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Variability of ocean stratification, sea ice coverage and bioproduction off NE Greenland in the Late Glacial to Holocene reconstructed from planktic foraminifer morphotypes

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We use stable isotope data from different morphotypes of the polar species Neogloboquadrina pachyderma in a sediment core from the NE Greenland continental margin (79°N) as proxies for the variability of salinity, ice coverage, and bioproductivity/carbon fluxes. Stable oxygen and carbon isotopes ($d^{18}O$, $d^{13}C$) were measured on both thin- and thick shelled specimens of planktic foraminifers N. pachyderma. Since this species is known to attain the thick carbonate crust of adult specimens in deeper water, the isotopic difference between thick-shelled (morphotypes 1 and 2, according to Eynaud, 2011) and thin-shelled specimens (morphotypes 4 and 5) is proposed to reflect the salinity difference between subsurface and near-surface waters. In Late Glacial sediments only minor $d^{18}O$ differences between the morphotypes suggest an upper water mass structure with only minor salinity differences. The high $d^{13}C$ difference of >0.5‰ is ascribed to strong quantitative differences in the decomposition of isotopically light organic carbon within the upper water column (likely from intense ice coverage and reduced bioproductivity) which precludes that the $d^{18}O$ similarities merely result from a reduced vertical migration activity of the foraminifers. After 13 ka, a series of $d^{18}O$ spikes (amplitudes >1.5‰ in morphotypes 4/5) preserved in laminated sediments reflects a strong freshwater event at the NE Greenland margin, likely related to the export of freshwater from the Arctic Ocean and/or the decay of the nearby outer Greenland Ice Sheet. Within these spikes, $d^{18}O$ and $d^{13}C$ differences of N. pachyderma morphotypes reach maximum values, pointing at extreme salinity differences in the upper few hundred meters of the water column and likely high portions of isotopically light dissolved inorganic carbon from terrestrial sources (meltwater). In the Holocene, $d^{18}O$ differences are reduced to ca. 0.5‰ and relatively low $d^{13}C$ differences may indicate an activity of organic carbon decomposition reaching significantly deeper in the water column than in the glacial and deglacial, possibly related to a more open ice cover, enhanced bioproduction and higher C fluxes.

Reference

Eynaud, F., 2011. Planktonic foraminifera in the Arctic: potentials and issues regarding modern and quaternary populations. IOP Conf. Series, Earth and Environmental Science 14, 012005, doi:10.1088/1755-1315/14/1/012005

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