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Variability of Benthic Foraminifera North and South of the Denmark Strait



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Abstract

The Denmark Strait is a key area for the exchange of water masses and functions as a deep-water gateway between the Nordic Seas and the North Atlantic. Thus it constitutes an important part of the global thermohaline circulation (THC). The gateway aperture is influenced by eustatically and isostatically controlled changes of the Denmark Strait sill and by alteration in density contrasts between the water masses in North and South.

In order to determine the faunal exchange through the changing aperture, benthic foraminiferal assemblages were analysed. Eight surface sediment samples were taken along the East Greenland continental margin during the RV "Polarstern" cruise ARK XVIII/1 in July 2002 by means of a multicorer and a box corer respectively. Faunal assemblages of living (stained) and dead benthic foraminifera north and south of the Denmark Strait (980–2564 m water depth) were compared with each other. Northern and southern stations exhibit clear differences in abundances, diversities, number of species, and species composition. Due to strong bottom currents and low carbonate dissolution rates, high abundances with predominating calcareous species of dead and evidently allochthonous foraminifera were recorded south of the sill. Rather low abundances of dead autochthonous foraminiferal assemblages, containing mainly agglutinated species, were found north of the sill because of weak bottom currents and high carbonate dissolution rates. Southern stations showed a large portion of epibenthic species living as suspension feeders. In contrast endobenthic species living as substrate feeders dominated northern stations, pointing to lateral advection of food particles in South and sedimentation of food particles in North.

Morphometric measurements were performed on the high abundant foraminifer *Cibicides wuellerstorfi*. In order to supplement the data of the surface sediment samples and obtain morphometric data of glacial specimens, two long sediment cores were investigated as well. These cores were taken during the RV "Polarstern" cruise ARK XVIII/1 north of the Denmark Strait and the RV "Poseidon" cruise POS 210/2 in August 1995 south of the sill. Northern glacial samples contained no *C. wuellerstorfi*. The morphometric investigations included counting of chambers within the last whorl, determination of the maximum test diameter, identification of the coiling direction, measurement of the proloculus (initial chamber) diameter, and weighing of individual tests. It was statistically significant that chamber numbers decreased from glacial over northern to southern stations. Maximum diameters, percentages of coiling direction, proloculus diameters, and weight of single tests showed no differences. Evidences of a faunal exchange over the sill lead to the conclusion that *C. wuellerstorfi* from both sides of the sill response to diverse environmental conditions and develop two different ecophenotypes rather than genotypes. For *C. wuellerstorfi* the Denmark Strait is more likely a migration passage than a barrier.

Kurzfassung

Die Dänemarkstraße spielt eine wichtige Rolle in der globalen thermohalinen Zirkulation. Über ihre Schwelle strömt die Hauptmasse des im europäischen Nordmeer gebildeten Tiefenwassers in den Nordatlantik. Die Öffnung und der Durchfluss der Dänemarkstraße werden durch eustatische Meeresspiegelschwankungen und isostatische Ausgleichsbewegungen sowie durch Veränderungen des Dichtekontrastes der Wassermassen nördlich und südlich der Schwelle beeinflusst.

Um den Einfluss der sich ändernden Bedingungen auf den Faunenaustausch zu untersuchen, wurden benthische Foraminiferenvergesellschaftungen nördlich und südlich der Dänemarkstraße analysiert. Während der *Polarstern*-Expedition ARK-XVIII/1 im Juli 2002 wurden mit Hilfe von Multicorer und Großkastengreifer acht Sedimentoberflächenproben entlang des Ostgrönländischen Kontinentalrandes in 980 bis 2564 m Wassertiefe genommen. Die Faunenvergesellschaftungen lebender und toter benthischer Foraminiferen aus Proben nördlich und südlich der Schwelle wurden miteinander verglichen. Nördliche und südliche Stationen zeigen deutliche Unterschiede in ihrer Abundanz, Diversität, Artenzahl und Artenzusammensetzung. Aufgrund der niedrigen Karbonatlösungsraten und der starken Bodenströmungen wurden südlich der Schwelle tote Kalkschaler mit überwiegend allochthoner Herkunft beobachtet. Im Gegensatz dazu wurden im Norden aufgrund der schwachen Bodenströmungen und der hohen Karbonatlösungsraten eher wenig tote Foraminiferen autochthoner Herkunft mit einem hohen Anteil an Sandschalern gefunden. Stationen im Süden der Dänemarkstraße wurden von epibenthisch lebenden, suspensionsfressenden Foraminiferen dominiert. Dagegen wurden in den nördlichen Stationen hauptsächlich endobenthische, substratfressende Foraminiferen gefunden. Dieser Umstand deutet auf einen Lateraltransport von Nahrungspartikeln im Süden und einer Sedimentation von Nahrungspartikeln im Norden hin.

Morphometrische Messungen wurden an dem kosmopolitischen Kalkschaler *Cibicides wuellerstorfi* durchgeführt. Um auch Daten von glazialen Individuen zu erhalten, wurden ergänzend zu den Sedimentoberflächenproben zwei Sedimentkerne untersucht. Die Sedimentkerne wurden im Rahmen der *Polarstern*-Expedition ARK-XVIII/1 und der *Poseidon*-Expedition POS 210/2 im August 1995 nördlich bzw. südlich der Dänemarkstraße genommen. Im nördlichen Kern wurden keine Gehäuse von *C. wuellerstorfi* gefunden. Die morphometrischen Untersuchungen umfassten das Zählen der Kammern des letzten Umganges, die Messung des maximalen Gehäusedurchmessers, die Bestimmung der Windungsrichtung, die Messung des Procolusdurchmessers und das Wiegen einzelner Gehäuse. Statistische Untersuchungen ergaben einen signifikanten Unterschied in der Kammerzahl. Glaziale Proben zeigten die höchste Anzahl, südliche die geringsten. Die anderen untersuchten Parameter wiesen keine statistisch signifikanten Unterschiede auf. Hinweise auf einen Faunenaustausch über die Schwelle der Dänemarkstraße führen zu der Schlussfolgerung, dass sich *C. wuellerstorfi* den unterschiedlichen Umweltbedingun-

gen auf beiden Seiten der Schwelle angepasst hat und dass es zur Entwicklung von zwei verschiedenen Ökophänotypen gekommen ist. Für *C. wuellerstorfi* stellt die Dänemarkstraße demnach eine Migrationspassage und keine Barriere dar.

1 Introduction

1.1 The Denmark Strait

Today the Denmark Strait is a key area for the exchange of water masses between the Nordic Seas and the North Atlantic (Hansen & Østerhus 2000). The major part of the deep water formed in the Nordic Seas flows as Denmark Strait Overflow (DSO) across the sill and enters the North Atlantic where it contributes to the North Atlantic Deep Water. This outflow holds a crucial position within the global thermohaline circulation system (THC) known as the “Oceanic Conveyor Belt” (Broecker 1997, Broecker 2000). Among other effects, the THC is responsible for the relative warm climate of Northern Europe. Therefore assumptions of the future stability of the THC’s current balance made by Broecker (1997) and Hansen et al. (2004) are of great interest. During geological time scales the DSO intensity was influenced by eustatically and isostatically controlled changes in sill depth, but it mainly depended on the density contrast between the water masses north and south of the Denmark Strait (Whitehead et al. 1974). Under this aspect Dickson et al. (2002) emphasise the sensitivity of the DSO particularly to changes of sea-surface salinity due to meltwater release from retreating ice sheets. The modern surface circulation of the Denmark Strait is characterised by two contrasting currents. On the western side of the Strait cold and less saline waters are transported inside the East Greenland Current (EGC) to the South whereas on the eastern side the North Icelandic Irminger Current (NIIC), a branch of the North Atlantic Current, transports warm and high saline waters into the Nordic Seas (Swift 1986, Hansen & Østerhus 2000).

The DFG funded research unit “Ocean Gateways” focuses on the Denmark Strait to study the impact of ocean gateways on ocean circulation, climate, and evolution. Two of the major objectives are to uncover the interaction of differing gateway apertures with the faunal composition and to study the influence of ocean gateways on the lateral interoceanic migration of marine biota, their diversity, (rate of) evolution, and productivity. The question if the Denmark Strait functions as a migration passage or as a barrier for the exchange between Polar and Atlantic faunas is not answered yet. It has to be investigated if the character of the Denmark Strait changed in the past due to varying environmental conditions and if a faunal exchange takes place. This study tries to trace the faunal exchange through the Denmark Strait by means of analysis of benthic foraminiferal assemblages and morphologies originating from north and south of the Denmark Strait.

1.2 Foraminifera in general

Foraminifera are amoeboid protists characterised by a netlike (granuloreticulate) system of pseudopodia (Gooday 2001). The most obvious characteristic of foraminifera is the pres-

ence of a test that largely encloses the cytoplasmic body and is composed of one or more chambers. In some groups the test consists of foreign particles (e.g. mineral grains, sponge spicules, shells of other foraminifera) stuck together by an organic cement. In others, it is composed of calcium carbonate (usually calcite, occasionally aragonite) or organic material secreted by the organism itself (Loeblich & Tappan 1988). Foraminifera are single-celled organisms that occur in nearly every marine environment from periodically dried up salt marshes (Alve & Murray 1999, Lehmann 2000) to the deepest ocean trenches from over 10,000 m water depth (Akimoto et al. 2001). Benthic foraminifera exhibit a wide variety of trophic mechanisms (e.g. suspension feeding, deposit feeding, substrate feeding, parasitism, and symbiosis) and are omnivores, herbivores, carnivores or scavengers (Gooday et al. 1992). They are known to distinguish food and non-food particles while feeding (Langezaal et al. 2005). Their nutritional resources include among others algae, bacteria, fungi, protozoans, and in some cases, smaller animals and dissolved organic carbon (Goldstein 1999, Heeger 1990). Foraminifera are prey for scaphopod molluscs, certain isopods, and also ingested, probably incidentally, in large numbers by surface deposit feeders such as holothurians (Gooday 2001). Benthic foraminifera are a major component of deep-sea communities, sometimes accounting for 50% or more of eukaryotic biomass (Gooday et al. 1992). They play an important role in ecosystem functioning and biogeochemical cycling, and are enormously diverse in terms of species numbers and test morphology (Gooday 2001). Because particularly calcareous tests have a high fossilisation potential, benthic foraminifera are also the most abundant benthic organisms preserved in the deep-sea fossil record and are important tools for investigations on stratigraphy, paleoproductivity, paleoecology and paleoceanography (Heinz et al. 2004). Already in earlier years there has been a growing appreciation that foraminifera are ecologically a very significant group of organisms (Gooday 1986). Benthic foraminifera are useful indicators of ecological variability, because their species composition, abundance, and distributional pattern mainly depend on environmental conditions. Taxa are used as indicators for distinct sediment facies or particular hydrographic conditions (Lohmann 1978, Lutze 1980, Lutze & Coulbourn 1984). A limiting factor for foraminifera is the oxygen supply (Jorissen et al. 1995) but some benthic species are even known to survive anoxia by dormancy or anaerobic metabolic pathways (Bernhard & Alve 1996). The flux of organic carbon is another important environmental factor controlling benthic foraminiferal distribution patterns (Altenbach et al. 2003). In oligotrophic areas some opportunistic species react very quickly to seasonal phytodetritus pulses arriving on the sediment surface (Gooday 1988). Several studies have suggested that benthic foraminifera are well adapted to specific habitats at the seafloor and respond to changes in near bottom lateral advection of food and to the seasonality of organic carbon flux from the sea surface (Corliss 1985, Linke & Lutze 1993).

1.3 Purpose of this study

Investigations on the impact of environmental conditions on benthic foraminifera and the resulting environmental optimum for species in general have largely been made (Lutze

& Thiel 1989, Schönfeld 1997, Altenbach et al. 2003). But so far only studies exist that deal either with benthic foraminiferal assemblages north of the Denmark Strait (Lutze & Salomon 1987, Linke 1989, Thies 1991) or even quite far South (Gooday 1986). In none of those studies, foraminiferal assemblages from both sides of the sill were compared with each other until now.

In case that the Denmark Strait served as a migration passage, benthic foraminifera must have developed strategies to move over large distances besides their usual self-locomotion in small scales due to ingestion of food (Kitazato 1988, Bornmalm et al. 1997). For example this strategy, also needed in order to recover deep-sea marine ecosystems after catastrophic events, was observed after the ash layer from the Mt. Pinatubo eruption covered the sea floor (Kuhnt et al. 2005). Two dispersal methods seem to be of general importance, as there are release and transport of “embryonic juveniles” and passive suspension and transport of various growth stages (Loose 1970, Alve 1999). Small, infaunal species, both calcareous and agglutinated, are among the first and most successful colonisers of soft bottom habitats from shallow waters to the deep sea (Alve 1999).

Concerning benthic foraminifera, each microhabitat category as well as environmental condition has distinct morphological species characteristics (Severin 1983, Bernhard 1986, Corliss 1991). But also morphological differences within single species indicate particular environmental conditions (Williams et al. 1988, Walton & Sloan 1990). Growth rates and test sizes of foraminifera are influenced by temperature, salinity, and food supply (Bradshaw 1961, Schmidt et al. 2004). The test size of benthic species also correlates with oxygen content (Kaiho 1999). Shell size variations of one planktic foraminifer in the Norwegian-Greenland Sea during the last 1.3 Ma document an evolutionary adaptation to the cold water habitat (Huber et al. 2000). Hemleben et al. (1987) observed with decreasing temperatures decreasing growth rates of the planktic foraminifer *Globigerinoides sacculifer* and additionally more chamber formations with increasing salinity. Among other characteristics the number of chambers within the last whorl were used for morphotype selection of specimens (Sautter 1998). Differences in coiling ratios of benthic and planktic foraminifera seem to be affected by water temperature and further depend on shell size (Thiede 1971, Hallock & Rosenkrands Larsen 1979, Galeotti & Coccioni 2002, Darling et al. 2003). Proloculus (initial chamber) sizes were used to distinguish between dimorphic forms (microspheric and megalospheric) that are believed to be influenced by temperature and salinity (Schenck 1944, Nigam & Rao 1987, Nigam & Caron 2001). Röttger et al. (1990) determined that microspheric and megalospheric specimens of *Calcarina gaudichaudii* exhibit a wide variation in morphological appearance. Some benthic foraminifera show even different morphologies within one species indicating a significant hydrodynamic function (Almers & Cedhagen 1996). Thies (1991) documented a wide range of morphologic variability of selected benthic species from the Nordic Seas.

In the present study the record of foraminiferal assemblages originating from north and south of the Denmark Strait is documented. Sediment sampling along to the East Greenland continental margin enables a comparison of living and dead benthic foraminiferal communities from north and south of the sill. In order to determine the faunal exchange

through the changing aperture of the Denmark Strait there are four central questions to be answered:

- What kinds of foraminiferal populations are found north and south of the Denmark Strait?
- Are there differences in species composition and diversity at both sides of the sill? And would these differences also appear in the morphology of benthic foraminifera?
- If so, which biotic or abiotic factors might regulate these differences?
- How do fossil foraminifera from the Last Glacial Maximum fit into this pattern?

1.4 Genetic investigations

In order to trace the impact of the changing intensity of the Denmark Strait Overflow during geological time scales on the North-South exchange of benthic foraminifera, potential new insights were expected from molecular genetics. The origination of new species is contingent on the build up of mutations within isolated sub-populations, and results from interruptions to gene flow caused by tectonic, ecological or climatic barriers (Steel et al. 2003). Genetic investigations, concerning the Denmark Strait area, were only made on planktic foraminifera so far (Darling et al. 2000, Stewart et al. 2001, Bauch et al. 2003). First molecular phylogenies of benthic foraminifera were already obtained, but the investigated specimens originated from other areas (Ertan et al. 2004, Schweizer et al. 2005). It is important to combine phylogenetic investigations with morphological measurements in order to distinguish “cryptic” species, meaning different genotypes with more or less the same morphology (Steel et al. 2003), from identical genotypes with different developed ecophenotypes. Gooday & Lamshead (1989) found a number of morphological differences between abyssal and bathyal calcareous species, but the assumption that these differences are not sufficient to separate the populations at species level, was not proved by means of molecular genetics. Hayward et al. (2004) already combined genetical and morphological determinations on different *Ammonia* species. Genetic investigations were performed within another sub-project of the research unit “Ocean Gateways” and will be discussed later in this study.

2 Study area

2.1 Bathymetry and physiography

The Denmark Strait is located between Greenland and Iceland and separates the Nordic Seas in the North from the North Atlantic Ocean in the South (Figure 2.1). It is characterised by a shallow sill with a maximum water depth of 620 m and represents the western part of the Greenland-Scotland Ridge, whereto Iceland, the Iceland-Faeroe Ridge, and the Wyville-Thomson Ridge contribute as well (Perry 1986, Hansen & Østerhus 2000). The southern end of the Denmark Strait is bounded by the Irminger Basin, which descends to water depths of over 3000 m, the northern end is bounded by the shallower Blosseville Basin followed by the Scoresby Basin, both slightly in excess of 1600 m water depth (Perry 1986). A relatively low sill of 1500 m water depth separates the Blosseville and Scoresby Basin (for general depth contour see Figure 4.1 b, page 22).

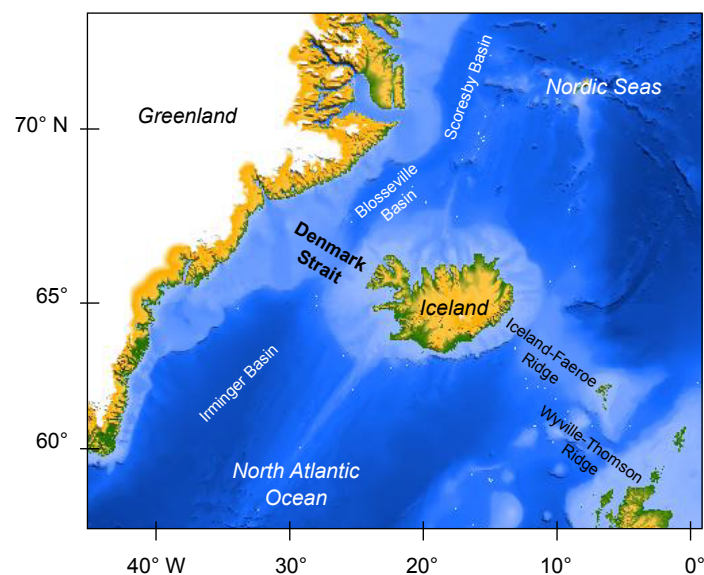


Figure 2.1: Physiography of the study area around the Denmark Strait (modified after Perry 1986, Hansen & Østerhus 2000).

2.2 Modern hydrography and circulation

The modern surface circulation of the Denmark Strait is characterised by two convergent currents (Hopkins 1991; see Figure 2.2). The NIIC forms a clockwise gyre around Ice-

land and transports relatively warm and saline Atlantic water (6–10°C and >35‰; Swift 1986) through the eastern Denmark Strait into the Nordic Seas. The East Greenland Current (EGC) transports cold and low-saline polar water (<0°C and <34‰; Swift 1986) southward through the western Denmark Strait into the North Atlantic.

Under present climate conditions most of the deep water is formed by open ocean convection (Lazier 2001). During winter, the Greenland and Iceland Seas are regions of intense surface cooling and deep convection (Tomczak & Godfrey 1994, Swift et al. 1980). Cold, saline and therefore dense waters sink downwards, form deep waters, and out-flow from the Norwegian and Iceland Seas into the North Atlantic by overflowing the Greenland-Scotland Ridge. Although they mix with less dense waters during their passage, they retain sufficient density to be primary contributors to the deep and bottom waters of the North Atlantic (Swift 1986).

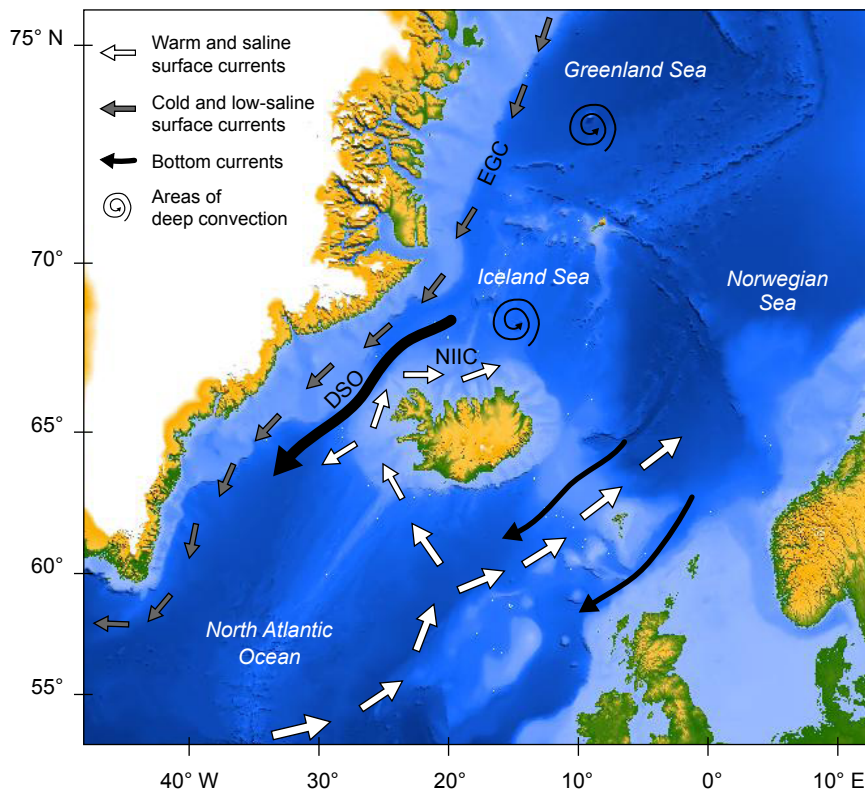


Figure 2.2: Modern surface and bottom circulation patterns of the Denmark Strait (modified after Hopkins 1991). Abbreviations: EGC = East Greenland Current, NIIC = North Icelandic Irminger Current, DSO = Denmark Strait Overflow.

The DSO contributes the main portion of the Greenland-Scotland Ridge Overflow (Rudels et al. 2002). The strength of the DSO mainly depends on the density gradient between water masses north and south of the Denmark Strait and the height of dense water above the straits sill (Whitehead et al. 1974). According to Dickson & Brown (1994) and Hopkins (1991) this overflow derives a value of 2.9 Sverdrup (1 Sv = 10^6 m³/s). At different

water depths, currents north of the sill showed velocities of about 0.10 m/s towards the strait (Jonsson & Valdimarsson 2004). South of the sill velocities up to 1.30 m/s and a mean velocity of 0.56 m/s were observed (Girton & Sanford 2003). The DSO provides the densest fraction of the Northwest Atlantic Bottom Water, a principal part of the North Atlantic Deep Water (Swift et al. 1980). This North Atlantic Deep Water is a fundamental component of the THC, the so-called ocean conveyor belt (Broecker 1991). The THC helps driving the currents around the globe and is important to the worlds climate (Hansen et al. 2004). It provides the warm Atlantic inflow into the Norwegian Sea and thus the European heat pump. Therefore the Denmark Strait can be regarded as a key region for assessing climate change.

2.3 Glacial hydrography and circulation

The Last Glacial Maximum (LGM) is defined as the most recent interval between 22 and 14 ka BP (Funder et al. 1998) when global ice sheets reached their maximum volume and extent during the last glaciation (Mix et al. 2001).

The intensity of the DSO is influenced by eustatically and isostatically controlled changes of the Denmark Strait aperture. The advance and retreat of the land-based ice sheets of Iceland and Greenland are responsible for the accompanying isostatic uplift and rebound as well as for eustatic sea level lowering and rising (Bennike et al. 2002, Fleming & Lambeck 2004), and hence for changes in the bathymetry of the Denmark Strait. Clark & Mix (2002) suggest a net decrease in eustatic sea level from 120 to 135 m during the LGM. Growth and decay of ice sheets, which reached up to Greenlandic and Icelandic shelves flanking the Denmark Strait, alter the aperture size and therefore influence the overflow as well (Funder et al. 1998, Andrews et al. 2000).

The suspected current pattern under the changed conditions during the LGM are shown in Figure 2.3. Owing to the narrowing of the Denmark Strait and increased northerly winds, the NIIC was strongly reduced but still existent whereas there was an increased surface water transport in a counter-clockwise gyre around Iceland (Kösters et al. 2004). According to Sarnthein et al. (1995) the EGC was not existent during the LGM. However, recent investigations on ice rafted debris of Kuijpers et al. (2003) found evidences for an existence of the EGC during the LGM.

The members of the CLIMAP project (CLIMAP 1981) have reconstructed a perennial sea ice cover in the Nordic Seas during glacial times, and model simulations of Ganopolski et al. (1998) suggest that the LGM deep-water renewal took place South of the Greenland-Scotland Ridge. In contrast Weinelt et al. (1996) and Sarnthein et al. (2003) came to the conclusion that wide areas of the glacial Nordic Seas were ice-free during summer. Accordingly, deep water was formed in the Nordic Seas during the LGM due to open ocean convection in summer and/or owing to brine release during enhanced sea-ice formation (Dokken & Jansen 1999). However, Schulz & Paul (2004) simulated for both LGM scenarios a reduction of 50% in the export of North Atlantic Deep Water to the Atlantic Ocean compared to recent conditions. The model of Paul & Schäfer-Neth (2003) shows an ongoing LGM convection in the Nordic Seas additionally to deep convection

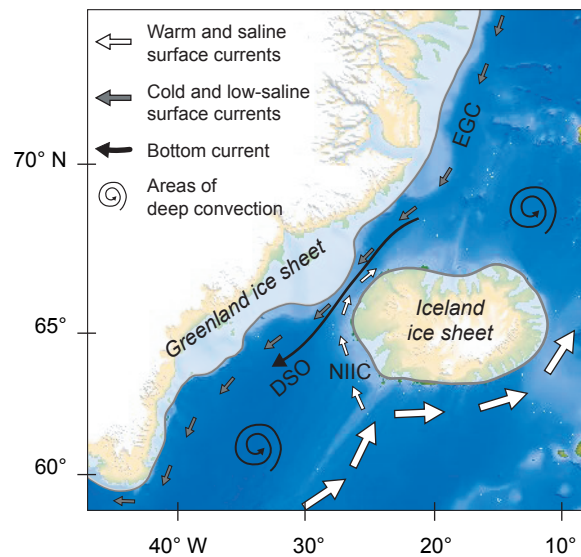


Figure 2.3: Surface and bottom circulation patterns of the Denmark Strait during the Last Glacial Maximum (simplified). Abbreviations: EGC = East Greenland Current, NIIC = North Icelandic Irminger Current, DSO = Denmark Strait Overflow. Greenland ice margin adapted from Funder et al. (1998). Iceland ice margin adapted from Andrews et al. (2000).

South of Iceland. This assumption is supported by reconstructions of Millo (2005) from the glacial DSO. Stable-isotope records of epibenthic and planktic foraminifera gave hints for both deep-water convection in the Nordic Seas and a further convection cell South of Iceland.

Even if there are different opinions about the location of the LGM deep-water renewal, the north-south density gradient of the water masses was in any case so much reduced that the DSO during the LGM was weaker than today or even reversed (Schulz & Paul 2004, Ganopolski et al. 1998). Modelling experiments of Kösters (2004) indicate that the DSO has almost vanished and was in a range of 0 to 0.5 Sv. He points out that the ice extent on the shelves and the lowered sea level are of minor importance, about 66% of the reduction in the DSO is due to a decreased density contrast. Modelled maximum velocities at the sill in southerly direction lay between 0.10 and 0.30 m/s, depending on the degree of supposed shelves glaciations (Kösters 2004).

3 Material and Methods

3.1 Sampling

A total of ten sampling stations was selected along the East Greenland continental margin at the North and South of the Denmark Strait in water depths between 980 and 2564 m (Table 3.1 and Figure 3.1).

Table 3.1: Station list with corresponding positions, date of sampling, water depth, used sampling gear, and investigated sediment depth.

Station	Latitude [°N]	Longitude [°W]	Sampling date	Water depth [m]	Gear	Sediment depth [cm]
PS62/002-3	61°47.7′	39°22.4′	1. July 2002	1891	Box corer	0-1
PS62/004-2	61°31.5′	38°07.4′	2. July 2002	2564	Multicorer	0-1
PS62/010-2	64°59.7′	32°54.4′	3. July 2002	1702	Box corer	0-1
PS62/012-2	64°37.5′	31°41.6′	4. July 2002	2402	Box corer	0-1
PS62/015-4	67°55.8′	25°25.7′	6. July 2002	980	Box corer	0-1
PS62/017-1	67°51.1′	24°34.9′	6. July 2002	1458	Box corer	0-1
PS62/020-1	70°59.9′	18°54.9′	8. July 2002	1322	Multicorer	0-1
PS62/021-1	71°30.2′	16°50.2′	8. July 2002	1704	Multicorer	0-1
PS62/017-4	67°51.0′	24°35.1′	6. July 2002	1458	Piston corer	173-174
PS62/017-4	67°51.0′	24°35.1′	6. July 2002	1458	Piston corer	175-176
PS62/017-4	67°51.0′	24°35.1′	6. July 2002	1458	Piston corer	177-178
GIK23519-5	64°47.8′	29°35.8′	18. Aug. 1995	1893	Gravity corer	67-68
GIK23519-5	64°47.8′	29°35.8′	18. Aug. 1995	1893	Gravity corer	79-80

Sediment samples containing modern benthic foraminifera were collected south and north of the sill during the RV “Polarstern” cruise ARK-XVIII/1 in July 2002 (Lemke 2003). In order to get undisturbed surface sediments, a multicorer with 8 parallel tubes, each with an outer diameter of 10 cm, and a box corer with a size of 50 x 50 x 60 cm were used respectively. A defined area of the surface sediment (0–1 cm) was taken at each sampling site. The sediment was preserved in ethanol mixed with Rose Bengal (2 g/l). At two multicorer sites (PS62/004-2 and PS62/020-1) a flocc layer (Lampitt 2001) was observed within the sediment-water interface. This layer (in the following called “fluff”) was carefully removed with a flexible tube and preserved as well in ethanol and Rose Bengal before the upper sediment centimetre was sampled.

In order to supplement morphometric measurements on modern foraminifera with those of glacial times, samples of two long sediment cores were investigated as well. One piston

3 Material and Methods

core (PS62/017-4) was taken also during the RV “Polarstern” cruise ARK-XVIII/1 and one gravity core (GIK23519-5) was taken during the RV “Poseidon” cruise POS 210/2 in August 1995 (Pflaumann et al. 1996), north and south of the Denmark Strait respectively. These two cores were sampled in sediment depths which represent a time frame, henceforth termed as glacial. According to (Millo 2005) this investigated time frame includes the Last Glacial Maximum (LGM) up to the Deglaciation, i.e. the beginning of Termination IA (18–15 ka BP; Hagen & Hald 2002). The investigated sediment depths from station GIK23519-5 were 67–68 and 79–80 cm. The core of station PS62/017-4 was sampled three times at sediment depths from 173 to 178 cm (Table 3.1).

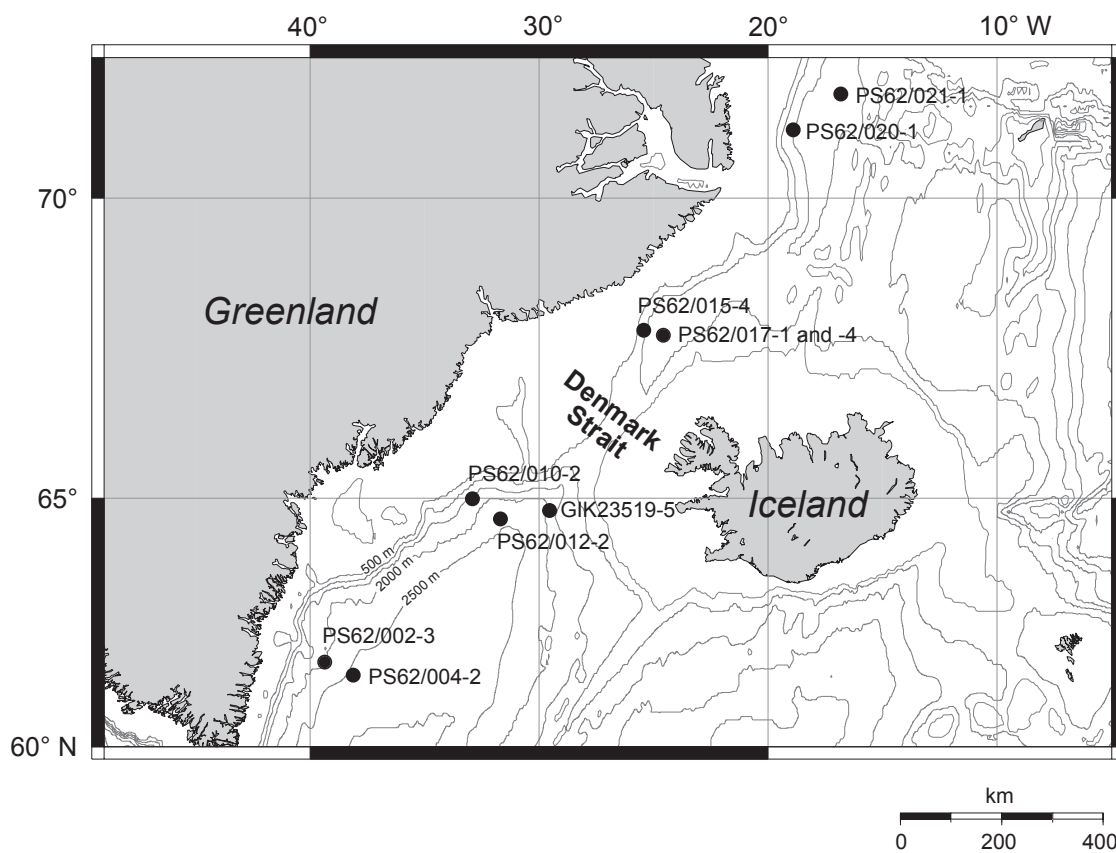


Figure 3.1: Study area including sampling sites of the RV “Polarstern” cruise ARK-XVIII/1 in July 2002 and the RV “Poseidon” cruise POS 210/2 in August 1995. Surface sediment samples were used for faunal and morphometric investigations. Core samples of station PS62/017-4 (cruise ARK-XVIII/1) as well as samples of station GIK23519-5 (cruise POS 210/2) represented glacial times and were used to supplement only the morphometric measurements on modern samples.

3.2 Biotic and abiotic parameters

The salinity and the oxygen content of the overlaying water of all surface sediment samples were measured with a WTW 190 conductometer and a WTW Oxi-LF 340 oxi-meter respectively, directly after core recovery. Furthermore the temperature of the sediment in 1 cm depth as well as the temperature of the overlaying water was determined immediately by means of a Testotherm 720 thermometer (measurement accuracy $\pm 0.2^{\circ}\text{C}$).

Sub-samples for later analyses of chlorophyll *a*, phaeopigment, DNA, and water content were taken. The samples were stored frozen until measurements were performed at the laboratory of the Institute of Polar Ecology in Kiel. In order to determine chlorophyll *a* and phaeopigment concentrations, the pigments were extracted with acetone (90%) and analysed by means of a Shimadzo UV-150-01 photometer (Arar & Collins 1997). DNA concentrations were determined by DAPI-reaction and subsequent measurement with a Kontron SFM 25 spectral fluorometer (Russell et al. 1975, Teucher 1986). The proportional water content of the sediment was calculated by weighing the wet samples, drying them at 63°C , and weighing the dried samples again.

Additional surface sediment samples for elemental analyses were taken and stored in amber glass bottles at -30°C until further treatment at the laboratory of the Alfred-Wegener-Institute in Bremerhaven. A Leco elemental analyser was used to analyse the content of total nitrogen, total carbon (TC), and total organic carbon (TOC). Carbonate contents (in weight percentage) were calculated by means of the formula: carbonate = $(\text{TC} - \text{TOC}) * 8.333$.

3.3 Sample treatment

The surface sediment samples were washed simultaneously over two sieves with a mesh size of 2000 and $63\ \mu\text{m}$ respectively, and rinsed into glass dishes. The overlaying water was decanted over filter paper to catch the organic residual with eventually buoying foraminifera. If existent, the “fluff”-layer of the sediment-water interface, found above multicorer samples, was sieved over a $63\ \mu\text{m}$ sieve. All residues were dried at 50°C and fractionated in five different size classes ($63-125$, $125-250$, $250-630$, $630-2000$, and $>2000\ \mu\text{m}$) in addition to the already existent fractions called “organic residual” and “fluff”. The fractions were weighed for particle size analysis. All living (stained) and dead benthic foraminifera $>125\ \mu\text{m}$ were picked from each sample. Specimens of *Cibicides wuellerstorfi* known as cosmopolitan species (Loeblich & Tappan 1988) were picked separately to carry out additional morphometric measurements. If necessary, single fractions were split by means of a micro splitter to approximately 300 specimens prior to counting and measuring. Schmiedl (1995) and Schumacher (2001) showed that after counting 300 individuals, the species number basically does not increase any more, and therefore a quantity of 300 specimens is sufficient for statistical calculations of the foraminiferal fauna. All foraminifera were identified at the lowest possible taxonomic level. Total abundance was expressed as number of individuals ($>125\ \mu\text{m}$) per $10\ \text{cm}^3$ wet sediment. Wet sediment volumes were calculated following Ahrens et al. (1997), by marking

the sediment height in the full sampling container, filling the empty container with water to the mark and determining its volume.

Glacial sediment samples were received already dried and sieved into size fractions of 150–250, 250–315, 315–400, and >400 μm . From these samples only individuals of *C. wuellerstorfi* were picked to supplement the morphometric measurements on modern specimens.

3.4 Morphometric measurements

Morphometric investigations on *Cibicidoides wuellerstorfi* from both surface and long-core samples included five different measurements:

- Counting of chambers within the last whorl
- Determination of the maximum test diameter
- Identification of the coiling direction
- Measurement of the proloculus (initial chamber) diameter
- Weighing of individual tests

The number of chambers within the last whorl was counted while looking at the involute umbilical side and wetting the specimens individually with water and therefore making the sutures more visible. In order to determine the maximum test diameter of *C. wuellerstorfi* the stereomicroscope LEICA MZ 125 equipped with a measuring ocular was used. A view at the spiral side of the low trochospiral tests was carried out to identify the coiling direction. Clockwise and counter-clockwise coiling was named right and left coiled respectively. In order to measure the diameter of the proloculus X-ray photographs of all specimens were taken with a Hewlett Packard Cabinet X-ray System on an AGFA Industrial X-ray Film (Structurix D4 FW). The specimens, placed on micropaleontological slides, were X-rayed with an exposure time of 2 min and a voltage of 35 kV. The X-ray photographs were analysed with the help of a stereomicroscope equipped with a measuring ocular and brightfield illumination. The diameter was determined to the nearest 5 μm . Individual specimens of *C. wuellerstorfi* were weighed by means of a microbalance Satorius SC2 (measurement accuracy $\pm 0.1 \mu\text{g}$). Only undamaged tests were used to determine the weight.

Signs of carbonate dissolution on modern *C. wuellerstorfi* tests were determined and divided in five different dissolution stages.

3.5 Statistical analysis

For all foraminiferal community analysis procedures, including both univariate and multivariate methods, abundances were calculated as individuals per 10 cm^3 wet sediment (in

the following labelled as ind/10 cm³). Large tubular agglutinated foraminifera, such as *Saccorhiza ramosa* or related species, easily broke into fragments during handling and were thus difficult to count. According to Ahrens et al. (1997) those fragments were counted as individual specimens.

3.5.1 Univariate methods

Community data usually comprise matrices which cells are filled with species abundances and a high proportion of zero entries. In order to analyse those kind of data, univariate methods can help to reduce all informations on the species composition to a single coefficient, like number of individuals, total number of species, or diversity indices.

Species diversity was determined according to the Shannon-Wiener index (Shannon & Weaver 1963). The Shannon-Wiener diversity is an index for species richness or species variety of the faunal assemblage and is calculated as a log-function of the species number. Theoretically the index can reach infinite values. Additionally to the Shannon-Wiener index a second diversity index, the Fisher α index, was calculated. As described by Murray (1973) the Fisher α index takes rare species into account.

Equitability was determined by means of the Pielou's evenness index (Clarke & Warwick 1994). If species are perfectly equally distributed, the ratio reaches its maximum value of 1. All mentioned indices above were calculated by means of the computer program PRIMER.

3.5.2 Multivariate methods

Multivariate classification aims to find groupings of samples such that those within a group are more similar to each other in biotic composition than samples in different groups (Warwick 2001). From the starting point of a ranked triangular similarity matrix (here the Bray-Curtis similarity) between all pairs of samples, the procedures encompass the following, supported by the computer program PRIMER except for the canonical correspondence analysis.

Multi-dimensional scaling (MDS) plots were used to illustrate results of the analysis of faunal similarities. According to Clarke & Warwick (1994) MDS constructs a configuration of the samples which attempts to satisfy all the conditions imposed by the rank similarity matrix, e.g. if sample 1 has a higher similarity to sample 2 than to sample 3, then sample 1 will be placed closer on the map to sample 2 than to sample 3.

In order to test differences between groups of samples the analysis of similarities (ANOSIM) was performed. The null hypothesis (H_0) is that there are no differences in faunal community composition at previously defined sites (in this study: location). In addition to the significance level (p), of which the value should be below $p = 5\%$ to prove the null hypothesis, the R-value was calculated (Clarke & Warwick 1994), since it gives an absolute measure of how separated the groups are, on a scale of 0 (indistinguishable) to 1 (totally separated).

The next step after the analysis of similarities was to detect the contributions from each species to similarity and dissimilarity respectively. Average similarity within a group and average dissimilarity between groups as well as the identification of those species that were principally responsible for sample groupings were performed by the PRIMER program SIMPER (similarity percentages-species contributions). The extreme values of similarities are 0 and 100. If the values for two species are the same at all sites, the similarity is 100. A similarity of 0 indicates that two species have no samples in common, i.e. are never found at the same sites. Similarity can easily be turned into dissimilarity by subtracting it from 100. Here again the limits reach 0 (no dissimilarity) to 100 (total dissimilarity).

Linking patterns of community analyses to patterns of biotic and abiotic environmental variables were carried out by using the BIOENV procedure. Each environmental variable is related to a coefficient ρ which indicates a rank correlation with $\rho = 1$ meaning complete agreement, $\rho = 0$ representing absence of any match, and $\rho = -1$ standing for complete opposition.

In order to explore the relationship between species abundances and the environmental variables besides BIOENV, canonical ordination was applied to the data. The canonical correspondence analysis (CCA) is a multivariate statistical tool to identify the observed environmental variables that “best” explain the patterns of variation in the species data. CCA is a technique that selects the linear combination of environmental variables that maximises the dispersion of the species scores. That means CCA chooses the best weights for the environmental variables, which is given by the first CCA axis (Jongman, ter Braak & van Tongeren 1995). The canonical correspondence analysis was generated by means of the computer program CANOCO 4.5. Original counts (ind/10 cm³) were converted to a logarithmic scale to reduce over-representation of extremely abundant taxa. Abiotic parameters like grain-size distribution as well as biotic parameters such as chlorophyll *a*, phaeopigment, TOC, and DNA content of the sediment were incorporated for environmental interpretation.

3.5.3 Statistical tests on performed morphometric measurements

In order to compare the results of morphometric measurements on *Cibicidoides wuellerstorfi* (maximum test diameter, number of chambers within the last whorl, and proloculus diameter) the Kruskal-Wallis similarity test was used. The test was performed to check if three or more groups are affected by a single factor. Kruskal-Wallis is a nonparametric test that does not require that the samples be drawn from a normally distributed population. The calculated p-value determines if there is a statistically significant difference between the medians of the groups. If this value is below a certain level (usually 5%), the conclusion is that there is a difference between the single groups.

The proloculus and maximum test diameters of *C. wuellerstorfi* are plotted in box plots. Each box encloses 50% of the data with the median value of the variable displayed as a line. The top and bottom of the box mark the limits of $\pm 25\%$ (quartile) of the variable population. The lines extending from the top and bottom of each box form the boundary of the minimum and maximum values within the data set that fall within an acceptable

range. Any value outside of this range, called an outlier, is displayed as an individual point. Outliers are points whose value is either greater than $UQ + 1.5 * IQD$ or less than $LQ - 1.5 * IQD$ whereas UQ is the upper and LQ the lower quartile and IQD is the inter quartile distance.

The difference in the stages of dissolution and coiling direction of *C. wuellerstorfi* tests was calculated by means of the χ^2 -test. This test is a nonparametric test of statistical significance for bivariate tabular analysis. The hypothesis tested with χ^2 is whether or not two different samples (here: left and right coiled specimens) are different enough that it can be generalised that the populations from which the samples are drawn are also that different.

Analysis of covariance (ANCOVA) was used to test the effects of categorical variables like location, number of chambers within the last whorl, and coiling direction on a continuous dependent variable (weight of individual tests), controlling for the effects of other continuous variables (maximum test diameter) which covary with the dependent. The purpose of ANCOVA in this study was the statistical comparison of regression lines, according to their parallelism and position.

4 Results

In the following, short terms for the surface sediment sampling stations will be used, as there are the numbers 2, 4, 10, and 12 for stations lying in the area south of the Denmark Strait, instead of PS62/002-3, PS62/004-2, PS62/010-2 and PS62/012-2 as well as 15, 17, 20 and 21 for the stations situated north of the sill, instead of PS62/015-4 etc. (for long terms see Table 3.1). The southern and northern stations were summarised in the two groups “South” and “North” respectively.

4.1 Faunal assemblages

A total number of 163 benthic foraminiferal taxa could be distinguished in this study, whereas 128 species were found in the group “South” and 104 species occurred in “North”. Table 4.1 lists all found species identified at the lowest possible taxonomic level in alphabetical order. Raw data sets are shown in the appendix (Tables A.1–A.8).

Table 4.1: Alphabetical list of all species found in this study including their super generic assignment (Textulariina and Allogromiina = “agglutinated”; Miliolina = “porcellaneous”; Rotaliina, Lagenina, Robertinina, and Spirillina = “perforate”) and their occurrence related to the Denmark Strait.

Species name	Super generic assignment	Occurrence	
<i>Adercotryma glomerata</i> (Brady 1878)	Agglutinated	South,	North
<i>Ammobaculites agglutinans</i> (d’Orbigny 1846)	Agglutinated	South	
<i>Ammobaculites filiformis</i> Earland 1934	Agglutinated	South	
<i>Ammodiscus catinus</i> Höglund 1947	Agglutinated	South,	North
<i>Ammolagena clavata</i> (Jones & Parker 1860)	Agglutinated	South	
<i>Astrorhiza</i> sp.	Agglutinated		North
<i>Atlantiella atlantica</i> (Parker 1952)	Agglutinated		North
<i>Bathysiphon</i> cf. <i>filiformis</i> Sars 1871	Agglutinated	South,	North
<i>Bolivina pacifica</i> Cushman & McCulloch 1942	Perforate	South	
<i>Bolivina pseudoplicata</i> Heron-Allen & Earland 1930	Perforate	South	
<i>Bolivina</i> cf. <i>seminuda</i> Cushman 1911	Perforate		North
<i>Bolivina</i> sp.	Perforate	South	
<i>Buccella frigida</i> (Cushman 1921)	Perforate	South,	North
<i>Buccella</i> sp.	Perforate	South	
<i>Bulimina mexicana</i> Cushman 1922	Perforate	South	
<i>Buzasina wiesneri</i> (Parr 1950)	Agglutinated	South	
<i>Cassidella loeblichii</i> Feyling-Hanssen 1954	Perforate	South	
<i>Cassidulina laevigata</i> d’Orbigny 1826	Perforate	South,	North
<i>Cassidulina teretis</i> Tappan 1951	Perforate	South,	North
<i>Cassidulina</i> sp.	Perforate	South	
cf. <i>Cibicides</i>	Perforate		North
<i>Cibicides kullenbergi</i> (Parker 1953)	Perforate	South	

4 Results

Table 4.1: continued

Species name	Super generic assignment	Occurrence	
<i>Cibicides lobatulus</i> (Walker & Jacob 1798)	Perforate	South,	North
<i>Cibicides refulgens</i> Montfort 1808	Perforate	South	
<i>Cibicidoides</i> cf. <i>mundulus</i> (Brady, Parker, & Jones 1888)	Perforate		North
<i>Cibicidoides wuellerstorfi</i> (Schwager 1866)	Perforate	South,	North
<i>Cornuloculina inconstans</i> Brady 1879	Procellaneous	South,	North
<i>Cornuspira involvens</i> (Reuss 1850)	Procellaneous	South,	North
<i>Criboelphidium excavatum</i> Cushman 1930	Perforate		North
<i>Cribrostomoides scitulum</i> (Brady 1881)	Agglutinated		North
<i>Cribrostomoides subglobosum</i> (Sars 1871)	Agglutinated	South,	North
<i>Crithionina cushmani</i> Hofker 1972	Agglutinated	South,	North
<i>Crithionina hispida</i> Flint 1899	Agglutinated		North
<i>Cruciloculina ericsoni</i> Loeblich & Tappan 1957	Procellaneous	South	
<i>Cyclammina cancellata</i> Brady 1879	Agglutinated	South	
<i>Cyclogyra involvens</i> (Reuss 1849)	Procellaneous	South	
<i>Cystammina pauciloculata</i> Brady 1879	Agglutinated	South	
<i>Dentalina</i> cf. <i>aphelis</i> (Loeblich & Tappan 1986)	Perforate	South	
<i>Dentalina communis</i> (d'Orbigny 1826)	Perforate		North
<i>Dentalina pauperata</i> d'Orbigny 1846	Perforate	South,	North
<i>Dentalina</i> sp.	Perforate		North
<i>Dentalina</i> (juvenile)	Perforate	South	
<i>Deuterammina grahami</i> Brönnimann & Whittaker 1988	Agglutinated		North
<i>Eggerella bradyi</i> (Cushman 1911)	Agglutinated	South,	North
<i>Eggerelloides advena</i> Cushman 1922	Agglutinated		North
<i>Ehrenbergina undulata</i> Parker 1953	Perforate	South	
cf. <i>Elphidium</i>	Perforate		North
<i>Elphidium excavatum</i> (Terquem 1875)	Perforate	South,	North
<i>Epistomina</i> sp.	Perforate	South,	North
<i>Epistominella exigua</i> (Brady 1884)	Perforate	South,	North
<i>Epistominella rugosa</i> (Phleger & Parker 1951)	Perforate	South	
<i>Fissurina</i> spp.	Perforate	South,	North
<i>Fursenkoina fusiformis</i> (Williamson 1858)	Perforate	South,	North
<i>Globocassidulina subglobosa</i> (Brady 1884)	Perforate	South,	North
<i>Glomospira irregularis</i> (Grzybowski 1898)	Agglutinated	South,	North
<i>Guttulina dawsoni</i> Cushman & Ozawa 1930	Perforate		North
<i>Gyroidina soldanii</i> (d'Orbigny 1826)	Perforate	South	
<i>Haplophragmoides bradyi</i> (Robertson 1891)	Agglutinated		North
<i>Haplophragmoides membranaceum</i> Höglund 1947	Agglutinated	South,	North
<i>Haplophragmoides sphaeriloculus</i> Cushman 1910	Agglutinated	South	
<i>Hemisphaerammina bradyi</i> Loeblich & Tappan 1957	Agglutinated	South,	North
<i>Hemisphaerammina marisalbi</i> (Stschedrina 1962)	Agglutinated	South,	North
<i>Hoeglundia elegans</i> (d'Orbigny 1826)	Perforate	South	
<i>Hormosina guttifera</i> (Brady 1881)	Agglutinated	South,	North
<i>Hyperammina elongata</i> Brady 1884	Agglutinated	South,	North
<i>Hyperammina</i> cf. <i>elongata</i> Brady 1884	Agglutinated	South	
<i>Hyperammina fragilis</i> Höglund 1947	Agglutinated		North
<i>Hyperammina friabilis</i> Brady 1884	Agglutinated		North
<i>Hyperammina</i> sp. sensu Thies 1991	Agglutinated		North
<i>Karriella bradyi</i> (Cushman 1911)	Agglutinated	South	
<i>Karriella catenata</i>	Agglutinated		North

Table 4.1: continued

Species name	Super generic assignment	Occurrence
<i>Karreriella novangliae</i> (Cushman 1922)	Agglutinated	South
<i>Karrerulina conversa</i> (Grzybowski 1901)	Agglutinated	South
<i>Labrospira crassimargo</i> (Norman 1892)	Agglutinated	South
<i>Labrospira jeffreysii</i> (Williamson 1858)	Agglutinated	South, North
<i>Lagena</i> spp.	Perforate	South, North
<i>Lagenammina</i> cf. <i>diffflugiformis</i> (Brady 1884)	Perforate	North
<i>Lagenammina tubulata</i> (Rhumbler 1931)	Perforate	South, North
<i>Laryngosigma hyalascidia</i> Loeblich & Tappan 1953	Perforate	South
<i>Lenticulina peregrina</i> (Schwager 1866)	Perforate	South
<i>Marginulina costata</i> (Batsch 1791)	Perforate	North
<i>Marginulina glabra</i> d'Orbigny 1826	Perforate	South, North
<i>Marsipella cylindrica</i> Brady 1878	Agglutinated	South, North
cf. <i>Martinottiella</i>	Agglutinated	North
<i>Melonis barleeianum</i> (Williamson 1858)	Perforate	South, North
<i>Melonis pompilioides</i> (Fichtel & Moll 1798)	Perforate	South
<i>Miliolonella subrotunda</i> (Montagu 1803)	Procellaneous	North
<i>Nonion labradoricum</i> (Dawson 1860)	Perforate	South, North
<i>Nonion</i> sp.	Perforate	South, North
<i>Nonionella grateloupi</i> (d'Orbigny 1836)	Perforate	South
<i>Nummoloculina irregularis</i> (d'Orbigny 1839)	Procellaneous	South, North
<i>Oolina</i> spp.	Perforate	South, North
<i>Oridorsalis umbonatus</i> (Reuss 1851)	Perforate	South, North
<i>Oridorsalis</i> sp.	Perforate	South
cf. <i>Ovammina</i>	Agglutinated	South, North
<i>Parafissurina groenlandica</i> (Stschedrina 1946)	Perforate	North
<i>Patellina corrugata</i> Williamson 1858	Perforate	South
<i>Pelosina variabilis</i> Brady 1879	Agglutinated	South
<i>Placopsilina</i> sp.	Agglutinated	North
<i>Placopsilinella aurantiaca</i> Earland 1934	Agglutinated	South, North
<i>Planispirinoides bucculentus</i> Brady 1884	Procellaneous	South, North
<i>Portatrochammina karica</i> (Stchedrina 1946)	Agglutinated	South, North
<i>Psammosphaera parva</i> Flint 1899	Agglutinated	South, North
<i>Pullenia bulloides</i> (d'Orbigny 1826)	Perforate	South, North
<i>Pullenia quinqueloba</i> (Reuss 1851)	Perforate	South
<i>Pullenia salisburyi</i> Stewart & Stewart 1930	Perforate	South
<i>Pullenia subcarinata</i> (d'Orbigny 1826)	Perforate	South
<i>Pyrgo lucernula</i> (Schwager 1866)	Procellaneous	South
<i>Pyrgo murrhina</i> (Schwager 1866)	Procellaneous	South
<i>Pyrgo oblonga</i> (d'Orbigny 1839)	Procellaneous	South, North
<i>Pyrgo rotalaria</i> Loeblich & Tappan 1953	Procellaneous	South, North
<i>Pyrgo williamsoni</i> (Silvestri 1923)	Procellaneous	South, North
<i>Pyrgo</i> (juvenile)	Procellaneous	South, North
<i>Pyrgoella sphaera</i> (d'Orbigny 1839)	Procellaneous	South, North
<i>Quinqueloculina pulchella</i> d'Orbigny 1826	Procellaneous	South
<i>Quinqueloculina seminula</i> (Linné 1758)	Procellaneous	South, North
<i>Quinqueloculina</i> sp.	Procellaneous	South
<i>Recurvoides contortus</i> Earland 1934	Procellaneous	North
<i>Recurvoides</i> (juvenile)	Agglutinated	South
<i>Reophax aduncus</i> Brady 1882	Agglutinated	North

4 Results

Table 4.1: continued

Species name	Super generic assignment	Occurrence	
<i>Reophax bilocularis</i> Flint 1897	Agglutinated	South,	North
<i>Reophax dentaliniformis</i> Brady 1881	Agglutinated	South,	North
<i>Reophax difflugiformis</i> Brady 1879	Agglutinated	South,	North
<i>Reophax helenae</i> (Rhumbler 1913)	Agglutinated	South,	North
<i>Reophax nodulosum</i> Brady 1879	Agglutinated		North
<i>Reophax sabulosus</i> Brady 1882	Agglutinated		North
<i>Reophax scorpiurus</i> Montfort 1808	Agglutinated	South,	North
<i>Reophax subfusiformis</i> Earland 1933	Agglutinated		North
<i>Reophax</i> sp. sensu Gooday 1986	Agglutinated		North
<i>Rhabdammina abyssorum</i> Sars 1868	Agglutinated	South,	North
<i>Rhizammina algaeformis</i> Brady 1879	Agglutinated	South	
<i>Robertina arctica</i> Loeblich & Tappan 1953	Perforate	South,	North
<i>Robertina bradyi</i> Cushman & Parker 1936	Perforate		North
<i>Robertina</i> sp.	Perforate	South	
<i>Rupertina stabilis</i> (Wallich 1877)	Perforate	South,	North
<i>Saccammina sphaerica</i> Sars 1868	Agglutinated	South,	North
<i>Saccorhiza ramosa</i> (Brady 1879)	Agglutinated	South,	North
<i>Sigmoilopsis schlumbergeri</i> (Silvestri 1904)	Agglutinated	South	
<i>Siphotextularia philippinensis</i> (Keijzer 1953)	Agglutinated	South	
<i>Spirillina obconica</i> Brady 1879	Procellaneous	South	
<i>Spirillina</i> cf. <i>vivipara</i> Ehrenberg 1843	Procellaneous	South	
<i>Stainforthia fusiformis</i> (Williamson 1858)	Perforate	South,	North
<i>Subreophax guttifer</i> (Brady 1881)	Agglutinated	South,	North
<i>Textularia torquata</i> Parker 1952	Agglutinated		North
<i>Textularia wiesneri</i> Earland 1933	Agglutinated	South,	North
<i>Thurammina papillata</i> Brady 1879	Agglutinated	South,	North
<i>Tolypammina vagans</i> (Brady 1879)	Agglutinated	South	
<i>Tosaia</i> cf. <i>hanzawai</i> Takayanagi 1953	Perforate	South	
<i>Trifarina angulosa</i> (Williamson 1858)	Perforate	South	
<i>Trifarina carinata</i> Cushman 1927	Perforate	South	
<i>Triloculina tricarinata</i> d'Orbigny 1826	Procellaneous	South,	North
<i>Trochammina globigeriniformis pygmaea</i> Höglund	Agglutinated	South,	North
<i>Trochammina</i> ex gr. <i>squamata</i> Jones & Parker 1860	Agglutinated	South	
<i>Valvulineria minuta</i> (Schubert 1904)	Perforate		North
Unidentified agglutinated (attached)	Agglutinated	South,	North
Unidentified agglutinated (ovoid)	Agglutinated	South,	North
Unidentified agglutinated (spheroidal)	Agglutinated	South,	North
Unidentified agglutinated (tubular)	Agglutinated	South	
Unidentified perforate I (trochospiral)	Perforate	South	
Unidentified perforate II (trochospiral)	Perforate	South,	North
Unidentified perforate III (trochospiral)	Perforate	South	
Unidentified perforate IV (trochospiral)	Perforate	South	
Unidentified porcellaneous (miliolid)	Procellaneous		North

4.1.1 Abundances

Figure 4.1 a) shows the station map including the sampling sites named by their short terms. The line through the sampling area indicates a cross section. The corresponding depth contour is drawn in Figure 4.1 b) including the abundances of the total foraminiferal fauna at single stations subdivided in living and dead assemblages. The abundance of southern foraminifera, generally sampled in greater water depths, was up to four times higher than the abundance of those found north of the Denmark Strait. Abundance values ranged from 3861 to 8249 ind/10 cm³ in “South” and from 1192 to 2414 ind/10 cm³ in “North”. Dead assemblages south of the sill consisted of 122 different taxa, while the northern dead assemblages showed 98 different species. However, more species (74) were found living in the northern than in the southern stations (67). The absolute abundance of living foraminifera ranged between 93 and 658 ind/10 cm³ south of the sill and between 120 and 228 ind/10 cm³ at northern sites. The relative abundance of living species was much higher in “North” (8.6–18.2%) as in “South” (1.5–9.7%).

In Figure 4.2 abundances of living and dead assemblages in their super generic assignment are plotted. According to Schumacher (2001) the sub-orders Textulariina and Allogromiina were summarised as “agglutinated” foraminifera, the sub-order Miliolina was supplied to “porcellaneous” fauna, and all Rotaliina, Lagenina, Robertinina, and Spirillina were assigned to the “perforate” foraminifera. Within the dead assemblages, perforate species dominated south of the sill whereas the northern assemblages contained predominantly agglutinated species. This pattern changes, looking at the living assemblages: At both sides of the Denmark Strait agglutinated living species were dominant. Abundances in “South” were much more heterogeneous (93–658 ind/10 cm³) compared with those in “North” (120–276 ind/10 cm³). Porcellaneous foraminifera were extremely rare in both living and dead assemblages.

DeLaca (1986) divides foraminiferal abundances into three groups: Species with an occurrence >15% are abundant, 2–10% are common, and <2% are rare. Common species of the total dead fauna found north and south of the Denmark Strait were listed in Table 4.2. At southern stations 11 species showed a relative abundance of >2%, while at northern stations 13 species occurred with relative abundances >2%. The portion of perforate and agglutinated reflected very well the pattern of Figure 4.2: Perforate species dominated south of the sill and agglutinated species were much more frequent at northern stations. The only abundant foraminifer of the southern dead assemblage was the perforate species *Cibicides lobatulus*. In “North” only the agglutinated species *Hormosina guttifera* was abundant. The two agglutinated species *Saccorhiza ramosa* and *Reophax difflugiformis* were common in northern as well as in southern dead assemblages. Table 4.3 represents common species of the total living fauna found north and south of the sill. Here again less species (11) occurred “South” than in “North”, where 16 species showed a relative abundance of >2%. In both areas, agglutinated species dominated the living assemblages. Only at southern stations two of the found species could be called abundant: the agglutinated species *Hemisphaerammina marisalbi* and *Placopsilinella aurantiaca*. Northern and southern living assemblages had six agglutinated species in common. None of all species but one single perforate foraminifer was common in both “South” and “North” as

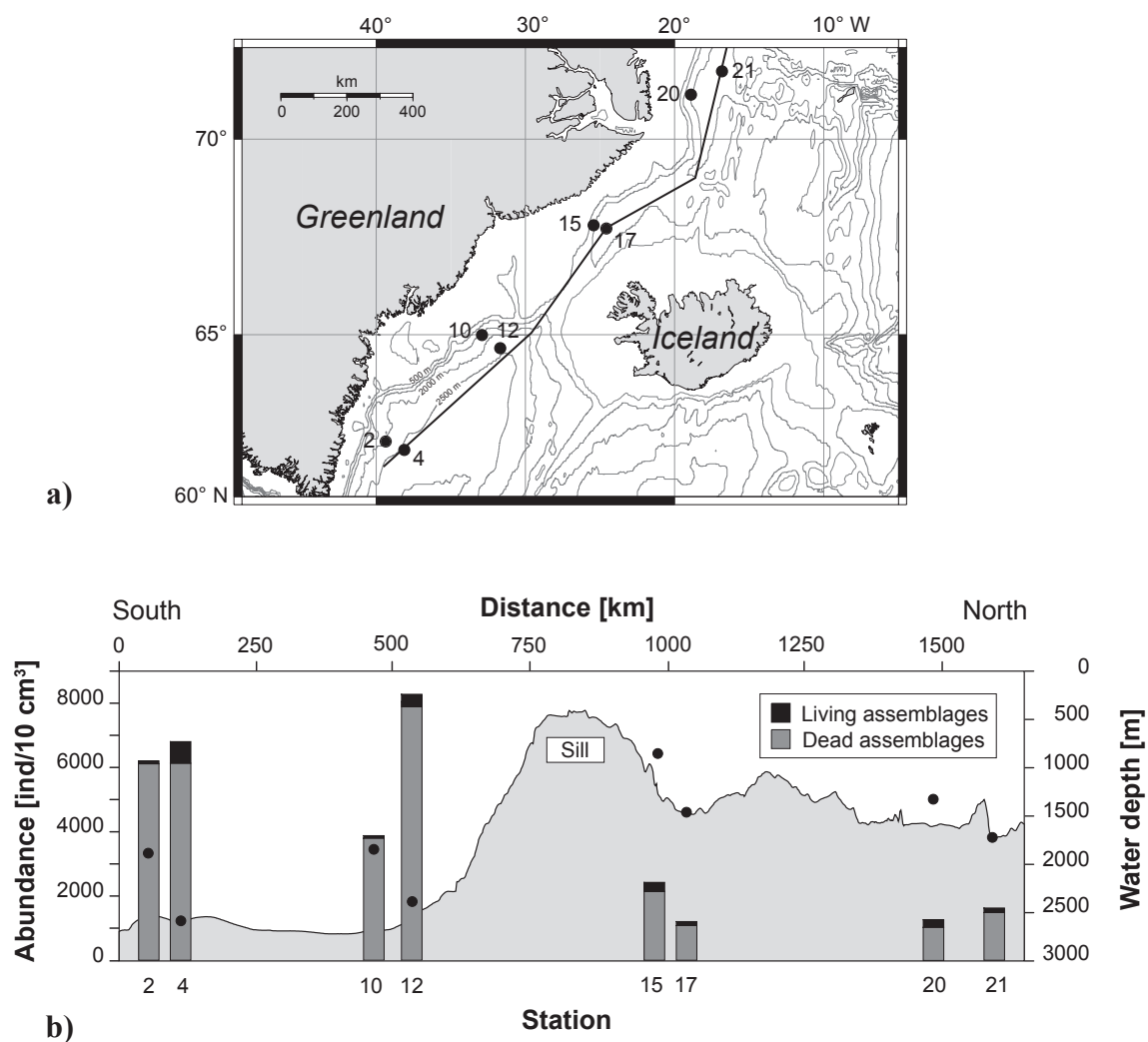


Figure 4.1: **a)** Station map including sampling sites (filled circles). Line indicates a cross section. **b)** South to North cross section across the Denmark Strait showing the depth contour and abundances of the total foraminiferal assemblages $>125 \mu\text{m}$ subdivided into dead and living specimens at stations indicated (filled circles: water depth of sampling stations).

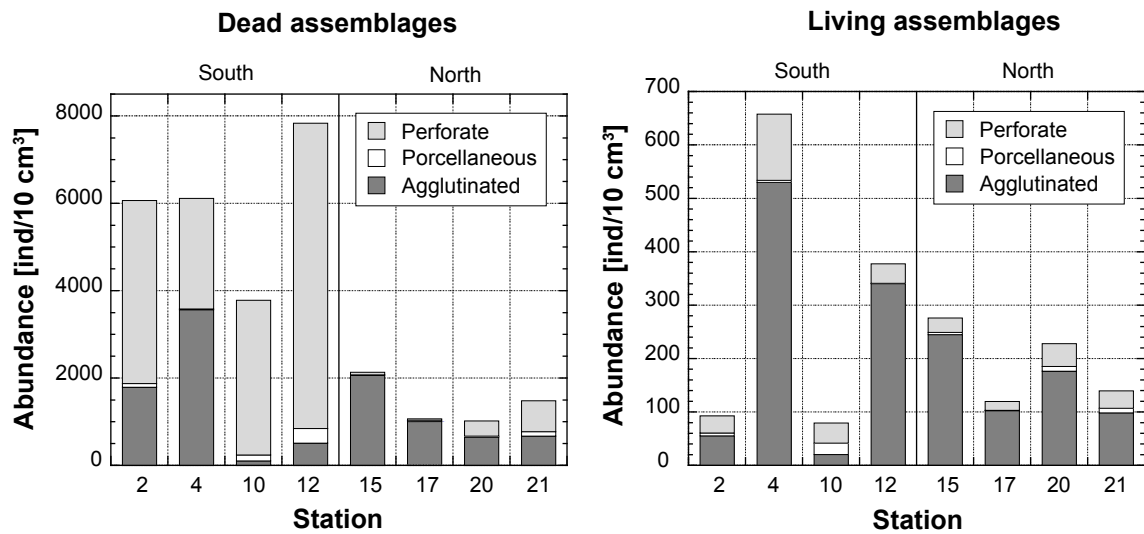


Figure 4.2: Abundance of dead and living benthic foraminiferal assemblages and their super generic assignment. (Textulariina and Allogromiina = “agglutinated”; Miliolina = “porcellaneous”; Rotaliina, Lagenina, Robertinina, and Spirillina = “perforate”).

well as in dead and living assemblages namely *Cibicidoides wuellerstorfi* (more detailed lists of abundances are shown in the appendix, Tables A.10 – A.14).

4.1.2 Diversity, evenness, and number of species

A comparison of the Shannon-Wiener diversity, number of species, and equitability at individual stations for dead and living fauna is given in Figure 4.3. In general, the stations of the group “South” showed a heterogeneous pattern in number of species as well as in diversity and Pielou’s evenness indices, while the data in “North” were more homogeneous.

Looking at the dead assemblages, the diversity of the northern stations reached values around 2.6 and the species number was between 50 and 60. The southern stations showed a wide range in Shannon-Wiener diversity with values from 1.7 to 3.3 as well as in numbers of species (51–79). The evenness index ranged widely from 0.4 to 0.8 in “South” and slightly from 0.6 to 0.7 in “North”.

The diversity of living assemblages reached values around 3 and the number of species varied slightly between 36 and 45 in the northern stations. The diversity of the southern stations was clearly lower. Values ranged from 1.3 to 2.5 and species numbers showed a wide range from 19 to 40. All living assemblages in “North” had an evenness index slightly above 0.8, while the equitability in “South” varied between 0.4 and 0.8.

Regarding the Fisher α diversity (Figure 4.4) the pattern is very similar to the Shannon-Wiener diversity. In the group “South” values were very heterogeneous while indices in “North” were rather homogeneous. Looking at the dead fauna, values from 7.1 to 8.7 were determined in “North”, and the indices in “South” varied between 6.2 and 9.6. The living

4 Results

Table 4.2: Relative abundance >2% of dead benthic foraminifera >125 μm in surface samples north and south of the Denmark Strait (for more details see appendix, Table A.10).

Dead species “South”	Rel. abund. >2%	Dead species “North”	Rel. abund. >2%
<i>Cibicides lobatulus</i>	28.12	<i>Hormosina guttifera</i>	17.59
<i>Cibicoides wuellerstorfi</i>	7.66	<i>Saccorhiza ramosa</i>	11.95
<i>Saccorhiza ramosa</i>	6.57	<i>Cribrostomoides subglobosum</i>	9.39
<i>Rupertina stabilis</i>	6.15	<i>Cibicoides wuellerstorfi</i>	8.96
<i>Saccammina sphaerica</i>	3.89	<i>Reophax difflugiformis</i>	7.08
<i>Elphidium excavatum</i>	3.10	<i>Trochammina globigeriniformis pygmaea</i>	5.88
<i>Fissurina</i> spp.	2.91	<i>Hemisphaerammina bradyi</i>	3.77
<i>Reophax difflugiformis</i>	2.62	<i>Cassidulina teretis</i>	3.72
<i>Globocassidulina subglobosa</i>	2.51	<i>Oridorsalis umbonatus</i>	3.66
<i>Ammolagena clavata</i>	2.26	<i>Reophax scorpiurus</i>	2.88
<i>Cassidulina laevigata</i>	2.26	<i>Adercotryma glomerata</i>	2.56
		<i>Reophax aduncus</i>	2.45
		<i>Portatrochammina karica</i>	2.30

Table 4.3: Relative abundance >2% of living (stained) benthic foraminifera >125 μm in surface samples north and south of the Denmark Strait (for more details see appendix, Table A.10).

Living species “South”	Rel. abund. >2%	Living species “North”	Rel. abund. >2%
<i>Hemisphaerammina marisalbi</i>	25.19	<i>Hemisphaerammina marisalbi</i>	8.49
<i>Placopsilinella aurantiaca</i>	15.96	<i>Hormosina guttifera</i>	8.45
<i>Saccorhiza ramosa</i>	11.94	<i>Reophax difflugiformis</i>	7.39
<i>Reophax difflugiformis</i>	6.80	<i>Saccorhiza ramosa</i>	6.09
<i>Reophax scorpiurus</i>	5.56	<i>Marsipella cylindrica</i>	5.89
<i>Pullenia bulloides</i>	3.31	<i>Crithonia cushmani</i>	5.25
Unidentified agglutinated (spheroidal) cf. <i>Ovamina</i>	3.12	<i>Reophax scorpiurus</i>	4.45
<i>Epistominella exigua</i>	2.52	<i>Cribrostomoides subglobosum</i>	4.41
<i>Cibicoides wuellerstorfi</i>	2.42	<i>Psammoshaera parva</i>	4.02
<i>Fissurina</i> spp.	2.29	<i>Trochammina globigeriniformis pygmaea</i>	3.55
	2.12	Unidentified perforate II (trochospiral)	3.08
		<i>Placopsilinella aurantiaca</i>	2.51
		<i>Cibicoides wuellerstorfi</i>	2.38
		<i>Cassidulina teretis</i>	2.34
		cf. <i>Ovamina</i>	2.09
		<i>Adercotryma glomerata</i>	2.06

assemblages in the northern stations had a Fisher α index between 7.6 and 9.3, and values of southern stations ranged extremely from 3.4 to 8.3.

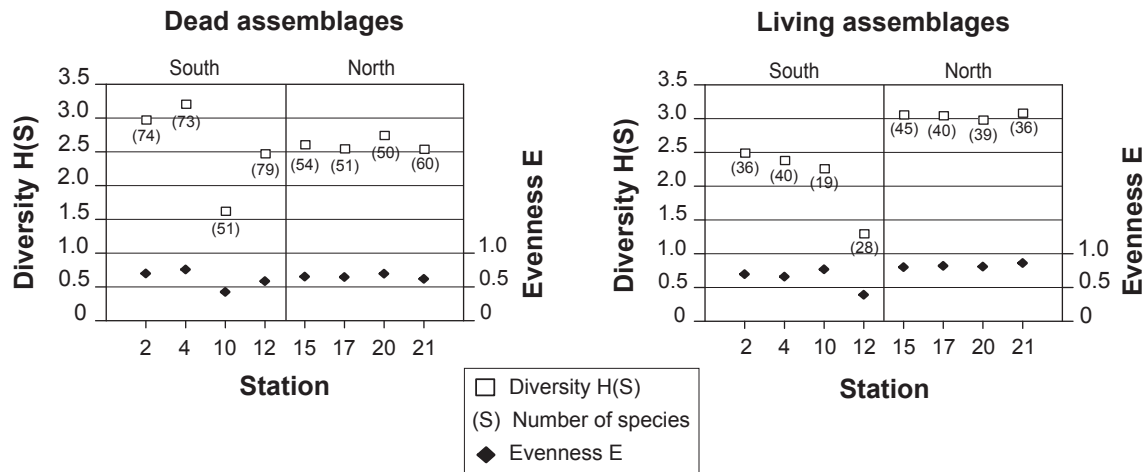


Figure 4.3: Shannon-Wiener diversity $H(S)$, number of species (S), and Pielou's evenness E of dead and living benthic foraminiferal assemblages.

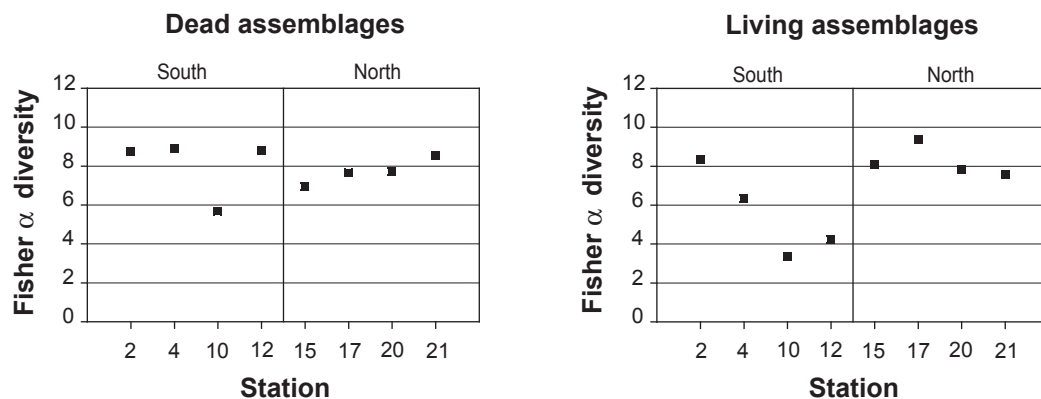


Figure 4.4: Fisher α diversity of dead and living benthic foraminiferal assemblages.

4.1.3 Analysis of similarities (ANOSIM)

ANOSIM was performed to detect faunal similarities. The results of the analysis considering dead and living assemblages are shown in Figure 4.5 as MDS plots. The dead assemblages of each sampling site separated very well into two groups ($R = 1$, $p = 2.9\%$) with stations located in "North" and "South". The separation of the living assemblages in the northern and southern group was not that clear ($R = 0.469$ and $p = 2.9\%$), but still different. Here the similarity within the southern stations was smaller than within the northern stations.

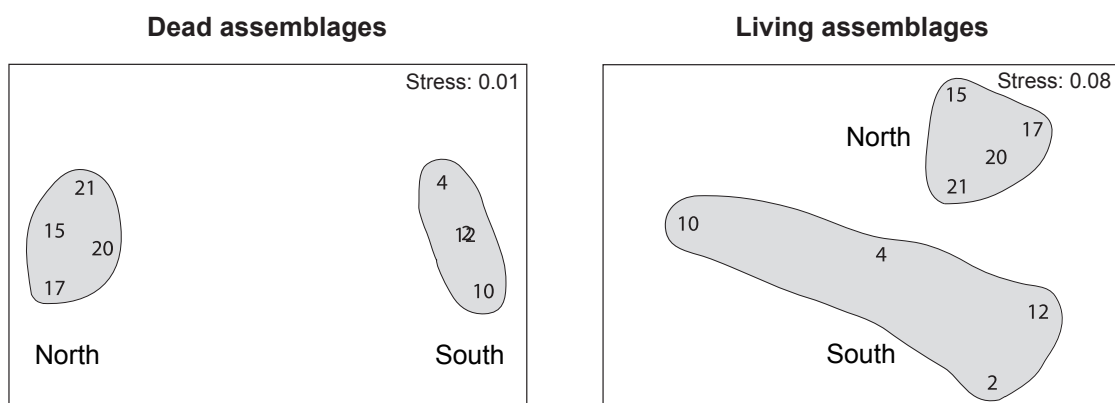


Figure 4.5: Ordination of all stations (indicated by their station number) of dead and living benthic foraminiferal assemblages. Stations are plotted in two dimensions using multi-dimensional scaling. Axis scales are arbitrary.

4.1.4 Species contributions - similarity percentages (SIMPER)

The program SIMPER, which breaks down the contribution of individual species to the overall similarity within and dissimilarity between groups, was used for further analysis of communities within faunal groups as well as for analysis of differences between diverse groups.

The average similarity within the single groups “South” and “North” of the dead assemblages was 55.04 and 54.25 respectively (Table 4.4). *Cibicidoides wuellerstorfi* contributed 4.75% and 3.30% to the average similarity within the single groups “South” and “North”. The average dissimilarity between the groups “South” and “North” was 69.12. The perforate species *Cibicides lobatulus* was the strongest discriminator and contributed 2.81% to the average dissimilarity. The same species accounted for 5.96% of the average similarity within the group “South”. *Hormosina guttifera* contributed the largest portion (9.48%) to the average similarity within the group “North” and was ranked as discriminator species on the fourth place. This agglutinated species accounted for 2.13% of the average dissimilarity (69.12) between the groups “South” and “North”.

Considering the living assemblages (Table 4.5) the average similarity within the single groups “South” and “North” was 30.02 and 50.78 respectively. Of this, five identical agglutinated species of group “South” and “North” contributed 24.4% and 22.9% respectively, as there were *Crithionina cushmani*, *Placopsilinella aurantiaca*, *Reophax difflugiiformis*, *Trochammina globigeriniformis pygmaea*, and an unidentified spheroidal species. *Cibicidoides wuellerstorfi* and *Hemisphaerammina marisalbi* accounted for a very high percentage (30.8%) to the average similarity within “South”. The average dissimilarity between the groups “South” and “North” was 69.38. The two strongest discriminators between these groups were *Hormosina guttifera* and *Cribrostomoides subglobosum* (4.12% and 3.46%). This two species and *Hemisphaerammina marisalbi* contributed 24.9% to the average similarity within the group “North”.

Table 4.4: Average similarities within the single groups “South” and “North” as well as average dissimilarity between these two groups implemented by the PRIMER program SIMPER. Breakdown of average similarity and dissimilarity into contributions from the ten most important species of the dead foraminiferal assemblage. The species are ordered in decreasing contribution.

Group “South” Average similarity = 55.04		Group “North” Average similarity = 54.25		Groups “South” + “North” Average dissimilarity = 69.12	
Species	Contribution [%]	Species	Contribution [%]	Species	Contribution [%]
<i>Cibicides lobatulus</i>	5.96	<i>Hormosina guttifera</i>	9.48	<i>Cibicides lobatulus</i>	2.81
<i>Cibicides wuellerstorfi</i>	4.75	<i>Cribrostomoides subglobosum</i>	7.46	<i>Rupertina stabilis</i>	2.41
<i>Elphidium excavatum</i>	4.70	<i>Saccorhiza ramosa</i>	7.01	<i>Elphidium excavatum</i>	2.23
<i>Globocassidulina subglobosa</i>	4.38	<i>Reophax scorpionis</i>	6.00	<i>Hormosina guttifera</i>	2.13
Fissurina spp.	4.23	<i>Trochammina globigeriniformis pygmaea</i>	5.79	<i>Gyroidina soldanii</i>	2.01
<i>Cassidulina laevigata</i>	4.13	<i>Reophax aduncus</i>	5.60	<i>Trifarina angulosa</i>	2.00
<i>Pullenia bulloides</i>	3.66	<i>Reophax difflugiformis</i>	5.19	Fissurina spp.	1.99
<i>Saccammina sphaerica</i>	3.42	<i>Adercotrinya glomerata</i>	4.84	<i>Pullenia bulloides</i>	1.97
<i>Melonis barleeanum</i>	3.30	<i>Thurammina papillata</i>	3.97	<i>Hoeglundia elegans</i>	1.92
Lagena spp.	3.17	<i>Cibicides wuellerstorfi</i>	3.30	<i>Reophax aduncus</i>	1.78

Table 4.5: Average similarities within the single groups “South” and “North” as well as average dissimilarity between these two groups implemented by the PRIMER program SIMPER. Breakdown of average similarity and dissimilarity into contributions from the ten most important species of the living foraminiferal assemblage. The species are ordered in decreasing contribution.

Group “South” Average similarity = 30.02		Group “North” Average similarity = 50.78		Groups “South” + “North” Average dissimilarity = 69.38	
Species	Contribution [%]	Species	Contribution [%]	Species	Contribution [%]
<i>Cibicides wuellerstorfi</i>	16.23	<i>Hemisphaerammina marisalbi</i>	8.95	<i>Hormosina guttifera</i>	4.12
<i>Hemisphaerammina marisalbi</i>	14.53	<i>Cribrostomoides subglobosum</i>	8.20	<i>Cribrostomoides subglobosum</i>	3.46
<i>Saccammina sphaerica</i>	6.85	<i>Hormosina guttifera</i>	7.75	<i>Reophax scorpionis</i>	3.43
Unidentified agglutinated (spheroidal)	5.81	<i>Reophax scorpionis</i>	6.91	<i>Reophax difflugiformis</i>	3.13
<i>Trochammina globigeriniformis pygmaea</i>	5.55	<i>Saccorhiza ramosa</i>	6.10	<i>Saccorhiza ramosa</i>	3.13
<i>Placopsilinella aurantiaca</i>	5.09	<i>Trochammina globigeriniformis pygmaea</i>	6.09	<i>Hemisphaerammina marisalbi</i>	2.83
Unidentified perforate II (trochospiral)	4.61	<i>Reophax difflugiformis</i>	5.03	<i>Psammospaera parva</i>	2.68
<i>Pullenia bulloides</i>	4.45	<i>Placopsilinella aurantiaca</i>	4.46	<i>Pullenia bulloides</i>	2.57
<i>Critthonina cushmani</i>	4.04	Unidentified agglutinated (spheroidal)	3.84	cf. <i>Ovammmina</i>	2.51
<i>Reophax difflugiformis</i>	3.94	<i>Critthonina cushmani</i>	3.50	<i>Placopsilinella aurantiaca</i>	2.46

4.2 Linking community analyses to environmental variables

Single values of biotic and abiotic parameters of sediment samples like temperature, chlorophyll *a*, phaeopigment, DNA, TOC, carbonate, total nitrogen, C/N-ratio, and water content were used for multivariate statistical analysis. Salinity, oxygen content and temperature of the overlaying water, water depth, and grain-size distribution were incorporated for environmental interpretation as well. All data values are listed in Table A.15 of the appendix.

The grain-size distributions of sediment particles of the dried and sieved fractions 63–125, 125–250, 250–630, 630–2000, and >2000 μm are given in Figure 4.6. For methodical reasons the fine fractions <63 μm were washed out and discarded. At southern stations almost half (49.8%) of the sediment contained intermediate size fractions from 125 to 630 μm . Smaller and coarser grains occurred with 19.2 and 31% respectively. At northern stations the pattern was different. Here the intermediate grain-size fractions made up only 26.1% and much higher percentages of smaller and coarser grains were recorded (31.8 and 42% respectively).

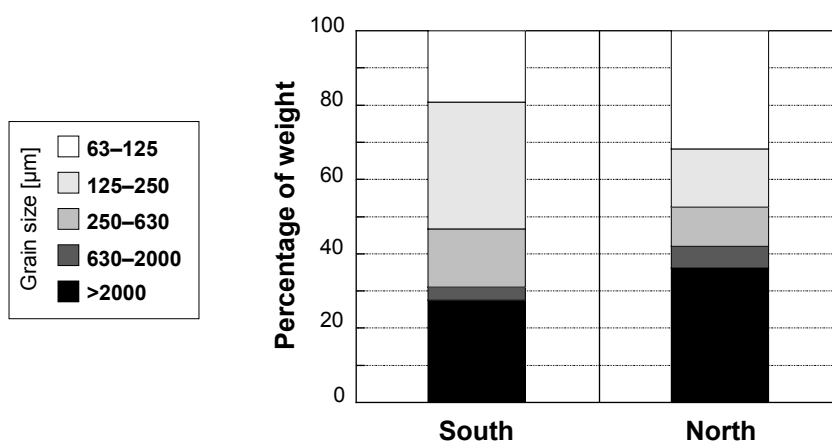


Figure 4.6: Grain-size distribution given in weight percentage (dried sediment).

4.2.1 Linking of biological patterns to environmental variables (BIOENV)

Table 4.6 lists the environmental variables and their corresponding coefficients for dead and living benthic foraminiferal assemblages. The strongest link for the dead and living faunal pattern to the environmental variables seemed to be the temperature of the overlaying water with $\rho = 0.895$ and 0.626 respectively. Further parameters showing a good agreement with the dead faunal pattern were total nitrogen, TOC, and carbonate. Concerning the coefficient ρ , C/N-ratio and oxygen content of the overlaying water resulted a good agreement to the faunal pattern of the living assemblage. The other biotic and abiotic parameters showed little to no matches related to the dead and living assemblage patterns by using the BIOENV procedure.

Table 4.6: Environmental variables and their corresponding coefficient ρ for dead and living benthic foraminiferal assemblages after using the BIOENV procedure ($\rho = 1$ complete agreement, $\rho = 0$ absence of any match, and $\rho = -1$ complete opposition). Coefficients values of $\rho > 0.5$ are marked bold.

Parameter	Dead assemblages	Living assemblages
Water temperature	0.895	0.626
C/N-ratio	0.316	0.563
Oxygen content	0.095	0.554
Water content	0.450	0.436
Total nitrogen content	0.781	0.409
250–630 μm	0.370	0.393
TOC content	0.756	0.379
125–250 μm	0.343	0.352
Carbonate content	0.540	0.267
Phaeopigments	0.203	0.172
>2000 μm	0.068	0.134
Chlorophyll a	0.006	0.094
630–2000 μm	0.094	0.068
Salinity	0.395	0.006
63–125 μm	0.045	0.001
Water depth	0.314	-0.002
Sediment temperature	0.245	-0.033
DNA content	-0.198	-0.039

4.2.2 Canonical correspondence analysis (CCA)

CCA was used to analyse the distribution of dead and living benthic foraminiferal assemblages linked to environmental parameters. In order to avoid a complex illustration of the correspondence analysis with all 163 species, only species with sufficient abundances and at least an occurrence at three stations were used for analysis. Therefore 50 and 46 species were taken into account for dead and living benthic foraminiferal distribution patterns respectively.

Five different grain-size fractions of the sediment (63–125, 125–250, 250–630, 630–2000, and >2000 μm) were incorporated for environmental interpretation. The CCA ordination diagram of the dead benthic foraminifera linked to the grain-size fractions is given in Figure 4.7. The first two axes represented 81.9% of the data variance. Most of the agglutinated species showed positive first axis values, while almost all perforate and porcellaneous species plotted towards negative first axis values (see appendix, Table A.16). The sampling sites separated even clearer. All southern stations had negative first axis values and all northern stations showed positive first axis values (see appendix, Table A.17). The finest sediment fraction (63–125 μm) was closely related to the first axis and increased towards higher values. The two coarsest fractions (>2000 μm and 630–2000 μm) were more related to the second axis but increased towards higher first axis values as well. The intermediate sediment fractions (125–250 μm and 250–630 μm) showed a close relation to the first axis and increased towards negative values.

The CCA ordination diagram of the living benthic foraminifera linked to the grain-size distribution is shown in Figure 4.8. The first two axes represented 72.6% of the data variance. The separation of agglutinated and perforate species was not that clear as seen in the dead assemblages but still obvious. Perforate species showed a tendency towards positive first axis values while agglutinated species plotted predominantly at negative first axis values (see appendix, Table A.18). The sampling sites were clearly separated with northern stations showing negative first axis values and southern stations showing positive first axis values (see appendix, Table A.19). All sediment fractions were closely related to the first axis. The intermediate sediment fractions (125–250 μm and 250–630 μm) increased towards higher first axis values. The two coarsest (>2000 μm and 630–2000 μm) and the finest sediment fraction (63–125 μm) increased towards negative values in direction of the northern stations.

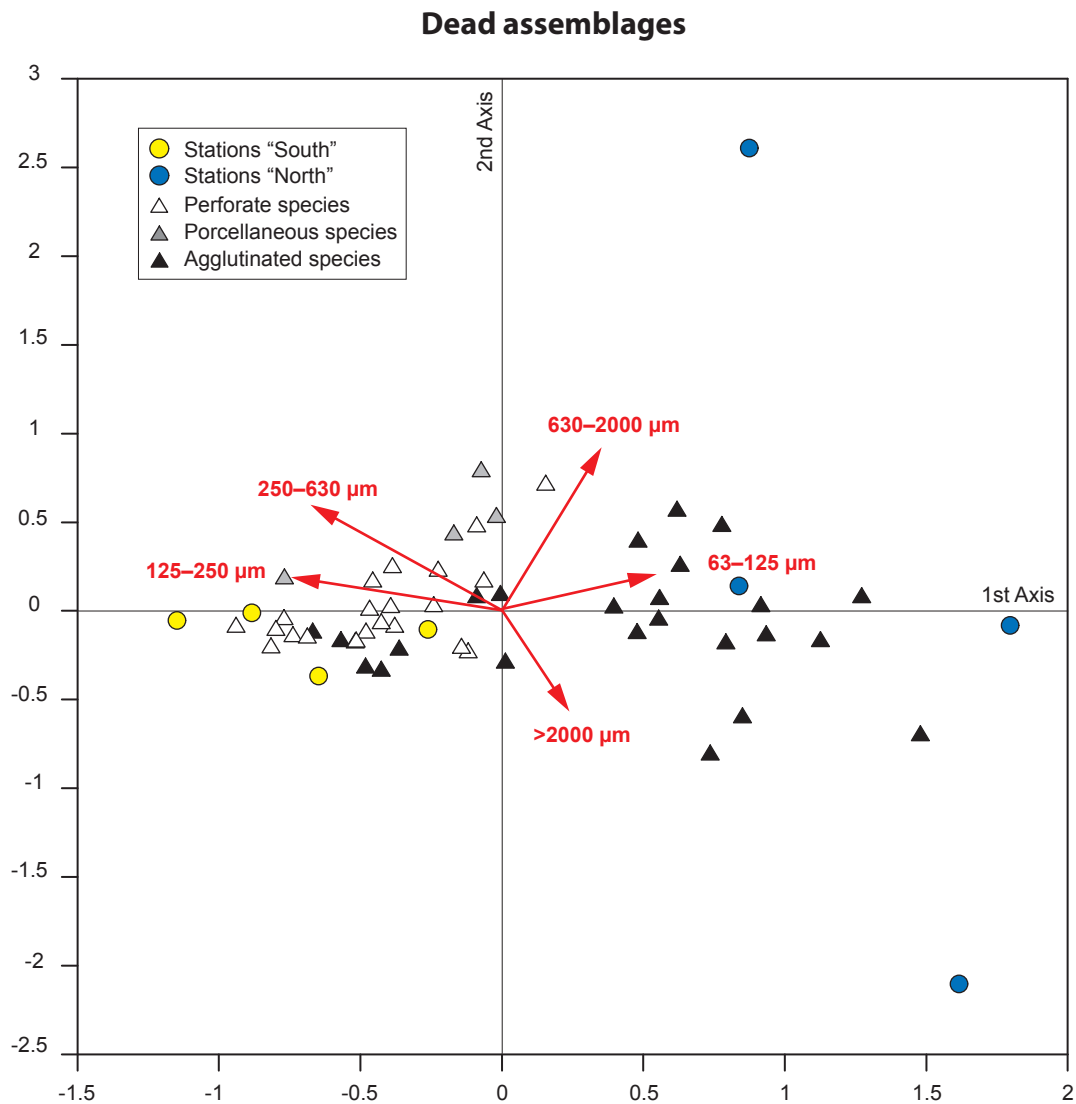


Figure 4.7: CCA ordination diagram of the dead benthic foraminiferal distribution pattern represented by 50 species (triangles coloured in their super generic assignment). Sampling stations are plotted as dots indicated by their position related to the Denmark Strait. Arrows represent the abiotic environmental variables of five different grain-size fractions. The arrow direction of the respective fraction indicates an increasing portion of the total amount. The first two axes represented 81.9% of the data variance.

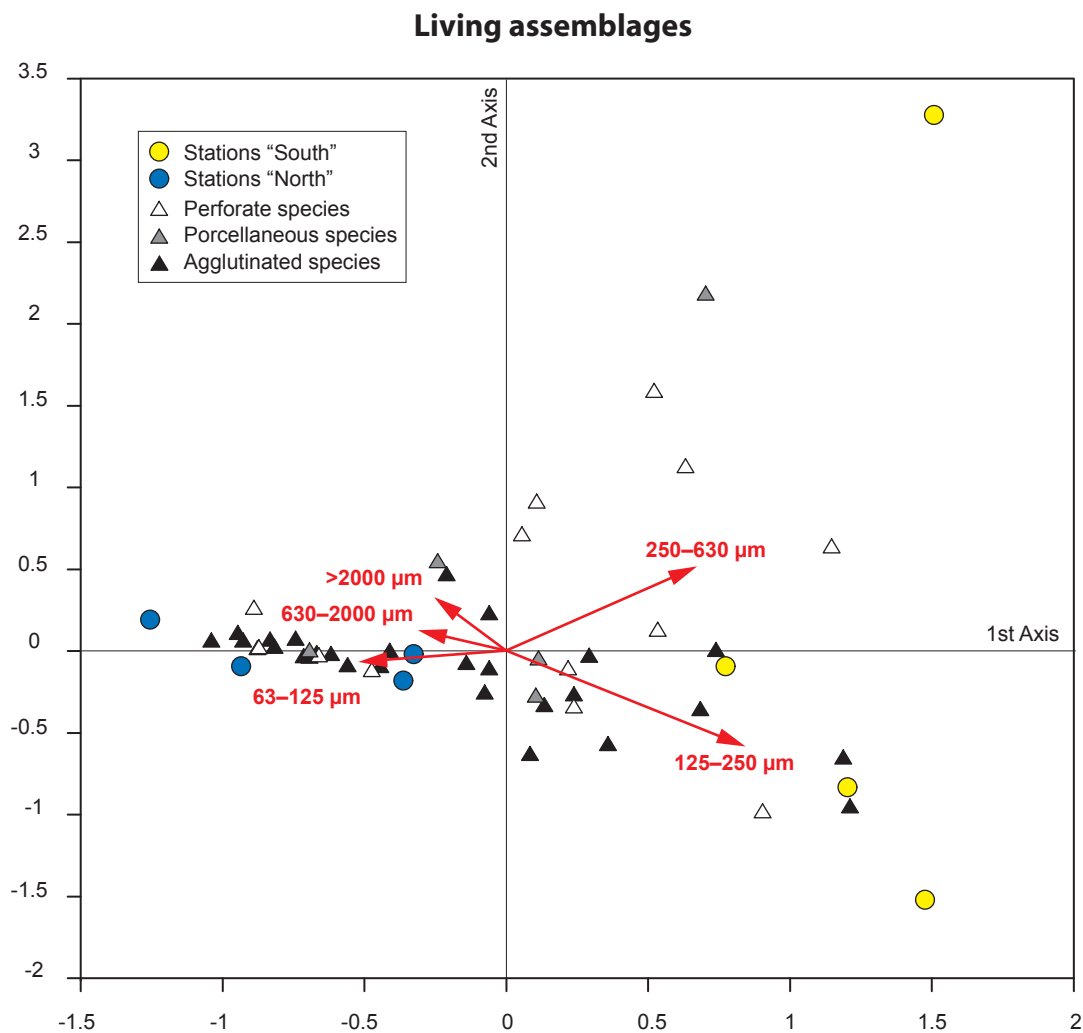


Figure 4.8: CCA ordination diagram of the living benthic foraminiferal distribution pattern represented by 46 species (triangles coloured in their super generic assignment). Sampling stations are plotted as dots indicated by their position related to the Denmark Strait. Arrows represent the abiotic environmental variables of five different grain-size fractions. The arrow direction of the respective fraction indicates an increasing portion of the total amount. The first two axes represented 72.6% of the data variance.

Besides the grain-size fractions, four biotic parameters were used for further canonical correspondence analysis: Values of chlorophyll *a*, phaeopigments, TOC, and DNA content of the sediment as four different indicators for food supply were incorporated for further environmental interpretations. The CCA ordination diagram of the dead benthic foraminifera linked to these biotic parameters is given in Figure 4.9. The first two axes represented 83.9% of the data variance. Most of the agglutinated species showed positive first axis values, while almost all perforate species plotted towards negative first axis values (see appendix, Table A.20, page 105). Porcellaneous species occurred close to first axis values around zero. The sampling sites separated very clear with negative first axis values for all southern stations and positive first axis values for all northern stations (see appendix, Table A.21, page 105). Chlorophyll *a* was closely related to the first axis and increased towards negative values. TOC and phaeopigments were related to the first axis as well but not that close. Their values increased towards positive first axis values. DNA content of the sediment showed a close relation to the second axis and increased towards negative values.

The CCA ordination diagram of the living benthic foraminifera linked to the selected biotic parameters is shown in Figure 4.10. The first two axes represented 66.0% of the data variance. The separation of agglutinated and perforate species was not that clear as seen in the dead assemblages but still obvious. Perforate species showed a tendency towards positive first axis values while agglutinated species plotted predominantly at negative first axis values (see appendix, Table A.22). The sampling sites separated well into northern (negative first axis values) and southern stations (positive first axis values) as shown in Table A.23 (see appendix). In contrast to the dead assemblages chlorophyll *a* was related to the second axis and increased towards positive values. TOC and phaeopigments were related to the first axis while TOC showed a much stronger relation. Values of both TOC and phaeopigments increased towards negative first axis values. DNA content of the sediment showed an extreme close relation to the second axis and increased towards positive second axis values.

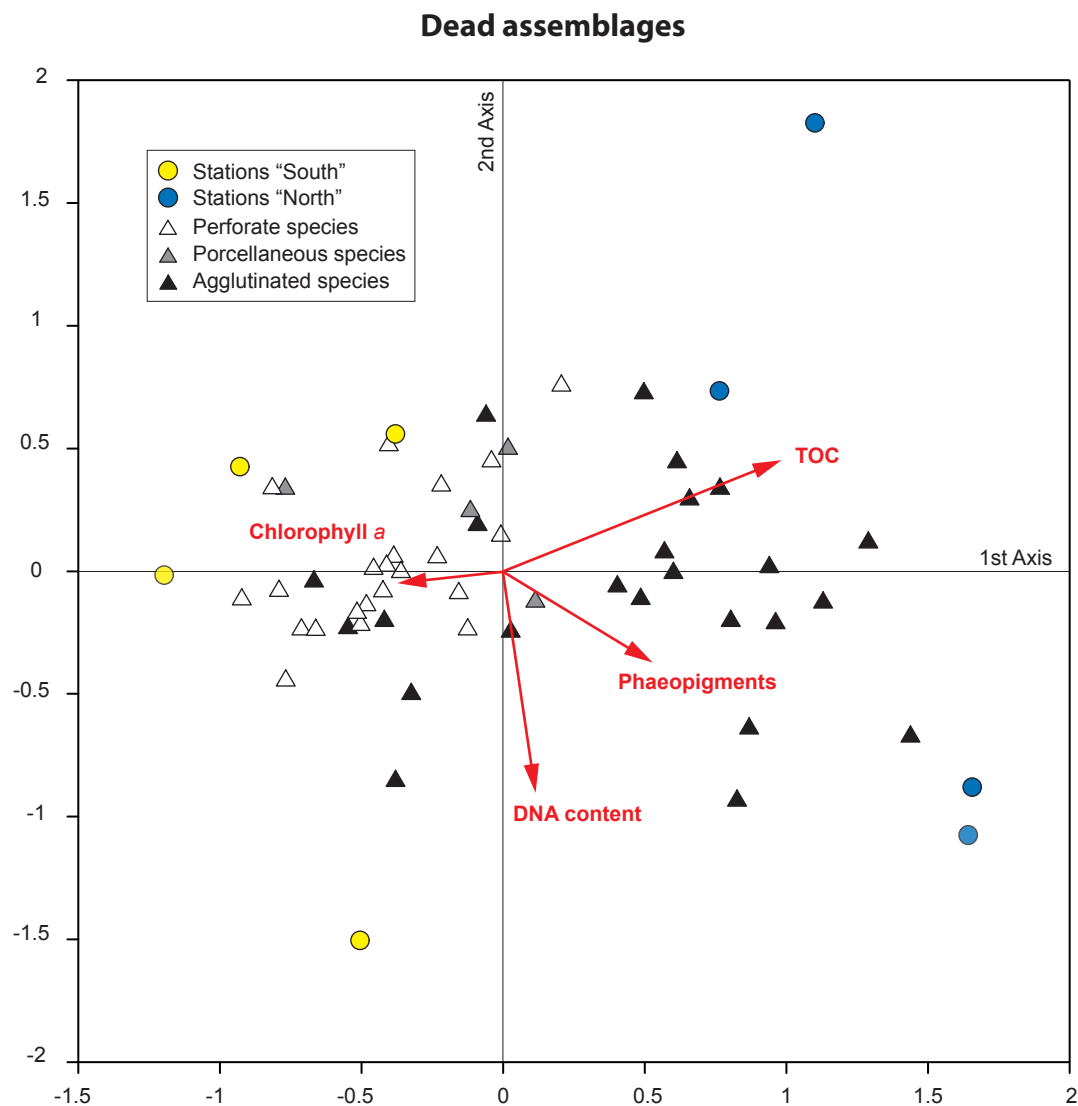


Figure 4.9: CCA ordination diagram of the dead benthic foraminiferal distribution pattern represented by 50 species (triangles coloured in their super generic assignment). Sampling stations are plotted as dots indicated by their position related to the Denmark Strait. Arrows represent the biotic environmental variables chlorophyll *a*, phaeopigments, TOC, and DNA content. The arrow direction of the respective parameter indicates an increasing portion of the total amount. The first two axes represented 83.9% of the data variance.

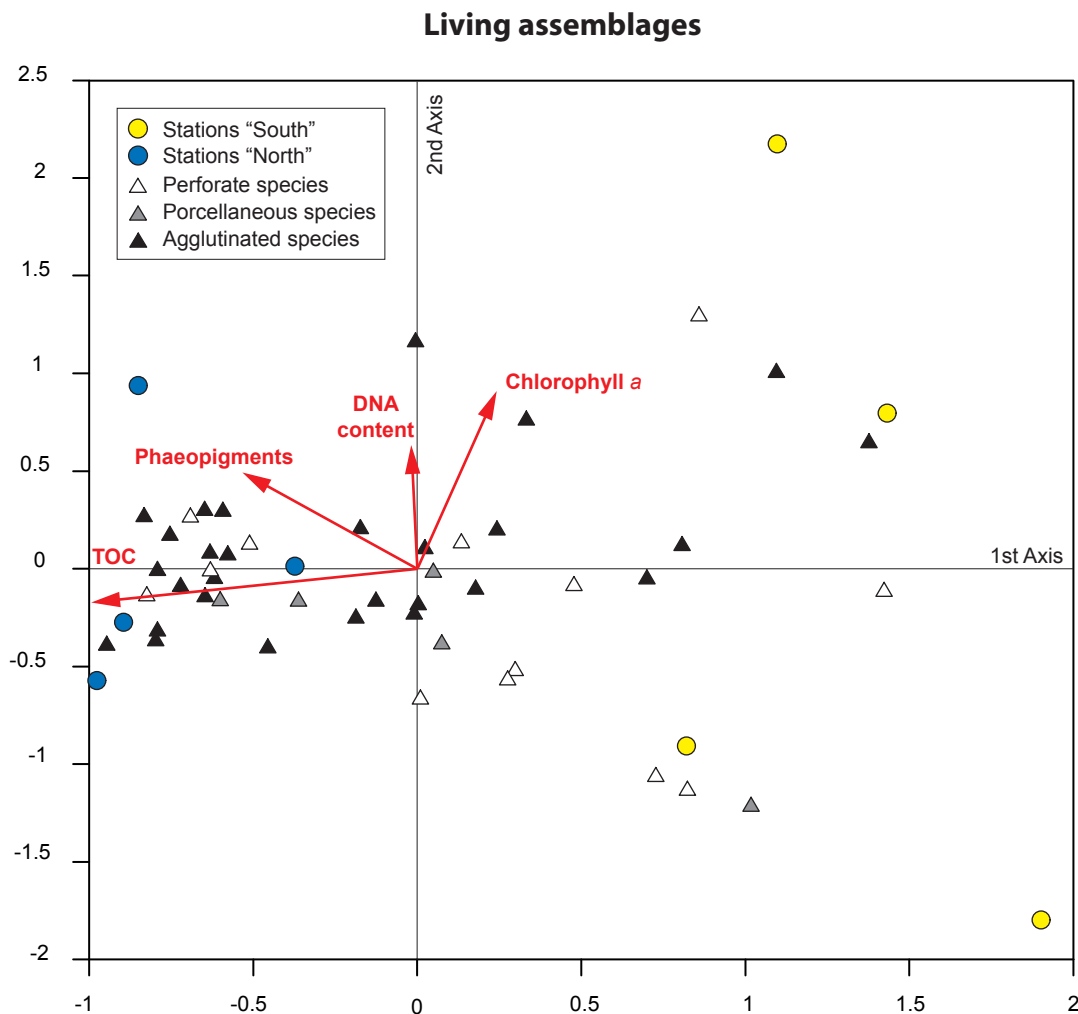


Figure 4.10: CCA ordination diagram of the living benthic foraminiferal distribution pattern represented by 46 species (triangles coloured in their super generic assignment). Sampling stations are plotted as dots indicated by their position related to the Denmark Strait. Arrows represent the biotic environmental variables chlorophyll *a*, phaeopigments, TOC, and DNA content. The arrow direction of the respective parameter indicates an increasing portion of the total amount. The first two axes represented 66.0% of the data variance.

4.3 Abundances and morphology of *Cibicidoides wuellerstorfi*

4.3.1 Modern *C. wuellerstorfi*

Total abundances of modern *C. wuellerstorfi* divided into living and dead assemblages are shown in Figure 4.11. Abundances of dead specimens at southern stations ranged from 62 to 1105 ind/10 cm³. While abundances of dead specimens were generally lower in “North” (values varied from 0 ind/10 cm³ at station 15 to 441 ind/10 cm³ at station 21), the number of living *C. wuellerstorfi* was more or less the same at northern and southern stations, except for station 15 where no living specimens of *C. wuellerstorfi* were found at all. The mean value of living specimens in “South” and “North” was 6.9 and 6.1 ind/10 cm³ respectively.

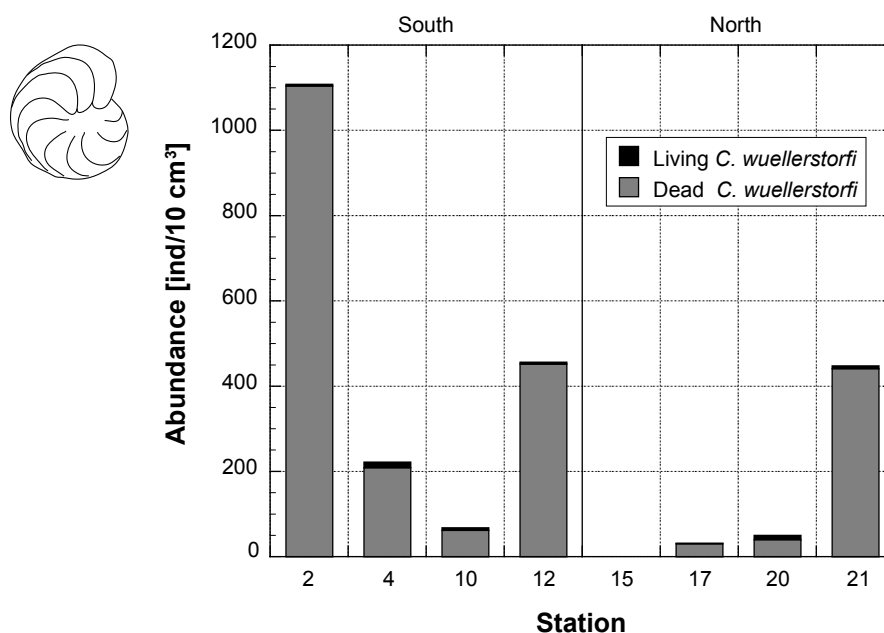


Figure 4.11: Total abundance of modern *Cibicidoides wuellerstorfi* subdivided into dead and living specimens.

Figure 4.12 shows the maximum test diameter of *C. wuellerstorfi* within the single size fractions 125–250, 250–630, 630–2000, and >2000 μm . This plot includes living and dead specimens individuals of northern and southern stations. Tested by Kruskal-Wallis, there was no significant difference between “North” and “South” ($U = 2.216$, $p = 13.7\%$) as well as between living and dead individuals ($U = 2.866$, $p = 9.0\%$). The median values of the maximum diameter of single specimens within the fractions 125–250, 250–630, and 630–2000 μm were in the range of the respective size classes. Whereas the measured maximum diameters of the fraction >2000 μm showed a much lower range as one would expect from this particular size class: The median value was 356 μm and 50% of all data lay between 250 and 600 μm .

4.3 Abundances and morphology of *Cibicidoides wuellerstorfi*

Abundances of those *C. wuellerstorfi* found in the size fraction $>2000 \mu\text{m}$ are plotted in Figure 4.13 to have a closer look at this particular fraction. In “South” abundances were generally higher with 0.9 to 6.9 ind/ 10 cm^3 of wet sediment. Except for station 10 the portion of living specimens in “South” was higher than the portion of dead specimens. Abundances in “North” were very low and varied between 0.3 and 0.8 ind/ 10 cm^3 . Regarding the northern stations living individuals only occurred at station 21, and here the portion was very small in contrast to dead individuals.

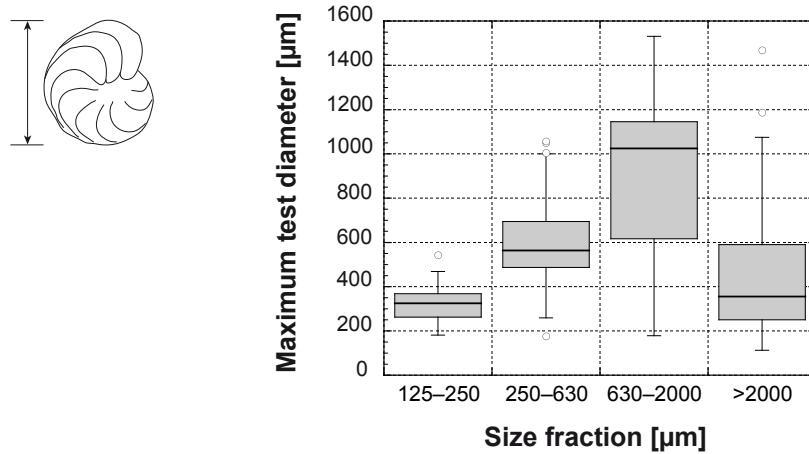


Figure 4.12: Box plots of four different size fractions used in this study showing the maximum test diameter of modern *C. wuellerstorfi*.

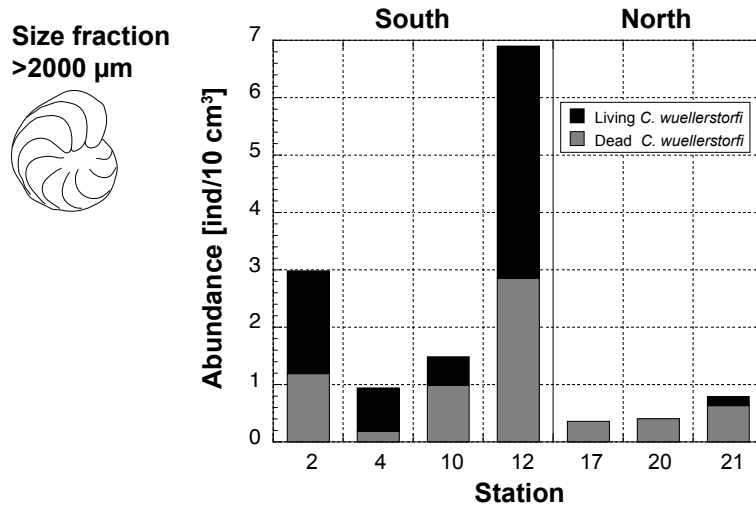


Figure 4.13: Abundances of modern *C. wuellerstorfi* of the single size fraction $>2000 \mu\text{m}$ subdivided into dead and living specimens.

4.3.2 Glacial *C. wuellerstorfi*

In order to supplement the morphometric measurements on modern samples, two cores (PS62/017-4 and GIK23519-5), representing glacial times north and south of the Denmark Strait, were additionally used to pick *C. wuellerstorfi* (see Figure 3.1, page 10). At station 15 of the modern group “North” and the glacial station PS62/017-4, located north of the sill as well, no individuals of *C. wuellerstorfi* were found. Thus, no morphometric investigations on specimens, representing glacial fauna north of the Denmark Strait, could be done in this study. However, samples south of the sill representing glacial times (station GIK23519-5) contained *C. wuellerstorfi*. These samples were summarised to the group “Glacial”. In the following, the southern glacial samples of station GIK23519-5 are going to be abbreviated by their sediment sampling depths, i.e. 67 and 79 for the sediment depths 67–68 and 79–80 cm respectively (see Table 3.1).

4.3.3 Morphometric measurements

In the following five paragraphs results of the performed morphometric investigations on modern and glacial *C. wuellerstorfi* as there were counting of chambers within the last whorl, determination of the maximum test diameter, identification of the coiling direction, measurement of the proloculus diameter, and weighing of individual tests are shown. Table 4.7 lists the number of all modern and glacial specimens used for morphometric measurements assigned to their station and group. In total 1167 individual tests of *C. wuellerstorfi* were measured.

Table 4.7: Number of *C. wuellerstorfi* individuals used for morphometric measurements according to their sampling site, sediment depth, and group assignment.

Station	Sediment depth [cm]	Group	Measured specimens
PS62/002-3	0-1	South	203
PS62/004-2	0-1	South	66
PS62/010-2	0-1	South	36
PS62/012-2	0-1	South	134
PS62/015-4	0-1	North	0
PS62/017-1	0-1	North	101
PS62/020-1	0-1	North	239
PS62/021-1	0-1	North	199
PS62/017-4	173-174	Glacial	0
PS62/017-4	175-176	Glacial	0
PS62/017-4	177-178	Glacial	0
GIK23519-5	67-68	Glacial	107
GIK23519-5	79-80	Glacial	82

4.3.4 Number of chambers within the last whorl

In Figure 4.14 relative abundances of the number of chambers from *C. wuellerstorfi* at (a) each of the stations and (b) within the groups “South”, “North”, and “Glacial” are shown. At all stations (Figure 4.14 a) specimens with eight, nine, and ten chambers within the last whorl were found. Tests with twelve chambers only occurred at the glacial station 79 with 1.25%. Eleven chambers were more frequent but still not available at every station in “South”: Only at station 12, 1% of the specimens had tests with eleven chambers within the last whorl. All stations in “North” showed individuals with eleven chambers (from 0.05% at station 21 to 3.98% at station 20). Regarding the three groups (Figure 4.14 b), tests with nine chambers within the last whorl occurred the most with over 50%. In “South” one third (33%) of all *C. wuellerstorfi* showed eight chambers, this portion got fewer in the northern samples (25%) and occurred the lowest in the glacial samples with 12% of all measured specimens. Looking at *C. wuellerstorfi* with ten and more chambers this pattern turns the other way round: Southern samples showed the lowest percentage and glacial the highest. At the southern and northern sites eleven chambers were found only in less than 1% of the total fauna (versus 6% in “Glacial”). Twelve chambers only occurred in the glacial sample with 0.5%. According to the number of chambers within the last whorl, there was a highly significant difference between the three groups (similarity test of Kruskal-Wallis: $U = 61.055$ and $p < 0.01\%$). Therefore in general, chamber numbers decreased from “Glacial” over “North” to “South”.

4.3.5 Maximum test diameter

Results according to the maximum test diameter are shown as box plots in Figure 4.15 for (a) each of the stations and (b) within the groups “South”, “North”, and “Glacial”. All median values of the test diameter had a narrow range between 388 μm at station 17 and 536 μm at station 20 (Figure 4.15 a). The only exception was station 10 showing a higher median value of 763 μm . Regarding the groups (Figure 4.15 b), 50% of all measured test sizes ranged between approximately 300 and 600 μm . The median value lay between 430 μm in “South”, 431 μm in “Glacial”, and 456 μm in “North”. Tested by Kruskal-Wallis, there was no significant difference between the groups according to the test diameter ($U = 5.340$, $p = 6.9\%$).

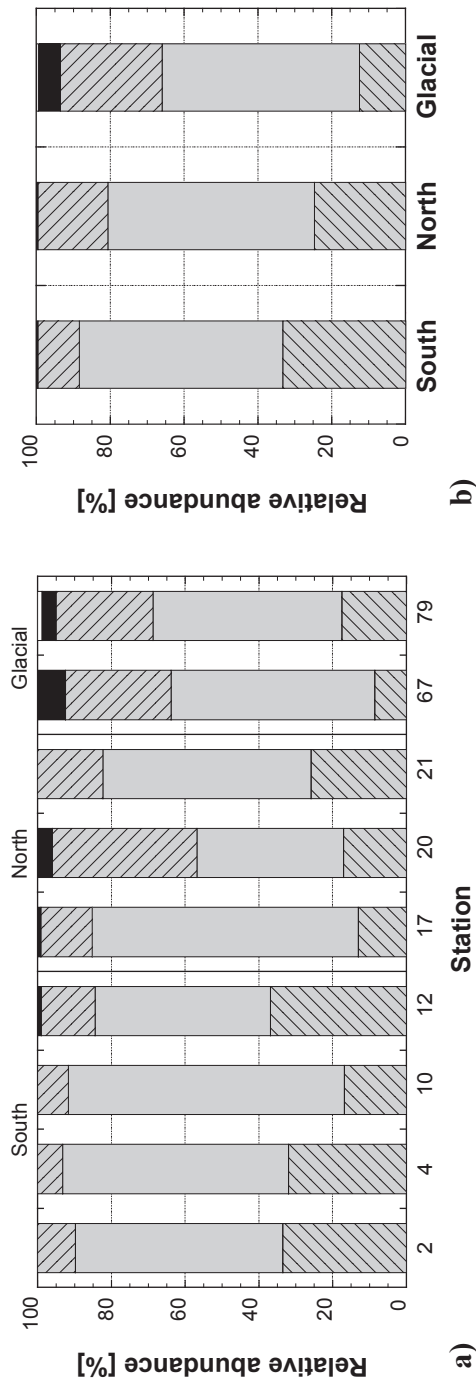


Figure 4.14: Number of chambers within the last whorl of *C. wuellerstorfi*. **a)** Stations **b)** Groups.

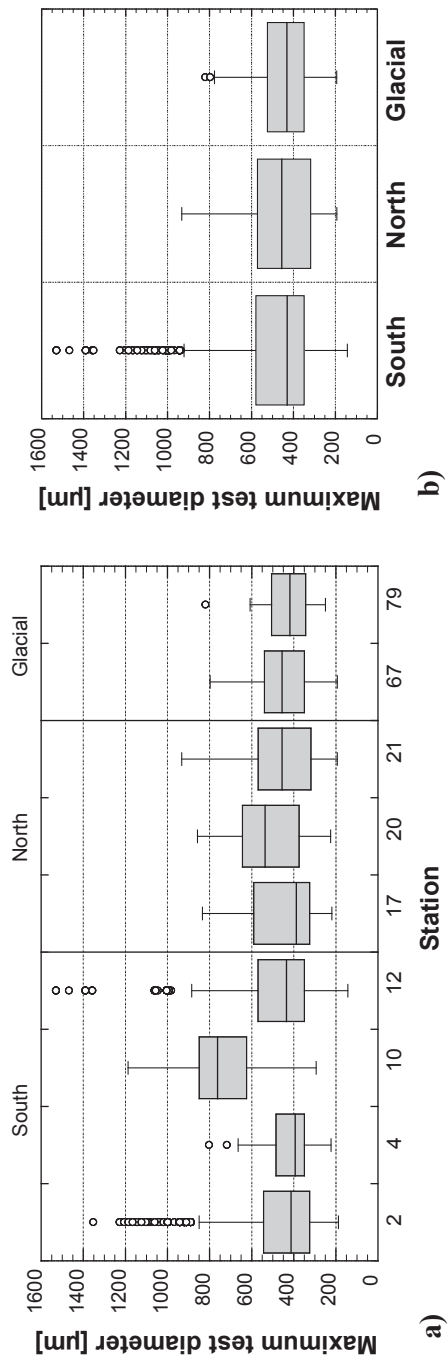


Figure 4.15: Maximum test diameter of *C. wuellerstorfi*. **a)** Stations **b)** Groups.

4.3.6 Coiling direction

The percentage of left and right coiled *C. wuellerstorfi* at (a) each of the stations and (b) within the groups “South”, “North”, and “Glacial” are shown in Figure 4.16. At all stations left coiled tests dominated clearly over right coiled tests from 57% at station 20 up to 75% at station 21 (Figure 4.16 a). The percentage of left coiled tests at all three groups were rather the same and differed only slightly between 69% in “South”, 67% in “North”, and 66% in “Glacial” (Figure 4.16 b). There was no significant difference between the three groups according to the coiling direction of the tests ($\chi^2 = 0.637$, $p = 72.7\%$), whereas the dominance of the left coiled individuals was highly significant in all three groups “South”, “North”, and “Glacial” ($\chi^2 = 59.156$, 45.779 , and 18.816 respectively, $p < 0.01\%$).

4.3.7 Proloculus diameter

The measurements of the proloculus diameter to the nearest $5 \mu\text{m}$ are shown as box plots in Figure 4.17 for (a) each of the stations and (b) within the groups “South”, “North”, and “Glacial”. At all stations the main range of the proloculus diameter lay between 30 and $55 \mu\text{m}$ and the median values differed only slightly around $40 \mu\text{m}$ (Figure 4.17 a). Looking at the three groups (Figure 4.17 b), the median value was always $40 \mu\text{m}$ and the main range (50 % of all measured proloculi) was 30 to $45 \mu\text{m}$. No significant difference in proloculus diameter was calculated by the Kruskal-Wallis test ($U = 1.025$, $p = 59.9\%$).

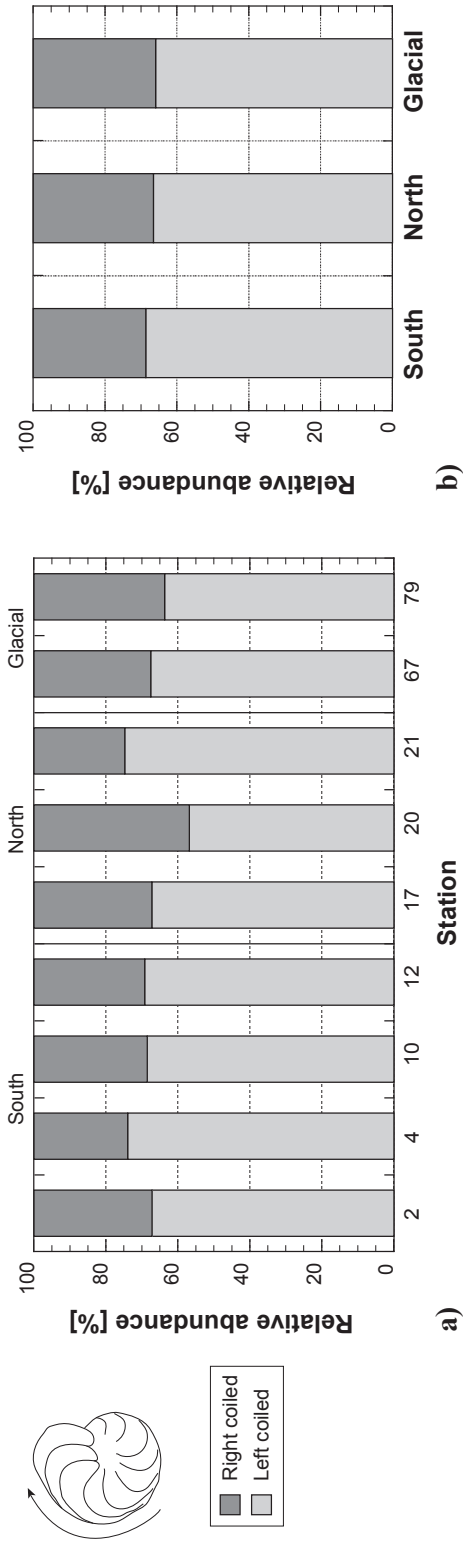


Figure 4.16: Coiling direction of *C. wuellerstorfi*. a) Stations b) Groups.

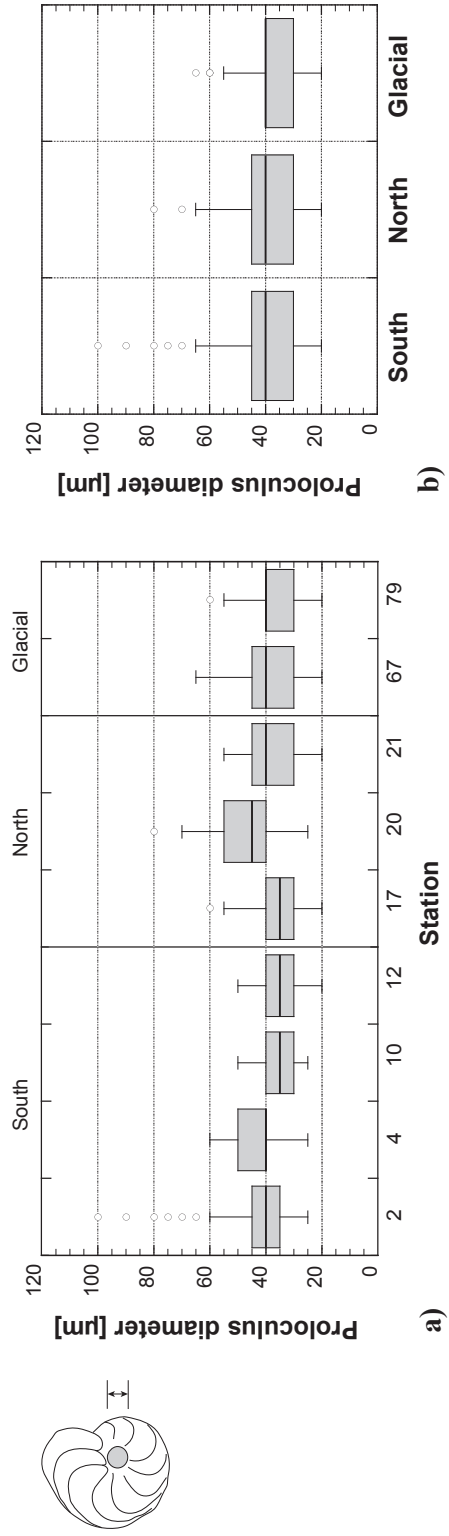


Figure 4.17: Proloculus diameter of *C. wuellerstorfi*. a) Stations b) Groups.

The proloculus diameter within the single size fractions 125–250, 250–630, 630–2000, and >2000 μm are plotted in Figure 4.18. The median values of the proloculus diameter within all fractions were 40 μm . However, slight tendencies were visible, that the proloculus diameters of *C. wuellerstorfi* became smaller the smaller the respective size fraction was.

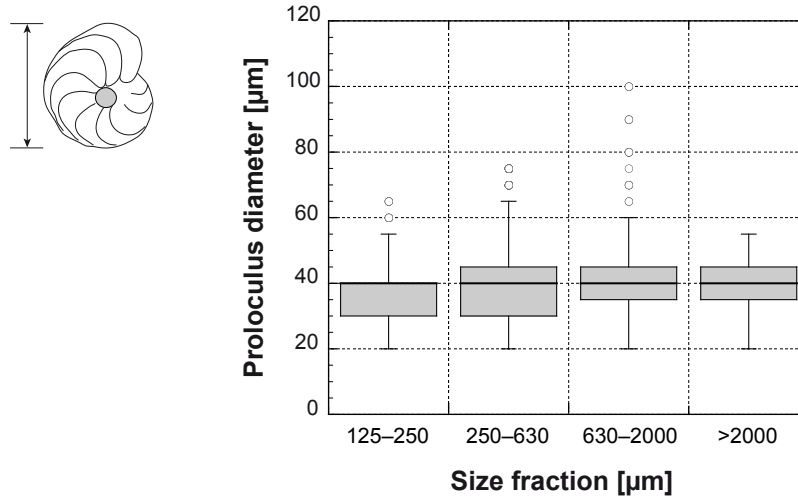


Figure 4.18: Maximum test diameter divided into four size fractions plotted against the proloculus diameter of *C. wuellerstorfi*.

4.3.8 Weight of individual tests

In order to compare the weight of individual foraminifera with each other, one has to exclude the influence of the test size which naturally is linked to weight. One way to manage this is to plot weight and size against each other, compare regression lines through selected data points, and subsequently see if the lines show different slopes or positions. The function of the maximum diameter of *C. wuellerstorfi* and its weight was exponential (Figure 4.19). Thus, in order to afford the construction of regression lines through these data points, the values of diameter and weight were logarithmised.

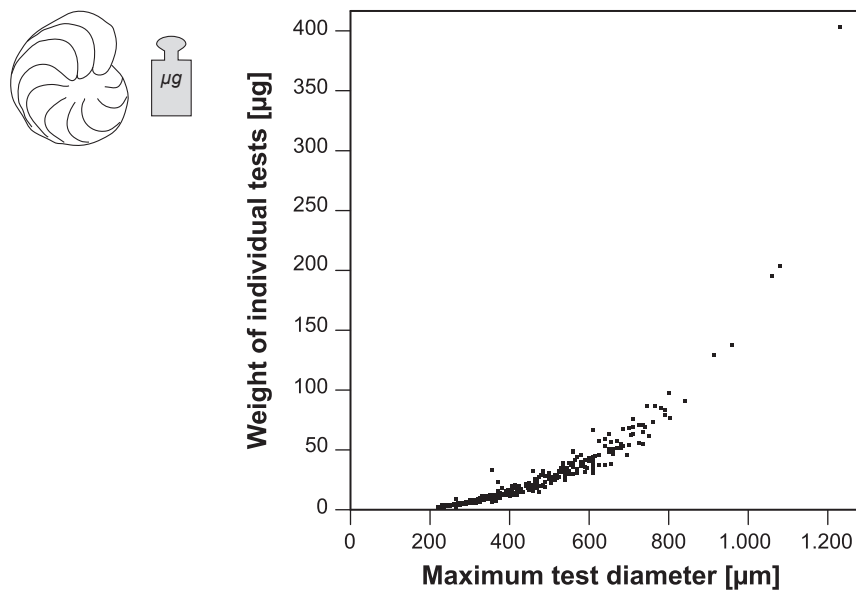


Figure 4.19: Maximum test diameter plotted against the weight of individual tests of *C. wuellerstorfi*.

By means of the analysis of covariance (ANCOVA) three regression lines through the respective data points of the groups “South”, “North”, and “Glacial” were compared with each other (Figure 4.20). Due to a better overall view, regression lines are not shown in the graph. The three lines ran parallel ($F = 1.969$, $p = 14.1\%$) and there was no significant difference in line positions ($F = 2.590$, $p = 7.7\%$). That means the weight of individual tests did not differ statistically between the three groups “South”, “North”, and “Glacial”.

Figure 4.21 shows the interrelation between weight of individual tests, which depends on the maximum diameter, and the number of chambers within the last whorl. Due to a better overall view, regression lines are not shown in this graph as well. Because only undamaged tests were used to determine the weight, no individuals with twelve chambers were available. ANCOVA showed that the four regression lines going through the data points representing eight, nine, ten, and eleven chambers ran parallel ($F = 1.059$, $p = 30.4\%$). There was no significant difference in the position of the lines ($F = 0.264$, $p = 60.8\%$). That means the weight of individual tests related to the number of chambers did not differ statistically.

An additional performed ANCOVA showed that there was also no statistical significant difference in coiling direction of individual tests according to weight.

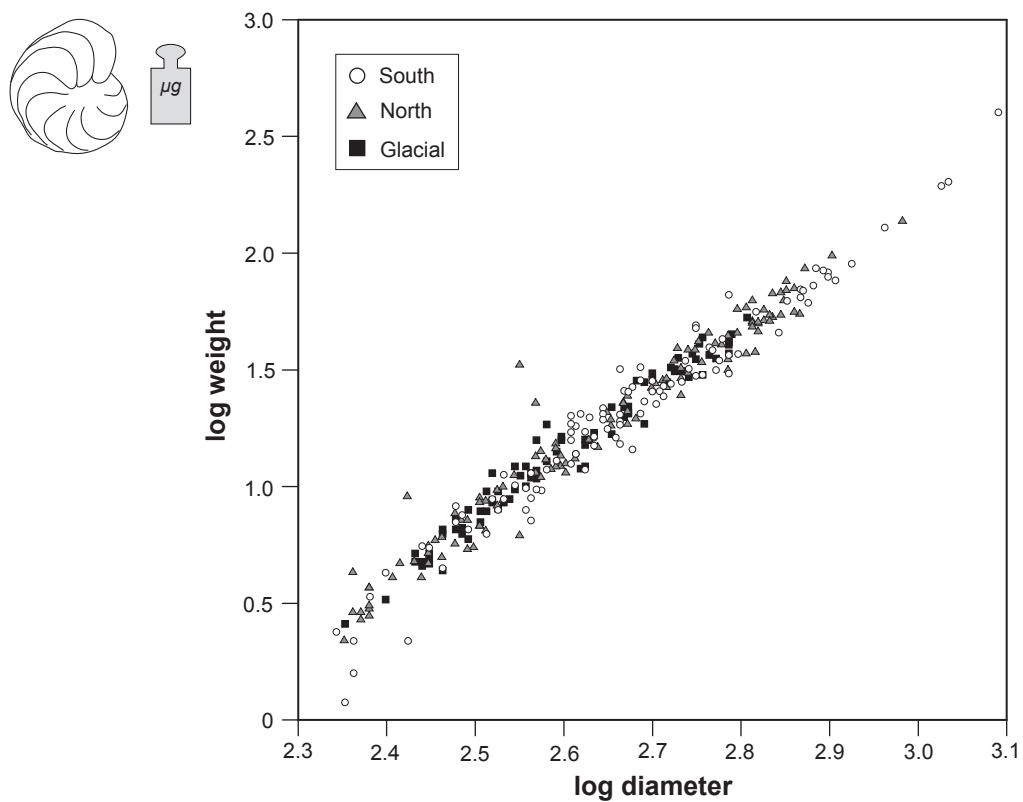


Figure 4.20: Maximum test diameter plotted against the weight of individual tests of *C. wuellerstorfi*, both logarithmised, and the assignment to the locations “South”, “North”, and “Glacial”.

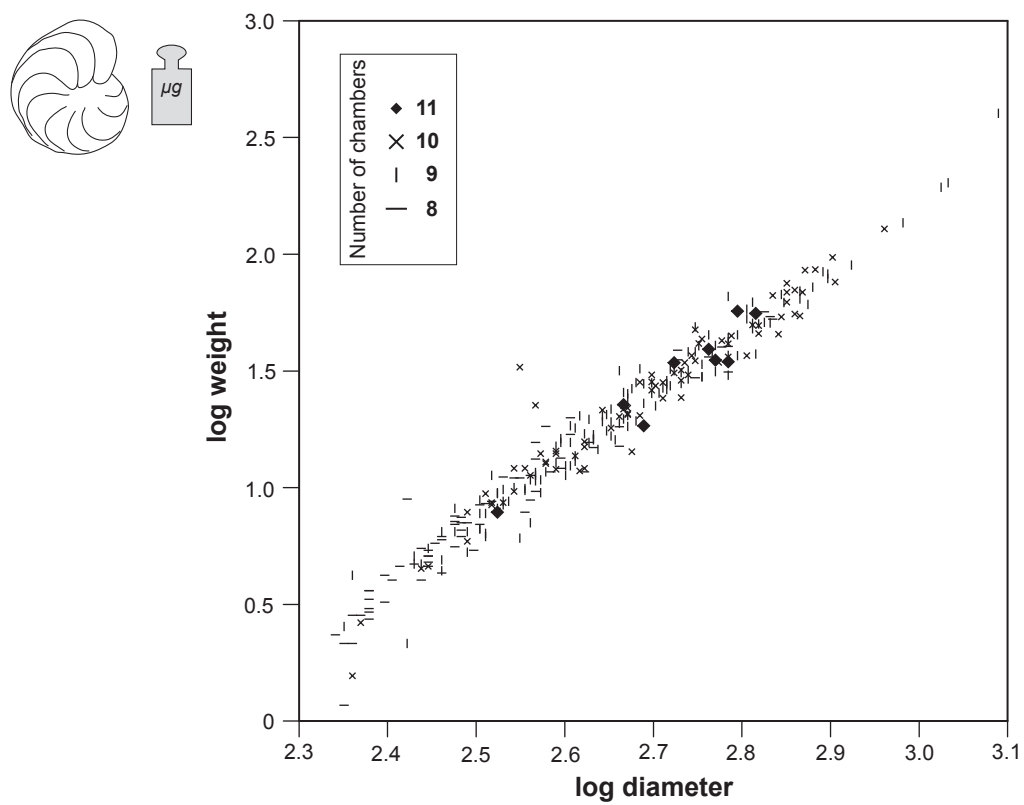


Figure 4.21: Maximum test diameter plotted against the weight of individual tests of *C. wuellerstorfi*, both logarithmised, and the assignment to the number of chambers within the last whorl.

4.3.9 Stages of dissolution

Different dissolution states of modern *C. wuellerstorfi* tests were divided in five stages (Figure 4.22 a–e). Stage 1 (Figure 4.22 a) indicated tests with no recognisable signs of dissolution. Specimens of stage 2 (Figure 4.22 b) were little affected by dissolution and showed a dull test surface or slightly damaged chambers without influencing the original test shape. Stage 3 (Figure 4.22 c) contained *C. wuellerstorfi* that lost single but major parts of the test, which mainly concerned the last chamber. Individuals of stage 4 (Figure 4.22 d) showed heavy signs of dissolution with several damaged chambers. Stage 5 (Figure 4.22 e) included specimens which were totally affected by dissolution except for their sutures.

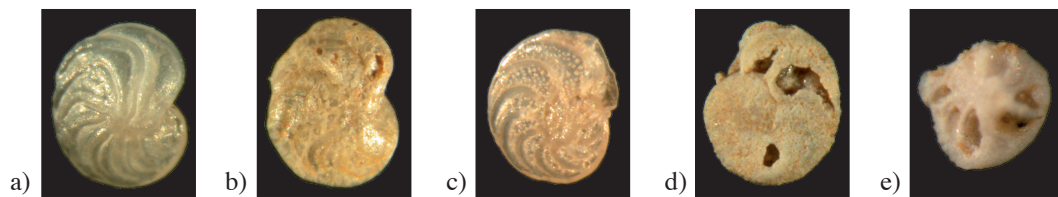


Figure 4.22: Photographs showing increasing stages of dissolution of *C. wuellerstorfi* tests. **a)** Stage 1 **b)** Stage 2 **c)** Stage 3 **d)** Stage 4 **e)** Stage 5 (a, b, and e = umbilical side; c and d = spiral side). The specimens were picked from the 250–630 μm size fraction of station P62/002-3. For further explanations see text.

In Figure 4.23 the percentages of the five stages of dissolution in “North” and “South” are shown. Stage 1 occurred the most in the southern stations with 35.8%, while in the northern stations only 19.5% of the tests were undamaged. Merely a tenth part of specimens in “South” was heavily affected by dissolution (stage 4: 6.6%, stage 5: 2.8%) but one fourth of all *C. wuellerstorfi* showed these strong damages in “North” (stage 4: 16.7%, stage 5: 8.4%). Calculated by the χ^2 -test, there was a highly significant difference in the stages of dissolution north and south of the Denmark Strait ($\chi^2 = 36.329$, $p < 0.01\%$). The affect by dissolution increased form “South” to “North”.

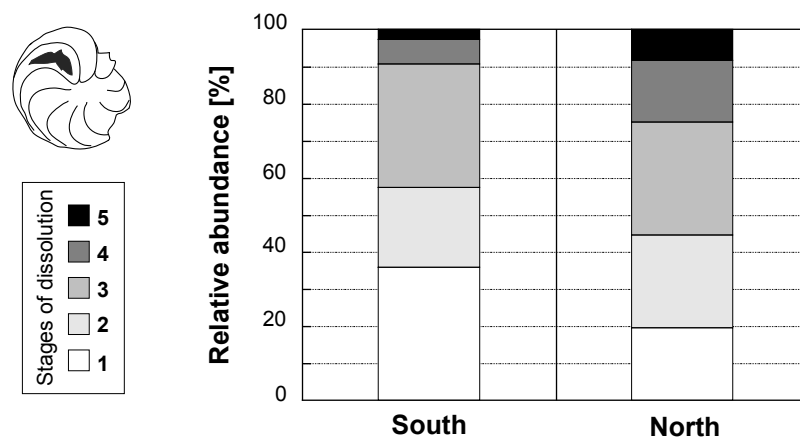


Figure 4.23: Stages of dissolution on *C. wuellerstorfi* from stage 1 (not affected by dissolution) to stage 5 (totally affected by dissolution). For further explanations see text.

5 Discussion

5.1 Critical evaluation of used methods

5.1.1 Sampling

The advantage of a multicorer is that it obtains the sediment-water interface in a virtually undisturbed condition (Barnett et al. 1984). Because of coarse and hard substrate the use of the multicorer was limited in this study (Lemke 2003). In this case a box corer was deployed instead (see Table 3.1, page 9) like Heinz et al. (2004) did as well in their studies. Although optically the sediment surfaces of multicorer samples appeared to be less disturbed. Ahrens et al. (1997) found no statistical difference between multicorer and box corer samples. However, the sediment surface of the box corer sample at station 10 seemed to be affected. Evidences of a major disturbance arise from the results of the foraminiferal abundances in general and those of *Cibicidoides wuellerstorfi*, the diversities and number of species, the maximum test diameter of *C. wuellerstorfi*, and the grain-size distribution. At station 10 the abundances of dead and living benthic foraminifera as well as of the single species *C. wuellerstorfi* were the lowest of all southern stations. This could be a hint for a general loss of foraminiferal material during sampling. In the dead and living assemblage of station 10 great differences in number of species, Shannon-Wiener and Fisher α diversities as well as in the evenness index occurred compared to other southern stations. This points to the supposed disturbance of the sediment surface at this station. The lower number of species as well as the lower evenness and diversity indices, especially of the dead assemblages, indicate that mainly empty and therefore light tests were washed out during core recovery. Regarding the maximum test diameter of *C. wuellerstorfi*, there is an obvious lack of small specimens. Further the grain-size distribution of the sediment showed a different pattern at station 10 compared to other southern stations. Small size fractions were clearly lower and more than half of the sediment portion belonged to the coarsest size fraction (see appendix, Table A.15). This altogether indicates that the sediment sample was somehow affected especially by washing small and/or light particles away. However, despite all mentioned differences of station 10, general statements about benthic foraminiferal assemblages and morphology of *C. wuellerstorfi* corresponded very well with all other southern stations.

Southern samples lay generally deeper than northern samples because of the physiography of the sea floor (see depth contour in Figure 4.1 b), page 22). Although the shallowest station south of the sill (station 10) and the deepest station north of the sill (station 21) lay at almost the same water depth (1702 and 1704 m respectively), foraminiferal assemblages were completely different. Therefore other parameters than water depth seem to affect the foraminifera. This was also confirmed by using the BIOENV procedure: Community patterns of neither dead nor living foraminifera showed any match with water

depth (Table 4.6, page 29). It turned out to be wrong that abiotic parameters like temperature, salinity, oxygen content, and water depth alone were able to explain patterns of benthic foraminiferal assemblages (Thies 1991). Lutze & Thiel (1989) believe that adaptation to nutritional conditions mainly controls benthic foraminiferal distributions rather than watermass properties like salinity, temperature or water depth.

The uppermost sediment centimetre was used to pick modern benthic foraminifera for faunal and morphometric investigations. In arctic sediments the mean habitat depth, described as the 95% interval on a cumulative frequency curve (Corliss & Emerson 1990), for foraminifera $>125 \mu\text{m}$ is the uppermost surface centimetre (Wollenburg & Mackensen 1998b, Wollenburg & Kuhnt 2000). Mackensen et al. (1990) showed that most of the specimens found below the first centimetre belong to species, which are also found within the uppermost sediment layer. However, some species prefer to live several centimetres within the sediment. These species are rare and do not significantly alter the total faunal composition as calculated from the top 1 cm (Mackensen et al. 1990, Schumacher 2001).

Stained assemblages provide a snapshot of the foraminifera that were alive at the moment when the samples were collected. The use of Rose Bengal to distinguish living foraminifera (Walton 1952) has been under debate since the introduction of this method. Studies have shown that staining by Rose Bengal is still the best method available to separate those specimens, which were living or recently alive at the time of collection, from dead individuals in large samples (Bernhard 1988, Murray & Bowser 2000). Since the living assemblage varies in both time and space (Gooday 1988), it is also instructive to examine the dead assemblage that provides an averaged view of the foraminiferal fauna (Gooday 2001). For this reason dead benthic foraminiferal assemblages, standing for long time observation, and living assemblages, representing a snapshot, were regarded separately in this study.

5.1.2 Biotic and abiotic parameters

Determining the exact temperature of the sediment in 1 cm depth and the overlaying water was very difficult. It is not possible to raise the sampling gear with its overlaying water adiabatically. On the way back to the surface from about 1000 to 2500 m water depth, the samples inclusive the sampling water passes through much warmer water, which unavoidable heats the samples. Signs are obvious that this happened as well to the samples used in this study. The temperature difference between sediment and overlaying water, which should be *in situ* neglecting low, was much higher in the southern than in the northern samples (see appendix, Table A.15). This points to the fact that the surface water temperature south of the Denmark Strait was higher than in North and the samples started to adapt their temperature while getting through warmer water masses. The overlaying water heated faster than the sediment, because the water was mixed permanently during sampling while the sediment heated much slower beginning from the outer layers. Very likely a temperature difference between colder northern and warmer southern samples existed, but it was definitely not as high as measured. For this reason the BIOENV results with a strong link of the overlaying water temperatures to dead and living benthic foraminiferal

assemblages with $\rho = 0.895$ and 0.626 respectively has to be assessed very carefully. The water temperature values were probably an artefact and real values were more likely in the same range as the sediment temperatures. The link of the sediment temperatures to the dead and living foraminiferal assemblages ($\rho = 0.245$ and -0.033 respectively) showed hardly any match. So temperature in general could not have affected the benthic foraminiferal assemblages north and south of the Denmark Strait.

Organic matter rain (organic flux) is the most important source of food for benthic foraminifera (Van der Zwaan et al. 1999) and the TOC content of the sediment may be interpreted as a proxy for this organic flux. Though high TOC contents of Arctic Ocean sediments do not necessarily reflect primary production but instead mirror the amount of ice and current transported organic matter originating from the shelf areas of the surrounding landmasses (Schubert & Stein 1996). Probably this “non-eatable” carbon could have caused more than twice as high TOC values at northern stations compared to southern stations (see appendix, Table A.15). However, biomarker analysis of Kierdorf (pers. comm.) at both sides of the Denmark Strait showed no differences in the composition of organic matter North and South. The organic matter is mainly marine-derived and only small amounts of immature terrestrial-derived biomarkers occur. Therefore the main part of the measured TOC is a possible food source for benthic foraminifera. This assumption is supported by the C/N-ratios, which also indicates a marine source of the organic carbon. The mean C/N-ratio of marine zooplankton and phytoplankton is 5.4 and 6.0 respectively (Müller 1977 and references within). Bacteria show even lower C/N-ratios of about 2–4, which attributes to a high protein content of up to 80% (Schwarz pers. comm.). Higher land plants comprise more carbon because of their cellulose skeleton. Therefore terrestrial organic matter is characterised by C/N-ratios of more than 10 and can reach values of about 200 (Müller 1977 and references within). The higher the C/N values in the sediment are, the less food is available for benthic foraminifera. C/N-ratios of northern and southern stations were comparable and ranged between 6.6 and 8.6. These C/N-ratios below 10 indicate that the measured TOC values reflected quite well the amount of “eatable” organic carbon, which was available for foraminifera.

Other parameters indicating food supply besides the TOC are the chlorophyll *a*, phaeopigment, and DNA content of the sediment. Chlorophyll *a* represents the “fresh” material of the primary production that shortly reached the sea floor. Phaeopigment is a decomposition product of chlorophyll *a* and stands for the “older” deposits of the primary production. The DNA content of the sediment is an indicator for the total “living” benthic biomass including bacteria, protozoans, algae, and metazoans (Teucher 1986). In contrast to TOC, this value detects only organisms that were living at the time of sampling, due to the rapid decay of DNA. Therefore the DNA content could help to estimate the values of food supply to benthic foraminifera that are not feeding directly on primary production. Unfortunately the values of the DNA content were extremely patchy although mean values of five parallel samples were taken. The reason for this is of course that one bigger metazoan in a single parallel sample could influence the mean value dramatically. Hence it is questionable how meaningful the DNA content of the sediment is as an evidence for food supply to benthic foraminiferal assemblages.

5.1.3 Sample treatment

In order to minimise the number of wrongly identified living foraminifera, translucent specimens were individually wetted with water (Heinz et al. 2004) and only foraminifera exhibiting a bright red coloration in at least one chamber of the older test portion of multi-chambered tests were counted as living specimens (Wollenburg & Mackensen 1998a). The identification of non-translucent living specimens like agglutinated species was more difficult. In this case only those individuals providing a definite red coloration within their apertures were counted as living. An eventual error of determination would be the same for all samples because, only one person decided whether specimens were living or dead. This enables a rather correct comparison between the different assemblages of this study.

In the last years, the use of a fine 63 μm mesh sieve has become more prevalent with the realisation that some small but important species are not adequately retained by coarser sieves (Alve 2003, Heinz et al. 2004). However, Gooday (2001) concluded that the additional information gained by examining fine fractions must be weighed against the considerable time and effort required to sort foraminifera from them. Fine fractions contain great numbers of juvenile species. Especially for the perforate juveniles with only a few first chambers the identification of the right taxon is very difficult and requires a lot of experience and time. For this reason the 63–125 μm fraction was not used for faunal investigations in this study.

5.1.4 Morphometric measurements

Cibicidoides wuellerstorfi occurred in sufficient abundances at both sides of the gateway. It turned out to be the only perforate foraminifer that was common in both living and dead as well as northern and southern assemblages and therefore selected for morphometric investigations. Agglutinated species are not that suitable for morphometric measurements, because their morphology depends strongly on the available substrate they live in. Clones of one single agglutinated species were offered different types of substrate and they built tests actually known as a different species or even genera (Kuhnt pers. comm.). As the substrate in northern and southern stations were not identical (e.g. see grain-size distribution, Figure 4.6, page 28), agglutinated species were not used for morphometric investigations.

Adult specimens of *C. wuellerstorfi* shows eight to twelve chambers within the final whorl (Loeblich & Tappan 1988). In this study individuals with seven, six, and even five chambers were found as well. These individuals were obviously juvenile specimens with an untypical morphology, indicated by an incomplete building of chambers around the proloculus, i.e. the formation of the very first whorl (Figure 5.1). Therefore only adult individuals with eight and more chambers within the last whorl were chosen for statistical analyses.

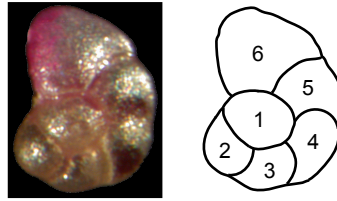


Figure 5.1: Photograph and sketch showing a juvenile *Cibicidoides wuellerstorfi* from Station PS62/021-1 with six chambers and an incomplete formation of the very first whorl. The maximum test diameter was 206 μm .

5.1.5 Statistical analysis

Large tubular and fragile agglutinated foraminifera like *Saccorhiza ramosa* and *Hormosina guttifera* respectively easily broke into fragments, which then were counted as individual specimens. Although this procedure invariably increases the abundances of these species somewhat, it avoids the subjectivity in distinguishing whole individuals from fragments and leads to a more representative estimate (Ahrens et al. 1997).

Univariate methods are very helpful for a first approach to compare faunal assemblages. But they are not based on particular species identities, and two samples could have exactly the same diversity without having a single species in common (Warwick 2001). This stands in contrast to multivariate methods. Compared with univariate techniques of data analysis, multivariate methods are much more sensitive in detecting differences between communities.

Causality of community change can only be established with certainty by means of controlled experiments. But Warwick (2001) points out that inferences can be drawn from the relationships between multivariate patterns in the biological and environmental data, which are established e.g. by using the BIOENV procedure. Of course the used environmental data have to correspond to the *in situ* data. This is why a link of the foraminiferal community to the overlaying water temperature for example has to be interpreted very carefully (see paragraph 5.1.2 Biotic and abiotic parameters).

5.2 Habitat characterisations

5.2.1 Modern habitats

Much higher velocities of bottom currents at southern stations compared to northern stations (see paragraph 2.2 Modern hydrography and circulation) create very dynamic and unstable habitats in South. This explains the extreme heterogeneous pattern of diversities, evenness, and number of species shown in the dead assemblages South of the Denmark Strait. The higher number of species, compared to the northern stations, occurred because most of the foraminifera south of the sill were probably transported there passively

as already dead individuals by strong bottom currents and therefore could be called allochthonous. In addition abundances of dead *Cibicidoides wuellerstorfi* as well as of total dead assemblages south of the sill was huge compared to dead foraminifera North. This again points to the fact that most of the empty tests in South were allochthonous. Living foraminifera were able to resist high current velocities by attaching themselves to substrate particles or by burrowing themselves into the sediment (Alve 1999, Schönfeld 2002). This should be the reason why the abundances of living foraminifera south and north of the sill, in contrast to dead foraminifera, were quite similar.

The lower number of species and the Shannon-Wiener as well as Fisher α diversity of the living assemblages south of the Denmark Strait points to the fact that in general, marine assemblages show lower diversities and number of species with increasing water depth. The main reason for this effect is that food gets less available the higher the overlying water column is (Weinelt et al. 2001). For bathymetrical reasons it was not possible to get samples in similar water depths from both sides of the sill, therefore southern samples originated from greater water depths than northern samples (see depth contour in Figure 4.1 b), page 22). The TOC values within the sediment were more than twice as high at northern stations than at southern stations (see appendix, Table A.15). Strong bottom currents south and weak bottom currents north of the Denmark Strait may have affected the food supply in addition. Tweddle et al. (2005) found clear evidences of physical controls of the food supply for benthic filter feeders due to horizontal advection in the Menai Strait, UK. Therefore the different bottom current velocities might cause lateral advection of food particles south of the sill and sedimentation of food particles north of the sill. This leads to the assumption that the southern habitats seem to have very small amounts of food particles in the sediment itself and therefore provide only good living conditions for epibenthic living suspension feeders. This is reflected by the lower number of species and the Shannon-Wiener as well as Fisher α diversity of the living assemblages south of the Denmark Strait.

Differences in bottom current velocities north and south of the sill are confirmed by the grain-size distribution of the sediment (Figure 4.6, page 28). The amount of the small sediment fraction (63–125 μm) is much higher at northern than at southern stations. The observed pattern is confirmed by Vogt (1986) who found coarser sediments only south of the sill. This points to lateral advection due to high current velocities in South and sedimentation in North. South of the Denmark Strait smaller sediment particles stay in suspension and also will be relocated after sedimentation.

An increasing level of environmental stress is generally considered to decrease species diversity, richness, and evenness. However, the intermediate disturbance hypothesis suggests that diversity is maximal at intermediate levels of disturbance, falling off at very low frequencies and intensities of disturbance due to competitive exclusion between species, and decreasing again at high levels as species become eliminated (Warwick 2001). The stronger bottom currents south of the Denmark Strait indicate a great intensity of disturbance. The high current velocities are not only responsible for “blowing food particles away” but also for mechanical effects on foraminifera like overwhelming them with sed-

iment or even displace them. This causes a lower diversity and number of living species south of the sill.

Steinsund & Hald (1994) demonstrated, that higher values of agglutinating foraminifera frequency shows a positive correlation with low amounts of calcium carbonate. The same observation was made in this study regarding the northern assemblages. Agglutinated foraminifera dominated the dead assemblages in North and values of carbonate were clearly lower compared to the values at southern stations (see appendix, Table A.15). Scanning microscope photographs of Steinsund & Hald (1994) support the suggestion that dissolution has attacked the calcareous foraminiferal tests. Evidences for dissolution were found in this study as well: Investigations on stages of dissolution of *C. wuellerstorfi* tests showed a highly significant increase of dissolution from southern to northern stations. Dissolution is caused by the presence of dense, cold, saline, and CO₂-rich bottom water, which is linked to sea-ice production and the position of the Oceanic Polar Front (Steinsund & Hald 1994). All stations north of the Denmark Strait lay within the boundaries of seasonal sea-ice coverage even during so-called minimum years (Wadhams 1986, Völker 1999, Swientek 1997 and references within). Due to the extensive carbonate dissolution in Arctic and Subarctic shelf and slope areas (Steinsund & Hald 1994) foraminiferal dead assemblages are often dominated by agglutinated species (Wollenburg & Mackensen 1998a). This is the case in northern assemblages of the Denmark Strait. Even though at southern stations many of the empty tests were very likely transported passively because of the high bottom current velocities and therefore had to cope with mechanical destruction, tests of *C. wuellerstorfi* were much more destroyed at northern stations. Therefore the effect of carbonate dissolution in North is much stronger than an eventually mechanical destruction of the tests in South.

5.2.2 Glacial habitat

At glacial times conditions south of the sill were comparable to those conditions north of the sill today. Bottom currents reached similar velocities and were quite weak (see paragraph 2.3 Glacial hydrography and circulation, page 7). Sedimentation of food particles was more likely than lateral advection of food particles. Therefore food supplies and bottom currents in southern stations were more suitable for substrate than for suspension feeders during the LGM. Probably the general amount of food was even lower at glacial times because of the larger amounts of sea ice, which lowered the primary production.

5.3 Faunal assemblages and species composition

Thies (1991) and Wollenburg (1995) noticed that in deep-sea environments, where loosely agglutinated species (e.g. *Rhizammina algaeformis* and *Reophax fusiformis*) dominate living assemblages, corresponding dead assemblages are often characterised by calcareous taxa due to the low fossilisation potential of these fragile agglutinated species. Exactly the same pattern was observed in this study concerning foraminiferal assemblages south of the Denmark Strait. This fact also explains the predominantly perforate dead assem-

blages in South additionally to the assumption of passive transport because of high current velocities. Besides carbonate dissolution that already minimised calcareous species north of the sill, predominately agglutinated dead assemblages could be explained because of the very weak bottom currents occurring there. Fragile agglutinated species were probably much lower affected by mechanical destruction and therefore better preserved as in southern stations. This is confirmed exemplary by the relative abundances of the two agglutinated species *Saccorhiza ramosa* and *Reophax difflugiformis* (Tables 4.2 and 4.3). While abundances of those species living in “South” were higher or at least similar compared to “North”, the abundances of dead species reversed dramatically. Abundances of dead *S. ramosa* and *R. difflugiformis* species were more than twice as high at northern stations, which points to a much better preservation of the tests.

Higher numbers of common species occurring in the living assemblages north of the sill confirm the higher evenness indices at this site. The species were much more equally distributed, than at the dynamic and therefore unstable southern habitats. The range in relative abundances was quite narrow at northern stations, and the highest value was 8.5% for the species *Hemisphaerammina marisalbi* in contrast to 25.2% at southern stations (Table 4.3).

The very low evenness index of 0.4 regarding the living assemblages at station 12, although the number of species was 28, was caused by the absolute dominance of the agglutinated species *Hemisphaerammina marisalbi* that showed a relative abundance of 66.7% of the total fauna (see appendix, Table A.13). This again is a hint for the very dynamic and unstable habitats created by the much higher bottom current velocities south of the Denmark Strait. Another reason for the very low equitability at station 12 could be explained with the spatial variability (patchiness) of foraminiferal assemblages. Patchy distributions of benthic foraminiferal populations are already well documented (Bernstein & Meador 1979, Gooday & Lambshead 1989). Because most of the individuals of *H. marisalbi* were found in the smallest determined fraction of 125–250 μm , (see appendix, Table A.4) it is possible that this particular species reproduced just shortly before the sample was taken and therefore caused this high abundance resulting to the low evenness index at station 12.

After characterising the habitats with those obvious differences between stations north and south of the Denmark Strait, the clear separation of dead and living faunal assemblages into “North” and “South” by using ANOSIM was not surprising. The living foraminiferal assemblages even reflected the much more dynamic and unstable southern habitat because of higher current velocities and its resulting consequences: The similarity within southern stations was smaller than within northern stations.

By means of the computer program SIMPER particular characteristic species were determined, which contributed the largest portion to average similarity within single assemblages as well as to average dissimilarity between different assemblages. *C. wuellerstorfi* belonged to those species that contributed to the average similarity of dead assemblages within both groups “South” and “North”. *C. wuellerstorfi* is known as cosmopolitan species (Loeblich & Tappan 1988), which influences benthic foraminiferal faunas of the deep sea with its high abundances especially within the dead assemblages (Thies 1991). Hence,

both northern and southern habitats were inhabited by *C. wuellerstorfi* as characteristic species for similarity within foraminiferal assemblages. *Cibicides lobatulus* contributed the largest portion to the average dissimilarity of dead foraminifera between the groups “North” and “South”. The difference of the total abundance of dead *C. lobatulus* south and north of the Denmark Strait was extremely high: 1677.88 ind/10 cm³ were determined in “South” and only 5.45 ind/10 cm³ were found in “North” (see appendix Table A.10). This species lives in water depths <1000 m (Holbourn & Henderson 2002) attached to coarse sediments dependent on lateral transport of food particles and therefore on high current velocities. According to Altenbach (1992) and Magnus (2000) dead individuals of *C. lobatulus* belong to typical allochthonous fauna: Empty tests of those species are preferred to be transported into greater water depths, due to the exposed and turbulent habitats they used to live in. The high occurrence of *C. lobatulus* in dead assemblages of southern habitats confirms the existence of high current velocities, which were strong enough to transport huge amounts of dead specimens from shallower into greater water depths. And therefore *C. lobatulus* is the species that characterises this particular habitat best by contributing the largest portion also to the average similarity of dead assemblages in “South”. Small numbers of dead individuals north of the sill points to the low bottom current velocities occurring there. While empty tests are part of regular sediments, passive transport of living substrate feeders has to be regarded as exception, (Lutze 1980). Actually, the total abundance of living *C. lobatulus* at southern stations was only 1.95 ind/10 cm³. Hence living individuals did not characterise the habitat and contribute neither to similarities within nor to dissimilarities between living assemblages. *Rupertina stabilis* was the second characteristic species contributing to the average dissimilarity of dead foraminifera between the groups “North” and “South”. The relationships are closely comparable to those of *C. lobatulus*: Total abundances of *R. stabilis* were much higher in southern than in northern habitats (see appendix Table A.10). *R. stabilis* is a highly adapted suspension feeder that uses sponge needles to construct an effective net for catching food particles out of the water column and therefore depends on strong bottom currents (Lutze & Altenbach 1988), which only occur at southern stations.

Regarding the average similarities of northern dead assemblages, *Hormosina guttifer*, *Cribrostomoides subglobosum*, and *Saccorhiza ramosa* contributed the largest portion. The total abundance of *H. guttifer* was much higher in “North” with 251.46 ind/10 cm³ than in “South” with 8.71 ind/10 cm³. These high abundances in northern stations could have resulted out of the used method of sample treatment. These extreme fragile agglutinated species broke easily into fragments, which then were counted as individual specimens. Although this procedure could cause an overestimation of abundances, it would not explain the clear differences between the northern and southern values. *C. subglobosum* is an endobenthic living species and adapted to high sedimentation rates, which refuses strong currents (Linke 1989). *S. ramosa* is a very fragile tubular foraminifer that lives partly burrowed in the sediment in an upright position as suspension feeder. Due to large tree-like branches, huge amounts of water volume are filtered for food particles, and low bottom current velocities are preferred (Altenbach et al. 1987). Hence these three species characterise the “North” as a habitat with weak bottom currents and therefore high sedi-

mentation rates of food particles to the sea floor. The same three species contribute also important portions to the average dissimilarity between “South” and “North” and the average similarity within the living assemblages in “North”. This points to the fact that they really live in northern habitats and were not transported there passively after death. The assumption that those dead assemblages are autochthon, confirms the occurrence of low current velocities and sedimentation of food particles at northern stations. The average similarity of the living assemblages was clearly lower (30.02) in “South” than in “North” (50.78). That emphasises the results of ANOSIM, which showed that the similarity within living southern foraminiferal assemblages was smaller than within northern assemblages. This is a further indication for the much more dynamic and unstable southern habitat because of higher bottom current velocities and its resulting environmental conditions.

5.3.1 Linking foraminiferal assemblages to environmental parameters

Many investigations about habitat preferences of single benthic foraminiferal species were already conducted (Gooday & Lamshead 1989, Thies 1991, Altenbach 1992, Linke & Lutze 1993, Gooday 1994, Struck 1995, Wollenburg & Mackensen 1998b, Gooday 2001, Schönfeld 2002). The main difference in characterising different preferences is to divide benthic foraminifera in epibenthic and endobenthic species. Following species were described as epibenthic living forms: *Ammolagena clavata*, *Cibicides lobatulus*, *Cibicides refulgens*, *Rupertina stabilis*, and *Saccorhiza ramosa*, while *Cassidulina teretis*, *Cribrostomoides subglobosum*, *Crithionona hispida*, *Reophax difflugiformis*, and *Reophax scorpiurus* were documented as typical endobenthic living species. Some species were characterised in different publications as both epibenthic and endobenthic: *Cibicidoides wuellerstorfi*, *Pyrgo rotalaria*, and *Rhizammina algaeformis*. Schönfeld (2002) found out that epibenthic species make up as much as 60% of the living assemblage at sites with high current velocities and only 3 to 18% in areas with low velocities. CCA analyses of dead and living benthic foraminiferal assemblages showed a clear preference of epibenthic species to habitats with strong bottom currents (Figures 5.2 and 5.3). The grain-size distribution of intermediate size classes occurring in South, indicating high bottom current velocities, and the finest size fraction occurring in North, pointing to low current velocities, is strongly correlated to epibenthic species at southern stations and endobenthic species at northern stations respectively. Species, which were not assigned clearly in the literature to an endo- or epibenthic way of living, were located around the value zero of the first axis. This indicates that those species have not committed themselves to a distinct way of living. Living *C. wuellerstorfi* were located towards higher current velocities indicated by positive first axis values (Figure 5.3). This leads to the assumption that *C. wuellerstorfi* clearly prefers the epibenthic way of living as suspension feeder, although it is also able to live endobenthic as substrate feeder.

The DNA content as indicator for total “living” biomass showed an extreme close relation to the second axis in the living as well as in the dead assemblages (Figures 5.2 and 5.3). Therefore the linkage between the DNA content of the sediment and benthic foraminiferal assemblages north and south of the sill is not that explicit. This was also confirmed by BIOENV showing hardly any match with dead and living foraminiferal assemblages

($\rho = -0.198$ and -0.039 respectively). Concerning benthic foraminifera, the availability of the “living” biomass probably shows no differences north and south of the Denmark Strait. Maybe single species or even genera of bacteria, protozoans, and metazoans were affected by the different habitat conditions at both sides of the sill, but in general the value of the biomass was comparable. This pattern changes completely regarding the other three indicators for food supply, as there were the contents of TOC, chlorophyll *a*, and phaeopigment in the sediment. The dead and living foraminifera of the northern habitats were influenced by TOC and phaeopigment contents, while foraminifera occurring in South were closely related to chlorophyll *a* contents. This indicates that generally, due to higher TOC values, more food particles were available in the sediment for species at northern stations in contrast to those species in South. An increase of food availability initially leads to an increase of infaunal live abundances unless a high input of organic matter does not result in dysoxic conditions in bottom environments (Wollenburg & Mackensen 1998b). Species north of the sill were strongly linked to the phaeopigment content in the sediment. Weak bottom currents enabled sedimentation of high contents of chlorophyll *a*, initiating decomposition of the accumulated material into phaeopigments. These “older” deposits of the primary production provide large amounts of food ingested directly or indirectly as bacteria, which feed on phaeopigments as well, by endobenthic foraminifera that occurred in higher portions north of the Denmark Strait. With increasing water depth, infaunal live abundance decreases (Wollenburg & Mackensen 1998b). This is true for the southern assemblages that were generally sampled at greater water depths. But the reason for a lower portion of endobenthic species in south is not only because of the general lower food supply in greater water depths due to consumption of food particles on their way down to the sea floor. Strong bottom currents transported a large amount of “fresh” material of the primary production, indicated by chlorophyll *a* contents, by lateral advection to the southern stations. These food particles were caught immediately out of the water column by epibenthic suspension feeders, which were found in higher portions south of the sill. Therefore and due to extremely low sedimentation rates because of the strong currents no chlorophyll *a* was able to accumulate and hence no decomposition into phaeopigments took place, so that there was no sufficient food for endobenthic species at southern stations. Linke (1992) already summarised that food particles ingested by substrate feeders are generally “older”, while suspension feeders usually gather “fresh” particles. This assumption is confirmed in this study.

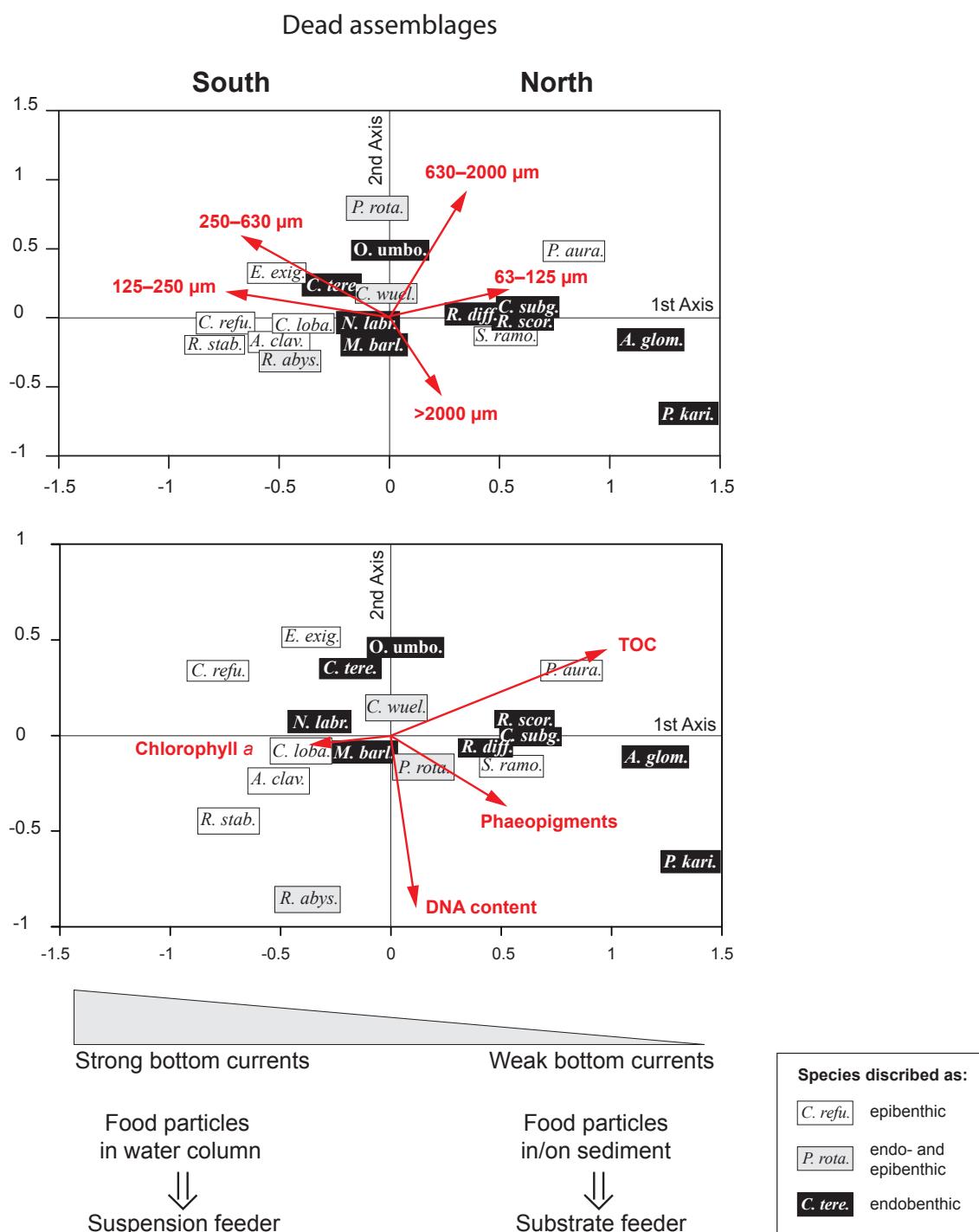


Figure 5.2: Overview of two CCA ordination diagrams, showing abiotic and biotic environmental parameter plots and the distribution of selected species, assigned to their endo- or epibenthic way of living, inclusive the resulting environmental conditions of dead benthic foraminifera. (For full species names corresponding to the abbreviations see appendix Table A.9).

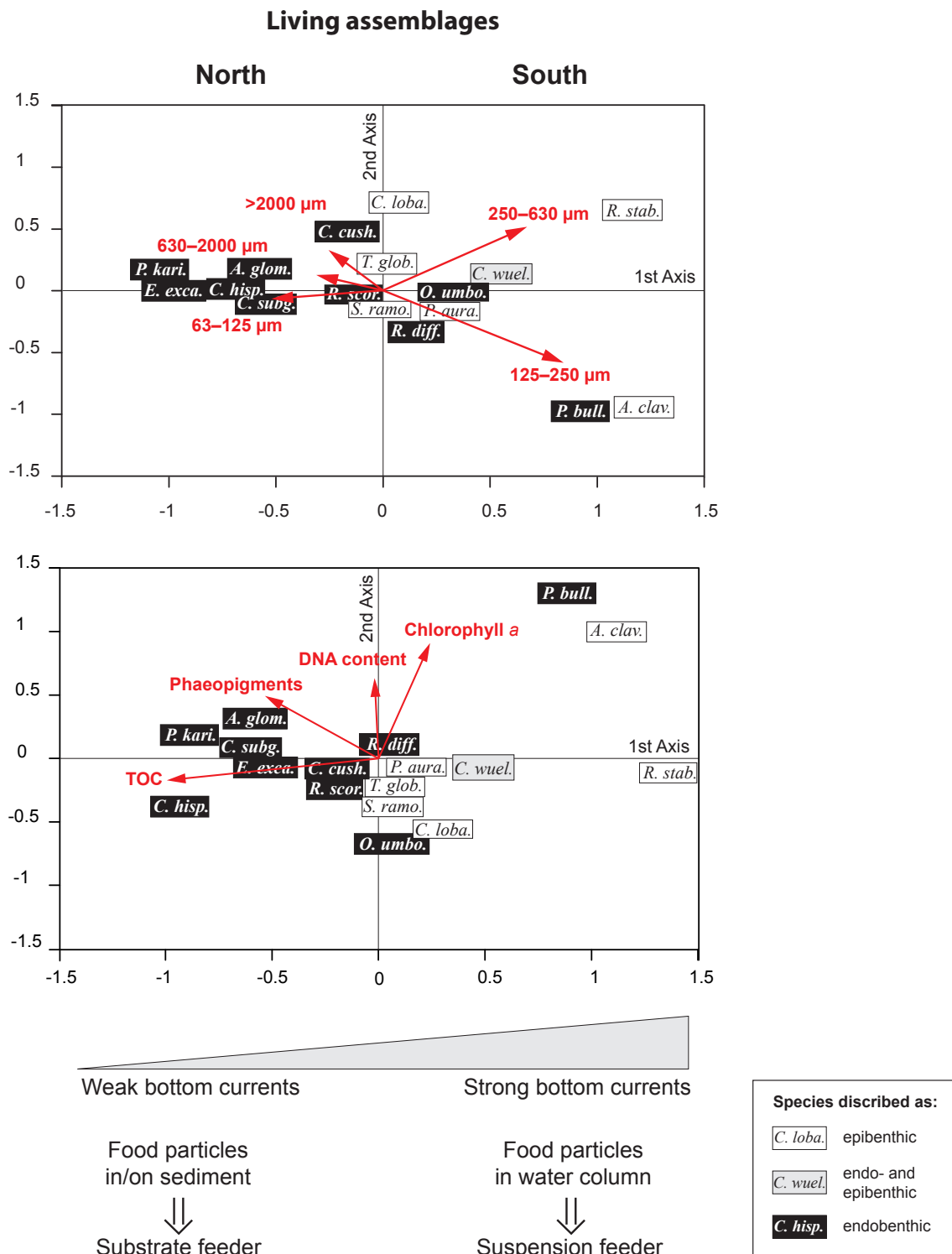


Figure 5.3: Overview of two CCA ordination diagrams, showing abiotic and biotic environmental parameter plots and the distribution of important species, assigned to their endo- or epibenthic way of living, inclusive the resulting environmental conditions of living benthic foraminifera. (For full species names corresponding to the abbreviations see appendix Table A.9).

5.4 Abundance and morphology of *C. wuellerstorfi*

Struck (1995) recorded the faunal fluctuation of benthic foraminifera in sediments originating from the Norwegian Sea from accumulation rates of individual species from the LGM to the Holocene. The accumulation rate of *Cibicidoides wuellerstorfi* is extremely low during the LGM and only becomes important during the late deglaciation near 10 ka BP. The species distribution is a quantitative indicator for changes in bottom currents and amounts of food supply (Struck 1995). This is a possible explanation for the lack of *C. wuellerstorfi* at the northern glacial station PS62/017-4. Today a characteristic threshold value of approximately 2–2.5 g organic carbon per square meter and year separates oligotrophic deep water assemblages (dominated by *C. wuellerstorfi*) from assemblages adapted to higher carbon flux rates, this value is reached at 1200 to 1600 m water depth at the Nordic Seas (Weinelt et al. 2001). This explains the lack of *C. wuellerstorfi* at the modern station PS62/015-4, because it was the only station lying clearly underneath this threshold values by providing a water depth of 980 m. Considering a net sea level decrease of 120 to 135 m at the LGM, the northern glacial station PS62/017-4 with a modern water depth of 1458 m lay right within this range as well. At both modern and glacial stations in North *C. wuellerstorfi* could be replaced due to competitive exclusion by other foraminifera e.g. *Cibicides lobatulus* that is known to have the same habitat preferences like *C. wuellerstorfi* (Wollenburg & Mackensen 1998b). Furthermore, *C. wuellerstorfi* is known to occur at water depths >1000 m, while *C. lobatulus* is mainly found in water depths <1000 m (Altenbach 1992, Altenbach et al. 1999, Holbourn & Henderson 2002). Distributional patterns of benthic foraminifera correlate with certain flux rates of organic carbon (Altenbach et al. 1999). Each species has its own organic flux range in which it occurs. *C. wuellerstorfi* was found in habitats with low-intermediate flux rates from 0.2 to 10 g organic carbon per m² and year, while *C. lobatulus* showed a much larger range of 0.6 to 100 g organic carbon per m² and year (Altenbach et al. 1999). This leads to the assumption that due to this very narrow flux range *C. wuellerstorfi* was replaced at lower water depths by competitive exclusion of *C. lobatulus*. Food particles (organic flux) decrease with increasing water depth (Weinelt et al. 2001). In oligotrophic and therefore deep habitats *C. wuellerstorfi* is successful but at lower water depths with higher organic flux rates *C. lobatulus* is the stronger competitive species. At station 15 where *C. wuellerstorfi* was completely missing, living *C. lobatulus* showed the highest abundance of all determined stations with 5.07 ind/10 cm³ (see appendix, Table A.14).

5.4.1 Maximum test diameter

Regarding the maximum test diameter of *C. wuellerstorfi* within single size fractions the fraction >2000 μm is most remarkable (Fig. 4.12, page 37). The maximum diameter showed a much smaller range as usually expected, resulting to a median value of only 356 μm. Those *C. wuellerstorfi* found in the coarsest fraction actually belonged to the 125–250 and 250–630 μm fraction respectively but were attached to bigger substrate particles. Own observations showed that the specimens were attached so tight to the substrate that even dead individuals were quite difficult to remove for further investigations. The

attached *C. wuellerstorfi* were definitely suspension feeders and gathered their food particles out of the water column instead of getting it out of the sediment like substrate feeders do. Foraminifera living at exposed positions are not able to reach food particles in the sediment, they depend on lateral advection of food particles (Altenbach 1992). The abundances of *C. wuellerstorfi* within the fraction $>2000\ \mu\text{m}$ was much higher at southern stations, although the amount of coarse sediment particles $>2000\ \mu\text{m}$ was even larger at northern stations (Fig. 4.6, page 28). In “South” the portion of living individuals dominated over dead individuals, while individuals living in “North” only occurred at one single station with an extreme small portion. This stands in contrast to the living/dead ratio of the total abundances of *C. wuellerstorfi*, where the number of living specimens at northern and southern stations was more or less the same. Schönfeld (2002) found hints that active microhabitat selection is pursued as basic strategy of benthic foraminifera to optimise their food acquisition and therefore they respond to the strength of near-bottom currents. Wollenburg & Mackensen (1998b) observed that *C. wuellerstorfi*, actually regarded as strictly epifaunal species (Lutze & Thiel 1989, Linke & Lutze 1993), also occurs living below the uppermost sediment centimetre. This points to the fact that a large portion of southern *C. wuellerstorfi* were attached to bigger substrate particles and lived as suspension feeders, filtrating “passively” food out of the water column, while most of the northern *C. wuellerstorfi* lived mainly as substrate feeders, searching “actively” for food in or on the sediment, although enough coarse substrate was available. Probably this different live strategy is an answer to the different southern and northern habitat with lateral advection of food particles south of the sill and sedimentation of food particles north of the sill (see paragraph 5.2 Habitat characterisation).

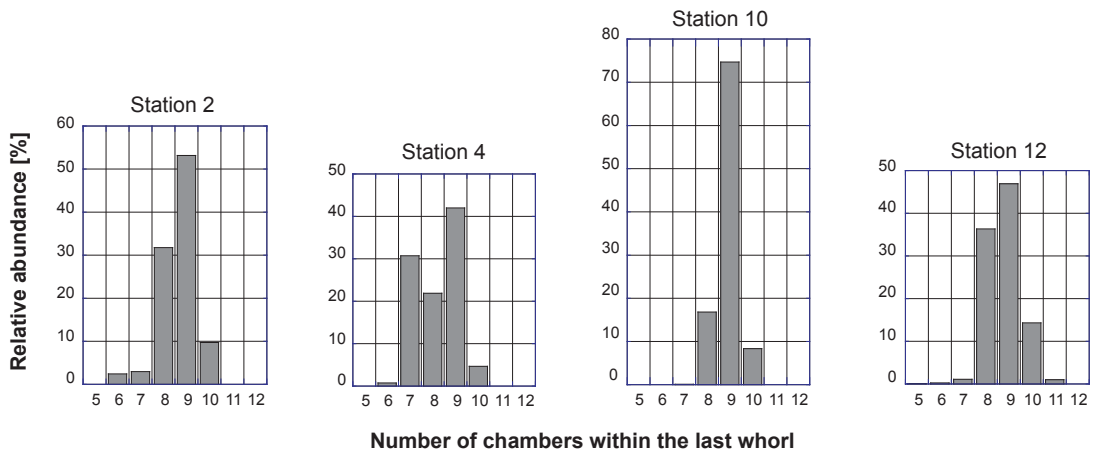
5.4.2 Number of chambers within the last whorl

From all performed morphometrical determinations on *C. wuellerstorfi* the number of chambers within the last whorl was the only parameter that showed highly significant differences between the groups “South”, “North”, and “Glacial”. Schwager (1866) already noticed different forms of *C. wuellerstorfi* with slim and wide chambers and their transitions, without mentioning under which conditions the respective forms occurred. It is noticeable that the glacial samples, although taken south of the sill, were more similar to northern modern samples than to southern modern samples. Gooday & Lamshead (1989) discovered that foraminiferal species living in different habitats showed different morphologies. Therefore the habitats in glacial South must have been comparable to those in modern North. In deed, bottom current velocities and resulting food supply were similar (see paragraph 5.2.2 Glacial habitat). Because more food particles were available in the sediment than in the water column, *C. wuellerstorfi* from glacial South and modern North lived very likely as substrate feeders which was probably not their optimal way of living. Benthic foraminifera distinguish food and non-food particles while collecting (Langezaal et al. 2005). *C. wuellerstorfi* from “North” and “Glacial” had to spend probably more energy on searching “actively” for food particles within the sediment instead of filtrating “passively” food particles out of the water column transported by lateral advection. For this reason they grew slower with slimmer and therefore more chambers within

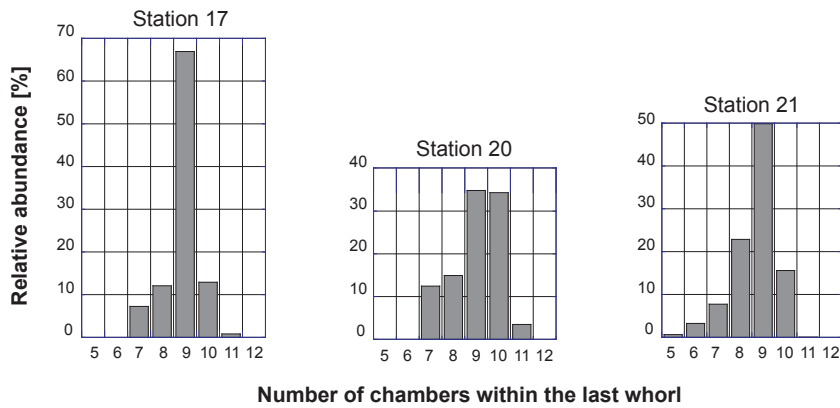
the last whorl. Individuals from glacial South had to cope with even worse conditions because of the reduced primary production due to the larger amounts of sea ice during the LGM. Therefore they grew even slower and performed the most chambers within the last whorl of all investigated specimens. *C. wuellerstorfi* of modern South had the most favourable environmental conditions, so that they were able to live epibenthic as suspension feeders. This individuals grew faster with wider and therefore less chambers within the last whorl. Additionally to the food supply, carbonate dissolution may have affected the growth of *C. wuellerstorfi*. Steinsund & Hald (1994) suggest that dissolution is linked to sea-ice production, therefore carbonate dissolution of glacial South and modern North should be widely comparable, while carbonate dissolution of modern South supposed to be much lower (see paragraph 5.2.1 Modern habitats). In areas with high carbonate dissolution rates, building and support of calcareous tests require higher amounts of energy. Hence, in case of *C. wuellerstorfi*, new chambers would be built slimmer resulting to more chambers within the last whorl.

Several species of living adult benthic foraminifera in plankton samples indicate a turbulent transport as important distributional mechanism (Loose 1970). Hints for a transport of adult *C. wuellerstorfi* were given at station 12, which was the closest located station to the sill. It was the only southern station providing specimens with eleven chambers within the last whorl. Additionally the percentage of tests with 10 chambers was the highest of all stations in “South”. After individuals got entrained, once in suspension, they were probably transported over the sill due to bottom currents in southerly direction. Currents of 0.10–0.15 m/s are required to entrain living adult benthic foraminifera (Alve 1999). These current velocities correspond to the maximum velocities reached north of the Denmark Strait (see paragraph 2.3 Glacial hydrography and circulation, page 7). Because specimens originating from the North lived very likely as substrate feeders on or in the sediment without being attached to larger particles, turbulent currents could catch them more easily. In total four tests of which three were living were found with eleven chambers at station 12 (see appendix, Table A.27). This indicates a possible transport of *C. wuellerstorfi* over the Denmark Strait as an adult individual and a successful re-settling after crossing the sill.

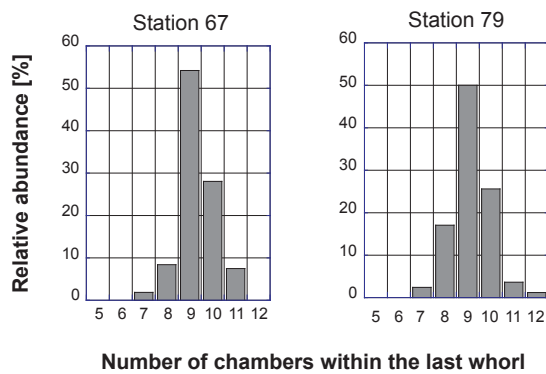
Relative abundances of number of chambers within the last whorl (Figure 5.4) showed a certain correlation with the total abundances of living *C. wuellerstorfi* (Figure 4.11, page 36). At those stations providing the three highest abundances of living *C. wuellerstorfi* (station 4, 20, and 21 with 13.4, 9.8, and 7.1 ind/10 cm³ respectively) the relative abundances of juvenile individuals with less than eight chambers had values of over 10%. It is very likely that at these particular stations a reproduction of *C. wuellerstorfi* took place shortly before sampling. Therefore even if the northern and southern habitats are quite different (see paragraph 5.2 Habitat characterisation) the living conditions of both regions seem to be sufficient enough for *C. wuellerstorfi* to reproduce. For glacial *C. wuellerstorfi* no assumptions for reproduction were feasible because the percentages of individuals with less than eight chambers were extremely low. Surely the fossilisation potential of these juvenile and therefore fragile tests is much lower than those of adult specimens, and of course most of the juvenile individuals grow up into adults before they get fossilised.



a) South



b) North



c) Glacial

Figure 5.4: *C. wuellerstorfi*. Relative abundances of number of chambers within the last whorl at single stations divided in the three groups a) “South” b) “North” c) “Glacial”.

5.4.3 Coiling direction

Coiling ratios of planktic foraminifera varying between 50 and 80% for left coiled individuals, never showing a preference for right coiled individuals, were found by Darling et al. (2003). Although the exact mechanism is not understood, Darling et al. (2003) conclude that the percentage of left coiled specimens increases with decreasing temperature. Left coiled morphospecies of the planktic foraminifer *Neogloboquadrina pachyderma* are dominant in the cold, high-northern latitudes, while right coiled *N. pachyderma* are found in more temperate environments (Bauch et al. 2003). Left coiled ratios of the benthic foraminifera *Cibicidoides pseudoacutus* also increase with decreasing temperature (Galeotti & Coccioni 2002). But genetic data points to the fact that coiling direction of planktic foraminifera were associated with genetic divergence and not with temperature during development (Darling et al. 2000). In contrast, laboratory experiments of *Amphistegina* species showed that coiling proportions in clones were independent of the coiling direction of individual clone parents (Hallock & Rosenkrands Larsen 1979). Although the portion of left coiled *C. wuellerstorfi* was significantly dominant (between 66 and 69%), it is not proved yet if the assumptions of increasing left coiled ratios with decreasing temperatures are guilty for all foraminifera. Because there was no significant difference between the groups “South”, “North”, and “Glacial” according to coiling direction in this study, there is no evidence neither for temperature nor genetic differences at all.

5.4.4 Proloculus diameter

Measurements of the proloculus diameter were made to find out whether or not *C. wuellerstorfi* performs a dimorphism and to what extent the differences in number of chambers within the last whorl are coupled with this. In general, the megalospheric form, also called form A, reproduces sexually and shows a large proloculus with a small test and a few number of chambers, in contrast the microspheric form, also called form B, reproduces asexually and shows a small proloculus with a large test and a large number of chambers within the last whorl (Rönnfeld 1999). Although Munier-Chalmas 1880 (cited in Schenck 1944) announced the conclusion that each species has two forms, unfortunately nobody proved that a dimorphism exists by the particular foraminifer *C. wuellerstorfi* until today. In this study no evidences for dimorphism were found either. Proloculus diameters of megalospheric and microspheric forms of different foraminiferal species were measured and showed that megalospheric prolocoli were 4 to 15 times larger than microspheric proloculi (Schenck 1944). Such high variations did not occur in this study. The range of proloculi sizes was much too narrow to assume a dimorphism of the investigated *C. wuellerstorfi*. Namely no significant difference in proloculus diameter was determined in the groups “South”, “North”, and “Glacial”. The median value of all groups was 40 μm . There was no significant difference in maximum test diameter of the groups “South”, “North”, and “Glacial” either. This result excludes as well the assumption of dimorphism. Again a median value of 40 μm occurred looking at the proloculus diameter within different size fractions (Figure 4.18, page 43). Here only a slight tendency was recognisable that smaller size fractions supplied smaller proloculi. This attributes to the fact that, if

the following chambers were built at exactly the same size, individuals with a small initial chamber of course show smaller tests compared to those started with a larger initial chamber.

An interesting pattern arised as the number of chambers within the last whorl, including those specimens with less than eight chambers, were plotted against the proloculus diameter (Figure 5.5). The less chambers occurred within the last whorl the larger the proloculi got. Spindler (pers. comm.) made already this kind of observations on planktic foraminifera. He noticed that foraminifera with a striking large proloculus had an obviously low number of chambers. The assumption is that something in the early stage of growth caused a deformity of the tests and that those individuals did not grow any further. Figure 5.5 also shows that the proloculi got larger the more chambers occurred. This is very likely a methodical fault. *C. wuellerstorfi* is a calcareous foraminifer with quite thick sutures (Schwager 1866, Holbourn & Henderson 2002). The sutures cover parts of the proloculus and made the interpretation of X-ray photographs difficult, especially in the centre of the test. The more chambers and therefore sutures occurred the more difficult was the determination of the initial chamber on the X-ray photographs. But despite these results one can say that there is still no evidence for *C. wuellerstorfi* showing a dimorphism. The highly significant differences in number of chambers within the last whorl must have another origin.

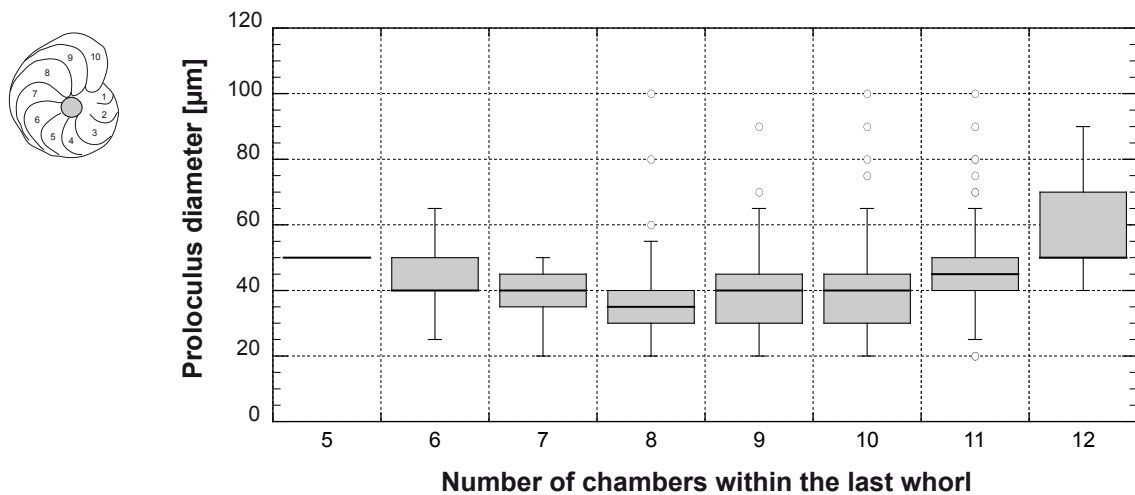


Figure 5.5: Number of chambers within the last whorl of *C. wuellerstorfi* plotted against the proloculus diameter.

5.4.5 Weight of individual tests

The weight of *C. wuellerstorfi* was determined to detect, whether or not tests with more chambers within the last whorl are lighter than those with less chambers. If tests with the same size but different number of chambers differ in their weight this will point to differences in thickness of the chamber wall. Thinner chamber walls are regarded as a

hint for faster growth or for tactics to save material and therefore energy while building up new chambers. Neither the weight of individuals of the groups “South”, “North” or “Glacial” differed nor was a weight difference visible linked to number of chambers. The wall thickness of the tests seemed to be always the same despite of different habitats and chamber morphologies. Therefore *C. wuellerstorfi* is very likely not compensating different food supplies and carbonate dissolution rates with wall thickness but with the size of chambers. Probably the generally quite thin chamber walls of *C. wuellerstorfi* (Schwager 1866) were always that thin as possible to perform an optimal growth rate and provide enough protection against mechanical destruction at the same time. In spite of building thinner chamber walls at unfavourable living conditions, the number of chambers within the last whorl increased due to slimmer chambers.

Besides the connection of test weight with number of chambers Figure 4.21 (page 46) shows quite well the relation of maximum test diameter to the number of chambers within the last whorl. All individuals with eight to eleven chambers covered the complete spectrum of test sizes. Hence, specimens with eight chambers did not perform only small tests and those with eleven chambers did not show only large tests. On account of this, the number of chambers within the last whorl, higher or equal eight, does not indicate the age of *C. wuellerstorfi*.

5.5 Genetic assumptions on the status of *C. wuellerstorfi*

All results about faunal assemblages, habitats, and morphology of *C. wuellerstorfi* north and south of the Denmark Strait raises one question: Is the difference in chamber numbers of modern *C. wuellerstorfi* from both sides of the sill a response to different environmental conditions made visible by two different ecophenotypes or did two different genotypes develop separately due to the temporary blockade of the Denmark Strait during glacial times? The easiest way to answer this question would be to make genetic investigations on *C. wuellerstorfi* and obtain DNA-sequences of southern and northern individuals. This was one of the aims within the research group “Ocean Gateways”, wherein this study is involved as well, but unfortunately failed in some way: Because of technical problems it was only possible to get sequences from *C. wuellerstorfi* quite far north of the Denmark Strait. The samples were taken along one transect at the East Greenland margin at approximately 76°N, reaching from the shelf area up to the deep sea (Blümel pers. comm.). DNA-sequences from specimens south of the Denmark Strait were not obtained at all. Blümel (pers. comm.) recognised two different genotypes of *C. wuellerstorfi* in the North, not supposing that these two types already represent two different species. Schweizer et al. (2005) obtained DNA-sequences of *C. wuellerstorfi* from the Portuguese coast, but due to the small sampling volume of one single specimen, no statements about possibly different genotypes could be made here. However, this genotype, found at the Portuguese coast, clustered with type 2 of those genotypes investigated by Blümel (pers. comm.), while type 1 of the northern samples was in the same cluster than one DNA-sequence of *Cibicides lobatulus*. Type 1 and type 2 showed two different morphotypes, expressed by

a significant difference in the ratio between maximum diameter and number of chambers within the last whorl.

A high morphological plasticity of *Uvigerina* species was observed by Schweizer et al. (2005). The determined low genetic diversity of this perforate foraminifer leads to the assumption that the origin of the variation is presumably ecological rather than genetic. Numbers of morphological differences between abyssal and bathyal calcareous species were described by Gooday & Lamshead (1989). They recognised that some bathyal specimens are smaller than those collected in the abyssal area but these differences are not sufficient to separate the populations at species level. This indicates that the bathyal site provides a more stressful environment for these species, because it lies near the limit of their bathymetric ranges (Gooday & Lamshead 1989). The smaller growth of those species is possibly comparable with the slimmer chambers of *C. wuellerstorfi* north of the Denmark Strait living in less favourable conditions due to food supply and high carbonate dissolution rates.

Opposite connections were documented as well: “Cryptic” speciation, meaning the same morphospecies showing highly divergent genotypes, is common among planktic foraminifera (Darling et al. 1999, Steel et al. 2003). Those “cryptic” species seem to have different environmental preferences (Bauch et al. 2003). Therefore, even if no obvious morphological differences were determined, it is definitely possible that different genotypes exist. Probably several genotypes of *C. wuellerstorfi* live already at both sides of the Denmark Strait without being morphologically divided. Those hypothetical genotypes must not urgently provide exactly the same morphology, the definite morphological difference, e.g. the size or number of the test pores, was possibly just not detected yet.

A chance of gene exchange has to be ensured to keep genotypes over a large distance or a supposed barrier identical. One identical genotype was identified for three different planktic foraminiferal species occurring in the Arctic and Antarctic, indicating a trans-tropical gene flow even over very large distances (Darling et al. 2000). On the other hand de Vargas et al. (2002) found at least four different genotypes within the planktic foraminifer *Globigerinella siphonifera* sampled along an Atlantic transect. Due to the rather short distances between the sampling sites, they emphasise the importance of water column stability serving as a gene flow barrier. Although there are hints for an exchange of *C. wuellerstorfi* at least from North to South, there is no sure evidence for an existing gene flow. Probably northern and southern *C. wuellerstorfi* show already such different genotypes that a gene exchange would not be possible any more, even if they meet sporadic.

Detailed knowledge about evolution rates is absolute necessary to find out if it is theoretically possible to perform two different genotypes out of one single species since the LGM. Until now only evolution rates of few foraminiferal genera and species are known (Pawlowski et al. 1997). All determined divergence times were higher than 10 million years, which is a much longer period of time than investigated in this study. Therefore even if different genotypes of *C. wuellerstorfi* exist today north and south of the Denmark Strait, the temporary blockade during the LGM is unlike to be the cause. In addition, although the cross sill transport was significantly reduced during the LGM, exchange of

foraminifera was still possible. A counter-clockwise circulation around Iceland was identified which could have carried foraminifera from south of the Denmark Strait to the north crossing the Iceland-Faeroe-Ridge (Kösters 2004).

However, without a molecular phylogenetic approach it is not possible to determine whether morphotypic variants represent natural variation within a population, phenotypic variation induced by different environmental conditions, or separate species with different ecological requirements (Darling et al. 1999). In order to solve this problem, combined genetic and morphologic studies on the same living individuals or populations of benthic foraminifera are required. This approach would hopefully be realisable in the near future.

6 Conclusions

Living conditions for benthic foraminifera at both sides of the Denmark Strait are so diverse that different living and dead assemblages were established in North and South. The simplified scheme of Figure 6.1 shows the different environmental conditions and their consequences for foraminiferal assemblages. Higher bottom current velocities and lower carbonate dissolution rates at southern stations lead to an accumulation of dead species and dead calcareous specimens respectively. At northern stations both are rare. Low TOC contents due to lateral advection of food particles in surface sediment samples of southern stations cause a high portion of species known as epifaunal living suspension feeders. In contrast, sedimentation of food particles causing high TOC contents in surface sediment samples explain the large portion of typical endobenthic species living as substrate feeders within the northern foraminiferal assemblages. Abundances and diversities point to a generally more dynamic habitat in South because of the higher bottom current velocities.

The different environmental conditions at both sides of the Denmark Strait seem to affect not only the benthic foraminiferal assemblages but also the morphology of *Cibicides wuellerstorfi*. Due to evidences of exchange of *C. wuellerstorfi* between areas north and south of the sill, the differing morphologies represent probably no different genotypes but more likely two different phenotypes responding to obviously different habitat conditions. The southern habitats seem to provide more favourable environmental conditions due to low carbonate dissolution rates and lateral advection of food particles facilitating an epibenthic way of living as suspension feeder, which is typical for *C. wuellerstorfi*. These conditions leads to fast growing rates with wider and therefore less chambers within the last whorl. In contrast, high carbonate dissolution rates and sedimentation of food particles demanding an untypical endobenthic way of life as substrate feeder indicates rather unfavourable environmental conditions at the northern habitats for *C. wuellerstorfi*. The growth rates are slow with slimmer and therefore more chambers within the last whorl. Hence the number of chambers might be an indicator to distinguish epifaunal from endofaunal living *C. wuellerstorfi*.

The environmental conditions during the LGM south of the sill were more similar to modern conditions in North than in South. The morphology of *C. wuellerstorfi* reflects these circumstances quite well, because southern glacial and northern modern specimens show a much greater similarity than southern modern with southern glacial individuals do. Therefore different morphologies have developed due to different habitat conditions and not because of geographical separated locations. This also confirms the assumption that different ecophenotypes of *C. wuellerstorfi* occur north and south of the Denmark Strait rather than different genotypes. These evidences for faunal exchange of *C. wuellerstorfi* over the sill lead to the conclusion that the Denmark Strait is more likely a migration passage than a barrier.

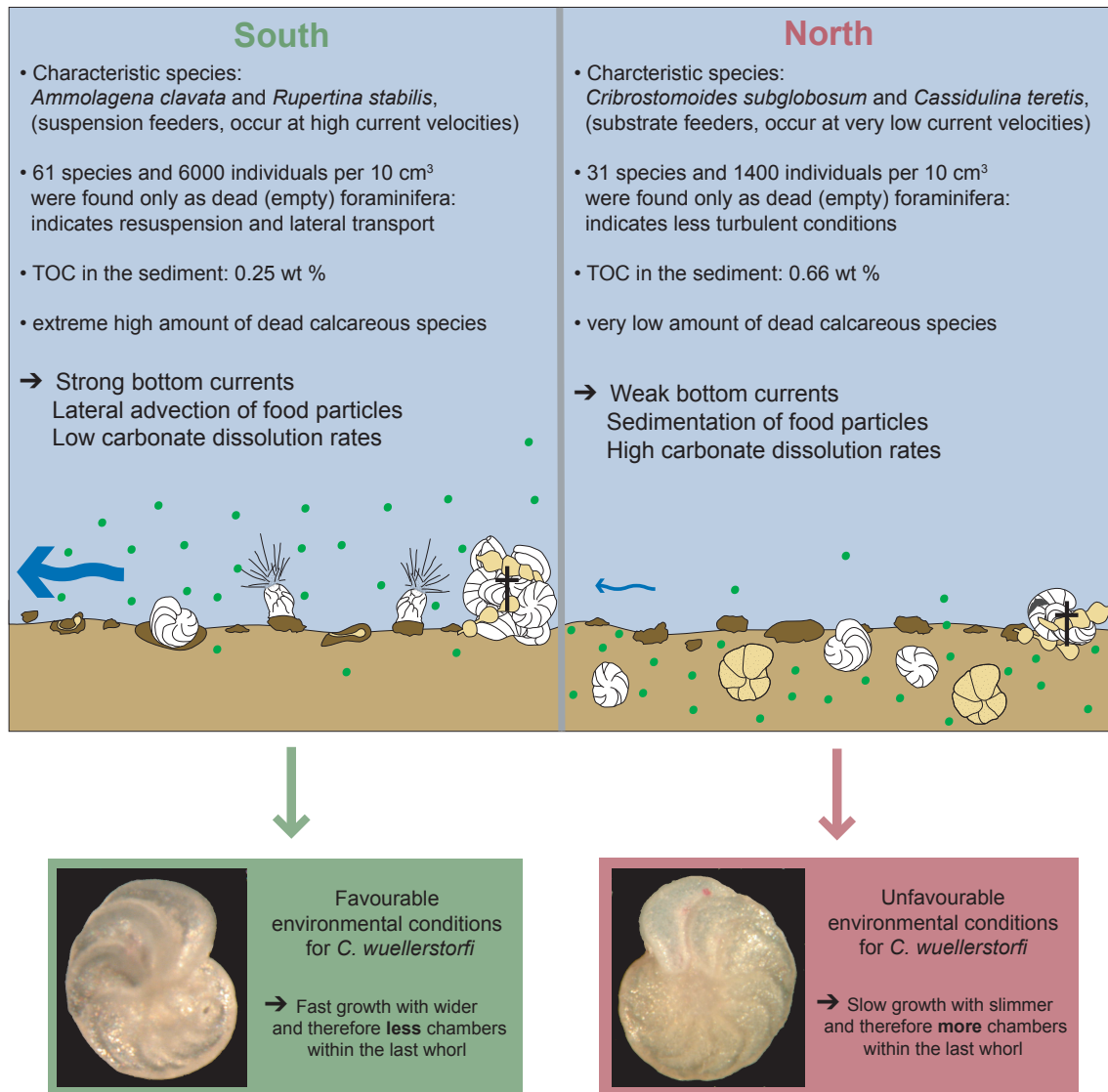


Figure 6.1: Differences of southern and northern microhabitats of the Denmark Strait.

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Appendix

Tables A.1–A.8: Counts of dead and living (stained) benthic foraminifera.

Tables A.9–A.14: Absolute and relative abundances of dead and living benthic foraminifera.

Table A.15: Biotic and abiotic parameters.

Tables A.16–A.23: CCA axis values of species, stations, and environmental parameters.

Tables A.24–A.34: Lists of morphometric measurements on *Cibicides wuellerstorfi*.

Appendix

Table A.1: Raw data set of all benthic foraminifera $>125 \mu\text{m}$ found at station PS62/002-3. The wet sediment volume of this sample was 67 cm^3 . (Org. res.= organic residual, for further explanations see chapter 3.3 Sample treatment).

Species	Dead					Living (stained)				
	Size fraction [μm]		630-2000 1/1	>2000 1/1	Org. res. 1/1	125-250 1/64	250-360 1/32	630-2000 1/1	>2000 1/1	Org. res. 1/1
	125-250 1/64	250-360 1/32								
Sample split	1/64	1/32	1/1	1/1	1/1	1/64	1/32	1/1	1/1	1/1
<i>Ammobaculites filiformis</i>				1						
<i>Ammodiscus catinus</i>									1	
<i>Ammolagena clavata</i>	5	15	103	663				1	7	
<i>Bolivina pacifica</i>					2					
<i>Bolivina pseudoplicata</i>	1									
<i>Bolivina</i> sp.					1					
<i>Bulimina mexicana</i>		3								
<i>Cassidulina laevigata</i>	10	1	1		2				1	
<i>Cassidulina teretis</i>		1								
<i>Cibicides kullenbergi</i>		1								
<i>Cibicides lobatulus</i>	44	30		11	3				1	
<i>Cibicidoides wuellerstorfi</i>	61	106	40	60	7				26	
<i>Cornuloculina inconstans</i>					1				1	
<i>Cribrostomoides subglobosum</i>	5	11	5		1					
<i>Crithionina cushmani</i>			10	19					4	
<i>Cyclammina cancellata</i>			1							
<i>Cyclogyra involvens</i>										1
<i>Cystammina pauciloculata</i>					3					
<i>Eggerella bradyi</i>			4	1						
<i>Elphidium excavatum</i>	8		9		6					
<i>Epistomina</i> sp.	4		1		4			1		
<i>Epistominella exigua</i>				2					1	
<i>Epistominella rugosa</i>	3									
<i>Fissurina</i> spp.	35	20		1	12					1
<i>Fursenkoina fusiformis</i>					6					
<i>Globocassidulina subglobosa</i>	8		1	1	1				1	
<i>Gyroidina soldanii</i>	20	14		3	2					
<i>Haplophragmoides sphaeriloculus</i>	2	9	1							
<i>Hemisphaerammina marisalbi</i>			2	7					3	
<i>Hoeglundia elegans</i>	10	9	1							
<i>Hormosina guttifer</i>	1				1					
<i>Hyperammina elongata</i>	3									
<i>Karrerella bradyi</i>		2								
<i>Labrospira jeffreysii</i>	2			2	12				1	
<i>Lagena</i> spp.	12	2		1	7			1		
<i>Lagenammina tubulata</i>	7	4								
<i>Lenticulina peregrina</i>	1				1					
<i>Marginulina glabra</i>	1									
<i>Marsipella cylindrica</i>										5
<i>Melonis barleanum</i>	2	2		1	2				1	
<i>Melonis pompilioides</i>	5	10								
<i>Nonion labradoricum</i>	1				7					
<i>Nonionella grateloupi</i>					1					
<i>Nummoloculina irregularis</i>			1							
<i>Oridorsalis umbonatus</i>	2	6								
<i>Oridorsalis</i> sp.	2									
<i>Patellina corrugata</i>										1
<i>Pelosina variabilis</i>					1					
<i>Placopsilinella aurantiaca</i>								5	8	
<i>Portatrochammina karica</i>					2					
<i>Psammospaera parva</i>	1		1		2				1	
<i>Pullenia bulloides</i>	8	6		1	3	1				
<i>Pullenia quinqueloba</i>	1	2			5					
<i>Pyrgo oblonga</i>	1				7				1	
<i>Pyrgo rotalaria</i>	2	5	2							
<i>Pyrgo</i> (juvenile)					2				1	
<i>Quinqueloculina seminula</i>	2	2	1					1		1
<i>Reophax dentaliniformis</i>	1				1					
<i>Reophax difflugiformis</i>	7	15		1						
<i>Reophax scorpiurus</i>	1			1				1		
<i>Rhabdammina abyssorum</i>	12	38			1					
<i>Rhizammina algaeformis</i>	2		1							
<i>Robertina arctica</i>	2				3					
<i>Rupertina stabilis</i>	17	135	33	8	3			1	2	8
<i>Saccammina sphaerica</i>	16	57	174	43	3				8	1
<i>Saccorhiza ramosa</i>	12	11	1	374	10			3	31	1
<i>Sigmioilopsis schlumbergeri</i>		6								
<i>Siphotextularia philippinensis</i>					1					
<i>Textularia wiesneri</i>					2					
<i>Thurammina papillata</i>		1			1					1
<i>Tolypammina vagans</i>			15	103						4
<i>Trifarina angulosa</i>	3				1					
<i>Trifarina carinata</i>	1									
<i>Triloculina tricarinata</i>			3	1	6					
<i>Trochammina</i> ex gr. <i>squamata</i>		1		4						9
<i>Trochammina globigeriniformis pygmaea</i>	1		1		2					7
Unidentified agglutinated (attached)				5						2
Unidentified agglutinated (spheroidal)										
Unidentified perforate II (trochospiral)			3	3	3	1	5	12	7	

Table A.1: continued

Species	Dead					Living (stained)				
	Size fraction [μm]		630-2000	>2000	Org. res.	125-250	250-360	630-2000	>2000	Org. res.
Sample split	125-250	250-360								
Unidentified perforate III (trochospiral)			1		1/1				1	

Table A.2: Raw data set of all foraminifera >125 μm found at station PS62/004-2. The wet sediment volume of this sample was 53 cm^3 . (Org. res.= organic residual, for further explanations see chapter 3.3 Sample treatment).

Species	Sample split	Dead					Fluff	Living (stained)				
		Size fraction [μm]		630-2000	>2000	Org. res.		125-250	250-360	630-2000	>2000	Org. res.
	125-250	250-360	1/1				1/1					
<i>Adercotryma glomerata</i>												1
<i>Ammobaculites agglutinans</i>		1	9					2				
<i>Ammolagena clavata</i>		6	120	10	35		1		1			
<i>Bolivina pseudoplicata</i>		2					1					14
<i>Buccella frigida</i>		8					7					4
<i>Bulimina mexicana</i>		1	1									
<i>Cassidulina laevigata</i>		7					7					1
<i>Cassidulina teretis</i>			1									
<i>Cibicides lobatulus</i>		9	26		1		7		2		1	9
<i>Cibicides refulgens</i>		5						1				
<i>Cibicoides wuellerstorfi</i>		12	42		1		3	1			4	3
<i>Cribrostomoides subglobosum</i>			19				1			2		
<i>Crithionina cushmani</i>				2	11						1	
<i>Cystamina pauciloculata</i>		1										
<i>Eggerella bradyi</i>			1	1								
<i>Elphidium excavatum</i>		25					11					1
<i>Epistominella exigua</i>		10				2	7	2				26
<i>Epistominella rugosa</i>		2					9					
<i>Fissurina</i> spp.		10				2	2	1				
<i>Globocassidulina subglobosa</i>		8					8					4
<i>Glomospira irregularis</i>							4					
<i>Gyroidina soldanii</i>		4	4	3				1		3		
<i>Haplophragmoides membranaceum</i>		5										
<i>Haplophragmoides sphaeriloculus</i>		10					2					
<i>Hemisphaerammina bradyi</i>			31	3	14				1			
<i>Hemisphaerammina marisalbi</i>		1		8	48			2	3	16	48	
<i>Hoeglundia elegans</i>			11	5								
<i>Hormosina guttifer</i>		2					2					
<i>Karrerella bradyi</i>							1					
<i>Karrerulina conversa</i>		10			1		2					1
<i>Labrospira crassimargo</i>			1									
<i>Labrospira jeffreysii</i>		6				26	2					1
<i>Lagena</i> spp.		4					1		1			
<i>Lagenammina tubulata</i>		4						1				
<i>Marsipella cylindrica</i>		3	4		7		2				2	
<i>Melonis barleeianum</i>		6	11									
<i>Melonis pompilioides</i>		18	53				5	1	2			
<i>Nonion labradoricum</i>		2					1					
<i>Oridorsalis umbonatus</i>		16				1	5	1				
<i>Placopsilinella aurantiaca</i>		4		2	4		2	15	3	1	6	1
<i>Pullenia bulloides</i>		20	14				3					
<i>Pullenia quinqueloba</i>		14	4				2					
<i>Pullenia salisburyi</i>		2										
<i>Pyrgo rotalaria</i>					1							
<i>Pyrgo williamsoni</i>			1									
<i>Pyrgo (juvenile)</i>							1					
<i>Pyrgoella sphaera</i>				1		1						
<i>Quinqueloculina pulchella</i>		1										
<i>Quinqueloculina seminula</i>			1						1		1	
<i>Recurviroides (juvenile)</i>		3										
<i>Reophax bilocularis</i>			6	11						1		
<i>Reophax dentaliformis</i>			1									
<i>Reophax diffugiformis</i>		35	8		1			4	1	2		2
<i>Reophax helenae</i>		1										
<i>Reophax scorpiurus</i>		20	10		2		2	5	4			2
<i>Saccamina sphaerica</i>		31	14	3	8		4		1			
<i>Saccorhiza ramosa</i>		90	114	22	259		19	9	10	4	70	7
<i>Sigmoilopsis schlumbergeri</i>		4	32				2		1			
<i>Stainforthia fusiformis</i>												
<i>Subreophax guttifer</i>		1				3						
<i>Textularia wiesneri</i>							5					
<i>Thurammina papillata</i>			1									
<i>Tolypammina vagans</i>			2	1	43							
<i>Tosaia cf. hanzawai</i>			2									
<i>Trifarina angulosa</i>		1										
<i>Triloculina tricarinata</i>						2	1			1		3
<i>Trochammina ex gr. squamata</i>			6		1				1		2	
<i>Trochammina globigeriniformis pygmaea</i>			5				4	1	1			6

Appendix

Table A.2: continued

Species	Dead						Living (stained)						
	Sample split	Size fraction [μm]				Org. res.	Fluff	125-250	250-360	630-2000	>2000	Org. res.	Fluff
		125-250	250-360	630-2000	>2000								
Unidentified agglutinated (attached)				2	21								1
Unidentified agglutinated (ovoid)												4	
Unidentified agglutinated (spheroidal)													3
Unidentified perforate I (trochospiral)												4	
Unidentified perforate II (trochospiral)		1		4	7						4		3
Unidentified perforate III (trochospiral)		1											
Unidentified perforate IV (trochospiral)												1	

Table A.3: Raw data set of all benthic foraminifera $>125 \mu\text{m}$ found at station PS62/010-2. The wet sediment volume of this sample was 121 cm^3 . (Org. res.= organic residual, for further explanations see chapter 3.3 Sample treatment).

Species	Dead						Living (stained)						
	Sample split	Size fraction [μm]				Org. res.	125-250	250-360	630-2000	>2000	Org. res.		
		125-250	250-360	630-2000	>2000							1/32	1/64
<i>Adercotryma glomerata</i>		1											
<i>Buccella</i> sp.		1											
<i>Cassidella loeblichii</i>													1
<i>Cassidulina laevigata</i>		18											
<i>Cassidulina teretis</i>		30			17	3							
<i>Cibicides lobatulus</i>		219	344	13	51	11	1						1
<i>Cibicides refulgens</i>			9										
<i>Cibicides wuellerstorfi</i>		3	10	4	12						1		6
<i>Cornuspira involvens</i>		2	1										
<i>Crithionina cushmani</i>		2			5		2						
<i>Elphidium excavatum</i>		38	7	1	6	5				1			
<i>Epistominina</i> sp.		1											
<i>Epistominella exigua</i>		2			3	3							
<i>Fissurina</i> spp.		14	3		3	4	3	1				1	1
<i>Fursenkoina fusiformis</i>					1	5							
<i>Globocassidulina subglobosa</i>		31		1	5	2	1						
<i>Gyroidina soldanii</i>		2											
<i>Hemisphaerammina bradyi</i>		3				1							
<i>Hemisphaerammina marisalbi</i>		1	4		1		2	1	4				1
<i>Hoeglundia elegans</i>			2	1									
<i>Hyperammina</i> cf. <i>elongata</i>		3											
<i>Labrospira jeffreysii</i>		2	1			2							1
<i>Lagena</i> spp.		4			1		2						
<i>Melonis barleanum</i>		3	2			1							
<i>Nonion</i> sp.						4							
<i>Nummoloculina irregularis</i>		8	15		6				4				2
<i>Oolina</i> spp.						1							
<i>Oridorsalis umbonatus</i>		2			2								
<i>Patellina corrugata</i>		1											
<i>Planispirinoides bucculentus</i>					3								1
<i>Portatrochammina karica</i>						1							
<i>Pullenia bulloides</i>		4	2		2	1							
<i>Pullenia quinqueloba</i>		1											
<i>Pullenia subcarinata</i>					1								
<i>Quinqueloculina seminula</i>		7			1								
<i>Rhabdammina abyssorum</i>		4	2	4	3								
<i>Robertina arctica</i>					1								
<i>Rupertina stabilis</i>		5	62	323	37				7		15		
<i>Saccammina sphaerica</i>				59	9				4		2		
<i>Sigmoilopsis schlumbergeri</i>			1										
<i>Spirillina</i> cf. <i>vivipara</i>			1										
<i>Spirillina obconica</i>						4							
<i>Stainforthia fusiformis</i>		1											
<i>Thurammina papillata</i>					1								
<i>Trifarina angulosa</i>		17							1				
<i>Trifarina carinata</i>		29							1				
<i>Triloculina tricarinata</i>		1			1	4							
<i>Trochammina</i> ex gr. <i>squamata</i>						1							
<i>Trochammina globigeriniformis pygmaea</i>		1							1				
Unidentified agglutinated (tubular)			1		5								4
Unidentified perforate II (trochospiral)						2							
Unidentified perforate III (trochospiral)		2											1

Table A.4: Raw data set of all benthic foraminifera >125 μm found at station PS62/012-2. The wet sediment volume of this sample was 84 cm^3 . (Org. res.= organic residual, for further explanations see chapter 3.3 Sample treatment).

Species	Dead						Living (stained)					
	Sample split	Size fraction [μm]		630-2000 1/4	>2000 1/1	Org. res. 1/1	125-250 1/256	250-360 1/32	630-2000 1/4	>2000 1/1	Org. res. 1/1	
		125-250 1/256	250-360 1/32									
<i>Adercotryma glomerata</i>						2						1
<i>Ammodiscus catinus</i>		1										
<i>Ammolagena clavata</i>				5	320							34
<i>Bathysiphon cf. filiformis</i>			1									
<i>Bolivina pseudoplicata</i>		1										
<i>Buccella frigida</i>		1			1							
<i>Buzasina wiesneri</i>			1			2						
<i>Cassidulina laevigata</i>		10				7						
<i>Cassidulina teretis</i>		7	4			3						
<i>Cassidulina sp.</i>				1								
<i>Cibicides kullenbergi</i>		1										
<i>Cibicides lobatulus</i>		82	283	4	29	67						
<i>Cibicides refulgens</i>			38									
<i>Cibicoides wuellerstorfi</i>		7	61	6	28	3			1		35	
<i>Cornuspira involvens</i>					1							
<i>Cribrostomoides subglobosum</i>			7	19	9				1		1	
<i>Crithionina cushmani</i>					5						9	
<i>Cruciloculina ericsoni</i>											1	
<i>Cyclammina cancellata</i>					1							
<i>Cystammina pauciloculata</i>			2									
<i>Dentalina cf. aphelis</i>						1						
<i>Dentalina pauperata</i>				1								
<i>Dentalina (juvenile)</i>						1						
<i>Eggerella bradyi</i>		1		1	1							
<i>Ehrenbergina undulata</i>			1									
<i>Elphidium excavatum</i>		6	8	2	2	25						
<i>Epistominella exigua</i>		1				27						
<i>Fissurina spp.</i>		2	7									
<i>Fursenkoina fusiformis</i>						1						
<i>Globocassidulina subglobosa</i>		11	1			18						
<i>Gyroidina soldanii</i>		4	9		3	3						
<i>Hemisphaerammina marisalbi</i>			1		12		8	1	5	16		
<i>Hoeglundia elegans</i>		3	17	2	1	8						
<i>Hormosina guttifer</i>					2	3						
<i>Hyperammina elongata</i>					1							
<i>Karrerella bradyi</i>			6									
<i>Karrerella novangliae</i>				2								
<i>Labrospira crassimargo</i>				7		1			1			
<i>Labrospira jeffreysii</i>			2		1	11						1
<i>Lagena spp.</i>		3	2			17						
<i>Laryngosigma hyalascidia</i>											1	
<i>Marsipella cylindrica</i>				5	9				2	5		
<i>Melonis barleeianum</i>		4	4									1
<i>Melonis pompilioides</i>			2			3						
<i>Nonion labradoricum</i>		1	4		1	11						
<i>Nonion sp.</i>						7						
<i>Nummoloculina irregularis</i>		2	8	2	3	2						
<i>Oolina spp.</i>						2						
<i>Oridorsalis umbonatus</i>		1	12		2	2						
cf. <i>Ovamina</i>							1					
<i>Placopsilinella aurantiaca</i>								1				
<i>Pullenia bulloides</i>		2	3			5	1		1			
<i>Pullenia quinqueloba</i>						1						
<i>Pyrgo lucernula</i>					1						1	
<i>Pyrgo murrhina</i>				1								
<i>Pyrgo oblonga</i>						1						
<i>Pyrgo rotalaria</i>					2						1	
<i>Pyrgo williamsoni</i>			2	1								
<i>Pyrgo (juvenile)</i>						2						
<i>Pyrgoella sphaera</i>											1	
<i>Quinqueloculina seminula</i>		3	27	2	3	1					1	
<i>Quinqueloculina sp.</i>						1						
<i>Reophax dentaliniformis</i>			1	1		4						
<i>Reophax difflugiformis</i>		1	5			3	1					
<i>Reophax helena</i>						4						
<i>Reophax scorpiurus</i>				1	66						2	
<i>Rhizammina algaeformis</i>			3		1							
<i>Robertina arctica</i>			1			3						
<i>Robertina sp.</i>						9						
<i>Rupertina stabilis</i>		2	34	131	26	2					1	
<i>Saccammina sphaerica</i>			13	11	53				2		3	
<i>Saccorhiza ramosa</i>			7	3	3							
<i>Sigmoilopsis schlumbergeri</i>		2	8		2							
<i>Siphotextularia philippinensis</i>			1									
<i>Textularia wiesneri</i>					1	1						
<i>Tolypammina vagans</i>				8	91					1	14	
<i>Tosaiia cf. hanzawai</i>			2									
<i>Trifarina angulosa</i>		10				3						
<i>Trifarina carinata</i>		6		1								
<i>Triloculina tricarinata</i>		1	1			2						

Table A.4: continued

Species	Dead					Living (stained)				
	Size fraction [μm]		630-2000 1/4	>2000 1/1	Org. res. 1/1	125-250 1/256	250-360 1/32	630-2000 1/4	>2000 1/1	Org. res. 1/1
	125-250 1/256	250-360 1/32								
<i>Trochammina</i> ex gr. <i>squamata</i>	1	1	1							
<i>Trochammina globigeriniformis pygmaea</i>				5	3				3	
Unidentified agglutinated (attached)			1	3					3	
Unidentified agglutinated (spheroidal)							3			
Unidentified perforate II (trochospiral)		1	1		19			2	1	

Table A.5: Raw data set of all benthic foraminifera $>125 \mu\text{m}$ found at station PS62/015-4. The wet sediment volume of this sample was 75 cm^3 . (Org. res.= organic residual, for further explanations see chapter 3.3 Sample treatment).

Species	Dead					Living (stained)				
	Size fraction [μm]		630-2000 1/1	>2000 1/1	Org. res. 1/1	125-250 1/8	250-360 1/2	630-2000 1/1	>2000 1/1	Org. res. 1/1
	125-250 1/8	250-360 1/2								
<i>Adercotryma glomerata</i>	68			9	11					1
<i>Ammodiscus catinus</i>	7		1	1	2					
<i>Astrorhiza</i> sp.		5	5	8						
<i>Atlantiella atlantica</i>					20					2
<i>Bathysiphon</i> cf. <i>filiformis</i>				1						
<i>Bolivina</i> cf. <i>seminuda</i>		1			1					
<i>Cassidulina laevigata</i>	30		1		6	6				5
<i>Cassidulina teretis</i>				4					1	
<i>Cibicides lobatulus</i>	3	10	1	13	1	2	5	1	11	
<i>Criboelphidium excavatum</i>										1
<i>Criboostomoides subglobosum</i>	34	167	51	49		1	12	22	10	
<i>Crithionina cushmani</i>				4		28		2		
<i>Crithionina hispida</i>	1					1	2		9	
<i>Deuterammina grahami</i>	22	1	1		22	1				
<i>Eggerelloides advena</i>	1				1					
<i>Elphidium excavatum</i>	1			3		4				
<i>Epistominella exigua</i>					2					
<i>Fissurina</i> spp.					1	1				1
<i>Globocassidulina subglobosa</i>	3			1	3	1				3
<i>Haplophragmoides bradyi</i>					1	5				
<i>Haplophragmoides membranaceum</i>	39			6	6					
<i>Hemisphaerammina bradyi</i>	99	25	6	3		3				
<i>Hemisphaerammina marisalbi</i>		1	6	1	5	24	5	11	22	1
<i>Hormosina guttifer</i>	336	2	2	30	37	40	1	1	2	1
<i>Hyperammina elongata</i>		8								
<i>Hyperammina fragilis</i>		4		2						
<i>Hyperammina</i> sp. (Thies 1991)		3	13							
<i>Lagena</i> spp.						2				
<i>Lagenammina tubulata</i>					2					
<i>Marsipella cylindrica</i>						1	1			
<i>Melonis barleeianum</i>	6	2				2	1			
<i>Nonion labradoricum</i>					2					3
<i>Nummoloculina irregularis</i>						1	1			
<i>Oolina</i> spp. cf. <i>Ovamina</i>					2					5
<i>Placopsilina</i> sp.			11	5						
<i>Placopsilinella aurantiaca</i>		26	8	9			4	1	1	
<i>Portatrochammina karica</i>	87	1	4	37	32	5			4	1
<i>Psammosphaera parva</i>	3				22	1				9
<i>Pullenia bulloides</i>	2				1	2		1		1
<i>Pyrgo oblonga</i>		1			1	1	1			
<i>Quinqueloculina seminula</i>	1	3	2		1	1	1			
<i>Recurvoides contortus</i>	27	3	3		19	2	1			
<i>Reophax aduncus</i>	34		1	2		5			3	
<i>Reophax bilocularis</i>	40					5				
<i>Reophax dentaliniformis</i>					2					
<i>Reophax difflugiformis</i>	242	272		55	4	12	28		6	
<i>Reophax sabulosus</i>		11	2	15			4	2		
<i>Reophax scoriurus</i>		71	6	26			13	5	5	
<i>Reophax</i> sp. (Gooday 1986)	2				72	4				3
<i>Rupertina stabilis</i>							1			
<i>Saccammina sphaerica</i>	2	5	9	26				1	3	
<i>Saccorhiza ramosa</i>	342	198	28	71	3	15	30	9	23	1
<i>Stainforthia fusiformis</i>					3					
<i>Subreophax guttifer</i>	48			2		10				
<i>Textularia torquata</i>					23					
<i>Textularia wiesneri</i>	4			1	9	1	1	1	1	
<i>Thurammina papillata</i>	15	3		1	10	3	1		1	1
<i>Triloculina tricarinata</i>	1									
<i>Trochammina globigeriniformis pygmaea</i>	160	2		18	60	6			1	4
Unidentified agglutinated (spheroidal)							3	1	2	

Appendix

Table A.7: Raw data set of all benthic foraminifera >125 μm found at station PS62/020-1. The wet sediment volume of this sample was 49 cm^3 . (Org. res.= organic residual, for further explanations see chapter 3.3 Sample treatment).

Species	Dead								Living (stained)				
	Sample split	Size fraction [μm]		630-2000 1/1	>2000 1/1	Org. res. 1/1	Fluff 1/1	125-250 1/4	250-360 1/1	630-2000 1/1	>2000 1/1	Org. res. 1/1	Fluff 1/1
		125-250 1/4	250-360 1/1										
<i>Adercotryma glomerata</i>		18			1	4	4	5					1
<i>Anmodiscus catinus</i>		4			1								
<i>Bathysiphon cf. filiformis</i>		5	2	1					1				
<i>Cassidulina laevigata</i>							9						5
<i>Cassidulina teretis</i>		247	10	6	4	20		27				3	
<i>Cibicides lobatulus</i>		12	3				9						1
<i>Cibicoides wuellerstorfi</i>		6	157	2	2		14	10	8				
<i>Cornuloculina inconstans</i>		1	6					1	7				
<i>Cribrostomoides scitulum</i>							3						1
<i>Cribrostomoides subglobosum</i>		2	122	28	4		6			24			1
<i>Crithionina cushmani</i>				1	3								
<i>Dentalina pauperata</i>			1										
<i>Deuterammina grahami</i>		3											
<i>Elphidium excavatum</i>			1										
<i>Epistominella exigua</i>				2									
<i>Fissurina</i> spp.		1				1							
<i>Globocassidulina subglobosa</i>		18	1	5		7	8	2					
<i>Glomospira irregularis</i>		10	1			1	1	1			1	1	1
<i>Hemisphaerammina bradyi</i>		29	55	5	17			2			1		
<i>Hemisphaerammina marisalbi</i>			2	1	3			3	13	3	1		3
<i>Hormosina guttifera</i>		233	10	7	4		32	9	1				3
<i>Lagena</i> spp.		4											
<i>Lagenammina tubulata</i>					2								
<i>Marsipella cylindrica</i>		9	3		6	1	7	43	19	2	4		6
<i>Melonis barleanum</i>		12	11			1		1	3	1			
<i>Nonion labradoricum</i>		2	2	2		4							
<i>Nummuloculina irregularis</i>		1						1	2				
<i>Oolina</i> spp.										1			
<i>Oridorsalis umbonatus</i>		45		2	2	6	2	1					
cf. <i>Ovamina</i>					2								5
<i>Placopsilinella aurantiaca</i>					1		1	4		2	8		
<i>Portatrochammina karica</i>		4	1			1	3	2					2
<i>Psammosphaera parva</i>		10	20					24	3	1			
<i>Pullenia bulloides</i>		1											
<i>Pyrgo oblonga</i>									2				
<i>Pyrgo williamsoni</i>			4										
<i>Pyrgo</i> (juvenile)		5		1									
<i>Pyrgoella sphaera</i>			3										
<i>Quinqueloculina seminula</i>		5	6					1	3	1			1
<i>Reophax aduncus</i>		83						10					
<i>Reophax difflugiformis</i>		37	3			3	7	25				2	3
<i>Reophax helenae</i>		12						5					
<i>Reophax nodulosum</i>		1	4										
<i>Reophax sabulosus</i>				1					6				
<i>Reophax scorpiurus</i>		25	40	3	1		11	14	10	3			10
<i>Robertina bradyi</i>									1				
<i>Saccammina sphaerica</i>		8						1					
<i>Saccorhiza ramosa</i>		123	109	4	8		21	7	22	1	1		1
<i>Textularia wiesneri</i>		2		1	2		3						1
<i>Thurammina papillata</i>		9	11				2	1	2				
<i>Triloculina tricarinata</i>		9		1	2		2	4					1
<i>Trochammina globigeriniformis pygmaea</i>		21	8			8	17	4	1		1	1	8
Unidentified agglutinated (spheroidal)									20		5		
Unidentified perforate II (trochospiral)		9	3			1	1	7	13	1			

Table A.8: Raw data set of all benthic foraminifera $>125 \mu\text{m}$ found at station PS62/021-1. The wet sediment volume of this sample was 63 cm^3 . (Org. res.= organic residual, for further explanations see chapter 3.3 Sample treatment).

Species	Dead						Living (stained)				
	Sample split	Size fraction [μm]		630-2000 1/1	>2000 1/1	Org. res. 1/1	125-250 1/8	250-360 1/2	630-2000 1/1	>2000 1/1	Org. res. 1/1
		125-250 1/8	250-360 1/2								
<i>Adercotryma glomerata</i>		5				7					3
<i>Anmodiscus catinus</i>		9	1								
<i>Buccella frigida</i>		1									
<i>Cassidulina laevigata</i>			1								
<i>Cassidulina teretis</i>		4									
<i>Cibicides lobatulus</i>						6					
<i>Cibicidoides wuellerstorfi</i>		173	684	24	4		3	10		1	
<i>Cornuspira involvens</i>			1								
<i>Cribrostomoides subglobosum</i>		10	376	435	310			7	31	13	
<i>Crithionina cushmani</i>		6			1			6		3	
<i>Crithionina hispida</i>							4	2	3	16	
<i>Dentalina communis</i>			3								
<i>Dentalina pauperata</i>			5	1				1			
<i>Dentalina</i> sp.			1								
<i>Elphidium excavatum</i>		2	2								
cf. <i>Elphidium</i>		1									
<i>Epistominella exigua</i>				1		19					
<i>Fissurina</i> spp.		9	1			8	2				
<i>Globocassidulina subglobosa</i>		3				3					
<i>Glomospira irregularis</i>		1									
<i>Hemisphaerammina bradyi</i>		31	66	14			1	3			
<i>Hemisphaerammina marisalbi</i>		2	2	2			6	10	16	6	
<i>Hormosina guttifer</i>		108	29	11		100	3	6			1
<i>Hyperammina elongata</i>		1									
<i>Hyperammina</i> sp. (Thies 1991)				11	112				1	6	
<i>Lagena</i> spp.		2		1		4					
<i>Lagenammina</i> cf. <i>diffflugiformis</i>		6				3	1				
<i>Marginulina costata</i>			1								
<i>Marginulina glabra</i>				9							
<i>Marsipella cylindrica</i>			1				1	2	1		
<i>Miliolionella subrotunda</i>		10	20					1			
<i>Nonion</i> sp.						1					
<i>Nummoloculina irregularis</i>		1									
<i>Oolina</i> spp.		1	2	1		2		2			
<i>Oridorsalis umbonatus</i>		130	8	5	2	8	4	1			
cf. <i>Ovamina</i>											1
<i>Parafissurina groenlandica</i>		7	5				1	1			
<i>Placopsilinella aurantiaca</i>		9			1		4	8	3	2	
<i>Planispirinoides bucculentus</i>									1		
<i>Pyrgo oblonga</i>		1						1			
<i>Pyrgo rotalaria</i>			8	24	35			1	5	5	
<i>Pyrgo</i> (juvenile)						3					
<i>Pyrgoella sphaera</i>			17	9	2	3		1		2	
<i>Quinqueloculina seminula</i>		8	112	3			1	11			
<i>Reophax aduncus</i>		11	6	3				1			
<i>Reophax bilocularis</i>			5	10				2			
<i>Reophax diffflugiformis</i>		17				3	11				
<i>Reophax helena</i>			16					16			
<i>Reophax sabulosus</i>		2	3		4			8			
<i>Reophax scoriopus</i>		4	62	30	9		3	12	6	1	
<i>Reophax subfusiformis</i>						4					
<i>Rhabdammina abyssorum</i>			2								
<i>Robertina arctica</i>		3					2				
<i>Saccammina sphaerica</i>			5								
<i>Saccorhiza ramosa</i>		14	4				3	3			
<i>Stainforthia fusiformis</i>		1				1					
<i>Subreophax guttifer</i>		5									
<i>Thurammina papillata</i>		3	3			3					
<i>Triloculina tricarinata</i>		7	1	2	1	5			1		
<i>Trochammina globigeriniformis pygmaea</i>		10				4	2				
<i>Valvulinera minuta</i>		6				3					
Unidentified agglutinated (spheroidal)							1				
Unidentified perforate II (trochospiral)		17	10		2	16	4	16	6	3	5
Unidentified porcellaneous (miliolid)						2					

Appendix

Table A.9: Abbreviations of all found benthic foraminifera species used in Figures 5.2–5.3 and Tables A.10–A.14.

Species name	Abbreviation	Species name	Abbreviation
<i>Adercotryma glomerata</i>	A. glom.	<i>Marsipella cylindrica</i>	M. cyli.
<i>Ammobaculites agglutinans</i>	A. aggl.	cf. <i>Martinottiella</i>	cf. Mart.
<i>Ammobaculites filiformis</i>	A. fili.	<i>Melonis barleeaenum</i>	M. barl.
<i>Ammodiscus catinus</i>	A. cati.	<i>Melonis pompilioides</i>	M. pomp.
<i>Ammolagena clavata</i>	A. clav.	<i>Miliolonella subrotunda</i>	M. subr.
<i>Astrorhiza</i> sp.	Ast. sp.	<i>Nonion labradoricum</i>	N. labr.
<i>Atlantiella atlantica</i>	A. atla.	<i>Nonion</i> sp.	Non. sp.
<i>Bathysiphon</i> cf. <i>filiformis</i>	B. cf. fili.	<i>Nonionella grateloupi</i>	N. grat.
<i>Bolivina pacifica</i>	B. paci.	<i>Nummuloculina irregularis</i>	N. irre.
<i>Bolivina pseudoplicata</i>	B. pseu.	<i>Oolina</i> spp.	Ooli. spp.
<i>Bolivina</i> cf. <i>seminuda</i>	B. cf. semi.	<i>Oridorsalis umbonatus</i>	O. umbo.
<i>Bolivina</i> sp.	Bol. sp.	<i>Oridorsalis</i> sp.	Ori. sp.
<i>Buccella frigida</i>	B. frig.	cf. <i>Ovamina</i>	cf. Ovam.
<i>Buccella</i> sp.	Buc. sp.	<i>Parafissurina groenlandica</i>	P. groe.
<i>Bulimina mexicana</i>	B. mexi.	<i>Patellina corrugata</i>	P. corr.
<i>Buzasina wiesneri</i>	B. wies.	<i>Pelosina variabilis</i>	P. vari.
<i>Cassidella loeblichii</i>	C. loeb.	<i>Placopsilina</i> sp.	Plac. sp.
<i>Cassidulina laevigata</i>	C. laev.	<i>Placopsilina aurantiaca</i>	P. aura.
<i>Cassidulina teretis</i>	C. tere.	<i>Planispirinoides bucculentus</i>	P. bucc.
<i>Cassidulina</i> sp.	Cas. sp.	<i>Portatrochammina karica</i>	P. kari.
cf. <i>Cibicides</i>	cf. Cibi.	<i>Psanmosphaera parva</i>	P. parv.
<i>Cibicides kullenbergi</i>	C. kull.	<i>Pullenia bulloides</i>	P. bull.
<i>Cibicides lobatulus</i>	C. loba.	<i>Pullenia quinqueloba</i>	P. quin.
<i>Cibicides refulgens</i>	C. refu.	<i>Pullenia satisburyi</i>	P. sati.
<i>Cibicides</i> cf. <i>mundulus</i>	C. cf. mund.	<i>Pullenia subcarinata</i>	P. subc.
<i>Cibicides</i> cf. <i>wuellerstorfi</i>	C. wuel.	<i>Pyrgo lucemula</i>	P. luce.
<i>Cornuloculina inconstans</i>	C. inco.	<i>Pyrgo murrhina</i>	P. murr.
<i>Cornuspira involvens</i>	Co. inv.	<i>Pyrgo oblonga</i>	P. oblo.
<i>Criboelphidium excavatum</i>	C. exca.	<i>Pyrgo rotalaria</i>	P. rota.
<i>Cribrostomoides scitulum</i>	C. scit.	<i>Pyrgo williamsoni</i>	P. will.
<i>Cribrostomoides subglobosum</i>	C. subg.	<i>Pyrgo</i> (juvenile)	Pyr. juv.
<i>Crithionina cushmani</i>	C. cush.	<i>Pyrgoella sphaera</i>	P. spha.
<i>Crithionina hispida</i>	C. hisp.	<i>Quinqueloculina pulchella</i>	Q. pulc.
<i>Cruciloculina ericsoni</i>	C. eric.	<i>Quinqueloculina seminula</i>	Q. semi.
<i>Cyclammina cancellata</i>	C. canc.	<i>Quinqueloculina</i> sp.	Quin. sp.
<i>Cyclogyra involvens</i>	Cy. inv.	<i>Recurvoides contortus</i>	R. cont.
<i>Cystammina pauciloculata</i>	C. pauc.	<i>Recurvoides</i> (juvenile)	Rec. juv.
<i>Dentalina</i> cf. <i>aphelis</i>	D. cf. apha.	<i>Reophax aduncus</i>	R. adun.
<i>Dentalina communis</i>	D. comm.	<i>Reophax bilocularis</i>	R. bilo.
<i>Dentalina pauperata</i>	D. paup.	<i>Reophax dentaliniformis</i>	R. dent.
<i>Dentalina</i> sp.	Dent. sp.	<i>Reophax difflugiformis</i>	R. diff.
<i>Dentalina</i> (juvenile)	Dent. juv.	<i>Reophax helenae</i>	R. hele.
<i>Deuterammina grahami</i>	D. grah.	<i>Reophax nodulosum</i>	R. nodu.
<i>Eggerella bradyi</i>	E. brad.	<i>Reophax sabulosus</i>	R. sabu.
<i>Eggerelloides advena</i>	E. adve.	<i>Reophax scorpiurus</i>	R. scor.
<i>Ehrenbergina undulata</i>	E. undu.	<i>Reophax subfusiformis</i>	R. subf.
cf. <i>Elphidium</i>	cf. Elph.	<i>Reophax</i> sp.	Reo. sp.
<i>Elphidium excavatum</i>	E. exca.	<i>Rhabdammina abyssorum</i>	R. abys.
<i>Epistomina</i> sp.	Epi. sp.	<i>Rhizammina algaeformis</i>	R. alga.
<i>Epistominella exigua</i>	E. exig.	<i>Robertina arctica</i>	R. arct.
<i>Epistominella rugosa</i>	E. rugo.	<i>Robertina bradyi</i>	R. brad.
<i>Fissurina</i> spp.	Fiss. spp.	<i>Robertina</i> sp.	Rob. sp.
<i>Fursenkoina fusiformis</i>	F. fusi.	<i>Rupertina stabilis</i>	R. stab.
<i>Globocassidulina subglobosa</i>	G. subg.	<i>Saccammina sphaerica</i>	S. spha.
<i>Glomospira irregularis</i>	G. irre.	<i>Saccorhiza ramosa</i>	S. ramo.
<i>Guttulina dawsoni</i>	G. daws.	<i>Sigmoilopsis schlumbergeri</i>	S. schl.
<i>Gyroidina soldanii</i>	G. sold.	<i>Siphotextularia philippinensis</i>	S. phil.
<i>Haplophragmoides bradyi</i>	Ha. bra.	<i>Spirillina obconica</i>	S. obco.
<i>Haplophragmoides membranaceum</i>	H. memb.	<i>Spirillina</i> cf. <i>vivipara</i>	S. cf. vivi.
<i>Haplophragmoides sphaeriloculus</i>	H. spha.	<i>Stainforthia fusiformis</i>	S. fusi.
<i>Hemisphaerammina bradyi</i>	He. bra.	<i>Subreophax guttifer</i>	S. gutt.
<i>Hemisphaerammina marisalbi</i>	H. mari.	<i>Textularia torquata</i>	T. torq.
<i>Hoeglundia elegans</i>	H. eleg.	<i>Textularia wiesneri</i>	T. wies.
<i>Hormosina guttifer</i>	H. gutt.	<i>Thurammina papillata</i>	T. papi.
<i>Hyperammina elongata</i>	H. elon.	<i>Tolypammina vagans</i>	T. vaga.
<i>Hyperammina</i> cf. <i>elongata</i>	H. cf. elon.	<i>Tasaia</i> cf. <i>hanczawai</i>	T. cf. hanz.
<i>Hyperammina fragilis</i>	H. frag.	<i>Trifarina angulosa</i>	T. angu.
<i>Hyperammina friabilis</i>	H. fria.	<i>Trifarina carinata</i>	T. cari.
<i>Hyperammina</i> sp.	Hyp. sp.	<i>Triloculina tricarinata</i>	T. tric.
<i>Karrerella bradyi</i>	K. brad.	<i>Trochammina globigeriniformis pygmaea</i>	T. glob.
<i>Karrerella catenata</i>	K. cate.	<i>Trochammina</i> ex gr. <i>squamata</i>	T. squa.
<i>Karrerella novangliae</i>	K. nova.	<i>Valvulinera minuta</i>	V. minu.
<i>Karrerellina conversa</i>	K. conv.	Unidentified agglutinated (attached)	agglu. a
<i>Labrospira crassimargo</i>	L. cras.	Unidentified agglutinated (ovoid)	agglu. b
<i>Labrospira jeffreysii</i>	L. jeff.	Unidentified agglutinated (spheroidal)	agglu. c
<i>Lagena</i> spp.	Lag. spp.	Unidentified agglutinated (tubular)	agglu. d
<i>Lagenammina</i> cf. <i>difflugiformis</i>	L. cf. diff.	Unidentified perforate I (trochospiral)	perfo. a
<i>Lagenammina tubulata</i>	L. tubu.	Unidentified perforate II (trochospiral)	perfo. b
<i>Laryngosigma hyalascidia</i>	L. hyal.	Unidentified perforate III (trochospiral)	perfo. c
<i>Lenticulina peregrina</i>	L. pere.	Unidentified perforate IV (trochospiral)	perfo. d
<i>Marginulina costata</i>	M. cost.	Unidentified porcellaneous (miliolid)	porcel. a
<i>Marginulina glabra</i>	M. glab.		

Table A.10: Average abundances given in number of individuals per 10 cm³ wet sediment (#) and relative abundances (%) of all counted dead and living foraminifera >125 μm of the Denmark Strait subdivided in “North” and “South”. For full species names corresponding to the abbreviations see Table A.9.

Dead assemblages “South”			Dead assemblages “North”			Living assemblages “South”			Living assemblages “North”		
Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%
<i>C. loba</i>	1677.88	28.12	<i>H. gutt.</i>	251.46	17.59	<i>H. mari.</i>	76.11	25.19	<i>H. mari.</i>	16.21	8.49
<i>C. wuel.</i>	457.18	7.66	<i>S. ramo.</i>	170.77	11.95	<i>P. aura.</i>	48.23	15.96	<i>H. gutt.</i>	16.15	8.45
<i>S. ramo.</i>	392.14	6.57	<i>C. subg.</i>	134.19	9.39	<i>S. ramo.</i>	36.07	11.94	<i>R. diff.</i>	14.12	7.39
<i>R. stab.</i>	366.88	6.15	<i>C. wuel.</i>	128.15	8.96	<i>R. diff.</i>	20.55	6.80	<i>S. ramo.</i>	11.63	6.09
<i>S. spha.</i>	231.95	3.89	<i>R. diff.</i>	101.27	7.08	<i>R. scor.</i>	16.80	5.56	<i>M. cyli.</i>	11.25	5.89
<i>E. exca.</i>	184.68	3.10	<i>T. glob.</i>	84.07	5.88	<i>P. bull.</i>	10.01	3.31	<i>C. cush.</i>	10.04	5.25
<i>Fiss. spp.</i>	173.60	2.91	<i>He. bra.</i>	53.85	3.77	<i>agglu. c</i>	9.42	3.12	<i>R. scor.</i>	8.50	4.45
<i>R. diff.</i>	156.10	2.62	<i>C. tere.</i>	53.24	3.72	<i>cf. Ovam.</i>	7.62	2.52	<i>C. subg.</i>	8.42	4.41
<i>G. subg.</i>	149.73	2.51	<i>O. umbo.</i>	52.34	3.66	<i>E. exig.</i>	7.30	2.42	<i>P. parv.</i>	7.67	4.02
<i>A. clav.</i>	135.07	2.26	<i>R. scor.</i>	41.17	2.88	<i>C. wuel.</i>	6.93	2.29	<i>T. glob.</i>	6.78	3.55
<i>C. laev.</i>	134.95	2.26	<i>A. glom.</i>	36.57	2.56	<i>Fiss. spp.</i>	6.41	2.12	<i>perfo. b</i>	5.88	3.08
<i>G. sold.</i>	118.94	1.99	<i>R. adun.</i>	34.97	2.45	<i>L. tubu.</i>	5.41	1.79	<i>P. aura.</i>	4.79	2.51
<i>P. bull.</i>	115.82	1.94	<i>P. kari.</i>	32.82	2.30	<i>N. irre.</i>	5.33	1.76	<i>C. wuel.</i>	4.55	2.38
<i>M. pomp.</i>	100.45	1.68	<i>H. elon.</i>	15.67	1.10	<i>T. glob.</i>	4.69	1.55	<i>C. tere.</i>	4.47	2.34
<i>T. angu.</i>	97.79	1.64	<i>S. gutt.</i>	14.46	1.01	<i>perfo. b</i>	4.69	1.55	<i>cf. Ovam.</i>	4.00	2.09
<i>H. eleg.</i>	81.29	1.36	<i>S. spha.</i>	13.84	0.97	<i>M. pomp.</i>	3.77	1.25	<i>A. glom.</i>	3.94	2.06
<i>O. umbo.</i>	81.06	1.36	<i>Q. semi.</i>	13.49	0.94	<i>G. sold.</i>	3.16	1.05	<i>C. laev.</i>	3.75	1.96
<i>R. abys.</i>	79.59	1.33	<i>T. papi.</i>	12.42	0.87	<i>C. refu.</i>	3.02	1.00	<i>agglu. c</i>	3.60	1.88
<i>C. tere.</i>	79.05	1.32	<i>R. bilo.</i>	11.46	0.80	<i>O. umbo.</i>	3.02	1.00	<i>R. adun.</i>	3.40	1.78
<i>Lag. spp.</i>	71.40	1.20	<i>P. aura.</i>	10.64	0.74	<i>R. stab.</i>	2.20	0.73	<i>C. hisp.</i>	2.96	1.55
<i>R. scor.</i>	68.85	1.15	<i>H. memb.</i>	10.60	0.74	<i>C. loba.</i>	1.95	0.64	<i>P. kari.</i>	2.69	1.41
<i>M. barl.</i>	68.48	1.15	<i>C. laev.</i>	10.46	0.73	<i>C. cush.</i>	1.79	0.59	<i>S. gutt.</i>	2.67	1.40
<i>T. cari.</i>	67.39	1.13	<i>D. grah.</i>	10.27	0.72	<i>Lag. spp.</i>	1.70	0.56	<i>R. hele.</i>	2.52	1.32
<i>C. refu.</i>	63.19	1.06	<i>R. cont.</i>	10.04	0.70	<i>A. clav.</i>	1.69	0.56	<i>Q. semi.</i>	2.07	1.09
<i>Q. semi.</i>	61.16	1.02	<i>perfo. b</i>	9.04	0.63	<i>Q. semi.</i>	1.69	0.56	<i>He. bra.</i>	1.82	0.95
<i>S. schl.</i>	55.65	0.93	<i>A. cati.</i>	7.08	0.50	<i>L. jeff.</i>	1.33	0.44	<i>C. loba.</i>	1.68	0.88
<i>P. quin.</i>	49.52	0.83	<i>G. subg.</i>	7.07	0.49	<i>S. spha.</i>	1.25	0.41	<i>O. umbo.</i>	1.56	0.81
<i>N. irre.</i>	48.53	0.81	<i>P. parv.</i>	7.00	0.49	<i>agglu. a</i>	0.97	0.32	<i>R. bilo.</i>	1.49	0.78
<i>H. spha.</i>	45.84	0.77	<i>M. barl.</i>	5.57	0.39	<i>G. subg.</i>	0.89	0.29	<i>E. exca.</i>	1.43	0.75
<i>C. subg.</i>	41.81	0.70	<i>Hyp. sp.</i>	5.51	0.39	<i>T. squa.</i>	0.81	0.27	<i>H. fria.</i>	1.41	0.74
<i>E. exig.</i>	40.56	0.68	<i>C. loba.</i>	5.45	0.38	<i>A. aggl.</i>	0.76	0.25	<i>H. memb.</i>	1.33	0.70
<i>L. tubu.</i>	33.57	0.56	<i>T. tric.</i>	4.98	0.35	<i>T. vaga.</i>	0.69	0.23	<i>T. papi.</i>	1.28	0.67
<i>B. frig.</i>	32.13	0.54	<i>M. subr.</i>	4.76	0.33	<i>M. cyli.</i>	0.67	0.22	<i>R. sabu.</i>	1.27	0.67
<i>K. com.</i>	30.33	0.51	<i>R. hele.</i>	4.04	0.28	<i>B. pseu.</i>	0.66	0.22	<i>Reo. sp.</i>	1.17	0.61
<i>L. jeff.</i>	29.68	0.50	<i>T. wies.</i>	3.66	0.26	<i>T. angu.</i>	0.66	0.22	<i>G. subg.</i>	1.11	0.58
<i>N. labr.</i>	20.62	0.35	<i>Fiss. spp.</i>	3.59	0.25	<i>T. cari.</i>	0.66	0.22	<i>M. barl.</i>	1.10	0.57
<i>B. pseu.</i>	16.09	0.27	<i>P. rota.</i>	2.98	0.21	<i>T. tric.</i>	0.52	0.17	<i>R. cont.</i>	0.96	0.50
<i>H. memb.</i>	15.10	0.25	<i>Reo. sp.</i>	2.93	0.21	<i>He. bra.</i>	0.38	0.12	<i>Fiss. spp.</i>	0.94	0.49
<i>He. bra.</i>	14.51	0.24	<i>G. irre.</i>	2.88	0.20	<i>R. dent.</i>	0.38	0.12	<i>T. tric.</i>	0.91	0.48
<i>E. rugo.</i>	13.63	0.23	<i>M. cyli.</i>	2.79	0.19	<i>S. schl.</i>	0.38	0.12	<i>T. wies.</i>	0.77	0.40
<i>H. mari.</i>	13.28	0.22	<i>P. groe.</i>	2.62	0.18	<i>C. subg.</i>	0.25	0.08	<i>N. irre.</i>	0.64	0.33
<i>P. aura.</i>	12.45	0.21	<i>C. cush.</i>	2.60	0.18	<i>B. frig.</i>	0.19	0.06	<i>R. arct.</i>	0.64	0.33
<i>T. squa.</i>	12.37	0.21	<i>R. sabu.</i>	2.38	0.17	<i>L. cras.</i>	0.12	0.04	<i>P. bull.</i>	0.60	0.31
<i>M. cyli.</i>	11.85	0.20	<i>cf. Mart.</i>	2.36	0.17	<i>E. exca.</i>	0.09	0.03	<i>H. elon.</i>	0.59	0.31
<i>P. rota.</i>	10.93	0.18	<i>H. mari.</i>	2.10	0.15	<i>C. laev.</i>	0.09	0.03	<i>C. inco.</i>	0.56	0.29
<i>T. vaga.</i>	10.89	0.18	<i>P. spha.</i>	2.06	0.14	<i>agglu. d</i>	0.08	0.03	<i>D. grah.</i>	0.54	0.28
<i>Epi. sp.</i>	10.40	0.17	<i>L. cf. diff.</i>	2.03	0.14	<i>A. glom.</i>	0.08	0.03	<i>Lag. spp.</i>	0.53	0.28
<i>T. tric.</i>	9.91	0.17	<i>V. minu.</i>	2.03	0.14	<i>M. barl.</i>	0.07	0.02	<i>P. oblo.</i>	0.52	0.27
<i>Rec. juv.</i>	9.06	0.15	<i>Lag. spp.</i>	1.88	0.13	<i>perfo. c</i>	0.06	0.02	<i>P. rota.</i>	0.48	0.25
<i>C. kull.</i>	8.82	0.15	<i>H. fria.</i>	1.64	0.11	<i>K. com.</i>	0.05	0.02	<i>P. groe.</i>	0.40	0.21
<i>H. gutt.</i>	8.71	0.15	<i>B. cf. fili.</i>	1.52	0.11	<i>R. bilo.</i>	0.05	0.02	<i>S. spha.</i>	0.34	0.18
<i>E. brad.</i>	8.38	0.14	<i>E. exca.</i>	1.39	0.10	<i>A. cati.</i>	0.04	0.01	<i>L. cf. diff.</i>	0.32	0.17
<i>K. brad.</i>	8.15	0.14	<i>Pyr. juv.</i>	1.19	0.08	<i>C. inco.</i>	0.04	0.01	<i>A. cati.</i>	0.31	0.16
<i>R. alga.</i>	7.70	0.13	<i>E. exig.</i>	0.96	0.07	<i>Cy. inv.</i>	0.04	0.01	<i>Hyp. sp.</i>	0.28	0.15
<i>A. cati.</i>	7.62	0.13	<i>R. arct.</i>	0.95	0.07	<i>Epi. sp.</i>	0.04	0.01	<i>Epi. sp.</i>	0.27	0.14
<i>H. elon.</i>	7.20	0.12	<i>N. labr.</i>	0.89	0.06	<i>P. corr.</i>	0.04	0.01	<i>Ooli. spp.</i>	0.25	0.13
<i>B. mexi.</i>	6.98	0.12	<i>L. jeff.</i>	0.77	0.05	<i>P. parv.</i>	0.04	0.01	<i>P. spha.</i>	0.24	0.12
<i>A. aggl.</i>	6.42	0.11	<i>P. bull.</i>	0.77	0.05	<i>Pyr. juv.</i>	0.04	0.01	<i>G. irre.</i>	0.21	0.11
<i>P. sali.</i>	6.04	0.10	<i>Ast. sp.</i>	0.77	0.05	<i>P. oblo.</i>	0.04	0.01	<i>N. labr.</i>	0.10	0.05
<i>R. arct.</i>	5.95	0.10	<i>T. torq.</i>	0.77	0.05	<i>T. papi.</i>	0.04	0.01	<i>F. fusi.</i>	0.09	0.05
<i>perfo. b</i>	5.55	0.09	<i>R. nodu.</i>	0.73	0.05	<i>C. eric.</i>	0.03	0.01	<i>agglu. a</i>	0.09	0.05
<i>T. glob.</i>	5.47	0.09	<i>R. abys.</i>	0.70	0.05	<i>L. hyal.</i>	0.03	0.01	<i>P. bucc.</i>	0.09	0.04
<i>C. pauc.</i>	5.04	0.08	<i>A. atla.</i>	0.67	0.05	<i>P. luce.</i>	0.03	0.01	<i>C. pauc.</i>	0.08	0.04
<i>Ori. sp.</i>	4.78	0.08	<i>Ooli. spp.</i>	0.66	0.05	<i>P. rota.</i>	0.03	0.01	<i>M. subr.</i>	0.08	0.04
<i>perfo. c</i>	4.38	0.07	<i>Plac. sp.</i>	0.53	0.04	<i>P. spha.</i>	0.03	0.01	<i>A. atla.</i>	0.07	0.04
<i>R. dent.</i>	3.99	0.07	<i>N. irre.</i>	0.52	0.04	<i>C. loeb.</i>	0.02	0.01	<i>R. stab.</i>	0.07	0.04
<i>C. cush.</i>	3.27	0.05	<i>C. inco.</i>	0.51	0.04	<i>P. bucc.</i>	0.02	0.01	<i>B. cf. fili.</i>	0.05	0.03
<i>R. hele.</i>	3.14	0.05	<i>D. paup.</i>	0.49	0.03				<i>C. scit.</i>	0.05	0.03
<i>S. gutt.</i>	3.07	0.05	<i>S. fusi.</i>	0.46	0.03				<i>R. brad.</i>	0.05	0.03
<i>Q. pulc.</i>	3.02	0.05	<i>P. oblo.</i>	0.42	0.03				<i>Co. inv.</i>	0.05	0.02
<i>R. bilo.</i>	2.78	0.05	<i>M. glab.</i>	0.36	0.03				<i>G. dawvs.</i>	0.05	0.02
<i>P. oblo.</i>	2.68	0.04	<i>H. frag.</i>	0.33	0.03				<i>R. nodu.</i>	0.05	0.02
<i>Co. inv.</i>	2.68	0.04	<i>B. frig.</i>	0.32	0.02				<i>agglu. b</i>	0.05	0.02
<i>T. cf. hanz.</i>	2.66	0.04	<i>cf. Elph.</i>	0.32	0.02				<i>C. exca.</i>	0.03	0.02
<i>P. parv.</i>	2.50	0.04	<i>C. hisp.</i>	0.31	0.02						
<i>L. pere.</i>	2.43	0.04	<i>E. adve.</i>	0.30	0.02						
<i>P. will.</i>	2.40	0.04	<i>D. comm.</i>	0.24	0.02						
<i>M. glab.</i>	2.39	0.04	<i>P. will.</i>	0.21	0.01						
<i>H. cf. elon.</i>	1.98	0.03	<i>cf. Ovam.</i>	0.19	0.01						
<i>T. papi.</i>	1.63	0.03	<i>E. brad.</i>	0.18	0.01						

Table A.10: continued

Dead assemblages "South"			Dead assemblages "North"			Living assemblages "South"			Living assemblages "North"		
Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%
agglu. a	1.48	0.02	<i>K. cate.</i>	0.18	0.01						
agglu. d	1.43	0.02	<i>R. stab.</i>	0.18	0.01						
<i>S. cf. vivi.</i>	1.32	0.02	<i>L. tubu.</i>	0.17	0.01						
<i>L. cras.</i>	1.24	0.02	<i>R. subf.</i>	0.16	0.01						
<i>B. wies.</i>	1.01	0.02	<i>C. scit.</i>	0.15	0.01						
<i>S. phil.</i>	0.99	0.02	<i>B. cf. semi.</i>	0.15	0.01						
<i>B. cf. fili.</i>	0.95	0.02	agglu. b	0.14	0.01						
<i>E. undu.</i>	0.95	0.02	<i>Co. inv.</i>	0.13	0.01						
<i>S. fusi.</i>	0.80	0.01	cf. <i>Cibi.</i>	0.09	0.01						
<i>A. glom.</i>	0.72	0.01	<i>C. cf. mund.</i>	0.09	0.01						
<i>Buc. sp.</i>	0.66	0.01	<i>Epi. sp.</i>	0.09	0.01						
<i>P. corr.</i>	0.66	0.01	<i>Dent. sp.</i>	0.08	0.01						
<i>F. fusi.</i>	0.38	0.01	<i>M. cost.</i>	0.08	0.01						
<i>T. wies.</i>	0.37	0.01	porcel. a	0.08	0.01						
<i>Non. sp.</i>	0.29	0.00	<i>R. dent.</i>	0.07	0.00						
<i>Rob. sp.</i>	0.27	0.00	<i>F. fusi.</i>	0.05	0.00						
<i>K. nova.</i>	0.24	0.00	<i>Non. sp.</i>	0.04	0.00						
<i>G. irre.</i>	0.19	0.00	<i>Ha. bra.</i>	0.03	0.00						
agglu. b	0.19	0.00									
perfo. a	0.19	0.00									
<i>Pyr. juv.</i>	0.18	0.00									
<i>Cas. sp.</i>	0.12	0.00									
<i>D. paup.</i>	0.12	0.00									
<i>P. murr.</i>	0.12	0.00									
<i>P. kari.</i>	0.10	0.00									
<i>P. spha.</i>	0.10	0.00									
<i>S. obco.</i>	0.08	0.00									
<i>Ooli. spp.</i>	0.08	0.00									
<i>B. paci.</i>	0.08	0.00									
<i>C. canc.</i>	0.07	0.00									
<i>P. bucc.</i>	0.06	0.00									
perfo. d	0.05	0.00									
<i>A. fili.</i>	0.04	0.00									
<i>Bol. sp.</i>	0.04	0.00									
<i>C. inco.</i>	0.04	0.00									
<i>N. grat.</i>	0.04	0.00									
<i>P. vari.</i>	0.04	0.00									
<i>Dent. juv.</i>	0.03	0.00									
<i>D. cf. aphe.</i>	0.03	0.00									
<i>P. luce.</i>	0.03	0.00									
<i>Quin. sp.</i>	0.03	0.00									
<i>P. subc.</i>	0.02	0.00									

Table A.11: Average abundances given in number of individuals per 10 cm³ wet sediment (#) and relative abundances (%) of all counted dead foraminifera >125 μm at single stations South of the Denmark Strait. For full species names corresponding to the abbreviations see Table A.9.

Dead assemblages of station 2			Dead assemblages of station 4			Dead assemblages of station 10			Dead assemblages of station 12		
Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%
<i>C. wuel.</i>	1104,93	18,17	<i>S. ramo.</i>	1315,47	21,45	<i>C. loba.</i>	2405,95	63,64	<i>C. loba.</i>	3590,48	45,62
<i>R. stab.</i>	813,73	13,38	<i>R. diff.</i>	435,85	7,11	<i>R. stab.</i>	397,60	10,52	<i>C. wuel.</i>	452,26	5,75
<i>C. loba.</i>	565,67	9,30	<i>S. spha.</i>	398,30	6,49	<i>E. exca.</i>	138,60	3,67	<i>G. subg.</i>	341,19	4,33
<i>S. spha.</i>	457,91	7,53	<i>E. exca.</i>	303,96	4,96	<i>N. irre.</i>	100,99	2,67	<i>C. laev.</i>	305,60	3,88
<i>Fiss. spp.</i>	431,79	7,10	<i>M. pomp.</i>	298,30	4,86	<i>G. subg.</i>	82,73	2,19	<i>T. angu.</i>	305,12	3,88
<i>R. abys.</i>	296,27	4,87	<i>P. bull.</i>	263,21	4,29	<i>C. tere.</i>	80,99	2,14	<i>R. stab.</i>	256,19	3,25
<i>G. sold.</i>	258,66	4,25	<i>A. clav.</i>	262,26	4,28	<i>T. cari.</i>	76,69	2,03	<i>C. tere.</i>	228,93	2,91
<i>A. clav.</i>	233,73	3,84	<i>R. scor.</i>	257,36	4,20	<i>C. wuel.</i>	62,48	1,65	<i>E. exca.</i>	217,50	2,76
<i>S. ramo.</i>	224,63	3,69	<i>C. wuel.</i>	209,06	3,41	<i>Fiss. spp.</i>	53,47	1,41	<i>Q. semi.</i>	195,71	2,49
<i>H. eleg.</i>	138,66	2,28	<i>O. umbo.</i>	194,34	3,17	<i>C. laev.</i>	47,60	1,26	<i>T. cari.</i>	183,33	2,33
<i>R. diff.</i>	138,66	2,28	<i>P. quin.</i>	175,47	2,86	<i>C. refu.</i>	47,60	1,26	<i>H. eleg.</i>	158,21	2,01
<i>Lag. spp.</i>	125,37	2,06	<i>C. loba.</i>	149,43	2,44	<i>T. angu.</i>	44,96	1,19	<i>G. sold.</i>	156,90	1,99
<i>P. bull.</i>	105,67	1,74	<i>E. exig.</i>	122,45	2,00	<i>H. mari.</i>	23,88	0,63	<i>C. refu.</i>	144,76	1,84
<i>C. subg.</i>	101,19	1,66	<i>Fiss. spp.</i>	121,51	1,98	<i>R. abys.</i>	22,07	0,58	<i>M. barl.</i>	137,14	1,74
<i>C. laev.</i>	100,75	1,66	<i>K. com.</i>	121,32	1,98	<i>P. bull.</i>	21,40	0,57	<i>Lag. spp.</i>	101,07	1,28
<i>M. pomp.</i>	95,52	1,57	<i>H. spha.</i>	121,13	1,98	<i>M. barl.</i>	18,60	0,49	<i>N. irre.</i>	92,98	1,18
<i>L. tubu.</i>	85,97	1,41	<i>G. subg.</i>	98,11	1,60	<i>Q. semi.</i>	18,60	0,49	<i>S. schl.</i>	91,67	1,16
<i>E. exca.</i>	78,66	1,29	<i>B. frig.</i>	97,92	1,60	<i>H. eleg.</i>	10,74	0,28	<i>Fiss. spp.</i>	87,62	1,11
<i>G. subg.</i>	76,87	1,26	<i>S. schl.</i>	96,98	1,58	<i>L. jeff.</i>	10,74	0,28	<i>O. umbo.</i>	76,67	0,97
<i>H. spha.</i>	62,24	1,02	<i>M. barl.</i>	89,06	1,45	<i>Lag. spp.</i>	10,66	0,28	<i>P. bull.</i>	72,98	0,93
<i>O. umbo.</i>	47,76	0,79	<i>C. laev.</i>	85,85	1,40	<i>Co. inv.</i>	10,58	0,28	<i>S. spha.</i>	61,07	0,78
<i>P. rota.</i>	43,28	0,71	<i>L. jeff.</i>	77,74	1,27	<i>S. spha.</i>	10,50	0,28	<i>R. diff.</i>	49,88	0,63
<i>Epi. sp.</i>	38,96	0,64	<i>C. refu.</i>	60,38	0,98	<i>He. bra.</i>	8,02	0,21	<i>N. labr.</i>	47,14	0,60
<i>M. barl.</i>	29,10	0,48	<i>H. memb.</i>	60,38	0,98	<i>H. cf. elon.</i>	7,93	0,21	<i>A. clav.</i>	44,29	0,56
<i>Q. semi.</i>	28,81	0,47	<i>G. sold.</i>	54,91	0,90	<i>E. exig.</i>	5,79	0,15	<i>C. subg.</i>	36,79	0,47
<i>T. angu.</i>	28,81	0,47	<i>He. bra.</i>	50,00	0,82	<i>C. cush.</i>	5,70	0,15	<i>T. squa.</i>	34,76	0,44
<i>E. rugo.</i>	28,66	0,47	<i>P. aura.</i>	49,81	0,81	agglu. d	5,70	0,15	<i>T. tric.</i>	34,52	0,44
<i>H. elon.</i>	28,66	0,47	<i>Lag. spp.</i>	48,49	0,79	<i>O. umbo.</i>	5,45	0,14	<i>E. exig.</i>	33,69	0,43
<i>S. schl.</i>	28,66	0,47	<i>L. tubu.</i>	48,30	0,79	<i>G. sold.</i>	5,29	0,14	<i>E. brad.</i>	31,07	0,39
<i>L. jeff.</i>	21,19	0,35	<i>M. cyli.</i>	43,96	0,72	<i>S. schl.</i>	5,29	0,14	<i>B. frig.</i>	30,60	0,39
<i>P. quin.</i>	19,85	0,33	<i>Rec. juv.</i>	36,23	0,59	<i>S. cf. vivi.</i>	5,29	0,14	<i>A. cati.</i>	30,48	0,39

Table A.11: continued

Dead assemblages of station 2			Dead assemblages of station 4			Dead assemblages of station 10			Dead assemblages of station 12		
Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%
<i>R. arct.</i>	19,55	0,32	<i>C. subg.</i>	29,25	0,48	<i>perfo. c</i>	5,29	0,14	<i>B. pseu.</i>	30,48	0,39
<i>R. alga.</i>	19,25	0,32	<i>E. rugo.</i>	25,85	0,42	<i>T. tric.</i>	3,06	0,08	<i>C. kull.</i>	30,48	0,39
<i>Ori. sp.</i>	19,10	0,31	<i>A. aggl.</i>	25,66	0,42	<i>A. glom.</i>	2,64	0,07	<i>S. ramo.</i>	28,45	0,36
<i>T. vaga.</i>	17,61	0,29	<i>N. labr.</i>	24,72	0,40	<i>Buc. sp.</i>	2,64	0,07	<i>K. brad.</i>	22,86	0,29
<i>B. mexi.</i>	14,33	0,24	<i>H. gutt.</i>	24,53	0,40	<i>Epi. sp.</i>	2,64	0,07	<i>T. vaga.</i>	14,64	0,19
<i>N. labr.</i>	10,60	0,17	<i>B. pseu.</i>	24,34	0,40	<i>P. corr.</i>	2,64	0,07	<i>R. alga.</i>	11,55	0,15
<i>P. oblo.</i>	10,60	0,17	<i>P. sati.</i>	24,15	0,39	<i>P. quin.</i>	2,64	0,07	<i>L. jeff.</i>	9,05	0,11
<i>P. parv.</i>	10,00	0,16	<i>H. mari.</i>	22,64	0,37	<i>S. fusi.</i>	2,64	0,07	<i>R. scor.</i>	8,33	0,11
<i>T. glob.</i>	10,00	0,16	<i>H. eleg.</i>	17,55	0,29	<i>T. glob.</i>	2,64	0,07	<i>P. will.</i>	8,10	0,10
<i>H. gutt.</i>	9,70	0,16	<i>perfo. b</i>	14,15	0,23	<i>F. fusi.</i>	0,50	0,01	<i>M. pomp.</i>	7,98	0,10
<i>L. pere.</i>	9,70	0,16	<i>B. mexi.</i>	13,58	0,22	<i>Non. sp.</i>	0,33	0,01	<i>C. pauc.</i>	7,62	0,10
<i>R. dent.</i>	9,70	0,16	<i>S. gutt.</i>	12,26	0,20	<i>S. obco.</i>	0,33	0,01	<i>T. cf. hanz.</i>	7,62	0,10
<i>R. scor.</i>	9,70	0,16	<i>T. angu.</i>	12,26	0,20	<i>P. bucc.</i>	0,25	0,01	<i>perfo. b</i>	6,55	0,08
<i>B. pseu.</i>	9,55	0,16	<i>C. pauc.</i>	12,08	0,20	<i>perfo. b</i>	0,17	0,00	<i>H. mari.</i>	5,24	0,07
<i>K. brad.</i>	9,55	0,16	<i>Q. pulc.</i>	12,08	0,20	<i>Ooli. spp.</i>	0,08	0,00	<i>R. dent.</i>	4,76	0,06
<i>M. glab.</i>	9,55	0,16	<i>R. hele.</i>	12,08	0,20	<i>P. kari.</i>	0,08	0,00	<i>R. arct.</i>	4,17	0,05
<i>T. cari.</i>	9,55	0,16	<i>perfo. c</i>	12,08	0,20	<i>P. subc.</i>	0,08	0,00	<i>B. wies.</i>	4,05	0,05
<i>T. squa.</i>	5,37	0,09	<i>T. vaga.</i>	11,32	0,18	<i>R. arct.</i>	0,08	0,00	<i>B. cf. fli.</i>	3,81	0,05
<i>T. papi.</i>	4,93	0,08	<i>R. bilo.</i>	11,13	0,18	<i>T. papi.</i>	0,08	0,00	<i>E. undu.</i>	3,81	0,05
<i>C. tere.</i>	4,78	0,08	<i>T. squa.</i>	9,25	0,15	<i>T. squa.</i>	0,08	0,00	<i>S. phil.</i>	3,81	0,05
<i>C. kull.</i>	4,78	0,08	<i>T. glob.</i>	8,30	0,14				<i>L. cras.</i>	3,45	0,04
<i>C. cush.</i>	4,33	0,07	<i>agglu. a</i>	4,34	0,07				<i>M. cyli.</i>	3,45	0,04
<i>T. tric.</i>	1,49	0,02	<i>T. cf. hanz.</i>	3,02	0,05				<i>Rob. sp.</i>	1,07	0,01
<i>H. mari.</i>	1,34	0,02	<i>C. cush.</i>	2,45	0,04				<i>K. nova.</i>	0,95	0,01
<i>perfo. b</i>	1,34	0,02	<i>E. brad.</i>	1,70	0,03				<i>T. glob.</i>	0,95	0,01
<i>F. fusi.</i>	0,90	0,01	<i>C. tere.</i>	1,51	0,02				<i>Non. sp.</i>	0,83	0,01
<i>E. brad.</i>	0,75	0,01	<i>L. cras.</i>	1,51	0,02				<i>agglu. a</i>	0,83	0,01
<i>agglu. a</i>	0,75	0,01	<i>P. will.</i>	1,51	0,02				<i>C. cush.</i>	0,60	0,01
<i>C. pauc.</i>	0,45	0,01	<i>Q. semi.</i>	1,51	0,02				<i>H. gutt.</i>	0,60	0,01
<i>B. paci.</i>	0,30	0,00	<i>R. dent.</i>	1,51	0,02				<i>Cas. sp.</i>	0,48	0,01
<i>E. exig.</i>	0,30	0,00	<i>T. papi.</i>	1,51	0,02				<i>D. paup.</i>	0,48	0,01
<i>P. kari.</i>	0,30	0,00	<i>T. wies.</i>	0,94	0,02				<i>P. murr.</i>	0,48	0,01
<i>Pyr. juv.</i>	0,30	0,00	<i>G. irre.</i>	0,75	0,01				<i>R. hele.</i>	0,48	0,01
<i>T. wies.</i>	0,30	0,00	<i>agglu. b</i>	0,75	0,01						
<i>A. fli.</i>	0,15	0,00	<i>perfo. a</i>	0,75	0,01						
<i>Bol. sp.</i>	0,15	0,00	<i>S. fusi.</i>	0,57	0,01						
<i>C. inco.</i>	0,15	0,00	<i>T. tric.</i>	0,57	0,01						
<i>C. canc.</i>	0,15	0,00	<i>P. spha.</i>	0,38	0,01						
<i>N. grat.</i>	0,15	0,00	<i>K. brad.</i>	0,19	0,00						
<i>N. irre.</i>	0,15	0,00	<i>Pyr. juv.</i>	0,19	0,00						
<i>P. vari.</i>	0,15	0,00	<i>P. rota.</i>	0,19	0,00						
<i>S. phil.</i>	0,15	0,00	<i>perfo. d</i>	0,19	0,00						
<i>perfo. c</i>	0,15	0,00									

Table A.12: Average abundances given in number of individuals per 10 cm³ wet sediment (#) and relative abundances (%) of all counted dead foraminifera >125 μm at single stations North of the Denmark Strait. For full species names corresponding to the abbreviations see Table A.9.

Dead assemblages of station 15			Dead assemblages of station 17			Dead assemblages of station 20			Dead assemblages of station 21		
Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%
<i>S. ramo.</i>	431.20	20.17	<i>H. gutt.</i>	272.73	25.44	<i>C. tere.</i>	207.35	20.21	<i>C. wuel.</i>	441.27	29.76
<i>H. gutt.</i>	368.13	17.22	<i>C. subg.</i>	158.00	14.74	<i>H. gutt.</i>	201.02	19.59	<i>C. subg.</i>	250.32	16.88
<i>R. diff.</i>	338.53	15.84	<i>T. glob.</i>	117.45	10.95	<i>S. ramo.</i>	129.39	12.61	<i>O. umbo.</i>	170.00	11.47
<i>T. glob.</i>	181.60	8.50	<i>S. ramo.</i>	103.45	9.65	<i>R. adun.</i>	62.86	6.13	<i>H. gutt.</i>	163.97	11.06
<i>He. bra.</i>	113.47	5.31	<i>R. scor.</i>	78.91	7.36	<i>C. wuel.</i>	40.61	3.96	<i>He. bra.</i>	62.54	4.22
<i>P. kari.</i>	102.80	4.81	<i>H. elon.</i>	59.27	5.53	<i>He. bra.</i>	39.39	3.84	<i>Q. semi.</i>	46.19	3.12
<i>C. subg.</i>	94.13	4.40	<i>A. glom.</i>	47.09	4.39	<i>O. umbo.</i>	39.18	3.82	<i>R. scor.</i>	30.95	2.09
<i>A. glom.</i>	75.20	3.52	<i>S. spha.</i>	39.09	3.65	<i>C. subg.</i>	34.29	3.34	<i>perfo. b</i>	27.62	1.86
<i>S. gutt.</i>	51.47	2.41	<i>C. wuel.</i>	30.73	2.87	<i>R. diff.</i>	32.86	3.20	<i>R. diff.</i>	22.06	1.49
<i>R. bilo.</i>	42.67	2.00	<i>P. kari.</i>	24.00	2.24	<i>R. scor.</i>	31.63	3.08	<i>Hyp. sp.</i>	19.52	1.32
<i>H. memb.</i>	42.40	1.98	<i>R. adun.</i>	24.00	2.24	<i>T. glob.</i>	23.88	2.33	<i>M. subbr.</i>	19.05	1.28
<i>R. adun.</i>	36.67	1.72	<i>T. papi.</i>	16.18	1.51	<i>G. subg.</i>	18.98	1.85	<i>S. ramo.</i>	19.05	1.28
<i>C. laev.</i>	32.93	1.54	<i>D. grah.</i>	11.82	1.10	<i>A. glom.</i>	16.53	1.61	<i>R. adun.</i>	16.35	1.10
<i>R. cont.</i>	32.53	1.52	<i>R. diff.</i>	11.64	1.09	<i>C. loba.</i>	12.24	1.19	<i>T. glob.</i>	13.33	0.90
<i>P. aura.</i>	30.00	1.40	<i>P. parv.</i>	9.64	0.90	<i>M. barl.</i>	12.24	1.19	<i>Fiss. spp.</i>	13.02	0.88
<i>D. grah.</i>	26.80	1.25	<i>cf. Mart.</i>	9.45	0.88	<i>P. parv.</i>	12.24	1.19	<i>P. rota.</i>	11.90	0.80
<i>R. scor.</i>	23.20	1.09	<i>R. cont.</i>	7.64	0.71	<i>M. cyli.</i>	10.82	1.05	<i>A. cati.</i>	11.75	0.79
<i>T. papi.</i>	18.27	0.85	<i>C. laev.</i>	6.73	0.63	<i>T. papi.</i>	10.00	0.97	<i>P. aura.</i>	11.59	0.78
<i>Reo. sp.</i>	11.73	0.55	<i>H. fria.</i>	6.55	0.61	<i>R. hele.</i>	9.80	0.96	<i>P. groe.</i>	10.48	0.71
<i>S. spha.</i>	8.13	0.38	<i>T. wies.</i>	6.18	0.58	<i>G. irre.</i>	8.78	0.86	<i>T. tric.</i>	10.48	0.71
<i>A. cati.</i>	8.00	0.37	<i>A. cati.</i>	5.09	0.47	<i>T. tric.</i>	8.37	0.82	<i>L. cf. diff.</i>	8.10	0.55
<i>C. loba.</i>	7.87	0.37	<i>L. jeff.</i>	3.09	0.29	<i>perfo. b</i>	8.37	0.82	<i>V. minu.</i>	8.10	0.55
<i>M. barl.</i>	6.93	0.32	<i>M. barl.</i>	3.09	0.29	<i>S. spha.</i>	6.53	0.64	<i>C. cush.</i>	7.78	0.52
<i>P. parv.</i>	6.13	0.29	<i>R. abys.</i>	2.18	0.20	<i>Q. semi.</i>	5.31	0.52	<i>P. spha.</i>	7.62	0.51
<i>T. wies.</i>	5.60	0.26	<i>H. mari.</i>	1.82	0.17	<i>B. cf. fli.</i>	4.69	0.46	<i>A. glom.</i>	7.46	0.50
<i>R. sabu.</i>	5.20	0.24	<i>G. irre.</i>	1.45	0.14	<i>P. kari.</i>	4.49	0.44	<i>S. gutt.</i>	6.35	0.43
<i>G. subg.</i>	3.73	0.17	<i>B. cf. fli.</i>	1.27	0.12	<i>Pyr. juv.</i>	4.29	0.42	<i>T. papi.</i>	5.24	0.35
<i>Ast. sp.</i>	3.07	0.14	<i>C. cush.</i>	1.27	0.12	<i>A. cati.</i>	3.47	0.34	<i>C. tere.</i>	5.08	0.34
<i>T. iorq.</i>	3.07	0.14	<i>G. subg.</i>	1.27	0.12	<i>Lag. spp.</i>	3.27	0.32	<i>R. hele.</i>	5.08	0.34
<i>A. atla.</i>	2.67	0.12	<i>R. hele.</i>	1.27	0.12	<i>N. labr.</i>	3.27	0.32	<i>G. subg.</i>	4.29	0.29

Table A.12: continued

Dead assemblages of station 15			Dead assemblages of station 17			Dead assemblages of station 20			Dead assemblages of station 21		
Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%
<i>Hyp. sp.</i>	2.53	0.12	<i>R. nodu.</i>	1.27	0.12	<i>T. wies.</i>	2.86	0.28	<i>R. sabu.</i>	4.13	0.28
<i>P. bull.</i>	2.27	0.11	<i>Lag. spp.</i>	0.91	0.08	<i>D. grah.</i>	2.45	0.24	<i>R. arct.</i>	3.81	0.26
<i>Q. semi.</i>	2.27	0.11	<i>C. loba.</i>	0.73	0.07	<i>C. inco.</i>	2.04	0.20	<i>H. mari.</i>	3.49	0.24
<i>H. elon.</i>	2.13	0.10	<i>E. brad.</i>	0.73	0.07	<i>C. laev.</i>	1.84	0.18	<i>Lag. spp.</i>	3.33	0.22
<i>Plac. sp.</i>	2.13	0.10	<i>E. exca.</i>	0.73	0.07	<i>R. nodu.</i>	1.63	0.16	<i>E. exca.</i>	3.17	0.21
<i>H. mari.</i>	1.87	0.09	<i>K. cate.</i>	0.73	0.07	<i>H. mari.</i>	1.22	0.12	<i>E. exig.</i>	3.17	0.21
<i>E. exca.</i>	1.47	0.07	<i>R. stab.</i>	0.73	0.07	<i>Fiss. spp.</i>	1.02	0.10	<i>R. bilo.</i>	3.17	0.21
<i>H. frag.</i>	1.33	0.06	<i>P. aura.</i>	0.55	0.05	<i>C. cush.</i>	0.82	0.08	<i>Ooli. spp.</i>	2.38	0.16
<i>E. adve.</i>	1.20	0.06	agglu. b	0.55	0.05	<i>N. irre.</i>	0.82	0.08	<i>D. paup.</i>	1.75	0.12
<i>C. hisp.</i>	1.07	0.05	cf. <i>Cibi.</i>	0.36	0.03	<i>P. bull.</i>	0.82	0.08	<i>S. spha.</i>	1.59	0.11
<i>T. tric.</i>	1.07	0.05	cf. <i>Ovam.</i>	0.36	0.03	<i>P. will.</i>	0.82	0.08	<i>M. glab.</i>	1.43	0.10
<i>C. tere.</i>	0.53	0.02	<i>C. cf. mund.</i>	0.36	0.03	<i>C. scit.</i>	0.61	0.06	<i>S. fusi.</i>	1.43	0.10
<i>C. cush.</i>	0.53	0.02	<i>Ept. sp.</i>	0.36	0.03	<i>P. spha.</i>	0.61	0.06	<i>B. frig.</i>	1.27	0.09
<i>B. cf. semi.</i>	0.40	0.02	<i>B. cf. semi.</i>	0.18	0.02	cf. <i>Ovam.</i>	0.41	0.04	cf. <i>Elph.</i>	1.27	0.09
<i>P. oblo.</i>	0.40	0.02	<i>Co. inv.</i>	0.18	0.02	<i>G. irre.</i>	0.41	0.04	<i>G. irre.</i>	1.27	0.09
<i>S. fusi.</i>	0.40	0.02	<i>C. hisp.</i>	0.18	0.02	<i>L. tubu.</i>	0.41	0.04	<i>H. elon.</i>	1.27	0.09
<i>E. exig.</i>	0.27	0.01	<i>Fiss. spp.</i>	0.18	0.02	<i>P. aura.</i>	0.41	0.04	<i>N. irre.</i>	1.27	0.09
<i>L. tubu.</i>	0.27	0.01	<i>F. fusi.</i>	0.18	0.02	<i>D. paup.</i>	0.20	0.02	<i>P. oblo.</i>	1.27	0.09
<i>N. labr.</i>	0.27	0.01	<i>O. umbo.</i>	0.18	0.02	<i>E. exca.</i>	0.20	0.02	<i>C. loba.</i>	0.95	0.06
<i>Ooli. spp.</i>	0.27	0.01	<i>Q. semi.</i>	0.18	0.02	<i>R. sabu.</i>	0.20	0.02	<i>D. comm.</i>	0.95	0.06
<i>R. dent.</i>	0.27	0.01	perfo. b	0.18	0.02				<i>R. subf.</i>	0.63	0.04
<i>B. cf. fili.</i>	0.13	0.01							<i>R. abys.</i>	0.63	0.04
<i>Fiss. spp.</i>	0.13	0.01							<i>Pyr. juv.</i>	0.48	0.03
<i>Ha. bra.</i>	0.13	0.01							<i>C. laev.</i>	0.32	0.02
									<i>Co. inv.</i>	0.32	0.02
									<i>Dent. sp.</i>	0.32	0.02
									<i>M. cost.</i>	0.32	0.02
									<i>M. cyli.</i>	0.32	0.02
									porcel. a	0.32	0.02
									<i>Non. sp.</i>	0.16	0.01

Table A.13: Average abundances given in number of individuals per 10 cm³ wet sediment (#) and relative abundances (%) of all counted living foraminifera >125 μm at single stations South of the Denmark Strait. For full species names corresponding to the abbreviations see Table A.9.

Living assemblages of station 2			Living assemblages of station 4			Living assemblages of station 10			Living assemblages of station 12		
Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%
agglu. c	25.67	27.60	<i>P. aura.</i>	187.17	28.44	<i>N. irre.</i>	21.32	26.74	<i>H. mari.</i>	251.90	66.70
perfo. b	10.90	11.72	<i>S. ramo.</i>	139.06	21.13	<i>E. rugo.</i>	13.39	16.79	cf. <i>Ovam.</i>	30.48	8.07
<i>L. tubu.</i>	9.55	10.27	<i>R. scor.</i>	66.79	10.15	<i>H. mari.</i>	11.32	14.20	<i>P. bull.</i>	30.48	8.07
<i>P. bull.</i>	9.55	10.27	<i>R. diff.</i>	51.70	7.86	<i>C. wuel.</i>	5.79	7.26	<i>R. diff.</i>	30.48	8.07
<i>R. stab.</i>	6.27	6.74	<i>H. mari.</i>	40.75	6.19	<i>C. cush.</i>	5.29	6.63	agglu. c	11.43	3.03
<i>S. ramo.</i>	5.22	5.61	<i>E. exig.</i>	29.06	4.42	<i>Lag. spp.</i>	5.29	6.63	<i>C. wuel.</i>	4.64	1.23
<i>L. jeff.</i>	4.93	5.30	<i>M. pomp.</i>	15.09	2.29	<i>C. loba.</i>	2.73	3.42	<i>A. clav.</i>	4.05	1.07
<i>Q. semi.</i>	4.93	5.30	<i>T. glob.</i>	14.72	2.24	<i>G. subg.</i>	2.64	3.31	<i>P. aura.</i>	3.81	1.01
<i>C. wuel.</i>	3.88	4.17	<i>C. wuel.</i>	13.40	2.04	<i>T. angu.</i>	2.64	3.31	<i>T. vaga.</i>	2.14	0.57
<i>P. aura.</i>	1.94	2.09	<i>G. sold.</i>	12.64	1.92	<i>T. cari.</i>	2.64	3.31	<i>M. cyli.</i>	1.55	0.41
<i>S. spha.</i>	1.34	1.44	<i>C. refu.</i>	12.08	1.84	<i>T. glob.</i>	2.64	3.31	<i>S. spha.</i>	1.31	0.35
<i>T. squa.</i>	1.34	1.44	<i>E. rugo.</i>	12.08	1.84	<i>R. stab.</i>	2.40	3.01	<i>C. cush.</i>	1.07	0.28
<i>A. clav.</i>	1.19	1.28	<i>L. tubu.</i>	12.08	1.84	<i>S. spha.</i>	0.83	1.04	perfo. b	1.07	0.28
<i>T. glob.</i>	1.04	1.12	<i>O. umbo.</i>	12.08	1.84	agglu. d	0.33	0.41	<i>C. subg.</i>	0.60	0.16
<i>M. cyli.</i>	0.75	0.81	perfo. b	6.79	1.03	<i>E. exca.</i>	0.17	0.21	<i>L. cras.</i>	0.48	0.13
<i>C. cush.</i>	0.60	0.65	<i>C. loba.</i>	4.91	0.75	<i>C. loeb.</i>	0.08	0.10	<i>T. glob.</i>	0.36	0.10
<i>T. vaga.</i>	0.60	0.65	agglu. a	3.21	0.49	<i>L. jeff.</i>	0.08	0.10	agglu. a	0.36	0.10
<i>H. mari.</i>	0.45	0.48	<i>A. aggl.</i>	3.02	0.46	<i>P. bucc.</i>	0.08	0.10	<i>R. scor.</i>	0.24	0.06
agglu. a	0.30	0.32	<i>B. pseu.</i>	2.64	0.40	perfo. c	0.08	0.10	<i>A. glom.</i>	0.12	0.03
<i>A. cati.</i>	0.15	0.16	<i>T. tric.</i>	2.08	0.32				<i>C. eric.</i>	0.12	0.03
<i>C. laev.</i>	0.15	0.16	<i>T. squa.</i>	1.89	0.29				<i>L. jeff.</i>	0.12	0.03
<i>C. loba.</i>	0.15	0.16	<i>Q. semi.</i>	1.70	0.26				<i>L. hyal.</i>	0.12	0.03
<i>C. inco.</i>	0.15	0.16	<i>A. clav.</i>	1.51	0.23				<i>M. barl.</i>	0.12	0.03
<i>Cy. inv.</i>	0.15	0.16	<i>He. bra.</i>	1.51	0.23				<i>P. luce.</i>	0.12	0.03
<i>Ept. sp.</i>	0.15	0.16	<i>Lag. spp.</i>	1.51	0.23				<i>P. rota.</i>	0.12	0.03
<i>E. exig.</i>	0.15	0.16	<i>R. dent.</i>	1.51	0.23				<i>P. spha.</i>	0.12	0.03
<i>E. rugo.</i>	0.15	0.16	<i>S. spha.</i>	1.51	0.23				<i>Q. semi.</i>	0.12	0.03
<i>G. subg.</i>	0.15	0.16	<i>S. schl.</i>	1.51	0.23				<i>R. stab.</i>	0.12	0.03
<i>M. barl.</i>	0.15	0.16	<i>B. frig.</i>	0.75	0.11						
<i>P. corr.</i>	0.15	0.16	<i>G. subg.</i>	0.75	0.11						
<i>P. parv.</i>	0.15	0.16	agglu. c	0.57	0.09						
<i>Pyr. juv.</i>	0.15	0.16	<i>C. subg.</i>	0.38	0.06						
<i>P. oblo.</i>	0.15	0.16	<i>M. cyli.</i>	0.38	0.06						
<i>R. scor.</i>	0.15	0.16	<i>A. glom.</i>	0.19	0.03						
<i>T. papi.</i>	0.15	0.16	<i>C. laev.</i>	0.19	0.03						
perfo. c	0.15	0.16	<i>C. cush.</i>	0.19	0.03						
			<i>E. exca.</i>	0.19	0.03						
			<i>K. conv.</i>	0.19	0.03						
			<i>L. jeff.</i>	0.19	0.03						
			<i>R. bilo.</i>	0.19	0.03						

Table A.14: Average abundances given in number of individuals per 10 cm³ wet sediment (#) and relative abundances (%) of all counted living foraminifera >125 μm at single stations North of the Denmark Strait. For full species names corresponding to the abbreviations see Table A.9.

Living assemblages of station 15			Living assemblages of station 17			Living assemblages of station 20			Living assemblages of station 21		
Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%	Species abbr.	#	%
<i>H. gutt.</i>	43,47	15,74	<i>H. mari.</i>	12,55	10,46	<i>M. cyli.</i>	41,43	18,16	<i>H. mari.</i>	14,29	10,23
<i>H. mari.</i>	31,47	11,40	cf. <i>Ovam.</i>	12,00	10,00	<i>R. diff.</i>	21,43	9,39	<i>R. diff.</i>	13,97	10,00
<i>C. cush.</i>	30,13	10,91	<i>T. glob.</i>	12,00	10,00	<i>P. parv.</i>	20,41	8,95	perfo. b	12,38	8,86
<i>S. ramo.</i>	28,40	10,29	<i>A. glom.</i>	8,73	7,28	<i>C. tere.</i>	17,76	7,78	<i>C. subg.</i>	9,21	6,59
<i>R. diff.</i>	21,07	7,63	<i>P. parv.</i>	8,00	6,67	<i>R. scor.</i>	16,12	7,07	<i>C. hisp.</i>	8,73	6,25
<i>S. gutt.</i>	10,67	3,86	<i>H. gutt.</i>	7,09	5,91	<i>S. ramo.</i>	10,82	4,74	<i>R. scor.</i>	8,73	6,25
<i>C. subg.</i>	8,53	3,09	<i>C. laev.</i>	6,91	5,76	<i>C. wuel.</i>	9,80	4,30	<i>P. aura.</i>	8,41	6,02
<i>C. laev.</i>	7,07	2,56	<i>C. subg.</i>	6,55	5,46	<i>C. subg.</i>	9,39	4,12	<i>C. wuel.</i>	7,14	5,11
<i>T. glob.</i>	7,07	2,56	agglu. c	6,00	5,00	perfo. b	8,57	3,76	<i>H. gutt.</i>	5,87	4,20
<i>P. kari.</i>	6,00	2,17	<i>H. fria.</i>	5,64	4,70	<i>H. gutt.</i>	8,16	3,58	<i>O. umbo.</i>	5,40	3,87
<i>R. adun.</i>	5,73	2,08	<i>C. cush.</i>	5,09	4,24	<i>R. adun.</i>	7,55	3,31	<i>R. hele.</i>	5,08	3,64
<i>H. memb.</i>	5,33	1,93	<i>R. scor.</i>	4,36	3,63	<i>H. mari.</i>	6,53	2,86	<i>C. cush.</i>	4,92	3,52
<i>R. bilo.</i>	5,33	1,93	<i>P. kari.</i>	2,73	2,28	agglu. c	5,92	2,59	<i>Q. semi.</i>	4,76	3,41
<i>C. loba.</i>	5,07	1,84	<i>S. ramo.</i>	2,55	2,13	<i>T. glob.</i>	5,51	2,42	<i>S. ramo.</i>	4,76	3,41
<i>R. scor.</i>	4,80	1,74	perfo. b	2,55	2,13	<i>P. aura.</i>	5,31	2,33	<i>E. rugo.</i>	2,54	1,82
<i>Reo. sp.</i>	4,67	1,69	<i>H. elon.</i>	2,36	1,97	<i>A. glom.</i>	4,29	1,88	<i>R. sabu.</i>	2,54	1,82
<i>P. aura.</i>	4,53	1,64	<i>C. loba.</i>	1,45	1,21	<i>R. hele.</i>	4,08	1,79	<i>R. arct.</i>	2,54	1,82
<i>E. exca.</i>	4,27	1,55	<i>E. exca.</i>	1,45	1,21	<i>T. tric.</i>	3,47	1,52	<i>T. glob.</i>	2,54	1,82
<i>T. papi.</i>	3,73	1,35	<i>R. cont.</i>	1,45	1,21	<i>C. inco.</i>	2,24	0,98	<i>He. bra.</i>	2,22	1,59
<i>He. bra.</i>	3,20	1,16	<i>C. wuel.</i>	1,27	1,06	<i>G. subg.</i>	2,24	0,98	<i>M. cyli.</i>	2,06	1,47
<i>C. hisp.</i>	2,93	1,06	<i>T. wies.</i>	1,27	1,06	<i>P. kari.</i>	2,04	0,89	<i>P. rota.</i>	1,90	1,36
cf. <i>Ovam.</i>	2,80	1,01	<i>D. grah.</i>	1,09	0,91	<i>He. bra.</i>	1,84	0,81	<i>P. groe.</i>	1,59	1,14
<i>M. barl.</i>	2,40	0,87	<i>Epi. sp.</i>	1,09	0,91	<i>Q. semi.</i>	1,84	0,81	<i>L. cf. diff.</i>	1,27	0,91
<i>P. bull.</i>	2,40	0,87	<i>P. aura.</i>	0,91	0,76	<i>M. barl.</i>	1,63	0,71	agglu. c	1,27	0,91
<i>R. cont.</i>	2,40	0,87	<i>R. hele.</i>	0,91	0,76	<i>N. irre.</i>	1,22	0,53	<i>Hyp. sp.</i>	1,11	0,79
<i>A. glom.</i>	2,27	0,82	<i>G. subg.</i>	0,73	0,61	<i>R. sabu.</i>	1,22	0,53	<i>P. spha.</i>	0,95	0,68
<i>P. parv.</i>	2,27	0,82	<i>Fiss. spp.</i>	0,36	0,30	<i>T. papi.</i>	1,22	0,53	<i>Ooli. spp.</i>	0,63	0,45
<i>Lag. spp.</i>	2,13	0,77	<i>M. barl.</i>	0,36	0,30	<i>C. laev.</i>	1,02	0,45	<i>R. bilo.</i>	0,63	0,45
<i>T. wies.</i>	1,60	0,58	<i>Q. semi.</i>	0,36	0,30	cf. <i>Ovam.</i>	1,02	0,45	<i>A. glom.</i>	0,48	0,34
<i>G. subg.</i>	1,47	0,53	agglu. a	0,36	0,30	<i>G. irre.</i>	0,82	0,36	<i>D. paup.</i>	0,32	0,23
<i>M. cyli.</i>	1,33	0,48	<i>A. cati.</i>	0,18	0,15	<i>O. umbo.</i>	0,82	0,36	<i>M. subz.</i>	0,32	0,23
<i>N. irre.</i>	1,33	0,48	<i>Co. inv.</i>	0,18	0,15	<i>S. spha.</i>	0,82	0,36	<i>P. oblo.</i>	0,32	0,23
<i>P. oblo.</i>	1,33	0,48	<i>C. hisp.</i>	0,18	0,15	<i>P. oblo.</i>	0,41	0,18	<i>R. adun.</i>	0,32	0,23
<i>Q. semi.</i>	1,33	0,48	<i>G. daws.</i>	0,18	0,15	<i>B. cf. fili.</i>	0,20	0,09	cf. <i>Ovam.</i>	0,16	0,11
<i>R. sabu.</i>	1,33	0,48	<i>M. cyli.</i>	0,18	0,15	<i>C. loba.</i>	0,20	0,09	<i>P. bucc.</i>	0,16	0,11
<i>E. rugo.</i>	1,20	0,43	<i>Ooli. spp.</i>	0,18	0,15	<i>C. scit.</i>	0,20	0,09	<i>T. tric.</i>	0,16	0,11
agglu. c	1,20	0,43	<i>P. bucc.</i>	0,18	0,15	<i>Ooli. spp.</i>	0,20	0,09			
<i>A. cati.</i>	1,07	0,39	<i>R. nodu.</i>	0,18	0,15	<i>R. brad.</i>	0,20	0,09			
<i>D. grah.</i>	1,07	0,39	<i>T. papi.</i>	0,18	0,15	<i>T. wies.</i>	0,20	0,09			
<i>S. spha.</i>	0,53	0,19	agglu. b	0,18	0,15						
<i>N. labr.</i>	0,40	0,14									
<i>A. atla.</i>	0,27	0,10									
<i>R. stab.</i>	0,27	0,10									
<i>C. tere.</i>	0,13	0,05									
<i>C. exca.</i>	0,13	0,05									

Appendix

Table A.15: Biotic and abiotic parameters of the sediment used for the multivariate statistical analyses BIOENV and CCA in order to link community patterns to environmental variables. Salinity, oxygen content, and water temperature were measured in the overlaying water of the sediment samples directly after core recovery. The size fractions 63–125, 125–250, 250–630, 630–2000, and >2000 μm represent the proportion of the dried sediment given in percentage of weight.

Station	Water depth ^a [m]	Salinity ^a	Oxygen ^a [%]	Water temp. ^a [°C]	Sediment temp. ^a [°C]	Total nitrogen ^b [weight-%]	Total carbon ^b [weight-%]	C/N-ratio ^b [weight-%]	TOC ^b [weight-%]	Carbonate ^b [weight-%]
PS62/002-3	1891	35.5	65	6.7	2.1	0.03	2.20	7.17	0.20	17
PS62/004-2	2564	35.1	95	4.4	3.4	0.05	3.24	6.98	0.37	24
PS62/010-2	1702	35.5	no data	7.4	2.0	0.02	1.16	8.60	0.19	8
PS62/012-2	2402	35.5	94	6.7	1.1	0.03	2.75	8.13	0.23	21
PS62/015-4	980	34.0	86	-0.9	-0.8	0.09	0.75	6.74	0.59	1
PS62/017-1	1458	33.7	94	-1.4	-0.9	0.09	0.75	7.01	0.62	1
PS62/020-1	1322	35.3	78	-0.6	no data	0.10	0.99	6.57	0.64	3
PS62/021-1	1704	35.4	79	-0.4	-0.7	0.12	1.70	6.59	0.79	8

Station	Chlorophyll <i>a</i> ^c [$\mu\text{g}/\text{cm}^3$]	Phaeopigments ^c [$\mu\text{g}/\text{cm}^3$]	DNA ^c [$\mu\text{g}/\text{cm}^3$]	Water content ^c [%]	63–125 μm ^c [weight-%]	125–250 μm ^c [weight-%]	250–630 μm ^c [weight-%]	630–2000 μm ^c [weight-%]	>2000 μm ^c [weight-%]
PS62/002-3	0.18	1.09	279.07	31.58	24.75	41.50	12.93	2.37	18.45
PS62/004-2	0.15	0.96	70.49	54.54	33.50	33.78	14.28	2.99	15.45
PS62/010-2	0.04	0.17	107.38	25.99	6.36	13.57	22.98	5.09	52.01
PS62/012-2	0.47	1.91	114.43	30.76	12.19	47.50	12.57	3.62	24.12
PS62/015-4	0.20	2.71	120.97	54.30	52.51	11.69	9.79	4.42	21.60
PS62/017-1	0.18	2.16	246.79	52.69	2.90	2.04	3.40	3.68	87.98
PS62/020-1	0.10	0.86	163.44	59.21	51.04	24.48	12.50	3.65	8.33
PS62/021-1	0.08	0.80	79.56	66.04	20.91	23.95	16.73	11.41	27.00

^a Values determined directly on board of RV "Polarstern"

^b Values determined at the Alfred-Wegener-Institute in Bremerhaven (Kierdorf pers. comm.)

^c Values determined at the Institute of Polar Ecology in Kiel

Table A.16: First and second axes CCA values for 50 selected species of the dead benthic foraminiferal assemblage. Five different grain size fractions of the sediment (63–125, 125–250, 250–630, 630–2000, and >2000 μm) were incorporated for environmental interpretation.

Species	1st axis	2nd axis
<i>Adercotryma glomerata</i>	1.1264	-0.1693
<i>Ammodiscus catinus</i>	0.6304	0.2536
<i>Ammolagena clavata</i>	-0.5681	-0.1697
<i>Cassidulina laevigata</i>	-0.1190	-0.2330
<i>Cassidulina teretis</i>	-0.2247	0.2259
<i>Cibicides lobatulus</i>	-0.4260	-0.0702
<i>Cibicides reflugens</i>	-0.7701	-0.0458
<i>Cibicidoides wuellerstorfi</i>	-0.0622	0.1666
<i>Cribrostomoides subglobosum</i>	0.5581	0.0660
<i>Elphidium excavatum</i>	-0.4666	0.0071
<i>Epistominella exigua</i>	-0.3868	0.2473
<i>Fissurina</i> spp.	-0.4551	0.1652
<i>Globocassidulina subglobosa</i>	-0.2400	0.0277
<i>Gyrodina soldanii</i>	-0.6865	-0.1513
<i>Hemishpaerammina marisalbi</i>	-0.0889	0.0763
<i>Hemishpaerammina bradyi</i>	0.6200	0.5644
<i>Hoeglundia elegans</i>	-0.7370	-0.1425
<i>Hormosina guttifera</i>	0.9165	0.0274
<i>Hyperammina elongata</i>	0.7374	-0.8106
<i>Labrospira jeffreysii</i>	-0.4253	-0.3380
<i>Lagena</i> spp.	-0.3924	0.0227
<i>Lagenammina tubulata</i>	-0.3618	-0.2184
<i>Marsipella cylindrica</i>	-0.0048	0.0893
<i>Melonis barleanum</i>	-0.1414	-0.2075
<i>Melonis pompilioides</i>	-0.5174	-0.1770
<i>Nonion labradoricum</i>	-0.3789	-0.0899
<i>Nummuloculina irregularis</i>	-0.7686	0.1821
<i>Oridorsalis umbonatus</i>	-0.0876	0.4771
<i>Placopsilinella aurantiaca</i>	0.7777	0.4792
<i>Portatrochammina karica</i>	1.4809	-0.7003
<i>Psammosphaera parva</i>	0.8507	-0.5994
<i>Pullenia bulloides</i>	-0.4792	-0.1224
<i>Pullenia quinqueloba</i>	-0.5146	-0.1722
<i>Pyrgo rotalaria</i>	-0.0722	0.7869
<i>Quinqueloculina seminula</i>	-0.1684	0.4305
<i>Reophax aduncus</i>	1.2728	0.0767
<i>Reophax difflugiformis</i>	0.3958	0.0198
<i>Reophax helenae</i>	0.4824	0.3896
<i>Reophax scorpiurus</i>	0.5545	-0.0504
<i>Rhabdammina abyssorum</i>	-0.4813	-0.3190
<i>Rupertina stabilis</i>	-0.8155	-0.2053
<i>Saccammina sphaerica</i>	0.0126	-0.2912
<i>Saccorhiza ramosa</i>	0.4797	-0.1241
<i>Sigmoilopsis schlumbergeri</i>	-0.6677	-0.1231
<i>Thurammina papillata</i>	0.9355	-0.1382
<i>Trifarina angulosa</i>	-0.7984	-0.1075
<i>Trifarina carinata</i>	-0.9382	-0.0894
<i>Triloculina tricarinata</i>	-0.0179	0.5289
<i>Trochammina globigeriniformis pygmaea</i>	0.7922	-0.1825
Unidentified perforate II (trochospiral)	0.1561	0.7101

Table A.17: First and second axes CCA values for the sampling stations and five different grain size fractions of the sediment conformed with “environmental parameters” corresponding to the dead benthic foraminiferal assemblage.

Stations	1st axis	2nd axis	Parameters	1st axis	2nd axis
PS62/002-3	-0.6526	-0.3603	>2000 μm	0.1945	-0.4594
PS62/004-2	-0.2662	-0.0970	630-2000 μm	0.3089	0.8060
PS62/010-2	-1.1523	-0.0459	250-630 μm	-0.6010	0.5320
PS62/012-2	-0.8886	-0.0034	125-250 μm	-0.6617	0.1685
PS62/015-4	1.7915	-0.0746	63-125 μm	0.4660	0.1743
PS62/017-1	1.6119	-2.0951			
PS62/020-1	0.8340	0.1487			
PS62/021-1	0.8699	2.6139			

Table A.18: First and second axes CCA values for 46 selected species of the living benthic foraminiferal assemblage. Five different grain size fractions of the sediment (63–125, 125–250, 250–630, 630–2000, and >2000 μm) were incorporated for environmental interpretation.

Species	1st axis	2nd axis
<i>Adercotryma glomerata</i>	-0.6933	-0.0396
<i>Ammodiscus catinus</i>	-0.8761	0.0149
<i>Ammolagena clavata</i>	1.2121	-0.9547
<i>Cassidulina laevigata</i>	-0.8709	0.0197
<i>Cibicides lobatulus</i>	0.0552	0.7090
<i>Cibicidoides wuellerstorfi</i>	0.5339	0.1272
<i>Cribrostomoides subglobosum</i>	-0.5580	-0.0915
<i>Crithionia cushmani</i>	-0.2104	0.4650
<i>Crithionia hispida</i>	-0.7135	-0.0361
<i>Elphidium excavatum</i>	-0.8883	0.2614
<i>Fissurina</i> spp.	0.6317	1.1248
<i>Globocassidulina subglobosa</i>	0.1075	0.9092
<i>Hemishpaerammina marisalbi</i>	0.2925	-0.0334
<i>Hemishpaerammina bradyi</i>	-0.4108	-0.0019
<i>Hormosina guttifera</i>	-0.8165	0.0218
<i>Labrosira jeffreysii</i>	1.1885	-0.6541
<i>Lagena</i> spp.	0.5215	1.5863
<i>Marsipella cylindrica</i>	-0.0751	-0.2580
<i>Melonis barleeaanum</i>	-0.6603	-0.0290
<i>Nummuloculina irregularis</i>	0.7031	2.1812
<i>Oolina</i> spp.	-0.4730	-0.1208
<i>Oridorsalis umbonatus</i>	0.2178	-0.1096
cf. <i>Ovamina</i>	0.0847	-0.6338
<i>Placopsilinella aurantiaca</i>	0.2394	-0.2680
<i>Planispirinoides bucculentus</i>	-0.2415	0.5446
<i>Portatrochammina karica</i>	-0.9274	0.0602
<i>Psammospaera parva</i>	-0.6685	-0.0151
<i>Pullenia bulloides</i>	0.9039	-0.9834
<i>Pyrgo oblonga</i>	-0.6935	0.0006
<i>Quinqueloculina seminula</i>	0.1051	-0.2779
<i>Reophax aduncus</i>	-0.7423	0.0710
<i>Reophax bilocularis</i>	-0.9457	0.1066
<i>Reophax difflugiformis</i>	0.1346	-0.3334
<i>Reophax helenae</i>	-0.4439	-0.0948
<i>Reophax sabulosus</i>	-0.6174	-0.0207
<i>Reophax scorpiurus</i>	-0.1406	-0.0780
<i>Rupertina stabilis</i>	1.1466	0.6343
<i>Saccammina sphaerica</i>	0.7393	0.0039
<i>Saccorhiza ramosa</i>	-0.0591	-0.1088
<i>Textularia wiesneri</i>	-1.0392	0.0606
<i>Thurammina papillata</i>	-0.8319	0.0644
<i>Triloculina tricarinata</i>	0.1136	-0.0503
<i>Trochammina globigeriniformis pygmaea</i>	-0.0591	0.2263
Unidentified agglutinated (attached)	0.6837	-0.3591
Unidentified agglutinated (spheroidal)	0.3597	-0.5730
Unidentified perforate II (trochospiral)	0.2394	-0.3431

Table A.19: First and second axes CCA values for the sampling stations and five different grain size fractions of the sediment conformed with “environmental parameters” corresponding to the living benthic foraminiferal assemblage.

Stations	1st axis	2nd axis	Parameters	1st axis	2nd axis
PS62/002-3	1.1980	-0.8253	>2000 μm	-0.1864	0.2450
PS62/004-2	0.7686	-0.0862	630-2000 μm	-0.2305	0.0968
PS62/010-2	1.5033	3.2841	250-630 μm	0.5972	0.4594
PS62/012-2	1.4709	-1.5110	125-250 μm	0.7659	-0.5287
PS62/015-4	-1.2602	0.1990	63-125 μm	-0.4395	-0.0558
PS62/017-1	-0.9393	-0.0849			
PS62/020-1	-0.3307	-0.0110			
PS62/021-1	-0.3681	-0.1739			

Table A.20: First and second axes CCA values for 50 selected species of the dead benthic foraminiferal assemblage. Four biotic parameters (chlorophyll *a*, phaeopigment, TOC, and DNA content of the sediment) were incorporated for environmental interpretation.

Species	1st axis	2nd axis
<i>Adercotryma glomerata</i>	1.1091	-0.1177
<i>Ammodiscus catinus</i>	0.6393	0.3016
<i>Ammolagena clavata</i>	-0.5635	-0.2216
<i>Cassidulina laevigata</i>	-0.1422	-0.2265
<i>Cassidulina teretis</i>	-0.2361	0.3575
<i>Cibicides lobatulus</i>	-0.4415	-0.0711
<i>Cibicides refulgens</i>	-0.8311	0.3468
<i>Cibicoides wuellerstorfi</i>	-0.0256	0.1542
<i>Cribratomoides subglobosum</i>	0.5820	0.0031
<i>Elphidium excavatum</i>	-0.4734	0.0195
<i>Epistominella exigua</i>	-0.4210	0.5224
<i>Fissurina</i> spp.	-0.4287	0.0314
<i>Globocassidulina subglobosa</i>	-0.2498	0.0658
<i>Gyroidina soldanii</i>	-0.6782	-0.2295
<i>Hemishpaerammina marisalbi</i>	-0.1070	0.1972
<i>Hemishpaerammina bradyi</i>	0.5944	0.4531
<i>Hoeglundia elegans</i>	-0.7278	-0.2265
<i>Hormosina guttifera</i>	0.9211	0.0268
<i>Hyperammina elongata</i>	0.8060	-0.9237
<i>Labrospira jeffreysii</i>	-0.4368	-0.1926
<i>Lagena</i> spp.	-0.3777	0.0055
<i>Lagenammina tubulata</i>	-0.3410	-0.4899
<i>Marsipella cylindrica</i>	-0.0776	0.6417
<i>Melonis barleanum</i>	-0.1737	-0.0793
<i>Melonis pompilioides</i>	-0.5191	-0.2087
<i>Nonion labradoricum</i>	-0.4025	0.0678
<i>Nummuloculina irregularis</i>	-0.7856	0.3455
<i>Oridorsalis umbonatus</i>	-0.0591	0.4556
<i>Placopsilinella aurantiaca</i>	0.7460	0.3458
<i>Portatrochammina karica</i>	1.4175	-0.6627
<i>Psammospaera parva</i>	0.8485	-0.6294
<i>Pullenia bulloides</i>	-0.4996	-0.1283
<i>Pullenia quinqueloba</i>	-0.5322	-0.1597
<i>Pyrgo rotalaria</i>	0.0960	-0.1131
<i>Quinqueloculina seminula</i>	-0.1328	0.2548
<i>Reophax aduncus</i>	1.2697	0.1272
<i>Reophax difflugiformis</i>	0.3850	-0.0516
<i>Reophax helenae</i>	0.4787	0.7333
<i>Reophax scoriurus</i>	0.5503	0.0867
<i>Rhabdammina abyssorum</i>	-0.3970	-0.8420
<i>Rupertina stabilis</i>	-0.7841	-0.4343
<i>Saccamina sphaerica</i>	0.0087	-0.2362
<i>Saccorhiza ramosa</i>	0.4665	-0.1035
<i>Sigmoilopsis schlumbergeri</i>	-0.6840	-0.0326
<i>Thurammina papillata</i>	0.9425	-0.2005
<i>Trifarina angulosa</i>	-0.8070	-0.0707
<i>Trifarina carinata</i>	-0.9387	-0.1045
<i>Triloculina tricarinata</i>	-0.0004	0.5078
<i>Trochammina globigeriniformis pygmaea</i>	0.7853	-0.1926
Unidentified perforate II (trochospiral)	0.1877	0.7650

Table A.21: First and second axes CCA values for the sampling stations and four selected biotic parameters of the sediment corresponding to the dead benthic foraminiferal assemblage.

Stations	1st axis	2nd axis	Parameters	1st axis	2nd axis
PS62/002-3	-0.5012	-1.4887	Chlorophyll <i>a</i>	-0.2921	-0.0370
PS62/004-2	-0.3771	0.5687	Phaeopigments	0.4559	-0.3203
PS62/010-2	-1.1917	-0.0043	DNA content	0.0976	-0.8077
PS62/012-2	-0.9252	0.4370	TOC	0.9014	0.4148
PS62/015-4	1.6544	-0.8664			
PS62/017-1	1.6402	-1.0614			
PS62/020-1	0.7640	0.7439			
PS62/021-1	1.0992	1.8333			

Table A.22: First and second axes CCA values for 46 selected species of the living benthic foraminiferal assemblage. Four biotic parameters (chlorophyll *a*, phaeopigment, TOC, and DNA content of the sediment) were incorporated for environmental interpretation.

Species	1st axis	2nd axis
<i>Adercotryma glomerata</i>	-0.6518	0.2992
<i>Ammodiscus catinus</i>	-0.5818	0.0717
<i>Ammolagena clavata</i>	1.0870	1.0036
<i>Cassidulina laevigata</i>	-0.6945	0.2641
<i>Cibicides lobatulus</i>	0.2699	-0.5684
<i>Cibicidoides wuellerstorfi</i>	0.4713	-0.0866
<i>Cribrostomoides subglobosum</i>	-0.6354	0.0800
<i>Crithionia cushmani</i>	-0.1310	-0.1663
<i>Crithionia hispida</i>	-0.9495	-0.3924
<i>Elphidium excavatum</i>	-0.6347	-0.0123
<i>Fissurina</i> spp.	0.7204	-1.0635
<i>Globocassidulina subglobosa</i>	0.2925	-0.5207
<i>Hemishpaerammina marisalbi</i>	0.2370	0.1979
<i>Hemishpaerammina bradyi</i>	-0.4601	-0.4052
<i>Hormosina guttifera</i>	-0.7945	-0.0083
<i>Labrosira jeffreysii</i>	1.3684	0.6455
<i>Lagena</i> spp.	0.8162	-1.1351
<i>Marsipella cylindrica</i>	-0.1781	0.2050
<i>Melonis barleeianum</i>	-0.5154	0.1245
<i>Nummuloculina irregularis</i>	1.0087	-1.2156
<i>Oolina</i> spp.	-0.8282	-0.1384
<i>Oridorsalis umbonatus</i>	0.0046	-0.6663
cf. <i>Ovamina</i>	-0.0101	1.1613
<i>Placopsilinella aurantiaca</i>	0.1715	-0.1041
<i>Planispirinoides bucculentus</i>	-0.3659	-0.1669
<i>Portatrochammina karica</i>	-0.7575	0.1706
<i>Psammospaera parva</i>	-0.5970	0.2937
<i>Pullenia bulloides</i>	0.8506	1.2936
<i>Pyrgo oblonga</i>	-0.6038	-0.1642
<i>Quinqueloculina seminula</i>	0.0441	-0.0173
<i>Reophax aduncus</i>	-0.6503	-0.1439
<i>Reophax bilocularis</i>	-0.8001	-0.3693
<i>Reophax difflugiformis</i>	0.0184	0.1021
<i>Reophax helenae</i>	-0.7245	-0.0919
<i>Reophax sabulosus</i>	-0.7955	-0.3178
<i>Reophax scorpiurus</i>	-0.1916	-0.2531
<i>Rupertina stabilis</i>	1.4131	-0.1162
<i>Saccammina sphaerica</i>	0.7992	0.1177
<i>Saccorhiza ramosa</i>	-0.0141	-0.2316
<i>Textularia wiesneri</i>	-0.8362	0.2670
<i>Thurammina papillata</i>	-0.6219	-0.0492
<i>Triloculina tricarinata</i>	0.0688	-0.3844
<i>Trochammina globigeriniformis pygmaea</i>	-0.0031	-0.1834
Unidentified agglutinated (attached)	0.6929	-0.0521
Unidentified agglutinated (spheroidal)	0.3258	0.7611
Unidentified perforate II (trochospiral)	0.1281	0.1328

Table A.23: First and second axes CCA values for the sampling stations and four selected biotic parameters of the sediment corresponding to the living benthic foraminiferal assemblage.

Stations	1st axis	2nd axis	Parameters	1st axis	2nd axis
PS62/002-3	1.4187	0.8040	Chlorophyll <i>a</i>	0.2131	0.8007
PS62/004-2	0.8086	-0.8996	Phaeopigments	-0.4711	0.4379
PS62/010-2	1.8868	-1.7912	DNA content	-0.0153	0.5195
PS62/012-2	1.0847	2.1818	TOC	-0.9451	-0.1601
PS62/015-4	-0.9030	-0.2676			
PS62/017-1	-0.8591	0.9451			
PS62/020-1	-0.3826	0.0204			
PS62/021-1	-0.9840	-0.5648			

Table A.24: Morphomeric determinations on *C. wuellerstorfi* found in 0–1 cm sediment depth at station PS62/002-3 including maximum test diameter, number of chambers within the last whorl, state of living, stage of dissolution, and size fraction (Org. res. = organic residual) with corresponding split factor. The coiling direction was determined later in time and therefore could not be brought in connection with the other data any more. Of all 203 counted specimens, 137 were left-coiled and 66 individuals showed right-coiled tests.

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Size fraction [μm]	Split factor
113	7	living	1	>2000	1
156	6	living	1	>2000	1
163	6	living	1	>2000	1
163	7	living	1	>2000	1
188	8	dead	1	125-250	64
194	6	dead	1	125-250	64
194	6	dead	1	>2000	1
194	6	dead	1	>2000	1
194	9	dead	3	Org. res.	1
206	6	living	1	>2000	1
206	7	living	1	>2000	1
206	8	dead	1	Org. res.	1
206	9	dead	1	>2000	1
213	7	dead	1	Org. res.	1
213	8	living	1	>2000	1
219	8	dead	1	125-250	64
219	8	dead	3	125-250	64
225	8	dead	3	125-250	64
238	7	dead	1	125-250	64
238	7	dead	1	>2000	1
244	6	living	1	>2000	1
244	8	dead	1	125-250	64
244	8	dead	2	125-250	64
244	8	dead	1	125-250	64
244	8	dead	2	125-250	64
244	8	living	1	>2000	1
244	9	dead	3	125-250	64
250	7	dead	3	>2000	1
250	no data	dead	5	125-250	64
256	8	dead	1	125-250	64
263	9	dead	1	125-250	64
263	9	dead	3	125-250	64
275	8	dead	1	125-250	64
281	8	dead	2	>2000	1
288	7	dead	1	Org. res.	1
288	8	dead	1	125-250	64
288	9	dead	3	125-250	64
288	no data	dead	4	125-250	64
294	9	dead	1	125-250	64
300	8	dead	1	125-250	64
300	10	dead	3	125-250	64
300	no data	dead	5	125-250	64
301	no data	dead	5	250-630	32
306	8	dead	1	125-250	64
306	8	dead	1	125-250	64
313	no data	dead	5	125-250	64
319	9	dead	2	>2000	1
325	8	dead	1	125-250	64
331	9	dead	1	125-250	64
331	9	dead	1	125-250	64
338	9	living	1	>2000	1
344	9	dead	3	125-250	64
350	8	dead	1	125-250	64
350	8	dead	1	125-250	64
350	8	dead	2	125-250	64
352	9	dead	3	250-630	32
356	8	dead	1	125-250	64
356	8	dead	1	125-250	64
363	6	dead	1	>2000	1
369	9	dead	3	125-250	64
369	9	dead	2	125-250	64
369	10	dead	2	125-250	64
375	9	dead	2	125-250	64
375	10	dead	3	Org. res.	1
381	8	dead	1	125-250	64
381	9	dead	1	125-250	64
381	9	dead	3	125-250	64
381	9	living	1	>2000	1
381	no data	dead	5	125-250	64
388	7	dead	1	125-250	64
394	10	dead	1	125-250	64
400	8	dead	2	125-250	64
400	9	dead	1	125-250	64
400	9	dead	3	Org. res.	1
404	8	dead	3	250-630	32
406	6	living	1	>2000	1

Table A.24: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Size fraction [μm]	Split factor
406	9	dead	2	125-250	64
413	9	dead	2	125-250	64
415	9	dead	2	250-630	32
415	no data	dead	5	250-630	32
420	8	dead	1	250-630	32
425	8	dead	3	250-630	32
425	9	dead	2	250-630	32
425	9	dead	3	125-250	64
430	10	dead	3	250-630	32
435	9	dead	2	250-630	32
435	9	dead	1	250-630	32
435	10	dead	3	250-630	32
444	6	dead	2	125-250	64
446	9	dead	3	250-630	32
446	10	dead	2	250-630	32
451	8	dead	3	250-630	32
451	no data	dead	4	250-630	32
456	9	dead	2	250-630	32
463	no data	dead	5	125-250	64
466	9	dead	1	250-630	32
466	no data	dead	5	250-630	32
466	no data	dead	4	250-630	32
469	9	dead	2	125-250	64
472	9	dead	3	250-630	32
472	9	dead	3	250-630	32
472	no data	dead	4	250-630	32
477	9	dead	2	250-630	32
477	no data	dead	4	250-630	32
487	9	dead	3	250-630	32
487	9	dead	1	250-630	32
487	9	dead	1	250-630	32
492	9	dead	3	250-630	32
497	8	dead	1	250-630	32
497	9	dead	2	250-630	32
497	no data	dead	4	250-630	32
503	9	dead	2	250-630	32
503	9	dead	1	250-630	32
508	9	dead	3	250-630	32
508		dead	4	250-630	32
513	9	dead	3	250-630	32
518	9	dead	2	250-630	32
523	8	dead	2	250-630	32
529	9	dead	3	250-630	32
529	9	dead	3	250-630	32
529	10	dead	2	250-630	32
529	no data	dead	5	250-630	32
534	9	dead	3	250-630	32
534	9	dead	3	250-630	32
539	8	dead	3	250-630	32
539	9	dead	3	250-630	32
544	9	dead	3	125-250	64
544	9	dead	2	250-630	32
544	no data	dead	4	250-630	32
560	8	dead	3	250-630	32
560	9	dead	3	250-630	32
570	9	dead	1	250-630	32
570	10	dead	3	250-630	32
570	10	dead	3	250-630	32
570	no data	dead	4	250-630	32
575	9	dead	1	250-630	32
575	9	dead	1	250-630	32
580	9	dead	3	250-630	32
580	9	dead	3	250-630	32
601	9	dead	2	250-630	32
611	9	dead	3	250-630	32
622	9	dead	1	250-630	32
622	9	dead	3	250-630	32
622	9	dead	3	250-630	32
622	9	dead	3	250-630	32
632	8	dead	2	250-630	32
632	no data	dead	4	250-630	32
637	7	dead	2	250-630	32
666	9	dead	3	Org. res.	1
674	8	dead	3	250-630	32
674	9	dead	3	250-630	32
694	9	dead	3	250-630	32
694	9	dead	3	250-630	32
705	no data	dead	4	250-630	32
705	no data	dead	4	250-630	32
715	8	dead	3	250-630	32
715	9	dead	3	250-630	32
725	9	dead	3	250-630	32
725	10	dead	2	250-630	32
725	no data	dead	4	250-630	32
736	8	dead	3	250-630	32

Table A.24: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Size fraction [μm]	Split factor
767	9	dead	3	250-630	32
788	10	dead	3	250-630	32
813	9	dead	3	250-630	32
819	9	dead	3	250-630	32
829	9	dead	3	250-630	32
850	9	dead	3	250-630	32
850	9	dead	3	250-630	32
891	9	dead	3	250-630	32
912	10	dead	3	250-630	32
912	10	dead	2	250-630	32
922	10	dead	2	250-630	32
943	9	dead	3	250-630	32
943	9	dead	3	250-630	32
943	9	dead	3	250-630	32
969	9	dead	2	630-2000	1
1000	9	dead	3	250-630	32
1021	9	dead	3	630-2000	1
1021	9	dead	3	630-2000	1
1021	9	dead	3	630-2000	1
1042	9	dead	3	630-2000	1
1042	9	dead	3	630-2000	1
1042	9	dead	3	630-2000	1
1062	10	dead	3	630-2000	1
1083	9	dead	3	630-2000	1
1083	10	dead	3	630-2000	1
1094	9	dead	3	630-2000	1
1104	9	dead	3	630-2000	1
1104	9	dead	2	630-2000	1
1125	9	dead	2	630-2000	1
1125	9	dead	3	630-2000	1
1125	9	dead	3	630-2000	1
1146	9	dead	3	630-2000	1
1146	9	dead	3	630-2000	1
1146	10	dead	2	630-2000	1
1167	9	dead	3	630-2000	1
1167	9	dead	3	630-2000	1
1167	9	dead	3	630-2000	1
1187	9	dead	3	630-2000	1
1187	9	dead	2	630-2000	1
1208	9	dead	3	630-2000	1
1229	9	dead	3	630-2000	1
1229	10	dead	3	630-2000	1
1354	9	dead	3	630-2000	1

Table A.25: Morphomeric determinations on *C. wuellerstorfi* found in 0–1 cm sediment depth at station PS62/004-2 including maximum test diameter, number of chambers within the last whorl, state of living, stage of dissolution, coiling direction, and size fraction with corresponding split factor. Org. res. = organic residual.

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
144	7	living	1	left	>2000	1
206	7	living	1	right	>2000	1
206	7	living	1	right	125-250	64
213	7	dead	2	left	125-250	64
223	10	dead	1	right	Org. res.	1
225	7	dead	3	left	125-250	64
238	7	dead	2	left	125-250	64
250	7	dead	1	left	125-250	64
250	8	living	1	left	Org. res.	1
282	no data	dead	5	right	250-630	8
286	9	living	1	right	Org. res.	1
288	9	dead	2	left	>2000	1
289	no data	dead	4	right	250-630	8
313	9	dead	1	left	125-250	64
325	8	dead	2	left	125-250	64
350	9	dead	2	left	125-250	64
356	no data	dead	4	right	125-250	64
363	8	living	1	left	>2000	1
369	9	dead	1	left	125-250	64
381	9	dead	3	left	125-250	64
384	8	living	1	left	Org. res.	1
394	9	dead	3	left	125-250	64
399	9	dead	3	left	250-630	8
399	no data	dead	4	right	250-630	8
406	8	dead	1	left	125-250	64
407	8	dead	2	left	250-630	8
415	9	dead	2	left	250-630	8
415	10	dead	2	left	250-630	8
438	10	living	1	right	>2000	1
446	8	dead	3	right	250-630	8

Table A.25: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
446	9	dead	2	right	250-630	8
454	6	dead	3	right	250-630	8
454	8	dead	3	right	250-630	8
454	9	dead	3	left	250-630	8
461	10	dead	3	left	250-630	8
469	9	dead	2	left	250-630	8
469	9	dead	4	left	250-630	8
477	9	dead	3	left	250-630	8
483	no data	dead	4	left	Org. res.	1
485	9	dead	3	right	250-630	8
493	9	dead	1	left	250-630	8
501	8	dead	4	left	250-630	8
501	no data	dead	4	left	250-630	8
501	no data	dead	4	right	250-630	8
508	9	dead	3	left	250-630	8
508	9	dead	3	left	250-630	8
524	7	dead	4	left	250-630	8
524	8	dead	3	left	250-630	8
532	8	dead	3	left	250-630	8
532	10	dead	4	right	250-630	8
540	10	dead	3	left	250-630	8
547	8	dead	2	left	250-630	8
547	9	dead	2	right	250-630	8
571	8	dead	1	left	250-630	8
571	9	dead	3	left	250-630	8
579	8	dead	3	left	250-630	8
587	9	dead	1	left	250-630	8
594	8	dead	3	right	250-630	8
594	10	dead	3	left	250-630	8
602	9	dead	3	left	250-630	8
618	9	dead	3	left	250-630	8
634	8	dead	4	right	250-630	8
641	10	dead	3	left	250-630	8
665	8	dead	3	left	250-630	8
720	8	dead	4	right	250-630	8
805	9	dead	3	right	Org. res.	1

Table A.26: Morphomeric determinations on *C. wuellerstorfi* found in 0–1 cm sediment depth at station PS62/010-2 including maximum test diameter, number of chambers within the last whorl, state of living, stage of dissolution, coiling direction, and size fraction with corresponding split factor.

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
294	8	dead	2	left	125-250	32
338	7	dead	2	right	>2000	1
338	8	living	2	right	>2000	1
356	8	dead	3	left	125-250	32
363	8	dead	2	left	630-2000	2
375	9	dead	2	left	>2000	1
400	9	dead	3	left	125-250	32
413	8	living	1	right	>2000	1
425	8	living	2	right	>2000	1
488	10	dead	2	right	250-630	64
575	9	dead	2	right	>2000	1
588	8	dead	2	right	>2000	1
613	9	dead	1	right	>2000	1
625	9	dead	2	right	250-630	64
675	9	dead	1	left	>2000	1
688	9	dead	3	left	250-630	64
750	9	dead	1	left	250-630	64
763	9	dead	1	left	250-630	64
763	10	living	1	left	>2000	1
775	8	living	1	right	250-630	64
775	9	dead	2	left	250-630	64
788	8	dead	2	right	>2000	1
788	9	dead	1	left	>2000	1
838	10	dead	2	left	>2000	1
850	9	dead	1	left	250-630	64
875	8	dead	1	left	>2000	1
900	9	dead	1	left	250-630	64
913	9	dead	1	right	250-630	64
938	8	dead	1	left	>2000	1
988	9	living	1	left	>2000	1
1000	9	dead	2	left	630-2000	2
1025	10	dead	1	left	630-2000	2
1050	9	dead	2	left	250-630	64
1075	9	dead	2	left	>2000	1
1113	8	dead	2	left	630-2000	2
1188	10	living	2	left	>2000	1

Table A.27: Morphomeric determinations on *C. wuellerstorfi* found in 0–1 cm sediment depth at station PS62/012-2 including maximum test diameter, number of chambers within the last whorl, state of living, stage of dissolution, coiling direction, and size fraction (Org. res. = organic residual) with corresponding split factor. The stage of dissolution was only determined within the size fraction >2000 μm .

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
116	6	dead	1	left	>2000	1
143	10	living	1	left	>2000	1
143	10	dead	1	left	>2000	1
161	6	living	1	right	>2000	1
170	6	living	1	right	>2000	1
179	5	dead	1	right	>2000	1
188	7	dead	2	left	>2000	1
197	7	dead	2	left	>2000	1
206	5	dead	1	left	>2000	1
219	8	dead	no data	left	Org. res.	1
223	9	dead	1	right	>2000	1
232	6	dead	1	left	>2000	1
232	7	living	1	right	>2000	1
250	6	living	1	right	>2000	1
250	7	living	1	left	>2000	1
250	10	living	1	right	>2000	1
259	6	living	1	right	>2000	1
259	6	living	1	right	>2000	1
268	9	living	1	right	>2000	1
277	10	dead	1	left	>2000	1
281	8	dead	no data	left	125-250	256
286	6	living	1	left	>2000	1
304	8	dead	1	left	>2000	1
304	9	living	1	left	>2000	1
313	7	living	1	left	>2000	1
313	10	living	2	left	>2000	1
319	8	dead	no data	right	125-250	256
322	8	dead	2	left	>2000	1
322	9	living	1	right	>2000	1
325	8	dead	no data	left	125-250	256
331	9	dead	1	left	>2000	1
331	10	dead	3	left	>2000	1
331	11	living	1	right	>2000	1
340	9	dead	1	left	>2000	1
340	11	living	1	left	>2000	1
349	6	living	1	left	>2000	1
350	9	dead	no data	left	125-250	256
356	8	dead	no data	right	125-250	256
375	7	living	1	left	>2000	1
388	9	dead	no data	left	125-250	256
404	8	dead	no data	left	250-630	32
406	10	living	no data	left	630-2000	4
411	7	dead	3	right	>2000	1
415	8	dead	no data	left	250-630	32
415	9	dead	no data	left	250-630	32
420	8	living	1	right	>2000	1
420	9	living	1	left	>2000	1
425	9	dead	no data	left	250-630	32
425	10	dead	no data	left	250-630	32
429	5	dead	2	right	>2000	1
435	9	dead	no data	left	250-630	32
435	9	dead	no data	left	250-630	32
435	9	dead	no data	right	250-630	32
435	10	dead	no data	left	250-630	32
446	8	dead	no data	right	250-630	32
446	9	dead	no data	left	250-630	32
456	8	dead	no data	left	250-630	32
456	9	dead	no data	left	250-630	32
456	9	dead	no data	left	250-630	32
456	9	dead	no data	right	250-630	32
456	9	dead	no data	left	Org. res.	1
465	9	living	1	left	>2000	1
466	10	dead	no data	left	250-630	32
477	9	dead	no data	left	250-630	32
477	9	dead	no data	right	250-630	32
483	9	living	1	left	>2000	1
497	8	dead	no data	left	250-630	32
497	9	dead	no data	left	250-630	32
497	9	dead	no data	left	250-630	32
497	9	dead	no data	right	250-630	32
501	9	living	1	right	>2000	1
508	9	dead	no data	left	250-630	32
510	9	living	1	right	>2000	1
518	10	dead	no data	left	250-630	32
518	10	dead	no data	right	250-630	32
527	9	living	1	right	>2000	1
539	11	dead	no data	right	250-630	32
545	10	dead	2	left	>2000	1

Table A.27: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
549	9	dead	no data	left	250-630	32
549	9	dead	no data	right	250-630	32
549	9	dead	no data	right	250-630	32
549	10	dead	no data	left	250-630	32
560	10	dead	no data	left	250-630	32
570	7	dead	no data	right	250-630	32
570	9	dead	no data	left	250-630	32
570	9	dead	no data	left	250-630	32
580	9	dead	no data	right	250-630	32
590	9	living	1	left	>2000	1
591	10	dead	no data	left	250-630	32
599	10	dead	3	right	>2000	1
611	9	dead	no data	left	250-630	32
611	10	dead	no data	right	250-630	32
617	8	living	1	right	>2000	1
622	8	dead	no data	right	250-630	32
626	8	living	1	left	>2000	1
653	10	dead	no data	left	250-630	32
661	10	dead	2	right	>2000	1
663	10	dead	no data	left	250-630	32
670	11	living	1	right	>2000	1
674	9	dead	no data	left	250-630	32
684	9	dead	no data	left	250-630	32
697	8	living	1	left	>2000	1
703	9	dead	no data	right	630-2000	4
705	9	dead	no data	left	250-630	32
706	8	living	2	right	>2000	1
715	9	dead	no data	left	250-630	32
715	9	dead	2	left	>2000	1
724	9	living	1	left	>2000	1
736	8	dead	no data	right	250-630	32
756	9	dead	no data	right	250-630	32
756	10	dead	no data	left	250-630	32
760	9	living	1	right	>2000	1
767	9	dead	no data	left	250-630	32
777	9	dead	no data	left	250-630	32
787	9	dead	no data	left	Org. res.	1
788	9	dead	no data	left	250-630	32
796	10	dead	2	left	>2000	1
839	9	dead	no data	right	250-630	32
839	10	dead	no data	left	250-630	32
849	10	dead	2	left	>2000	1
850	9	dead	no data	left	250-630	32
870	10	dead	no data	left	250-630	32
881	9	dead	no data	left	250-630	32
885	9	dead	3	right	>2000	1
984	10	dead	no data	left	250-630	32
995	9	dead	no data	left	250-630	32
1005	9	dead	no data	left	250-630	32
1057	8	dead	no data	left	250-630	32
1063	9	dead	no data	left	630-2000	4
1063	10	dead	no data	left	630-2000	4
1359	9	dead	no data	left	630-2000	4
1391	10	dead	no data	left	630-2000	4
1469	10	dead	3	right	>2000	1
1531	10	dead	no data	left	630-2000	4

Table A.28: Morphomeric determinations on *C. wuellerstorfi* found in 0–1 cm sediment depth at station PS62/017-1 including maximum test diameter, number of chambers within the last whorl, state of living, stage of dissolution, and size fraction (Org. res. = organic residual) with corresponding split factor. The coiling direction was determined later in time and therefore could not be brought in connection with the other data any more. Of all 101 counted specimens, 68 were left-coiled and 33 individuals showed right-coiled tests.

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Size fraction [μm]	Split factor
75	7	living	1	Org. res.	1
213	7	dead	3	125-250	4
219	7	dead	3	125-250	4
219	9	dead	3	125-250	4
225	9	dead	3	125-250	4
231	9	dead	2	125-250	4
238	8	dead	3	Org. res.	1
244	8	dead	2	125-250	4
244	8	dead	2	Org. res.	1
288	8	dead	2	125-250	4
288	9	dead	2	125-250	4
295	no data	dead	5	250-630	1
325	9	dead	2	125-250	4
331	9	dead	3	125-250	4
344	no data	dead	4	125-250	4
344	no data	dead	5	125-250	4
350	9	dead	2	125-250	4
350	9	dead	2	Org. res.	1
363	9	dead	2	125-250	4
363	9	dead	3	125-250	4
363	9	dead	3	125-250	4
363	no data	dead	4	250-630	1
363	no data	dead	5	250-630	1
363	no data	dead	5	250-630	1
373	no data	dead	5	250-630	1
388	9	dead	2	125-250	4
388	9	dead	2	125-250	4
394	no data	dead	4	250-630	1
394	no data	dead	4	250-630	1
415	10	dead	3	250-630	1
415	no data	dead	5	250-630	1
430	9	dead	2	250-630	1
430	10	dead	3	250-630	1
435	8	dead	2	250-630	1
435	9	dead	2	250-630	1
435	9	dead	3	250-630	1
435	10	dead	2	250-630	1
446	no data	dead	4	250-630	1
451	9	dead	3	250-630	1
456	9	dead	1	250-630	1
461	9	dead	3	250-630	1
463	no data	dead	5	>2000	1
466	8	dead	3	250-630	1
466	no data	dead	4	250-630	1
466	no data	dead	4	250-630	1
475	9	dead	4	>2000	1
482	9	dead	2	250-630	1
497	10	dead	2	250-630	1
503	no data	dead	4	250-630	1
508	8	dead	2	250-630	1
518	9	dead	2	250-630	1
518	9	dead	3	250-630	1
518	10	dead	2	250-630	1
518	no data	dead	4	250-630	1
518	no data	dead	4	250-630	1
523	no data	dead	4	250-630	1
529	9	dead	2	250-630	1
529	10	dead	1	250-630	1
529	no data	dead	4	250-630	1
529	no data	dead	5	250-630	1
534	9	dead	3	250-630	1
534	no data	dead	4	250-630	1
544	10	dead	3	250-630	1
549	9	dead	2	250-630	1
554	no data	dead	4	250-630	1
560	9	dead	2	250-630	1
560	10	dead	1	250-630	1
560	10	dead	3	250-630	1
560	no data	dead	4	250-630	1
586	9	living	1	250-630	1
591	9	dead	2	250-630	1
591	9	dead	2	250-630	1
591	9	dead	3	250-630	1
601	9	dead	1	250-630	1
606	10	dead	2	250-630	1
611	9	dead	2	250-630	1

Table A.28: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Size fraction [μm]	Split factor
611	no data	dead	4	250-630	1
617	9	dead	2	250-630	1
622	9	dead	1	250-630	1
622	9	dead	2	250-630	1
632	9	dead	3	250-630	1
632	9	dead	3	250-630	1
643	9	dead	2	250-630	1
643	9	dead	3	250-630	1
643	11	dead	2	250-630	1
643	no data	dead	4	250-630	1
648	9	dead	1	250-630	1
648	10	dead	2	250-630	1
653	9	dead	1	250-630	1
658	10	dead	3	250-630	1
663	8	dead	2	250-630	1
663	9	dead	3	250-630	1
684	9	dead	2	250-630	1
694	9	dead	2	250-630	1
705	10	dead	2	250-630	1
720	9	dead	2	250-630	1
725	10	dead	1	250-630	1
736	10	dead	2	250-630	1
777	8	dead	1	250-630	1
788	10	dead	2	250-630	1
834	9	dead	3	250-630	1

Table A.29: Morphomeric determinations on *C. wuellerstorfi* found in 0–1 cm sediment depth at station PS62/020-1 including maximum test diameter, number of chambers within the last whorl, state of living, stage of dissolution, coiling direction, and size fraction with corresponding split factor. Org. res. = organic residual.

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
188	7	dead	1	left	125-250	4
194	7	living	1	right	125-250	4
196	7	dead	1	right	Org. res.	1
203	7	dead	1	left	Org. res.	1
206	7	dead	1	left	125-250	4
211	7	dead	1	right	Org. res.	1
219	7	living	1	right	125-250	4
219	7	dead	1	right	Org. res.	1
225	8	living	1	left	125-250	4
231	7	dead	1	left	125-250	4
231	8	living	1	left	125-250	4
244	8	living	1	right	125-250	4
259	8	living	2	right	250-630	1
263	9	living	1	right	125-250	4
281	8	living	1	left	125-250	4
294	8	living	1	right	125-250	4
297	7	dead	1	left	Org. res.	1
321	no data	dead	4	right	Org. res.	1
325	9	living	1	left	125-250	4
325	9	dead	2	right	125-250	4
331	9	dead	2	left	250-630	1
331	9	dead	3	left	125-250	4
336	8	dead	3	right	Org. res.	1
336	9	dead	1	right	Org. res.	1
375	10	dead	3	left	125-250	4
375	8	living	1	left	250-630	1
375	10	dead	3	left	250-630	1
393	9	dead	2	left	250-630	1
402	9	dead	3	left	250-630	1
407	no data	dead	4	right	Org. res.	1
411	9	dead	3	left	250-630	1
411	no data	dead	4	left	250-630	1
411	no data	dead	4	right	250-630	1
429	9	dead	3	right	250-630	1
429	9	dead	3	right	250-630	1
438	9	dead	3	left	250-630	1
438	9	dead	3	left	250-630	1
438	10	dead	2	left	250-630	1
438	no data	dead	4	left	250-630	1
447	10	dead	2	left	250-630	1
456	9	dead	3	right	250-630	1
456	10	living	1	left	250-630	1
461	no data	dead	4	right	Org. res.	1
465	9	dead	3	right	250-630	1
465	10	dead	3	left	250-630	1
465	10	dead	3	left	250-630	1
465	no data	dead	4	left	250-630	1

Table A.29: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
465	no data	dead	4	no data	250-630	1
465	no data	dead	4	no data	250-630	1
474	8	living	1	left	250-630	1
474	9	dead	2	left	250-630	1
474	9	dead	2	left	250-630	1
474	11	dead	2	right	250-630	1
483	9	living	1	right	250-630	1
483	no data	dead	4	left	250-630	1
483	no data	dead	4	left	250-630	1
492	9	dead	2	right	250-630	1
492	10	dead	3	left	250-630	1
492	no data	dead	4	left	250-630	1
493	no data	dead	4	right	Org. res.	1
501	9	dead	3	right	250-630	1
501	9	dead	3	right	250-630	1
501	10	dead	1	left	250-630	1
501	no data	dead	4	left	250-630	1
501	no data	dead	4	right	250-630	1
501	no data	dead	4	right	250-630	1
510	10	dead	1	left	250-630	1
510	10	dead	2	left	250-630	1
510	10	dead	2	left	250-630	1
518	8	dead	3	right	250-630	1
518	9	living	1	left	250-630	1
518	9	dead	2	left	250-630	1
518	10	dead	2	right	250-630	1
518	no data	dead	4	left	250-630	1
518	no data	dead	4	left	250-630	1
527	8	dead	3	left	250-630	1
527	8	dead	3	left	250-630	1
527	9	dead	3	right	250-630	1
527	10	dead	3	left	250-630	1
527	10	dead	3	left	250-630	1
527	10	dead	3	left	250-630	1
527	10	dead	3	left	250-630	1
527	no data	dead	4	left	250-630	1
527	no data	dead	4	right	250-630	1
527	no data	dead	4	right	250-630	1
536	9	living	1	left	250-630	1
536	9	dead	2	left	250-630	1
536	9	dead	3	left	250-630	1
536	9	dead	3	left	250-630	1
536	10	dead	2	left	250-630	1
545	9	dead	3	left	250-630	1
545	10	dead	4	right	250-630	1
545	no data	dead	4	left	250-630	1
554	9	dead	3	right	250-630	1
554	9	dead	3	right	250-630	1
554	10	dead	3	left	250-630	1
554	11	living	1	left	250-630	1
554	11	dead	2	left	250-630	1
554	no data	dead	4	right	250-630	1
563	9	dead	3	left	250-630	1
563	9	dead	2	right	250-630	1
563	9	dead	3	right	250-630	1
563	10	dead	3	right	630-2000	1
563	10	dead	3	left	250-630	1
563	10	dead	3	left	250-630	1
563	11	dead	1	left	250-630	1
563	no data	dead	4	left	250-630	1
563	no data	dead	4	left	250-630	1
563	no data	dead	4	left	250-630	1
563	no data	dead	4	left	250-630	1
563	no data	dead	4	left	250-630	1
572	9	dead	2	left	250-630	1
572	9	dead	3	left	250-630	1
572	9	dead	3	left	250-630	1
572	10	dead	3	left	250-630	1
572	10	dead	3	left	250-630	1
572	10	dead	3	right	250-630	1
572	10	dead	3	right	250-630	1
572	no data	dead	4	right	250-630	1
581	9	dead	3	left	250-630	1
581	9	dead	3	left	250-630	1
581	9	dead	3	right	250-630	1
581	9	dead	3	right	250-630	1
581	10	dead	3	right	250-630	1
581	no data	dead	4	left	250-630	1
581	no data	dead	4	left	250-630	1
581	no data	dead	4	left	250-630	1
587	10	dead	3	right	>2000	1
590	9	dead	3	right	250-630	1
590	10	dead	3	left	250-630	1
590	no data	dead	4	left	250-630	1

Table A.29: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
590	no data	dead	4	left	250-630	1
590	no data	dead	4	right	250-630	1
594	9	dead	3	right	>2000	1
608	11	dead	1	left	250-630	1
608	no data	dead	4	left	250-630	1
608	no data	dead	4	left	250-630	1
617	8	dead	3	right	250-630	1
617	8	dead	3	right	250-630	1
617	9	dead	3	right	250-630	1
617	9	dead	3	right	250-630	1
617	10	dead	3	left	250-630	1
617	10	dead	3	left	250-630	1
617	11	dead	2	left	250-630	1
617	no data	dead	4	left	250-630	1
626	10	dead	3	left	250-630	1
626	10	dead	2	left	250-630	1
626	10	dead	3	right	250-630	1
644	8	dead	3	left	250-630	1
644	9	dead	3	right	250-630	1
644	10	dead	1	right	250-630	1
644	10	dead	3	right	250-630	1
644	10	dead	3	right	250-630	1
644	10	dead	3	right	250-630	1
644	10	dead	3	right	250-630	1
644	11	dead	2	right	250-630	1
653	9	dead	2	left	250-630	1
653	9	dead	3	right	250-630	1
653	10	dead	1	left	250-630	1
653	10	dead	3	right	250-630	1
653	10	dead	3	right	250-630	1
653	10	dead	3	right	250-630	1
653	no data	dead	4	left	250-630	1
653	no data	dead	4	right	250-630	1
661	10	dead	3	right	250-630	1
670	10	dead	3	left	250-630	1
679	9	dead	3	left	250-630	1
679	9	dead	2	left	250-630	1
679	9	dead	3	right	250-630	1
679	9	dead	3	right	250-630	1
679	10	dead	3	left	250-630	1
679	10	dead	3	left	250-630	1
679	no data	dead	4	left	250-630	1
688	10	dead	3	left	250-630	1
688	10	dead	3	left	250-630	1
697	10	dead	3	left	250-630	1
697	10	dead	3	left	250-630	1
697	10	dead	3	right	250-630	1
697	10	dead	3	right	250-630	1
706	10	dead	1	left	250-630	1
706	10	dead	3	left	250-630	1
706	10	dead	3	left	250-630	1
706	10	dead	2	right	250-630	1
706	no data	dead	4	right	250-630	1
715	9	dead	2	left	250-630	1
715	10	dead	3	right	250-630	1
724	10	dead	3	left	250-630	1
751	10	living	1	right	250-630	1
769	10	dead	2	left	250-630	1
778	9	dead	2	left	250-630	1
778	10	dead	1	right	250-630	1
778	10	dead	3	right	250-630	1
778	10	dead	3	right	250-630	1
782	9	dead	1	left	Org. res.	1
796	9	dead	3	right	250-630	1
805	10	dead	3	left	250-630	1
831	10	dead	2	right	630-2000	1
858	9	dead	3	right	250-630	1
no data	no data	dead	5	left	125-250	4
no data	no data	dead	4	left	250-630	1
no data	no data	dead	4	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1

Table A.29: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	5	left	250-630	1
no data	no data	dead	4	right	250-630	1
no data	no data	dead	4	right	250-630	1
no data	no data	dead	4	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	right	250-630	1
no data	no data	dead	5	no data	250-630	1
no data	no data	dead	5	no data	250-630	1
no data	no data	dead	5	no data	250-630	1

Table A.30: Morphomeric determinations on *C. wuellerstorfi* found in 0–1 cm sediment depth at station PS62/021-1 including maximum test diameter, number of chambers within the last whorl, state of living, stage of dissolution, coiling direction, and size fraction with corresponding split factor.

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
176	6	dead	1	right	250-630	16
179	6	dead	2	left	630-2000	1
181	6	living	1	left	125-250	16
181	no data	dead	4	left	125-250	16
188	6	living	1	right	125-250	16
188	7	dead	2	left	125-250	16
194	8	dead	3	left	125-250	16
200	5	dead	1	left	125-250	16
200	6	dead	1	left	125-250	16
200	7	dead	1	left	125-250	16
206	7	dead	1	left	125-250	16
206	7	dead	2	right	125-250	16
213	6	dead	1	right	125-250	16
213	7	dead	1	left	125-250	16
219	7	dead	2	left	125-250	16
219	8	dead	2	left	125-250	16
219	8	dead	2	left	125-250	16
225	8	dead	2	left	125-250	16
225	8	dead	2	left	125-250	16
225	no data	dead	4	left	125-250	16
231	7	dead	1	left	125-250	16
231	7	dead	1	left	125-250	16
231	7	dead	2	right	125-250	16
231	8	dead	1	left	125-250	16
231	8	living	1	right	125-250	16
238	8	dead	1	left	125-250	16
238	8	dead	3	right	125-250	16
241	8	dead	3	right	630-2000	1
244	8	dead	2	left	125-250	16
250	7	dead	1	left	125-250	16
250	7	dead	1	left	125-250	16
250	8	dead	3	right	125-250	16
250	9	dead	2	left	125-250	16
256	8	dead	2	left	125-250	16
256	8	dead	3	right	125-250	16
256	9	dead	2	right	125-250	16
263	8	living	1	left	125-250	16
269	no data	dead	4	left	125-250	16
275	8	dead	2	left	125-250	16
275	9	dead	2	left	125-250	16
275	9	dead	2	right	125-250	16
281	9	dead	1	right	125-250	16
288	8	dead	1	left	125-250	16
288	8	dead	1	right	125-250	16
288	9	dead	4	left	125-250	16
291	7	living	1	right	>2000	1
294	8	dead	2	right	125-250	16
300	8	dead	1	left	125-250	16
300	8	dead	2	left	125-250	16
300	8	dead	2	left	125-250	16
300	no data	dead	4	right	125-250	16

Table A.30: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
306	8	dead	1	left	125-250	16
306	9	dead	2	left	125-250	16
306	9	dead	2	left	125-250	16
306	9	dead	4	left	125-250	16
313	9	dead	3	right	125-250	16
313	9	dead	4	right	125-250	16
319	9	dead	1	left	125-250	16
319	9	dead	1	left	125-250	16
319	9	dead	2	right	125-250	16
319	no data	dead	4	right	125-250	16
325	8	dead	1	left	125-250	16
325	8	dead	3	left	125-250	16
325	9	dead	2	left	125-250	16
338	8	dead	2	left	125-250	16
338	9	dead	1	left	125-250	16
338	9	dead	2	left	125-250	16
338	10	dead	1	right	125-250	16
356	9	dead	1	right	125-250	16
356	9	dead	2	right	125-250	16
363	9	dead	2	left	125-250	16
369	9	dead	1	left	125-250	16
369	9	dead	3	left	125-250	16
369	9	dead	3	left	125-250	16
375	8	dead	1	left	>2000	1
375	9	dead	2	right	125-250	16
381	10	dead	1	left	125-250	16
381	10	dead	1	right	125-250	16
381	10	dead	2	left	125-250	16
384	8	dead	2	left	630-2000	1
384	8	dead	4	right	630-2000	1
388	8	dead	1	left	125-250	16
394	9	dead	2	left	125-250	16
394	9	dead	2	left	125-250	16
394	10	dead	3	left	125-250	16
394	no data	dead	4	left	250-630	16
394	no data	dead	4	right	250-630	16
400	9	dead	2	left	125-250	16
400	9	dead	2	right	125-250	16
404	9	dead	2	right	250-630	16
404	9	dead	3	left	250-630	16
413	no data	dead	4	right	125-250	16
416	8	dead	1	left	>2000	1
425	9	dead	2	left	250-630	16
425	9	dead	3	left	250-630	16
435	9	dead	1	right	250-630	16
435	no data	dead	4	right	250-630	16
444	10	dead	2	right	125-250	16
456	8	dead	1	left	250-630	16
456	9	dead	2	left	250-630	16
456	9	dead	2	left	250-630	16
456	9	dead	2	left	250-630	16
456	9	dead	3	left	250-630	16
456	10	dead	1	left	250-630	16
465	9	dead	2	left	630-2000	1
465	9	dead	2	right	630-2000	1
466	9	dead	1	left	250-630	16
466	9	dead	2	left	250-630	16
466	9	dead	3	left	250-630	16
466	9	dead	3	right	250-630	16
477	9	dead	4	left	250-630	16
477	10	dead	2	left	250-630	16
487	8	dead	3	left	250-630	16
487	8	dead	3	left	250-630	16
487	8	dead	3	left	250-630	16
487	9	dead	2	left	250-630	16
487	9	dead	3	left	250-630	16
487	9	dead	3	left	250-630	16
492	10	dead	2	left	630-2000	1
497	9	dead	1	left	250-630	16
497	9	dead	2	left	250-630	16
497	10	dead	3	left	250-630	16
497	no data	dead	4	right	250-630	16
497	no data	dead	4	right	250-630	16
508	8	dead	3	left	250-630	16
508	9	dead	3	right	250-630	16
508	10	dead	1	left	250-630	16
510	9	dead	4	left	630-2000	1
518	10	dead	3	left	250-630	16
520	11	dead	1	left	>2000	1
527	10	dead	1	left	630-2000	1
529	9	dead	2	left	250-630	16
529	9	dead	2	left	250-630	16
529	9	dead	3	left	250-630	16
529	10	dead	3	left	250-630	16
529	no data	dead	4	left	250-630	16

Table A.30: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Living/dead	Stage of dissolution	Coiling direction	Size fraction [μm]	Split factor
539	8	dead	1	left	250-630	16
539	9	dead	1	left	250-630	16
539	10	dead	2	left	250-630	16
545	9	dead	3	left	630-2000	1
560	9	dead	1	left	250-630	16
560	9	dead	2	left	250-630	16
560	9	dead	2	left	250-630	16
560	10	dead	3	left	250-630	16
570	9	dead	1	left	250-630	16
570	10	dead	2	left	250-630	16
570	10	dead	3	right	250-630	16
570	no data	dead	4	left	250-630	16
572	10	dead	3	right	630-2000	1
580	8	dead	1	right	250-630	16
590	8	dead	3	left	630-2000	1
591	9	dead	2	right	250-630	16
591	9	dead	3	left	250-630	16
591	9	dead	3	left	250-630	16
591	10	dead	3	left	250-630	16
601	9	dead	3	right	250-630	16
611	9	dead	3	left	250-630	16
611	10	dead	2	right	250-630	16
617	9	dead	1	left	630-2000	1
622	7	dead	1	left	250-630	16
622	9	dead	1	right	250-630	16
622	9	dead	2	left	250-630	16
622	10	dead	3	left	250-630	16
632	9	dead	2	left	250-630	16
632	9	dead	2	left	250-630	16
632	9	dead	2	left	250-630	16
632	10	dead	1	left	250-630	16
632	10	dead	3	right	250-630	16
632	no data	dead	4	right	250-630	16
635	8	dead	2	left	630-2000	1
635	8	dead	2	left	630-2000	1
643	9	dead	1	right	250-630	16
643	9	dead	4	right	250-630	16
652	9	dead	2	left	>2000	1
653	8	dead	3	right	250-630	16
653	9	dead	1	left	250-630	16
653	9	dead	1	right	250-630	16
653	10	dead	1	left	250-630	16
661	9	dead	3	left	630-2000	1
661	10	dead	2	right	630-2000	1
663	no data	dead	4	left	250-630	16
674	9	dead	1	left	250-630	16
674	9	dead	2	left	250-630	16
674	9	dead	2	left	250-630	16
674	9	dead	3	left	250-630	16
679	8	dead	1	left	630-2000	1
679	9	dead	3	left	630-2000	1
684	9	dead	1	right	250-630	16
684	10	dead	3	left	250-630	16
697	9	dead	4	left	630-2000	1
706	9	dead	3	left	630-2000	1
715	8	dead	3	left	250-630	16
746	9	dead	3	right	250-630	16
796	9	dead	3	left	630-2000	1
813	10	dead	3	left	630-2000	1
894	8	dead	4	left	630-2000	1
912	10	dead	2	left	250-630	16
933	9	dead	2	left	250-630	16
no data	no data	dead	5	left	125-250	16

Table A.31: Morphomeric determinations on *C. wuellerstorfi* found in 67–68 cm sediment depth at station GIK23519-5 including maximum test diameter, number of chambers within the last whorl, coiling direction, and size fraction with corresponding split factor.

Maximum test diameter [μm]	Number of chambers within the last whorl	Coiling direction	Size fraction [μm]	Split factor
194	8	right	150-250	1
219	9	right	150-250	1
250	7	right	150-250	1
250	9	left	150-250	1
263	9	left	150-250	1
263	10	left	150-250	1
269	9	left	150-250	1
275	9	left	150-250	1
275	10	left	150-250	1
281	9	right	150-250	1
288	9	right	150-250	1
294	9	left	150-250	1
294	9	right	150-250	1
300	8	left	150-250	1
300	9	left	150-250	1
300	9	right	150-250	1
306	10	left	150-250	1
313	9	left	150-250	1
319	9	right	150-250	1
325	10	left	150-250	1
331	8	left	150-250	1
338	9	left	150-250	1
338	9	left	150-250	1
338	11	left	150-250	1
344	10	left	150-250	1
344	10	left	150-250	1
350	9	left	150-250	1
350	10	right	150-250	1
356	9	left	150-250	1
356	10	left	150-250	1
363	8	left	150-250	1
363	10	left	150-250	1
363	10	right	150-250	1
363	10	right	150-250	1
375	9	right	150-250	1
375	10	right	150-250	1
381	9	left	150-250	1
381	10	left	150-250	1
381	11	left	150-250	1
388	9	left	250-315	1
400	9	left	150-250	1
400	10	left	250-315	1
406	10	left	150-250	1
406	11	left	150-250	1
406	11	right	150-250	1
413	9	right	150-250	1
419	9	left	250-315	1
419	10	left	150-250	1
425	10	left	150-250	1
425	11	left	150-250	1
431	8	left	250-315	1
438	9	left	150-250	1
438	10	right	150-250	1
450	7	left	150-250	1
456	9	left	250-315	1
456	10	left	250-315	1
463	11	right	250-315	1
469	9	left	250-315	1
469	9	left	250-315	1
469	10	left	250-315	1
475	9	left	250-315	1
475	9	left	250-315	1
475	9	right	250-315	1
481	9	left	250-315	1
488	10	left	250-315	1
488	10	left	250-315	1
488	10	right	250-315	1
494	8	right	250-315	1
494	9	left	250-315	1
500	9	right	250-315	1
506	9	left	250-315	1
506	10	right	250-315	1
513	9	left	250-315	1
513	10	left	250-315	1
516	9	right	315-400	1
516	9	right	315-400	1
519	9	left	250-315	1
525	9	left	250-315	1
525	10	left	250-315	1
531	9	left	250-315	1
540	9	right	315-400	1
547	9	left	315-400	1

Table A.31: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Coiling direction	Size fraction [μm]	Split factor
547	9	right	315-400	1
550	9	left	250-315	1
550	9	right	250-315	1
555	9	right	315-400	1
555	9	right	315-400	1
556	11	right	250-315	1
579	10	left	315-400	1
594	9	left	315-400	1
594	11	right	315-400	1
602	9	left	315-400	1
610	9	left	315-400	1
610	10	left	315-400	1
618	8	left	315-400	1
618	10	left	315-400	1
625	9	left	250-315	1
632	9	left	>400	1
641	8	right	315-400	1
643	9	left	>400	1
649	9	left	315-400	1
663	10	left	>400	1
665	9	right	315-400	1
704	9	left	315-400	1
725	8	left	>400	1
777	9	right	>400	1
798	9	right	>400	1

Table A.32: Morphomeric determinations on *C. wuellerstorfi* found in 79–80 cm sediment depth at station GIK23519-5 including maximum test diameter, number of chambers within the last whorl, coiling direction, and size fraction with corresponding split factor.

Maximum test diameter [μm]	Number of chambers within the last whorl	Coiling direction	Size fraction [μm]	Split factor
250	9	right	150-250	1
256	8	right	150-250	1
269	10	left	150-250	1
275	8	left	150-250	1
275	8	left	150-250	1
275	8	right	150-250	1
281	8	right	150-250	1
288	9	left	150-250	1
288	10	right	150-250	1
294	8	left	150-250	1
294	8	right	150-250	1
306	8	left	150-250	1
313	9	left	150-250	1
319	7	right	150-250	1
319	9	left	150-250	1
319	9	left	150-250	1
325	10	left	150-250	1
325	10	left	150-250	1
325	10	right	150-250	1
344	9	left	150-250	1
344	9	left	150-250	1
350	9	left	150-250	1
350	9	right	150-250	1
356	9	left	150-250	1
363	9	left	150-250	1
363	9	left	150-250	1
363	9	right	150-250	1
363	10	left	150-250	1
369	9	right	150-250	1
369	10	left	150-250	1
381	10	right	150-250	1
381	11	left	150-250	1
394	9	right	150-250	1
400	8	left	250-315	1
400	9	left	150-250	1
400	9	left	150-250	1
400	9	right	150-250	1
406	8	right	250-315	1
406	10	right	150-250	1
413	9	left	150-250	1
413	9	right	150-250	1
425	9	left	250-315	1
431	9	left	150-250	1
431	10	left	150-250	1
463	9	right	250-315	1
463	9	right	250-315	1
463	10	left	250-315	1
463	10	left	250-315	1

Table A.32: continued

Maximum test diameter [μm]	Number of chambers within the last whorl	Coiling direction	Size fraction [μm]	Split factor
463	11	right	250-315	1
469	9	left	250-315	1
469	10	left	250-315	1
469	10	left	250-315	1
475	9	left	250-315	1
488	9	left	250-315	1
488	9	right	250-315	1
488	9	right	250-315	1
488	12	right	250-315	1
494	8	left	250-315	1
500	9	left	250-315	1
500	10	left	250-315	1
506	9	left	250-315	1
506	10	right	250-315	1
519	9	left	250-315	1
525	9	left	250-315	1
525	9	right	250-315	1
527	7	right	315-400	1
531	10	left	250-315	1
536	9	left	315-400	1
536	10	right	315-400	1
545	8	right	315-400	1
545	9	left	315-400	1
554	10	left	315-400	1
563	9	left	250-315	1
563	9	left	315-400	1
563	10	right	315-400	1
572	9	right	315-400	1
572	10	left	315-400	1
581	9	left	315-400	1
581	9	right	315-400	1
590	8	left	315-400	1
608	8	left	315-400	1
822	11	left	>400	1

Table A.33: Proloculus diameter of *C. wuellerstorfi* specimens according to their sampling station, sediment depth, number of chambers within the last whorl, and size fraction including corresponding split factor.

Station	Sediment depth [cm]	Proloculus diameter [μm]	Number of chambers within the last whorl	Size fraction [μm]	Split factor
PS62/002-3	0-1	25	8	125-250	64
PS62/002-3	0-1	25	8	250-630	32
PS62/002-3	0-1	25	9	250-630	32
PS62/002-3	0-1	25	10	250-630	32
PS62/002-3	0-1	25	10	250-630	32
PS62/002-3	0-1	25	10	250-630	32
PS62/002-3	0-1	25	10	250-630	32
PS62/002-3	0-1	25	10	250-630	32
PS62/002-3	0-1	30	8	125-250	64
PS62/002-3	0-1	30	8	250-630	32
PS62/002-3	0-1	30	9	125-250	64
PS62/002-3	0-1	30	9	125-250	64
PS62/002-3	0-1	30	9	125-250	64
PS62/002-3	0-1	30	9	125-250	64
PS62/002-3	0-1	30	9	250-630	32
PS62/002-3	0-1	30	9	250-630	32
PS62/002-3	0-1	30	9	250-630	32
PS62/002-3	0-1	30	9	250-630	32
PS62/002-3	0-1	30	9	250-630	32
PS62/002-3	0-1	30	9	250-630	32
PS62/002-3	0-1	30	9	250-630	32
PS62/002-3	0-1	30	9	250-630	32
PS62/002-3	0-1	30	10	250-630	32
PS62/002-3	0-1	30	10	250-630	32
PS62/002-3	0-1	30	10	250-630	32
PS62/002-3	0-1	35	7	250-630	32
PS62/002-3	0-1	35	8	125-250	64
PS62/002-3	0-1	35	8	125-250	64
PS62/002-3	0-1	35	8	125-250	64
PS62/002-3	0-1	35	8	250-630	32
PS62/002-3	0-1	35	8	250-630	32
PS62/002-3	0-1	35	9	125-250	64
PS62/002-3	0-1	35	9	250-630	32
PS62/002-3	0-1	35	10	250-630	32
PS62/002-3	0-1	35	10	250-630	32
PS62/002-3	0-1	40	8	125-250	64
PS62/002-3	0-1	40	8	125-250	64
PS62/002-3	0-1	40	8	125-250	64
PS62/002-3	0-1	40	8	250-630	32
PS62/002-3	0-1	40	9	630-2000	1
PS62/002-3	0-1	40	9	125-250	64

Table A.33: continued

Station	Sediment depth [cm]	Proloculus diameter [μm]	Number of chambers within the last whorl	Size fraction [μm]	Split factor
PS62/002-3	0-1	40	9	125-250	64
PS62/002-3	0-1	40	9	125-250	64
PS62/002-3	0-1	40	9	125-250	64
PS62/002-3	0-1	40	9	250-630	32
PS62/002-3	0-1	40	9	250-630	32
PS62/002-3	0-1	40	9	250-630	32
PS62/002-3	0-1	40	9	250-630	32
PS62/002-3	0-1	40	9	250-630	32
PS62/002-3	0-1	40	10	250-630	32
PS62/002-3	0-1	40	10	250-630	32
PS62/002-3	0-1	40	10	250-630	32
PS62/002-3	0-1	40	10	250-630	32
PS62/002-3	0-1	40	10	250-630	32
PS62/002-3	0-1	40	10	250-630	32
PS62/002-3	0-1	40	10	250-630	32
PS62/002-3	0-1	40	10	250-630	32
PS62/002-3	0-1	40	10	250-630	32
PS62/002-3	0-1	40	10	250-630	32
PS62/002-3	0-1	40	11	125-250	64
PS62/002-3	0-1	40	11	250-630	32
PS62/002-3	0-1	40	11	250-630	32
PS62/002-3	0-1	45	7	125-250	64
PS62/002-3	0-1	45	8	250-630	32
PS62/002-3	0-1	45	9	125-250	64
PS62/002-3	0-1	45	9	125-250	64
PS62/002-3	0-1	45	9	250-630	32
PS62/002-3	0-1	45	9	250-630	32
PS62/002-3	0-1	45	9	250-630	32
PS62/002-3	0-1	45	9	250-630	32
PS62/002-3	0-1	45	9	250-630	32
PS62/002-3	0-1	45	9	250-630	32
PS62/002-3	0-1	45	9	250-630	32
PS62/002-3	0-1	45	10	250-630	32
PS62/002-3	0-1	45	10	250-630	32
PS62/002-3	0-1	45	10	250-630	32
PS62/002-3	0-1	45	10	250-630	32
PS62/002-3	0-1	45	11	250-630	32
PS62/002-3	0-1	45	11	250-630	32
PS62/002-3	0-1	50	7	125-250	64
PS62/002-3	0-1	50	7	Org. res.	1
PS62/002-3	0-1	50	8	125-250	64
PS62/002-3	0-1	50	8	125-250	64
PS62/002-3	0-1	50	8	250-630	32
PS62/002-3	0-1	50	9	125-250	64
PS62/002-3	0-1	50	9	125-250	64
PS62/002-3	0-1	50	9	250-630	32
PS62/002-3	0-1	50	9	250-630	32
PS62/002-3	0-1	50	9	250-630	32
PS62/002-3	0-1	50	10	250-630	32
PS62/002-3	0-1	50	10	250-630	32
PS62/002-3	0-1	50	10	250-630	32
PS62/002-3	0-1	50	10	250-630	32
PS62/002-3	0-1	50	11	630-2000	1
PS62/002-3	0-1	50	11	630-2000	1
PS62/002-3	0-1	50	11	250-630	32
PS62/002-3	0-1	50	11	Org. res.	1
PS62/002-3	0-1	50	12	630-2000	1
PS62/002-3	0-1	50	12	630-2000	1
PS62/002-3	0-1	50	12	250-630	32
PS62/002-3	0-1	55	10	250-630	32
PS62/002-3	0-1	55	10	250-630	32
PS62/002-3	0-1	55	11	630-2000	1
PS62/002-3	0-1	55	11	630-2000	1
PS62/002-3	0-1	60	9	250-630	32
PS62/002-3	0-1	60	9	250-630	32
PS62/002-3	0-1	60	10	630-2000	1
PS62/002-3	0-1	60	10	630-2000	1
PS62/002-3	0-1	60	10	630-2000	1
PS62/002-3	0-1	60	10	630-2000	1
PS62/002-3	0-1	60	10	630-2000	1
PS62/002-3	0-1	60	10	630-2000	1
PS62/002-3	0-1	60	10	630-2000	1
PS62/002-3	0-1	60	10	250-630	32
PS62/002-3	0-1	60	11	250-630	32
PS62/002-3	0-1	60	12	630-2000	1
PS62/002-3	0-1	65	10	630-2000	1
PS62/002-3	0-1	70	11	630-2000	1
PS62/002-3	0-1	70	12	250-630	32
PS62/002-3	0-1	75	10	630-2000	1
PS62/002-3	0-1	75	11	250-630	32
PS62/002-3	0-1	80	10	630-2000	1
PS62/002-3	0-1	80	10	630-2000	1
PS62/002-3	0-1	80	10	630-2000	1
PS62/002-3	0-1	80	11	630-2000	1
PS62/002-3	0-1	80	11	630-2000	1
PS62/002-3	0-1	80	11	630-2000	1
PS62/002-3	0-1	90	9	630-2000	1
PS62/002-3	0-1	90	9	630-2000	1
PS62/002-3	0-1	90	10	630-2000	1
PS62/002-3	0-1	90	11	630-2000	1
PS62/002-3	0-1	90	12	630-2000	1

Table A.33: continued

Station	Sediment depth [cm]	Proloculus diameter [μm]	Number of chambers within the last whorl	Size fraction [μm]	Split factor
PS62/002-3	0-1	100	8	630-2000	1
PS62/002-3	0-1	100	10	630-2000	1
PS62/002-3	0-1	100	11	630-2000	1
PS62/004-2	0-1	25	9	250-630	8
PS62/004-2	0-1	30	8	Fluff	1
PS62/004-2	0-1	30	8	Fluff	1
PS62/004-2	0-1	30	9	250-630	8
PS62/004-2	0-1	30	9	250-630	8
PS62/004-2	0-1	35	8	125-250	64
PS62/004-2	0-1	35	8	Fluff	1
PS62/004-2	0-1	35	10	250-630	8
PS62/004-2	0-1	40	7	125-250	64
PS62/004-2	0-1	40	7	125-250	64
PS62/004-2	0-1	40	8	125-250	64
PS62/004-2	0-1	40	8	250-630	8
PS62/004-2	0-1	40	8	250-630	8
PS62/004-2	0-1	40	8	Fluff	1
PS62/004-2	0-1	40	9	125-250	64
PS62/004-2	0-1	40	9	250-630	8
PS62/004-2	0-1	40	9	250-630	8
PS62/004-2	0-1	40	9	250-630	8
PS62/004-2	0-1	40	9	250-630	8
PS62/004-2	0-1	40	9	250-630	8
PS62/004-2	0-1	40	10	250-630	8
PS62/004-2	0-1	40	11	250-630	8
PS62/004-2	0-1	45	8	250-630	8
PS62/004-2	0-1	45	8	Fluff	1
PS62/004-2	0-1	45	9	250-630	8
PS62/004-2	0-1	45	10	>2000	1
PS62/004-2	0-1	45	10	250-630	8
PS62/004-2	0-1	45	10	250-630	8
PS62/004-2	0-1	45	10	Fluff	1
PS62/004-2	0-1	50	6	>2000	1
PS62/004-2	0-1	50	7	250-630	8
PS62/004-2	0-1	50	8	>2000	1
PS62/004-2	0-1	50	8	250-630	8
PS62/004-2	0-1	50	9	125-250	64
PS62/004-2	0-1	50	9	250-630	8
PS62/004-2	0-1	50	10	250-630	8
PS62/004-2	0-1	50	10	250-630	8
PS62/004-2	0-1	55	8	>2000	1
PS62/004-2	0-1	55	8	125-250	64
PS62/004-2	0-1	55	8	250-630	8
PS62/004-2	0-1	55	9	250-630	8
PS62/004-2	0-1	60	9	250-630	8
PS62/004-2	0-1	60	9	250-630	8
PS62/004-2	0-1	60	9	250-630	8
PS62/004-2	0-1	60	9	250-630	8
PS62/010-2	0-1	25	8	250-630	64
PS62/010-2	0-1	25	9	250-630	64
PS62/010-2	0-1	30	8	>2000	1
PS62/010-2	0-1	30	8	>2000	1
PS62/010-2	0-1	30	9	630-2000	2
PS62/010-2	0-1	30	10	250-630	64
PS62/010-2	0-1	35	8	>2000	1
PS62/010-2	0-1	35	8	>2000	1
PS62/010-2	0-1	35	8	250-630	64
PS62/010-2	0-1	35	9	>2000	1
PS62/010-2	0-1	35	9	250-630	64
PS62/010-2	0-1	35	9	250-630	64
PS62/010-2	0-1	40	7	>2000	1
PS62/010-2	0-1	40	7	125-250	32
PS62/010-2	0-1	40	8	>2000	1
PS62/010-2	0-1	40	9	>2000	1
PS62/010-2	0-1	40	9	630-2000	2
PS62/010-2	0-1	40	9	250-630	64
PS62/010-2	0-1	40	9	250-630	64
PS62/010-2	0-1	45	8	>2000	1
PS62/010-2	0-1	45	8	630-2000	2
PS62/010-2	0-1	45	10	630-2000	2
PS62/010-2	0-1	50	8	>2000	1
PS62/010-2	0-1	50	8	250-630	64
PS62/010-2	0-1	50	9	>2000	1
PS62/010-2	0-1	50	9	>2000	1
PS62/010-2	0-1	50	10	>2000	1
PS62/012-2	0-1	20	10	>2000	1
PS62/012-2	0-1	25	8	>2000	1
PS62/012-2	0-1	25	8	125-250	256
PS62/012-2	0-1	25	9	>2000	1
PS62/012-2	0-1	25	9	>2000	1
PS62/012-2	0-1	25	9	630-205	32
PS62/012-2	0-1	25	9	Org. res.	1
PS62/012-2	0-1	25	10	>2000	1
PS62/012-2	0-1	25	10	630-205	32
PS62/012-2	0-1	25	10	630-205	32
PS62/012-2	0-1	25	10	630-205	32
PS62/012-2	0-1	30	7	630-205	32

Table A.33: continued

Station	Sediment depth [cm]	Proloculus diameter [μm]	Number of chambers within the last whorl	Size fraction [μm]	Split factor
PS62/012-2	0-1	30	8	>2000	1
PS62/012-2	0-1	30	8	125-250	256
PS62/012-2	0-1	30	8	125-250	256
PS62/012-2	0-1	30	8	630-205	32
PS62/012-2	0-1	30	9	>2000	1
PS62/012-2	0-1	30	9	>2000	1
PS62/012-2	0-1	30	9	630-205	32
PS62/012-2	0-1	30	9	630-205	32
PS62/012-2	0-1	30	9	630-205	32
PS62/012-2	0-1	30	9	630-205	32
PS62/012-2	0-1	30	9	630-205	32
PS62/012-2	0-1	30	9	630-205	32
PS62/012-2	0-1	30	9	630-205	32
PS62/012-2	0-1	30	9	630-205	32
PS62/012-2	0-1	30	10	630-205	32
PS62/012-2	0-1	30	10	630-205	32
PS62/012-2	0-1	30	10	630-205	32
PS62/012-2	0-1	30	10	630-205	32
PS62/012-2	0-1	30	10	630-205	32
PS62/012-2	0-1	30	11	>2000	1
PS62/012-2	0-1	35	8	>2000	1
PS62/012-2	0-1	35	8	125-250	256
PS62/012-2	0-1	35	8	630-205	32
PS62/012-2	0-1	35	8	630-205	32
PS62/012-2	0-1	35	8	630-205	32
PS62/012-2	0-1	35	9	>2000	1
PS62/012-2	0-1	35	9	>2000	1
PS62/012-2	0-1	35	9	>2000	1
PS62/012-2	0-1	35	9	>2000	1
PS62/012-2	0-1	35	9	630-205	32
PS62/012-2	0-1	35	9	630-205	32
PS62/012-2	0-1	35	9	630-205	32
PS62/012-2	0-1	35	9	630-205	32
PS62/012-2	0-1	35	9	630-205	32
PS62/012-2	0-1	35	10	>2000	1
PS62/012-2	0-1	35	10	>2000	1
PS62/012-2	0-1	35	10	>2000	1
PS62/012-2	0-1	35	10	>2000	1
PS62/012-2	0-1	35	10	>2000	1
PS62/012-2	0-1	35	10	630-205	32
PS62/012-2	0-1	35	10	630-205	32
PS62/012-2	0-1	35	11	630-205	32
PS62/012-2	0-1	40	7	>2000	1
PS62/012-2	0-1	40	8	>2000	1
PS62/012-2	0-1	40	8	>2000	1
PS62/012-2	0-1	40	8	125-250	256
PS62/012-2	0-1	40	8	630-205	32
PS62/012-2	0-1	40	9	>2000	1
PS62/012-2	0-1	40	9	>2000	1
PS62/012-2	0-1	40	9	>2000	1
PS62/012-2	0-1	40	9	>2000	1
PS62/012-2	0-1	40	9	630-205	32
PS62/012-2	0-1	40	9	630-205	32
PS62/012-2	0-1	40	9	630-205	32
PS62/012-2	0-1	40	9	630-205	32
PS62/012-2	0-1	40	10	630-205	32
PS62/012-2	0-1	40	10	630-205	32
PS62/012-2	0-1	40	10	630-205	32
PS62/012-2	0-1	40	10	630-205	32
PS62/012-2	0-1	40	10	630-205	32
PS62/012-2	0-1	40	10	630-205	32
PS62/012-2	0-1	45	7	>2000	1
PS62/012-2	0-1	45	7	630-205	32
PS62/012-2	0-1	45	8	630-205	32
PS62/012-2	0-1	45	9	>2000	1
PS62/012-2	0-1	45	9	>2000	1
PS62/012-2	0-1	45	9	>2000	1
PS62/012-2	0-1	45	9	125-250	256
PS62/012-2	0-1	45	9	630-205	32
PS62/012-2	0-1	45	9	630-205	32
PS62/012-2	0-1	45	9	630-205	32
PS62/012-2	0-1	45	10	630-205	32
PS62/012-2	0-1	45	10	630-205	32
PS62/012-2	0-1	50	7	>2000	1
PS62/012-2	0-1	50	8	630-205	32
PS62/012-2	0-1	50	8	630-205	32
PS62/012-2	0-1	50	9	630-205	32
PS62/012-2	0-1	50	9	630-205	32
PS62/012-2	0-1	50	9	630-205	32
PS62/012-2	0-1	50	10	630-205	32
PS62/012-2	0-1	50	10	630-205	32
PS62/017-1	0-1	20	7	125-250	4
PS62/017-1	0-1	20	9	250-630	1
PS62/017-1	0-1	20	10	250-630	1
PS62/017-1	0-1	25	8	125-250	4
PS62/017-1	0-1	25	8	125-250	4
PS62/017-1	0-1	25	9	250-630	1
PS62/017-1	0-1	25	9	250-630	1

Table A.33: continued

Station	Sediment depth [cm]	Proloculus diameter [μm]	Number of chambers within the last whorl	Size fraction [μm]	Split factor
PS62/017-1	0-1	25	10	250-630	1
PS62/017-1	0-1	25	10	250-630	1
PS62/017-1	0-1	25	10	250-630	1
PS62/017-1	0-1	25	10	250-630	1
PS62/017-1	0-1	25	11	250-630	1
PS62/017-1	0-1	30	7	125-250	4
PS62/017-1	0-1	30	7	Org. res.	1
PS62/017-1	0-1	30	8	125-250	4
PS62/017-1	0-1	30	8	125-250	4
PS62/017-1	0-1	30	8	250-630	1
PS62/017-1	0-1	30	8	250-630	1
PS62/017-1	0-1	30	8	250-630	1
PS62/017-1	0-1	30	9	125-250	4
PS62/017-1	0-1	30	10	250-630	1
PS62/017-1	0-1	30	10	250-630	1
PS62/017-1	0-1	30	10	250-630	1
PS62/017-1	0-1	30	10	250-630	1
PS62/017-1	0-1	30	10	250-630	1
PS62/017-1	0-1	35	6	250-630	1
PS62/017-1	0-1	35	7	250-630	1
PS62/017-1	0-1	35	8	125-250	4
PS62/017-1	0-1	35	8	250-630	1
PS62/017-1	0-1	35	8	250-630	1
PS62/017-1	0-1	35	9	125-250	4
PS62/017-1	0-1	35	9	125-250	4
PS62/017-1	0-1	35	9	250-630	1
PS62/017-1	0-1	35	9	250-630	1
PS62/017-1	0-1	35	9	250-630	1
PS62/017-1	0-1	35	9	250-630	1
PS62/017-1	0-1	35	9	250-630	1
PS62/017-1	0-1	35	10	250-630	1
PS62/017-1	0-1	35	10	250-630	1
PS62/017-1	0-1	35	10	250-630	1
PS62/017-1	0-1	35	10	250-630	1
PS62/017-1	0-1	35	10	250-630	1
PS62/017-1	0-1	40	6	125-250	4
PS62/017-1	0-1	40	8	125-250	4
PS62/017-1	0-1	40	8	250-630	1
PS62/017-1	0-1	40	8	250-630	1
PS62/017-1	0-1	40	8	250-630	1
PS62/017-1	0-1	40	8	Org. res.	1
PS62/017-1	0-1	40	9	125-250	4
PS62/017-1	0-1	40	9	250-630	1
PS62/017-1	0-1	40	9	250-630	1
PS62/017-1	0-1	40	9	250-630	1
PS62/017-1	0-1	40	9	250-630	1
PS62/017-1	0-1	40	9	250-630	1
PS62/017-1	0-1	40	9	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	10	250-630	1
PS62/017-1	0-1	40	11	250-630	1
PS62/017-1	0-1	45	9	250-630	1
PS62/017-1	0-1	45	9	250-630	1
PS62/017-1	0-1	45	10	125-250	4
PS62/017-1	0-1	45	10	250-630	1
PS62/017-1	0-1	45	10	250-630	1
PS62/017-1	0-1	45	10	250-630	1
PS62/017-1	0-1	45	10	250-630	1
PS62/017-1	0-1	45	10	250-630	1
PS62/017-1	0-1	45	10	250-630	1
PS62/017-1	0-1	45	11	250-630	1
PS62/017-1	0-1	50	9	250-630	1
PS62/017-1	0-1	50	9	250-630	1
PS62/017-1	0-1	50	10	250-630	1
PS62/017-1	0-1	50	10	250-630	1
PS62/017-1	0-1	50	10	250-630	1
PS62/017-1	0-1	50	10	250-630	1
PS62/017-1	0-1	50	10	250-630	1
PS62/017-1	0-1	50	10	250-630	1
PS62/017-1	0-1	50	10	250-630	1
PS62/017-1	0-1	50	10	250-630	1
PS62/017-1	0-1	50	11	250-630	1
PS62/017-1	0-1	50	11	250-630	1
PS62/017-1	0-1	50	11	250-630	1
PS62/017-1	0-1	55	8	250-630	1
PS62/017-1	0-1	55	8	250-630	1
PS62/017-1	0-1	55	10	250-630	1
PS62/017-1	0-1	60	11	250-630	1
PS62/020-1	0-1	25	8	250-630	1
PS62/020-1	0-1	25	8	250-630	1
PS62/020-1	0-1	25	9	250-630	1
PS62/020-1	0-1	25	9	250-630	1
PS62/020-1	0-1	25	9	250-630	1
PS62/020-1	0-1	25	10	250-630	1
PS62/020-1	0-1	25	11	250-630	1
PS62/020-1	0-1	25	11	250-630	1
PS62/020-1	0-1	30	7	Fluff	1

Table A.33: continued

Station	Sediment depth [cm]	Proloculus diameter [μm]	Number of chambers within the last whorl	Size fraction [μm]	Split factor
PS62/020-1	0-1	50	11	250-630	1
PS62/020-1	0-1	50	11	250-630	1
PS62/020-1	0-1	55	8	250-630	1
PS62/020-1	0-1	55	8	250-630	1
PS62/020-1	0-1	55	9	125-250	4
PS62/020-1	0-1	55	9	125-250	4
PS62/020-1	0-1	55	9	250-630	1
PS62/020-1	0-1	55	10	250-630	1
PS62/020-1	0-1	55	10	250-630	1
PS62/020-1	0-1	55	10	250-630	1
PS62/020-1	0-1	55	10	250-630	1
PS62/020-1	0-1	55	10	Fluff	1
PS62/020-1	0-1	55	11	250-630	1
PS62/020-1	0-1	55	11	250-630	1
PS62/020-1	0-1	60	6	125-250	4
PS62/020-1	0-1	60	8	250-630	1
PS62/020-1	0-1	60	8	250-630	1
PS62/020-1	0-1	60	9	250-630	1
PS62/020-1	0-1	60	9	250-630	1
PS62/020-1	0-1	60	9	250-630	1
PS62/020-1	0-1	60	9	250-630	1
PS62/020-1	0-1	60	9	250-630	1
PS62/020-1	0-1	60	9	250-630	1
PS62/020-1	0-1	60	10	250-630	1
PS62/020-1	0-1	60	10	250-630	1
PS62/020-1	0-1	60	10	250-630	1
PS62/020-1	0-1	60	10	250-630	1
PS62/020-1	0-1	60	10	250-630	1
PS62/020-1	0-1	60	10	250-630	1
PS62/020-1	0-1	60	10	250-630	1
PS62/020-1	0-1	60	10	250-630	1
PS62/020-1	0-1	60	11	250-630	1
PS62/020-1	0-1	60	12	250-630	1
PS62/020-1	0-1	65	6	125-250	4
PS62/020-1	0-1	65	11	250-630	1
PS62/020-1	0-1	70	9	250-630	1
PS62/020-1	0-1	70	9	250-630	1
PS62/020-1	0-1	70	9	250-630	1
PS62/020-1	0-1	70	11	250-630	1
PS62/020-1	0-1	80	8	250-630	1
PS62/021-1	0-1	20	8	125-250	16
PS62/021-1	0-1	20	9	630-2000	1
PS62/021-1	0-1	20	9	250-630	16
PS62/021-1	0-1	20	9	250-630	16
PS62/021-1	0-1	20	11	>2000	1
PS62/021-1	0-1	25	7	125-250	16
PS62/021-1	0-1	25	7	125-250	16
PS62/021-1	0-1	25	8	125-250	16
PS62/021-1	0-1	25	8	250-630	16
PS62/021-1	0-1	25	8	250-630	16
PS62/021-1	0-1	25	8	250-630	16
PS62/021-1	0-1	25	9	630-2000	1
PS62/021-1	0-1	25	9	630-2000	1
PS62/021-1	0-1	25	9	630-2000	1
PS62/021-1	0-1	25	9	125-250	16
PS62/021-1	0-1	25	9	125-250	16
PS62/021-1	0-1	25	9	250-630	16
PS62/021-1	0-1	25	9	250-630	16
PS62/021-1	0-1	25	9	250-630	16
PS62/021-1	0-1	25	10	630-2000	1
PS62/021-1	0-1	25	10	125-250	16
PS62/021-1	0-1	30	8	630-2000	1
PS62/021-1	0-1	30	8	630-2000	1
PS62/021-1	0-1	30	8	630-2000	1
PS62/021-1	0-1	30	8	125-250	16
PS62/021-1	0-1	30	8	125-250	16
PS62/021-1	0-1	30	8	125-250	16
PS62/021-1	0-1	30	8	125-250	16
PS62/021-1	0-1	30	8	125-250	16
PS62/021-1	0-1	30	8	125-250	16
PS62/021-1	0-1	30	9	630-2000	1
PS62/021-1	0-1	30	9	630-2000	1
PS62/021-1	0-1	30	9	125-250	16
PS62/021-1	0-1	30	9	125-250	16
PS62/021-1	0-1	30	9	125-250	16
PS62/021-1	0-1	30	9	125-250	16
PS62/021-1	0-1	30	9	250-630	16
PS62/021-1	0-1	30	9	250-630	16
PS62/021-1	0-1	30	9	250-630	16
PS62/021-1	0-1	30	9	250-630	16
PS62/021-1	0-1	30	9	250-630	16
PS62/021-1	0-1	30	9	250-630	16
PS62/021-1	0-1	30	9	250-630	16
PS62/021-1	0-1	30	9	250-630	16
PS62/021-1	0-1	30	10	630-2000	1
PS62/021-1	0-1	30	10	630-2000	1
PS62/021-1	0-1	30	10	125-250	16
PS62/021-1	0-1	30	10	125-250	16

Table A.33: continued

Station	Sediment depth [cm]	Proloculus diameter [μm]	Number of chambers within the last whorl	Size fraction [μm]	Split factor
PS62/021-1	0-1	50	8	>2000	1
PS62/021-1	0-1	50	8	>2000	1
PS62/021-1	0-1	50	9	630-2000	1
PS62/021-1	0-1	50	9	630-2000	1
PS62/021-1	0-1	50	9	250-630	16
PS62/021-1	0-1	50	9	250-630	16
PS62/021-1	0-1	50	9	250-630	16
PS62/021-1	0-1	50	9	250-630	16
PS62/021-1	0-1	50	10	250-630	16
PS62/021-1	0-1	55	9	250-630	16
PS62/021-1	0-1	55	9	250-630	16
PS62/021-1	0-1	55	9	250-630	16
GIK23519-5	67-68	20	8	150-250	1
GIK23519-5	67-68	20	9	150-250	1
GIK23519-5	67-68	20	9	150-250	1
GIK23519-5	67-68	20	10	150-250	1
GIK23519-5	67-68	20	10	150-250	1
GIK23519-5	67-68	20	11	315-400	1
GIK23519-5	67-68	25	8	150-250	1
GIK23519-5	67-68	25	9	150-250	1
GIK23519-5	67-68	25	9	150-250	1
GIK23519-5	67-68	25	9	150-250	1
GIK23519-5	67-68	30	7	150-250	1
GIK23519-5	67-68	30	8	150-250	1
GIK23519-5	67-68	30	8	315-400	1
GIK23519-5	67-68	30	8	315-400	1
GIK23519-5	67-68	30	9	150-250	1
GIK23519-5	67-68	30	9	150-250	1
GIK23519-5	67-68	30	9	150-250	1
GIK23519-5	67-68	30	9	150-250	1
GIK23519-5	67-68	30	9	315-400	1
GIK23519-5	67-68	30	9	315-400	1
GIK23519-5	67-68	30	10	150-250	1
GIK23519-5	67-68	30	10	150-250	1
GIK23519-5	67-68	30	10	150-250	1
GIK23519-5	67-68	30	10	150-250	1
GIK23519-5	67-68	30	10	150-250	1
GIK23519-5	67-68	30	10	150-250	1
GIK23519-5	67-68	30	10	150-250	1
GIK23519-5	67-68	30	10	315-400	1
GIK23519-5	67-68	30	10	315-400	1
GIK23519-5	67-68	30	11	150-250	1
GIK23519-5	67-68	30	11	150-250	1
GIK23519-5	67-68	30	11	150-250	1
GIK23519-5	67-68	35	7	150-250	1
GIK23519-5	67-68	35	8	150-250	1
GIK23519-5	67-68	35	9	150-250	1
GIK23519-5	67-68	35	9	150-250	1
GIK23519-5	67-68	35	9	150-250	1
GIK23519-5	67-68	35	9	315-400	1
GIK23519-5	67-68	35	10	150-250	1
GIK23519-5	67-68	35	10	150-250	1
GIK23519-5	67-68	35	10	315-400	1
GIK23519-5	67-68	35	10	315-400	1
GIK23519-5	67-68	35	11	150-250	1
GIK23519-5	67-68	35	no data	150-250	1
GIK23519-5	67-68	40	8	150-250	1
GIK23519-5	67-68	40	8	150-250	1
GIK23519-5	67-68	40	9	>400	1
GIK23519-5	67-68	40	9	150-250	1
GIK23519-5	67-68	40	9	150-250	1
GIK23519-5	67-68	40	9	150-250	1
GIK23519-5	67-68	40	9	150-250	1
GIK23519-5	67-68	40	9	150-250	1
GIK23519-5	67-68	40	9	150-250	1
GIK23519-5	67-68	40	9	315-400	1
GIK23519-5	67-68	40	9	315-400	1
GIK23519-5	67-68	40	9	315-400	1
GIK23519-5	67-68	40	9	315-400	1
GIK23519-5	67-68	40	9	315-400	1
GIK23519-5	67-68	40	9	315-400	1
GIK23519-5	67-68	40	9	315-400	1
GIK23519-5	67-68	40	9	315-400	1
GIK23519-5	67-68	40	9	315-400	1
GIK23519-5	67-68	40	10	150-250	1
GIK23519-5	67-68	40	10	150-250	1
GIK23519-5	67-68	40	10	150-250	1
GIK23519-5	67-68	40	10	150-250	1
GIK23519-5	67-68	40	10	315-400	1
GIK23519-5	67-68	40	10	315-400	1
GIK23519-5	67-68	40	10	315-400	1
GIK23519-5	67-68	40	10	315-400	1

Table A.33: continued

Station	Sediment depth [cm]	Proloculus diameter [μm]	Number of chambers within the last whorl	Size fraction [μm]	Split factor
GIK23519-5	67-68	40	10	315-400	1
GIK23519-5	67-68	40	10	315-400	1
GIK23519-5	67-68	40	10	315-400	1
GIK23519-5	67-68	40	12	315-400	1
GIK23519-5	67-68	40	12	315-400	1
GIK23519-5	67-68	45	9	150-250	1
GIK23519-5	67-68	45	9	150-250	1
GIK23519-5	67-68	45	9	315-400	1
GIK23519-5	67-68	45	9	315-400	1
GIK23519-5	67-68	45	10	315-400	1
GIK23519-5	67-68	45	10	315-400	1
GIK23519-5	67-68	45	10	315-400	1
GIK23519-5	67-68	45	10	315-400	1
GIK23519-5	67-68	45	11	315-400	1
GIK23519-5	67-68	50	9	150-250	1
GIK23519-5	67-68	50	9	315-400	1
GIK23519-5	67-68	50	9	315-400	1
GIK23519-5	67-68	50	10	>400	1
GIK23519-5	67-68	50	10	315-400	1
GIK23519-5	67-68	50	10	315-400	1
GIK23519-5	67-68	50	10	315-400	1
GIK23519-5	67-68	50	11	>400	1
GIK23519-5	67-68	50	11	315-400	1
GIK23519-5	67-68	50	11	315-400	1
GIK23519-5	67-68	50	no data	>400	1
GIK23519-5	67-68	55	9	315-400	1
GIK23519-5	67-68	55	9	315-400	1
GIK23519-5	67-68	60	9	315-400	1
GIK23519-5	67-68	60	9	315-400	1
GIK23519-5	67-68	60	10	315-400	1
GIK23519-5	67-68	60	10	315-400	1
GIK23519-5	67-68	60	10	315-400	1
GIK23519-5	67-68	65	9	>400	1
GIK23519-5	79-80	20	10	250-315	1
GIK23519-5	79-80	25	6	150-250	1
GIK23519-5	79-80	25	9	150-250	1
GIK23519-5	79-80	25	9	150-250	1
GIK23519-5	79-80	25	10	150-250	1
GIK23519-5	79-80	25	10	150-250	1
GIK23519-5	79-80	25	10	250-315	1
GIK23519-5	79-80	30	8	150-250	1
GIK23519-5	79-80	30	8	150-250	1
GIK23519-5	79-80	30	8	150-250	1
GIK23519-5	79-80	30	8	150-250	1
GIK23519-5	79-80	30	8	315-400	1
GIK23519-5	79-80	30	9	250-315	1
GIK23519-5	79-80	30	9	250-315	1
GIK23519-5	79-80	30	9	315-400	1
GIK23519-5	79-80	30	10	150-250	1
GIK23519-5	79-80	30	10	150-250	1
GIK23519-5	79-80	30	10	250-315	1
GIK23519-5	79-80	30	10	250-315	1
GIK23519-5	79-80	30	10	315-400	1
GIK23519-5	79-80	30	11	250-315	1
GIK23519-5	79-80	35	7	150-250	1
GIK23519-5	79-80	35	8	150-250	1
GIK23519-5	79-80	35	8	150-250	1
GIK23519-5	79-80	35	9	150-250	1
GIK23519-5	79-80	35	9	150-250	1
GIK23519-5	79-80	35	9	150-250	1
GIK23519-5	79-80	35	9	150-250	1
GIK23519-5	79-80	35	9	150-250	1
GIK23519-5	79-80	35	9	250-315	1
GIK23519-5	79-80	35	9	315-400	1
GIK23519-5	79-80	35	9	315-400	1
GIK23519-5	79-80	35	10	150-250	1
GIK23519-5	79-80	35	10	150-250	1
GIK23519-5	79-80	35	10	150-250	1
GIK23519-5	79-80	40	8	150-250	1
GIK23519-5	79-80	40	8	150-250	1
GIK23519-5	79-80	40	8	150-250	1
GIK23519-5	79-80	40	8	150-250	1
GIK23519-5	79-80	40	8	150-250	1
GIK23519-5	79-80	40	8	315-400	1
GIK23519-5	79-80	40	9	150-250	1
GIK23519-5	79-80	40	9	150-250	1
GIK23519-5	79-80	40	9	150-250	1
GIK23519-5	79-80	40	9	150-250	1
GIK23519-5	79-80	40	9	150-250	1
GIK23519-5	79-80	40	9	150-250	1
GIK23519-5	79-80	40	9	250-315	1
GIK23519-5	79-80	40	9	250-315	1
GIK23519-5	79-80	40	9	250-315	1
GIK23519-5	79-80	40	9	250-315	1
GIK23519-5	79-80	40	9	250-315	1

Table A.33: continued

Station	Sediment depth [cm]	Proloculus diameter [μm]	Number of chambers within the last whorl	Size fraction [μm]	Split factor
GIK23519-5	79-80	40	9	250-315	1
GIK23519-5	79-80	40	9	315-400	1
GIK23519-5	79-80	40	9	315-400	1
GIK23519-5	79-80	40	10	150-250	1
GIK23519-5	79-80	40	10	150-250	1
GIK23519-5	79-80	40	10	150-250	1
GIK23519-5	79-80	40	10	150-250	1
GIK23519-5	79-80	40	10	250-315	1
GIK23519-5	79-80	40	10	315-400	1
GIK23519-5	79-80	40	11	150-250	1
GIK23519-5	79-80	40	11	150-250	1
GIK23519-5	79-80	40	11	250-315	1
GIK23519-5	79-80	45	8	250-315	1
GIK23519-5	79-80	45	8	315-400	1
GIK23519-5	79-80	45	9	315-400	1
GIK23519-5	79-80	45	10	250-315	1
GIK23519-5	79-80	45	11	>400	1
GIK23519-5	79-80	45	11	250-315	1
GIK23519-5	79-80	50	8	150-250	1
GIK23519-5	79-80	50	8	315-400	1
GIK23519-5	79-80	50	9	150-250	1
GIK23519-5	79-80	50	9	250-315	1
GIK23519-5	79-80	50	10	150-250	1
GIK23519-5	79-80	50	10	250-315	1
GIK23519-5	79-80	50	10	250-315	1
GIK23519-5	79-80	55	10	250-315	1
GIK23519-5	79-80	60	9	315-400	1

Table A.34: Weight of single *C. wuellerstorfi* according to their sampling station, sediment depth, maximum test diameter, coiling direction, and number of chambers within the last whorl.

Station	Sediment depth [cm]	Test weight [μg]	Maximum test diameter [μm]	Coiling direction	Number of chambers within the last whorl
PS62/002-3	0-1	2,3	200	left	6
PS62/002-3	0-1	5,5	245	left	6
PS62/002-3	0-1	1,3	210	right	7
PS62/002-3	0-1	2,9	295	left	7
PS62/002-3	0-1	1,2	225	left	8
PS62/002-3	0-1	2,2	230	left	8
PS62/002-3	0-1	4,3	250	left	8
PS62/002-3	0-1	5,6	275	left	8
PS62/002-3	0-1	7,1	300	right	8
PS62/002-3	0-1	7,6	305	left	8
PS62/002-3	0-1	8,9	330	left	8
PS62/002-3	0-1	9,0	365	left	8
PS62/002-3	0-1	11,5	365	left	8
PS62/002-3	0-1	17,2	405	left	8
PS62/002-3	0-1	18,5	460	left	8
PS62/002-3	0-1	30,0	560	right	8
PS62/002-3	0-1	2,2	265	left	9
PS62/002-3	0-1	4,5	290	right	9
PS62/002-3	0-1	7,2	365	left	9
PS62/002-3	0-1	8,9	340	right	9
PS62/002-3	0-1	9,9	360	left	9
PS62/002-3	0-1	11,9	380	left	9
PS62/002-3	0-1	12,6	405	left	9
PS62/002-3	0-1	13,9	410	right	9
PS62/002-3	0-1	16,5	430	right	9
PS62/002-3	0-1	18,7	405	right	9
PS62/002-3	0-1	19,5	440	left	9
PS62/002-3	0-1	19,9	425	right	9
PS62/002-3	0-1	25,6	470	left	9
PS62/002-3	0-1	25,7	500	right	9
PS62/002-3	0-1	25,8	510	left	9
PS62/002-3	0-1	25,9	465	left	9
PS62/002-3	0-1	27,7	525	left	9
PS62/002-3	0-1	28,3	540	left	9
PS62/002-3	0-1	32,1	460	right	9
PS62/002-3	0-1	32,7	485	left	9
PS62/002-3	0-1	66,7	610	right	9
PS62/002-3	0-1	403,4	1230	right	9
PS62/002-3	0-1	20,5	460	left	10
PS62/002-3	0-1	28,7	485	left	10
PS62/002-3	0-1	129,3	915	left	10
PS62/002-3	0-1	39,7	580	left	11
PS62/004-2	0-1	1,2	210	right	7
PS62/004-2	0-1	3,4	275	left	7
PS62/004-2	0-1	3,4	240	left	8
PS62/004-2	0-1	9,8	370	left	8
PS62/004-2	0-1	11,9	420	left	8

Table A.34: continued

Station	Sediment depth [cm]	Test weight [μg]	Maximum test diameter [μm]	Coiling direction	Number of chambers within the last whorl
PS62/004-2	0-1	6,3	325	left	9
PS62/004-2	0-1	6,6	310	left	9
PS62/004-2	0-1	9,7	375	left	9
PS62/004-2	0-1	20,6	415	left	9
PS62/004-2	0-1	30,7	610	left	9
PS62/004-2	0-1	31,8	590	left	9
PS62/004-2	0-1	1,6	230	right	10
PS62/004-2	0-1	13,9	410	left	10
PS62/004-2	0-1	20,7	485	left	10
PS62/004-2	0-1	34,9	595	left	10
PS62/010-2	0-1	3,4	300	left	7
PS62/010-2	0-1	11,3	340	right	8
PS62/010-2	0-1	30,3	570	right	9
PS62/010-2	0-1	61,7	750	left	9
PS62/010-2	0-1	65,0	735	left	9
PS62/010-2	0-1	90,6	840	left	9
PS62/010-2	0-1	195,1	1060	left	9
PS62/010-2	0-1	203,4	1080	left	9
PS62/010-2	0-1	69,5	740	left	10
PS62/012-2	0-1	49,7	610	left	7
PS62/012-2	0-1	2,4	220	left	8
PS62/012-2	0-1	5,5	280	left	8
PS62/012-2	0-1	8,0	360	right	8
PS62/012-2	0-1	15,1	430	right	8
PS62/012-2	0-1	15,3	460	left	8
PS62/012-2	0-1	20,2	405	left	8
PS62/012-2	0-1	8,3	300	left	9
PS62/012-2	0-1	10,2	350	left	9
PS62/012-2	0-1	13,0	390	left	9
PS62/012-2	0-1	15,9	405	left	9
PS62/012-2	0-1	16,3	455	left	9
PS62/012-2	0-1	16,3	430	right	9
PS62/012-2	0-1	17,3	420	left	9
PS62/012-2	0-1	17,8	445	left	9
PS62/012-2	0-1	18,3	410	left	9
PS62/012-2	0-1	19,2	460	right	9
PS62/012-2	0-1	20,6	440	left	9
PS62/012-2	0-1	22,7	505	right	9
PS62/012-2	0-1	23,3	490	left	9
PS62/012-2	0-1	26,9	475	left	9
PS62/012-2	0-1	27,1	515	right	9
PS62/012-2	0-1	28,5	500	right	9
PS62/012-2	0-1	32,2	550	right	9
PS62/012-2	0-1	37,2	625	left	9
PS62/012-2	0-1	38,6	585	left	9
PS62/012-2	0-1	49,4	560	left	9
PS62/012-2	0-1	70,3	735	right	9
PS62/012-2	0-1	73,1	760	right	9
PS62/012-2	0-1	79,6	790	left	9
PS62/012-2	0-1	83,1	790	left	9
PS62/012-2	0-1	84,8	780	left	9
PS62/012-2	0-1	14,5	475	left	10
PS62/012-2	0-1	21,8	440	left	10
PS62/012-2	0-1	24,5	515	left	10
PS62/012-2	0-1	34,8	545	right	10
PS62/012-2	0-1	36,8	610	right	10
PS62/012-2	0-1	43,2	600	left	10
PS62/012-2	0-1	46,0	695	left	10
PS62/012-2	0-1	48,1	560	left	10
PS62/012-2	0-1	62,9	710	left	10
PS62/012-2	0-1	76,8	805	left	10
PS62/012-2	0-1	86,7	765	left	10
PS62/012-2	0-1	8,0	335	right	11
PS62/012-2	0-1	56,5	655	left	11
PS62/017-1	0-1	3,7	240	right	8
PS62/017-1	0-1	54,6	680	left	8
PS62/017-1	0-1	5,0	290	left	9
PS62/017-1	0-1	9,7	335	left	9
PS62/017-1	0-1	11,5	370	left	9
PS62/017-1	0-1	14,8	435	left	9
PS62/017-1	0-1	38,7	550	left	9
PS62/017-1	0-1	38,7	560	left	9
PS62/017-1	0-1	51,7	670	right	9
PS62/017-1	0-1	58,7	640	left	9
PS62/017-1	0-1	62,9	650	right	9
PS62/017-1	0-1	2,7	235	left	10
PS62/017-1	0-1	12,2	390	left	10
PS62/017-1	0-1	14,6	390	right	10
PS62/017-1	0-1	18,3	450	left	10
PS62/017-1	0-1	24,7	540	left	10
PS62/017-1	0-1	26,5	500	right	10
PS62/017-1	0-1	29,2	540	left	10
PS62/017-1	0-1	32,3	540	left	10
PS62/017-1	0-1	50,1	660	right	10
PS62/017-1	0-1	50,4	650	left	10

Table A.34: continued

Station	Sediment depth [cm]	Test weight [μg]	Maximum test diameter [μm]	Coiling direction	Number of chambers within the last whorl
PS62/017-1	0-1	54,5	700	right	10
PS62/017-1	0-1	55,0	735	right	10
PS62/017-1	0-1	56,0	725	left	10
PS62/017-1	0-1	69,5	710	left	10
PS62/017-1	0-1	70,9	725	right	10
PS62/017-1	0-1	86,3	745	left	10
PS62/017-1	0-1	35,1	610	right	11
PS62/017-1	0-1	57,7	625	left	11
PS62/020-1	0-1	1,2	195	left	7
PS62/020-1	0-1	1,3	210	left	7
PS62/020-1	0-1	1,9	195	right	7
PS62/020-1	0-1	1,9	205	right	7
PS62/020-1	0-1	2,0	205	left	7
PS62/020-1	0-1	2,9	200	right	7
PS62/020-1	0-1	2,9	225	right	7
PS62/020-1	0-1	3,7	230	left	7
PS62/020-1	0-1	2,9	230	left	8
PS62/020-1	0-1	3,0	240	left	8
PS62/020-1	0-1	4,1	275	right	8
PS62/020-1	0-1	4,7	280	left	8
PS62/020-1	0-1	6,1	290	right	8
PS62/020-1	0-1	8,7	325	right	8
PS62/020-1	0-1	8,3	335	right	9
PS62/020-1	0-1	9,0	320	left	9
PS62/020-1	0-1	15,3	390	left	9
PS62/020-1	0-1	67,9	700	left	9
PS62/020-1	0-1	28,6	515	left	10
PS62/020-1	0-1	42,0	565	left	10
PS62/020-1	0-1	67,3	685	right	10
PS62/020-1	0-1	75,9	710	right	10
PS62/020-1	0-1	97,8	800	right	10
PS62/020-1	0-1	23,0	465	left	11
PS62/021-1	0-1	2,1	195	left	5
PS62/021-1	0-1	2,6	215	left	5
PS62/021-1	0-1	1,3	170	right	6
PS62/021-1	0-1	1,8	180	left	6
PS62/021-1	0-1	2,0	190	right	6
PS62/021-1	0-1	2,3	215	right	6
PS62/021-1	0-1	1,9	185	left	7
PS62/021-1	0-1	1,9	210	right	7
PS62/021-1	0-1	2,1	200	left	7
PS62/021-1	0-1	2,3	215	left	7
PS62/021-1	0-1	2,3	205	left	7
PS62/021-1	0-1	2,6	220	left	7
PS62/021-1	0-1	3,3	230	left	7
PS62/021-1	0-1	3,7	245	right	7
PS62/021-1	0-1	3,9	235	right	7
PS62/021-1	0-1	4,1	250	left	7
PS62/021-1	0-1	6,8	300	left	7
PS62/021-1	0-1	2,2	225	left	8
PS62/021-1	0-1	2,8	240	right	8
PS62/021-1	0-1	2,9	235	left	8
PS62/021-1	0-1	3,1	240	left	8
PS62/021-1	0-1	3,7	240	left	8
PS62/021-1	0-1	4,1	255	left	8
PS62/021-1	0-1	4,7	260	left	8
PS62/021-1	0-1	4,8	270	left	8
PS62/021-1	0-1	5,2	280	right	8
PS62/021-1	0-1	5,5	315	left	8
PS62/021-1	0-1	5,7	300	right	8
PS62/021-1	0-1	5,9	285	left	8
PS62/021-1	0-1	7,2	305	left	8
PS62/021-1	0-1	7,2	310	left	8
PS62/021-1	0-1	7,7	300	left	8
PS62/021-1	0-1	8,6	320	left	8
PS62/021-1	0-1	9,1	265	left	8
PS62/021-1	0-1	11,2	350	left	8
PS62/021-1	0-1	11,9	385	right	8
PS62/021-1	0-1	12,3	395	left	8
PS62/021-1	0-1	13,5	370	left	8
PS62/021-1	0-1	13,6	395	left	8
PS62/021-1	0-1	15,9	425	left	8
PS62/021-1	0-1	31,7	610	left	8
PS62/021-1	0-1	39,3	535	left	8
PS62/021-1	0-1	40,6	600	right	8
PS62/021-1	0-1	53,3	685	left	8
PS62/021-1	0-1	57,4	670	left	8
PS62/021-1	0-1	4,3	230	left	9
PS62/021-1	0-1	5,4	310	left	9
PS62/021-1	0-1	5,6	280	right	9
PS62/021-1	0-1	6,2	355	right	9
PS62/021-1	0-1	6,5	325	right	9
PS62/021-1	0-1	6,8	320	left	9
PS62/021-1	0-1	6,8	320	left	9
PS62/021-1	0-1	10,0	340	left	9

Table A.34: continued

Station	Sediment depth [cm]	Test weight [μg]	Maximum test diameter [μm]	Coiling direction	Number of chambers within the last whorl
PS62/021-1	0-1	11,0	375	left	9
PS62/021-1	0-1	11,5	400	left	9
PS62/021-1	0-1	12,6	400	left	9
PS62/021-1	0-1	13,2	410	right	9
PS62/021-1	0-1	18,6	470	left	9
PS62/021-1	0-1	19,4	450	right	9
PS62/021-1	0-1	19,6	480	right	9
PS62/021-1	0-1	20,9	445	right	9
PS62/021-1	0-1	24,5	470	left	9
PS62/021-1	0-1	26,7	520	left	9
PS62/021-1	0-1	29,1	520	left	9
PS62/021-1	0-1	34,2	570	left	9
PS62/021-1	0-1	37,8	655	left	9
PS62/021-1	0-1	41,2	590	left	9
PS62/021-1	0-1	44,4	610	right	9
PS62/021-1	0-1	45,7	625	left	9
PS62/021-1	0-1	45,7	580	right	9
PS62/021-1	0-1	48,5	650	right	9
PS62/021-1	0-1	50,9	660	right	9
PS62/021-1	0-1	51,2	650	right	9
PS62/021-1	0-1	51,4	680	left	9
PS62/021-1	0-1	62,8	705	right	9
PS62/021-1	0-1	137,6	960	left	9
PS62/021-1	0-1	8,8	340	right	10
PS62/021-1	0-1	13,1	380	left	10
PS62/021-1	0-1	14,2	375	right	10
PS62/021-1	0-1	21,1	470	left	10
PS62/021-1	0-1	22,8	465	left	10
PS62/021-1	0-1	22,9	370	left	10
PS62/021-1	0-1	27,7	505	left	10
PS62/021-1	0-1	30,8	550	left	10
PS62/021-1	0-1	33,3	355	left	10
PS62/021-1	0-1	37,2	640	left	10
PS62/021-1	0-1	46,2	660	left	10
PS62/021-1	0-1	34,7	530	left	11
GIK23519-5	67-68	7,3	300	left	8
GIK23519-5	67-68	15,9	370	left	8
GIK23519-5	67-68	18,6	380	left	8
GIK23519-5	67-68	40,8	610	left	8
GIK23519-5	67-68	2,6	225	right	9
GIK23519-5	67-68	4,8	275	left	9
GIK23519-5	67-68	4,8	270	left	9
GIK23519-5	67-68	7,9	320	left	9
GIK23519-5	67-68	7,9	325	right	9
GIK23519-5	67-68	8,6	340	left	9
GIK23519-5	67-68	8,9	345	left	9
GIK23519-5	67-68	9,6	335	left	9
GIK23519-5	67-68	10,9	370	right	9
GIK23519-5	67-68	11,5	330	left	9
GIK23519-5	67-68	15,9	395	left	9
GIK23519-5	67-68	16,5	395	left	9
GIK23519-5	67-68	16,9	450	left	9
GIK23519-5	67-68	17,1	430	right	9
GIK23519-5	67-68	20,0	465	left	9
GIK23519-5	67-68	22,0	450	left	9
GIK23519-5	67-68	28,2	490	right	9
GIK23519-5	67-68	29,6	550	right	9
GIK23519-5	67-68	31,5	540	right	9
GIK23519-5	67-68	32,6	525	left	9
GIK23519-5	67-68	37,4	610	left	9
GIK23519-5	67-68	41,1	565	right	9
GIK23519-5	67-68	42,7	610	left	9
GIK23519-5	67-68	53,4	640	left	9
GIK23519-5	67-68	4,6	275	left	10
GIK23519-5	67-68	6,0	310	right	10
GIK23519-5	67-68	8,0	310	left	10
GIK23519-5	67-68	9,8	350	left	10
GIK23519-5	67-68	11,5	365	left	10
GIK23519-5	67-68	12,0	415	left	10
GIK23519-5	67-68	12,3	360	left	10
GIK23519-5	67-68	12,3	350	right	10
GIK23519-5	67-68	15,2	420	left	10
GIK23519-5	67-68	16,0	420	right	10
GIK23519-5	67-68	20,9	470	right	10
GIK23519-5	67-68	22,0	465	left	10
GIK23519-5	67-68	22,2	470	left	10
GIK23519-5	67-68	28,8	500	left	10
GIK23519-5	67-68	31,4	530	right	10
GIK23519-5	67-68	35,4	560	right	10
GIK23519-5	67-68	41,8	610	left	10
GIK23519-5	67-68	45,3	615	left	10
GIK23519-5	67-68	18,7	490	left	11
GIK23519-5	67-68	35,6	590	right	11
GIK23519-5	79-80	4,2	325	right	7
GIK23519-5	79-80	3,3	250	right	8

Table A.34: continued

Station	Sediment depth [cm]	Test weight [μg]	Maximum test diameter [μm]	Coiling direction	Number of chambers within the last whorl
GIK23519-5	79-80	4,4	290	right	8
GIK23519-5	79-80	4,9	280	left	8
GIK23519-5	79-80	5,2	280	left	8
GIK23519-5	79-80	6,3	305	right	8
GIK23519-5	79-80	6,3	290	right	8
GIK23519-5	79-80	6,7	305	left	8
GIK23519-5	79-80	7,1	320	left	8
GIK23519-5	79-80	11,2	355	right	8
GIK23519-5	79-80	35,8	535	left	8
GIK23519-5	79-80	36,8	580	left	8
GIK23519-5	79-80	5,2	270	left	9
GIK23519-5	79-80	6,6	300	left	9
GIK23519-5	79-80	6,6	290	right	9
GIK23519-5	79-80	10,1	360	left	9
GIK23519-5	79-80	11,0	365	left	9
GIK23519-5	79-80	11,8	370	left	9
GIK23519-5	79-80	15,9	425	right	9
GIK23519-5	79-80	20,7	470	left	9
GIK23519-5	79-80	28,2	520	left	9
GIK23519-5	79-80	28,6	480	left	9
GIK23519-5	79-80	30,3	570	left	9
GIK23519-5	79-80	32,1	530	right	9
GIK23519-5	79-80	4,7	280	right	10
GIK23519-5	79-80	8,1	335	left	10
GIK23519-5	79-80	8,6	330	right	10
GIK23519-5	79-80	8,8	330	left	10
GIK23519-5	79-80	9,6	325	left	10
GIK23519-5	79-80	12,3	420	left	10
GIK23519-5	79-80	12,9	380	left	10
GIK23519-5	79-80	14,2	390	right	10
GIK23519-5	79-80	30,8	500	right	10
GIK23519-5	79-80	37,3	555	left	10
GIK23519-5	79-80	43,9	570	left	10

Lebenslauf

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circulation, climate, and evolution”
seit 12/04 Erstellung der Dissertation am Institut für Polarökologie der
Universität Kiel

Erklärung

Hiermit erkläre ich, dass die vorliegende Dissertation – abgesehen von der Beratung durch meine akademischen Lehrer – nach Inhalt und Form meine eigene Arbeit ist. Sie wurde keiner anderen Stelle im Rahmen eines Prüfungsverfahrens vorgelegt. Dies ist mein erster Promotionsversuch.

Kiel, im Dezember 2005