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A 1200-year high-resolution sedimentary record in Holsteinsborg Dyb on the West Greenland shelf: foraminiferal and diatom indication of oceanographic changes

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A deep buried valley, crossing the West Greenland continental shelf from the town of Sisimiut towards the southwest, appears to have been repeatedly eroded and subsequently filled up by a series of Quaternary deposits. Two gravity cores (GA306-GC3 and GA306-GC4; 435 cm and 501 cm long) were obtained during the Galathea 3 expedition in 2006, at water depths of 425 and 445 m, respectively. Each of the cores is supplemented with a boxcore, covering the top part of the record. Age models for the two cores, established by the help of radiocarbon dating, combined with lead-210 dating for the younger parts, show that 7000 cal. years are represented at core site GA306-GC3 and 1200 cal. years at GA306-GC4.

The present water masses along the West Greenland coast are dominated by two components. Closest to the shore, the East Greenland Current component brings water of Polar origin northward along the West Greenland Coast. This water is diluted by run-off water from the various fjord systems on its way, and the current turns westward towards Canada at around 65-66 degrees N. Atlantic Water masses, representing a current component originating from Irminger Water and the North Atlantic Current, is found below and to the west of the Polar Water component of the West Greenland Current. This water mass can be traced all the way along West Greenland to Thule in the north. Our core sites are located in the present "Irminger Mode Water" with temperature around 4 degrees C and salinity around 34.9 PSU.

The foraminiferal and diatom assemblages in the sedimentary record at the GA306-GC4 site show that there have been considerable changes in the oceanography during the last 1200 years. The time interval between AD 715 and 840 is characterised by relatively strong bottom water currents and probably stratification of the water column. Between AD 840 and 1290, corresponding in time to the Medieval Warm Period (MWP), there is foraminiferal indication of reduced bottom current speed and pronounced mixing of the water column, bringing cold Polar waters to the sea floor. The diatom assemblage, on the other hand, indicates cold sea-surface conditions, but not much sea ice during this time interval.

The foraminiferal assemblages in the interval AD 1290-1780 (top of gravity core), corresponding in time to a major part of the Little Ice Age, show that stratification of the water masses became strongly intensified. There is faunal indication of considerable influence of Atlantic water masses at the sea bottom and of relatively strong bottom currents. This interpretation is supported by diatom indication of an increase in the sea-ice cover on the shelf. The sea floor is still under the influence of Atlantic waters in the 20th century (AD 1925-2006), although there seems to become increased mixing compared to the LIA.

The environmental changes observed during the last 1200 years, covering the warm MWP and the cold

LIA on the West Greenland shelf, are suggested to be at least partly wind driven. Thus, the observed mixing of the water column during the MWP may to be related to a period of sustained positive NAO, resulting in south-westerly winds directed towards the Greenland coast. During probably sustained negative NAO in the cold LIA, on the other hand, the area would experience winds directed offshore from the ice cap, resulting in increased sea-ice cover and strongly stratified waters. Similar oceanographic changes have been observed at several other sites along the western and southwestern coast of Greenland during the MWP and the LIA.