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Arctic climates of the Quaternary

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The Atlantic Water (AW) inflow through the Fram Strait and across the Barents Sea and the freshwater runoff and brine rejection from sea ice formation on and close to the surrounding shelves are important processes for the formation of modern water masses in the interior Arctic Ocean. From microfossil and sedimentological data, isotopic data from planktic and benthic foraminifers, and 143Nd/144Nd ratios in leached sediment coatings from several well-dated Arctic sediment cores it is possible to reconstruct the variable influence of both processes on surface and intermediate waters in the Late Quaternary.

Interglacials and interstadials were characterized by a broken sea ice cover with some open waters (leads) and a strong subsurface AW advection of Atlantic Water, feeding the deeper water masses. During the last ca. 250 ky such events usually were of a relatively short duration (10 ky or less), at times when the northern Eurasian shelves were ice-free. An exception is the last 50 ky interval, when a continuous inflow is recorded. Low Nd ratios indicate also a strong AW contribution to the intermediate waters since 50 ka and during MIS 5e. This conclusion is corroborated by high benthic carbon isotope values, indicative of well-ventilated waters at ca. 1500 m water depth. The good correlation between microfossil contents and insolation values suggests a dominant solar control of the AW inflow history.

The time intervals of extended glaciations in northern Eurasia at ca. 190-130, 80-90, and 50-60 ka were characterized by a weak or lacking AW inflow and a strong input of terrestrial ice-rafted debris (IRD). Deglaciations were marked by strong influxes of freshwater from melting ice sheets and/or discharges from previously ice-dammed lakes. High Nd ratios indicate a significant contribution of brines from northern Siberian shelf/ice sheet margins to intermediate waters on the Lomonosov Ridge. The strongest freshwater events occurred at ca. 130 and 52 ka and resulted in an enhanced stratification of the upper water masses and poorly ventilated halocline and deep waters.

While sediment records from the northernmost North Atlantic indicate a trend towards warmer peak interglacials and lesser IRD input during peak glacials in the last 500 ky, Arctic records do not reveal such a development. First strong IRD input occurred only during the Saalian glaciation, while earlier and even more extensive glaciations in northern Asia probably did not reach the Arctic paleo-coastline.