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Middle Pleistocene climate variations south off Greenland: the Marine Isotope Stage 9 to 15 record of IODP Site U1305

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As a region where deep-water convection occurs, the Labrador Sea is a key area to study the impact of climate change on the North Atlantic's subpolar gyre and subsequently the thermohaline circulation itself. IODP Site U1305 (57.5°N, 48.5°W) was retrieved from the Eirik ridge at a water depth of 3460 m. At this Site activity of the Western Boundary Undercurrent (WBUC) led to higher sedimentation rates during interglacial periods (Hillaire-Marcel et al., 2011 in Mar. Geol.) making it ideal to study interglacial climate variability. With its position south of the polar front, it is mostly influenced by the warmer, saline Irminger Current waters and reflects conditions in the "inner" Labrador Sea. In order to evaluate the inner Labrador Sea's response to climate change during the mid-Brunhes interval from Marine Isotope Stage (MIS) 9 to 15a (315-570 ka) we generated centennial-scale proxy records reflecting surface (dinocyst assemblage derived), subsurface (N. pachyderma isotope and abundance data) and deep water (benthic isotope data) conditions. In addition, the abundance of lithic fragments >150μm indicates ice-rafting episodes.

In the inner Labrador Sea, ice-rafting events coincided with lower sea-surface salinities (SSS) and are restricted to the glacial periods of MIS 14, 12 and 10 as well as the stadial periods during the MIS 11 to MIS 10 transition. Climate variability during the three interglacial periods varied significantly. MIS 9e recorded the influence of Irminiger Current waters with a reduced number of N. pachyderma and SSS close to 35. The high abundance of the pelagic diatom species Coscinodiscus during the late deglaciation and the onset of the interglacial period confirms the presence of Atlantic waters in the vicinity of Site U1305. Climate during MIS 11c can be dived into three phases. During the deglaciation of MIS 12 and the onset of the MIS 11c (420-430 ka) surface water conditions were very variable with frequent incursions of polar (cold, less saline) waters into the inner Labrador Sea and subsurface waters being poorly ventilated (low N. pachyderma δ13C values). Between 410 and 420 ka, the most stable period in SSS and minimal sea ice cover, relative warm sea-surface temperatures (SST) persisted in association with low percentages of N. pachyderma (around 40%) clearly indicating the presence of the Irminger Current. Between 410 and 400 ka, summer SST increased further, although the percentage of N. pachyderma already increased to values near 60-70% and short periods of lower SSS revealed less stable surface-water conditions, likely linked to oscillations in the position of the polar front. Conditions during MIS 13, one of the colder interglacial periods of the last 1 Ma, were much more variable. During MIS 13a, hydrographic conditions in the surface waters were comparable to late MIS 11c. Early MIS 13 (MIS 13 c-b), on the other hand, is marked by periods with a prolonged sea-ice cover interspersed with short intervals of warm, saline surface waters. Overall, the Site U1305 records reveal that none of mid-Brunhes interglacial periods experienced the same conditions highlighting the high variability in the North Atlantic's subpolar gyre.