

Marine and terrestrial investigations in the Norse Eastern Settlement, South Greenland

Naja Mikkelsen, Antoon Kuijpers, Susanne Lassen and Jesper Vedel

During the Middle Ages the Norse settlements in Greenland were the most northerly outpost of European Christianity and civilisation in the Northern Hemisphere. The climate was relatively stable and mild around A.D. 985 when Eric the Red founded the Eastern Settlement in the fjords of South Greenland. The Norse lived in Greenland for almost 500 years, but disappeared in the 14th century. Letters in Iceland report on a Norse marriage in A.D. 1408 in Hvalsey church of the Eastern Settlement, but after this account all written sources remain silent. Although there have been numerous studies and much speculation, the fate of the Norse settlements in Greenland remains an essentially unsolved question.

Previous and ongoing investigations

The main objective of the field work in the summer of 2000 was to continue the marine geological and hydrographic survey undertaken in 1998 and 1999 in the fjord complex of the Eastern Settlement (Kuijpers *et al.* 1999). In addition, the studies aimed to provide input to a collaborative archaeological project with the National Museum of Denmark, investigating environmental changes affecting the descendants of the Norse settlers in Greenland (e.g. Arneborg *et al.* 1999).

The focus of the investigations was directed towards a detailed survey of Sandhavn, the supposed 'Atlantic Harbour' of the Norse settlers of South Greenland. Sandhavn is close to the major Norse homestead and church of Herjolfsnæs, where archaeological investigations in 1921 provided much insight into the life of the Norse at a late stage of their presence in Greenland (Nørlund 1924). A hydrographic survey of the sheltered bay of Sandhavn was undertaken by the Royal Danish Administration for Navigation and Hydrography, Copenhagen, using the survey vessel *SKA 12* (Fig. 1), and included detailed depth recordings and side-scan sonar data acquisition. The field investigations also

included acoustic investigations of possible targets located in 1998 during shallow-water side-scan sonar investigations off Igaliku, the site of the Norse episcopal church Gardar in Igaliku Fjord (Fig. 2). A brief investigation of soil profiles was conducted in Søndre Igaliku, a once prosperous Norse settlement that is now partly covered by sand dunes.

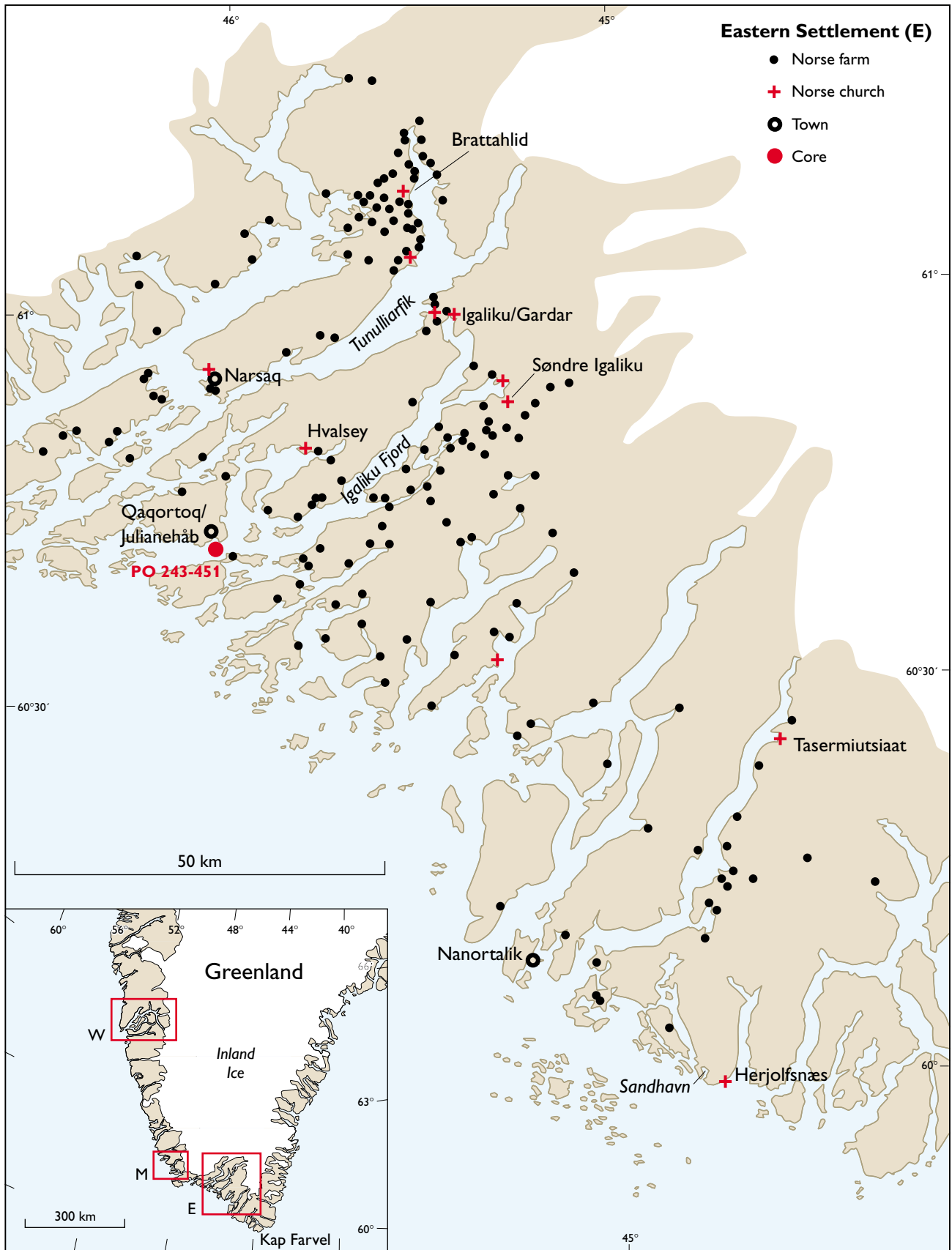
Field observations and preliminary results

Sandhavn

Sandhavn is a sheltered bay that extends from the coast north-north-west for approximately 1.5 km (Fig. 2). The entrance faces south-east and it is exposed to waves and swells from the storms sweeping in from the Atlantic around Kap Farvel, the south point of Greenland. A narrow entrance shelters the bay itself, and a wide sandy beach, a feature that is rarely seen in Greenland, borders the inner harbour.



Fig. 1. The survey vessel *SKA 12* of the Royal Danish Administration for Navigation and Hydrography in Sandhavn; 'Warehouse Cliff' is in the background.



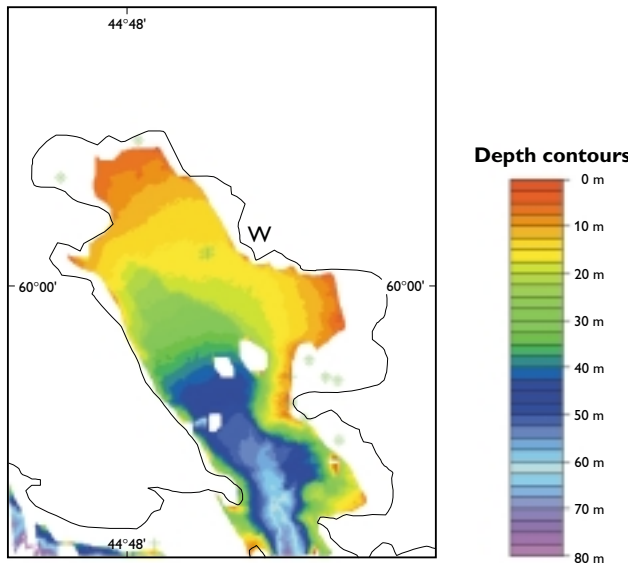


Fig. 3. Depth survey of Sandhavn by the Royal Danish Administration for Navigation and Hydrography showing the narrow entrance to the harbour. The bay offers favourable docking opportunities, in particular at the site here called ‘Warehouse Cliff’ (W).

The bottom of Sandhavn gently deepens towards the harbour entrance (Fig. 3). It is relatively deep in the vicinity of the 5 m high and steep ‘Warehouse Cliff’ on which the ruin of a massive Norse stone building is perched. This building is considered most likely to have been a warehouse used by traders, although one might speculate that it had been a chapel serving the sea-going Norse. Taking into account the relative sea-level rise of *c.* 3 m since the Norse lived in the area 1000 years ago (Kuijpers *et al.* 1999), the harbour must have had a different outline and smaller size during the Norse period. Such a bathymetric setting inferred for *c.* A.D. 1000 would favour the location of the ‘Warehouse Cliff’ as an important docking position for loading and unload-

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Fig. 2. Descendants of the Nordic Vikings established the Eastern Settlement in South Greenland around A.D. 1000 during the Medieval Climatic Optimum. The locations of the study areas (Igaliku/Gardar, Søndre Igaliku, Sandhavn/Herjolfsnæs) and core PO 243-451 discussed in the text are indicated. Ruins of Norse farms are marked by **black dots** and the location of churches and monasteries by **red crosses** (modified after Krogh 1982). The index map shows the location of the Norse Eastern Settlement (E), the Western Settlement (W) and the less important Middle Settlement (M).



Fig. 4. Soil profile from the Norse settlement of Søndre Igaliku, showing alternating layers of aeolian sand and darker horizons. Notebook 18 cm long for scale.

ing cargo vessels bound to and from Norway and Iceland.

Søndre Igaliku

Pilot studies were undertaken of soil profiles containing aeolian sand layers close to Norse farms in Søndre Igaliku (Fig. 4). It has been suggested that the extensive sand horizons in the area are the result of soil erosion linked to Norse farming activities (Fredskild 1978; Jakobsen 1991; Sandgren & Fredskild 1991). However, the aeolian deposits are likely to be a result of increased storm activity recorded around A.D. 1300, for which evidence is seen in the marine core PO 243-451 (Lassen *et al.* 2000) taken in nearby Igaliku Fjord (Fig. 2). The profiles show rhythmic alternations of sand and darker horizons, whose age will need to be verified by dating.

The bay off the Søndre Igaliku settlement is today dry at low tide over a large area, but covered by 1–2.5 m of water at high tide. As noted above, previous work in the area (Kuijpers *et al.* 1999) has demonstrated a rise in the relative sea level of at least 3 m during the last 1000 years. It can therefore not be excluded that this vast area was once fertile lowland utilised by the Norse for production of winter hay for cattle. Field investigations in the summer of 2001 will address this problem.

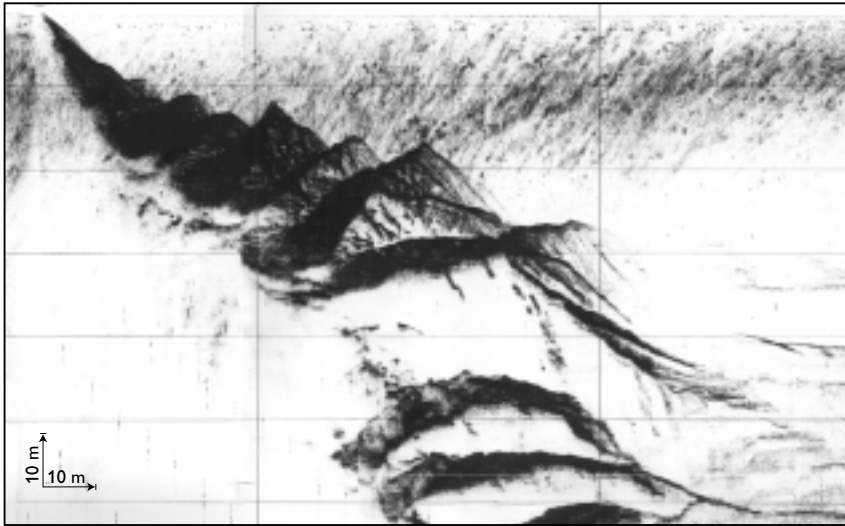


Fig. 5. Sonograph from Igaliku Fjord showing the slope of the delta off Søndre Igaliku with large sand beds concentrated along the northern side of the fjord. Bedforms have a wavelength of 10–15 m, and are up to 3 m high, and were probably generated by sediment deposition from meltwater discharge in a tidal current domain.

A side-scan sonar survey off this tidewater delta showed a spectacular asymmetry in the fjord sedimentation. Whereas high sedimentation rates and large sand waves characterised the relatively shallow seabed along the northern fjord bank (Fig. 5), outcropping bedrock and a much greater water depth indicate mainly non-deposition along the southern fjord bank. This marked difference clearly reflects an estuarine circulation pattern, with a marked Coriolis-force induced asymmetry of sediment-loaded meltwater outflow concentrated along the northern side of the fjord.

Discussion and conclusion

It has been debated whether Sandhavn is the Norse 'Atlantic Harbour' where the Norse landed after an often stormy crossing of the Atlantic. The Norwegian priest Ivar Bardarson (in Jónsson 1930) describes in his sailing directions from c. A.D. 1300 that, after crossing the Atlantic, ships would see a tall mountain on a peninsula called Herjolfsnæs, and close by a harbour called 'Sand', regularly used by merchant ships. The area today known as Sandhavn is about 5 km west-north-west of Herjolfsnæs, the site where well-preserved medieval clothing was discovered in the permafrost of the church yard (Nørlund 1924). In the bay area of Sandhavn numerous Norse ruins have been located (Berglund 1988). It is anticipated that the new bathymetric investigations, together with further work planned by the National Museum of Denmark in the summer of 2001, will increase the plausibility of the Sandhavn area being identified as the Norse harbour 'Sand'.

It has been argued that Norse farmers had a major impact on the fragile arctic environment through cultivation of areas around the fjords, and that associated substantial soil erosion was the ultimate cause of the decline and extinction of the Norse culture (Fredskild 1978; Jakobsen 1991; Sandgren & Fredskild 1991). Today intensive sheep farming and cultivation of hay is taking place in some of the same areas that were used by the Norse, and concern has therefore been expressed as to whether these activities might have an adverse environmental impact – comparable to the postulated impact of the former Norse activities. However, preliminary studies of the marine cores and onshore soil profiles indicate that the soil erosion was not a consequence of Norse farming. A more likely scenario is that there is a link between soil erosion and a pronounced increase in the wind stress over South Greenland and the Igaliku Fjord region at the transition from the Medieval Climatic Optimum to the Little Ice Age (Lassen *et al.* 2000). Concern as to the impact of modern farming on the environment is therefore less serious than some have feared.

Field investigations in collaboration with the National Museum of Denmark will continue in 2001 with detailed geomorphological and soil-profile analyses in the vicinity of Søndre Igaliku, while marine investigations will include studies and coring operations off Søndre Igaliku.

To gain additional data and information on the life and gradual change of the natural environment of the Norse in Greenland, a coring programme is planned in 2002 for the inner parts of the Godthåbsfjord system in the Western Settlement (Fig. 2).

Acknowledgements

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Authors' addresses

N.M., A.K. & S.L., *Geological Survey of Denmark and Greenland, Thoravej 8, DK-2400 Copenhagen NV, Denmark*. E-mail: nm@geus.dk
J.V., *Royal Danish Administration for Navigation and Hydrography, Over Gaden oven Vandet 62B, DK-1401 Copenhagen SV, Denmark*.