A molecular fossil's perspective on palaeo sea ice and climate dynamics

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Polar sea ice is a crucial element in the global climate system. Feedback mechanisms between a changing sea ice cover and shifts in oceanic and atmospheric circulation or the heat and gas exchange are, however, only poorly constrained. Palaeoclimate studies of sea ice-ocean-atmosphere interactions during past climate fluctuations, are an essential means to improve our understanding of how these complex processes affect climate - provided that proxy records deliver reliable information on palaeo sea ice conditions.

The most recent and probably most promising approach for tracking a palaeo sea ice cover is based upon the organic geochemical analysis of marine sediments and therein preserved biomarker lipids (C25 highly branched isoprenoids (HBIs)) that are produced by specific sea ice diatoms. While a C25-HBI monoene (IP25) has been frequently applied for Arctic Ocean sea ice reconstructions, hitherto only few studies focused on the Southern Ocean, where a C25-HBI diene serves as sea ice proxy. In any case, only the combination of the sea ice biomarker with lipids synthesised by organisms thriving in (seasonally) ice-free water, enables an unambiguous discrimination between an extended, marginal and reduced sea ice coverage. The so-called PIP25 index applies this, as yet qualitative, concept of considering a phytoplankton biomarker alongside IP25 and there are ongoing efforts to make this approach fully quantitative.

This presentation provides an overview on C25-HBI-based sea ice reconstructions, the advantages and limitations of the PIP25 index, and current approaches targeting at the development of a reasonably calibrated and hence quantitative sea ice proxy.