Variability of sea ice cover in northern Fram Strait during the past 30 ka: A biomarker approach

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The major exchange between cold water (and sea ice) from the Arctic Ocean and warm water from the North Atlantic occurs through Fram Strait via the East Greenland Current and the West Spitsbergen Current. This process is coupled to the global thermohaline circulation and is highly sensitive to climatic changes, i.e. warming and cooling events [1].

In this study we investigated samples from a sediment core (PS2837-5) obtained from the western Yermak Plateau (northern Fram Strait, northwest of Svalbard) closely located to today's (and past) summer sea ice margin. The main aim of the study was to reconstruct sea ice variability throughout the last 30 kyrs BP, using specific biomarkers and, in particular, the so-called "IP_{25}". This recently established proxy, a C_{25} highly branched isoprenoid, is biosynthesized by sea ice restricted diatoms [2]. Thus, the presence and variability of IP_{25} in sediments may be used as a direct hint for sea ice coverage and variability. As such, the identification of IP_{25} in sediments from the Yermak Plateau may allow for monitoring changes in sea ice cover in northern Fram Strait during the transition from the last Glacial to the Holocene interglacial interval.
In addition to the information provided by IP_{25} we considered further biomarker and bulk proxy data to avoid ambiguity. Brassicasterol, a biomarker molecule ascribed to open-water algae, and the sediment bulk organic-carbon contents complement our study for a more precise paleoenvironmental reconstruction. Due to relatively high sedimentation rates, it was even possible to detect short-term climatic events. We defined periods of different sea ice conditions for the Late Weichselian (constant sea ice margin), the Last Glacial Maximum (perennial sea ice cover), the Bølling warm phase (dominantly ice-free) and the Early to Mid Holocene (seasonally ice-covered). These intervals can be correlated with climatic fluctuations, i.e., an increase (decrease) in sea ice coverage coincided with a decrease (increase) in warm Atlantic water influx.

With this study we provide further evidence that IP_{25} is a useful tool for reconstructing sea ice coverage and change through time. However, since the absence of IP_{25} in marine (Arctic) sediments could reflect either the absence of sea ice or, in contrast, a permanent ice cover (preventing any algal growth), as also already pointed out in the original paper by Belt et al. (2007), other organic geochemical parameters should be taken into consideration when using this new sea ice proxy for paleoenvironmental reconstructions.

References

[1] Hald, M., et al. (2007) Quat. Sci. Rev., 26, 3423- 3440.
[2] Belt, S.T., et al. (2007) Org. Geochem., 38, 16-27.