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Holocene evolution of water masses and sea ice on the western Barents Sea margin: a multiproxy review

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The present climate in the Arctic shows signs of rapid change with decreasing sea ice cover and increasing temperature of the Atlantic Water. The implications of this warming are highly uncertain; hence it is crucial to obtain longer records of climate changes in the past to assess the natural limits of Arctic climate. Consequently, in order to investigate natural rapid ocean changes on longer time scales, robust reconstructions of past surface water masses and sea ice need to be carried out. The aim of the study is to elucidate the limits of different water mass and sea ice conditions using a multi-proxy-based approach. The study site is situated close to the modern day marginal ice zone and is influenced by Atlantic and Arctic waters. A gravity core from the western Barents Sea margin has been investigated using benthic and planktic foraminifera, stable isotopes (δ^{18}O, δ^{13}C), coccoliths and biomarkers (IP_{25}, brassicasterol and 24-methylenecholesterol). A depth-age model was developed using eight radiocarbon dates, and showed sediment accumulation rates from ca. 3 cm/kyr – 25 cm/kyr. During the Early Holocene, the bottom and subsurface water mass temperature proxies show an overall warming of 2.5 - 3°C from ca. 11.700 – 9.400 cal. yr BP and ca. 11.700 – 10.600 cal. yr BP, respectively. Additionally, the sea ice proxies show a decrease of seasonal sea ice throughout the period. Coccolith ratios (surface water proxy) indicate a continuous influence of Atlantic Water, although distributions may also be caused by melt water and a strong stratification of the upper surface water masses during this time interval. During the Mid – Late Holocene, the temperature of bottom and subsurface water masses remain relatively stable from ca. 9.400 and 10.600 cal. yr BP until 1.500 cal. yr BP. The benthic and planktic δ^{18}O values reflect slightly decreasing temperatures consistent with the decreasing insolation. The coccolith ratio reflects the fluctuations of the Arctic Front and the variations of Arctic and Atlantic Water in the surface water during this time interval. The relative abundance of the coccolith *G. muellerae* also indicates a sustained flow of Atlantic Water from ca. 9.500 – 5.500 cal. yr BP. Seasonal sea ice disappears after 8.500 cal. yr BP, but re-appears in intermittent intervals from ca. 7.500 - 5.000 cal. yr BP. After ca. 1.100 cal. yr BP, all proxies generally fluctuate, reflecting more unstable oceanographic conditions. The planktic foraminiferal fauna indicates slightly lower salinities in the subsurface water masses and the benthic foraminiferal fauna also indicates more unstable conditions. The coccolith record indicates an increased inflow of Atlantic water after 1.500 cal. yr BP. Seasonal sea ice is again present from 1.500 cal. yr BP towards the present. These apparent contradicting findings after 1.5 ka BP may reflect a decoupling of the water masses and/or different forcings of ocean currents and atmospheric circulation. This study illustrates well the different signatures of biological-based proxies and how integrated multi-proxy studies enable a more comprehensive reconstruction of paleoceanographic and climatic evolution.