Geophysical Research Abstracts
Vol. 21, EGU2019-15402, 2019
EGU General Assembly 2019

Environmental variability off NE Greenland (western Fram Strait) during the Holocene

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While the Holocene history of the eastern Fram Strait is well investigated, only little is known about the past climate and the oceanographic conditions of the western part near Greenland. To fill this knowledge gap, a high-resolution Holocene sediment record from the outermost NE Greenland shelf, obtained during expedition PS93.1 (2015) of RV Polarstern, was investigated using micropaleontological and geochemical methods. Used proxies allow a profound assessment of Atlantic Water advection, bioproductivity, sea-ice coverage, water mass properties (e.g., temperature, salinity, ventilation) and stratification, while also indicating possible cold events and their cyclicity.

The 264 cm long sediment record (80.5°N, 8.5°W, 290 m water depth) was radiocarbon-dated and investigated at high resolution for sediment composition, foraminifer contents, grain size variations (sortable silt, grain size distribution), contents of ice-rafted debris, element ratios and the isotopic composition of planktic and benthic foraminifers. Planktic and benthic foraminifer flux rates show highest values between 10.6 and 8.0 cal. ky BP, marking the maximum in bioproductivity and indicating either ice-free conditions or a reduced sea-ice cover during this time interval. Correlating high planktic foraminifer fragmentation values are likely related to dissolution through organic carbon oxidation due to an increased accumulation of organic matter. The subpolar planktic foraminifer species T. quinqueloba appears continuously until ca. 5.6 cal. ky BP and can be linked to an increased advection of warmer Atlantic Water (AW). Low shares of rounded IRD and quartz grains before 5.0 cal. ky BP are characteristic for low amounts of sea-ice sediments and therefore display a lower degree of sea-ice coverage, possibly also due to the mentioned AW advection. Between 10.0 and 5.0 cal. ky BP, the IRD-corrected sortable silt curve tends towards coarse grains, reflecting stronger currents. Afterwards, a trend to finer grains implies weaker currents and thus a decreasing AW advection. Low foraminifer flux rates after 4.4 cal. ky BP and an increase in rounded IRD and quartz grains beginning at ca. 5.0 cal. ky BP imply a stronger sea-ice coverage. Grain size distribution curves are flat with a decreasing coarse-silt mode around 35 μm until 6.0 cal. ky BP, representing sea-ice and iceberg deposition. From 5.0 cal. ky BP onwards, distribution curves show an increasing medium-silt mode at 15 μm and only small amounts of coarser grains, which is typical for sea-ice deposition. Pronounced isotope peaks and high shares of T. quinqueloba around 2.0 and 1.0 cal. ky BP correlate with the Roman Warm Period and the Medieval Warm Period. In addition, 11 short-timed cold events like the 8.2 event, the Dark Ages Cold Period and the Little Ice Age can be identified by using the sortable silt curve and the isotope records.