	4.44	2.06	0.79	142.51	57.00	19.32	81.37	5.11	8.14	869.05	25.67	49.54	5.17	17.23
1124C_7H-6_143-145_2	35.76	7.63	13.92	0.62	103.41	170.08	21.66	142.70	6.99	4.87	707.46	32.99	66.28	7.28	27.65
1124C_7H-6_143-145_3	48.19	5.64	2.62	0.75	126.17	110.44	18.68	154.82	7.53	5.95	775.16	22.37	44	4.93	16.78
1124C_7H-6_143-145_4	39.59	5.49	2.99	1.11	115.53	117.13	20.09	161.62	8.24	5.52	855.32	25.01	50.88	5.49	16.45
1124C_7H-6_143-145_5	47.60	9.17	2.74	0.70	122.52	77.00	26.65	148.72	6.82	6.39	800.89	23.33	50.68	5.7	22.52
1124C_7H-6_143-145_10	35.94	5.22	8.48	0.78	114.63	109.64	19.96	150.43	6.85	5.34	780.07	22.64	44.9	4.69	17.31
1124C_8H-1_104-106_1	46.16	10.09	2.90	1.81	131.69	92.38	19.15	168.12	6.42	6.32	791.29	19.42	38.19	4.15	15.46
1124C_8H-1_104-106_8	56.18	5.63	2.29	0.74	150.35	71.79	13.92	84.26	5.35	6.92	883.33	19.92	39.62	3.98	12.85
1124C_8H-1_104-106_10	36.96	11.15	6.63	3.74	157.26	89.67	18.76	158.45	8.14	6.52	1037.74	19.39	37.11	4.14	14.35
1124D_1H-2_148-150_1	39.85	4.57	2.99	0.86	111.18	95.09	13.19	97.24	5.35	5.41	811.91	19.72	36.47	3.76	12.7
1124D_1H-2_148-150_2	42.93	4.34	1.95	0.73	107.36	93.19	12.71	99.06	5.47	5.47	805.13	19.73	36.22	3.84	11.58
1124D_1H-2_148-150_6	38.50	4.68	7.19	0.65	126.14	77.79	15.14	80.23	4.94	6.75	834.23	21.51	39.17	4.14	14.7
1124D_1H-2_148-150_7	25.60	4.40	2.93	1.06	82.31	75.03	11.03	96.16	4.26	3.65	509.55	13.04	24.09	2.57	9.74
1124D_1H-2_148-150_9	41.64	4.89	4.17	0.89	133.80	100.30	13.82	100.27	5.98	5.98	853.74	20.67	36.54	3.9	13.25
1124D_1H-3_50-52_6	50.28	5.54	1.86	0.78	126.51	67.11	13.34	84.86	5.67	5.93	814.07	19.64	37.56	3.73	12.95
1124D_1H-3_50-52_7	50.69	5.57	1.92	0.82	132.06	88.00	12.98	99.80	5.72	6.41	830.26	19.86	37.62	3.97	12.29
1124D_1H-3_50-52_8	51.65	6.32	2.48	0.94	131.28	94.92	13.01	108.52	5.51	6.66	831.81	20.56	36.62	4.05	13.85
1124D_1H-3_50-52_9	59.18	5.93	2.12	0.71	142.53	74.52	14.45	88.47	6.30	7.09	881.67	21.92	41.18	4.01	14.07
1124D_1H-3_50-52_10	46.87	5.98	2.74	0.93	127.17	84.39	12.86	94.77	5.84	6.28	820.52	19.39	37.54	3.89	12.32
1124D_1H-5_79-81_3	37.17	5.14	1.76	0.59	97.02	46.96	17.50	65.55	4.28	4.80	658.84	22.2	45.58	5.73	18.61
1124D_1H-5_79-81_6	53.60	7.52	2.42	0.89	135.03	65.65	15.51	89.94	5.74	6.46	901.96	20.73	42.55	4.17	14.02
1124D_1H-5_79-81_9	55.78	7.22	3.02	0.76	126.40	60.41	14.74	86.73	5.88	6.67	893.97	20.12	40.49	4.05	14.4
1124D_1H-5_79-81_10	55.83	7.62	2.74	0.68	145.88	63.94	16.19	95.22	6.01	6.91	930.04	21.04	41.59	4.36	15.33
1124D_1H-5_79-81_2	35.73	6.25	89.76	2.43	153.32	63.91	14.24	90.29	5.28	9.57	861.99	20.73	42.78	4.19	15.12
1124D_1H-7_24-26_3	33.61	9.97	2.85	0.53	120.95	74.62	31.85	202.76	8.93	5.19	689.79	24.61	50.92	5.94	20.89
1124D_1H-7_24-26_2	43.28	13.39	4.45	1.79	148.12	110.57	41.23	293.49	11.01	6.28	857.84	31.08	63.96	7.69	29.69
1124D_1H-7_24-26_4	38.52	13.26	2.65	1.08	115.38	115.83	34.89	334.31	11.14	4.78	806.19	27.89	56.38	7.18	27
1124D_1H-7_24-26_5	35.91	10.23	2.12	0.87	97.55	91.75	29.48	260.52	8.72	4.14	609.02	22.23	46.39	5.65	20.34
1124D_1H-7_24-26_10	34.99	10.90	2.15	0.93	101.50	91.81	31.43	274.85	9.25	4.52	646.08	22.78	49.67	5.84	22.12
1124D_2H-2_53-55_1	33.87	10.42	2.35	1.55	102.06	110.83	28.69	244.08	7.79	4.83	672.44	23.14	48.07	5.93	22.01
1124D_2H-2_53-55_3	34.71	11.21	2.56	1.56	96.68	117.15	30.06	234.82	8.29	4.93	683.82	24.13	48.16	5.68	22.24
1124D_2H-2_53-55_4	34.07	11.78	2.04	1.78	99.46	127.25	31.23	239.79	8.33	4.74	677.05	24.44	49.76	5.73	22.98
1124D_2H-2_53-55_6	34.50	10.95	1.81	1.64	105.48	117.37	31.27	251.68	8.17	5.08	698.40	24.46	50.86	6.05	22.42
1124D_2H-2_53-55_7	30.82	11.77	2.08	1.68	92.82	119.54	28.51	227.69	8.32	4.54	648.14	22.43	45.96	5.4	21.63
1124D_2H-5_87-89_1	37.87	10.26	2.23	1.77	98.84	103.81	27.89	269.04	8.36	4.74	707.20	23.43	49.88	5.86	24.31
1124D_2H-5_87-89_2	39.62	10.02	2.10	1.31	105.64	104.16	27.48	269.02	8.73	5.12	710.07	23.68	48.51	5.53	21.54
1124D_2H-5_87-89_4	32.07	9.41	2.46	1.19	89.76	100.64	26.94	250.52	7.85	4.64	663.51	22.3	45.59	5.7	19.58
1124D_2H-5_87-89_5	31.77	10.15	3.21	1.11	93.28	97.34	26.52	250.83	7.52	4.70	649.38	21.92	46.18	5.52	18.63
1124D_2H-5_87-89_10	39.13	10.14	2.24	1.40	106.92	104.93	27.74	269.30	9.04	5.49	724.13	23.8	48.56	5.62	22.38
1124D_2H-CC_10-12_11	43.90	8.89	2.59	0.37	124.28	55.81	29.53	142.08	9.52	5.72	736.25	26.31	56.2	6.55	25.27
1124D_2H-CC_10-12_12	49.07	9.53													

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1124C_6H-4_52-54_10	6.01	0.89	5.77	0.90	5.41	1.14	3.19	0.50	3.32	0.53	6.34	0.843	24.35	17.99	4.04
1124C_6H-5_20-22_2	3.94	0.63	2.79	0.57	3.40	0.80	1.79	0.33	2.59	0.41	3.53	0.559	17.47	10.39	2.41
1124C_6H-5_20-22_3	1.61	0.22	1.82	0.25	1.48	0.30	1.01	0.12	0.90	0.15	1.80	0.3	8.16	4.98	1.242
1124C_6H-5_20-22_5	3.35	0.60	2.96	0.53	2.99	0.70	1.92	0.32	2.07	0.32	3.80	0.579	15.05	10.37	2.6
1124C_6H-5_20-22_9	3.08	0.67	2.84	0.51	3.40	0.66	1.85	0.28	1.94	0.30	2.97	0.429	13.79	9.29	2.22
1124C_6H-5_20-22_10	3.51	0.67	3.00	0.54	3.20	0.74	2.09	0.31	2.40	0.31	3.90	0.631	18.09	10.85	2.82
1124C_6H-5 37-39cm_7	2.16	0.45	1.90	0.34	1.93	0.47	1.32	0.20	1.43	0.25	3.01	0.567	13.21	10.61	2.77
1124C_6H-5 37-39cm_1	5.36	0.72	5.08	0.72	5.06	1.05	2.91	0.41	3.19	0.45	5.66	0.727	21.88	16.34	3.81
1124C_6H-5 37-39cm_3	1.59	0.28	1.29	0.24	1.48	0.27	0.87	0.23	1.11	0.18	1.99	0.447	14.63	10.35	2.61
1124C_6H-5 37-39cm_5	2.91	0.35	2.15	0.41	2.47	0.54	1.45	0.20	1.54	0.24	3.06	0.37	11.33	7.62	1.92
1124C_6H-5 37-39cm_6	5.69	0.82	4.57	0.83	5.05	1.12	3.05	0.48	3.27	0.45	6.05	0.784	22.39	17.14	4.24
1124C_6H-5 37-39cm_8	2.49	0.38	2.47	0.38	2.22	0.47	1.17	0.19	1.31	0.24	2.47	0.616	14.63	11.67	3.01
1124C_7H-3_117-119_3	4.55	0.57	4.34	0.72	3.98	0.87	2.94	0.38	3.29	0.49	4.02	0.575	17.34	10.16	2.3
1124C_7H-3_117-119_4	4.36	0.55	4.14	0.67	4.44	0.94	2.83	0.49	3.09	0.41	3.92	0.6	19.37	11.55	2.68
1124C_7H-3_117-119_6	4.21	0.44	3.98	0.64	4.00	0.81	2.61	0.42	2.88	0.42	3.12	0.532	18.05	11.16	2.66
1124C_7H-3_117-119_7	4.39	0.46	4.01	0.73	4.14	0.97	2.81	0.39	3.40	0.48	3.40	0.562	20.26	12.8	2.94
1124C_7H-3_117-119_9	4.32	0.45	4.38	0.71	4.48	0.97	2.77	0.44	2.88	0.51	3.81	0.703	19.74	12.58	2.89
1124C_7H-4_85-87_2	4.72	0.81	4.89	0.86	5.52	1.21	3.42	0.48	3.64	0.51	6.82	0.456	18.81	9.95	2.33
1124C_7H-4_85-87_4	5.42	1.01	5.65	0.90	5.42	1.23	3.60	0.60	3.46	0.62	7.17	0.61	21.44	10.24	2.29
1124C_7H-4_85-87_5	5.59	0.95	4.81	0.78	5.63	1.15	3.59	0.53	3.77	0.46	6.44	0.55	19.67	9.43	2.28
1124C_7H-4_85-87_10	5.37	1.09	5.20	0.86	5.85	1.03	3.12	0.48	3.36	0.55	6.69	0.581	19.24	9.46	2.13
1124C_7H-5_15-17_1	1.84	0.37	2.00	0.36	2.06	0.48	1.51	0.22	1.18	0.25	2.35	0.646	13.59	11.83	2.94
1124C_7H-5_15-17_7	2.24	0.31	1.91	0.34	2.04	0.38	1.33	0.20	1.42	0.21	2.15	0.567	12.59	11.35	2.42
1124C_7H-5_15-17_9	2.62	0.42	2.05	0.41	2.37	0.45	1.66	0.24	1.74	0.26	2.62	0.687	15.05	13.63	2.97
1124C_7H-5_92-94_2	3.61	0.34	2.95	0.41	3.10	0.65	2.11	0.33	2.70	0.41	2.97	0.636	21.35	14.53	3.35
1124C_7H-5_92-94_3	3.95	0.28	2.48	0.48	3.39	0.75	2.21	0.33	2.04	0.34	3.33	0.586	21.99	14.34	3.07
1124C_7H-5_92-94_8	3.15	0.76	2.59	0.42	2.82	0.60	2.14	0.24	2.12	0.40	3.50	0.546	20.36	12.77	3.38
1124C_7H-5_92-94_11	3.48	0.45	3.21	0.44	3.01	0.69	2.37	0.26	2.53	0.41	3.26	0.681	20.97	14.41	3.3
1124C_7H-5_92-94_9	3.23	0.38	2.44	0.49	3.24	0.64	2.07	0.32	2.35	0.45	2.75	0.56	19.64	13.92	2.9
1124C_7H-6_143-145_2	5.35	1.11	4.59	0.78	3.85	0.79	2.32	0.32	2.03	0.36	4.02	0.518	13.71	14.13	2.84
1124C_7H-6_143-145_3	3.43	0.66	2.85	0.51	2.94	0.67	2.02	0.34	2.12	0.30	4.29	0.572	16.78	10.79	2.72
1124C_7H-6_143-145_4	5.37	0.71	3.59	0.71	3.94	0.95	2.73	0.39	2.65	0.45	4.67	0.85	19.45	13.34	3.47
1124C_7H-6_143-145_5	5.03	0.71	4.26	0.73	4.78	1.04	3.00	0.42	3.10	0.42	4.58	0.543	20.26	11.53	2.59
1124C_7H-6_143-145_10	3.78	0.67	3.65	0.61	2.96	0.83	2.06	0.32	2.33	0.25	4.80	0.47	16.1	11.35	2.62
1124C_8H-1_104-106_1	2.54	0.46	2.70	0.50	3.18	0.66	1.96	0.29	2.06	0.35	4.59	0.528	16.1	11.08	2.59
1124C_8H-1_104-106_8	2.31	0.37	2.19	0.31	2.24	0.49	1.13	0.24	1.88	0.27	2.81	0.499	17.82	12.71	3.09
1124C_8H-1_104-106_10	2.86	0.39	2.88	0.48	2.95	0.60	1.80	0.30	2.15	0.32	3.97	0.522	17.62	11.44	2.52
1124D_1H-2_148-150_1	2.05	0.49	2.64	0.30	1.55	0.53	1.50	0.28	1.75	0.24	2.87	0.445	24.66	10.06	2.5
1124D_1H-2_148-150_2	2.65	0.52	2.10	0.36	1.51	0.30	1.18	0.28	1.61	0.37	2.56	0.5	13.71	10.28	2.36
1124D_1H-2_148-150_6	2.41	0.43	3.91	0.49	2.26	0.59	0.74	0.31	0.65	0.24	4.20	0.52	19.4	11.58	2.33
1124D_1H-2_148-150_7	1.66	0.39	2.19	0.27	1.66	0.37	1.04	0.19	1.23	0.18	2.38	0.359	24.02	6.79	1.476
1124D_1H-2_148-150_9	2.27	0.53	2.03	0.37	2.13	0.42	1.66	0.26	1.86	0.27	2.90	0.512	17.46	11.37	2.63
1124D_1H-3_50-52_6	1.96	0.38	1.77	0.29	1.99	0.46	1.40	0.19	1.37	0.26	2.63	0.533	15.98	12.5	2.55
1124D_1H-3_50-52_7	2.68	0.45	2.06	0.32	2.26	0.50	1.34	0.24	1.61	0.21	3.12	0.615	15.77	12.07	2.92
1124D_1H-3_50-52_8	1.66	0.45	1.69	0.32	1.63	0.53	1.39	0.33	1.73	0.18	2.63	0.667	13.95	11.7	2.8
1124D_1H-3_50-52_9	2.27	0.37	2.45	0.33	2.15	0.48	1.54	0.28	1.89	0.26	2.89	0.559	17.29	13.47	3.06
1124D_1H-3_50-52_10	1.94	0.41	2.11	0.27	1.82	0.42	1.26	0.21	1.59	0.22	2.87	0.521	16.25	11.94	2.61
1124D_1H-5_79-81_3	3.91	0.42	3.40	0.54	3.07	0.63	1.76	0.24	1.80	0.29	2.04	0.375	12.29	9.17	2.01
1124D_1H-5_79-81_6	2.72	0.36	2.11	0.39	2.30	0.48	1.73	0.30	1.95	0.36	3.05	0.561	17.63	12.41	2.98
1124D_1H-5_79-81_9	2.93	0.40	2.53	0.46	2.54	0.54	1.68	0.29	2.19	0.36	3.19	0.667	16.37	12.48	2.83
1124D_1H-5_79-81_10	2.78	0.34	2.43	0.42	2.61	0.55	1.73	0.28	2.04	0.26	3.46	0.614	16.17	12.99	3.05
1124D_1H-5_79-81_2	3.12	0.40	2.56	0.37	2.16	0.28	1.42	0.43	1.73	0.49	1.88	0.68	31.64	10.56	2.54
1124D_1H-7_24-26_3	5.60	1.00	5.06	0.76	5.06	1.07	3.00	0.48	3.03	0.49	5.95	0.742	19.42	10.83	2.41
1124D_1H-7_24-26_2	6.41	1.50	5.81	0.98	6.53	1.37	4.11	0.46	3.60	0.56	7.62	0.738	21.21	13.52	3.11
1124D_1H-7_24-26_4	5.43	1.15	5.08	0.77	7.19	1.28	4.92	0.51	3.36	0.66	9.31	0.53	17.68	11.86	3.09
1124D_1H-7_24-26_5	4.60	0.66	4.63	0.85	3.88	1.00	3.57	0.46	2.95	0.48	6.25	0.552	14.9	9.59	2.31
1124D_1H-7_24-26_10	5.32	0.84	4.56	0.87	5.54	0.99	3.42	0.45	3.47	0.40	7.00	0.68	16.34	10.76	2.55
1124D_2H-2_53-55_1	4.85	1.00	4.65	0.71	4.47	0.94	2.95	0.44	3.35	0.51	6.44	0.534	14.54	10.13	2.53
1124D_2H-2_53-55_3	5.27	1.03	5.25	0.79	5.30	1.09	3.36	0.46	3.10	0.54	5.90	0.656	14.64	9.48	2.09
1124D_2H-2_53-55_4	4.95	1.03	4.57	0.86	5.66	1.01	3.19	0.44	3.62	0.50	6.03	0.563	14.53	10.37	2.25
1124D_2H-2_53-55_6	5.12	0.95	5.35	0.79	5.69	1.15	3.13	0.51	3.67	0.55	6.87	0.67	14.89	10.6	2.4
1124D_2H-2_53-55_7	5.09	1.04	5.15	0.85	4.90	1.09	3.35	0.50	3.36	0.53	5.88	0.601	14.5	9.38	2.15
1124D_2H-5_87-89_1	4.04	0.93	4.72	0.70	4.52	0.96	2.78	0.51	3.25	0.43	6.67	0.665	16.3	10.63	2.48
1124D_2H-5_87-89_2	4.24	1.00	4.05	0.66	4.51	0.86	2.58	0.45	3.02	0.50	6.63	0.665	15.49	10.47	2.57
1124D_2H-5_87-89_4	4.28	0.75	4.03	0.73	4.73	0.98	2.51	0.34	2.78	0.50	6.31	0.669	13.55	10.58	2.14
1124D_2H-5_87-89_5	4.05	0.95	3.50	0.72	3.98	0.90	2.67	0.39	2.47	0.54	6.15	0.498	13.41	9.25	2
1124D_2H-5_87-89_10	4.18	0.95	4.51	0.74	4.58	1.03	2.94	0.41	3.08	0.49	6.75	0.734	15.68	10.42	2.39
1124D_2H-CC_10-12_11	5.34	0.75	4.91	0.74	4.92	1.11	3.20	0.46	3.30	0.48	4.75	0.698	20.17	11.86	2.78
1124D_2H-CC_10-12_12	5.55	0.77	5.86	0.81	5.41	1.21	3.01	0.50	3.59	0.55	4.78	0.701	21.12	12.67	2.91
1124D_2H-CC_10-12_6	5.11	0.81	5.26	0.88	4.99	1.17	3.24	0.51	3.55	0.51	4.67	0.687	19.49	12.44	2.74

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1124D_2H-CC_10-12_13	39.68	9.41	2.51	0.56	111.42	70.47	28.93	189.51	9.62	5.19	703.05	24.82	54.26	6.2	24.05
1124D_2H-CC_10-12_14	42.68	10.10	2.80	0.49	113.32	74.88	31.17	208.40	10.08	5.21	758.23	27.13	58.07	6.79	25.83
1124D_3H-1_3-5_1	45.07	10.09	3.36	0.87	124.36	75.34	21.68	114.18	7.52	5.64	732.17	22.37	45.74	4.69	17.65
1124D_3H-1_3-5_3	40.69	10.32	2.53	0.72	135.35	72.88	22.65	111.17	7.48	6.49	762.93	23.34	46.94	5.22	19.03
1124D_3H-1_3-5_4	41.89	9.48	2.19	0.64	126.62	63.90	20.76	99.37	7.10	6.33	766.92	23.12	47.81	5.09	19.33
1124D_3H-1_3-5_5	43.58	9.15	2.51	0.62	131.10	64.83	21.96	104.16	6.90	6.15	741.10	22.68	46.89	4.79	17.87
1124D_3H-1_3-5_7	48.67	10.14	2.37	0.81	131.86	80.83	24.08	123.48	7.67	6.70	855.74	26.55	53.99	5.74	20.77
1124D_3H-4_96-98_1	29.30	11.69	2.29	0.33	93.74	64.50	30.94	229.69	8.59	4.33	660.08	23.32	50.92	5.81	24.03
1124D_3H-4_96-98_2	41.26	10.45	1.95	0.41	108.29	72.97	30.67	186.29	8.79	5.57	692.33	24.68	53.3	6.28	24.29
1124D_3H-4_96-98_4	36.62	10.51	3.80	0.53	112.82	75.28	31.22	190.00	8.78	5.42	733.64	26.09	53.78	6.12	24.07
1124D_3H-4_96-98_8	31.40	9.61	3.11	0.53	100.10	75.72	31.39	186.28	9.07	5.20	722.90	26.45	53.55	6.72	26.89
1124D_3H-4_96-98_9	39.92	11.82	2.71	0.65	126.44	83.24	34.76	210.42	10.08	6.34	825.42	28.49	60.39	7.37	27.75
1124C_10H-6_12-140_1	41.16	11.95	2.49	0.46	106.64	73.88	33.17	238.98	9.96	5.60	754.67	26.52	58.12	7.04	28.03
1124C_10H-6_12-140_2	41.06	12.10	2.77	0.40	113.68	75.65	34.87	250.59	10.09	5.70	783.36	27.58	59.87	6.98	27.66
1124C_10H-6_12-140_3	43.99	12.22	3.09	0.47	115.62	75.14	33.52	244.77	10.18	5.81	774.91	27.41	58.85	6.91	27.6
1124C_10H-6_12-140_9	49.66	13.00	3.01	0.35	121.61	81.42	37.02	267.40	11.16	6.18	842.30	29.38	64.26	7.55	28.75
1124C_10H-6_12-140_10	42.13	11.75	3.43	0.40	115.55	73.33	33.10	239.98	10.11	5.67	762.60	27.13	58.31	6.78	26.68
1124D_3H-5_112-114_1	1.68	0.50	0.13	0.03	4.03	3.58	1.32	9.99	0.38	0.21	29.71	1.084	2.34	0.259	0.883
1124D_3H-5_112-114_10	4.79	1.47	0.24	0.08	11.61	11.57	3.73	27.52	1.12	0.62	93.99	3.25	6.84	0.798	3.44
1124D_3H-5_112-114_11	4.68	1.36	0.24	0.06	11.45	9.95	3.32	24.92	0.99	0.59	78.42	2.738	5.94	0.709	2.89
1124D_3H-5_112-114_12	3.22	0.99	0.16	0.04	7.91	7.66	2.38	18.17	0.72	0.41	57.45	2.031	4.39	0.521	2.014
1124D_3H-5_112-114_13	4.35	1.50	0.33	0.07	12.61	11.30	3.84	27.72	1.09	0.64	87.26	3.08	6.57	0.776	3.24
1124D_3H-5_147-149_1	44.70	11.04	2.08	0.37	113.28	61.23	32.97	166.00	9.30	5.63	775.12	27.28	59.6	6.99	26.42
1124D_3H-5_147-149_10	48.63	11.33	2.09	0.40	126.75	65.90	35.26	171.90	9.98	6.77	864.36	31.82	68.87	7.77	29.14
1124D_3H-5_147-149_3	44.27	10.43	1.92	0.31	105.83	73.02	31.68	188.88	8.86	5.65	762.70	26.99	58.07	6.95	26.52
1124D_3H-5_147-149_8	42.74	10.95	1.96	0.49	105.71	73.18	31.94	193.60	9.05	5.77	766.02	27.7	57.98	6.77	28.23
1124D_3H-6_116-118_1	44.16	9.40	2.99	1.40	109.03	123.00	29.02	242.18	7.68	5.59	799.36	25.08	51.31	6.43	25.18
1124D_3H-6_116-118_6	40.92	9.06	3.16	2.05	116.62	121.18	28.48	230.75	7.84	5.82	765.61	25.3	51.2	6.26	23.17
1124D_3H-6_116-118_9	35.68	7.80	2.16	2.11	101.60	113.23	26.42	214.27	6.87	5.32	701.76	23.6	50.02	5.66	22.09
1124D_3H-6_116-118_10	42.55	8.55	2.32	1.75	107.85	125.57	28.91	229.84	8.24	5.48	766.01	25.42	51.83	6.36	20.46
1124D_4H-2_116-118_1	43.00	12.32	5.04	0.56	128.15	66.01	37.27	263.34	9.21	7.17	871.62	32.44	68.14	7.88	31.33
1124D_4H-2_116-118_6	44.87	12.31	2.53	0.42	125.38	66.38	36.61	254.60	9.18	6.39	813.15	31.14	63.7	7.67	28.01
1124D_4H-2_116-118_8	44.13	11.16	2.88	0.41	124.25	67.92	35.03	248.68	9.05	6.67	803.48	29.49	61.3	7.26	28.26
1124D_4H-2_116-118_10	50.83	12.64	2.52	0.31	131.48	74.39	41.78	283.09	9.94	7.35	936.15	35.15	69.27	8.62	32.12
1124D_4H-2_116-118_3	14.45	4.27	0.90	0.12	40.24	36.86	12.60	88.98	3.15	2.17	290.28	10.2	21.42	2.51	9.83
1124D_4H-2_137-139_6	42.34	13.16	2.95	1.23	107.90	87.88	34.38	260.96	10.42	5.64	766.45	27.57	61.54	7.18	26.81
1124D_4H-2_137-139_8	39.73	12.14	3.51	1.33	99.59	81.61	30.71	231.80	9.10	5.27	671.97	24.58	54.01	6.35	25.12
1124D_4H-2_137-139_10	43.24	14.03	3.23	0.41	118.56	88.36	36.59	275.54	10.56	6.40	806.16	29.29	63.6	7.6	29.08
1124D_4H-2_137-139_1	36.86	10.79	3.06	0.38	109.58	60.22	26.02	141.45	7.16	5.85	715.18	23.32	49.9	5.75	22.47
1124D_4H-2_137-139_5	43.43	10.82	3.00	0.53	119.27	59.43	26.32	123.96	6.69	6.37	755.32	24.31	50.16	5.73	23.36
1124D_4H-2_137-139_7	53.37	10.10	2.33	2.92	133.60	54.15	24.55	78.25	6.34	7.19	808.87	24.05	52.03	5.84	21.64
1124D_4H-4_100-102_5	48.00	4.04	4.53	0.65	129.41	78.19	17.66	89.70	5.62	6.36	890.69	22.44	44.19	5.18	15.8
1124D_4H-4_100-102_6	65.21	4.12	1.89	0.74	127.81	73.44	15.72	87.18	5.69	6.82	857.46	21.79	43.9	4.65	15.35
1124D_4H-4_100-102_7	56.20	4.33	2.25	0.65	133.62	79.21	15.38	86.24	5.17	6.81	920.62	22.12	45.3	4.57	15.68
1124D_4H-4_100-102_8	55.38	4.12	2.29	0.76	127.05	81.44	15.56	84.67	5.23	6.45	900.75	23.19	45.46	4.44	15.32
1124D_4H-4_100-102_9	52.65	4.91	2.44	0.74	150.92	79.21	17.85	89.44	5.98	7.79	946.08	24.2	47.65	5.1	18.18
1124D_4H-5_77-79_3	45.09	12.83	2.61	0.60	135.13	82.81	35.23	249.74	11.28	7.42	857.59	31.91	67.33	7.68	31.37
1124D_4H-5_77-79_4	43.80	12.26	2.43	0.55	121.44	90.94	32.74	260.90	10.36	6.98	806.46	30.24	62.91	7.33	26.43
1124D_4H-5_77-79_6	45.43	11.91	1.99	0.56	114.75	90.24	32.74	258.15	10.70	6.58	800.32	29.2	61.5	7.09	27.05
1124D_4H-5_77-79_8	45.22	11.24	2.05	0.29	123.30	63.21	33.23	200.02	10.10	6.54	825.48	30.37	65.54	7.25	28.67
1124D_4H-5_77-79_9	44.32	11.87	2.27	0.34	125.56	64.76	34.24	207.65	10.61	6.36	790.01	30.94	64.6	7.59	29.15
1124D_4H-6_18-20_3	50.90	12.17	2.60	1.18	137.68	102.99	33.65	288.22	10.52	8.03	798.97	29.83	63.45	7.47	27.93
1124D_4H-6_18-20_4	40.35	10.82	2.20	1.58	128.24	95.67	31.37	262.18	9.68	7.11	751.82	27	58.82	6.63	25.87
1124D_4H-6_18-20_6	37.77	9.89	2.73	0.80	115.67	87.61	31.02	251.59	9.29	6.44	721.44	26.72	55.35	6.48	25.94
1124D_4H-6_18-20_8	38.53	10.40	2.20	4.65	121.74	94.38	28.92	248.24	9.19	6.98	710.49	26.1	54.48	6.34	25.4
1124D_4H-6_18-20_9	44.36	11.21	2.13	1.11	141.24	98.31	34.75	284.35	10.47	8.08	821.73	30.19	63.71	7.46	29.37
1124D_4H-6_57-59_1	33.00	10.46	4.52	1.82	124.82	128.31	31.51	298.44	9.70	6.77	745.89	26.8	54.75	6.67	25.54
1124D_4H-6_57-59_3	39.81	11.66	8.21	2.15	125.07	157.04	34.11	307.78	10.14	6.99	792.43	27.85	57.93	7.29	28.38
1124D_4H-6_57-59_6	46.52	11.49	3.15	2.57	120.81	155.91	29.42	269.16	10.26	6.62	714.90	25.15	54.8	6.49	24.69
1124D_4H-6_57-59_7	42.38	10.78	2.35	2.21	114.04	151.86	28.37	259.39	9.76	6.42	694.21	24.59	54.23	6.3	24.69
1124D_4H-6_57-59_10	40.02	10.58	2.50	2.39	117.69	127.98	29.72	269.43	10.24	6.50	747.50	25.91	58.08	6.61	22.84
1124D_4H-6_86-88_1	50.42	9.92	2.07	0.57	163.07	61.41	36.43	186.05	10.51	9.13	850.63	32.92	69.61	7.86	31.31
1124D_4H-6_86-88_3	44.89	8.62	2.03	0.36	140.59	55.01	33.38	164.46	9.42	8.09	788.02	29.53	62.51	7.19	29.12
1124D_4H-6_86-88_4	48.51	9.15	2.61	0.39	146.90	57.07	34.86	173.12	9.68	8.43	803.40	31.29	65.51	7.63	29.18
1124D_4H-6_86-88_8	43.67	8.37	1.95	0.34	132.33	54.47	32.61	164.92	9.00	7.53	744.41	29.11	61.6	7.12	25.27
1124D_4H-6_86-88_10	41.40	9.02	2.50	0.42	133.86	69.33	31.76	184.96	8.83	7.62	750.94	28.51	58.68	6.81	26.03
1124D_4H-6_117-119_1	49.58	10.68	5.91	1.43	168.52	57.77	36.67	237.35	11.62	9.98	863.08	33.57	70.2	8.39	30.43
1124D_4H-6_117-119_4	48.19	11.73	3.00	1.16	164.84	58.88	35.44	234.86	10.75	9.59	865.42	32.54	68.54	7.84	29.92
1124D_4H-6_1															

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1124D_2H-CC_10-12_13	5.14	0.89	4.98	0.71	5.34	1.05	3.08	0.48	3.39	0.56	5.17	0.682	18	10.79	2.57
1124D_2H-CC_10-12_14	6.14	1.05	5.25	0.90	5.60	1.09	3.36	0.48	3.81	0.54	5.90	0.779	19.05	11.61	2.66
1124D_3H-1_3-5_1	3.70	0.56	3.67	0.53	3.36	0.83	2.11	0.32	1.90	0.37	3.66	0.736	17.23	11.14	2.72
1124D_3H-1_3-5_3	3.58	0.56	2.91	0.54	3.30	0.69	2.02	0.28	2.55	0.37	3.40	0.554	17.55	12.09	2.77
1124D_3H-1_3-5_4	3.19	0.50	3.24	0.64	3.48	0.66	1.97	0.35	2.00	0.41	3.11	0.668	16.73	11.31	2.58
1124D_3H-1_3-5_5	3.72	0.48	3.06	0.56	3.30	0.66	1.99	0.32	2.77	0.39	3.28	0.543	15.75	11.95	2.83
1124D_3H-1_3-5_7	4.56	0.50	3.69	0.65	3.56	0.84	2.48	0.32	3.18	0.33	3.90	0.676	18.36	12.56	2.99
1124D_3H-4_96-98_1	5.49	0.88	5.19	0.78	5.92	1.02	3.24	0.38	2.89	0.54	5.76	0.39	15.22	10.19	2.48
1124D_3H-4_96-98_2	5.79	0.78	4.81	0.80	5.42	1.01	3.17	0.52	3.02	0.49	4.98	0.697	17.49	11.12	2.64
1124D_3H-4_96-98_4	5.70	0.96	5.26	0.86	5.40	1.09	3.42	0.43	3.56	0.49	5.24	0.624	18.09	10.94	2.6
1124D_3H-4_96-98_8	4.91	1.08	4.07	0.77	4.80	1.36	3.13	0.42	2.62	0.53	4.87	0.78	15.62	10.93	2.56
1124D_3H-4_96-98_9	6.38	1.03	5.67	0.87	6.04	1.20	3.91	0.50	3.80	0.57	5.76	0.823	21.65	11.91	2.8
1124C_10H-6_12-140_1	6.17	1.10	5.43	0.81	5.64	1.23	4.06	0.56	4.06	0.62	7.07	0.606	18.16	11.03	2.53
1124C_10H-6_12-140_2	6.39	1.05	5.33	0.86	5.94	1.24	3.61	0.58	4.19	0.57	6.85	0.696	17.92	10.95	2.52
1124C_10H-6_12-140_3	5.95	1.04	5.25	0.91	5.67	1.15	3.84	0.53	3.42	0.52	6.63	0.706	19.07	11.07	2.74
1124C_10H-6_12-140_9	6.30	1.27	6.09	0.98	6.21	1.28	4.10	0.55	3.97	0.60	7.34	0.82	19.88	11.92	3.05
1124C_10H-6_12-140_10	5.51	1.00	5.21	0.83	5.80	1.18	3.67	0.47	3.52	0.53	6.43	0.687	18.5	10.77	2.77
1124D_3H-5_112-114_1	0.21	0.04	0.25	0.03	0.20	0.05	0.18	0.02	0.15	0.02	0.24	0.02	0.707	0.453	0.0894
1124D_3H-5_112-114_10	0.70	0.15	0.76	0.11	0.72	0.16	0.41	0.05	0.51	0.07	0.79	0.0746	2.17	1.293	0.278
1124D_3H-5_112-114_11	0.56	0.11	0.57	0.10	0.63	0.12	0.36	0.05	0.38	0.06	0.68	0.0751	1.877	1.143	0.274
1124D_3H-5_112-114_12	0.41	0.08	0.42	0.06	0.41	0.09	0.27	0.04	0.30	0.04	0.51	0.0479	1.412	0.836	0.202
1124D_3H-5_112-114_13	0.68	0.13	0.65	0.11	0.67	0.13	0.40	0.06	0.44	0.06	0.72	0.0743	2.083	1.218	0.281
1124D_3H-5_147-149_1	5.43	0.92	6.05	0.76	5.26	1.25	3.20	0.53	3.82	0.57	4.79	0.701	19.3	11.77	2.78
1124D_3H-5_147-149_10	5.82	0.98	6.19	0.97	6.66	1.34	3.82	0.59	3.76	0.46	5.42	0.914	22.6	14.06	3.17
1124D_3H-5_147-149_3	5.81	1.03	5.85	0.85	5.52	1.13	3.35	0.58	3.36	0.50	5.47	0.575	18.42	11.77	2.54
1124D_3H-5_147-149_8	5.85	1.13	5.73	0.81	5.35	1.27	3.62	0.56	3.35	0.52	5.04	0.612	19.49	11.69	2.79
1124D_3H-6_116-118_1	4.51	1.11	6.10	0.73	5.46	1.18	2.74	0.40	3.46	0.56	6.42	0.661	17.2	11.8	2.52
1124D_3H-6_116-118_6	4.88	0.85	4.59	0.75	4.83	0.99	3.10	0.47	3.03	0.40	5.99	0.602	18.1	11.36	2.59
1124D_3H-6_116-118_9	4.18	0.81	4.21	0.83	4.72	1.16	2.84	0.39	2.95	0.45	6.28	0.542	17.61	10.84	2.58
1124D_3H-6_116-118_10	3.79	0.78	4.28	0.88	4.74	1.00	3.04	0.42	3.69	0.46	6.55	0.596	17.1	11.83	2.59
1124D_4H-2_116-118_1	6.36	0.98	6.68	1.03	6.74	1.48	4.12	0.64	3.66	0.70	7.40	0.648	21.31	13.59	2.94
1124D_4H-2_116-118_6	7.05	0.82	6.49	1.16	7.01	1.29	3.62	0.64	4.32	0.54	6.81	0.676	19.66	13.68	2.7
1124D_4H-2_116-118_8	5.93	0.85	6.14	0.99	5.80	1.35	3.50	0.53	3.89	0.56	6.60	0.603	20.11	13.02	2.68
1124D_4H-2_116-118_10	7.13	0.82	4.44	0.93	7.09	1.46	4.82	0.65	5.28	0.61	8.26	0.66	20.99	15.1	2.65
1124D_4H-2_116-118_3	2.20	0.34	2.42	0.31	1.90	0.36	1.41	0.23	1.53	0.15	2.43	0.214	6.61	4.55	0.877
1124D_4H-2_137-139_6	6.89	0.96	5.43	0.91	5.88	1.20	3.80	0.54	3.79	0.58	6.57	0.71	19.78	12.11	3.06
1124D_4H-2_137-139_8	5.40	1.04	4.89	0.85	5.35	1.16	3.43	0.46	3.34	0.48	6.05	0.643	16.98	10.36	2.47
1124D_4H-2_137-139_10	6.66	1.06	5.67	1.05	6.12	1.37	3.96	0.59	4.17	0.57	7.47	0.667	19.39	12.19	2.77
1124D_4H-2_137-139_1	4.76	0.63	4.22	0.69	4.49	0.94	2.77	0.39	2.85	0.47	4.39	0.537	16.07	10.43	2.447
1124D_4H-2_137-139_5	4.94	0.72	4.67	0.79	4.51	0.95	2.82	0.39	2.89	0.41	3.54	0.529	17.04	11.14	2.57
1124D_4H-2_137-139_7	4.69	0.50	4.22	0.65	4.61	0.88	2.42	0.40	2.82	0.37	3.24	0.569	18.64	11.79	2.89
1124D_4H-4_100-102_5	3.78	0.30	2.54	0.58	2.45	0.51	2.01	0.36	2.16	0.33	3.13	0.45	13.84	11.16	2.2
1124D_4H-4_100-102_6	2.83	0.38	2.31	0.40	2.66	0.54	1.87	0.27	1.65	0.26	2.83	0.524	17.7	11.5	2.8
1124D_4H-4_100-102_7	3.30	0.54	2.53	0.47	2.73	0.67	1.70	0.31	2.07	0.34	3.27	0.718	24.58	11.22	2.86
1124D_4H-4_100-102_8	3.22	0.45	2.86	0.38	2.22	0.63	1.49	0.14	1.71	0.25	3.36	0.551	16.86	11.68	2.59
1124D_4H-4_100-102_9	3.42	0.45	2.68	0.41	2.94	0.66	1.92	0.28	2.03	0.37	3.23	0.635	20.99	13.11	2.94
1124D_4H-5_77-79_3	6.17	0.95	6.16	0.98	6.10	1.28	4.05	0.61	4.15	0.64	7.22	0.837	22.21	14.73	3.28
1124D_4H-5_77-79_4	5.32	1.04	5.38	1.04	5.43	1.36	3.82	0.55	3.94	0.63	7.58	0.841	20.83	13.54	3.09
1124D_4H-5_77-79_6	6.08	1.12	5.68	1.00	5.18	1.32	3.71	0.54	3.80	0.50	6.83	0.611	19.85	13.77	2.8
1124D_4H-5_77-79_8	5.43	0.99	7.04	0.89	5.97	1.28	2.94	0.49	4.40	0.52	6.08	0.78	20.21	14.36	3.06
1124D_4H-5_77-79_9	5.26	1.01	6.54	1.04	6.39	1.14	3.94	0.53	3.75	0.48	5.81	0.83	20.93	15.3	3.23
1124D_4H-6_18-20_3	6.16	1.04	6.31	0.91	6.03	1.25	3.73	0.57	4.05	0.57	7.31	0.737	22.18	13.89	3.47
1124D_4H-6_18-20_4	5.63	1.07	5.14	0.86	5.18	1.19	3.66	0.50	3.82	0.60	7.31	0.717	21.63	13.13	3.16
1124D_4H-6_18-20_6	5.79	0.91	5.60	0.83	5.38	1.13	3.34	0.58	3.87	0.53	5.89	0.746	17.8	12.91	2.64
1124D_4H-6_18-20_8	5.21	0.86	5.15	0.81	5.22	1.18	3.20	0.48	3.43	0.48	6.42	0.736	21.5	12.26	3.04
1124D_4H-6_18-20_9	6.47	1.04	5.70	0.91	6.08	1.33	3.92	0.58	3.81	0.62	7.54	0.745	22.74	14.43	3.41
1124D_4H-6_57-59_1	5.86	1.21	4.51	0.75	5.30	1.14	3.54	0.48	3.69	0.55	6.80	0.647	18.96	12.74	2.92
1124D_4H-6_57-59_3	6.31	1.22	5.64	0.96	5.64	1.33	3.81	0.59	4.20	0.58	7.32	0.633	19.29	13.21	3.02
1124D_4H-6_57-59_6	5.34	1.21	5.02	0.84	5.17	1.10	3.22	0.44	3.59	0.53	6.95	0.743	18.81	12.42	3.05
1124D_4H-6_57-59_7	4.75	1.13	4.93	0.73	4.80	1.15	3.25	0.57	3.39	0.47	6.98	0.651	19.18	12.65	3.23
1124D_4H-6_57-59_10	5.47	1.21	3.97	0.80	6.33	0.96	2.60	0.49	3.74	0.50	7.23	0.673	18.34	12.91	3.43
1124D_4H-6_86-88_1	7.14	0.75	5.62	0.99	6.75	1.34	3.84	0.60	3.83	0.56	5.48	0.867	24.37	17.18	4.07
1124D_4H-6_86-88_3	6.01	0.68	5.16	0.92	5.57	1.21	3.72	0.49	4.05	0.56	5.22	0.708	20.43	14.9	3.3
1124D_4H-6_86-88_4	6.14	0.82	5.69	0.95	6.05	1.19	3.77	0.58	3.88	0.59	4.95	0.78	21.84	16.85	3.48
1124D_4H-6_86-88_8	5.68	0.78	5.81	0.76	5.93	1.04	2.73	0.64	4.05	0.55	5.18	0.635	20.35	14.35	3.26
1124D_4H-6_86-88_10	5.96	0.87	5.30	0.84	5.24	1.24	3.15	0.57	3.08	0.49	5.44	0.598	20.5	15.01	3.02
1124D_4H-6_117-119_1	6.20	0.87	5.92	1.03	6.10	1.21	3.81	0.52	3.65	0.50	6.49	0.658	24.57	18.52	3.99
1124D_4H-6_117-119_4	6.35	0.84	6.35	1.05	5.79	1.38	3.66	0.50	3.73	0.55	6.15	0.878	22.61	18.04	3.87
1124D_4H-6_117-119_5	5.35	0.78	5.70	0.86	5.11	1.07	3.31	0.51	3.89	0.61	6.00	0.651	21.97	16.19	4.01
1124D_4H-6_117-119_6	6.20	0.71	5.64	0.91	6.02	1.21	3.30	0.50	4.01	0.52	6.71	0.79	23.11	16.04	4.06

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1124D_4H-6_117-119_9	48.32	10.36	1.85	1.46	139.70	54.28	31.53	213.88	9.39	8.06	760.58	29.62	63.16	7.51	27.36
1124D_5H-7_12-14_2	51.03	11.91	2.25	0.71	115.53	57.30	25.34	117.79	7.10	6.10	796.40	24.13	50.58	5.7	20.31
1124D_5H-7_12-14_5	41.36	11.85	3.60	0.83	118.92	58.04	26.35	122.06	6.88	6.38	841.81	24.38	51.67	5.78	21.87
1124D_5H-7_12-14_6	46.20	11.60	2.21	1.15	115.71	61.73	26.08	119.53	7.00	5.10	681.56	19.82	41.92	4.81	17.57
1124D_5H-7_12-14_9	50.25	12.17	2.28	0.61	121.38	58.31	27.19	121.87	6.78	5.38	720.93	21.46	43.75	5.03	19.02
1124D_5H-7_12-14_11	37.31	11.10	4.18	0.86	119.68	58.57	27.00	121.42	6.49	5.42	719.45	21.89	44.23	5.1	18.21
1124D_6H-1_142-144_4	40.99	10.01	5.09	4.07	130.27	87.61	22.79	150.73	7.17	6.12	1120.91	22.25	45.46	4.91	17.8
1124D_6H-1_142-144_10	51.66	6.31	2.19	0.80	132.40	75.84	19.28	94.42	5.13	7.20	845.05	22.4	44.94	5.04	18.42
1124D_6H-1_142-144_2	48.97	5.11	2.34	0.62	144.02	55.17	18.68	77.75	4.85	7.92	843.04	24.16	47.38	5.15	16.8
1124D_6H-1_142-144_5	51.09	5.92	6.23	0.84	169.32	68.40	23.09	95.46	5.58	8.86	991.11	29.07	53.68	5.88	18.86
1124D_6H-1_142-144_8	48.80	5.16	2.32	0.84	139.71	55.92	18.20	76.98	5.16	7.41	828.28	23.24	46	4.99	16.37
1124D_6H-4_29-31_4	45.47	8.34	2.76	1.54	121.89	89.57	18.93	162.72	5.94	6.17	822.33	20.41	39.47	4.32	15.98
1124D_6H-4_29-31_6	40.57	8.59	2.15	1.57	117.80	88.33	17.95	156.39	5.95	5.96	795.14	19.89	38.9	4.11	16.45
1124D_6H-4_29-31_9	35.30	7.47	2.47	1.58	110.00	85.60	17.98	153.94	5.59	5.48	745.06	19.18	36.48	4.06	15.1
1124D_6H-4_29-31_10	38.93	7.82	3.46	1.60	119.45	86.18	17.84	153.33	5.65	6.04	778.02	19.44	37.02	4.18	15.49
1124D_6H-4_29-31_8	46.37	4.34	2.03	0.88	133.02	75.08	13.96	117.44	4.77	7.14	867.26	20.6	38.59	3.95	11.27

Appendix A

Supplementary Table S15: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1124.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1124D_4H-6_117-119_9	6.01	0.72	5.73	0.83	5.45	1.28	2.74	0.41	3.94	0.67	6.28	0.909	21.53	17.24	3.76
1124D_5H-7_12-14_2	5.38	0.59	4.67	0.75	4.27	0.91	2.70	0.43	3.74	0.54	3.89	0.532	18.96	10.42	2.66
1124D_5H-7_12-14_5	4.66	0.56	4.50	0.66	4.56	0.89	3.28	0.46	3.50	0.56	4.09	0.673	20.64	11.25	2.59
1124D_5H-7_12-14_6	3.99	0.59	3.10	0.65	4.10	0.79	2.78	0.33	2.38	0.37	3.20	0.416	16.93	9.93	2.28
1124D_5H-7_12-14_9	4.01	0.56	4.07	0.68	4.13	0.93	2.46	0.28	2.32	0.40	3.45	0.482	17.37	10.72	2.4
1124D_5H-7_12-14_11	4.18	0.52	3.74	0.66	3.99	0.81	2.60	0.39	2.39	0.37	3.09	0.511	16.3	10.19	2.27
1124D_6H-1_142-144_4	3.55	0.50	3.54	0.59	3.56	0.93	2.68	0.35	2.65	0.32	5.01	0.584	22.37	11.16	2.23
1124D_6H-1_142-144_10	4.08	0.53	2.46	0.48	3.06	0.65	2.29	0.42	2.40	0.41	3.50	0.432	18.12	11.96	2.67
1124D_6H-1_142-144_2	2.88	0.50	2.74	0.50	2.52	0.60	2.27	0.23	2.73	0.36	3.25	0.583	19.41	13.33	2.99
1124D_6H-1_142-144_5	3.75	0.53	3.21	0.45	2.95	0.77	2.46	0.42	2.57	0.38	2.92	0.453	22.63	15.26	3.21
1124D_6H-1_142-144_8	2.88	0.35	2.95	0.48	2.70	0.66	2.47	0.23	2.51	0.44	2.91	0.584	19.8	13.03	3.04
1124D_6H-4_29-31_4	3.43	0.51	3.06	0.52	3.06	0.59	2.07	0.30	2.29	0.38	4.80	0.486	15.18	11.09	2.54
1124D_6H-4_29-31_6	2.87	0.48	2.99	0.45	3.15	0.70	1.98	0.31	2.04	0.35	4.34	0.473	16.7	10.65	2.45
1124D_6H-4_29-31_9	2.83	0.43	3.18	0.54	2.83	0.68	1.98	0.26	2.43	0.32	4.36	0.594	14.01	10.09	2.34
1124D_6H-4_29-31_10	2.78	0.45	2.74	0.50	2.69	0.67	1.81	0.28	1.88	0.28	4.45	0.447	15.89	10.31	2.48
1124D_6H-4_29-31_8	1.97	0.34	2.25	0.37	1.91	0.47	1.44	0.26	1.92	0.23	4.03	0.458	18.32	12.48	6.12

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s9	1125A_1H-1_71-73_1	4.04	2.98	1.17	73.72	0.09	0.04	0.97	0.04	11.27	0.02	94.35
	1125A_1H-1_71-73_1	3.97	2.72	1.10	72.12	0.12	0.12	1.02	0.07	11.48	0.03	92.76
	1125A_1H-1_71-73_2	3.98	2.73	1.16	71.94	0.13	0.09	1.14	0.13	11.60	0.02	92.93
	1125A_1H-1_71-73_3	4.06	2.81	1.12	72.97	0.10	0.09	1.04	0.03	11.80	0.03	94.04
	1125A_1H-1_71-73_4	3.92	2.69	1.22	71.76	0.13	0.09	1.11	0.06	11.25	0.02	92.24
	1125A_1H-1_71-73_5	4.11	2.60	1.22	72.28	0.14	0.08	1.16	0.09	11.53	0.03	93.23
	1125A_1H-1_71-73_6	3.84	2.88	1.12	72.69	0.09	0.11	0.96	0.07	11.55	0.04	93.35
	1125A_1H-1_71-73_7	4.21	3.44	1.31	70.96	0.13	0.09	0.88	0.04	11.49	0.06	92.61
	1125A_1H-1_71-73_8	4.30	2.75	1.28	72.86	0.10	0.15	1.03	0.10	11.80	0.01	94.37
	1125A_1H-1_71-73_9	3.83	2.74	1.02	72.07	0.13	0.10	1.01	0.05	11.39	0.03	92.36
	1125A_1H-1_71-73_10	3.89	2.70	1.24	72.99	0.14	0.12	1.05	0.05	11.34	0.00	93.52
	1125A_1H-1_71-73_11	4.06	2.71	1.28	73.74	0.11	0.15	1.11	0.07	11.76	0.00	94.99
	1125A_1H-1_71-73_12	4.19	2.66	1.18	73.38	0.09	0.14	1.09	0.06	11.47	0.00	94.26
	1125A_1H-1_71-73_13	3.83	2.70	1.11	72.52	0.16	0.10	1.06	0.03	11.59	0.05	93.14
	1125A_1H-1_71-73_14	4.03	2.79	1.00	72.15	0.10	0.08	0.92	0.04	11.49	0.00	92.60
	1125A_1H-1_71-73_15	3.88	2.70	1.27	72.08	0.11	0.12	1.13	0.06	11.68	0.04	93.07
	1125A_1H-1_71-73_16	4.20	2.92	1.12	72.79	0.11	0.10	0.99	0.07	11.71	0.01	94.02
	1125A_1H-1_71-73_17	3.89	2.75	1.20	71.76	0.11	0.10	1.12	0.03	11.51	0.02	92.49
	1125A_1H-1_71-73_18	4.10	2.67	1.05	72.98	0.15	0.09	1.09	0.05	11.49	0.02	93.69
	1125A_1H-1_71-73_19	3.87	2.90	1.15	73.98	0.11	0.10	1.03	0.06	11.65	0.03	94.89
	1125A_1H-1_71-73_2	4.17	2.84	1.18	73.64	0.11	0.13	1.10	0.03	11.38	0.00	94.58
	1125A_1H-1_71-73_3	4.20	2.69	1.24	73.75	0.10	0.07	0.94	0.08	11.13	0.00	94.20
	1125A_1H-1_71-73_4	3.74	2.77	1.23	73.09	0.10	0.09	0.98	0.07	10.96	0.06	93.10
	1125A_1H-1_71-73_5	3.93	2.71	1.21	72.31	0.12	0.08	1.07	0.00	11.48	0.02	92.93
	1125A_1H-1_71-73_6	3.74	2.90	1.16	73.99	0.13	0.12	1.03	0.11	11.16	0.02	94.37
	1125A_1H-1_71-73_7	4.09	2.76	1.21	72.80	0.10	0.09	0.99	0.07	11.11	0.02	93.23
	1125A_1H-1_71-73_8	4.16	2.71	1.22	73.87	0.09	0.12	1.11	0.04	11.19	0.00	94.52
	1125A_1H-1_71-73_9	4.08	2.88	0.95	73.34	0.13	0.09	1.07	0.00	11.42	0.00	93.96
	1125A_1H-1_71-73_10	4.04	2.73	1.21	73.74	0.11	0.14	1.13	0.09	11.43	0.02	94.65
	1125A_1H-1_71-73_11	4.19	2.77	1.13	70.92	0.12	0.08	1.06	0.04	11.33	0.01	91.65
	1125A_1H-1_71-73_12	3.89	2.80	1.19	73.73	0.12	0.12	1.14	0.02	11.55	0.00	94.56
	1125A_1H-1_71-73_13	3.60	3.42	1.06	73.10	0.15	0.14	1.07	0.01	11.66	0.01	94.22
	1125A_1H-1_71-73_14	4.07	2.63	1.20	72.67	0.10	0.10	1.12	0.05	11.47	0.02	93.44
	1125A_1H-1_71-73_15	3.92	2.63	1.27	72.03	0.10	0.12	1.11	0.00	11.32	0.04	92.55
	1125A_1H-1_71-73_16	3.81	2.74	1.09	71.85	0.10	0.12	0.96	0.04	10.77	0.00	91.49
	1125A_1H-1_71-73_17	4.16	2.64	1.13	72.27	0.12	0.13	1.12	0.09	11.51	0.00	93.17
	1125A_1H-1_71-73_18	4.02	2.76	1.09	72.18	0.12	0.11	0.95	0.10	10.96	0.02	92.31
	1125A_1H-1_71-73_20	4.14	2.69	1.12	72.69	0.13	0.07	1.11	0.09	11.45	0.00	93.50
u14	1125A_2H-4_17-19_1	3.52	2.99	1.15	74.38	0.17	0.18	1.29	0.07	11.39	0.05	95.19
	1125A_2H-4_17-19_2	3.64	3.11	0.95	73.60	0.12	0.12	1.20	0.04	11.54	0.02	94.33
	1125A_2H-4_17-19_3	3.47	2.97	1.08	74.16	0.12	0.19	1.27	0.05	11.38	0.02	94.70
	1125A_2H-4_17-19_4	3.41	2.95	0.94	73.53	0.15	0.14	1.29	0.03	11.20	0.00	93.63
	1125A_2H-4_17-19_5	3.46	3.24	0.99	73.77	0.14	0.08	1.01	0.07	11.30	0.02	94.09
	1125A_2H-4_17-19_6	3.96	2.83	1.14	72.77	0.15	0.19	1.20	0.10	11.54	0.00	93.87
	1125A_2H-4_17-19_7	3.71	2.94	1.06	73.52	0.15	0.15	1.31	0.04	11.30	0.02	94.20
	1125A_2H-4_17-19_8	3.73	3.20	0.97	74.43	0.11	0.14	0.99	0.09	11.57	0.01	95.25
	1125A_2H-4_17-19_9	3.73	3.21	1.02	73.88	0.08	0.11	1.02	0.08	11.50	0.03	94.66
	1125A_2H-4_17-19_10	3.81	3.16	0.92	74.17	0.10	0.12	1.00	0.00	11.48	0.03	94.79
	1125A_2H-4_17-19_11	3.84	3.13	0.93	74.20	0.11	0.14	1.00	0.07	11.64	0.00	95.05
	1125A_2H-4_17-19_12	3.67	3.33	1.02	73.99	0.10	0.12	0.96	0.03	11.42	0.03	94.68
	1125A_2H-4_17-19_13	3.53	3.03	1.01	73.23	0.15	0.20	1.23	0.00	11.28	0.03	93.70
	1125A_2H-4_17-19_14	3.49	3.17	0.94	73.85	0.09	0.08	1.02	0.06	11.42	0.00	94.11
	1125A_2H-4_17-19_15	3.88	2.85	1.09	73.80	0.16	0.15	1.27	0.05	11.35	0.00	94.61
	1125A_2H-4_17-19_16	3.85	3.20	0.87	73.61	0.10	0.12	1.03	0.01	11.57	0.00	94.36
	1125A_2H-4_17-19_17	3.53	3.15	0.98	73.47	0.13	0.09	1.00	0.00	11.34	0.00	93.70
	1125A_2H-4_17-19_18	3.76	3.06	1.24	73.20	0.15	0.17	1.25	0.00	11.66	0.02	94.52
	1125A_2H-4_17-19_19	3.57	3.24	1.04	73.41	0.10	0.10	0.99	0.05	11.53	0.00	94.02
	1125A_2H-4_17-19_20	3.80	3.17	1.04	73.94	0.12	0.11	0.96	0.02	11.38	0.00	94.55
s19	1125A_3H-2_67-69_1	4.07	3.43	1.07	73.60	0.15	0.15	0.98	0.03	11.28	0.02	94.78
	1125A_3H-2_67-69_2	3.74	3.28	1.16	71.93	0.14	0.10	0.91	0.06	11.43	0.02	92.78
	1125A_3H-2_67-69_3	3.71	3.33	1.11	73.19	0.12	0.11	0.93	0.02	11.45	0.05	94.01
	1125A_3H-2_67-69_4	3.78	3.25	1.18	73.67	0.14	0.16	0.96	0.07	11.38	0.03	94.62
	1125A_3H-2_67-69_5	3.82	3.28	1.17	73.65	0.13	0.12	0.96	0.06	11.18	0.03	94.40
	1125A_3H-2_67-69_6	3.75	3.34	1.16	73.66	0.12	0.17	0.95	0.05	11.44	0.03	94.67
	1125A_3H-2_67-69_7	3.72	3.25	0.98	73.15	0.14	0.12	0.93	0.06	11.58	0.02	93.95
	1125A_3H-2_67-69_8	3.95	3.26	1.01	73.67	0.13	0.11	0.94	0.03	11.61	0.01	94.72
	1125A_3H-2_67-69_9	3.64	3.39	1.22	72.47	0.15	0.15	0.97	0.09	11.41	0.00	93.49
	1125A_3H-2_67-69_10	3.79	3.32	0.93	73.04	0.12	0.06	0.94	0.04	11.43	0.00	93.67
	1125A_3H-2_67-69_11	3.94	3.36	0.95	73.84	0.12	0.10	0.94	0.00	11.64	0.00	94.90
	1125A_3H-2_67-69_12	3.49	3.31	1.03	73.36	0.16	0.13	0.95	0.00	11.54	0.02	93.98

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s22	1125A_3H-2_67-69_13	3.64	3.27	0.85	72.38	0.10	0.14	0.84	0.07	11.52	0.01	92.83
	1125A_3H-2_67-69_14	3.61	3.19	0.95	73.27	0.14	0.11	0.99	0.03	11.45	0.03	93.76
	1125A_3H-2_67-69_15	3.72	3.39	1.02	73.07	0.10	0.08	0.94	0.02	11.37	0.00	93.71
	1125A_3H-2_67-69_16	3.70	3.21	1.10	73.02	0.13	0.12	0.92	0.10	11.34	0.00	93.64
	1125A_3H-2_67-69_17	3.90	3.36	1.08	73.77	0.13	0.10	0.95	0.04	11.54	0.02	94.90
	1125A_3H-2_67-69_18	4.02	3.28	1.14	73.64	0.13	0.12	0.94	0.06	11.40	0.00	94.73
	1125A_3H-2_67-69_19	3.50	3.58	1.16	73.17	0.17	0.09	0.97	0.07	11.43	0.00	94.14
	1125A_3H-2_67-69_20	3.63	3.42	1.11	73.24	0.16	0.10	1.02	0.07	11.52	0.00	94.28
	1125A_3H-2_67-69_6	3.71	3.44	0.58	74.88	0.00	0.11	0.95	0.01	11.93	0.01	95.62
	1125A_3H-2_67-69_7	3.70	3.45	1.16	74.75	0.04	0.14	0.98	0.05	11.93	0.01	96.21
	1125A_3H-2_67-69_8	3.71	3.32	1.03	73.68	0.02	0.11	0.91	0.04	11.83	0.01	94.65
	1125A_3H-2_67-69_10	3.79	3.37	1.17	74.55	0.11	0.15	0.98	0.00	11.95	0.00	96.07
	1125A_3H-4_64-66_1	4.15	3.28	1.14	72.82	0.16	0.08	0.79	0.04	11.49	0.03	93.98
	1125A_3H-4_64-66_2	3.41	3.79	1.09	72.63	0.12	0.10	0.73	0.07	11.44	0.02	93.41
	1125A_3H-4_64-66_3	4.13	3.56	1.22	73.25	0.17	0.09	0.90	0.08	12.24	0.04	95.68
	1125A_3H-4_64-66_5	4.02	3.28	1.14	72.60	0.22	0.08	0.79	0.02	11.65	0.00	93.80
	1125A_3H-4_64-66_6	4.10	3.45	1.06	72.23	0.14	0.10	0.76	0.03	11.65	0.02	93.54
	1125A_3H-4_64-66_7	3.91	3.33	1.16	72.34	0.11	0.13	0.82	0.06	11.32	0.00	93.18
	1125A_3H-4_64-66_8	4.16	3.34	0.94	73.36	0.16	0.10	0.77	0.02	11.52	0.00	94.37
	1125A_3H-4_64-66_9	4.03	3.22	1.19	72.48	0.12	0.13	0.77	0.05	11.38	0.00	93.36
u24	1125A_3H-4_64-66_10	3.99	3.27	0.99	72.82	0.12	0.14	0.75	0.07	11.50	0.01	93.67
	1125A_3H-4_64-66_11	3.95	3.24	0.96	72.55	0.12	0.08	0.81	0.00	11.19	0.00	92.90
	1125A_3H-4_64-66_12	3.79	3.56	1.34	72.22	0.16	0.10	0.79	0.08	11.77	0.04	93.84
	1125A_3H-4_64-66_13	3.86	3.29	1.10	72.56	0.10	0.11	0.81	0.06	11.60	0.02	93.51
	1125A_3H-4_64-66_14	3.95	3.23	1.08	72.44	0.12	0.13	0.76	0.08	11.51	0.00	93.29
	1125A_3H-4_64-66_15	3.10	4.34	1.56	68.36	0.15	0.11	0.97	0.07	11.77	0.03	90.47
	1125A_3H-4_64-66_16	4.05	3.47	2.02	67.72	0.32	0.29	1.30	0.05	12.57	0.04	91.83
	1125A_3H-4_64-66_17	4.08	3.27	1.34	71.90	0.16	0.06	0.85	0.01	11.87	0.00	93.54
	1125A_3H-4_64-66_18	3.87	3.30	1.02	72.57	0.12	0.09	0.78	0.00	11.55	0.02	93.33
	1125A_3H-4_64-66_19	4.01	3.21	1.17	72.08	0.14	0.10	0.85	0.04	11.41	0.04	93.03
	1125A_3H-4_64-66_20	4.25	3.24	0.94	72.92	0.13	0.09	0.80	0.00	11.61	0.04	94.02
	1125A_3H-5_124-126_1	4.68	3.04	1.46	71.74	0.15	0.11	0.97	0.02	12.19	0.01	94.37
	1125A_3H-5_124-126_2	4.43	3.05	1.60	71.46	0.14	0.12	0.98	0.04	12.31	0.03	94.15
	1125A_3H-5_124-126_3	4.41	3.12	1.49	70.68	0.13	0.10	0.94	0.11	11.95	0.01	92.95
	1125A_3H-5_124-126_4	4.40	3.09	1.44	70.31	0.11	0.09	0.94	0.11	12.29	0.00	92.78
	1125A_3H-5_124-126_5	4.50	3.18	1.54	71.74	0.16	0.13	0.99	0.00	12.35	0.01	94.60
	1125A_3H-5_124-126_6	4.47	3.07	1.58	70.74	0.12	0.10	0.98	0.00	12.14	0.02	93.22
	1125A_3H-5_124-126_7	4.34	3.20	1.22	70.89	0.11	0.12	0.85	0.03	11.76	0.02	92.55
	1125A_3H-5_124-126_8	4.16	3.10	1.51	70.30	0.14	0.12	0.92	0.05	12.14	0.02	92.46
	1125A_3H-5_124-126_9	4.55	3.03	1.56	70.72	0.13	0.13	0.92	0.12	11.94	0.02	93.12
	1125A_3H-5_124-126_10	4.19	3.15	1.41	70.92	0.14	0.14	0.92	0.06	12.05	0.00	92.98
23*/s24	1125A_3H-5_124-126_11	4.65	3.11	1.61	71.35	0.12	0.14	0.96	0.03	12.24	0.00	94.20
	1125A_3H-5_124-126_12	4.63	3.12	1.51	71.86	0.12	0.10	0.92	0.07	12.25	0.00	94.58
	1125A_3H-5_124-126_13	4.53	3.14	1.48	70.29	0.11	0.09	0.96	0.02	11.88	0.01	92.50
	1125A_3H-5_124-126_14	4.74	2.99	1.74	71.45	0.20	0.15	0.99	0.08	12.18	0.01	94.53
	1125A_3H-5_124-126_15	3.95	3.13	1.49	70.55	0.14	0.09	0.92	0.07	12.11	0.01	92.45
	1125A_3H-5_124-126_16	4.53	3.01	1.53	70.39	0.15	0.12	0.92	0.09	12.07	0.02	92.82
	1125A_3H-5_124-126_17	4.52	3.06	1.54	71.15	0.14	0.08	0.89	0.12	12.17	0.05	93.73
	1125A_3H-5_124-126_18	3.90	3.18	1.55	68.68	0.16	0.14	1.21	0.02	12.11	0.04	91.00
	1125A_3H-5_124-126_19	4.13	3.09	1.55	70.14	0.14	0.09	0.91	0.02	12.22	0.01	92.30
	1125A_3H-5_124-126_20	4.45	3.08	1.57	71.15	0.12	0.16	0.95	0.04	12.15	0.03	93.69
	1125A_3H-6_57-59_1	4.08	3.06	1.43	71.01	0.16	0.15	1.06	0.05	11.87	0.03	92.91
	1125A_3H-6_57-59_2	4.25	3.12	1.65	71.94	0.12	0.14	1.00	0.06	11.94	0.02	94.24
	1125A_3H-6_57-59_3	4.09	3.18	1.38	71.10	0.20	0.10	1.05	0.06	11.94	0.00	93.11
	1125A_3H-6_57-59_4	4.27	3.18	1.48	71.22	0.17	0.13	1.10	0.03	11.91	0.01	93.50
	1125A_3H-6_57-59_5	4.38	3.06	1.57	70.51	0.19	0.15	1.29	0.02	12.26	0.03	93.47
	1125A_3H-6_57-59_6	4.06	3.07	1.75	70.76	0.20	0.14	1.26	0.03	12.46	0.02	93.75
	1125A_3H-6_57-59_7	4.21	2.92	1.49	69.35	0.17	0.16	1.24	0.15	12.07	0.00	91.76
	1125A_3H-6_57-59_8	4.17	3.13	1.45	71.32	0.16	0.13	1.08	0.05	12.01	0.00	93.50
	1125A_3H-6_57-59_9	4.31	3.13	1.44	71.54	0.13	0.10	1.05	0.09	12.08	0.02	93.89
	1125A_3H-6_57-59_10	4.34	3.12	1.42	71.90	0.16	0.11	1.07	0.01	12.13	0.01	94.28
	1125A_3H-6_57-59_11	4.27	3.13	1.50	71.29	0.19	0.15	1.06	0.05	12.00	0.03	93.67
	1125A_3H-6_57-59_12	4.25	3.04	1.47	70.58	0.15	0.12	1.06	0.06	12.09	0.01	92.83
	1125A_3H-6_57-59_13	4.30	3.01	1.61	69.45	0.20	0.15	1.24	0.02	12.29	0.00	92.28
	1125A_3H-6_57-59_14	3.70	3.37	1.32	71.52	0.16	0.13	1.10	0.01	11.76	0.04	93.11
	1125A_3H-6_57-59_15	4.03	3.12	1.51	69.67	0.19	0.18	1.28	0.01	12.22	0.01	92.22
	1125A_3H-6_57-59_16	4.31	3.02	1.67	70.68	0.17	0.17	1.26	0.00	12.28	0.01	93.57
	1125A_3H-6_57-59_17	4.08	3.03	1.71	70.50	0.23	0.13	1.22	0.01	12.39	0.02	93.31
	1125A_3H-6_57-59_18	4.09	3.36	1.62	71.52	0.16	0.10	1.02	0.07	11.85	0.06	93.85
	1125A_3H-6_57-59_19	3.89	3.21	1.27	70.60	0.16	0.14	1.04	0.05	11.82	0.00	92.18

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s25	1125A_3H-6_57-59_20	4.26	3.07	1.48	70.98	0.11	0.12	1.04	0.07	11.96	0.02	93.11
	1125A_3H-6_57-59_5	4.26	3.03	1.62	71.72	0.18	0.18	1.31	0.08	13.09	0.02	95.50
	1125A_3H-6_57-59_8	4.17	3.11	1.43	71.35	0.18	0.11	1.18	0.02	12.64	0.01	94.21
	1125A_3H-6_57-59_7	4.47	2.94	1.50	71.51	0.19	0.16	1.33	0.10	12.82	0.02	95.03
	1125A_3H-6_57-59_2	4.07	3.06	1.61	72.38	0.21	0.19	1.26	0.05	12.43	0.03	95.29
	1125A_3H-6_57-59_4	4.23	3.24	1.46	72.68	0.13	0.13	1.08	0.10	12.18	0.01	95.24
	1125A_3H-6_57-59_6	4.18	3.15	1.49	72.01	0.21	0.12	1.19	0.07	12.21	0.02	94.65
	1125A_3H-6_57-59_1	2.52	3.28	1.44	72.57	0.15	0.09	1.07	0.06	12.26	0.03	93.47
	1125A_3H-6_57-59_9	2.11	3.09	1.60	72.81	0.17	0.16	1.21	0.00	12.58	0.05	93.78
	1125A_3H-6_57-59_3	4.18	3.32	1.41	72.74	0.14	0.10	1.06	0.06	12.37	0.02	95.41
	1125A_3H-6_57-59_10	4.05	3.10	1.25	73.09	0.15	0.14	1.04	0.00	12.51	0.00	95.33
	1125A_3H-6_105-107_1	4.51	3.10	1.51	71.57	0.13	0.10	0.93	0.10	12.29	0.01	94.24
	1125A_3H-6_105-107_2	4.63	3.08	1.75	71.02	0.18	0.13	0.95	0.00	12.20	0.00	93.93
	1125A_3H-6_105-107_3	4.25	3.05	1.54	70.88	0.18	0.09	0.99	0.08	12.29	0.01	93.36
	1125A_3H-6_105-107_4	4.30	3.17	1.47	71.56	0.16	0.14	0.95	0.06	12.23	0.02	94.06
	1125A_3H-6_105-107_5	4.57	3.04	1.59	71.17	0.14	0.15	0.96	0.07	12.33	0.00	94.02
	1125A_3H-6_105-107_6	4.35	3.18	1.55	71.10	0.18	0.08	0.98	0.04	12.18	0.02	93.66
	1125A_3H-6_105-107_7	4.50	3.14	1.58	72.16	0.15	0.12	0.96	0.08	12.16	0.01	94.87
	1125A_3H-6_105-107_8	4.47	3.35	1.65	71.93	0.16	0.14	1.01	0.07	12.37	0.02	95.18
	1125A_3H-6_105-107_9	4.49	3.11	1.59	70.93	0.18	0.08	0.97	0.02	12.51	0.04	93.91
	1125A_3H-6_105-107_10	4.24	3.04	1.59	71.25	0.18	0.13	0.95	0.07	12.29	0.00	93.74
s32	1125A_3H-6_105-107_11	4.65	3.21	1.52	71.19	0.15	0.13	0.97	0.04	12.59	0.00	94.45
	1125A_3H-6_105-107_12	4.73	3.15	1.59	72.00	0.20	0.09	1.00	0.06	12.24	0.03	95.09
	1125A_3H-6_105-107_13	4.55	3.17	1.66	71.80	0.15	0.12	0.95	0.06	12.17	0.00	94.63
	1125A_3H-6_105-107_14	4.33	3.02	1.65	71.67	0.14	0.11	0.96	0.03	12.13	0.04	94.07
	1125A_3H-6_105-107_15	4.47	3.15	1.60	71.82	0.16	0.17	0.96	0.13	12.32	0.01	94.79
	1125A_3H-6_105-107_16	4.28	3.27	1.54	71.73	0.17	0.12	0.96	0.09	12.62	0.03	94.81
	1125A_3H-6_105-107_17	4.41	3.17	1.54	71.14	0.15	0.11	0.95	0.05	12.40	0.00	93.92
	1125A_3H-6_105-107_18	4.48	3.12	1.81	71.27	0.18	0.10	0.98	0.03	12.32	0.00	94.29
	1125A_3H-6_105-107_19	4.42	3.09	1.65	70.00	0.14	0.09	0.91	0.07	12.22	0.00	92.59
	1125A_3H-6_105-107_20	4.53	3.22	1.69	71.24	0.14	0.11	0.98	0.06	12.38	0.01	94.35
	1125A_4H-2_52-54_1	3.61	2.95	1.30	72.31	0.18	0.15	1.28	0.05	11.02	0.01	92.86
	1125A_4H-2_52-54_2	3.41	3.17	1.13	73.48	0.18	0.13	1.33	0.08	11.20	0.01	94.10
	1125A_4H-2_52-54_3	3.72	3.14	1.16	72.70	0.15	0.20	1.30	0.04	11.26	0.00	93.66
	1125A_4H-2_52-54_4	3.58	3.17	1.21	72.95	0.19	0.19	1.34	0.00	11.36	0.01	94.00
	1125A_4H-2_52-54_5	3.61	3.11	1.15	72.49	0.13	0.15	1.25	0.06	11.20	0.01	93.17
	1125A_4H-2_52-54_6	3.35	3.07	1.21	73.17	0.16	0.20	1.26	0.03	11.01	0.01	93.47
	1125A_4H-2_52-54_7	3.57	3.21	1.10	73.30	0.15	0.16	1.29	0.08	11.37	0.03	94.27
	1125A_4H-2_52-54_9	3.45	3.23	1.35	72.68	0.14	0.17	1.34	0.03	11.34	0.00	93.73
	1125A_4H-2_52-54_10	3.30	3.13	1.21	72.12	0.16	0.10	1.29	0.05	11.16	0.04	92.55
	1125A_4H-2_52-54_12	3.53	3.23	1.30	71.45	0.14	0.17	1.28	0.02	11.32	0.02	92.46
	1125A_4H-2_52-54_13	3.47	3.17	1.22	72.51	0.14	0.19	1.27	0.10	11.35	0.03	93.45
s35*	1125A_4H-2_52-54_14	3.61	3.04	1.21	70.00	0.17	0.14	1.27	0.05	11.28	0.01	90.77
	1125A_4H-2_52-54_15	3.42	2.99	1.13	74.22	0.16	0.18	1.24	0.02	11.11	0.01	94.48
	1125A_4H-2_52-54_16	3.78	3.07	1.27	72.41	0.19	0.16	1.29	0.02	11.09	0.01	93.29
	1125A_4H-2_52-54_17	3.41	3.11	1.36	71.44	0.17	0.17	1.29	0.00	11.31	0.04	92.29
	1125A_4H-2_52-54_18	3.61	3.17	1.22	72.01	0.15	0.15	1.27	0.04	11.32	0.00	92.93
	1125A_4H-2_52-54_19	3.54	3.11	1.28	72.33	0.14	0.14	1.25	0.06	11.09	0.02	92.96
	1125A_4H-2_52-54_20	3.34	3.09	1.35	72.38	0.17	0.14	1.25	0.00	11.40	0.02	93.14
	1125A_4H-3_31-33_1	4.51	2.82	1.94	71.64	0.15	0.08	0.96	0.04	11.67	0.05	93.86
	1125A_4H-3_31-33_2	4.45	2.97	1.94	71.49	0.18	0.06	1.02	0.14	11.94	0.01	94.21
	1125A_4H-3_31-33_3	4.57	3.14	1.97	71.42	0.17	0.10	1.02	0.07	11.86	0.01	94.33
	1125A_4H-3_31-33_4	4.60	2.89	2.08	70.45	0.14	0.12	1.00	0.10	11.70	0.00	93.08
	1125A_4H-3_31-33_6	4.76	2.98	1.86	70.91	0.17	0.11	1.01	0.09	11.85	0.00	93.74
	1125A_4H-3_31-33_7	4.84	2.95	1.88	70.48	0.14	0.10	1.02	0.05	11.72	0.00	93.18
	1125A_4H-3_31-33_8	3.93	3.41	1.39	72.50	0.10	0.03	0.60	0.06	11.24	0.02	93.28
	1125A_4H-3_31-33_9	4.65	2.96	2.10	69.57	0.15	0.07	1.01	0.06	12.03	0.02	92.62
	1125A_4H-3_31-33_10	4.70	3.11	1.95	70.04	0.15	0.05	0.97	0.08	12.02	0.01	93.09
	1125A_4H-3_31-33_11	4.59	3.05	1.79	70.52	0.16	0.06	1.02	0.06	11.92	0.00	93.17
	1125A_4H-3_31-33_12	4.63	2.98	1.89	71.51	0.17	0.06	0.98	0.08	11.79	0.00	94.09
	1125A_4H-3_31-33_13	4.44	3.01	1.93	70.19	0.16	0.09	0.93	0.06	11.60	0.01	92.41
	1125A_4H-3_31-33_14	4.54	3.07	2.11	70.64	0.18	0.11	0.98	0.04	11.87	0.01	93.56
	1125A_4H-3_31-33_15	4.30	3.43	1.37	72.45	0.11	0.01	0.59	0.06	11.29	0.00	93.60
s35*	1125A_4H-3_31-33_16	4.93	3.11	1.97	71.22	0.16	0.08	0.98	0.05	11.84	0.00	94.34
	1125A_4H-3_31-33_17	4.55	2.87	1.98	69.58	0.14	0.09	0.99	0.10	11.60	0.01	91.91
	1125A_4H-3_31-33_18	4.52	3.01	2.07	70.04	0.17	0.07	0.99	0.07	11.94	0.00	92.88
s35*	1125A_4H-3_31-33_19	4.52	2.89	1.88	69.79	0.16	0.02	0.96	0.11	11.70	0.09	92.13
	1125A_4H-3_31-33_20	4.80	2.94	2.00	69.23	0.20	0.05	0.96	0.02	12.27	0.00	92.47
	1125A_4H-3_73-75_1	4.40	2.29	4.46	67.25	0.68	1.06	3.36	0.12	14.12	0.19	97.94
s35*	1125A_4H-3_73-75_2	4.41	3.01	2.06	72.04	0.13	0.08	1.13	0.04	12.07	0.00	94.97

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s42*	1125A_4H-3_73-75_3	4.37	2.95	1.83	71.01	0.13	0.11	1.14	0.14	11.67	0.01	93.35
	1125A_4H-3_73-75_4	4.38	3.23	1.98	70.50	0.18	0.10	1.01	0.04	11.92	0.01	93.36
	1125A_4H-3_73-75_5	4.25	2.95	1.72	71.29	0.15	0.09	1.23	0.07	11.94	0.02	93.70
	1125A_4H-3_73-75_6	4.43	2.87	1.96	70.67	0.13	0.10	1.23	0.05	12.23	0.01	93.68
	1125A_4H-3_73-75_7	5.14	2.11	4.97	65.19	0.89	1.42	4.30	0.20	14.67	0.26	99.16
	1125A_4H-3_73-75_8	3.83	3.61	1.27	72.21	0.13	0.03	0.90	0.00	11.61	0.00	93.59
	1125A_4H-3_73-75_9	4.44	2.90	2.01	70.94	0.13	0.08	1.23	0.00	12.13	0.04	93.92
	1125A_4H-3_73-75_10	4.38	2.85	2.09	72.21	0.18	0.09	1.21	0.08	12.13	0.06	95.28
	1125A_4H-3_73-75_11	4.50	2.84	1.93	71.94	0.15	0.13	1.30	0.05	12.12	0.02	94.98
	1125A_4H-3_73-75_12	4.50	2.87	1.88	72.21	0.15	0.11	1.22	0.01	11.96	0.06	94.97
	1125A_4H-3_73-75_13	4.30	2.96	2.08	71.37	0.16	0.13	1.24	0.10	12.21	0.01	94.55
	1125A_4H-3_73-75_14	4.75	2.85	2.27	70.43	0.15	0.08	1.24	0.11	12.00	0.06	93.94
	1125A_4H-3_73-75_15	4.78	2.00	5.46	64.23	0.99	1.55	4.40	0.21	14.58	0.35	98.54
	1125A_4H-3_73-75_16	4.11	2.80	1.86	71.79	0.11	0.07	1.20	0.09	11.80	0.01	93.83
	1125A_4H-3_73-75_17	4.01	3.38	1.37	73.28	0.09	0.03	0.91	0.04	11.53	0.01	94.64
	1125A_4H-3_73-75_18	3.97	3.01	2.02	70.71	0.13	0.08	1.29	0.00	12.11	0.01	93.34
	1125A_4H-3_73-75_19	4.72	2.92	2.33	70.60	0.17	0.16	1.42	0.11	12.46	0.04	94.93
	1125A_4H-3_73-75_20	4.79	2.83	1.94	71.80	0.14	0.07	1.28	0.05	12.04	0.04	94.98
	1125A_4H-4_115-117_1	4.69	3.12	2.23	69.66	0.15	0.09	1.04	0.09	12.51	0.03	93.61
	1125A_4H-4_115-117_2	4.72	3.29	1.87	70.81	0.17	0.10	0.95	0.07	12.16	0.00	94.13
	1125A_4H-4_115-117_3	4.31	3.24	2.01	69.92	0.14	0.08	1.10	0.00	12.36	0.01	93.17
	1125A_4H-4_115-117_4	4.14	3.27	1.86	70.24	0.12	0.06	0.95	0.04	12.26	0.01	92.96
	1125A_4H-4_115-117_5	4.54	3.51	1.82	70.79	0.16	0.07	0.94	0.15	12.39	0.00	94.37
	1125A_4H-4_115-117_6	4.25	3.26	1.97	69.47	0.18	0.09	1.04	0.06	12.26	0.02	92.60
	1125A_4H-4_115-117_7	4.50	3.30	2.10	70.35	0.14	0.09	1.02	0.14	12.44	0.03	94.11
	1125A_4H-4_115-117_8	4.14	3.53	2.08	70.56	0.15	0.10	1.05	0.10	12.41	0.03	94.16
	1125A_4H-4_115-117_10	4.56	1.75	2.09	70.81	0.17	0.08	0.63	0.02	12.34	0.05	92.50
	1125A_4H-4_115-117_15	4.47	3.30	1.88	70.51	0.13	0.11	0.95	0.07	12.22	0.01	93.65
	1125A_4H-4_115-117_16	3.88	3.82	1.35	71.92	0.09	0.03	0.66	0.02	11.53	0.01	93.31
	1125A_4H-4_115-117_17	3.74	4.23	1.50	70.43	0.09	0.06	0.79	0.01	11.47	0.02	92.34
	1125A_4H-4_115-117_18	4.77	3.44	2.16	69.83	0.16	0.07	1.00	0.01	12.36	0.02	93.83
	1125A_4H-4_115-117_19	4.87	3.11	2.10	69.08	0.16	0.10	1.03	0.05	12.25	0.00	92.76
	1125A_4H-4_115-117_20	4.18	3.47	1.65	71.14	0.13	0.05	0.84	0.08	11.59	0.01	93.14
	1125A_4H-4_115-117_2	4.19	2.78	1.74	73.09	0.18	0.08	0.73	0.03	12.44	0.04	95.29
	1125A_4H-4_115-117_5	4.56	3.16	2.09	70.75	0.14	0.06	1.05	0.13	12.62	0.03	94.60
	1125A_4H-4_115-117_9	4.82	3.36	2.16	71.44	0.14	0.08	1.08	0.05	12.87	0.00	96.00
	1125A_4H-4_115-117_4	4.37	3.47	1.83	71.55	0.13	0.10	1.04	0.05	12.96	0.00	95.51
	1125A_4H-4_115-117_7	4.50	3.34	1.99	71.19	0.14	0.07	1.05	0.10	12.46	0.00	94.84
	1125A_4H-4_115-117_8	4.37	3.44	1.66	71.81	0.14	0.05	0.96	0.05	12.70	0.00	95.18
	1125A_4H-4_115-117_10	4.41	3.39	1.30	72.45	0.07	0.03	0.93	0.12	12.12	0.00	94.82
	1125A_4H-4_115-117_6	4.75	3.24	1.90	71.48	0.16	0.09	1.10	0.08	12.95	0.03	95.78
	1125A_4H-4_115-117_1	4.12	3.61	1.44	72.98	0.07	0.05	0.68	0.09	12.11	0.00	95.16
u33	1125A_4H-5_120-122_1	4.80	3.08	2.19	68.84	0.19	0.16	1.20	0.05	12.99	0.02	93.53
	1125A_4H-5_120-122_2	4.66	3.18	2.22	68.34	0.19	0.18	1.19	0.04	12.64	0.00	92.64
	1125A_4H-5_120-122_3	4.50	3.25	2.13	68.67	0.22	0.16	1.21	0.06	12.84	0.00	93.05
	1125A_4H-5_120-122_4	4.55	3.22	2.08	68.85	0.21	0.17	1.19	0.09	12.89	0.00	93.25
	1125A_4H-5_120-122_5	4.40	3.55	1.89	69.84	0.15	0.10	0.99	0.10	12.53	0.02	93.57
	1125A_4H-5_120-122_6	4.61	3.18	2.23	68.74	0.20	0.17	1.17	0.09	12.68	0.00	93.07
	1125A_4H-5_120-122_7	4.47	3.28	2.23	68.71	0.21	0.15	1.19	0.02	12.85	0.03	93.14
	1125A_4H-5_120-122_8	4.65	3.26	2.27	69.12	0.19	0.11	1.28	0.09	13.03	0.00	94.01
	1125A_4H-5_120-122_9	4.61	3.26	2.20	68.82	0.15	0.15	1.25	0.10	12.86	0.00	93.40
	1125A_4H-5_120-122_10	4.61	3.22	2.12	68.70	0.19	0.17	1.21	0.09	12.72	0.04	93.07
	1125A_4H-5_120-122_11	4.84	3.28	2.31	69.19	0.20	0.18	1.22	0.09	12.72	0.00	94.02
	1125A_4H-5_120-122_12	4.63	3.18	2.21	68.51	0.20	0.16	1.23	0.11	12.88	0.02	93.13
	1125A_4H-5_120-122_13	4.58	3.37	1.87	68.92	0.20	0.15	1.16	0.11	12.85	0.03	93.24
	1125A_4H-5_120-122_14	4.57	3.16	2.24	68.85	0.21	0.15	1.19	0.05	12.74	0.03	93.18
	1125A_4H-5_120-122_15	4.67	3.22	2.01	69.09	0.23	0.18	1.22	0.06	12.70	0.02	93.39
	1125A_4H-5_120-122_16	4.57	3.10	2.14	68.76	0.18	0.18	1.23	0.04	12.96	0.02	93.18
	1125A_4H-5_120-122_17	4.00	4.28	1.37	71.11	0.07	0.03	0.61	0.10	11.62	0.03	93.23
	1125A_4H-5_120-122_18	4.31	3.22	2.18	67.76	0.20	0.15	1.21	0.04	12.75	0.03	91.85
	1125A_4H-5_120-122_19	4.67	3.22	2.14	68.64	0.17	0.19	1.19	0.11	12.76	0.01	93.10
	1125A_4H-5_120-122_20	4.30	3.17	2.10	67.78	0.21	0.13	1.23	0.08	12.64	0.02	91.66
s84*	1125A_5H-3_13-15_	4.10	2.82	1.52	72.22	0.16	0.21	1.50	0.05	12.02	0.00	94.60
	1125A_5H-3_13-15_	4.20	2.88	1.56	72.41	0.18	0.18	1.53	0.09	12.00	0.02	95.06
	1125A_5H-3_13-15_3	3.86	3.66	1.00	73.19	0.08	0.11	0.94	0.06	11.76	0.00	94.65
	1125A_5H-3_13-15_4	3.94	2.86	1.58	71.97	0.20	0.20	1.52	0.12	12.00	0.03	94.42
	1125A_5H-3_13-15_5	4.13	3.08	1.14	74.11	0.10	0.12	1.05	0.04	11.19	0.01	94.97
	1125A_5H-3_13-15_6	3.50	3.53	1.12	73.37	0.11	0.09	1.12	0.06	11.45	0.00	94.35
	1125A_5H-3_13-15_7	4.02	2.88	1.41	72.11	0.17	0.22	1.42	0.08	12.09	0.00	94.40
	1125A_5H-3_13-15_8	3.73	3.72	1.01	73.80	0.08	0.10	0.99	0.02	11.29	0.02	94.77

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s89*	1125A_5H-3_13-15_9	3.65	3.77	1.07	74.01	0.04	0.10	0.93	0.06	11.53	0.03	95.18
	1125A_5H-3_13-15_10	3.94	3.49	1.02	73.63	0.10	0.09	0.94	0.00	11.43	0.02	94.66
	1125A_5H-3_13-15_11	3.62	3.25	1.15	73.54	0.11	0.12	1.02	0.07	11.36	0.00	94.23
	1125A_5H-3_13-15_12	3.97	2.93	1.32	72.69	0.19	0.22	1.48	0.00	12.16	0.01	94.97
	1125A_5H-3_13-15_13	3.85	2.92	1.53	71.20	0.16	0.19	1.50	0.12	11.90	0.04	93.40
	1125A_5H-3_13-15_14	3.71	3.63	0.92	73.23	0.10	0.08	0.89	0.08	11.58	0.00	94.21
	1125A_5H-3_13-15_15	4.03	2.86	1.53	71.62	0.16	0.18	1.45	0.03	11.96	0.03	93.86
	1125A_5H-3_13-15_16	3.66	3.17	1.92	69.47	0.24	0.42	1.65	0.02	12.64	0.02	93.22
	1125A_5H-3_13-15_17	3.89	2.78	1.39	71.19	0.14	0.18	1.48	0.03	12.30	0.03	93.41
	1125A_5H-3_13-15_18	3.99	2.70	1.44	70.58	0.17	0.18	1.43	0.00	12.33	0.01	92.83
	1125A_5H-3_13-15_19	3.85	2.95	1.21	72.80	0.11	0.11	1.09	0.01	11.79	0.04	93.98
	1125A_5H-3_13-15_20	3.91	2.82	1.53	70.65	0.18	0.20	1.56	0.02	12.28	0.00	93.16
	1125A_5H-6_36-38_1	4.17	3.27	1.59	72.31	0.14	0.09	1.00	0.04	11.44	0.00	94.04
	1125A_5H-6_36-38_2	4.01	3.28	1.38	73.00	0.10	0.05	0.91	0.00	11.25	0.01	93.99
	1125A_5H-6_36-38_3	3.87	3.30	1.38	72.76	0.13	0.06	1.03	0.00	11.66	0.04	94.22
	1125A_5H-6_36-38_4	3.93	3.25	1.64	72.34	0.12	0.07	1.04	0.03	11.59	0.00	94.01
	1125A_5H-6_36-38_5	4.42	2.75	1.70	72.29	0.18	0.22	1.43	0.05	12.16	0.03	95.22
	1125A_5H-6_36-38_6	4.19	3.15	1.82	71.70	0.13	0.09	1.20	0.06	11.89	0.04	94.28
	1125A_5H-6_36-38_7	3.68	3.49	1.23	72.19	0.10	0.06	0.89	0.00	11.45	0.01	93.10
	1125A_5H-6_36-38_8	3.96	3.12	1.52	71.07	0.14	0.14	1.22	0.06	12.03	0.01	93.26
	1125A_5H-6_36-38_9	4.32	3.10	1.56	70.70	0.14	0.10	1.19	0.03	11.61	0.02	92.77
s90	1125A_5H-6_36-38_10	4.16	3.08	1.64	71.44	0.16	0.10	1.20	0.05	11.89	0.03	93.74
	1125A_5H-6_36-38_11	3.90	3.38	1.45	72.79	0.11	0.08	0.91	0.03	11.44	0.04	94.13
	1125A_5H-6_36-38_18	3.83	2.30	1.32	71.00	0.12	0.08	0.62	0.00	11.31	0.03	90.61
	1125A_5H-6_36-38_19	3.88	3.42	1.51	71.00	0.12	0.05	0.96	0.00	11.53	0.03	92.50
	1125A_5H-6_36-38_20	4.11	3.34	1.69	70.24	0.15	0.06	1.03	0.08	11.82	0.00	92.51
	1125A_5H-6_36-38_1	4.24	3.19	1.61	72.93	0.11	0.09	1.05	0.04	12.45	0.00	95.71
	1125A_5H-6_36-38_2	4.11	3.28	1.45	72.07	0.12	0.09	1.00	0.06	11.99	0.05	94.22
	1125A_5H-6_36-38_7	4.43	3.23	1.66	72.62	0.15	0.13	1.18	0.01	12.94	0.02	96.38
	1125A_5H-6_36-38_8	4.06	3.20	1.68	71.58	0.11	0.13	1.21	0.04	12.27	0.00	94.27
	1125A_5H-6_36-38_9	4.07	3.20	1.67	71.23	0.13	0.11	1.20	0.08	12.91	0.00	94.60
	1125A_5H-6_36-38_3	4.08	3.36	1.28	71.98	0.08	0.10	1.02	0.13	12.07	0.02	94.11
	1125A_5H-6_36-38_4	4.07	3.47	1.36	72.89	0.14	0.11	1.04	0.06	12.21	0.00	95.34
	1125A_5H-6_36-38_5	4.00	3.58	1.23	73.94	0.07	0.07	0.97	0.14	11.78	0.00	95.78
	1125A_5H-6_36-38_6	4.17	3.27	1.58	72.43	0.15	0.08	1.18	0.00	12.46	0.00	95.33
	1125A_5H-6_36-38_10	4.37	3.14	1.54	72.72	0.14	0.08	1.25	0.06	12.25	0.02	95.57
	1125A_5H-6_65-67_1	3.96	3.09	1.68	71.43	0.16	0.18	1.31	0.06	12.44	0.02	94.32
	1125A_5H-6_65-67_2	4.10	3.18	1.55	71.64	0.15	0.16	1.33	0.05	12.45	0.03	94.63
	1125A_5H-6_65-67_15	4.04	3.08	1.54	71.90	0.17	0.19	1.31	0.06	12.36	0.02	94.68
	1125A_5H-6_65-67_17	4.24	3.13	1.76	71.32	0.21	0.23	1.33	0.03	12.30	0.01	94.55
	1125A_5H-6_65-67_18	4.21	3.05	1.55	71.57	0.16	0.19	1.29	0.06	12.37	0.01	94.45
s91	1125A_5H-6_65-67_19	3.92	3.18	1.56	71.86	0.16	0.21	1.35	0.04	12.56	0.01	94.85
	1125A_5H-6_65-67_20	3.94	3.12	1.46	70.94	0.15	0.20	1.34	0.07	12.35	0.00	93.57
	1125A_5H-6_65-67_1	4.17	3.09	1.44	70.84	0.12	0.18	1.33	0.06	13.19	0.02	94.43
	1125A_5H-6_65-67_3	4.26	3.10	1.45	71.75	0.15	0.22	1.32	0.06	12.60	0.03	94.94
	1125A_5H-6_65-67_4	4.05	3.11	1.53	70.60	0.18	0.18	1.31	0.05	12.36	0.01	93.38
	1125A_5H-6_65-67_6	4.29	3.15	1.64	71.85	0.16	0.18	1.36	0.02	13.12	0.03	95.80
	1125A_5H-6_65-67_8	4.03	3.10	1.64	71.33	0.15	0.20	1.35	0.07	13.04	0.04	94.95
	1125A_5H-6_65-67_2	4.01	3.12	1.34	72.60	0.16	0.22	1.38	0.09	13.10	0.00	96.03
	1125A_5H-6_65-67_5	4.23	2.98	1.51	71.30	0.17	0.16	1.31	0.00	12.90	0.04	94.60
	1125A_5H-6_65-67_9	4.03	3.04	1.44	71.47	0.14	0.22	1.29	0.09	12.97	0.05	94.72
	1125A_5H-6_65-67_10	4.03	3.08	1.50	71.72	0.15	0.17	1.33	0.04	12.73	0.01	94.76
	1125A_5H-6_65-67_7	3.82	3.04	1.75	70.98	0.23	0.22	1.46	0.03	12.71	0.02	94.25
	1125A_6H-1_23-25_1	3.58	2.89	1.44	73.25	0.25	0.24	1.48	0.02	11.37	0.03	94.55
	1125A_6H-1_23-25_2	3.42	3.65	1.08	73.51	0.09	0.07	1.03	0.02	11.44	0.03	94.34
	1125A_6H-1_23-25_3	3.52	2.94	1.62	73.55	0.23	0.21	1.47	0.00	11.51	0.00	95.06
	1125A_6H-1_23-25_4	3.33	2.96	1.41	72.01	0.23	0.19	1.45	0.05	11.06	0.00	92.69
	1125A_6H-1_23-25_5	3.85	2.66	1.49	72.20	0.24	0.26	1.42	0.00	11.18	0.00	93.30
	1125A_6H-1_23-25_6	3.67	2.99	1.36	73.56	0.22	0.22	1.47	0.00	11.39	0.01	94.89
	1125A_6H-1_23-25_7	2.70	2.95	1.45	73.73	0.24	0.21	1.45	0.00	11.32	0.04	94.09
	1125A_6H-1_23-25_8	3.42	2.80	1.46	71.94	0.23	0.28	1.41	0.02	11.03	0.00	92.60
	1125A_6H-1_23-25_9	3.50	2.81	1.47	72.74	0.19	0.21	1.45	0.05	11.18	0.01	93.61
	1125A_6H-1_23-25_10	3.76	2.91	1.41	72.67	0.17	0.23	1.43	0.06	11.26	0.00	93.91
	1125A_6H-1_23-25_11	3.50	2.94	1.51	72.51	0.24	0.26	1.48	0.02	11.25	0.02	93.72
	1125A_6H-1_23-25_12	3.90	3.61	0.96	73.36	0.07	0.06	0.88	0.05	11.39	0.04	94.32
	1125A_6H-1_23-25_13	3.54	2.89	1.34	72.39	0.21	0.18	1.46	0.03	11.23	0.02	93.30
	1125A_6H-1_23-25_14	3.65	3.03	1.46	73.18	0.22	0.19	1.45	0.00	11.18	0.03	94.40
	1125A_6H-1_23-25_15	3.80	2.84	1.30	73.01	0.23	0.20	1.44	0.08	11.01	0.00	93.91
	1125A_6H-1_23-25_16	3.52	2.80	1.45	71.72	0.23	0.23	1.43	0.08	11.10	0.04	92.60
	1125A_6H-1_23-25_17	3.58	2.96	1.44	73.11	0.23	0.17	1.39	0.02	11.26	0.03	94.19

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s97*	1125A_6H-1_23-25_18	3.45	2.96	1.49	71.65	0.24	0.23	1.44	0.07	11.00	0.04	92.56
	1125A_6H-1_23-25_19	3.57	3.02	1.39	73.76	0.21	0.24	1.47	0.07	11.29	0.02	95.04
	1125A_6H-1_23-25_20	3.53	2.94	1.47	73.53	0.24	0.22	1.46	0.10	11.34	0.00	94.83
	1125A_6H-5_71-73_1	4.14	2.74	1.56	70.91	0.18	0.16	1.25	0.06	12.01	0.00	93.01
	1125A_6H-5_71-73_2	4.19	2.94	1.26	72.63	0.15	0.16	1.14	0.02	11.79	0.00	94.29
	1125A_6H-5_71-73_3	4.15	2.71	1.31	71.51	0.16	0.22	1.33	0.02	12.23	0.00	93.65
	1125A_6H-5_71-73_4	4.05	2.81	1.33	72.06	0.14	0.14	1.18	0.05	11.82	0.03	93.61
	1125A_6H-5_71-73_5	3.93	2.92	1.11	72.08	0.15	0.12	1.11	0.04	11.58	0.02	93.05
	1125A_6H-5_71-73_6	3.56	3.66	1.12	72.75	0.08	0.10	0.96	0.08	11.79	0.02	94.12
	1125A_6H-5_71-73_7	3.97	2.91	1.10	71.77	0.15	0.18	1.16	0.04	11.82	0.02	93.10
	1125A_6H-5_71-73_8	3.63	3.68	1.05	71.80	0.08	0.07	0.98	0.02	11.69	0.00	93.00
	1125A_6H-5_71-73_9	4.19	2.76	1.47	70.84	0.19	0.20	1.44	0.09	12.40	0.03	93.61
	1125A_6H-5_71-73_10	3.94	2.88	1.16	71.81	0.14	0.13	1.10	0.06	11.67	0.00	92.89
	1125A_6H-5_71-73_11	4.11	2.81	1.38	71.70	0.17	0.18	1.26	0.04	12.18	0.01	93.85
	1125A_6H-5_71-73_12	4.09	2.78	1.23	72.24	0.17	0.15	1.16	0.03	11.64	0.03	93.52
	1125A_6H-5_71-73_13	3.80	2.92	1.07	71.27	0.10	0.13	1.04	0.02	11.35	0.00	91.70
	1125A_6H-5_71-73_14	4.15	2.85	1.41	70.84	0.17	0.19	1.36	0.06	11.90	0.04	92.97
	1125A_6H-5_71-73_15	4.07	2.84	1.25	71.79	0.15	0.17	1.21	0.09	11.76	0.02	93.35
	1125A_6H-5_71-73_16	4.24	2.81	1.24	70.44	0.16	0.21	1.41	0.07	12.10	0.00	92.68
	1125A_6H-5_71-73_17	4.16	2.70	1.15	71.10	0.15	0.19	1.19	0.07	11.59	0.02	92.32
s98	1125A_6H-5_71-73_18	3.87	2.84	1.04	72.09	0.15	0.16	1.15	0.08	11.93	0.00	93.32
	1125A_6H-5_71-73_19	4.08	2.73	1.36	70.99	0.19	0.21	1.34	0.06	12.25	0.01	93.22
	1125A_6H-5_71-73_20	4.25	2.90	1.22	72.04	0.16	0.13	1.22	0.04	11.90	0.01	93.86
	1125A_7H-1_138-140_1	3.83	3.44	1.18	72.52	0.08	0.07	0.80	0.00	11.83	0.00	93.75
	1125A_7H-1_138-140_2	3.81	3.56	1.02	72.52	0.07	0.06	0.79	0.07	11.55	0.00	93.45
	1125A_7H-1_138-140_3	3.72	3.53	1.14	71.84	0.09	0.03	0.78	0.00	11.79	0.01	92.92
	1125A_7H-1_138-140_4	3.83	3.70	1.06	72.69	0.06	0.03	0.75	0.00	11.73	0.01	93.87
	1125A_7H-1_138-140_5	4.10	3.46	1.06	72.21	0.06	0.02	0.73	0.00	11.36	0.02	93.01
	1125A_7H-1_138-140_6	3.73	3.59	1.06	73.25	0.06	0.01	0.78	0.13	11.88	0.02	94.51
	1125A_7H-1_138-140_7	3.51	3.60	1.03	72.18	0.04	0.04	0.75	0.04	11.53	0.00	92.71
	1125A_7H-1_138-140_8	3.65	3.50	1.14	71.61	0.09	0.03	0.74	0.03	11.45	0.00	92.25
	1125A_7H-1_138-140_9	3.91	3.59	1.34	71.83	0.07	0.05	0.83	0.06	11.48	0.00	93.16
	1125A_7H-1_138-140_12	3.66	3.46	1.22	70.78	0.10	0.01	0.92	0.09	11.88	0.00	92.11
	1125A_7H-1_138-140_13	3.74	3.66	0.92	71.85	0.06	0.03	0.81	0.04	11.54	0.02	92.65
	1125A_7H-1_138-140_14	3.86	3.55	1.05	72.46	0.07	0.05	0.77	0.06	11.56	0.01	93.45
	1125A_7H-1_138-140_16	3.64	3.44	0.98	71.85	0.07	0.06	0.93	0.06	11.77	0.01	92.81
	1125A_7H-1_138-140_17	3.73	3.60	1.10	71.52	0.07	0.03	0.77	0.03	11.47	0.00	92.32
	1125A_7H-1_138-140_18	3.94	3.76	1.07	72.75	0.05	0.03	0.77	0.09	11.61	0.02	94.09
	1125A_7H-1_138-140_19	3.88	3.51	1.27	71.86	0.08	0.06	0.92	0.01	11.91	0.00	93.49
	1125A_7H-1_138-140_20	3.64	3.59	0.99	72.48	0.06	0.04	0.75	0.05	11.36	0.00	92.96
u1	1125B_1H-2_147-149_1	3.99	3.43	1.09	75.23	0.09	0.09	0.82	0.01	11.28	0.00	96.04
	1125B_1H-2_147-149_2	4.13	2.70	1.16	74.43	0.11	0.07	1.26	0.13	11.51	0.03	95.52
	1125B_1H-2_147-149_3	4.18	3.44	0.84	74.82	0.09	0.10	0.79	0.05	11.44	0.00	95.76
	1125B_1H-2_147-149_4	3.79	3.19	1.11	74.03	0.08	0.06	0.80	0.00	11.49	0.02	94.56
	1125B_1H-2_147-149_5	3.90	3.18	0.93	73.57	0.07	0.07	0.78	0.02	11.37	0.02	93.91
	1125B_1H-2_147-149_6	4.03	3.36	1.07	75.32	0.16	0.12	0.92	0.05	11.60	0.00	96.63
	1125B_1H-2_147-149_7	4.15	3.17	1.01	74.42	0.07	0.07	0.77	0.02	11.52	0.03	95.24
	1125B_1H-2_147-149_8	3.64	3.30	0.92	74.83	0.12	0.08	0.79	0.00	11.40	0.00	95.09
	1125B_1H-2_147-149_9	3.91	3.31	1.08	74.26	0.10	0.07	0.82	0.09	11.50	0.00	95.15
	1125B_1H-2_147-149_10	3.73	3.32	1.08	74.42	0.09	0.06	0.79	0.03	11.33	0.04	94.89
	1125B_1H-2_147-149_11	4.00	3.28	0.97	74.75	0.10	0.06	0.80	0.00	11.45	0.00	95.41
	1125B_1H-2_147-149_12	3.78	3.48	1.00	75.47	0.11	0.04	0.82	0.00	11.73	0.03	96.46
	1125B_1H-2_147-149_13	3.70	3.50	0.97	74.04	0.10	0.07	0.84	0.10	11.38	0.02	94.73
	1125B_1H-2_147-149_14	4.10	3.28	0.91	74.24	0.07	0.08	0.79	0.05	11.67	0.00	95.20
	1125B_1H-2_147-149_15	4.19	3.13	0.91	74.08	0.10	0.03	0.81	0.04	11.27	0.00	94.56
	1125B_1H-2_147-149_16	4.00	3.16	0.94	74.53	0.07	0.08	0.80	0.09	11.41	0.02	95.10
	1125B_1H-2_147-149_17	3.98	3.18	1.23	74.68	0.09	0.07	0.81	0.02	11.38	0.00	95.45
	1125B_1H-2_147-149_18	4.04	3.13	0.99	74.57	0.10	0.08	0.78	0.02	11.61	0.02	95.34
	1125B_1H-2_147-149_19	3.88	3.22	1.07	74.01	0.08	0.09	0.78	0.00	11.39	0.00	94.53
	1125B_1H-2_147-149_20	3.92	3.45	0.97	74.88	0.08	0.07	0.83	0.00	11.49	0.00	95.69
	1125B_1H-2_147-149_1	3.92	3.27	0.89	72.93	0.08	0.06	0.79	0.05	11.11	0.00	93.10
	1125B_1H-2_147-149_3	3.91	3.22	0.99	72.97	0.08	0.07	0.80	0.00	11.46	0.01	93.53
	1125B_1H-2_147-149_4	3.96	3.49	0.91	73.69	0.10	0.07	0.81	0.07	11.34	0.03	94.47
	1125B_1H-2_147-149_6	3.67	3.54	0.88	74.17	0.09	0.12	0.77	0.01	10.98	0.03	94.26
	1125B_1H-2_147-149_9	3.91	3.28	0.89	73.50	0.05	0.07	0.81	0.09	11.39	0.03	94.02
	1125B_1H-2_147-149_2	3.74	3.38	0.86	73.12	0.09	0.09	0.79	0.06	11.16	0.01	93.31
	1125B_1H-2_147-149_5	3.82	3.35	1.02	74.61	0.05	0.07	0.79	0.08	11.44	0.01	95.24
	1125B_1H-2_147-149_7	3.87	3.42	0.98	73.74	0.08	0.06	0.80	0.05	11.32	0.04	94.36
	1125B_1H-2_147-149_8	3.86	3.12	1.02	73.22	0.08	0.11	0.93	0.00	11.15	0.00	93.49
	1125B_1H-2_147-149_10	3.80	3.41	0.98	74.50	0.09	0.06	0.80	0.10	11.67	0.02	95.43

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s19	1125B_2H-3_143-145_1	3.63	3.26	1.07	73.18	0.14	0.12	0.93	0.01	11.47	0.00	93.80
	1125B_2H-3_143-145_2	3.82	3.25	1.00	72.25	0.14	0.11	0.91	0.01	11.66	0.00	93.14
	1125B_2H-3_143-145_3	3.71	3.51	1.03	72.92	0.13	0.10	0.95	0.09	11.50	0.03	93.98
	1125B_2H-3_143-145_4	3.79	3.39	0.99	72.27	0.10	0.12	0.86	0.00	11.50	0.01	93.04
	1125B_2H-3_143-145_5	3.59	3.33	1.12	73.22	0.14	0.12	0.91	0.03	11.50	0.01	93.98
	1125B_2H-3_143-145_6	3.86	3.33	1.11	72.99	0.17	0.14	1.00	0.07	11.63	0.00	94.29
	1125B_2H-3_143-145_7	3.81	3.40	1.06	72.19	0.14	0.11	0.97	0.01	11.30	0.05	93.04
	1125B_2H-3_143-145_8	3.62	3.28	1.03	72.58	0.12	0.16	0.95	0.00	11.31	0.03	93.08
	1125B_2H-3_143-145_9	3.66	3.41	1.12	73.30	0.15	0.12	1.03	0.08	11.45	0.05	94.37
	1125B_2H-3_143-145_10	3.49	3.34	1.18	73.32	0.15	0.13	0.96	0.02	11.79	0.02	94.41
	1125B_2H-3_143-145_11	3.64	3.45	1.12	73.76	0.12	0.12	1.00	0.01	11.49	0.04	94.75
	1125B_2H-3_143-145_12	3.78	3.25	1.05	73.31	0.14	0.09	0.91	0.08	11.50	0.00	94.11
	1125B_2H-3_143-145_13	3.82	3.38	1.05	72.76	0.13	0.10	0.95	0.01	11.45	0.01	93.66
	1125B_2H-3_143-145_14	3.77	3.28	1.09	72.92	0.16	0.11	0.97	0.10	11.44	0.04	93.88
	1125B_2H-3_143-145_15	4.03	3.28	1.13	72.00	0.15	0.10	0.93	0.01	11.41	0.00	93.04
	1125B_2H-3_143-145_16	3.73	3.27	1.12	72.26	0.13	0.13	0.94	0.03	11.39	0.05	93.05
	1125B_2H-3_143-145_17	3.63	3.32	1.09	72.70	0.13	0.09	0.94	0.12	11.54	0.04	93.60
	1125B_2H-3_143-145_18	3.66	3.28	0.99	72.95	0.12	0.10	0.92	0.00	11.37	0.07	93.47
	1125B_2H-3_143-145_19	3.84	3.39	1.01	72.49	0.13	0.12	0.96	0.05	11.49	0.00	93.48
	1125B_2H-3_143-145_20	3.82	3.28	0.98	73.35	0.12	0.10	0.95	0.03	11.31	0.01	93.95
	1125B_3H-1_5-7_1	4.03	2.99	1.47	71.78	0.15	0.11	1.02	0.05	11.67	0.02	93.29
	1125B_3H-1_5-7_2	3.43	3.90	1.16	69.64	0.11	0.09	0.84	0.00	11.34	0.00	90.51
	1125B_3H-1_5-7_3	4.12	3.16	1.32	72.77	0.18	0.11	1.06	0.00	11.71	0.00	94.43
	1125B_3H-1_5-7_4	4.12	3.15	1.40	71.99	0.16	0.09	1.07	0.04	11.72	0.00	93.74
	1125B_3H-1_5-7_5	4.30	2.98	1.66	72.03	0.18	0.14	1.25	0.07	12.28	0.00	94.88
	1125B_3H-1_5-7_6	4.42	2.94	1.59	71.30	0.18	0.15	1.28	0.02	12.27	0.00	94.15
	1125B_3H-1_5-7_7	3.89	3.27	1.47	70.12	0.18	0.13	1.12	0.04	11.80	0.00	92.03
	1125B_3H-1_5-7_8	3.95	3.27	1.33	72.46	0.18	0.13	1.06	0.00	11.94	0.00	94.33
	1125B_3H-1_5-7_9	4.14	3.15	1.73	72.21	0.17	0.17	1.19	0.16	12.19	0.00	95.11
	1125B_3H-1_5-7_10	4.20	3.20	1.57	72.38	0.14	0.12	1.06	0.10	11.58	0.00	94.35
	1125B_3H-1_5-7_11	4.10	3.12	1.70	72.12	0.19	0.14	1.18	0.00	12.14	0.01	94.70
	1125B_3H-1_5-7_12	4.04	3.14	1.95	72.68	0.36	0.20	0.78	0.09	11.62	0.07	94.94
	1125B_3H-1_5-7_13	4.08	3.36	1.21	73.93	0.09	0.06	0.82	0.09	11.48	0.00	95.11
	1125B_3H-1_5-7_14	4.23	3.06	1.44	72.26	0.15	0.12	1.04	0.06	11.77	0.00	94.13
	1125B_3H-1_5-7_15	4.57	3.39	1.72	73.10	0.10	0.11	1.08	0.06	12.19	0.00	96.33
	1125B_3H-1_5-7_16	3.98	3.30	1.90	71.83	0.10	0.17	1.20	0.05	12.07	0.00	94.59
	1125B_3H-1_5-7_17	4.27	3.17	1.78	71.74	0.18	0.15	1.24	0.00	12.12	0.06	94.72
	1125B_3H-1_5-7_19	4.50	2.94	1.49	71.97	0.15	0.13	1.22	0.08	12.04	0.00	94.53
	1125B_3H-1_5-7_20	3.94	3.00	1.41	70.45	0.17	0.15	1.03	0.05	11.82	0.02	92.05
s25	1125B_3H-1_32-34_1	4.71	3.08	1.59	71.84	0.14	0.11	0.96	0.02	12.10	0.01	94.57
	1125B_3H-1_32-34_2	4.43	3.25	1.68	71.76	0.15	0.13	0.97	0.06	12.00	0.05	94.48
	1125B_3H-1_32-34_3	4.40	3.21	1.70	72.55	0.17	0.09	1.02	0.00	11.93	0.00	95.07
	1125B_3H-1_32-34_4	4.40	3.01	1.73	71.69	0.18	0.14	1.00	0.07	11.92	0.02	94.17
	1125B_3H-1_32-34_5	4.64	3.09	1.83	72.63	0.17	0.10	0.96	0.03	11.77	0.02	95.23
	1125B_3H-1_32-34_6	4.42	3.05	1.65	71.77	0.14	0.09	0.95	0.03	12.03	0.03	94.16
	1125B_3H-1_32-34_7	4.33	3.14	1.59	72.17	0.14	0.14	0.96	0.09	11.94	0.01	94.52
	1125B_3H-1_32-34_8	4.60	3.15	1.65	71.73	0.16	0.12	0.99	0.07	11.88	0.00	94.36
	1125B_3H-1_32-34_9	4.30	3.19	1.65	72.27	0.16	0.09	0.99	0.12	12.10	0.00	94.88
	1125B_3H-1_32-34_10	4.27	3.33	1.57	71.20	0.14	0.11	1.02	0.06	12.05	0.01	93.77
	1125B_3H-1_32-34_11	4.40	3.08	1.45	71.85	0.18	0.10	0.95	0.08	11.83	0.02	93.94
	1125B_3H-1_32-34_12	4.36	2.94	1.60	71.90	0.17	0.12	0.90	0.00	12.02	0.00	94.01
	1125B_3H-1_32-34_13	4.67	3.14	1.65	72.02	0.16	0.09	0.99	0.03	12.12	0.03	94.90
	1125B_3H-1_32-34_14	4.16	3.12	1.61	71.50	0.17	0.12	0.97	0.06	12.01	0.00	93.72
	1125B_3H-1_32-34_15	4.52	3.13	1.68	71.81	0.17	0.13	1.01	0.07	11.90	0.05	94.47
	1125B_3H-1_32-34_16	4.72	3.00	1.66	71.85	0.13	0.14	0.98	0.05	12.02	0.02	94.57
	1125B_3H-1_32-34_17	4.54	3.16	1.68	72.20	0.16	0.11	0.99	0.01	11.85	0.02	94.73
	1125B_3H-1_32-34_18	4.44	3.00	1.58	71.57	0.18	0.11	0.98	0.08	12.02	0.01	93.97
	1125B_3H-1_32-34_19	4.14	3.40	1.47	72.39	0.13	0.09	0.91	0.05	12.04	0.05	94.67
	1125B_3H-1_32-34_20	4.42	3.06	1.65	71.86	0.17	0.10	0.98	0.11	11.95	0.03	94.33
s27	1125B_3H-3_26-28_1	3.90	3.41	1.25	73.18	0.09	0.09	0.99	0.05	11.83	0.03	94.82
	1125B_3H-3_26-28_2	4.01	3.19	1.17	72.77	0.11	0.07	0.92	0.11	11.55	0.03	93.94
	1125B_3H-3_26-28_3	3.72	3.64	1.07	74.71	0.08	0.08	0.76	0.01	12.00	0.00	96.06
	1125B_3H-3_26-28_4	4.21	3.01	1.23	73.86	0.12	0.08	1.04	0.05	11.86	0.03	95.50
	1125B_3H-3_26-28_5	4.01	3.32	1.18	73.58	0.11	0.05	0.92	0.01	11.77	0.01	94.96
	1125B_3H-3_26-28_6	4.25	3.22	1.31	73.04	0.13	0.11	1.08	0.00	12.47	0.01	95.62
	1125B_3H-3_26-28_7	3.67	4.06	0.94	73.91	0.09	0.06	0.69	0.05	11.86	0.03	95.37
	1125B_3H-3_26-28_8	3.90	3.67	1.12	74.03	0.10	0.06	0.72	0.00	11.81	0.00	95.41
	1125B_3H-3_26-28_9	4.31	3.26	1.18	73.92	0.13	0.12	0.95	0.02	11.85	0.02	95.76
	1125B_3H-3_26-28_10	3.54	3.50	1.31	74.20	0.12	0.08	0.96	0.03	11.86	0.00	95.61
	1125B_3H-3_26-28_11	3.65	4.05	1.08	74.18	0.11	0.10	0.84	0.09	12.04	0.00	96.14

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s32	1125B_3H-3_26-28_12	3.80	3.36	1.12	74.16	0.13	0.12	0.94	0.05	11.89	0.04	95.62
	1125B_3H-3_26-28_13	3.97	3.09	1.16	72.71	0.11	0.13	1.02	0.04	11.75	0.03	94.02
	1125B_3H-3_26-28_14	4.01	3.53	1.27	74.66	0.12	0.12	0.93	0.07	11.99	0.02	96.72
	1125B_3H-3_26-28_15	3.97	3.45	1.04	74.04	0.12	0.08	0.73	0.03	11.85	0.02	95.32
	1125B_3H-3_26-28_16	3.75	3.26	1.14	72.89	0.14	0.10	0.90	0.05	11.53	0.00	93.75
	1125B_3H-3_26-28_17	4.13	3.61	1.08	73.45	0.04	0.05	0.69	0.07	11.62	0.00	94.74
	1125B_3H-3_26-28_19	3.92	3.71	0.94	73.42	0.06	0.06	0.72	0.00	11.73	0.00	94.56
	1125B_3H-3_26-28_20	3.85	3.23	1.07	73.23	0.13	0.10	0.90	0.05	11.74	0.00	94.30
	1125B_3H-3_26-28_2	4.13	3.78	0.91	74.04	0.10	0.04	0.74	0.04	12.04	0.01	95.82
	1125B_3H-3_26-28_6	3.89	3.27	1.17	73.66	0.13	0.10	0.93	0.00	11.38	0.00	94.53
	1125B_3H-3_26-28_8	4.04	3.68	0.93	74.11	0.08	0.07	0.74	0.09	11.94	0.02	95.69
	1125B_3H-3_26-28_10	3.90	3.71	0.98	73.84	0.09	0.06	0.74	0.05	11.89	0.03	95.29
	1125B_3H-3_26-28_5	4.09	3.38	1.07	73.51	0.14	0.11	1.03	0.08	12.21	0.02	95.65
	1125B_3H-3_26-28_1	3.89	3.70	0.80	73.97	0.08	0.09	0.77	0.00	11.56	0.03	94.90
	1125B_3H-3_26-28_3	4.04	3.60	1.02	74.35	0.08	0.09	0.81	0.03	11.51	0.03	95.56
	1125B_3H-3_26-28_4	3.87	3.65	0.89	74.05	0.10	0.07	0.77	0.06	11.82	0.01	95.29
	1125B_3H-3_26-28_7	4.05	3.88	1.23	74.01	0.07	0.08	0.68	0.12	11.89	0.00	96.01
	1125B_3H-3_26-28_9	3.86	3.41	1.19	73.86	0.14	0.08	0.93	0.00	11.58	0.01	95.07
	1125B_3H-5_32-34_1	3.72	3.08	1.13	72.91	0.14	0.14	1.27	0.11	11.58	0.00	94.07
	1125B_3H-5_32-34_2	3.51	3.02	1.19	72.96	0.17	0.16	1.30	0.00	11.39	0.01	93.71
	1125B_3H-5_32-34_3	3.42	3.15	1.30	72.57	0.13	0.18	1.32	0.08	11.34	0.00	93.50
	1125B_3H-5_32-34_4	3.23	3.13	1.14	72.84	0.17	0.20	1.25	0.06	11.65	0.00	93.67
	1125B_3H-5_32-34_5	3.34	3.18	1.15	72.67	0.19	0.16	1.31	0.04	11.57	0.02	93.63
	1125B_3H-5_32-34_6	3.56	2.95	1.32	72.27	0.11	0.13	1.28	0.02	11.39	0.04	93.07
	1125B_3H-5_32-34_7	3.53	3.05	1.16	71.59	0.17	0.13	1.27	0.03	11.49	0.00	92.43
	1125B_3H-5_32-34_8	3.10	3.95	0.90	72.03	0.11	0.09	1.01	0.01	11.43	0.05	92.68
	1125B_3H-5_32-34_9	3.28	3.17	1.09	73.19	0.15	0.12	1.26	0.01	11.46	0.05	93.79
	1125B_3H-5_32-34_10	3.53	3.12	1.23	72.53	0.15	0.17	1.34	0.00	11.34	0.01	93.42
	1125B_3H-5_32-34_11	3.51	2.99	1.13	73.13	0.17	0.19	1.33	0.06	11.48	0.02	94.02
	1125B_3H-5_32-34_12	3.38	3.10	1.24	71.83	0.17	0.17	1.32	0.02	11.36	0.01	92.59
	1125B_3H-5_32-34_13	3.64	3.07	1.13	72.65	0.15	0.17	1.31	0.04	11.29	0.03	93.48
	1125B_3H-5_32-34_14	3.52	3.14	1.25	72.63	0.14	0.15	1.41	0.00	11.43	0.03	93.70
	1125B_3H-5_32-34_15	3.99	3.35	1.14	72.31	0.05	0.03	0.64	0.02	11.32	0.01	92.86
	1125B_3H-5_32-34_16	3.53	3.18	1.18	73.42	0.17	0.13	1.30	0.02	11.48	0.00	94.40
	1125B_3H-5_32-34_18	3.61	3.14	1.30	72.50	0.14	0.16	1.30	0.12	11.40	0.00	93.67
	1125B_3H-5_32-34_19	3.41	3.28	1.35	72.64	0.16	0.17	1.36	0.00	11.41	0.02	93.81
	1125B_3H-5_32-34_20	3.70	3.20	1.25	72.94	0.19	0.16	1.29	0.08	11.70	0.01	94.52
	1125B_3H-5_86-88_1	3.37	3.20	1.25	74.11	0.13	0.17	1.33	0.00	11.21	0.04	94.82
	1125B_3H-5_86-88_2	3.50	3.18	1.28	73.64	0.18	0.20	1.31	0.00	11.37	0.02	94.67
	1125B_3H-5_86-88_3	3.43	3.13	1.19	73.85	0.18	0.15	1.35	0.05	11.10	0.01	94.44
	1125B_3H-5_86-88_4	3.48	3.14	1.19	72.74	0.17	0.12	1.29	0.05	11.10	0.00	93.27
	1125B_3H-5_86-88_5	3.39	3.15	1.22	73.76	0.18	0.13	1.34	0.00	11.43	0.04	94.64
	1125B_3H-5_86-88_6	3.51	3.23	1.18	74.23	0.20	0.20	1.32	0.01	11.28	0.00	95.16
	1125B_3H-5_86-88_7	3.41	3.15	1.19	73.93	0.18	0.15	1.34	0.00	11.20	0.04	94.59
	1125B_3H-5_86-88_8	3.41	3.20	1.29	73.44	0.16	0.17	1.29	0.00	11.29	0.04	94.28
	1125B_3H-5_86-88_9	3.36	3.04	1.22	73.86	0.18	0.17	1.26	0.02	11.44	0.02	94.57
	1125B_3H-5_86-88_10	3.41	3.04	1.11	73.38	0.17	0.17	1.26	0.00	11.06	0.04	93.63
	1125B_3H-5_86-88_11	3.33	3.10	1.17	72.69	0.14	0.13	1.32	0.02	11.02	0.01	92.93
	1125B_3H-5_86-88_12	3.80	3.28	1.19	74.47	0.17	0.13	1.32	0.02	11.62	0.00	95.99
	1125B_3H-5_86-88_13	3.40	3.17	1.30	73.59	0.16	0.14	1.30	0.00	11.28	0.04	94.37
	1125B_3H-5_86-88_14	3.70	2.97	1.28	73.69	0.17	0.15	1.29	0.00	11.25	0.01	94.51
	1125B_3H-5_86-88_15	3.31	3.18	1.20	73.37	0.18	0.17	1.26	0.00	11.19	0.01	93.88
	1125B_3H-5_86-88_16	3.64	3.16	1.09	74.46	0.18	0.17	1.27	0.02	11.23	0.04	95.25
	1125B_3H-5_86-88_17	3.46	3.19	1.12	74.34	0.16	0.21	1.26	0.01	11.08	0.00	94.82
	1125B_3H-5_86-88_18	3.46	3.07	1.14	73.10	0.13	0.16	1.29	0.06	10.92	0.00	93.33
	1125B_3H-5_86-88_19	3.47	3.23	1.24	73.65	0.18	0.15	1.30	0.00	11.32	0.00	94.54
	1125B_3H-5_86-88_20	3.34	3.02	1.30	73.34	0.16	0.15	1.24	0.00	11.02	0.00	93.56
u29*	1125B_3H-6_43-45_1	4.63	2.99	1.94	71.83	0.16	0.11	1.03	0.14	12.02	0.03	94.88
	1125B_3H-6_43-45_2	4.61	2.94	1.79	71.92	0.14	0.06	0.97	0.12	11.86	0.00	94.42
	1125B_3H-6_43-45_3	4.48	3.00	1.93	72.55	0.16	0.06	0.98	0.07	11.81	0.04	95.08
	1125B_3H-6_43-45_4	4.34	3.27	1.37	74.60	0.07	0.00	0.62	0.03	11.16	0.03	95.50
	1125B_3H-6_43-45_5	4.71	2.96	1.85	72.61	0.16	0.09	1.02	0.06	12.00	0.02	95.49
	1125B_3H-6_43-45_6	4.35	3.02	1.87	71.93	0.17	0.10	0.98	0.12	11.89	0.03	94.45
	1125B_3H-6_43-45_7	4.48	3.00	2.09	72.18	0.17	0.10	0.98	0.05	11.84	0.00	94.88
	1125B_3H-6_43-45_8	4.58	2.94	1.93	72.47	0.19	0.05	1.03	0.14	11.91	0.00	95.24
	1125B_3H-6_43-45_9	4.41	2.93	1.96	71.65	0.19	0.09	1.00	0.08	12.09	0.00	94.39
	1125B_3H-6_43-45_10	4.45	3.03	2.03	71.62	0.16	0.07	1.01	0.03	11.76	0.01	94.16
	1125B_3H-6_43-45_11	4.10	3.29	1.31	73.93	0.10	0.05	0.59	0.03	11.06	0.01	94.47
	1125B_3H-6_43-45_12	4.46	3.11	1.93	72.93	0.14	0.04	0.97	0.10	11.84	0.00	95.53
	1125B_3H-6_43-45_13	4.21	3.22	1.40	73.84	0.09	0.04	0.64	0.05	11.01	0.00	94.50

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s37	1125B_3H-6_43-45_14	4.44	2.95	2.11	71.99	0.14	0.08	1.00	0.05	11.87	0.00	94.63
	1125B_3H-6_43-45_15	4.34	3.17	1.57	72.62	0.08	0.04	0.73	0.07	11.23	0.04	93.90
	1125B_3H-6_43-45_16	4.51	3.09	1.95	72.22	0.15	0.08	0.95	0.07	11.90	0.02	94.94
	1125B_3H-6_43-45_17	4.50	2.90	2.06	71.24	0.15	0.15	0.99	0.08	11.85	0.00	93.93
	1125B_3H-6_43-45_18	4.46	2.86	1.84	72.15	0.18	0.08	1.00	0.07	11.88	0.04	94.56
	1125B_3H-6_43-45_19	4.86	3.03	2.04	72.62	0.18	0.07	1.01	0.10	12.15	0.00	96.07
	1125B_3H-6_43-45_20	4.57	2.89	1.98	71.71	0.16	0.08	1.01	0.11	11.86	0.03	94.39
	1125B_4H-1_27-29_1	4.37	3.15	2.04	69.86	0.14	0.10	1.02	0.08	12.36	0.01	93.13
	1125B_4H-1_27-29_2	3.69	3.95	0.82	72.58	0.04	0.00	0.69	0.00	11.51	0.04	93.33
	1125B_4H-1_27-29_3	3.34	4.11	0.90	71.27	0.03	0.02	0.68	0.07	11.79	0.00	92.21
	1125B_4H-1_27-29_4	3.45	4.31	0.81	74.04	0.05	0.04	0.68	0.12	11.55	0.01	95.06
	1125B_4H-1_27-29_5	3.38	4.43	0.74	73.53	0.01	0.03	0.61	0.02	11.44	0.00	94.19
	1125B_4H-1_27-29_6	3.54	4.10	0.87	72.58	0.02	0.01	0.67	0.03	11.63	0.03	93.47
	1125B_4H-1_27-29_7	3.52	4.23	0.88	71.63	0.04	0.03	0.65	0.05	11.85	0.03	92.90
	1125B_4H-1_27-29_8	3.70	4.05	0.83	72.33	0.05	0.02	0.65	0.00	11.48	0.00	93.10
	1125B_4H-1_27-29_9	3.21	4.27	0.80	71.75	0.05	0.02	0.72	0.03	11.55	0.03	92.44
	1125B_4H-1_27-29_10	4.23	3.59	1.90	71.02	0.16	0.10	0.99	0.07	12.13	0.00	94.20
	1125B_4H-1_27-29_11	3.35	4.54	0.84	72.85	0.03	0.03	0.66	0.07	11.62	0.01	94.00
	1125B_4H-1_27-29_12	3.46	3.96	0.82	73.14	0.03	0.03	0.70	0.00	11.49	0.00	93.64
	1125B_4H-1_27-29_13	3.34	4.27	0.88	74.35	0.03	0.02	0.72	0.05	11.71	0.00	95.37
	1125B_4H-1_27-29_14	3.54	4.09	0.86	72.42	0.03	0.04	0.67	0.06	11.52	0.01	93.22
	1125B_4H-1_27-29_15	3.90	3.63	1.28	73.39	0.08	0.07	0.67	0.04	11.31	0.05	94.43
	1125B_4H-1_27-29_16	3.33	4.38	0.89	72.56	0.03	0.06	0.68	0.01	11.56	0.01	93.51
	1125B_4H-1_27-29_17	4.09	3.59	1.52	72.92	0.09	0.06	0.71	0.02	11.45	0.00	94.45
	1125B_4H-1_27-29_18	3.59	3.63	0.83	71.68	0.02	0.00	0.58	0.05	11.53	0.00	91.92
	1125B_4H-1_27-29_20	3.38	4.17	0.78	71.39	0.04	0.04	0.63	0.07	11.56	0.02	92.08
	1125B_4H-1_27-29_1	3.34	4.14	0.64	73.13	0.01	0.02	0.69	0.05	11.42	0.01	93.45
	1125B_4H-1_27-29_2	3.35	4.50	0.93	73.77	0.01	0.03	0.70	0.01	11.93	0.00	95.23
	1125B_4H-1_27-29_3	3.39	4.41	0.80	73.28	0.03	0.05	0.59	0.08	11.88	0.01	94.51
	1125B_4H-1_27-29_8	3.33	4.15	0.69	72.92	0.04	0.03	0.71	0.06	11.51	0.00	93.43
	1125B_4H-1_27-29_10	3.44	4.08	0.75	72.67	0.04	0.01	0.70	0.00	11.55	0.00	93.24
	1125B_4H-1_27-29_4	3.33	4.44	0.73	73.64	0.01	0.02	0.67	0.00	11.57	0.03	94.45
	1125B_4H-1_27-29_5	3.58	4.23	0.64	72.74	0.01	0.05	0.70	0.05	11.56	0.00	93.56
	1125B_4H-1_27-29_6	3.54	4.34	0.76	73.08	0.02	0.03	0.68	0.09	11.78	0.01	94.33
	1125B_4H-1_27-29_7	3.13	4.72	0.80	72.43	0.02	0.04	0.68	0.04	11.44	0.00	93.31
	1125B_4H-1_27-29_9	4.44	3.28	1.72	70.89	0.16	0.07	1.03	0.06	11.96	0.03	93.64
s42*	1125B_4H-1_59-61_1	4.56	3.25	1.91	69.43	0.15	0.05	1.09	0.15	12.38	0.00	92.97
	1125B_4H-1_59-61_2	4.07	3.64	1.39	70.83	0.10	0.05	0.70	0.00	11.89	0.00	92.66
	1125B_4H-1_59-61_3	4.03	3.59	1.45	73.70	0.10	0.05	0.70	0.04	11.51	0.03	95.20
	1125B_4H-1_59-61_4	4.51	3.32	2.02	70.56	0.17	0.04	1.11	0.11	12.48	0.03	94.37
	1125B_4H-1_59-61_5	3.82	3.86	1.50	71.48	0.07	0.03	0.68	0.05	11.67	0.00	93.16
	1125B_4H-1_59-61_6	3.93	3.50	1.35	70.92	0.09	0.03	0.71	0.00	11.40	0.00	91.93
	1125B_4H-1_59-61_7	4.26	3.49	1.99	70.56	0.15	0.05	1.04	0.12	12.43	0.01	94.10
	1125B_4H-1_59-61_8	4.16	3.67	1.40	73.03	0.10	0.07	0.62	0.02	11.65	0.04	94.76
	1125B_4H-1_59-61_9	4.03	3.73	1.39	70.81	0.11	0.05	0.63	0.06	11.61	0.00	92.41
	1125B_4H-1_59-61_10	4.62	3.30	2.14	69.22	0.12	0.06	1.05	0.07	12.26	0.02	92.85
	1125B_4H-1_59-61_11	4.39	3.45	1.39	71.86	0.10	0.06	0.78	0.09	11.49	0.01	93.62
	1125B_4H-1_59-61_12	3.85	3.62	1.49	72.39	0.08	0.04	0.71	0.07	11.61	0.04	93.91
	1125B_4H-1_59-61_13	4.24	3.41	1.42	71.45	0.07	0.01	0.72	0.08	11.85	0.06	93.31
	1125B_4H-1_59-61_14	4.22	3.64	1.57	72.68	0.10	0.05	0.82	0.15	11.91	0.01	95.15
	1125B_4H-1_59-61_15	3.86	3.49	1.38	70.93	0.05	0.05	0.68	0.02	11.36	0.00	91.82
	1125B_4H-1_59-61_16	4.62	3.42	1.40	71.49	0.09	0.01	0.77	0.09	11.69	0.00	93.58
	1125B_4H-1_59-61_17	4.76	3.31	2.03	70.93	0.16	0.06	0.96	0.12	12.25	0.00	94.58
	1125B_4H-1_59-61_18	4.34	3.25	1.93	70.04	0.15	0.13	1.07	0.05	12.29	0.00	93.26
	1125B_4H-1_59-61_19	4.60	3.19	2.01	71.66	0.16	0.08	1.05	0.09	12.45	0.01	95.30
	1125B_4H-1_59-61_20	4.30	3.34	1.82	71.54	0.13	0.05	0.95	0.07	12.01	0.02	94.24
s42*	1125B_4H-2_11-13_1	3.95	3.61	1.33	73.00	0.08	0.00	0.68	0.11	11.32	0.00	94.07
	1125B_4H-2_11-13_2	4.53	3.19	2.04	69.81	0.20	0.15	1.20	0.00	12.62	0.00	93.74
	1125B_4H-2_11-13_3	4.24	3.89	1.39	73.17	0.10	0.04	0.70	0.10	11.53	0.00	95.15
	1125B_4H-2_11-13_4	4.67	2.96	2.81	67.29	0.29	0.40	2.03	0.10	13.80	0.02	94.37
	1125B_4H-2_11-13_5	4.61	3.31	2.06	70.14	0.19	0.17	1.22	0.08	12.78	0.05	94.63
	1125B_4H-2_11-13_6	4.63	3.32	2.31	70.40	0.20	0.19	1.25	0.03	12.81	0.03	95.17
	1125B_4H-2_11-13_7	4.10	3.65	1.40	72.90	0.08	0.00	0.70	0.02	11.64	0.03	94.52
	1125B_4H-2_11-13_8	4.68	3.17	2.03	71.41	0.15	0.10	1.05	0.03	12.41	0.03	95.06
	1125B_4H-2_11-13_9	4.47	3.34	1.80	70.93	0.17	0.08	0.95	0.03	12.18	0.01	93.95
	1125B_4H-2_11-13_10	4.62	3.19	2.17	70.31	0.21	0.20	1.18	0.09	12.52	0.01	94.50
	1125B_4H-2_11-13_11	4.55	3.28	2.13	70.63	0.11	0.11	1.06	0.02	12.26	0.00	94.16
	1125B_4H-2_11-13_12	4.51	3.12	2.25	69.82	0.20	0.11	1.19	0.07	12.66	0.06	93.99
	1125B_4H-2_11-13_13	4.62	3.24	1.88	71.24	0.17	0.07	1.05	0.04	12.32	0.00	94.64
	1125B_4H-2_11-13_14	4.10	3.41	1.45	72.55	0.10	0.02	0.71	0.03	11.44	0.00	93.82

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s63	1125B_4H-2_11-13_15	4.27	3.62	1.29	71.69	0.10	0.06	0.69	0.05	11.81	0.02	93.61
	1125B_4H-2_11-13_16	4.31	3.34	2.12	70.97	0.17	0.12	1.22	0.03	12.62	0.01	94.90
	1125B_4H-2_11-13_17	4.55	3.33	2.00	69.14	0.13	0.07	1.07	0.02	12.41	0.02	92.75
	1125B_4H-2_11-13_18	4.69	3.31	2.21	69.57	0.21	0.15	1.23	0.08	12.84	0.01	94.30
	1125B_4H-2_11-13_20	4.71	3.20	1.93	70.45	0.24	0.12	1.19	0.02	12.54	0.03	94.43
	1125B_4H-2_124-126_1	4.18	3.28	2.38	68.56	0.18	0.14	1.40	0.04	12.73	0.03	92.91
	1125B_4H-2_124-126_2	4.44	3.31	2.37	68.82	0.16	0.13	1.36	0.07	12.12	0.01	92.80
	1125B_4H-2_124-126_3	4.24	3.43	2.06	68.89	0.16	0.13	1.27	0.10	12.35	0.04	92.68
	1125B_4H-2_124-126_5	4.17	3.42	2.14	68.88	0.18	0.19	1.32	0.03	12.66	0.00	92.99
	1125B_4H-2_124-126_6	4.41	3.52	2.11	69.59	0.23	0.23	1.39	0.09	12.70	0.03	94.30
	1125B_4H-2_124-126_7	4.20	3.39	2.45	67.83	0.21	0.16	1.39	0.05	12.80	0.05	92.53
	1125B_4H-2_124-126_8	4.51	3.37	2.06	69.70	0.17	0.17	1.23	0.07	12.39	0.06	93.72
	1125B_4H-2_124-126_9	4.26	3.36	2.06	70.09	0.22	0.13	1.35	0.13	12.39	0.05	94.03
	1125B_4H-2_124-126_10	4.31	3.34	2.05	70.03	0.16	0.12	1.14	0.02	12.28	0.00	93.45
	1125B_4H-2_124-126_11	4.04	3.41	2.06	68.58	0.22	0.17	1.39	0.03	12.79	0.05	92.75
	1125B_4H-2_124-126_12	4.41	3.47	2.12	69.17	0.17	0.09	1.22	0.02	12.41	0.02	93.10
	1125B_4H-2_124-126_13	4.33	3.44	2.00	69.10	0.21	0.12	1.22	0.08	12.26	0.02	92.78
	1125B_4H-2_124-126_14	4.51	3.43	2.06	69.84	0.18	0.13	1.27	0.08	12.37	0.00	93.87
	1125B_4H-2_124-126_15	4.27	3.46	2.17	68.52	0.19	0.12	1.33	0.08	12.60	0.00	92.74
	1125B_4H-2_124-126_16	4.58	3.42	2.22	68.65	0.18	0.11	1.35	0.15	12.63	0.04	93.33
	1125B_4H-2_124-126_17	4.43	3.32	2.15	68.57	0.19	0.19	1.31	0.13	12.61	0.05	92.95
	1125B_4H-2_124-126_18	4.62	3.15	2.85	68.02	0.30	0.23	1.72	0.11	13.15	0.06	94.21
	1125B_4H-2_124-126_19	4.43	3.35	2.25	68.58	0.19	0.14	1.39	0.03	12.50	0.01	92.88
	1125B_4H-2_124-126_20	4.29	3.33	2.07	68.00	0.22	0.05	1.30	0.02	12.27	0.00	91.55
	1125B_4H-4_61-63_1	3.28	4.87	1.76	69.39	0.15	0.05	1.01	0.00	12.05	0.00	92.57
	1125B_4H-4_61-63_2	3.92	4.41	1.81	70.68	0.16	0.10	1.03	0.00	12.15	0.03	94.29
	1125B_4H-4_61-63_3	3.90	4.46	1.92	70.51	0.12	0.06	0.95	0.04	12.22	0.00	94.19
	1125B_4H-4_61-63_4	3.94	4.25	1.71	70.37	0.15	0.07	0.96	0.07	12.22	0.00	93.74
	1125B_4H-4_61-63_5	4.12	4.23	1.98	71.09	0.15	0.09	1.05	0.01	12.34	0.02	95.10
	1125B_4H-4_61-63_6	4.03	4.34	1.78	71.03	0.15	0.03	0.96	0.05	12.31	0.00	94.67
	1125B_4H-4_61-63_7	4.19	4.30	2.08	70.71	0.12	0.08	1.05	0.16	12.59	0.04	95.32
	1125B_4H-4_61-63_8	3.89	4.25	2.01	71.07	0.12	0.04	0.98	0.00	12.26	0.02	94.64
	1125B_4H-4_61-63_9	3.84	4.42	1.77	70.83	0.14	0.08	0.98	0.06	12.53	0.01	94.66
	1125B_4H-4_61-63_10	4.06	4.34	2.02	70.83	0.15	0.11	1.11	0.08	12.47	0.00	95.17
	1125B_4H-4_61-63_11	4.02	4.19	1.87	70.59	0.14	0.06	0.98	0.04	12.27	0.01	94.17
	1125B_4H-4_61-63_12	4.06	4.32	1.86	71.73	0.14	0.08	1.05	0.07	12.33	0.00	95.63
	1125B_4H-4_61-63_13	4.24	4.41	1.75	71.21	0.14	0.10	0.94	0.05	12.43	0.01	95.28
	1125B_4H-4_61-63_14	4.09	4.21	1.85	70.86	0.12	0.07	0.99	0.03	12.08	0.01	94.32
	1125B_4H-4_61-63_15	4.11	4.54	1.85	71.64	0.13	0.10	1.06	0.11	12.40	0.05	96.00
	1125B_4H-4_61-63_16	3.89	4.45	1.83	71.01	0.11	0.08	0.99	0.13	12.22	0.00	94.71
	1125B_4H-4_61-63_17	3.93	4.43	1.87	70.90	0.14	0.09	1.06	0.00	12.15	0.02	94.60
	1125B_4H-4_61-63_18	3.84	4.40	1.22	72.87	0.10	0.08	0.69	0.00	11.36	0.01	94.57
	1125B_4H-4_61-63_19	4.15	4.47	1.80	70.72	0.15	0.04	1.06	0.02	12.30	0.03	94.73
	1125B_4H-4_61-63_20	3.81	4.18	1.91	70.64	0.10	0.09	0.98	0.05	12.19	0.03	93.96
	1125B_4H-4_69-71_1	3.98	4.32	1.84	71.13	0.14	0.04	0.99	0.00	12.38	0.03	94.85
	1125B_4H-4_69-71_2	3.92	4.46	1.99	71.27	0.15	0.07	0.99	0.02	12.36	0.02	95.25
	1125B_4H-4_69-71_3	4.08	4.39	1.74	70.66	0.14	0.05	1.08	0.00	12.28	0.03	94.45
	1125B_4H-4_69-71_4	3.93	4.40	1.90	71.39	0.14	0.12	1.00	0.03	12.62	0.00	95.53
	1125B_4H-4_69-71_5	3.68	4.59	1.80	70.41	0.15	0.09	1.09	0.00	12.39	0.00	94.19
	1125B_4H-4_69-71_6	3.82	4.34	1.75	71.46	0.14	0.09	0.98	0.00	12.37	0.00	94.95
	1125B_4H-4_69-71_7	3.89	4.47	1.82	70.73	0.09	0.06	1.14	0.04	12.58	0.01	94.83
	1125B_4H-4_69-71_8	4.02	4.47	1.76	70.88	0.14	0.07	1.02	0.01	12.28	0.00	94.65
	1125B_4H-4_69-71_9	4.21	4.25	2.15	70.99	0.15	0.10	1.00	0.07	12.44	0.00	95.36
	1125B_4H-4_69-71_10	4.06	4.31	1.99	71.35	0.16	0.08	0.98	0.08	12.41	0.02	95.43
	1125B_4H-4_69-71_11	3.67	4.53	1.49	71.82	0.11	0.03	0.74	0.04	11.95	0.01	94.39
	1125B_4H-4_69-71_12	4.06	4.20	1.89	70.83	0.15	0.09	1.02	0.09	12.47	0.04	94.84
	1125B_4H-4_69-71_13	4.00	4.24	1.80	71.09	0.16	0.09	1.00	0.09	12.36	0.00	94.82
	1125B_4H-4_69-71_14	4.04	4.17	1.93	70.99	0.14	0.07	1.00	0.09	12.52	0.00	94.95
	1125B_4H-4_69-71_15	3.81	4.20	1.89	70.46	0.12	0.13	0.98	0.06	12.47	0.03	94.15
	1125B_4H-4_69-71_16	3.87	4.51	1.83	70.36	0.13	0.07	1.00	0.00	12.20	0.01	93.98
	1125B_4H-4_69-71_17	3.97	4.40	1.71	71.24	0.15	0.10	0.99	0.03	12.28	0.00	94.87
	1125B_4H-4_69-71_18	4.08	4.54	1.92	71.00	0.15	0.05	1.03	0.04	12.52	0.00	95.33
	1125B_4H-4_69-71_19	4.07	4.43	1.96	71.06	0.13	0.10	1.02	0.00	12.44	0.04	95.25
	1125B_4H-4_69-71_20	4.03	4.44	1.92	71.36	0.14	0.07	1.01	0.09	12.26	0.00	95.32
u50	1125B_4H-4_74-76_1	3.89	4.37	1.82	71.01	0.13	0.02	1.08	0.11	12.23	0.04	94.70
	1125B_4H-4_74-76_3	4.03	4.29	1.65	70.52	0.14	0.11	1.00	0.05	12.27	0.00	94.05
	1125B_4H-4_74-76_4	3.63	3.35	1.19	72.46	0.10	0.12	1.16	0.03	11.23	0.02	93.29
	1125B_4H-4_74-76_5	3.88	3.58	0.71	74.13	0.15	0.09	0.82	0.12	11.44	0.01	94.93
	1125B_4H-4_74-76_6	4.13	4.13	1.98	70.34	0.13	0.05	1.07	0.00	12.33	0.02	94.18
	1125B_4H-4_74-76_7	4.98	2.17	1.22	67.78	0.15	0.14	3.33	0.00	15.18	0.02	94.97

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s89*	1125B_4H-4_74-76_8	3.47	3.57	0.82	74.73	0.10	0.06	0.81	0.06	11.67	0.02	95.31
	1125B_4H-4_74-76_13	3.94	4.34	1.94	71.04	0.14	0.08	1.01	0.09	12.38	0.01	94.96
	1125B_4H-4_74-76_14	4.14	4.42	1.76	70.88	0.15	0.06	1.08	0.01	12.11	0.00	94.62
	1125B_4H-4_74-76_15	3.90	4.37	1.95	70.89	0.14	0.09	1.10	0.07	12.21	0.01	94.74
	1125B_4H-4_74-76_16	4.00	4.30	1.83	71.08	0.12	0.03	1.00	0.08	12.18	0.05	94.67
	1125B_4H-4_74-76_17	4.12	4.44	1.84	71.36	0.16	0.09	1.08	0.01	12.40	0.02	95.52
	1125B_4H-4_74-76_18	3.77	4.41	1.66	70.96	0.12	0.01	1.01	0.05	12.23	0.00	94.22
	1125B_4H-4_74-76_19	3.95	4.25	1.74	70.91	0.12	0.01	0.94	0.02	12.22	0.01	94.17
	1125B_4H-4_74-76_20	3.68	4.30	1.41	72.42	0.10	0.04	0.79	0.02	11.99	0.00	94.75
	1125B_5H-2_131-133_1	3.95	3.27	1.44	73.06	0.09	0.04	1.03	0.00	11.57	0.01	94.46
	1125B_5H-2_131-133_2	3.93	3.03	1.81	71.59	0.14	0.09	1.18	0.00	11.93	0.02	93.72
	1125B_5H-2_131-133_3	4.22	3.30	1.57	72.16	0.09	0.05	1.00	0.01	11.43	0.03	93.86
	1125B_5H-2_131-133_4	4.08	3.36	1.50	72.23	0.11	0.09	1.07	0.00	11.60	0.00	94.04
	1125B_5H-2_131-133_5	4.36	3.11	1.80	72.04	0.14	0.05	1.19	0.00	11.78	0.03	94.50
	1125B_5H-2_131-133_6	3.70	3.44	1.56	72.81	0.11	0.05	0.97	0.04	11.30	0.00	93.97
	1125B_5H-2_131-133_7	4.05	3.09	1.75	70.81	0.13	0.12	1.22	0.07	11.95	0.00	93.19
	1125B_5H-2_131-133_8	4.18	3.13	1.73	72.34	0.16	0.11	1.20	0.11	11.86	0.00	94.81
	1125B_5H-2_131-133_9	4.03	3.09	1.67	71.00	0.13	0.07	1.24	0.06	12.01	0.03	93.34
	1125B_5H-2_131-133_10	4.30	3.05	1.85	71.16	0.14	0.10	1.24	0.09	11.98	0.02	93.92
	1125B_5H-2_131-133_11	3.99	3.32	1.58	72.54	0.12	0.10	1.01	0.02	11.50	0.01	94.19
	1125B_5H-2_131-133_12	4.00	3.09	1.59	72.14	0.12	0.12	1.21	0.02	11.82	0.01	94.12
	1125B_5H-2_131-133_13	3.90	3.08	1.44	70.70	0.10	0.08	0.97	0.03	11.72	0.01	92.03
	1125B_5H-2_131-133_14	4.18	3.10	1.66	70.41	0.15	0.10	1.20	0.01	11.78	0.02	92.61
	1125B_5H-2_131-133_15	4.25	3.11	1.59	70.40	0.14	0.10	1.12	0.05	11.85	0.03	92.63
	1125B_5H-2_131-133_16	4.03	3.20	1.44	72.46	0.11	0.06	1.05	0.02	11.55	0.00	93.93
	1125B_5H-2_131-133_17	4.19	3.48	1.75	72.32	0.14	0.13	1.15	0.03	11.86	0.03	95.08
	1125B_5H-2_131-133_18	3.93	3.55	1.63	73.12	0.12	0.09	1.02	0.00	11.52	0.02	95.01
	1125B_5H-2_131-133_19	4.13	3.32	1.61	72.93	0.12	0.09	1.03	0.00	11.78	0.02	95.02
	1125B_5H-2_131-133_20	4.07	3.26	1.55	73.12	0.11	0.05	1.04	0.05	11.48	0.01	94.73
	1125B_5H-2_136-138_1	4.00	3.22	1.34	72.09	0.13	0.17	1.32	0.06	12.72	0.00	95.05
	1125B_5H-2_136-138_2	4.46	3.18	1.57	71.02	0.13	0.18	1.27	0.08	12.58	0.00	94.48
	1125B_5H-2_136-138_3	4.26	3.11	1.43	71.54	0.15	0.17	1.32	0.00	12.62	0.01	94.60
	1125B_5H-2_136-138_4	4.36	2.68	2.00	70.02	0.29	0.37	1.82	0.09	12.81	0.02	94.47
	1125B_5H-2_136-138_5	4.03	3.21	1.40	72.01	0.14	0.19	1.32	0.09	12.60	0.04	95.02
	1125B_5H-2_136-138_6	4.25	3.02	1.61	71.94	0.14	0.22	1.31	0.05	12.67	0.04	95.25
	1125B_5H-2_136-138_7	3.97	3.15	1.64	71.94	0.15	0.22	1.32	0.04	12.75	0.02	95.19
	1125B_5H-2_136-138_8	4.33	3.24	1.45	71.86	0.14	0.08	0.97	0.00	11.99	0.00	94.06
	1125B_5H-2_136-138_9	4.24	3.00	1.60	69.99	0.14	0.19	1.27	0.07	12.71	0.02	93.22
	1125B_5H-2_136-138_10	4.07	3.11	1.41	70.16	0.17	0.19	1.27	0.06	12.64	0.07	93.14
	1125B_5H-2_136-138_11	4.09	3.16	1.66	71.65	0.13	0.21	1.29	0.06	12.72	0.06	95.03
	1125B_5H-2_136-138_12	2.34	3.08	1.65	71.47	0.16	0.19	1.31	0.05	12.85	0.00	93.11
	1125B_5H-2_136-138_13	3.05	3.17	1.46	70.65	0.17	0.18	1.26	0.04	12.67	0.01	92.66
	1125B_5H-2_136-138_14	4.22	3.12	1.53	71.64	0.18	0.19	1.35	0.00	12.71	0.04	94.97
	1125B_5H-2_136-138_15	2.35	2.67	1.83	69.96	0.27	0.35	1.77	0.13	13.22	0.00	92.55
	1125B_5H-2_136-138_16	4.34	3.23	1.40	72.28	0.18	0.17	1.33	0.05	12.95	0.03	95.96
	1125B_5H-2_136-138_17	4.30	3.10	1.50	70.11	0.15	0.22	1.23	0.06	12.72	0.03	93.42
	1125B_5H-2_136-138_18	4.01	3.07	1.49	71.09	0.15	0.19	1.31	0.01	12.59	0.02	93.93
	1125B_5H-2_136-138_19	4.17	3.10	1.47	68.61	0.16	0.19	1.27	0.00	12.83	0.04	91.84
	1125B_5H-2_136-138_20	4.08	3.14	1.46	71.54	0.16	0.18	1.24	0.04	12.55	0.03	94.41
s90	1125B_5H-3_18-20_1	3.97	3.50	1.60	71.30	0.11	0.00	0.94	0.07	11.76	0.00	93.24
	1125B_5H-3_18-20_2	4.36	2.77	1.63	70.36	0.18	0.17	1.39	0.10	12.18	0.00	93.14
	1125B_5H-3_18-20_3	3.95	2.72	1.75	70.98	0.18	0.20	1.40	0.08	11.92	0.06	93.24
	1125B_5H-3_18-20_4	4.33	2.74	1.64	71.52	0.18	0.21	1.44	0.03	12.07	0.02	94.17
	1125B_5H-3_18-20_5	3.77	3.23	1.50	71.46	0.12	0.07	1.03	0.09	11.55	0.00	92.81
	1125B_5H-3_18-20_6	4.57	2.77	1.95	71.86	0.18	0.20	1.41	0.06	12.01	0.04	95.05
	1125B_5H-3_18-20_7	4.08	2.89	1.79	70.64	0.21	0.15	1.44	0.08	11.98	0.03	93.29
	1125B_5H-3_18-20_8	3.51	2.67	1.91	70.46	0.22	0.13	1.38	0.05	12.04	0.01	92.39
	1125B_5H-3_18-20_10	2.80	2.69	1.81	70.52	0.19	0.09	1.37	0.05	11.69	0.03	91.24
	1125B_5H-3_18-20_11	4.26	2.83	1.64	71.01	0.19	0.14	1.38	0.04	12.32	0.01	93.83
	1125B_5H-3_18-20_12	4.56	2.61	1.97	70.54	0.18	0.17	1.39	0.06	12.32	0.02	93.82
	1125B_5H-3_18-20_13	4.17	2.69	1.86	68.99	0.19	0.21	1.36	0.00	12.07	0.00	91.54
	1125B_5H-3_18-20_14	4.41	2.71	1.69	69.38	0.21	0.21	1.43	0.08	12.11	0.02	92.26
	1125B_5H-3_18-20_15	4.45	2.70	1.83	71.45	0.21	0.21	1.40	0.05	12.00	0.05	94.34
	1125B_5H-3_18-20_16	4.58	2.65	1.82	70.28	0.22	0.17	1.42	0.04	12.27	0.00	93.45
	1125B_5H-3_18-20_17	4.25	2.64	1.82	70.76	0.20	0.17	1.38	0.08	12.01	0.05	93.36
	1125B_5H-3_18-20_18	4.41	2.80	1.95	70.59	0.20	0.21	1.43	0.04	12.07	0.06	93.77
	1125B_5H-3_18-20_19	4.38	2.79	1.77	70.88	0.21	0.16	1.45	0.05	12.17	0.00	93.86
	1125B_5H-3_18-20_20	3.38	3.95	1.24	72.63	0.16	0.10	0.87	0.10	11.00	0.02	93.44
	1125B_5H-3_120-122_1	4.55	2.80	1.54	70.53	0.14	0.09	1.54	0.04	13.15	0.03	94.41
	1125B_5H-3_120-122_2	4.24	3.16	1.79	71.89	0.12	0.12	1.14	0.04	12.44	0.00	94.95

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s91	1125B_5H-3_120-122_3	4.16	2.94	1.88	70.92	0.20	0.23	1.52	0.00	12.35	0.03	94.23
	1125B_5H-3_120-122_4	4.10	3.12	1.69	71.62	0.13	0.10	1.14	0.03	12.19	0.00	94.11
	1125B_5H-3_120-122_5	4.11	2.98	1.89	71.67	0.20	0.19	1.48	0.08	12.36	0.03	94.99
	1125B_5H-3_120-122_6	4.08	2.94	1.76	71.26	0.22	0.23	1.54	0.03	12.60	0.02	94.68
	1125B_5H-3_120-122_7	4.05	2.81	1.80	70.30	0.23	0.19	1.39	0.07	12.16	0.02	93.02
	1125B_5H-3_120-122_8	4.29	3.06	1.61	71.61	0.07	0.09	1.07	0.07	12.14	0.02	94.03
	1125B_5H-3_120-122_9	4.22	2.79	1.86	71.91	0.11	0.13	1.25	0.03	12.30	0.01	94.60
	1125B_5H-3_120-122_10	4.59	2.98	1.71	72.03	0.15	0.06	1.17	0.02	12.23	0.02	94.96
	1125B_5H-3_120-122_11	4.13	2.88	1.90	71.49	0.22	0.21	1.47	0.07	12.31	0.03	94.71
	1125B_5H-3_120-122_12	3.89	3.01	1.78	70.55	0.20	0.14	1.43	0.00	12.31	0.00	93.31
	1125B_5H-3_120-122_13	4.23	3.08	1.47	71.89	0.10	0.09	1.12	0.02	12.22	0.00	94.22
	1125B_5H-3_120-122_14	4.28	3.00	1.87	71.08	0.21	0.18	1.49	0.01	12.36	0.00	94.48
	1125B_5H-3_120-122_15	4.11	3.12	1.66	71.64	0.11	0.07	1.09	0.17	12.38	0.00	94.35
	1125B_5H-3_120-122_16	4.35	3.03	1.58	71.93	0.14	0.09	1.13	0.05	12.25	0.02	94.58
	1125B_5H-3_120-122_17	4.06	2.86	2.06	71.64	0.22	0.21	1.43	0.00	12.41	0.01	94.90
	1125B_5H-3_120-122_18	3.77	2.96	1.86	71.81	0.22	0.21	1.51	0.12	12.49	0.01	94.97
	1125B_5H-3_120-122_19	4.02	2.86	1.84	70.99	0.19	0.19	1.46	0.06	12.49	0.01	94.11
	1125B_5H-3_120-122_20	4.01	2.83	1.72	70.93	0.20	0.22	1.49	0.12	12.29	0.03	93.84
	1125B_5H-3_120-122_1	4.22	3.02	1.81	71.38	0.22	0.21	1.50	0.06	12.50	0.00	94.92
	1125B_5H-3_120-122_2	4.13	2.96	1.74	72.33	0.23	0.21	1.49	0.03	12.74	0.00	95.86
	1125B_5H-3_120-122_6	4.05	3.02	1.71	71.54	0.23	0.21	1.46	0.09	12.45	0.03	94.79
	1125B_5H-3_120-122_8	3.96	3.08	1.74	71.61	0.25	0.18	1.46	0.04	12.19	0.03	94.53
	1125B_5H-3_120-122_10	4.11	2.97	1.93	71.15	0.20	0.18	1.46	0.07	12.51	0.00	94.58
	1125B_5H-3_120-122_3	4.23	2.92	1.68	71.24	0.19	0.20	1.37	0.03	12.44	0.00	94.31
	1125B_5H-3_120-122_4	4.29	3.10	1.54	72.63	0.13	0.10	1.12	0.03	12.36	0.02	95.32
	1125B_5H-3_120-122_5	4.10	2.92	1.64	71.78	0.23	0.20	1.43	0.00	12.46	0.02	94.78
	1125B_5H-3_120-122_7	4.14	3.15	1.57	71.71	0.13	0.10	1.12	0.05	12.39	0.00	94.36
	1125B_5H-3_120-122_9	4.04	3.05	1.80	72.39	0.20	0.24	1.43	0.01	12.58	0.02	95.76
	1125B_5H-4_64-66_1	3.77	2.89	1.58	73.57	0.22	0.26	1.55	0.00	11.35	0.00	95.19
	1125B_5H-4_64-66_2	3.63	2.95	1.37	73.54	0.24	0.23	1.46	0.05	11.20	0.04	94.71
	1125B_5H-4_64-66_3	3.63	2.92	1.34	72.84	0.24	0.22	1.44	0.01	11.10	0.00	93.74
	1125B_5H-4_64-66_4	3.18	4.01	1.03	74.36	0.12	0.05	1.10	0.00	11.41	0.02	95.29
	1125B_5H-4_64-66_5	3.70	2.94	1.43	73.41	0.25	0.26	1.41	0.06	10.96	0.03	94.44
	1125B_5H-4_64-66_6	3.38	2.98	1.43	73.96	0.25	0.19	1.47	0.00	11.26	0.05	94.97
	1125B_5H-4_64-66_7	3.83	2.95	1.37	73.99	0.22	0.16	1.48	0.01	11.37	0.02	95.39
	1125B_5H-4_64-66_8	3.55	2.95	1.41	74.16	0.25	0.25	1.44	0.00	11.26	0.05	95.32
	1125B_5H-4_64-66_9	3.74	3.36	1.11	73.11	0.07	0.08	0.90	0.05	11.59	0.00	94.01
	1125B_5H-4_64-66_10	3.70	3.41	1.00	73.31	0.07	0.09	1.00	0.01	11.36	0.01	93.95
	1125B_5H-4_64-66_11	3.56	3.52	1.04	73.30	0.10	0.09	0.99	0.00	11.30	0.01	93.91
	1125B_5H-4_64-66_12	3.52	2.89	1.56	73.20	0.21	0.21	1.48	0.06	11.17	0.02	94.32
	1125B_5H-4_64-66_13	3.41	2.89	1.38	72.59	0.25	0.19	1.41	0.02	11.00	0.02	93.17
	1125B_5H-4_64-66_14	3.68	3.45	1.28	73.93	0.12	0.11	1.11	0.01	11.27	0.00	94.96
	1125B_5H-4_64-66_15	3.53	3.53	1.02	72.78	0.06	0.10	0.97	0.04	11.38	0.01	93.42
	1125B_5H-4_64-66_16	3.65	3.66	1.03	74.34	0.07	0.07	0.98	0.08	11.57	0.00	95.45
	1125B_5H-4_64-66_17	3.41	2.99	1.33	74.13	0.25	0.22	1.45	0.01	11.14	0.01	94.94
	1125B_5H-4_64-66_18	3.57	2.87	1.40	72.83	0.27	0.24	1.45	0.04	11.15	0.01	93.82
	1125B_5H-4_64-66_19	3.65	2.83	1.46	73.34	0.23	0.21	1.47	0.00	11.06	0.01	94.26
	1125B_5H-4_64-66_20	3.58	2.90	1.42	72.60	0.21	0.21	1.44	0.08	10.86	0.00	93.30
	1125B_5H-4_64-66_1	3.34	3.70	1.23	73.03	0.10	0.11	0.96	0.01	11.18	0.01	93.68
	1125B_5H-4_64-66_2	3.53	3.44	0.94	72.32	0.10	0.11	0.96	0.03	11.05	0.00	92.48
	1125B_5H-4_64-66_7	3.33	3.45	1.10	73.73	0.09	0.13	1.03	0.06	11.35	0.02	94.29
	1125B_5H-4_64-66_10	3.72	3.52	0.85	72.42	0.06	0.10	0.99	0.03	11.25	0.01	92.94
	1125B_5H-4_64-66_9	3.69	3.04	1.41	73.15	0.24	0.18	1.47	0.05	11.29	0.02	94.54
	1125B_5H-4_64-66_3	3.46	3.76	1.22	73.54	0.10	0.13	1.08	0.06	11.65	0.01	95.02
	1125B_5H-4_64-66_4	3.68	2.87	1.35	71.78	0.25	0.26	1.48	0.06	11.05	0.04	92.81
	1125B_5H-4_64-66_5	3.42	3.59	1.00	72.12	0.08	0.07	0.98	0.03	11.62	0.00	92.91
	1125B_5H-4_64-66_6	3.38	3.60	0.95	73.60	0.12	0.11	1.03	0.01	11.43	0.02	94.24
	1125B_5H-4_64-66_8	3.34	2.96	1.45	71.76	0.22	0.20	1.41	0.01	11.30	0.00	92.65
s97*	1125B_6H-1_147-149_1	4.33	2.90	1.13	73.51	0.15	0.14	1.20	0.09	11.93	0.01	95.39
	1125B_6H-1_147-149_2	4.28	2.86	1.14	73.35	0.14	0.13	1.20	0.07	12.07	0.01	95.26
	1125B_6H-1_147-149_3	4.16	2.90	1.27	73.61	0.16	0.15	1.08	0.06	11.88	0.01	95.28
	1125B_6H-1_147-149_4	3.48	3.80	1.23	73.09	0.09	0.07	0.95	0.02	11.93	0.01	94.68
	1125B_6H-1_147-149_5	4.02	2.87	1.11	73.66	0.13	0.10	1.12	0.00	12.02	0.01	95.03
	1125B_6H-1_147-149_6	4.28	2.84	1.33	73.25	0.16	0.24	1.24	0.06	12.20	0.02	95.62
	1125B_6H-1_147-149_7	4.01	2.83	1.19	74.92	0.13	0.14	1.11	0.01	11.95	0.02	96.31
	1125B_6H-1_147-149_8	4.12	2.98	1.46	72.46	0.18	0.18	1.40	0.00	12.41	0.02	95.21
	1125B_6H-1_147-149_9	3.78	2.75	1.45	72.70	0.18	0.20	1.33	0.10	12.45	0.04	94.98
	1125B_6H-1_147-149_10	4.18	2.80	1.26	73.58	0.15	0.19	1.13	0.03	12.14	0.01	95.48
	1125B_6H-1_147-149_11	3.77	3.04	1.30	73.99	0.12	0.16	1.19	0.00	12.03	0.01	95.61
	1125B_6H-1_147-149_12	4.29	2.86	1.46	72.49	0.15	0.20	1.38	0.00	12.53	0.01	95.37

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s98	1125B_6H-1_147-149_13	4.03	2.82	1.55	71.90	0.16	0.20	1.40	0.07	12.04	0.04	94.21
	1125B_6H-1_147-149_14	4.14	2.82	1.31	72.74	0.19	0.19	1.26	0.11	12.03	0.01	94.80
	1125B_6H-1_147-149_15	4.02	3.08	1.28	74.83	0.12	0.13	0.95	0.06	11.89	0.00	96.36
	1125B_6H-1_147-149_16	4.03	2.87	1.14	73.06	0.12	0.15	1.13	0.00	11.77	0.00	94.27
	1125B_6H-1_147-149_17	3.86	3.04	1.25	73.15	0.11	0.12	1.02	0.10	11.92	0.02	94.59
	1125B_6H-1_147-149_18	4.06	2.66	1.46	71.82	0.20	0.17	1.42	0.04	12.23	0.00	94.06
	1125B_6H-1_147-149_19	4.10	2.93	0.97	74.38	0.14	0.08	0.91	0.07	11.55	0.02	95.15
	1125B_6H-1_147-149_20	3.52	3.89	1.19	73.90	0.07	0.05	0.98	0.00	11.88	0.01	95.49
	1125B_6H-1_147-149_1	3.92	2.99	1.26	72.45	0.16	0.15	1.27	0.01	12.24	0.01	94.45
	1125B_6H-1_147-149_3	4.15	2.75	1.56	71.49	0.20	0.32	1.59	0.07	12.23	0.03	94.39
	1125B_6H-1_147-149_8	4.16	2.72	1.46	72.04	0.15	0.18	1.26	0.04	11.94	0.02	93.96
	1125B_6H-1_147-149_9	3.99	2.96	1.22	73.18	0.14	0.15	1.14	0.04	12.15	0.03	95.01
	1125B_6H-1_147-149_5	3.79	2.94	1.03	72.52	0.15	0.09	1.01	0.02	11.62	0.00	93.18
	1125B_6H-1_147-149_2	4.33	2.95	1.18	72.19	0.16	0.15	1.10	0.03	11.71	0.00	93.80
	1125B_6H-1_147-149_4	4.38	2.89	1.21	72.12	0.15	0.14	1.23	0.07	12.18	0.00	94.38
	1125B_6H-1_147-149_6	4.32	2.87	1.18	73.15	0.18	0.16	1.19	0.02	12.22	0.00	95.30
	1125B_6H-1_147-149_7	4.40	2.76	1.36	72.05	0.15	0.25	1.37	0.03	12.24	0.00	94.61
	1125B_6H-1_147-149_10	4.25	2.85	1.23	73.06	0.16	0.17	1.19	0.05	12.28	0.00	95.25
	1125B_6H-5_133-235_1	4.12	3.69	0.97	74.03	0.06	0.01	0.80	0.04	11.76	0.01	95.51
	1125B_6H-5_133-235_2	3.99	3.68	1.09	74.32	0.08	0.02	0.76	0.13	11.93	0.02	96.02
	1125B_6H-5_133-135_3	3.88	3.85	1.04	73.41	0.06	0.02	0.80	0.03	11.47	0.01	94.57
	1125B_6H-5_133-135_4	3.87	3.69	1.15	74.83	0.07	0.06	0.76	0.00	11.98	0.00	96.42
	1125B_6H-5_133-135_5	4.01	3.48	1.12	72.74	0.06	0.03	0.79	0.08	11.90	0.00	94.22
	1125B_6H-5_133-135_6	3.84	3.64	1.12	74.45	0.07	0.03	0.76	0.08	11.92	0.01	95.92
	1125B_6H-5_133-135_7	3.64	3.74	0.98	74.25	0.07	0.03	0.74	0.00	11.86	0.05	95.35
	1125B_6H-5_133-135_8	3.94	4.09	1.19	74.22	0.04	0.04	0.77	0.04	11.84	0.02	96.19
	1125B_6H-5_133-135_9	3.71	3.63	0.97	73.65	0.07	0.06	0.77	0.08	11.63	0.00	94.57
	1125B_6H-5_133-135_10	3.72	3.49	1.14	74.16	0.06	0.04	0.77	0.04	11.82	0.00	95.24
	1125B_6H-5_133-135_11	3.92	3.50	1.09	73.08	0.04	0.05	0.77	0.02	11.73	0.00	94.19
	1125B_6H-5_133-135_12	4.06	3.57	1.06	73.23	0.06	0.05	0.79	0.04	11.67	0.00	94.53
	1125B_6H-5_133-135_13	3.84	3.76	0.99	72.00	0.06	0.06	0.77	0.04	11.82	0.02	93.36
	1125B_6H-5_133-135_14	3.70	3.75	1.01	73.28	0.07	0.03	0.73	0.01	11.79	0.00	94.37
	1125B_6H-5_133-135_15	3.96	3.52	1.09	73.25	0.06	0.04	0.74	0.05	11.62	0.00	94.33
	1125B_6H-5_133-135_16	3.82	3.47	0.87	69.78	0.06	0.07	0.76	0.05	11.47	0.00	90.35
	1125B_6H-5_133-135_17	3.67	4.00	1.06	70.55	0.09	0.04	0.76	0.07	11.76	0.00	91.99
	1125B_6H-5_133-135_18	3.82	3.75	1.00	72.14	0.06	0.00	0.73	0.00	11.88	0.04	93.42
	1125B_6H-5_133-135_19	3.87	3.60	1.14	69.19	0.05	0.04	0.73	0.00	11.54	0.02	90.19
	1125B_6H-5_133-135_20	3.85	3.75	1.07	70.36	0.06	0.05	0.74	0.05	11.83	0.03	91.80
	1125B_6H-5_133-135_2	4.14	3.64	0.92	73.28	0.09	0.03	0.74	0.03	11.93	0.00	94.80
	1125B_6H-5_133-135_4	4.10	3.52	1.13	72.89	0.05	0.05	0.74	0.02	11.93	0.00	94.42
	1125B_6H-5_133-135_5	3.86	3.74	1.03	73.28	0.07	0.08	0.76	0.02	11.63	0.03	94.49
	1125B_6H-5_133-135_6	3.69	3.73	1.14	72.60	0.06	0.02	0.75	0.05	11.78	0.02	93.84
	1125B_6H-5_133-135_9	3.99	3.60	1.14	72.74	0.07	0.03	0.77	0.03	11.91	0.02	94.29
	1125B_6H-5_133-135_1	3.84	3.86	1.01	73.74	0.04	0.05	0.80	0.03	11.99	0.00	95.36
	1125B_6H-5_133-135_3	3.96	3.58	1.02	73.03	0.05	0.05	0.78	0.00	11.66	0.00	94.13
	1125B_6H-5_133-135_7	3.88	3.72	1.16	73.36	0.05	0.02	0.78	0.03	11.68	0.02	94.69
	1125B_6H-5_133-135_8	4.00	3.58	1.07	73.37	0.07	0.03	0.73	0.09	11.56	0.00	94.51
	1125B_6H-5_133-135_10	3.92	3.85	0.96	73.67	0.05	0.04	0.76	0.04	12.00	0.01	95.29

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

Sample name	Li7	Se45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1125A_3H-2_67-69_6	42.69	3.39	2.59	0.71	124.04	62.74	16.55	101.92	6.12	6.02	721.21	20.01	38.62	4.18	13.83
1125A_3H-2_67-69_7	39.30	3.19	2.71	0.70	142.97	74.06	17.49	103.98	6.59	7.22	813.85	22.26	42.49	4.42	15.3
1125A_3H-2_67-69_8	40.73	3.76	2.59	0.70	139.00	69.62	18.39	111.19	6.79	7.11	787.53	21.59	42.04	4.55	15.98
1125A_3H-2_67-69_10	37.75	3.58	2.73	0.78	114.31	62.71	16.05	98.89	5.71	5.69	678.78	19.57	35.31	3.77	13.26
1125A_3H-6_57-59_7	26.87	9.50	5.38	0.88	116.45	93.72	30.10	202.30	8.36	5.38	735.97	25.7	51.73	6.27	23.44
1125A_3H-6_57-59_2	33.93	9.33	2.98	0.78	108.72	100.97	32.76	209.94	9.12	5.06	786.93	27.2	53.78	6.76	24.56
1125A_3H-6_57-59_4	43.72	9.25	2.66	0.77	128.68	85.03	31.03	175.51	9.00	6.41	822.09	27.52	57.49	6.46	25.73
1125A_3H-6_57-59_6	32.99	9.58	2.83	0.85	104.51	108.18	31.01	249.95	9.22	5.33	746.34	27.07	55.41	6.34	25.96
1125A_3H-6_57-59_1	36.84	8.18	2.61	0.78	121.07	84.82	30.34	171.25	8.58	6.14	819.92	27.52	57.99	6.39	24.36
1125A_4H-4_115-117_7	45.35	10.93	2.44	0.38	135.34	76.52	33.49	253.53	11.13	7.23	842.71	29.73	61.97	7.06	28.36
1125A_4H-4_115-117_8	50.63	10.41	2.67	0.24	129.48	64.93	34.44	249.99	10.78	7.31	839.11	29.3	64.23	7.62	27.8
1125A_4H-4_115-117_10	38.51	8.90	2.41	0.39	120.38	68.05	32.06	188.14	9.30	6.62	793.32	28.79	58.45	6.63	25.42
1125A_4H-4_115-117_6	46.44	10.90	2.79	0.51	138.58	79.82	34.59	260.94	11.42	7.34	864.84	30.49	62.5	7.12	28.31
1125A_4H-4_115-117_1	50.61	8.45	2.20	0.25	137.04	40.83	30.28	147.88	10.10	7.63	805.80	27.91	59.43	6.88	26.88
1125A_5H-6_36-38_1	48.00	9.01	2.49	0.80	133.77	72.27	28.84	156.75	7.55	7.04	839.74	25.43	53.56	6.28	23.73
1125A_5H-6_36-38_2	49.18	7.78	1.81	0.51	122.90	66.35	28.94	142.04	6.61	6.49	805.39	24.37	50.23	5.91	21.8
1125A_5H-6_36-38_7	39.26	9.55	1.86	0.82	116.32	83.40	28.61	170.74	6.52	6.24	789.48	24.46	50.54	5.84	22.82
1125A_5H-6_36-38_8	52.25	9.85	2.02	0.76	134.05	80.41	30.22	166.43	7.63	7.06	864.28	25.7	55.23	6.27	23.24
1125A_5H-6_36-38_9	45.17	9.99	2.54	0.90	130.58	83.59	29.88	177.99	7.63	6.92	837.85	24.92	51.96	5.97	23.89
1125A_5H-6_65-67_2	36.78	5.45	2.86	0.97	124.55	121.98	21.19	166.06	7.31	5.94	841.60	24.62	48.29	5.06	18.86
1125A_5H-6_65-67_5	51.51	5.12	3.55	0.70	126.61	114.02	19.91	159.26	7.64	6.34	810.23	22.82	45.89	4.98	19.1
1125A_5H-6_65-67_9	43.01	4.99	2.58	0.71	117.80	110.15	19.61	153.69	6.94	5.71	797.48	23.1	45.36	5.01	18.49
1125A_5H-6_65-67_10	46.11	4.43	1.87	0.77	118.72	113.46	20.59	157.42	7.38	5.75	798.22	23.3	44.78	4.91	18.81
1125A_5H-6_65-67_7	44.32	10.07	2.08	2.46	110.82	96.44	26.66	193.10	6.62	5.38	744.71	21.73	47.06	5.02	22.55
1125B_1H-2_147-149_1	48.71	6.03	2.61	0.42	116.99	62.84	21.39	80.21	6.19	5.27	832.78	23.34	44.97	5.05	18.43
1125B_1H-2_147-149_3	51.18	6.74	2.80	0.35	126.53	64.92	22.23	83.70	6.72	5.78	874.62	24.32	47.2	5.22	17.93
1125B_1H-2_147-149_4	38.71	5.63	2.38	0.42	124.88	63.42	21.57	79.40	6.66	5.69	839.60	23.45	45.32	5.12	18.77
1125B_1H-2_147-149_6	43.95	6.02	2.23	0.33	110.52	58.70	21.16	79.14	5.90	4.92	778.66	21.79		4.72	18.37
1125B_1H-2_147-149_9	57.31	6.51	2.52	0.48	129.18	68.98	24.19	88.87	7.27	6.28	918.37	25.84	50.52	5.43	20.91
1125B_3H-3_26-28_2	50.30	3.70	4.06	0.31	153.43	49.14	24.94	81.24	7.68	8.23	871.35	30.09	58.58	6.29	23.31
1125B_3H-3_26-28_6	37.81	4.80	2.72	0.64	123.15	64.17	21.92	103.69	7.22	6.26	777.39	24.26	47.73	4.8	19.55
1125B_3H-3_26-28_8	43.83	3.28	5.00	0.50	137.97	52.33	21.01	77.68	6.96	7.25	832.75	25.8	50.38	5.65	19.06
1125B_3H-3_26-28_10	43.93	3.40	8.36	0.48	126.78	50.54	20.91	74.25	6.60	6.75	799.74	24.72	48.41	5.24	18.29
1125B_3H-3_26-28_5	45.50	4.58	11.76	0.68	145.13	105.98	23.55	125.52	7.89	6.49	1418.01	26.16	52.84	5.69	21.41
1125B_4H-1_27-29_1	45.02	4.27	7.05	0.26	171.32	39.72	21.44	57.16	5.03	10.41	749.34	21.66	40.49	4.52	15.69
1125B_4H-1_27-29_2	65.07	3.92	2.32	0.14	160.63	38.30	19.59	54.08	5.34	10.73	721.80	19.41	39.54	4.18	14.28
1125B_4H-1_27-29_3	59.52	4.44	2.91	0.24	197.96	25.44	23.96	57.43	5.69	12.75	401.73	19.85	40.29	4.41	15.76
1125B_4H-1_27-29_8	63.87	4.66	2.78	0.24	169.13	39.92	20.67	56.63	5.16	10.79	757.32	20.86	41.39	4.49	15.72
1125B_4H-1_27-29_10	66.53	4.00	2.32	0.17	151.14	38.47	20.08	53.08	4.48	9.54	712.35	19.44	39.04	4.04	13.74
1125B_5H-3_120-122_3	47.22	8.61	2.11	1.21	109.51	87.57	25.19	179.24	6.32	5.54	665.66	19.84	42.56	4.67	19.04
1125B_5H-3_120-122_4	42.11	8.63	1.92	0.78	122.92	78.74	27.16	160.73	7.59	6.22	763.06	23.1	47.64	5.51	21.07
1125B_5H-3_120-122_5	45.18	9.44	2.13	1.12	107.81	87.37	25.77	184.97	6.46	5.27	705.39	21.43	45.3	5.21	20.5
1125B_5H-3_120-122_7	40.64	9.59	2.95	0.55	112.25	76.74	26.96	153.97	6.40	5.65	739.85	23	48.41	5.23	20.69
1125B_5H-3_120-122_9	43.78	9.03	2.08	1.32	112.70	87.40	25.45	181.98	6.44	5.51	690.69	20.73	43.06	4.88	19.27
1125B_5H-4_64-66_1	38.42	5.62	2.11	7.41	130.38	62.30	12.48	70.94	4.27	6.52	835.77	19	35.68	3.58	12.23
1125B_5H-4_64-66_2	49.20	2.76	2.26	0.63	140.59	64.27	13.46	77.31	4.73	7.41	865.65	20.82	39.73	4.1	13.61
1125B_5H-4_64-66_7	47.87	4.42	13.09	0.91	163.18	74.97	13.72	87.52	5.42	8.30	952.80	21.87	41.75	4.29	14.55
1125B_5H-4_64-66_10	40.29	3.40	2.08	0.60	139.24	67.65	13.85	76.19	5.23	7.42	827.35	21.82	41.88	4.23	12.52
1125B_5H-4_64-66_9	42.71	7.80	2.99	1.69	121.89	90.89	19.55	169.19	6.03	6.00	832.76	20.76	41.63	4.61	15.03
1125B_6H-1_147-149_1	42.89	9.27	2.16	0.55	106.33	114.75	22.57	147.14	7.24	4.97	868.78	24.61	46.68	5.2	17.6
1125B_6H-1_147-149_3	42.18	10.01	3.54	1.15	104.63	139.23	21.66	166.08	7.29	4.94	828.67	23.26	45.11	5.1	19.07
1125B_6H-1_147-149_8	43.71	8.76	2.37	0.65	104.08	116.36	20.76	156.89	7.34	5.14	828.60	22.47	44.65	4.96	19.04
1125B_6H-1_147-149_9	38.45	7.54	2.02	0.65	104.01	97.34	19.91	127.08	6.60	4.80	791.46	21.47	42.08	4.6	17.38
1125B_6H-1_147-149_5	37.28	7.38	3.67	0.49	101.89	86.49	18.50	110.22	6.14	4.68	755.74	20.63	40.17	4.45	15.37
1125B_6H-5_133-135_2	39.55	6.71	2.06	0.37	140.94	45.63	23.25	76.94	6.20	7.43	851.26	24.03	48.07	5.34	19.41
1125B_6H-5_133-135_4	41.68	6.60	2.14	0.39	139.13	47.24	22.98	81.57	6.17	7.40	831.44	23.45	48.74	5.47	20.14
1125B_6H-5_133-135_5	33.97	6.95	2.45	0.35	135.76	45.62	22.87	74.42	5.95	6.93	830.23	23.56	48.52	5.5	20.31
1125B_6H-5_133-135_6	38.09	6.01	2.23	0.32	139.84	45.27	22.55	72.89	5.86	7.25	821.08	23.24	47.12	5.23	19.44
1125B_6H-5_133-135_9	39.75	6.38	2.27	0.42	142.29	45.85	23.74	76.47	6.20	7.58	876.03	24.56	50.18	5.44	19.57

Appendix A

Supplementary Table S16: Individual glass shard analyses of Quaternary marine tephra layers, ODP Leg 181 - Site 1125.

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1125A_3H-2_67-69_6	3.07	0.40	2.52	0.37	2.63	0.53	1.73	0.31	2.09	0.36	3.48	0.591	15.17	11.6	2.66
1125A_3H-2_67-69_7	2.46	0.41	2.41	0.39	2.75	0.56	1.78	0.28	2.41	0.40	2.97	0.509	18.81	12.73	2.94
1125A_3H-2_67-69_8	2.96	0.42	2.68	0.42	2.71	0.52	1.91	0.30	2.20	0.39	3.50	0.575	15.62	12.46	2.93
1125A_3H-2_67-69_10	2.60	0.39	1.94	0.31	2.28	0.49	1.71	0.23	2.25	0.31	3.17	0.462	13.24	10.23	2.64
1125A_3H-6_57-59_7	4.87	1.09	4.83	0.77	5.18	1.05	2.92	0.45	3.11	0.42	5.09	0.595	19.19	11.05	2.33
1125A_3H-6_57-59_2	6.03	0.93	5.02	0.93	5.06	1.22	3.52	0.44	4.04	0.55	6.12	0.657	18.17	10.93	2.78
1125A_3H-6_57-59_4	5.64	0.91	4.70	0.82	5.10	1.15	3.25	0.44	3.48	0.49	5.11	0.714	20.66	12.14	2.59
1125A_3H-6_57-59_6	5.27	1.24	5.06	0.85	5.01	1.08	3.44	0.53	3.66	0.48	6.58	0.708	17.83	11.09	2.35
1125A_3H-6_57-59_1	5.86	0.80	4.33	0.89	5.33	1.10	3.11	0.43	3.56	0.46	4.57	0.65	20.42	12.38	2.7
1125A_4H-4_115-117_7	6.73	1.09	5.34	0.86	5.54	1.25	3.46	0.60	3.62	0.57	6.97	0.715	21.14	12.77	3.24
1125A_4H-4_115-117_8	5.91	0.98	5.21	0.93	5.63	1.30	3.71	0.63	4.09	0.53	6.46	0.852	21.63	14.91	3.04
1125A_4H-4_115-117_10	5.07	0.86	4.85	0.83	5.18	1.15	3.13	0.51	3.26	0.53	5.23	0.629	19.92	12.27	2.86
1125A_4H-4_115-117_6	6.47	1.05	5.76	0.90	5.77	1.20	3.65	0.55	3.83	0.56	7.10	0.883	21.58	13.38	3.38
1125A_4H-4_115-117_1	5.47	0.66	5.20	0.74	5.12	1.11	3.12	0.51	3.50	0.53	4.65	0.765	20.51	14.39	3.36
1125A_5H-6_36-38_1	5.19	0.72	4.79	0.77	5.06	1.00	3.10	0.49	2.99	0.50	4.97	0.547	21.4	12.12	2.78
1125A_5H-6_36-38_2	4.92	0.69	5.15	0.74	4.92	1.06	3.08	0.46	3.22	0.44	4.67	0.534	19.17	11.58	2.54
1125A_5H-6_36-38_7	5.19	0.64	4.46	0.80	4.72	0.95	3.06	0.48	2.99	0.45	4.90	0.536	19.33	10.99	2.37
1125A_5H-6_36-38_8	5.08	0.69	5.43	0.78	4.68	1.10	3.69	0.49	3.55	0.54	5.23	0.702	22.89	12.38	2.95
1125A_5H-6_36-38_9	4.61	0.73	4.91	0.84	4.84	1.07	3.12	0.44	3.38	0.45	5.31	0.65	21.42	11.67	2.76
1125A_5H-6_65-67_2	3.71	0.73	3.56	0.53	3.75	0.69	2.24	0.34	2.64	0.41	5.03	0.681	16.76	11.7	2.91
1125A_5H-6_65-67_5	3.67	0.73	2.81	0.49	3.15	0.69	2.05	0.30	2.22	0.33	4.61	0.61	16.97	11.51	2.68
1125A_5H-6_65-67_9	3.58	0.74	3.42	0.52	3.10	0.61	1.92	0.31	1.97	0.32	4.63	0.581	16.19	11.55	2.73
1125A_5H-6_65-67_10	3.49	0.65	2.60	0.54	3.26	0.64	2.27	0.32	2.47	0.39	4.40	0.67	16.44	11.68	2.68
1125A_5H-6_65-67_7	5.15	0.61	4.49	0.82	4.47	0.98	3.17	0.49	2.79	0.40	5.19	0.613	18.78	12.05	2.32
1125B_1H-2_147-149_1	3.52	0.59	3.29	0.63	3.62	0.74	2.29	0.39	2.32	0.38	3.13	0.647	14.65	11.87	2.48
1125B_1H-2_147-149_3	3.56	0.59	3.32	0.59	3.68	0.92	2.31	0.39	2.44	0.39	3.01	0.57	15.21	11.85	2.61
1125B_1H-2_147-149_4	3.53	0.51	3.52	0.62	3.64	0.74	2.19	0.32	2.36	0.38	2.89	0.609	14.24	11.35	2.6
1125B_1H-2_147-149_6	3.78	0.56	3.26	0.50	3.40	0.75	1.92	0.33	2.26	0.29	2.53	0.617	13.2	10.55	2.33
1125B_1H-2_147-149_9	3.95	0.52	3.92	0.66	3.58	0.81	2.34	0.37	2.79	0.45	3.20	0.574	16.16	12.68	2.76
1125B_3H-3_26-28_2	4.21	0.42	3.14	0.67	3.66	0.84	2.75	0.41	2.76	0.38	3.13	0.718	21.02	15.8	3.39
1125B_3H-3_26-28_6	3.44	0.51	3.60	0.58	3.80	0.72	2.25	0.31	2.58	0.42	3.45	0.594	19.74	12.11	2.71
1125B_3H-3_26-28_8	3.87	0.41	3.28	0.54	3.50	0.71	2.24	0.36	2.65	0.38	2.85	0.592	19.96	13.6	2.98
1125B_3H-3_26-28_10	3.85	0.45	2.91	0.49	3.52	0.63	2.17	0.33	2.59	0.37	3.04	0.697	21.16	13.28	2.81
1125B_3H-3_26-28_5	4.29	0.86	3.49	0.68	3.87	0.85	2.75	0.40	2.44	0.36	4.26	0.688	28.49	13.25	2.86
1125B_4H-1_27-29_1	3.15	0.30	2.60	0.58	3.18	0.72	2.08	0.36	2.54	0.47	2.62	0.665	19.86	17.34	3.89
1125B_4H-1_27-29_2	2.50	0.28	2.75	0.54	3.07	0.49	2.05	0.32	2.10	0.32	1.97	0.534	20.5	15.59	3.77
1125B_4H-1_27-29_3	3.30	0.20	2.83	0.55	3.47	0.82	2.48	0.37	2.71	0.44	2.30	0.965	21.77	18.5	4.74
1125B_4H-1_27-29_8	3.67	0.25	3.01	0.52	3.04	0.68	2.29	0.35	2.35	0.34	2.52	0.801	21.42	17.13	4.12
1125B_4H-1_27-29_10	2.51	0.20	2.67	0.45	3.09	0.70	1.68	0.40	2.40	0.36	2.43	0.728	19.37	16.68	3.92
1125B_5H-3_120-122_3	4.45	0.63	3.57	0.72	4.16	0.96	2.63	0.42	2.83	0.46	5.00	0.508	17.41	9.79	2.31
1125B_5H-3_120-122_4	4.53	0.77	4.15	0.78	4.59	0.99	2.83	0.46	2.98	0.48	4.90	0.565	18.46	11.52	2.57
1125B_5H-3_120-122_5	4.48	0.64	3.96	0.68	4.56	0.85	2.54	0.41	3.31	0.41	4.90	0.539	17.62	10.03	2.42
1125B_5H-3_120-122_7	4.54	0.78	4.06	0.81	4.93	0.93	2.74	0.38	3.16	0.48	4.66	0.474	16.3	10.93	2.72
1125B_5H-3_120-122_9	4.21	0.69	3.70	0.65	4.28	0.93	2.69	0.33	2.42	0.43	5.24	0.537	16.59	9.86	2.35
1125B_5H-4_64-66_1	1.92	0.32	2.00	0.27	1.89	0.38	1.30	0.21	1.61	0.25	2.48	0.417	15.24	11.48	2.44
1125B_5H-4_64-66_2	2.44	0.40	1.96	0.33	2.01	0.45	1.36	0.21	1.56	0.25	2.60	0.464	17.37	12.74	2.76
1125B_5H-4_64-66_7	2.57	0.40	2.02	0.37	2.10	0.49	1.41	0.22	1.83	0.30	3.02	0.45	26.41	12.94	2.91
1125B_5H-4_64-66_10	3.11	0.42	2.12	0.32	2.23	0.50	1.37	0.25	1.65	0.27	2.34	0.519	18.24	13.68	3.08
1125B_5H-4_64-66_9	2.98	0.43	3.16	0.55	3.50	0.66	2.09	0.28	2.26	0.43	5.05	0.467	15.55	11.31	2.61
1125B_6H-1_147-149_1	3.83	0.78	3.14	0.62	3.50	0.87	2.26	0.35	2.81	0.41	4.73	0.513	15.04	11.73	2.47
1125B_6H-1_147-149_3	3.58	0.77	3.92	0.59	3.52	0.76	2.35	0.35	2.57	0.43	4.38	0.524	15.12	10.55	2.39
1125B_6H-1_147-149_8	4.00	0.72	3.30	0.57	3.23	0.79	2.31	0.36	2.36	0.32	4.66	0.543	15.09	11.17	2.32
1125B_6H-1_147-149_9	3.55	0.58	2.72	0.49	3.27	0.71	2.08	0.36	2.16	0.37	3.62	0.542	14.11	10.91	2.36
1125B_6H-1_147-149_5	3.49	0.50	2.49	0.46	3.07	0.63	1.97	0.30	2.26	0.30	3.27	0.531	13.09	9.89	2.17
1125B_6H-5_133-135_2	3.76	0.50	3.55	0.67	4.16	0.83	2.54	0.37	2.63	0.36	3.22	0.555	19.79	13.23	2.77
1125B_6H-5_133-135_4	3.95	0.47	3.47	0.67	4.05	0.90	2.51	0.35	2.40	0.44	3.17	0.514	19.58	13.16	3.03
1125B_6H-5_133-135_5	3.96	0.49	3.85	0.68	3.82	0.90	2.73	0.33	2.44	0.43	2.94	0.478	18.13	13.27	2.82
1125B_6H-5_133-135_6	3.98	0.47	3.92	0.60	3.94	0.79	2.22	0.37	2.14	0.34	3.05	0.536	18.31	12.95	3.03
1125B_6H-5_133-135_9	4.87	0.57	3.93	0.56	3.60	0.89	2.79	0.34	2.30	0.39	3.23	0.665	20.17	14.02	3.27

Appendix A

Supplementary Table S17: Individual glass shard analyses of Quaternary marine tephra layers, IODP Leg 329 - Site U1371.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s38	1371D_1H-2_64-66_1	6.82	5.00	6.33	60.65	0.29	0.02	1.68	0.18	15.24	0.04	96.25
	1371D_1H-2_64-66_2	4.76	3.01	1.26	67.28	0.30	0.14	3.76	0.01	16.91	0.05	97.49
	1371D_1H-5_68-70_1	3.95	3.29	1.14	73.28	0.10	0.08	0.91	0.03	11.56	0.04	94.38
	1371D_1H-5_68-70_2	4.18	3.32	1.10	73.09	0.10	0.03	0.66	0.06	11.40	0.00	93.94
	1371D_1H-5_68-70_3	4.17	3.30	1.64	71.68	0.17	0.15	1.16	0.07	12.36	0.01	94.71
	1371D_1H-5_68-70_5	4.21	3.32	1.02	73.38	0.08	0.07	0.80	0.07	11.58	0.01	94.54
	1371D_1H-CC_2-4_1	0.00	3.38	0.02	72.50	0.08	0.00	0.83	0.00	11.58	0.02	88.41
	1371D_1H-CC_2-4_3	3.80	3.32	1.06	72.99	0.09	0.10	0.85	0.01	11.69	0.01	93.92
	1371D_1H-CC_2-4_4	3.93	3.33	0.91	72.72	0.10	0.09	0.80	0.01	11.74	0.00	93.63
	1371D_1H-CC_2-4_5	5.02	4.06	2.77	69.59	0.12	0.00	0.31	0.12	11.33	0.01	93.34
	1371D_1H-CC_2-4_6	4.09	3.12	1.42	71.80	0.12	0.19	1.21	0.08	12.19	0.02	94.25
	1371D_1H-CC_2-4_8	3.75	3.36	0.97	72.50	0.09	0.03	0.81	0.09	11.38	0.03	93.01
	1371D_1H-CC_2-4_9	3.84	3.34	0.98	72.77	0.11	0.02	0.81	0.06	11.61	0.00	93.55
	1371D_1H-CC_2-4_10	3.24	4.12	0.90	72.35	0.17	0.08	0.76	0.06	11.72	0.01	93.40
	1371D_1H-CC_2-4_11	4.07	3.44	0.99	73.00	0.08	0.06	0.79	0.03	11.60	0.01	94.07
	1371D_2H-1_131-133_2	3.69	3.33	1.08	72.26	0.09	0.10	0.96	0.13	11.62	0.03	93.28
	1371D_2H-1_131-133_3	3.62	2.88	1.18	72.68	0.16	0.17	1.29	0.09	11.38	0.00	93.44
	1371D_2H-2_125-127_1	4.10	3.19	1.26	72.12	0.15	0.10	0.89	0.13	11.93	0.00	93.86
	1371D_2H-2_125-127_2	3.60	3.78	1.03	72.59	0.13	0.14	0.86	0.02	11.51	0.05	93.71
	1371D_2H-2_125-127_3	3.89	3.46	1.16	72.29	0.13	0.08	0.77	0.07	11.23	0.00	93.07
	1371D_2H-2_125-127_4	3.75	3.73	1.01	72.31	0.14	0.09	0.94	0.10	11.70	0.01	93.78
	1371D_2H-2_125-127_5	4.10	3.15	1.24	72.37	0.10	0.06	0.80	0.08	11.37	0.03	93.30
	1371D_2H-2_125-127_6	3.47	3.70	0.94	72.62	0.11	0.08	0.87	0.01	11.52	0.00	93.32
	1371D_2H-2_125-127_7	5.09	3.21	2.19	70.05	0.14	0.06	1.03	0.10	12.56	0.03	94.46
	1371D_2H-2_137-139_1	4.08	3.11	1.35	72.66	0.14	0.10	0.91	0.07	11.78	0.01	94.21
	1371D_2H-2_137-139_2	4.55	2.65	1.88	69.75	0.21	0.16	1.06	0.00	12.46	0.03	92.76
	1371D_2H-2_137-139_3	4.25	2.55	1.50	70.23	0.20	0.27	1.45	0.05	12.38	0.00	92.88
	1371D_2H-2_137-139_4	4.10	3.30	1.16	72.36	0.13	0.07	0.77	0.04	11.30	0.00	93.22
	1371D_2H-2_137-139_5	4.24	3.21	1.28	71.59	0.12	0.11	0.92	0.06	11.93	0.01	93.47
	1371D_2H-2_137-139_6	4.46	3.10	1.61	70.84	0.16	0.13	1.29	0.09	12.48	0.03	94.20
	1371D_2H-2_137-139_7	4.22	3.19	1.13	71.96	0.12	0.10	0.92	0.09	11.62	0.01	93.37
	1371D_2H-2_137-139_8	3.59	3.69	1.14	71.95	0.14	0.09	0.86	0.06	11.59	0.00	93.11
	1371D_2H-2_137-139_9	5.57	2.04	2.50	69.24	0.20	0.14	1.10	0.11	12.49	0.03	93.43
	1371D_2H-2_137-139_10	4.02	3.35	1.31	73.20	0.13	0.10	0.74	0.00	11.47	0.00	94.31
	1371D_2H-2_137-139_11	4.13	4.10	1.71	70.48	0.16	0.07	0.89	0.00	12.28	0.02	93.84
s64	1371D_3H-3_56-58_5	4.98	2.94	1.97	70.51	0.16	0.07	1.03	0.06	12.04	0.01	93.77
	1371D_3H-3_56-58_6	4.52	2.85	2.10	70.50	0.14	0.12	0.98	0.08	12.12	0.03	93.44
	1371D_3H-3_56-58_7	4.62	3.07	1.98	70.63	0.17	0.12	1.01	0.12	12.25	0.05	94.02
s66*	1371D_3H-6_2-4_13	4.60	3.25	2.15	69.69	0.18	0.08	1.02	0.05	12.50	0.00	93.52
	1371D_3H-6_2-4_14	4.50	3.17	2.19	70.05	0.16	0.14	1.01	0.04	12.32	0.00	93.58
	1371D_3H-6_2-4_15	4.79	3.12	2.02	70.01	0.15	0.10	1.03	0.10	12.67	0.02	94.01
	1371D_3H-6_2-4_16	4.65	3.31	1.99	69.65	0.17	0.15	1.07	0.09	12.42	0.00	93.51
	1371D_3H-6_2-4_17	4.68	3.20	2.25	70.24	0.15	0.12	1.10	0.07	12.51	0.00	94.32
	1371D_3H-6_2-4_18	4.87	3.02	2.31	69.71	0.15	0.05	1.01	0.10	12.47	0.02	93.71
	1371D_3H-6_2-4_19	3.86	3.58	2.16	64.86	0.11	0.07	0.90	0.10	11.40	0.01	87.06
	1371D_3H-6_2-4_20	4.38	3.34	2.01	69.86	0.15	0.07	1.07	0.01	12.41	0.02	93.31
	1371D_3H-6_63-65_1	3.94	3.44	1.01	72.05	0.09	0.07	0.87	0.12	11.51	0.01	93.11
	1371D_3H-6_63-65_2	3.77	3.50	1.06	72.63	0.08	0.04	0.83	0.07	11.53	0.01	93.51
s67*	1371D_3H-6_63-65_3	3.64	3.44	1.25	72.24	0.09	0.04	0.89	0.05	11.84	0.00	93.48
	1371D_3H-6_63-65_4	3.69	3.34	1.03	71.81	0.07	0.04	0.85	0.02	11.47	0.02	92.33
	1371D_3H-6_63-65_5	3.74	3.40	1.17	72.40	0.05	0.06	0.90	0.00	11.55	0.00	93.27
	1371D_3H-6_63-65_6	3.70	3.39	1.14	72.44	0.08	0.02	0.82	0.09	11.50	0.00	93.17
	1371D_3H-6_63-65_7	3.77	3.63	1.13	72.47	0.06	0.00	0.80	0.01	11.62	0.00	93.49
	1371D_3H-6_63-65_8	3.86	3.24	1.27	71.69	0.08	0.04	0.86	0.03	11.82	0.00	92.89
	1371D_3H-6_63-65_9	3.55	3.60	1.22	72.19	0.08	0.02	0.84	0.05	11.63	0.00	93.18
	1371D_3H-6_63-65_10	3.65	1.76	1.07	71.94	0.08	0.07	0.51	0.02	11.50	0.02	90.63
	1371D_3H-6_63-65_11	3.67	2.33	1.13	72.08	0.05	0.05	0.55	0.02	11.74	0.03	91.64
	1371D_3H-6_63-65_12	3.52	3.44	1.11	71.97	0.07	0.04	0.81	0.00	11.66	0.00	92.62

Appendix A

Supplementary Table S18: Individual glass shard analyses of Quaternary marine tephra layers, DSDP Leg 90 - Site 594.

volcanic event	Sample name	Na2O	K2O	FeO	SiO2	TiO2	MgO	CaO	MnO	Al2O3	P2O5	Total
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
s37	594_5H-2_36-38_1	3.42	4.18	1.06	72.66	0.15	0.09	0.77	0.00	11.59	0.00	93.91
	594_5H-2_36-38_2	3.37	4.00	1.16	72.50	0.14	0.11	0.75	0.02	11.61	0.00	93.66
	594_5H-2_36-38_3	3.62	4.08	1.06	72.67	0.14	0.09	0.77	0.05	11.39	0.01	93.87
	594_5H-2_36-38_4	3.49	4.19	0.91	73.07	0.12	0.11	0.78	0.04	11.60	0.01	94.32
	594_5H-2_36-38_5	2.93	4.34	0.94	72.79	0.14	0.08	0.77	0.04	11.35	0.02	93.40
	594_5H-2_36-38_6	3.65	4.09	0.91	72.94	0.16	0.10	0.78	0.03	11.71	0.02	94.38
	594_5H-2_36-38_7	3.54	4.07	1.00	72.51	0.12	0.08	0.75	0.05	11.78	0.04	93.95
	594_5H-2_36-38_8	3.54	4.18	1.02	72.70	0.13	0.09	0.76	0.08	11.59	0.02	94.12
	594_5H-2_36-38_9	3.46	4.19	1.00	72.63	0.14	0.12	0.75	0.01	11.49	0.03	93.82
	594_5H-2_36-38_10	3.56	4.02	1.05	72.69	0.12	0.11	0.77	0.09	11.49	0.00	93.89
	594_5H-2_36-38_11	3.63	4.02	0.95	73.14	0.12	0.09	0.79	0.04	11.72	0.02	94.51
	594_5H-2_36-38_12	3.60	4.00	1.04	72.46	0.14	0.08	0.76	0.03	11.53	0.01	93.64
	594_5H-2_36-38_13	3.42	4.07	1.03	72.37	0.10	0.10	0.83	0.00	11.49	0.00	93.42
	594_5H-2_36-38_14	3.68	4.15	0.95	72.27	0.15	0.09	0.77	0.13	11.46	0.00	93.64
	594_5H-2_36-38_15	3.55	4.10	0.94	72.93	0.10	0.10	0.76	0.02	11.68	0.00	94.18
	594_5H-2_36-38_16	3.35	4.15	1.01	73.02	0.13	0.07	0.80	0.05	11.72	0.01	94.31
	594_5H-2_36-38_17	3.51	4.05	0.94	72.40	0.13	0.10	0.81	0.07	11.52	0.02	93.55
	594_5H-2_36-38_18	3.40	4.08	1.03	72.74	0.17	0.06	0.81	0.02	11.64	0.02	93.96
	594_5H-2_36-38_19	3.54	3.96	1.06	72.75	0.13	0.10	0.81	0.00	11.61	0.00	93.95
	594_5H-2_36-38_20	3.56	4.21	1.00	72.38	0.16	0.09	0.74	0.03	11.59	0.00	93.75
	594-5H-2_36-38cm_2	3.38	4.10	1.15	74.93	0.13	0.06	0.72	0.09	11.96	0.00	96.52
	594-5H-2_36-38cm_4	3.41	3.92	1.01	75.16	0.13	0.11	0.73	0.04	11.63	0.01	96.14
	594-5H-2_36-38cm_5	3.47	4.12	1.04	75.16	0.14	0.10	0.75	0.05	11.74	0.03	96.60
	594-5H-2_36-38cm_6	3.31	4.15	0.89	75.08	0.13	0.05	0.76	0.03	11.77	0.03	96.19
	594-5H-2_36-38cm_7	3.15	4.20	0.96	75.25	0.11	0.11	0.74	0.06	11.69	0.00	96.27
	594-5H-2_36-38cm_10	3.29	4.06	0.99	74.84	0.13	0.08	0.71	0.04	11.70	0.00	95.84
	594-5H-2_36-38cm_1	3.46	4.02	1.02	74.93	0.12	0.11	0.76	0.06	11.68	0.04	96.21
	594-5H-2_36-38cm_3	3.39	4.00	1.15	74.84	0.13	0.07	0.74	0.10	11.86	0.02	96.29
	594-5H-2_36-38cm_8	3.49	4.10	1.03	75.24	0.14	0.07	0.76	0.00	11.81	0.01	96.65
	594-5H-2_36-38cm_9	3.43	4.13	0.97	75.89	0.14	0.09	0.76	0.04	12.05	0.01	97.53
	594-5H-2_36-38cm_11	3.31	4.02	1.06	75.63	0.15	0.08	0.74	0.00	12.04	0.01	97.05
	s71* 594_13H-CC_0-2_2	4.73	3.26	2.05	70.52	0.13	0.10	1.14	0.07	12.50	0.01	94.50
	594_13H-CC_0-2_3	4.05	3.80	1.45	72.36	0.09	0.04	0.75	0.10	11.85	0.00	94.48
	594_13H-CC_0-2_4	4.38	3.26	1.86	69.56	0.14	0.09	1.08	0.08	12.57	0.00	93.02
	594_13H-CC_0-2_5	4.36	3.42	1.63	71.58	0.14	0.05	0.98	0.04	12.17	0.00	94.38
	594_13H-CC_0-2_6	3.92	3.54	1.27	71.59	0.07	0.01	0.72	0.06	11.50	0.00	92.68
	594_13H-CC_0-2_7	4.47	3.11	2.00	70.55	0.16	0.12	1.14	0.02	12.48	0.04	94.08
	594_13H-CC_0-2_8	4.48	3.37	2.16	70.49	0.17	0.09	1.13	0.05	12.50	0.03	94.47
	594_13H-CC_0-2_9	4.47	3.20	1.87	69.56	0.18	0.09	1.12	0.01	12.34	0.00	92.84
	594_13H-CC_0-2_10	3.71	3.34	1.27	72.31	0.07	0.05	0.97	0.09	11.80	0.02	93.63
	594_13H-CC_0-2_12	4.17	3.70	1.30	72.73	0.09	0.01	0.68	0.06	11.63	0.03	94.40
	594-13H-CC 0-2cm_2	4.17	3.65	1.39	74.72	0.09	0.04	0.76	0.00	12.10	0.02	96.94
	594-13H-CC 0-2cm_3	3.81	3.87	1.16	74.72	0.07	0.00	0.73	0.00	11.99	0.00	96.35
	594-13H-CC 0-2cm_7	3.52	4.05	1.13	72.12	0.02	0.03	0.88	0.06	12.77	0.00	94.58
	594-13H-CC 0-2cm_1	4.36	3.37	2.07	72.18	0.14	0.04	1.02	0.13	12.46	0.05	95.82
	594-13H-CC 0-2cm_6	4.25	3.35	1.78	72.76	0.13	0.08	0.93	0.10	12.36	0.03	95.76
	594-13H-CC 0-2cm_4	4.40	3.36	1.96	72.80	0.13	0.07	0.90	0.07	12.37	0.00	96.06
	s71* 594A_8H-3_49-51_1	4.20	3.57	1.31	72.33	0.10	0.04	0.66	0.09	11.89	0.01	94.20
	594A_8H-3_49-51_2	4.40	3.29	1.96	69.79	0.13	0.10	1.08	0.00	12.55	0.01	93.31
	594A_8H-3_49-51_3	3.81	3.67	1.38	71.43	0.08	0.00	0.69	0.10	11.53	0.00	92.69
	594A_8H-3_49-51_4	4.02	3.62	1.31	71.96	0.06	0.01	0.71	0.01	11.51	0.00	93.22
	594A_8H-3_49-51_5	4.45	3.26	2.00	69.66	0.14	0.08	1.04	0.06	12.37	0.03	93.09
	594A_8H-3_49-51_6	4.77	3.17	1.97	70.39	0.17	0.11	1.00	0.09	12.58	0.01	94.27
	594A_8H-3_49-51_7	4.28	3.28	1.93	70.81	0.14	0.07	0.93	0.03	12.12	0.02	93.60
	594A_8H-3_49-51_8	4.51	3.29	1.98	70.83	0.14	0.09	0.97	0.12	12.49	0.00	94.42
	594A_8H-3_49-51_9	4.21	3.74	1.41	71.77	0.10	0.00	0.66	0.09	11.67	0.01	93.65
	594A_8H-3_49-51_10	4.20	3.31	1.90	70.04	0.15	0.07	0.98	0.06	12.30	0.01	93.03
	594A_8H-3_49-51_11	4.13	3.63	1.36	72.45	0.08	0.04	0.66	0.04	11.48	0.03	93.90
	594A_8H-3_49-51_12	4.02	3.73	1.16	72.30	0.08	0.00	0.68	0.02	11.76	0.00	93.76
	594A_8H-3_49-51_13	3.46	3.50	1.06	72.06	0.07	0.03	0.78	0.01	11.45	0.00	92.42
	594A_8H-3_49-51_14	3.93	3.60	1.27	72.14	0.08	0.04	0.64	0.04	11.52	0.00	93.26
	594A_8H-3_49-51_15	3.28	4.82	0.98	71.82	0.10	0.01	0.79	0.04	12.17	0.00	94.02
	594A_8H-3_49-51_16	4.53	3.06	1.77	70.19	0.13	0.07	0.93	0.13	12.22	0.03	93.06
	594A_8H-3_49-51_17	4.05	3.57	1.26	72.42	0.11	0.04	0.67	0.00	11.63	0.02	93.77
	594A_8H-3_49-51_18	4.32	3.82	1.37	72.79	0.10	0.06	0.67	0.04	11.72	0.00	94.89
	594A_8H-3_49-51_19	4.15	3.19	1.81	70.11	0.12	0.07	0.94	0.04	12.23	0.00	92.66
	594A_8H-3_49-51_20	4.30	3.30	1.71	70.38	0.14	0.07	0.93	0.05	12.17	0.01	93.06

Appendix A

Supplementary Table S18: Individual glass shard analyses of Quaternary marine tephra layers, DSDP Leg 90 - Site 594.

Sample name	Li7	Sc45	Cr53	Co59	Rb85	Sr88	Y89	Zr90	Nb93	Cs133	Ba137	La139	Ce140	Pr141	Nd146
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
594-5H-2 36-38cm_1	52.91	7.15	2.28	0.63	158.44	52.77	17.73	104.29	6.86	7.43	886.26	23.04	45.99	4.59	16.04
594-5H-2 36-38cm_3	55.60	7.01	3.15	0.69	152.89	50.63	17.26	101.62	6.61	7.12	861.01	22.4	43.86	4.54	15.65
594-5H-2 36-38cm_8	51.66	7.10	2.46	0.69	157.10	51.90	18.25	105.81	6.68	7.46	899.23	23.1	45.1	4.8	16.65
594-5H-2 36-38cm_9	54.16	7.39	2.15	0.72	161.37	51.85	18.81	108.68	7.20	7.86	917.61	24.14	47.16	4.92	16.91
594-5H-2 36-38cm_11	55.68	6.96	2.13	0.69	153.74	51.21	17.97	103.44	6.71	7.19	883.66	22.54	45.6	4.5	15.6
594-13H-CC 0-2cm_2	46.20	9.74	2.44	0.18	147.69	49.90	34.27	150.30	10.80	8.37	888.88	31.53	70.78	7.55	28.74
594-13H-CC 0-2cm_3	41.26	9.41	2.09	0.25	132.33	37.52	29.48	127.33	8.92	7.44	790.66	28.14	59.16	6.51	26.07
594-13H-CC 0-2cm_7	48.34	5.89	2.35	0.36	173.29	69.63	17.94	58.45	14.21	10.41	843.44	23.92	50.55	5.27	21.23
594-13H-CC 0-2cm_1	46.70	12.73	2.45	0.37	132.73	81.94	35.84	260.87	10.92	7.17	893.13	31	67.63	7.81	29.01
594-13H-CC 0-2cm_6	31.78	7.66	1.31	0.32	82.07	44.72	19.73	138.62	6.90	4.63	525.20	17.64	40.12	4.45	16.54

Sample name	Sm147	Eu153	Gd157	Tb159	Dy163	Ho165	Er166	Tm169	Yb172	Lu175	Hf178	Ta181	Pb208	Th232	U238
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
594-5H-2 36-38cm_1	3.09	0.46	2.69	0.41	3.00	0.65	1.77	0.30	2.01	0.31	3.09	0.658	15.93	14.49	3.29
594-5H-2 36-38cm_3	3.25	0.39	2.75	0.43	2.87	0.56	1.79	0.29	2.15	0.31	3.15	0.655	16.07	13.4	3.22
594-5H-2 36-38cm_8	2.98	0.39	2.98	0.46	2.93	0.61	1.98	0.27	2.03	0.34	3.31	0.668	16.4	14.2	3.45
594-5H-2 36-38cm_9	3.17	0.29	2.94	0.48	3.25	0.63	1.88	0.31	2.06	0.29	3.79	0.705	17.7	14.58	3.51
594-5H-2 36-38cm_11	2.79	0.41	2.84	0.43	2.95	0.65	1.81	0.28	2.24	0.32	2.93	0.654	16.27	13.98	3.36
594-13H-CC 0-2cm_2	5.28	0.65	6.66	1.17	5.50	1.21	2.84	0.50	3.78	0.58	6.10	0.9	24.54	16.01	3.7
594-13H-CC 0-2cm_3	4.96	0.69	4.63	0.77	5.35	1.05	3.21	0.41	3.72	0.53	3.42	0.716	19.89	14.01	3.03
594-13H-CC 0-2cm_7	4.76	0.61	2.62	0.53	2.67	0.65	1.51	0.32	1.60	0.23	2.56	1.09	22.95	14.51	4.73
594-13H-CC 0-2cm_1	6.46	1.13	6.13	0.97	6.39	1.42	3.79	0.55	3.93	0.60	6.56	0.815	22.21	14.49	3.34
594-13H-CC 0-2cm_6	3.62	0.66	3.89	0.56	3.48	0.75	2.32	0.30	2.30	0.32	3.86	0.529	13.84	8.23	2.17

Appendix A

Supplementary Table S19: Holistic estimation of repose times during the Quaternary.

volcanic event	volcanic event	Sample ID	Age [ka]	volcanic event	Quaternary eruption chronology [ka]
correlated	uncorrelated		indirect / direct	#	relying on most solid age models or average
s1		U1520D-1H-1_119-120	2.03	1	1.71
		U1519D_1H-2_15-17			
		U1519E_1H-2_7-9			
s2		U1520D-1H-3_26-30	5.59	2	3.38
		U1519D_1H-CC_4-6			
		U1519E_1H-3_95-97			
s3		U1520D-1H-3_67-69	6.27	3	5.54
		U1526B_1H-1_93-95			
s4		U1520D-1H-4_35-37	8.30	4	8.30
s5		U1520D-1H-4_87-90	9.13	5	9.47
		U1526B_1H-1_122-124			
s6		U1520D-2H-1_15-19	10.40	6	10.00
s7		U1520D-2H-3_77-79	15.25	7	10.50
s8		U1520D-4H-4_117-119	19.57	8	11.51
s9		U125A_1H-1_71-73	17.47	9	25.35
		U1526B_1H-3_36-38			
		U123C_1H-1_148-150	33.97		
s10		U123B_1H-2_5-7	35.56	10	32.50
		U123A_1H-2_6-8	35.78		
		U124B_1H-2_43-45	53.15		
		U122A_1H-4_26-28			
		U123C_1H-2_69-71	50.05		
s11		U124B_1H-3_15-17	86.74	11	45.17
		U124A_1H-1_71-73	83.44		
	u1	U125B_1H-2_147-149	110.99	12	110.99
	u2	U1526B_1H-3_111-113	111.20	13	111.20
s12	u3	U1526B_1H-3_116-118	111.80	14	111.80
		U1520D_15H-4_71-73	141.00	15	141.00
		U1526B_2H-1_94-96			
	u4	U1520D_16H-2_65-67	145.90	16	145.90
	u5	U124A_1H-3_35-37	156.13	17	156.13
	u6	U1520D_18H-2_108-110	177.40	18	177.40
	u7	U1520D_18H-5_123-125	185.70	19	185.70
	u8	U1520D_18H-6_107-109	188.20	20	188.20
	u9	U1520D_20F-1_125-127	200.50	21	200.50
	u10	U1520D_21F-4_6-8	210.30	22	210.30
	u11	U1520D_21F-4_48-50	210.80	23	210.80
	u12	U1520D_22F-2_60-62	213.10	24	213.10
	u13	U1520D_22F-2_80-82	213.30	25	213.30
s13		U1520D_23F-3_6-8	223.10	26	235.00
		U124C_1X-1_80-82	242.30		
		U123A_2H-5_66-68	248.62		
s14		U123B_2H-6_91-93	251.15	27	249.55
		U123C_2H-2_104-109	256.13		
	u14	U125A_2H-4_17-19	259.39	28	259.39
s15		U123A_2H-6_18-20	271.76	29	276.63
		U123C_2H-3_69-71	281.50		
s16		U123A_2H-6_70-72	283.54	30	289.65
		U123C_2H-3_132-134	295.77		
s17		U1520D_25F-2_10-14	301 / 363±33	31	310.00
		U1526B_2H-2_92-93			
	u15	U124A_1H-7_25-27	310.10	32	310.10
s18	u16	U1520D_26F-1_103-105	310.6 / 330±37	33	310.60
	u17	U1520D_26F-2_23-27	312.2 / 346±33	34	312.20
	u18	U1520D_26F-3_29-31	314.55	35	314.55
	u19	U1520D_26F-4_51-55	316.27 / 336±38	36	316.27
s19		U1520D_27F-1_44-46	317.18	37	317.18
		U1518F-13R-1_113-115	310.00		
	u20	U1520D_27F-1_96-98	317.89 / 235-300		
	u21	U1520D_27F-2_78-80	319.26 / 347±22		
s20		U1520D_27F-2_92-96	319.33 / 347±22	39	319.26
		U1520D_27F-3_74-78	319.75		
		U125B_2H-3_143-145	388.34		
s21*		U125A_3H-2_67-69	390.31	40	319.33
		U1520D_28F-1_93-95	321.04		
		U1518E-1H-4_16-18	320.00		
s20		U1520D_33X-3_60-62a I	334.16	41	321.04
		U1520D_33X-3_60-62 II			
		U1526B_2H-3_83-85			

Appendix A

Supplementary Table S19: Holistic estimation of repose times during the Quaternary.

volcanic event	volcanic event	Sample ID	Age [ka]	volcanic event	Quaternary eruption chronology [ka]
correlated	uncorrelated		indirect / direct	#	relying on most solid age models or average
		U1517C_35F-3_12-14	334.00		
	u22	U1517C_35F-4_61-63	460.00	43	460.00
s22		U1517C_35F-4_125-127	463.00	44	463.20
		1125A_3H-4_64-66	463.40		
	u23	U1518E-1H-4_118-120	500.00	45	500.00
	u24	1125A_3H-5_124-126	515.08	46	515.08
		U1520D_35X-7_72-74	496.78		
		1125A_3H-6_57-59 II	535.51		
s23*		U1526B_2H-3_101-10 II			
		U1518E-2H-1_136-138	508±109	47	504.00
		1526B_2H-3_101-103 I			
		U1520D_35X-7_86-88	496.84		
		U1518E-2H-4_26-28	>508±109		
	u25	U1518E-2H-6_109-111	508.00	48	508.00
	u26	U1518E-3H-1_73-75	510.00	49	510.00
		1125A_3H-6_57-59 I	535.51		
s24*		1124D_1H-2_70-72	583.00	50	535.00
		U1518E-3H-1_92-93	<585±39		
s25		1125B_3H-1_32-34	546.58	51	546.95
		1125A_3H-6_105-107	547.32		
s26		1123C_3H-4_84-86	558.47	52	558.47
		1124D_1H-2_148-150	659.70		
	u27	U1526B_2H-3_126-128	560.00	53	560.00
s27		1125B_3H-3_26-28	618.93	54	618.93
		1517C_36F-2_3-5			
s28		U1520D_35X-CC_2-4	631.78	55	631.78
		U1526B_2H-6_78-80			
s29		1124D_1H-3_50-52	661.07	56	661.93
		1124C-2X-6_53-55	662.80		
	u28	1123A_4H-5_71-73	665.59	57	665.59
		1124D-1H-4_86-88	665.00		
s30		U1518E-3H-3_36-40	585±39	58	665.00
		U1517C_36F-2_100-101			
s31		1124C_3H-1_85-87	691.98	59	693.06
		1124D_1H-5_79-81	694.13		
s32		1125A_4H-2_52-54	699.16	60	703.35
		1125B_3H-5_86-88	707.53		
		U1520D_38X-CC_37-39	711.64		
s33		1123A_4H-6_125-127	711.79	61	711.14
		U1518E-3H-6_16-18	710.00		
s34		U1520D_39X-3_20-22	725.69	62	725.69
	u29*	1125B_3H-6_43-45 I	733.86	63	733.86
		1125B_3H-6_43-45 II			
		1124D_1H-7_24-26 I	737.89		
s35*		1124D_1H-7_24-26 II		64	739.72
		1124C_3H-3_54-56	740.03		
		1125A_4H-3_73-75	741.25		
	u30	1124C_3H-4_50-52	766.11	65	766.11
		U1520D_39X-5_64-66	763.85		
s36		1124C_3H-4_107-109	776.29	66	772.80
		1124D_2H-1_42-44	778.25		
		U1518E-5H-2_66-70			
		1125B_4H-1_27-29	791.2		
s37		U1518E-9H-2_0-1	792.0	67	791.57
		594_5H-2_36-38	791.5		
		1124D_2H-1_128-130	793.61		
s38		1124C_3H-5_56-58	793.97	68	793.79
		U1371D_1H-CC_2-4			
	u31	1124C_3H-5_90-92	800.04	69	800.04
		U1520D_40X-1_60-62	782.69		
s39		1124D_2H-2_53-55	807.01	70	808.74
		1124C_3H-5_141-143	809.15		
		1123C_4H-6_68-70	836.12		
		U1520D_40X-1_77-79	782.84		
s40		1124D_2H-2_121-123	819.15	71	807.88
		1124C_3H-6_61-63	821.65		
s41		U1520D_40X-CC_38-40	783.35	72	807.91
		1122C_37X-1_37-38	800.00		
		1125A_4H-4_115-117 I	808.00		

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Supplementary Table S19: Holisitic estimation of repose times during the Quaternary.

volcanic event	volcanic event	Sample ID	Age [ka]	volcanic event	Quaternary eruption chronology [ka]
correlated	uncorrelated		indirect / direct	#	relying on most solid age models or average
s42*		1125A_4H-4_115-117 II			
		1125A_4H-4_115-117 III			
		1125B_4H-1_59-61a I	799.08	73	807.94
		1125B_4H-1_59-61 II			
		1125B_4H-2_11-13	824.18		
		U1519C_14R-2_48-50	800.50		
		U1520D_42X-1_97-99 I	815.50	74	815.50
		U1520D_42X-1_97-99 II			
		u33 1125A_4H-5_120-122	826.64	75	826.64
		u34 1124D_2H-3_128-130	847.19	76	847.19
s43		1123C_5H-1_90-92	850.61		
		1123B_5H-3_3-5	857.18	77	857.18
		1123A_5H-2_98-100	863.75		
		U1519C_15R-1_71-73			
		1124D_2H-4_88-90	866.8		
s44		U1520D_44X-1_5-7_2	906.60	78	894.51
		U1519C_15R-5_20-22	900.60		
		U1526B_3H-2_48-50	904.00		
		1124C_4H-1_26-28	851.12	79	896.50
s45		1124D_2H-4_128-130	873.98		
		1124D_2H-5_87-89	893.45		
		U1520D_44X-1_43-45	909.13	80	901.90
		U1519C_16R-1_146-148	900.00		
		U1526B_3H-2_64-66	905.00		
s46		U1519C_16R-5_111-114	909.20	81	909.20
		u35 U1519C_17R-1_9-11	909.25	82	909.25
		U1519C_19R-3_33-35	909.30	83	909.30
		U1526B_3H-2_85-87	909.30		
		1124C_4H-2_17-19	892.74		
s47		U1520D_44X-1_47-49	909.39	84	909.39
		U1371D_2H-2_137-139	800.00		
		1124D_2H-5_146-148	904.0	85	910.0
s48		1124C_4H-2_81-83	904.17		
		1124D_2H-CC_10-12 I	907.74		
		1124C_4H-2_118-120	910.78	86	910.50
		U1519C_19R-3_122-125	908.00		
s49		1124D_2H-CC_10-12 II			
		u37 U1519C_19R-4_35-36	910.00	87	911.00
		U1520D_44X-1_96-98	912.65		
		1123A_5H-3_66-68	890.47	88	912.70
		1124C_4H-3_48-50	925.07		
s50*		U1518E-9H-CC_14-16	910.00		
		1124C_4H-3_121-123	938.10	89	938.10
		1124C_4H-3_142-144	941.85	90	941.85
s51		1124C_4H-4_81-83	957.75	91	960.00
		1124D_3H-1_3-5	963.47		
s52		1124C_4H-4_111-113	963.11	92	965.00
		1124D_3H-1_27-29	967.75		
s53		1123C_5H-5_121-123	1012.80	93	1011.50
		U1526B_3H-2_105-107	1010.00		
		u40 U1526B_3H-3_37-39	1020.00	94	1020.00
		u41 U1520D_46X-1_11-12	1033.90	95	1033.90
		u42 1124D_3H-4_96-98	1060.45	96	1060.45
s54		1124C_5H-1_91-93	1066.34	97	1067.50
		1124D_3H-4_145-147	1069.20		
		1124C_5H-2_5-7	1077.77	98	1077.77
s55		1124C_5H-2_45-47 I	1085.00		
		1124C_5H-2_45-47 II		99	1083
		1124D_3H-5_60-62	1081.00		
		1124C_5H-2_65-67	1088.49	100	1089.00
s56*		1124D_3H-5_112-114	1090.10		
		1124D_3H-6_5-7 I	1097.78	101	1098.00
s57		1124D_3H-6_5-7 II	1097.78		
		u44 U1520D_47X-1_17-19	1098.08	102	1098.08
		1124D_3H-6_46-48	1105.10	103	1105.55
s58*		1124C_5H-3_13-15	1105.99		
		1124C_5H-3_107-109	1122.78		
s59		1124D_3H-6_116-118	1120.00	104	1120.93
		U1526B_3H-3_133-135	1120.00		

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Supplementary Table S19: Holisitc estimation of repose times during the Quaternary.

volcanic event	volcanic event	Sample ID	Age [ka]	volcanic event	Quaternary eruption chronology [ka]
correlated	uncorrelated		indirect / direct	#	relying on most solid age models or average
s61		1124C_5H-4_9-11	1132.07	105	1132.90
		U1520D_47X-3_0-2	1133.73		
		1123C_6H-1_77-79	1134.32		
s62		1123B_6H-6_50-52	1242.66	106	1171.00
		U1526B_3H-4_38-40	1136.00		
	u45	U1520D_47X-3_111-113	1150.95	107	1150.95
		1125B_4H-2_124-126	1241.04		
s63		1123C_6H-3_128-130	1247.17	108	1252.21
		1123B_6H-6_137-139	1270.63		
		U1519C_19R-5_100-102	1250.00		
		1123C_6H-4_62-64	1274.17		
s64		1124D_4H-2_69-71	1269.49	109	1279.02
		1124C_5H-6_57-59	1272.42		
		1371D_3H-3_56-58	1300.00		
	u46	U1520D_48X-2_47-49	1285.76	110	1285.76
	u47	U1519C_19R-6_86-88	1287.00	111	1287.00
		1123C_6H-4_93-95	1284.14		
		1124D_4H-2_116-118	1292.50		
s65		U1520D_48X-CC_22-24	1291.35	112	1289.33
		U1519C_20R-3_29-31			
		U1526B_3H-5_1-3			
		1124D_4H-2_137-139 I	1302.78		
s66*		1124C_5H-6_131-133	1308.66	113	1309.82
		1123A_6H-4_131-131	1327.86		
		U1371D_3H-6_2-4	1300.00		
		1124D_4H-2_137-139 II	1302.78		
s67*		1124C_5H-7_60-62	1347.34	114	1326.28
		U1526B_3H-5_8-10	1305.00		
		U1371D_3H-6_63-65	1350.00		
		1123C_6H-5_110-112	1337.82		
s68		1123A_6H-5_18-20	1339.75	115	1358.29
		1124C_5H-CC_10-12	1397.28		
		1123C_6H-5_123-125	1342.00		
s69		1124C_6H-1_26-28	1395.33	116	1355.19
		1124D_4H-3_70-72	1343.42		
		U1526B_3H-5_51-53	1340.00		
s70		1123B_7H-1_129-131	1387.65	117	1388.14
		1123C_6H-6_118-120	1388.62		
	u48	U1518E_24F-3_71-73	1392.00	118	1392.00
		1124C_6H-1_37-39 I	1400.71		
		U1518E-25F-2_30-32a I			
		594_13H-CC_0-2 II			
s71*		594A_8H-3_49-51 I		119	1400.71
		1124C_6H-1_37-39 II			
		U1518E-25F-2_30-32 II			
		594_13H-CC_0-2 I			
		594A_8H-3_49-51 II			
	u49	1123A_6H-6_64-66	1402.76	120	1402.76
	u50	1125B_4H-4_74-76	1404.56	121	1404.56
		1123C_6H-7_14-16 I	1403.41		
s72*		1123B_7H-2_38-40 II		122	1405.01
		1123C_6H-7_14-16 II			
		1123B_7H-2_38-40 II	1406.62		
	u51	1124D_4H-4_100-102	1408.06	123	1408.06
		1123A_6H-6_125-127	1422.38		
s73		1124D_4H-5_12-14	1438.41	124	1441.15
		U1520D_49X-1_15-17	1453.80		
		U1518E_29X-2_66-68	1450.00		
	u52	1123A_6H-7_15-17	1435.23	125	1435.23
	u53	1124C_6H-1_118-120	1440.37	126	1440.37
		1123B_7H-2_88-90	1422.70		
s74		1123C_6H-7_64-66	1455.49	127	1448.63
		1123A_7H-1_52-54	1467.70		
	u54	U1518E-29X-6_7-9	1452.00	128	1452.00
		U1518E-32X-1_20-24 I	1455.00		
s75*		U1520D_49X-1_28-30	1456.40	129	1455.70
		U1518E-32X-1_20-24a II	1455.00		
		1124C_6H-2_27-29 I	1469.26		
s76*		1124C_6H-2_27-29 II		130	1469.75

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Supplementary Table S19: Holisitic estimation of repose times during the Quaternary.

volcanic event	volcanic event	Sample ID	Age [ka]	volcanic event	Quaternary eruption chronology [ka]
correlated	uncorrelated		indirect / direct	#	relying on most solid age models or average
s77	u55	1124D_4H-5_77-79	1470.24	131	1516.51
		1124D_4H-6_18-20	1514.80		
		1124C_6H-2_127-129	1518.23		
		U1520D_49X-CC_29-31	1523.85		
s78	u56	1124D_4H-6_57-59	1533.89	133	1533.89
		1123C_7H-2_62-64	1519.14		
		1123B_7H-4_93-95	1520.75		
		1123A_7H-3_48-50	1562.86		
s79	u57*	1123B_7H-4_145-147	1537.47	135	1540.00
		1123C_7H-2_120-122	1537.79		
		1123A_7H-3_108-110	1582.15		
		1124D_4H-6_86-88 I	1548.09		
s80		1124D_4H-6_86-88 II		136	1548.09
		1124D_4H-6_117-119	1563.27		
		1124C_6H-3_90-92	1573.56		
		1123B_7H-5_115-117	1576.05		
s81		1123C_7H-3_132-134	1589.87	138	1576.05
		1123B_7H-6_13-15	1591.48		
		1123A_7H-4_108-110	1630.38		
		1123C_7H-4_60-62	1614.95		
s82		1123B_7H-6_87-89	1615.27	140	1649.78
		1123A_7H-5_33-35	1654.49		
		U1520D_50X-CC_37-39	649.78 / 1.69±0.1		
		1125A_5H-3_13-15 I	1657.05		
s84*		1125A_5H-3_13-15a II		141	1653.53
		U1526B_4H-1_103-105	1650.00		
		1123C_7H-5_11-13	1647.42		
		1123A_7H-5_125-127	1684.07		
s85		1124C_6H-4_52-54	1628.40	142	1665.74
		1122C_44X-2_57-59	1628.00		
		1124C_6H-5_20-22	1686.17		
		U1520D_51X-1_26-28	1839.18		
s86	u58	U1520D_51X-1_35-37	1840.98	143	1684.00
		U1520D_51X-1_49-50	1843.77		
		U1520D_51X-1_51-52	1844.17		
		U1520D_51X-1_54-55	1844.77		
s87	u59	U1520D_51X-1_55-56	1844.97	144	1686.17
		U1520D_51X-1_64-65	1846.76		
		U1520D_51X-1_64-65(2)	1846.80		
		1125A_5H-6_36-38 I	1951.88		
s88	u60	1125A_5H-6_36-38 II		145	1839.18
		U1520D_52X-1_8-10	2027.18		
		1125B_5H-2_131-133	2059.35		
		1124D_5H-7_12-14	2155.25		
s89*	u61	1124C_7H-3_117-119	2160.64	146	1840.98
		U1526B_4H-2_57-59			
		1122C_50X-5_5-7	2025.00		
		1125A_5H-6_65-67	1962.07		
s90	u62	1125B_5H-3_120-122	2108.16	147	1843.77
		1123A_9H-5_99-101	2340.54		
		1125B_5H-4_64-66	2141.17		
		1125A_6H-1_23-25	2146.79		
s91	u63	U1520D_53X-1_31-33	2199.88	148	1844.17
		1124C_7H-4_60-62	2206.17		
		1124C_7H-4_85-87	2218.41		
		1124C_7H-5_15-17	2257.59		
s92	u64	1124C_7H-5_92-94a I	2295.29	149	1844.77
		1124C_7H-5_92-94 II			
		1124D_6H-1_142-144 I	2296.27		
		1124D_6H-1_142-144 II			
s93*		1123C_9H-5_33-35	2321.25	150	1844.97
		1123B_10H-1_36-38	2322.22		
		1123A_9H-5_141-143	2354.04		
		1123B_10H-1_97-99	2341.83		
s94	u65	1123C_9H-5_99-101	2342.47	151	1846.76
		1123A_9H-6_58-60	2375.58		
		1124D_6H-3_27-29	2386.85		
		1124C_7H-6_143-145	2393.71		
s95	u66			152	1846.80

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Supplementary Table S19: Holisitic estimation of repose times during the Quaternary.

volcanic event	volcanic event	Sample ID	Age [ka]	volcanic event	Quaternary eruption chronology [ka]
correlated	uncorrelated		indirect / direct	#	relying on most solid age models or average
	u67	U1526A_2R-CC_28-29			
		1124D_6H-3_70-72	2407.91	162	2407.91
		1123B_10H-2_32-34	2369.15		
s96		1123A_9H-7_7-9	2407.41	163	2424.90
		1124D_6H-4_29-31	2461.28		
		1124C_8H-1_104-106	2461.77		
		1125B_6H-1_147-149	2372.95		
		1125A_6H-5_71-73 I	2374.35		
s97*		1125A_6H-5_71-73a II		164	2457.00
		U1520D_54X-2_3-5 I	2457.00		
		U1520D_54X-2_3-5a II			
s98		1125A_7H-1_138-140	2571.71	165	2575.23
		1125B_6H-5_133-135	2578.74		

Appendix A

Supplementary Table S20: First-order estimates of eruptive volumes and magnitudes for volcanic events where thickness data is rare (1 Point approach) based on the marine tephra record.

volcanic event	volcanic event			Distance	Thickness	Tephra volume	Magma mass	30° - 60° opening angle	Magma volume DRE	Magnitude II
correlated	un-correlated	Sample ID	Onshore correlative	[km]	[cm]	[km ³] after Legros (2000)*, not corrected for DRE	[kg]		[km ³] bulk densities after Klein and Johnson (1983)**	Mason et al. (2004)***
		U1519E_1H-2_7-9		222	4.5					
s1		U1520D-1H-1_119-120	Taupo 1718±10a	-	-	1.9 - 3.6	2.8E+12 - 5.3E+12		1.4 - 2.5	5.5 - 5.7
		U1519D_1H-2_15-17		-	-					
		U1520D-1H-3_26-30		270	9.0					
s2		U1519D_1H-CC_4-6	Waimihia 3382±50a	-	-	5.7 - 10.7	8.4E+12 - 1.6E+13		4.0 - 7.5	5.9 - 6.2
		U1519E_1H-3_95-97		-	-					
s3		U1520D-1H-3_67-69	Whakatane 5542±48a	257	5.5	3.2 - 5.9	4.7+12 - 8.7E+12		2.2 - 4.2	5.7 - 5.9
		U1526B_1H-1_93-95		-	-					
s4		U1520D-1H-4_35-37	Eg-6-8, 5.2 - 5.9ka	438	1.0	1.7 - 3.1	2.5E+12 - 4.6E+12		1.0 - 1.9	5.4 - 5.7
s6		U1520D-2H-1_15-19	Opepe 10004±122a	270	10.0	6.4 - 11.9	9.4E+12 - 1.8E+13		4.5 - 8.3	6.0 - 6.2
s7		U1520D-2H-3_77-79	Ruapehu	304	3.5	2.8 - 5.3	4.2E+12 - 7.8E+12		1.6 - 3.0	5.6 - 5.9
s8		U1520D-4H-4_117-119	Okupata Tephra 11.51ka	304	5.5	4.4 - 8.3	6.5E+12 - 1.2E+13		2.7 - 5.1	5.8 - 6.1
		1124B_1H-3_15-17		629	2.0					
s11		1123C_1H-2_69-71	Rotoehu 45170±3300a	-	-	6.9 - 12.9	1.0E+13 - 1.9E+13		4.8 - 9.0	6.0 - 6.3
		1124A_1H-1_71-73		-	-					
	u1	1125B_1H-2_147-149		665	10.0	38.6 - 72.2	5.7E+13 - 1.1E+14		27.1 - 50.5	6.8 - 7.0
s12		U1520D_15H-4_71-73		264	2.5	1.5 - 2.8	2.2E+12 - 4.2E+12		1.1 - 2.0	5.3 - 5.6
		U1526B_2H-1_94-96		-	-					
	u9	U1520D_20F-1_125-127		264	1.5	0.9 - 1.7	1.3E+12 - 2.5E+12		0.5 - 1.0	5.1 - 5.4
	u10	U1520D_21F-4_6-8		264	1.0	0.6 - 1.1	8.6E+11 - 1.7E+12		0.4 - 0.8	5.0 - 5.2
	u11	U1520D_21F-4_48-50		264	3.0	1.8 - 3.4	2.7E+12 - 5.0E+12		1.3 - 2.4	5.4 - 5.7
	u12	U1520D_22F-2_60-62		264	1.0	0.6 - 1.1	8.6E+11 - 1.7E+12		0.4 - 0.8	5.0 - 5.2
	u13	U1520D_22F-2_80-82		264	2.0	1.2 - 2.3	1.8E+12 - 3.4E+12		0.9 - 1.6	5.3 - 5.5
s13		U1520D_23F-3_6-8	Ararata Gully (Mamaku?) 0.735Ma	271	1.5	0.9 - 1.8	1.4E+12 - 2.6E+12		0.7 - 1.3	5.2 - 5.4
		1123B_2H-6_91-93		1120	4.0					
s14		1124C_1X-1_80-82		-	-	43.9 - 81.9	6.5E+13 - 1.2E+14		30.7 - 57.3	6.8 - 7.1
		1123A_2H-5_66-68		-	-					
		1123C_2H-2_104-109		-	-					
	u14	1125A_2H-4_17-19		665	11.0	42.5 - 79.4	6.3E+13 - 1.2E+14		29.8 - 55.6	6.8 - 7.1
s15		1123A_2H-6_18-20		1115	1.5	16.3 - 30.5	2.4E+13 - 4.5E+13		11.4 - 21.3	6.4 - 6.7
		1123C_2H-3_69-71		-	-					
s16		1123A_2H-6_70-72		1115	7.5	81.5 - 152.2	1.2E+14 - 2.2E+14		57.0 - 106.6	7.1 - 7.3
		1123C_2H-3_132-134		-	-					
s17		U1520D_25F-2_10-14	Fordell 0.31Ma	265	9.0	5.5 - 10.3	8.1E+12 - 1.5E+13		3.9 - 7.2	5.9 - 6.2
		U1526B_2H-2_92-93		-	-					
	u15	1124A_1H-7_25-27		641	60.0	215.4 - 402.5	3.2E+14 - 5.9E+14		150.8 - 281.8	7.5 - 7.8
	u16	U1520D_26F-1_103-105		264	11.0	6.7 - 12.5	9.6E+12 - 1.8E+13		4.7 - 8.8	6.0 - 6.3
	u17	U1520D_26F-2_23-27		264	32.0	19.5 - 36.4	2.9E+13 - 5.4E+13		13.6 - 25.5	6.5 - 6.7
	u18	U1520D_26F-3_29-31		264	7.5	4.6 - 8.5	6.7E+12 - 1.3E+13		3.2 - 6.0	5.8 - 6.1
	u19	U1520D_26F-4_51-55		264	20.0	12.2 - 22.8	1.8E+13 - 3.4E+13		8.5 - 15.9	6.3 - 6.5
s18		U1520D_27F-1_44-46		264	14.0	8.5 - 15.9	1.3E+13 - 2.3E+13		6.0 - 11.2	6.1 - 6.4
		U1518F-13R-1_113-115		-	-					
	u20	U1520D_27F-1_96-98		264	18.0	10.9 - 20.5	1.6E+13 - 3.0E+13		7.7 - 14.3	6.2 - 6.5
	u22	U1517C_35F-4_61-63		207	4.5	1.7 - 3.2	2.5E+12 - 4.6E+12		1.2 - 2.2	5.4 - 5.7
s22		1125A_3H-4_64-66		665	5.0	19.3 - 36.1	2.8E+13 - 5.3E+13		13.5 - 25.3	6.5 - 6.7
		U1517C_35F-4_125-127		-	-					
	u24	1125A_3H-5_124-126		665	15.0	57.9 - 108.3	8.5E+13 - 1.6E+14		40.6 - 75.8	6.9 - 7.2
	u25	U1518E-2H-6_109-111		241	3.0	1.5 - 2.9	2.2E+12 - 4.2E+12		1.1 - 2.0	5.3 - 5.6
	u26	U1518E-3H-1_73-75		241	4.0	2.0 - 3.8	2.9E+12 - 5.6E+12		1.4 - 2.7	5.5 - 5.7
s25		1125A_3H-6_105-107		665	9.0	34.8 - 64.9	5.1E+13 - 9.6E+13		24.3 - 45.5	6.7 - 7.0
		1125B_3H-1_32-34		-	-					
s26		1124D_1H-2_148-150		641	10.0	35.9 - 67.1	5.3E+13 - 9.9E+13		25.1 - 47.0	6.7 - 7.0
		1123C_3H-4_84-86		-	-					
	u27	U1526B_2H-3_126-128		277	5.0	3.3 - 6.3	4.9E+12 - 9.2E+12		2.3 - 4.4	5.7 - 6.0
s29		1124D_1H-3_50-52		641	16.0	57.4 - 107.3	8.4E+13 - 1.6E+14		40.2 - 75.1	6.9 - 7.2
		<		-	-					
s31		1124C_3H-1_85-87		641	5.0	17.9 - 33.5	2.6E+13 - 4.9E+13		12.6 - 23.5	6.4 - 6.7
		1124D_1H-5_79-81		-	-					
s32		1125A_4H-2_52-54		665	4.0	15.5 - 28.9	2.3E+13 - 4.3E+13		10.8 - 20.2	6.4 - 6.6
		1125B_3H-5_86-88		-	-					
s34		U1520D_39X-3_20-22	Kupe 0.63±0.08Ma	264	3.0	1.8 - 3.4	2.7E+12 - 5.0E+12		1.3 - 2.4	5.4 - 5.7
	u29*	1125B_3H-6_43-45		665	5.0	19.3 - 36.1	2.8E+13 - 5.3E+13		13.5 - 25.3	6.5 - 6.7
	u30	1124C_3H-4_50-52		641	80.0	287.2 - 536.7	4.2E+14 - 7.9E+14		201.1 - 375.7	7.6 - 7.9
	u31	1124C_3H-5_90-92		641	1.0	3.6 - 6.7	5.3E+12 - 9.9E+12		2.5 - 4.7	5.7 - 6.0
		1124C_3H-6_61-63		641	50.0					
s40		U1520D_40X-1_77-79		-	-	179.5 - 335.4	2.6E+14 - 4.9E+14		125.7 - 234.8	7.4 - 7.7

Appendix A

Supplementary Table S20: First-order estimates of eruptive volumes and magnitudes for volcanic events where thickness data is rare (1 Point approach) based on the marine tephra record.

volcanic event	volcanic event			Distance	Thickness	Tephra volume	Magma mass	Magma volume DRE	Magnitude II
d	ted	Sample ID	Onshore correlative			[km ³]	[kg]	[km ³]	
		1124D_2H-2_121-123		-	-				
		1125B_4H-2_11-13		665	5.0				
s42*		1125A_4H-4_115-117		-	-	19.3 - 36.1	2.8E+13 - 5.3E+13	13.5 - 25.3	6.5 - 6.7
		1125B_4H-1_59-61 I		-	-				
		U1519C_14R-2_48-50		-	-				
	u32*	U1520D_42X-1_97-99		264	4.0	2.4 - 4.6	3.6E+12 - 6.7E+12	1.7 - 3.2	5.6 - 5.8
	u33	1125A_4H-5_120-122		665	4.0	15.5 - 28.9	2.3E+12 - 4.3E+13	10.8 - 20.2	6.4 - 6.6
		1123A_5H-2_98-100		1152	8.5				
s43		1123C_5H-1_90-92		-	-	98.6 - 184.2	1.5E+14 - 2.7E+14	69.0 - 128.9	7.2 - 7.4
		1123B_5H-3_3-5		-	-				
		U1519C_15R-1_71-73		-	-				
		1124D_2H-4_88-90		680	7.5				
s44		U1520D_44X-1_5-7_2		-	-	30.3 - 56.6	4.5E+13 - 8.3E+13	21.2 - 39.6	6.6 - 6.9
		U1519C_15R-5_20-22		-	-				
		U1526B_3H-2_48-50		-	-				
s45		1124D_2H-4_128-130		680	15.0	60.6 - 113.3	8.9E+13 - 1.7E+14	42.4 - 79.3	6.9 - 7.2
		1124C_4H-1_26-28		-	-				
		1124D_2H-5_87-89		680	20.0				
s46		U1520D_44X-1_43-45		-	-	80.8 - 151.0	1.2E+14 - 2.2E+14	56.6 - 105.7	7.1 - 7.3
		U1519C_16R-1_146-148		-	-				
		U1526B_3H-2_64-66		-	-				
s49		1124C_4H-2_81-83	Kidnappers-B 1.03±0.07Ma	680	7.0	28.3 - 52.9	402E+13 - 7.8E+13	19.8 - 37.0	6.6 - 6.9
		1124D_2H-5_146-148		-	-				
		1124C_4H-2_118-120		641	8.0				
s50*		1124D_2H-CC_10-12 I		-	-	28.7 - 53.7	4.2E+13 - 7.9E+13	20.1 - 37.6	6.6 - 6.9
		U1519C_19R-3_122-125		-	-				
		1124D_2H-CC_10-12 2		-	-				
	u38	1124C_4H-3_121-123		641	7.0	25.1 - 46.9	3.7E+13 - 6.9E+13	17.6 - 32.9	6.6 - 6.8
	u39	1124C_4H-3_142-144		641	2.0	7.2 - 13.4	1.1E+13 - 1.9E+13	5.0 - 9.4	6.0 - 6.3
s52		1124C_4H-4_81-83		641	15.0	53.9 - 100.6	7.9E+13 - 1.5E+14	37.7 - 70.4	6.9 - 7.2
		1124D_3H-1_3-5		-	-				
s53		1124D_3H-1_27-29		641	15.0	53.9 - 100.6	7.9E+13 - 1.5E+14	37.7 - 70.4	6.9 - 7.2
		1124C_4H-4_111-113		-	-				
	u42	1124D_3H-4_96-98		641	3.0	10.8 - 20.1	1.6E+13 - 2.9E+13	7.5 - 14.1	6.2 - 6.5
s55		1124C_5H-1_91-93		641	9.0	32.3 - 60.4	4.8E+13 - 8.9E+13	22.6 - 42.3	6.7 - 6.9
		1124D_3H-4_145-147		-	-				
	u43	1124C_5H-2_5-7		680	7.5	30.3 - 56.6	4.5E+13 - 8.3E+13	21.2 - 39.6	6.6 - 6.9
		1124D_3H-5_60-62		680	5.0				
s56*		1124C_5H-2_45-47 I	Rewa B 1.20±0.14Ma	-	-	20.2 - 37.8	2.9E+13 - 5.6E+13	14.1 - 26.4	6.5 - 6.7
		1124C_5H-2_45-47 II		-	-				
s57		1124C_5H-2_65-67		680	4.0	16.2 - 30.2	2.4E+13 - 4.4E+13	11.3 - 21.1	6.4 - 6.6
		1124D_3H-5_112-114		-	-				
s58*		1124D_3H-6_5-7	Sub-Rewa	680	10.0	40.4 - 75.5	5.9E+13 - 1.1E+14	28.3 - 52.9	6.8 - 7.0
	u44	U1520D_47X-1_17-19		264	4.0	2.4 - 4.5	3.6E+12 - 6.7E+12	1.7 - 3.2	5.6 - 5.8
s59		1124C_5H-3_13-15		641	15.0	53.9 - 100.6	7.9E+13 - 1.5E+14	37.7 - 70.4	6.9 - 7.2
		1124D_3H-6_46-48		-	-				
		1124D_3H-6_116-118		641	5.0				
s60		1124C_5H-3_107-109		-	-	17.9 - 33.5	2.6E+13 - 4.9E+13	12.6 - 23.5	6.4 - 6.7
		U1526B_3H-3_133-135		-	-				
s61		1124C_5H-4_9-11		641	12.5	44.9 - 83.9	6.6E+13 - 1.2E+14	31.4 - 58.7	6.8 - 7.1
		U1520D_47X-3_0-2		-	-				
		1123A_6H-5_18-20		1115	3.0				
s68		1123C_6H-5_110-112		-	-	32.6 - 60.9	4.8E+13 - 8.9E+13	22.8 - 42.6	6.7 - 7.0
		1124C_5H-CC_10-12		-	-				
s70		1123C_6H-6_118-120		1115	3.5	38.0 - 71.0	5.6E+13 - 1.0E+14	26.6 - 49.7	6.7 - 7.0
		1123B_7H-1_129-131		-	-				
	u48	U1518E_24F-3_71-73		241	12.0	6.1 - 11.4	8.9E+12 - 1.7E+13	4.3 - 8.0	6.0 - 6.2
s72*		1123B_7H-2_38-40		1115	5.5	59.8 - 111.7	8.8E+13 - 1.6E+14	41.8 - 78.2	6.9 - 7.2
		1123C_6H-7_14-16		-	-				
	u52	1123A_6H-7_15-17		1115	1.5	16.3 - 30.5	2.4E+13 - 4.5E+13	11.4 - 21.3	6.4 - 6.7
	u53	1124C_6H-1_118-120		641	4.0	14.4 - 26.8	2.1E+13 - 3.9E+13	10.1 - 18.8	6.3 - 6.6
		1123B_7H-2_88-90		1115	4.0				
s74		1123C_6H-7_64-66		-	-	43.5 - 81.2	6.4E+13 - 1.2E+14	30.4 - 56.8	6.8 - 7.1
		1123A_7H-1_52-54		-	-				
	u54	U1518E-29X-6_7-9		241	8.5	4.3 - 8.0	6.3E+12 - 1.2E+13	3.0 - 5.6	5.8 - 6.1
s75*		U1518E-32X-1_20-24		241	10.0	5.1 - 9.5	7.5E+12 - 1.4E+13	3.6 - 6.6	5.9 - 6.1
		U1520D_49X-1_28-30		-	-				
s76*		1124C_6H-2_27-29		641	15.0	53.9 - 100.6	7.9E+13 - 1.5E+14	37.7 - 70.4	6.9 - 7.2
		1124D_4H-5_77-79		-	-				

Appendix A

Supplementary Table S20: First-order estimates of eruptive volumes and magnitudes for volcanic events where thickness data is rare (1 Point approach) based on the marine tephra record.

volcanic event	volcanic event	Sample ID	Onshore correlative	Distance	Thickness	30° - 60° opening angle			Magnitude II
						Tephra volume	Magma mass	Magma volume DRE	
d	ted					[km ³]	[kg]	[km ³]	
s77		1124C_6H-2_127-129		641	4.0	14.4 - 26.8	2.1E+13 - 3.9E+13	10.1 - 18.8	6.3 - 6.6
		1124D_4H-6_18-20		-	-				
		1123A_7H-3_48-50		1115	5.0				
s78		1123C_7H-2_62-64	overlying Mangapipi tephra 1.53Ma	-	-	54.3 - 101.5	7.9E+13 - 1.5E+14	38.0 - 71.0	6.9 - 7.2
		1123B_7H-4_93-95		-	-				
		1123A_7H-3_108-110		1115	8.0				
s79		1123B_7H-4_145-147	Mangapipi Tephra 1.540±0.16Ma	-	-	86.9 - 162.4	1.3E+14 - 2.4E+14	60.8 - 113.7	7.1 - 7.4
		1123C_7H-2_120-122		-	-				
	u57*	1124D_4H-6_86-88		641	4.0	14.4 - 26.8	2.1E+13 - 3.9E+13	10.1 - 18.8	6.3 - 6.6
s80		1124C_6H-3_90-92		641	7.5	26.9 - 50.3	3.9E+13 - 7.4E+13	18.8 - 35.2	6.6 - 6.9
		1124D_4H-6_117-119		-	-				
		1123B_7H-6_13-15		1159	3.0				
s82		1123C_7H-3_132-134		-	-	35.2 - 65.8	5.2E+13 - 9.7E+13	24.7 - 46.1	6.7 - 7.0
		1123A_7H-4_108-110		-	-				
s85		1123A_7H-5_125-127		1159	3.0	35.2 - 65.8	5.2E+13 - 9.7E+13	24.7 - 46.1	6.7 - 7.0
		1123C_7H-5_11-13		-	-				
	u59	U1520D_51X-1_26-28		303	8.0	6.4 - 11.9	9.4E+12 - 1.8E+13	4.5 - 8.4	6.0 - 6.2
	u60	U1520D_51X-1_35-37		303	7.5	6.0 - 11.2	8.8E+12 - 1.7E+13	4.2 - 7.9	5.9 - 6.2
	u61	U1520D_51X-1_49-50		303	2.0	1.6 - 3.0	2.4E+12 - 4.4E+12	1.1 - 2.1	5.4 - 5.6
	u62	U1520D_51X-1_51-52		303	1.0	0.8 - 1.5	1.2E+12 - 2.2E+12	0.6 - 1.0	5.1 - 5.3
	u63	U1520D_51X-1_54-55		303	1.5	1.2 - 2.3	1.8E+12 - 3.3E+12	0.8 - 1.6	5.2 - 5.5
		U1520D_51X-1_55-56		303	1.0				
s87		1124C_6H-5_37-39		-	-	0.8 - 1.5	1.2E+12 - 2.2E+12	0.6 - 1.0	5.1 - 5.3
	u64	U1520D_51X-1_64-65		303	0.5	0.4 - 0.8	5.9E+11 - 1.1E+12	0.3 - 0.5	4.8 - 5.0
s88		U1520D_51X-1_64-65(2)	Vinegar Hill Tephra 1.75±0.2Ma	303	0.5	0.4 - 0.8	5.9E+11 - 1.1E+12	0.3 - 0.5	4.8 - 5.0
		1125B_5H-3_120-122		725	12.0				
s90		1125A_5H-6_65-67		-	-	55.1 - 102.9	8.1E+13 - 1.51E+14	38.6 - 72.1	6.9 - 7.2
		1123A_9H-5_99-101		-	-				
s91		1125B_5H-4_64-66		725	7.5	34.4 - 64.4	5.1E+13 - 9.5E+13	24.1 - 45.1	6.7 - 7.0
		1125A_6H-1_23-25		-	-				
s92		1124C_7H-4_60-62		671	4.5	17.7 - 33.1	2.6E+13 - 4.9E+13	12.4 - 23.2	6.4 - 6.7
		U1520D_53X-1_31-33		-	-				
	u65	1124C_7H-4_85-87		671	7.5	29.5 - 55.1	4.3E+13 - 8.1E+13	20.7 - 38.6	6.6 - 6.9
	u66	1124C_7H-5_15-17		671	3.5	13.8 - 25.7	2.0E+13 - 3.8E+13	9.6 - 18.0	6.3 - 6.6
s93*		1124C_7H-5_92-94		671	5.5	21.6 - 40.4	3.2E+13 - 5.9E+13	15.1 - 28.3	6.5 - 6.8
		1124D_6H-1_142-144		-	-				
		1123B_10H-1_36-38		1159	4.0				
s94		1123C_9H-5_33-35		-	-	46.9 - 87.7	6.9E+13 - 1.3E+14	32.9 - 61.4	6.8 - 7.1
		1123A_9H-5_141-143		-	-				
s98		1125B_6H-5_133-135		725	5.0	22.9 - 42.9	3.4E+13 - 6.3E+13	16.1 - 30.0	6.5 - 6.8
		1125A_7H-1_138-140		-	-				

* Legros, F. (2000). Minimum volume of a tephra fallout deposit estimated from a single isopach.

** Rhyolite: 2.1 g/cm³; Rhyodacite: 2.3 g/cm³; Dacite: 2.4 g/cm³; Andesite: 2.6 g/cm³ after Klein, D.P., Johnson, G.R. (1983). Density, porosity, and magnetic properties of rock specimens from southwestern Arizona.

*** Mason, B.G., Pyle, D.M., Oppenheimer, C., 2004. The size and frequency of the largest explosive eruptions on Earth.

Appendix A

Supplementary Table S21: Calculations of eruptive volumes and magnitudes for volcanic events with reliable thickness data (isopachs) based on the marine tephra record.

volcanic event	Sample ID	Onshore correlative	Thickness	Area within smallest isopach	1 Segment Volume	Magma mass	DRE volume	Magnitude
			[cm] only marine tephra layers with reliable thickness are considered					
				[km ²]	[km ³]	[kg]	[km ³] bulk densities after Klein and Johnson (1983)**	Mason et al. (2004)***
s9	1125A_1H-1_71-73	Kawakawa/Oruanui 25358±162a	5	261114.4	58.8	8.83E+13	42.0	6.9
	U1526B_1H-3_36-38		1					
	1123C_1H-1_148-150		-					
s10	1123B_1H-2_5-7	Omataroa 32.5ka	-	828713.1	134.5	2.02E+14	96.0	7.3
	1123A_1H-2_6-8		3					
	1124B_1H-2_43-45		4					
	1122A_1H-4_26-28		5					
	U1520D_27F-2_92-96		-					
	U1520D_27F-3_74-78		91					
s19	1125B_2H-3_143-145	Lower Griffin Road 0.3-0.4Ma	20	122177.2	114.4	1.72E+14	81.7	7.2
	1125A_3H-2_67-69		22					
	U1520D_35X-7_72-74		-					
	1125A_3H-6_57-59 II		10					
	U1526B_2H-3_101-10 II		-					
	U1518E-2H-1_136-138		7					
s23*	1526B_2H-3_101-103 I	Onepuhi 0.57Ma	2	233584.0	95.1	1.43E+14	67.9	7.2
	U1520D_35X-7_86-88		-					
	U1518E-2H-4_26-28		-					
	1125A_3H-6_57-59 I		10					
s24*	1124D_1H-2_70-72		2	531012.0	40.2	6.03E+13	28.7	6.8
	U1518E-3H-1_92-93		6					
s27	1125B_3H-3_26-28		15	211077.9	47.9	7.18E+13	34.2	6.9
	1517C_36F-2_3-5		5.5					
	1124D-1H-4_86-88		-					
s30	U1518E-3H-3_36-40		7	140174.6	9.5	1.42E+13	6.8	6.2
	U1517C_36F-2_100-101		4					
	U1520D_38X-CC_37-39		3.5					
s33	1123A_4H-6_125-127		2	159984.0	19.8	2.96E+13	14.1	6.5
	U1518E-3H-6_16-18		-					
	1124D_1H-7_24-26 I		-					
	1124D_1H-7_24-26 II		7					
s35*	1124C_3H-3_54-56		7	193214.5	15.9	2.38E+13	11.3	6.4
	1125A_4H-3_73-75		2					
	U1520D_39X-5_64-66		2.5					
	1124C_3H-4_107-109		4					
	1124D_2H-1_42-44		4					
s36	U1518E-5H-2_66-70		5	130774.0	98.8	1.48E+14	70.6	7.2
	1125B_4H-1_27-29		15					
	U1518E-9H-2_0-1		2					
	594_5H-2_36-38		7					
s37	1124D_2H-1_128-130		3	466512.4	87.4	1.31E+14	62.4	7.1
	U1520D_44X-1_47-49		3					
	U1371D_2H-2_137-139		4					
s38	U1520D_40X-1_60-62		7	427829.6	15.6	2.34E+13	11.1	6.4
	1124D_2H-2_53-55		4					
	U1520D_40X-1_60-62		7					
	1124D_2H-2_53-55		4					
s39	1124C_3H-5_141-143		2.5	227370.8	58.2	8.73E+13	41.6	6.9
	1123C_4H-6_68-70		4					
	U1520D_40X-CC_38-40		2					
s41	1122C_37X-1_37-38	Kaukatea 0.86±0.08Ma	1	210682.0	8.6	1.29E+13	6.1	6.1
	1124C_4H-2_17-19		5					
	U1520D_44X-1_47-49		7					
s48	U1371D_2H-2_137-139		4	543297.2	143.9	2.16E+14	102.8	7.3
	U1520D_44X-1_96-98		-					
	1123A_5H-3_66-68		4					
s51	1124C_4H-3_48-50	Potaka 1.0±0.05Ma	3	273935.8	234.8	3.52E+14	167.7	7.5
	U1518E-9H-CC_14-16		5					
	1123C_6H-1_77-79		1					
	1123B_6H-6_50-52		-					
s62	U1526B_3H-4_38-40		3	182387.6	6.7	1.00E+13	4.8	6.0
	1123C_6H-4_62-64		6					
	1124D_4H-2_69-71		8					
s64	1124C_5H-6_57-59		9	547245.0	67.0	1.01E+14	47.9	7.0
	1371D_3H-3_56-58		3					
	1123C_6H-4_93-95		5					

Appendix A

Supplementary Table S21: Calculations of eruptive volumes and magnitudes for volcanic events with reliable thickness data (isopachs) based on the marine tephra record.

volcanic event	Sample ID	Onshore correlative	Thickness	Area within smallest isopach	1 Segment Volume	Magma mass	DRE volume	Magnitude
			[cm]	[km ²]	[km ³]	[kg]	[km ³]	
			only marine tephra layers with reliable thickness are considered				bulk densities after Klein and Johnson (1983)**	Mason et al. (2004)***
	1124D_4H-2_116-118		7					
s65	U1520D_48X-CC_22-24		-	266465.1	115.0	1.73E+14	82.2	7.2
	U1519C_20R-3_29-31		2.5					
	U1526B_3H-5_1-3		3					
	1124D_4H-2_137-139 I		4					
s66*	1124C_5H-6_131-133		6	547245.0	44.7	6.70E+13	31.9	6.8
	1123A_6H-4_131-131		4					
	U1371D_3H-6_2-4		2					
	1124D_4H-2_137-139 II		4					
s67*	1124C_5H-7_60-62		-	504955.0	60.3	9.05E+13	43.1	7.0
	U1526B_3H-5_8-10		-					
	U1371D_3H-6_63-65		2.5					
	1123C_6H-5_123-125		2.5					
s69	1124C_6H-1_26-28		-	274603.0	24.8	3.72E+13	17.7	6.6
	1124D_4H-3_70-72		5					
	U1526B_3H-5_51-53		6					
	1124C_6H-1_37-39 I		-					
	U1518E-25F-2_30-32a I		-					
	594_13H-CC_0-2 II		-					
s71*	594A_8H-3_49-51 I		-	108626.5	16.9	2.53E+13	12.0	6.4
	1124C_6H-1_37-39 II		-					
	U1518E-25F-2_30-32 II		10					
	594_13H-CC_0-2 I		2					
	594A_8H-3_49-51 II		5					
	1123A_6H-6_125-127		2					
s73	1124D_4H-5_12-14		-	212606.5	21.4	3.21E+13	15.3	6.5
	U1520D_49X-1_15-17		3					
	U1518E_29X-2_66-68		5					
	1123C_7H-4_60-62		7					
s83	1123B_7H-6_87-89	Ototoka 1.72±0.32Ma	-	194755.5	57.3	8.59E+13	40.9	6.9
	1123A_7H-5_33-35		5					
	U1520D_50X-CC_37-39		17					
s86	1124C_6H-4_52-54	Table Flat Tephra 1.71±0.12Ma	10	327890.9	48.9	7.33E+13	34.9	6.9
	1122C_44X-2_57-59		4					
	1125A_5H-6_36-38 I		-					
	1125A_5H-6_36-38 II		8					
	U1520D_52X-1_8-10		2					
s89*	1125B_5H-2_131-133	Hikuroa Pumice 2.0±0.6Ma	10	416965.2	57.4	8.62E+13	41.0	6.9
	1124D_5H-7_12-14		9					
	1124C_7H-3_117-119		9					
	U1526B_4H-2_57-59		-					
	1122C_50X-5_5-7		3.5					
	1123B_10H-1_97-99		-					
	1123C_9H-5_99-101		4					
s95	1123A_9H-6_58-60	PU-16-04 2 & Lower Papamoa Ignimbrite 2.4 Ma	4	421661.6	62.3	9.34E+13	44.5	7.0
	1124D_6H-3_27-29		12					
	1124C_7H-6_143-145		11					
	U1526A_2R-CC_28-29		9					
	1123B_10H-2_32-34		3.5					
s96	1123A_9H-7_7-9	TUK-16-16 (3.0±1.6Ma)	4.5	272874.7	44.5	6.68E+13	31.8	6.8
	1124D_6H-4_29-31		10					
	1124C_8H-1_104-106		9					
	1125B_6H-1_147-149		12.5					
	1125A_6H-5_71-73 I		-					
s97*	1125A_6H-5_71-73a II		-	189729.1	43.3	6.50E+13	31.0	6.8
	U1520D_54X-2_3-5 I		-					
	U1520D_54X-2_3-5a II		3					

**Rhyolite: 2.1 g/cm³; Rhyodacite: 2.3 g/cm³; Dacite: 2.4 g/cm³; Andesite: 2.6 g/cm³ after Klein, D.P., Johnson, G.R. (1983). Density, porosity, and magnetic properties of rock specimens from southeastern Arizona.

***Mason, B.G., Pyle, D.M., Oppenheimer, C., 2004. The size and frequency of the largest explosive eruptions on Earth.

Appendix A

Supplementary Table S22: Cumulative magma mass estimations for New Zealand's Quaternary volcanism based on the marine tephra record.

volcanic event	volcanic event	Age	Magma mass [kg]	Cumulative magma mass [kg]
correlated	uncorrelated	[ka]	average magma mass (30° to 60° distribution angle) for 1 Point approach	
s1		1.71	4.086E+12	8.812E+15
s2		3.38	1.209E+13	8.807E+15
s3		5.54	6.693E+12	8.795E+15
s4		8.30	3.534E+12	8.789E+15
s6		9.47	1.343E+13	8.785E+15
s7		10.50	5.959E+12	8.772E+15
s8		11.51	9.365E+12	8.766E+15
s9		25.35	8.825E+13	8.756E+15
s10		32.50	2.017E+14	8.668E+15
s11		45.17	1.458E+13	8.466E+15
	u1	110.99	8.147E+13	8.452E+15
s12		141.00	3.210E+12	8.370E+15
	u9	200.50	1.926E+12	8.367E+15
	u10	210.30	1.284E+12	8.365E+15
	u11	210.80	3.852E+12	8.364E+15
	u12	213.10	1.284E+12	8.360E+15
	u13	213.30	2.568E+12	8.359E+15
s13		235.00	2.030E+12	8.356E+15
s14		249.55	9.244E+13	8.354E+15
	u14	259.39	8.962E+13	8.262E+15
s15		276.63	3.436E+13	8.172E+15
s16		289.65	1.718E+14	8.138E+15
s17		310.00	1.164E+13	7.966E+15
	u15	310.10	4.542E+14	7.954E+15
	u16	310.60	1.412E+13	7.500E+15
	u17	312.20	4.109E+13	7.486E+15
	u18	314.55	9.630E+12	7.445E+15
	u19	316.27	2.568E+13	7.435E+15
s18		317.18	1.798E+13	7.410E+15
	u20	317.89	2.311E+13	7.392E+15
s19		319.33	1.715E+14	7.369E+15
	u22	460.00	3.552E+12	7.197E+15
s22		463.20	4.074E+13	7.193E+15
	u24	515.08	1.222E+14	7.153E+15
s23*		504.00	1.427E+14	7.031E+15
	u25	508.00	3.210E+12	6.888E+15
	u26	510.00	4.280E+12	6.885E+15
s24*		535.00	6.033E+13	6.880E+15
s25		546.95	7.333E+13	6.820E+15
s26		558.47	7.570E+13	6.747E+15
	u27	560.00	7.068E+12	6.671E+15
s27		618.93	7.183E+13	6.664E+15
s29		661.93	1.211E+14	6.592E+15
s30		665.00	1.418E+13	6.471E+15
s31		693.06	3.785E+13	6.457E+15
s32		703.35	3.259E+13	6.419E+15
s33		711.14	2.964E+13	6.386E+15
s34		725.69	3.852E+12	6.357E+15
	u29*	733.86	4.074E+13	6.353E+15
s35*		739.72	2.379E+13	6.312E+15
	u30	766.11	6.056E+14	6.288E+15
s36		772.80	1.483E+14	5.683E+15
s37		791.57	1.311E+14	5.534E+15
s38		793.79	2.336E+13	5.403E+15
	u31	800.04	7.570E+12	5.380E+15
s39		808.74	8.726E+13	5.372E+15
s40		807.88	3.785E+14	5.285E+15
s41		807.91	1.287E+13	4.907E+15
s42*		807.94	4.074E+13	4.894E+15
	u32*	815.50	5.136E+12	4.853E+15
	u33	826.64	3.259E+13	4.848E+15
s43		857.18	2.078E+14	4.815E+15
s44		894.51	6.389E+13	4.608E+15
s45		896.50	1.278E+14	4.544E+15
s46		901.90	1.704E+14	4.416E+15
s48		909.39	2.158E+14	4.246E+15
s49		910.00	5.963E+13	4.030E+15
s50*		910.50	6.056E+13	3.970E+15

Appendix A

Supplementary Table S22: Cumulative magma mass estimations for New Zealand's Quaternary volcanism based on the marine tephra record.

volcanic event	volcanic event	Age	Magma mass [kg]	Cumulative magma mass [kg]
correlated	uncorrelated	[ka]	average magma mass (30° to 60° distribution angle) for 1 Point approach	
s51		912.70	3.522E+14	3.909E+15
	u38	938.10	5.299E+13	3.557E+15
	u39	941.85	1.514E+13	3.504E+15
s52		960.00	1.135E+14	3.489E+15
s53		965.00	1.135E+14	3.376E+15
	u42	1060.45	2.271E+13	3.262E+15
s55		1067.50	6.813E+13	3.239E+15
	u43	1077.77	6.389E+13	3.171E+15
s56*		1083.00	4.260E+13	3.107E+15
s57		1089.00	3.408E+13	3.065E+15
s58*		1098.00	8.519E+13	3.031E+15
	u44	1098.08	5.136E+12	2.945E+15
s59		1105.55	1.135E+14	2.940E+15
s60		1120.93	3.785E+13	2.827E+15
s61		1132.90	9.462E+13	2.789E+15
s62		1171.00	1.004E+13	2.694E+15
s64		1279.02	1.005E+14	2.684E+15
s65		1289.33	1.726E+14	2.584E+15
s66*		1309.82	6.700E+13	2.411E+15
s67*		1326.28	9.049E+13	2.344E+15
s68		1358.29	6.871E+13	2.254E+15
s69		1355.19	3.722E+13	2.185E+15
s70		1388.14	8.017E+13	2.148E+15
	u48	1392.00	1.284E+13	2.068E+15
s71*		1400.71	2.529E+13	2.055E+15
s72*		1405.01	1.260E+14	2.029E+15
s73		1441.15	3.208E+13	1.904E+15
	u52	1435.23	3.436E+13	1.871E+15
	u53	1440.37	3.028E+13	1.837E+15
s74		1448.63	9.162E+13	1.807E+15
	u54	1452.00	9.096E+12	1.715E+15
s75*		1455.70	1.070E+13	1.706E+15
s76*		1469.75	1.135E+14	1.695E+15
s77		1516.51	3.028E+13	1.582E+15
s78		1534.25	1.145E+14	1.552E+15
s79		1540.00	1.832E+14	1.437E+15
	u57*	1548.09	3.028E+13	1.254E+15
s80		1568.41	5.677E+13	1.224E+15
s82		1603.91	7.424E+13	1.167E+15
s83		1649.78	8.589E+13	1.092E+15
s85		1665.74	7.424E+13	1.007E+15
s86		1684.00	7.328E+13	9.324E+14
	u59	1839.18	1.353E+13	8.591E+14
	u60	1840.98	1.269E+13	8.455E+14
	u61	1843.77	3.383E+12	8.329E+14
	u62	1844.17	1.691E+12	8.295E+14
	u63	1844.77	2.537E+12	8.278E+14
s87		1844.97	1.691E+12	8.252E+14
	u64	1846.76	8.457E+11	8.236E+14
s88		1846.80	8.457E+11	8.227E+14
s89*		2027.18	8.615E+13	8.219E+14
s90		2136.92	1.162E+14	7.357E+14
s91		2143.98	7.263E+13	6.195E+14
s92		2203.03	3.733E+13	5.469E+14
	u65	2218.41	6.221E+13	5.095E+14
	u66	2257.59	2.903E+13	4.473E+14
s93*		2295.78	4.562E+13	4.183E+14
s94		2332.50	9.899E+13	3.727E+14
s95		2368.09	9.343E+13	2.737E+14
s96		2424.90	6.681E+13	1.802E+14
s97*		2457.00	6.502E+13	1.134E+14
s98		2575.23	4.842E+13	4.842E+13

Appendix B

Supplementary data for Study IV:

From core to correlation: a methodical approach for marine tephrostratigraphy.

K. Pank ¹, S. Kutterolf ¹, J.C. Schindbleck-Belo ¹

prepared for submission to Journal of Applied Volcanology

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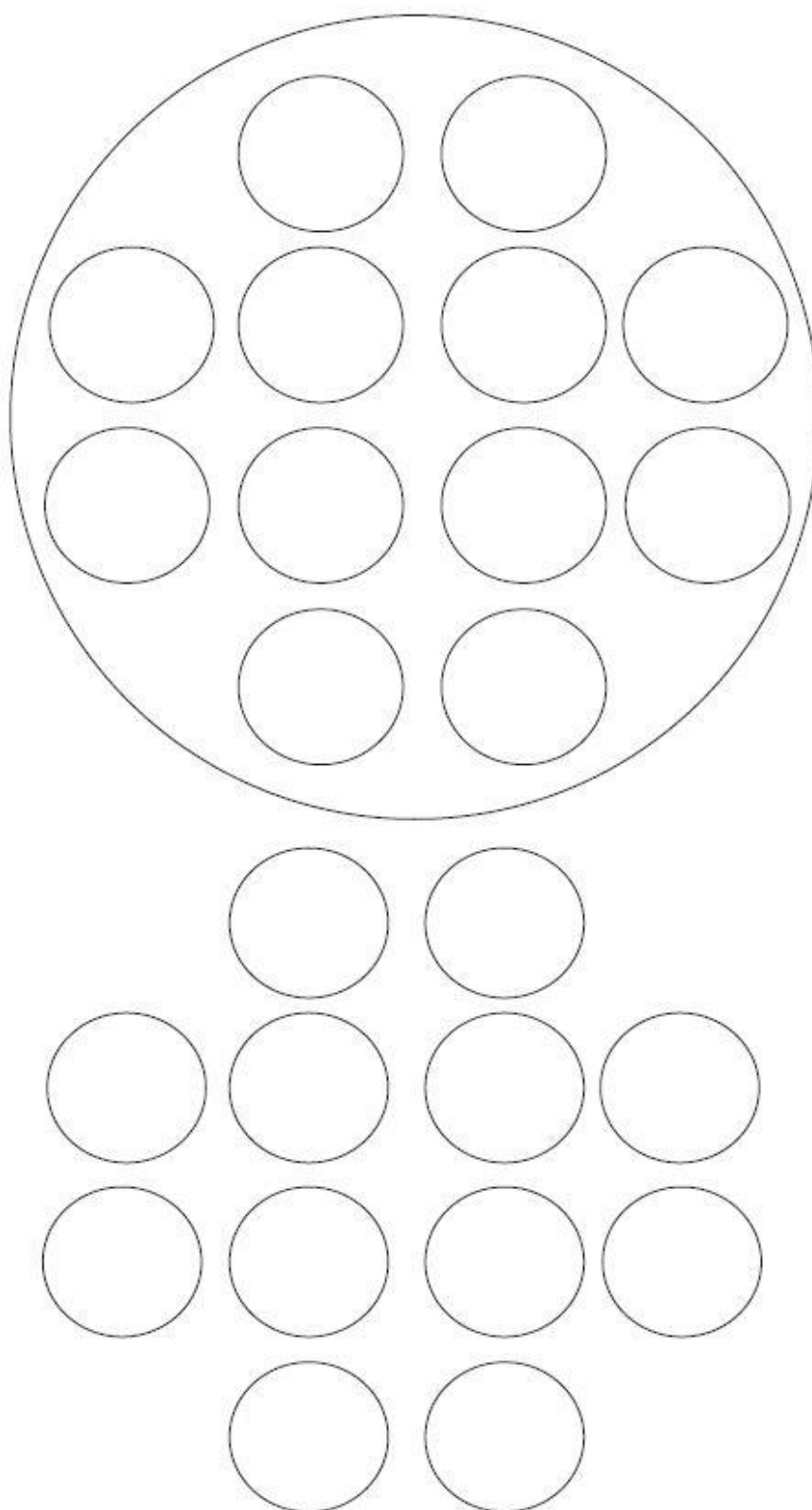
Visual Core Description

Visual Core Description	
GRAPHIC REPRESENTATION	GRAIN SIZE
	Clay
	Silt
	Very fine sand
	Fine sand
	Medium sand
	Coarse sand
	Very coarse sand
	Granule
	Small pebble
	Medium pebble
	Coarse pebble
	V. coarse pebble
CORING DISTURB.	
SS SAMPLES	
SHIP SAMPLES	
SHORE SAMPLES	
COLOR	

NO.
DATE:
EXP:
CORE:
SECTION:
OBSERVER:

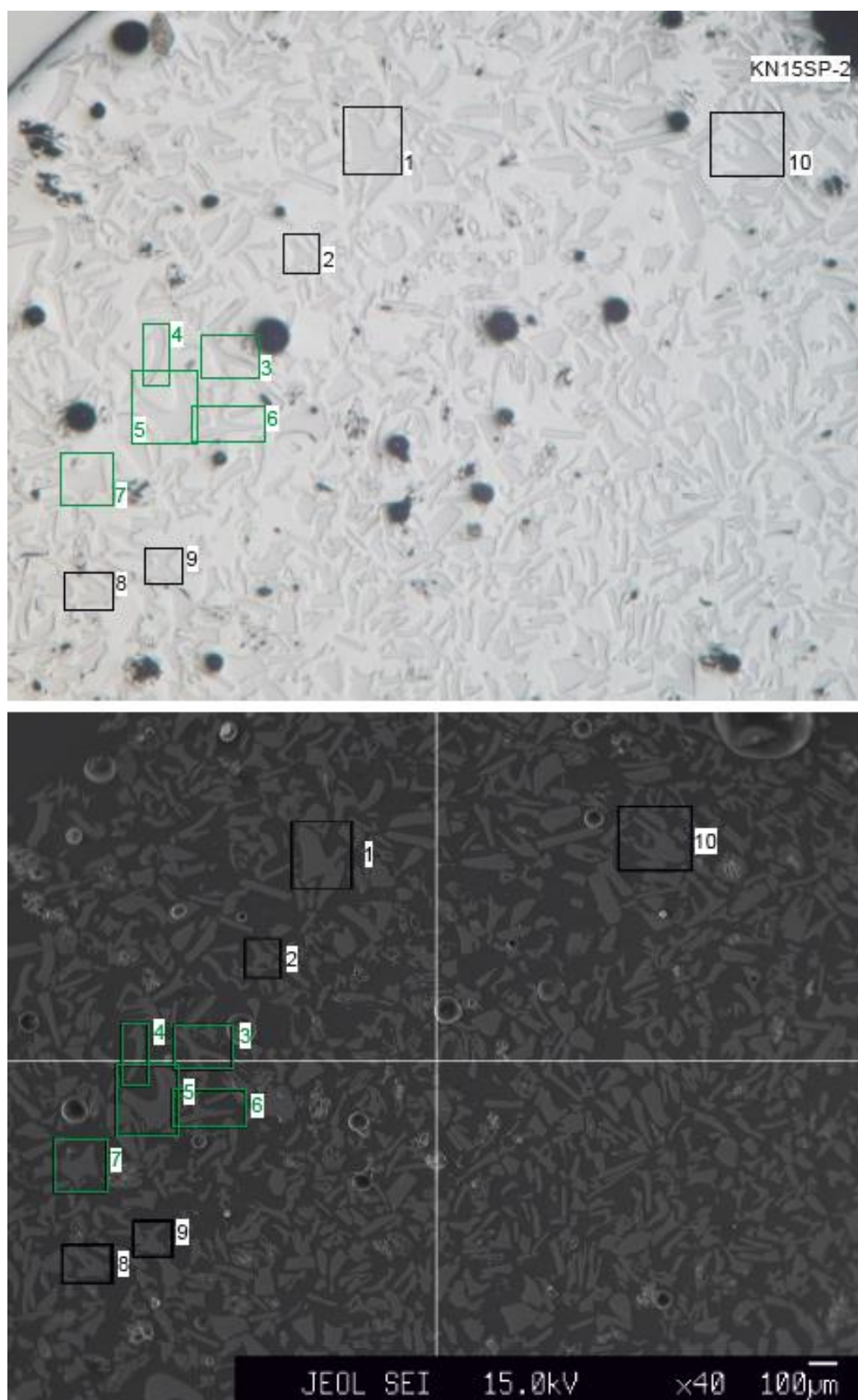
SMEAR SLIDE REPORT																																
Sample Identification:										Cruise																						
										Core																						
										Section																						
										Interval																						
										-																						
Sample Texture:										%Sand																						
										%																						
										%Silt																						
										%																						
										%Clay																						
										%																						
Lithology:																																
Constituents (provide estimates of %):																																
100%															100% Juv.																	
Monomineralic grains										Lithics		biogenic		Matrix		Juvenile		shape		vesicles												
Quartz	Plagioclase	Kalifeldspar	Pyroxene	Amphibole	Zircon	Apatite	Olivine	Biotite	Opaque	FeOOH	Pyrite	Carbonate Mineral	Volcanic lithic	Sedimentary	altered glass	Metamorphic	Nannofossils	Foraminifers	Radiolarian	Sponge Spicules	Clay	Silt	transparent glass	tachylitic	brown glass	blocky	cusped	pumiceous	dense	round	elongated	tubular
Comments (inc. Biogenics):																																
Observer:										Date:																						
M=major (>80%), D=dominant (50%-80%), A=abundant (20%-50%), C=common (5%-20%), P=present (1%-5%), R=rare (>0.1%-1%), T=trace (<0.1%)																																

Appendix B - F 2 Template for smear slide descriptions.



Appendix B - F 3 Template for mount overview.

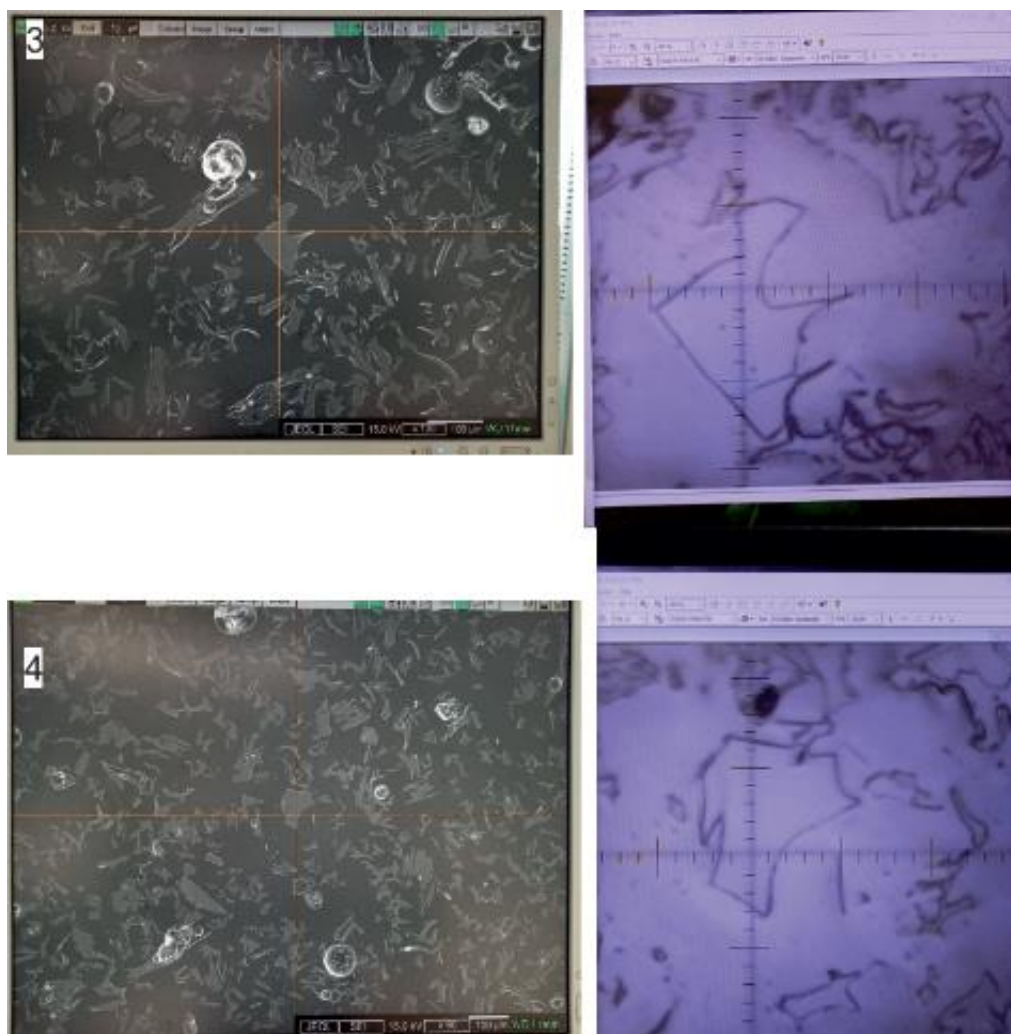
Each overview should be labelled with the mount name. The upper part of the mount overview is used during the embedding process. Label each hole with the corresponding, embedded sample. The lower part of the mount overview is used during analyses and should be a mirror-image of the upper part.



Appendix B - F 4 Illustration of the documentation of glass shards planned for LA-ICP-MS analyses.

Document and label (e.g. 1 to 10) each glass shard planned for LA-ICP-MS analysis on the BSE overview image (bottom) taken at the microprobe and on a microscopic overview (top). If applicable, highlight glass shards to be analysed in green, and alternate glass shards in black for a faster workflow at the laser.

Appendix B



Appendix B - F 5 Alternate documentation of glass shards planned for LA-ICP-MS analyses.

Documentation of individual glass shards can be done directly at the microprobe using the camera of a mobile phone.