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Holocene water mass history off NE Greenland - New insights from high-resolution sediment record PS93/025 (western Fram Strait)

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While the Holocene history of the eastern Fram Strait seems well investigated, no high-resolution paleoenvironmental records were available from the western Fram Strait so far. Our sedimentary record, obtained during expedition PS93.1 (2015) of RV Polarstern on the outermost NE Greenland shelf, allows for the first time to reconstruct Holocene paleoenvironmental changes potentially related to variations in Atlantic Water advection and the export of freshwater and sea ice from the Arctic Ocean.

The 260 cm long sedimentary record from site PS93/025 (80.5°N, 8.5°W; 290 m WD) was investigated for sediment composition, foraminifer contents, grain size variations (sortable silt), contents of ice-rafted debris and the isotopic composition of planktic and benthic foraminifers. Radiocarbon datings reveal an age of 10.2 cal-ka for the core base and continuous sedimentation throughout most of the Holocene.

The deposits are generally very fine-grained (<10% sand) and show a distinct fining-upwards trend. A comparison of foraminifer and coarse fraction abundances shows strong similarities. Apparently, the contribution of coarse terrestrial material from iceberg transport was extremely low throughout the last 10.2 cal-ka. The composition of the ice-rafted debris (>150 μm) shows only minor variability and is dominated by crystalline rocks, quartz and feldspar (ca. 70%). Carbonates are rare (<1%), suggesting that North American glaciers were not a significant source for icebergs. Foraminifer abundances (both planktic and benthic) are high in Early Holocene sediments until ca. 7 cal-ka and decrease rapidly thereafter, probably because of a decreasing advection of Atlantic Water to the NW Fram Strait and seasonally open waters (leads). Occurrences of subpolar foraminifer Turborotalita quinqueloba in deposits older than 7 cal-ka support this view. Sortable silt grain sizes are high (29-31 μm) in the older part of the record and gradually decrease between 7 cal-ka and 4 cal-ka. After ca. 4 cal-ka, sortable silt shows values of 20-23 μm and little variation. This change may result from a decline of bottom current velocities on the outer NE Greenland shelf after 7 cal-ka, related to a decrease of Atlantic Water advection. Additionally, it may reflect a shift towards the modern mode of sea ice sediment transport which is dominated by grains in the clay to fine silt range. The difference between planktic and benthic oxygen isotope data is low (ca. 0.8‰) in the Early Holocene and increases around 7 cal-ka to values around 1.5‰ , likely reflecting a stronger stratification caused by lower salinities in the subsurface water if compared to bottom waters on the outer shelf. Overall, our results reveal a sequence of coeval changes in Holocene environments on both sides of the Fram Strait.