Experiences from motorized GPR surveys in Iceland

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Abstract
Motorized multi-channel GPR investigations in Iceland in July 2022 showed great potential for large-scale archaeological geophysical surveys. Investigations on selected sites demonstrated effective fieldwork opportunities with excellent signal penetration through thick layers of ash and sand and very good contrast of turf houses towards the surrounding soil. Although Iceland has very challenging landscapes, many places are perfect suitable for motorized surveys making them very efficient for landscape archaeological investigations.

Keywords
archaeological prospection; heritage management; Iceland; landscape archaeology; motorized ground penetrating radar; turf houses

Introduction

Iceland is known for its diverse geology, harsh weather conditions, and fascinating history dating back to the 10th century AD. The appearance of archaeological sites is very different. On the one hand many remains of old houses or settlements can still be seen in the topography only covered with a thin layer of grass. On the other hand, many sites have been covered by thick layers of ash or sand due to volcanic activities or erosion, allowing perfect preservation conditions for archaeological remains in the ground. Earlier geophysical investigations around Iceland showed good results for magnetic, resistivity and ground penetrating radar (GPR) surveys for archaeological purposes (Stamnes et al. in print; Wilken et al. 2016; Wunderlich et al. 2015). So far, these surveys were all conducted with handheld systems on a rather small-scale. The introduction of large-scale motorized geophysical prospection methods in the latest decade has demonstrated huge benefits for landscape archaeological research and heritage management (Trinks et al. 2018). High-resolution GPR prospection has so far shown the greatest potential to successfully detect, and map buried archaeological remains in Scandinavian conditions (Nau et al. 2017, Stamnes 2016). It was therefore an obvious choice to test and demonstrate the potential of motorized GPR at known sites in Iceland.

In July 2022, the Norwegian Institute for Cultural Heritage Research (NIKU) in cooperation with Skálanessetur ehf., Antikva ehf., University of Iceland, Gunnarsstofnun, National Museum of Iceland and Byggðasafn Skagfirðinga conducted motorized GPR investigations at eleven sites across Iceland (Fig. 1). The main goals were to get a broader understanding of the methods potential in Iceland, its practicability, the signal penetration abilities through thick ash and sand layers and the contrast of turf buildings. The archaeological focus for the case studies was connected to monasteries, farms, and early farm-churches. Following some results from these investigations will be presented and discussed.

Materials and methods

The applied system is already well established and used since several years. It was developed by the LBI ArchPro and is based on Guideline Geo`s 16 channel Malå Imaging

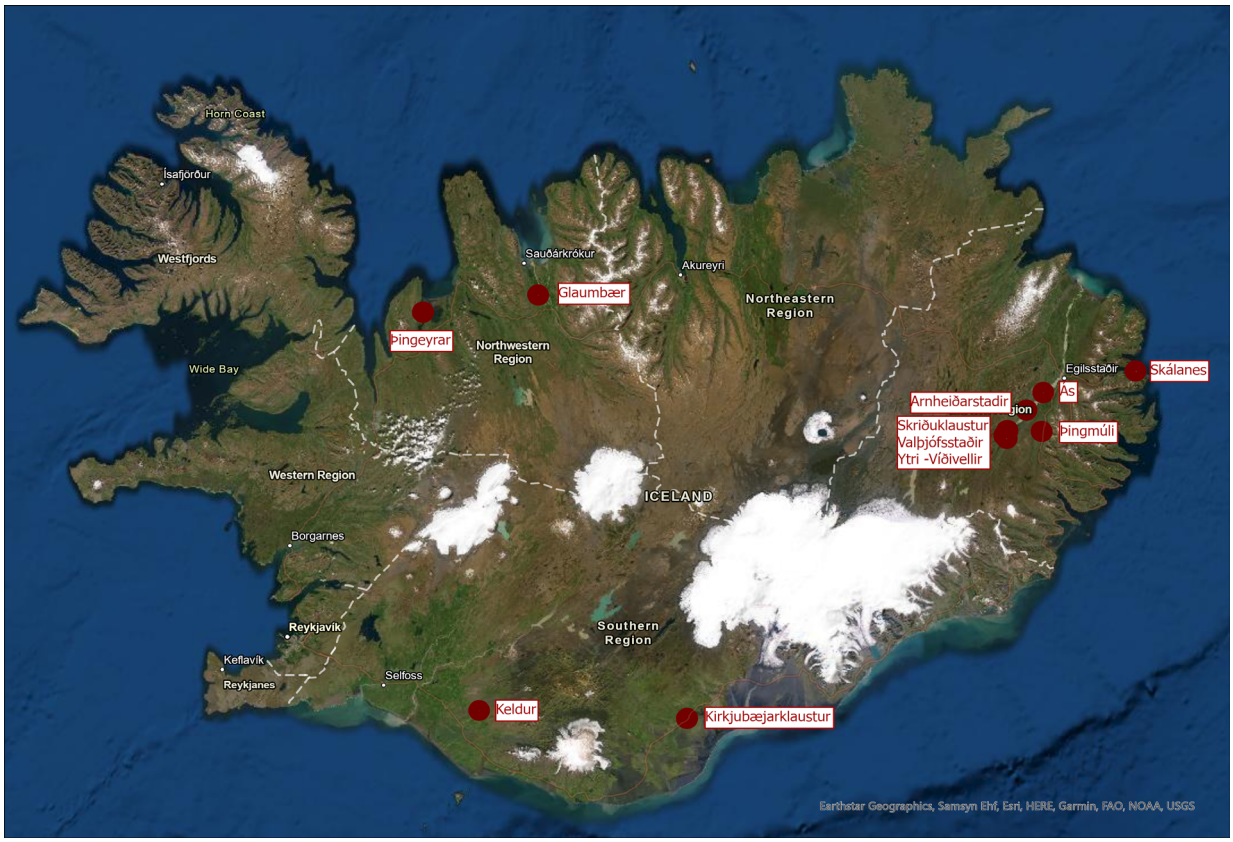

Fig. 1: Locations of the survey sites from July 2022. Background image: Esri ArcMap "World imagery" base map.

Fig. 2: Motorized GPR system (MIRA) during the survey at Keldur with traditional turf houses in the background. Image: Knut Paasche (NIKU).

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Fig. 3: Left image: GPR depth-slice from Keldur (120-160 cm depth). Turf walls (Area 1, 2) of old farm buildings are clearly visible as absorbing features. Right image: GPR depth-slice from Valþjófsstaðir (40-80 cm depth). The data show a variety of different geological patterns within one field. The graveyard with its enclosure and individual graves is clearly visible in the marked area. Background image: Esri ArcMap "World imagery" base map.

Radar Array (MIRA) equipped with 400 MHz antennas, mounted in front of a Kubota RTV900 (Fig. 2). Positioning was achieved with a RTK-GNSS system, mounted on top of the radarbox. Data processing and visualization was carried out using the software ApRadar, developed by the Central Institute for Meteorology and Geodynamics in Vienna and the LBI ArchPro.

Results

From a mechanical and logistic perspective, the used equipment was well suited for the investigations of the selected sites. Large areas in Iceland are used for hay production and offer very good driving conditions after harvesting. At many places the soil is very silt and sandy which offers a good natural drainage, enabling good driving conditions even after heavy rainfall. At all sites GPR worked well, with good signal penetration and good contrast of archaeological features towards the surrounding soils (see Fig. 3 as example). The detailed archaeological data interpretation is still work in progress, but two places will be presented in more detail to demonstrate the methods potential. At both below presented sites, earlier small-scale geophysical investigations showed promising results (Kristjánsdóttir et al. 2016, Jónasson 2019) and were there-fore chosen as case-studies for large-scale investigations.

Keldur

Keldur farm is a well-known historical place going back to the 10th century and is mentioned in many of the medieval sources. At Keldur one of Iceland oldest turf houses is still preserved. The GPR results clearly show an earlier known turf structure (1 in Fig. 3) but due to the large-scale application it was possible to detect an additional earlier unknown building complex just 80 m south of the known building under an approximately 1 m thick sand layer (2 in Fig. 3). The turf walls appear as absorbing features in the GPR data,

clearly limited towards the surrounding soil, making it possible to identify several buildings/rooms that are part of an approximately 100 x 90 m large farm.

Valþjófsstaðir

Valþjófsstaðir is an early chieftain's manor and churchsite at least since the thirteenth century. Historical sources date the farm to the Viking period. Within the investigated field (Fig. 3), different geological patterns can be observed, demonstrating the variety of Icelandic geology. The enclosure of the previous known graveyard and the graves have a very distinct contrast towards the surrounding and can clearly be identified in the GPR data (marked area in Fig. 3).

Observations and conclusion

The results of these investigations confirm the earlier promising results of archaeological geophysics in Iceland. The project also clearly demonstrated that large-scale motorized surveys can be applied successfully, effective, and with a high detection rate of archaeological features in Iceland. Turf structures showed an excellent contrast to the surrounding soil and could clearly be identified. That is of mayor importance as turf was one of the main building materials in Iceland's history. There are without doubt many challenges and clear limitations regarding logistic, accessibility and drivability at some sites but many of them can be solved with careful planning and local knowledge of the sites and its access is mandatory. The detection rate of many archaeological features with GPR is high and large areas in Iceland are perfectly suited for the method. In combination with other methods such as high-resolution LIDAR (many building remains are still visible in the topography) whole landscapes could be effective surveyed with non-invasive methods and should therefore be an integral part of the national heritage management in Iceland.

References

Jónasson OV. Jarðsjármælingar við Valþjófsstað í Fljótsdal. Rapport. 2019. Reykjavik. Icelandic.

Kristjánsdóttir S, Gunnarsdóttir V, Jónsdóttir H. Kortlagning klaustra á Íslandi: Keldur. Rapport: Vettvangsskýrsla XVII, Reykjavik, 2016. Icelandic.

Nau E, Gustavsen L, Kristiansen M, Gabler M, Paasche K, Hinterleitner A, Trinks I. Motorized archaeological geophysical prospection for large infrastructure projects - recent examples from Norway. In: Jennings B, Gaffney C, Sparrow T, Gaffney, (eds). Proceedings of the 12th International Conference of Archaeological Prospection, 2017 12th -16th september, The University of Bradford, Archaeopress, 2017, p. 163-165.

Stamnes AA. The Application of Geophysical Methods in Norwegian Archaeology. A study of the status, role and potential of geophysical methods in Norwegian archaeological research and cultural heritage management [dissertation]. NTNU Trondheim; 2016.

Stamnes AA, Cuenca-Garcia C., Gustavsen L, Horsley T., Jónasson OV, Koivisto S, Munch Kristiansen S, Perttola W, Schneidhofer P, Stott D, Tonning C, Traustadóttir R, Trinks I, Viberg A, Westergaard B. A review of the development and current role of ground-based geophysical methods for archaeological prospection in Scandinavia. In: One World Archaeology, Springer Nature, in print.

Trinks I, Hinterleitner A, Neubauer W, Nau E, Löcker K, Wallner M, Gabler M, Filzwieser R, Wilding J, Schiel H, Jansa V, Schneidhofer P, Trausmuth T, Sandici V, Ruß D, Flöry S, Kainz M, Kucera M, Vonkilch A, Tencer T, Gustavsen L, Kristiansen M, Bye-Johansen LM, Tonning C, Zitz T, Paasche K, Gansum T, Seren S. Large-area high-resolution ground-penetrating radar measurements for archaeological prospection. Archaeological Prospection 2018;25(3):171-195. doi: 10.1002/arp.1599

Wilken D, Wunderlich T, Zori D, Kalmring S, Rabbel W, Byock J. Integrated GPR and archaeological investigations reveal internal structure of man-made Skipháll mound in Leiruvogur, Iceland. In: Journal of Archaeological Science: Reports 2016;9:64-72. doi: 10.1016/j.jasrep.2016.07.005

Wunderlich T, Wilken D, Andersen J, Rabbel W, Zori D, Kalmring S, Byock J. On the Ability of Geophysical Methods to Image Medieval Turf Buildings in Iceland. Archaeological Prospection 2015;22 (3):171-186. doi: 10.1002/arp.1506