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Water mass characteristics and changes through the last millennium off North Iceland based on reconstructions of sea-surface temperature and sea-bottom temperature and salinity

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This study is based on a high-resolution 1000-year sedimentary record from IMAGES core sites MD99-2275 and MD99-2273 on the North Icelandic shelf, located at 470 and 650 m water depths and with a mean sedimentation rate of about 300 and 600 cm per 1000 years, respectively. The present position of the oceanographic Polar Front across the North Icelandic shelf separates Polar and Arctic surface waters of the East Greenland and East Icelandic currents from branches of the North Atlantic Current. The sedimentary and fossil record, which is extremely sensitive to past oceanographic and climatic changes in this boundary region, has shown that the position of the Polar Front has been very dynamic through the last millennium.

The chronology is based on a tephrochronological age model of nine well-constrained historical tephra marker horizons, combined with lead-210 dating for the uppermost part. This age model makes it possible to avoid the problem of spatial and temporal variations in marine reservoir ages, which applies to the area.

The sea-surface temperature reconstructions were based on the planktonic foraminiferal assemblages and oxygen isotopes, as well as diatoms and alkenones for one of the sites (MD99-2275). Sea-bottom temperature and salinity were reconstructed on the basis of benthic foraminiferal transfer function (TF). The oxygen isotope-based bottom-water temperatures have been corrected for salinity changes (TF-based) at both sites.

A comparison of instrumental and documentary data for the last 100 years from the North Icelandic shelf with sea-surface proxy data from the same area shows that there is a high degree of consistency, suggesting that the reconstructed sea-surface temperature records are reliable for the study of palaeoceanographic changes on the North Icelandic shelf in pre-instrumental time.

The present study shows that the last millennium was characterized by a general sea-surface cooling trend, but with some fluctuations. Warm and stable conditions with relatively strong influence of Atlantic waters (Irminger Current) on the North Icelandic shelf are indicated during the interval AD 950-1300, corresponding in time to the Medieval Warm Period (MWP). A considerable cooling at around AD 1300 indicates the transition to the Little Ice Age (LIA) with increased influence of Polar and Arctic water masses deriving from the East Greenland and East Icelandic currents. The extended cold period between AD 1300 and 1910 is furthermore characterized by oscillations. A considerable warming occurred at around AD 1920, and subsequently, the 20th century is characterised by oscillations. Thus, cold, low-salinity sea-surface waters reached the area during the Great Salinity Anomaly (GSA) in the late 1960s and early 1970s, a period of dominant negative state of the North Atlantic Oscillation (NAO) and northerly wind on the North Atlantic shelf.

The bottom-water reconstructions for the western site show persistently lower temperature at that site (MD99-

2273) than at the eastern site (MD99-2275) throughout the last 1000 years, although with temporal changes at both sites. Our results suggest that the deep basin west of the Kolbeinsey Ridge has been under the influence of the Greenland Water component of the Denmark Strait overflow water throughout the last 1000 years, whereas the bottom waters in the area east of the ridge were slightly warmer and had a slightly higher salinity and may have been under the influence of the return Atlantic water carried by the East Greenland Current from the Fram Strait to the Denmark Strait and the Iceland-Faeroe Ridge.