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Late Pliocene/Pleistocene changes in Arctic sea-ice cover: Biomarker and dinoflagellate records from Fram Strait/Yermak Plateau (ODP Sites 911 and 912)

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Sea ice is a critical component in the (global) climate system that contributes to changes in the Earth's albedo (heat reduction) and biological processes (primary productivity), as well as deep-water formation, a driving mechanism for global thermohaline circulation. Thus, understanding the processes controlling Arctic sea ice variability is of overall interest and significance. Recently, a novel and promising biomarker proxy for reconstruction of Arctic sea-ice conditions was developed and is based on the determination of a highly-branched isoprenoid with 25 carbons (IP25; Belt et al., 2007; PIP25 when combined with open-water phytoplankton biomarkers; Müller et al., 2011). Here, we present biomarker data from Ocean Drilling Program (ODP) Sites 911 and 912, recovered from the southern Yermak Plateau and representing information of sea-ice variability, changes in primary productivity and terrigenous input during the last about 3.5 Ma. As Sites 911 and 912 are close to the modern sea-ice edge, their sedimentary records seem to be optimal for studying past variability in sea-ice coverage and testing the applicability of IP25 and PIP25 in older sedimentary sequences. In general, our biomarker records correlate quite well with other climate and sea-ice proxies (e.g., dinoflagellates, IRD, etc.). The main results can be summarized as follows:

(1) The novel IP25/PIP25 biomarker approach has potential for semi-quantitative paleo-sea ice studies covering at least the last 3.5 Ma, i.e. the time interval including the onset (intensification) of major Northern Hemisphere Glaciation (NHG).
(2) These data indicate that sea ice of variable extent was present in the Fram Strait/southern Yermak Plateau area during most of the time period under investigation.
(3) Elevated IP25/PIP25 values indicative for an extended spring sea-ice cover, already occurred between 3.6 and 2.9 Ma, i.e. prior to the onset of major NHG. This may suggest that sea-ice and related albedo effects might have been important for general cooling and ice-sheet build-up.
(4) Maxima in sea ice occurred near 3.3, 2.7, 2.1, 1.7 and during the last 1.2 Ma whereas between about 2.6 and 2.2 Ma the sea-ice cover was surprisingly reduced. The IP25 maxima are similar to those determined for the late Holocene.
(5) Both, dinoflagellate and IP25/PIP25 data indicate that also during the Late Pliocene Warming Event at least occasionally sea ice must have occurred.
(6) This low-resolution pilot study motivates to carry out further detailed high-resolution sea-ice biomarker research on ODP/IODP material in order to prove or disprove these preliminary interpretations.

References

Belt, S.T., Massé, G., Rowland, S.J., Poulin, M., Michel, C., LeBlanc, B., 2007. A novel chemical fossil of palaeo sea ice: IP25. Organic Geochemistry 38, 16-27.
Müller, J., Wagner, A., Fahl, K., Stein, R., Prange, M., Lohmann, G., 2011. Towards quantitative sea ice reconstructions in the northern North Atlantic: A combined biomarker and numerical modelling approach. Earth Planetary Science Letters 306, 137-148.