Calibration and application of the biomarker IP_{25} for Arctic sea-ice reconstructions

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1) Introduction.

The work presented here is part of the Changing Arctic and Subarctic Environment program (EU CASE) which is an Initial training network on climate change and the marine environment and is an interdisciplinary project focussing on biological proxies. IP_{25} is a highly branched isoprenoid (HBI) alkene synthesised by some sea-ice diatoms which has been shown to be a specific, stable and sensitive proxy measure of Arctic sea ice when detected in underlying sediments. Here we present two studies of the Nordic Seas area involving both near surface sediment calibration and a downcore sediment application of IP_{25}.

2) Methods.

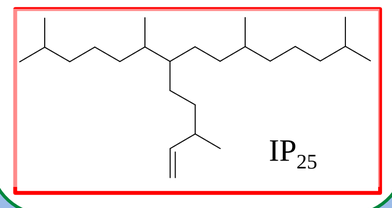
Study area shown in red

(a) For the calibration, analysis of 83 surface multicore sediment samples from the Barents Sea, collected during 2003-2004 were analysed for the sea ice biomarker IP_{25} .

(b) For the application of Analysis of IP_{25} to climatic reconstructions over 14.3 to 6.3 ka B.P 62 samples were analysed from Piston core JM99-1200, collected from the Andfjord (continental shelf off Tromsø, northern Norway).

Extraction process

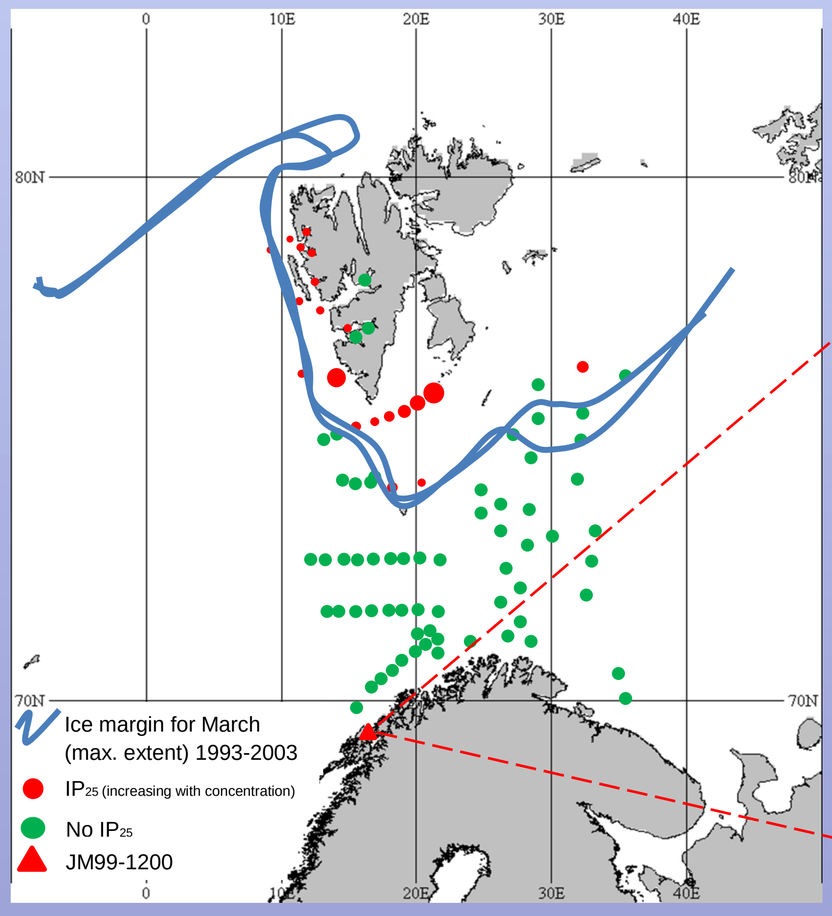
Sediment → Extraction → Purification → Analysis GC-MS



3) Results (a) Calibration

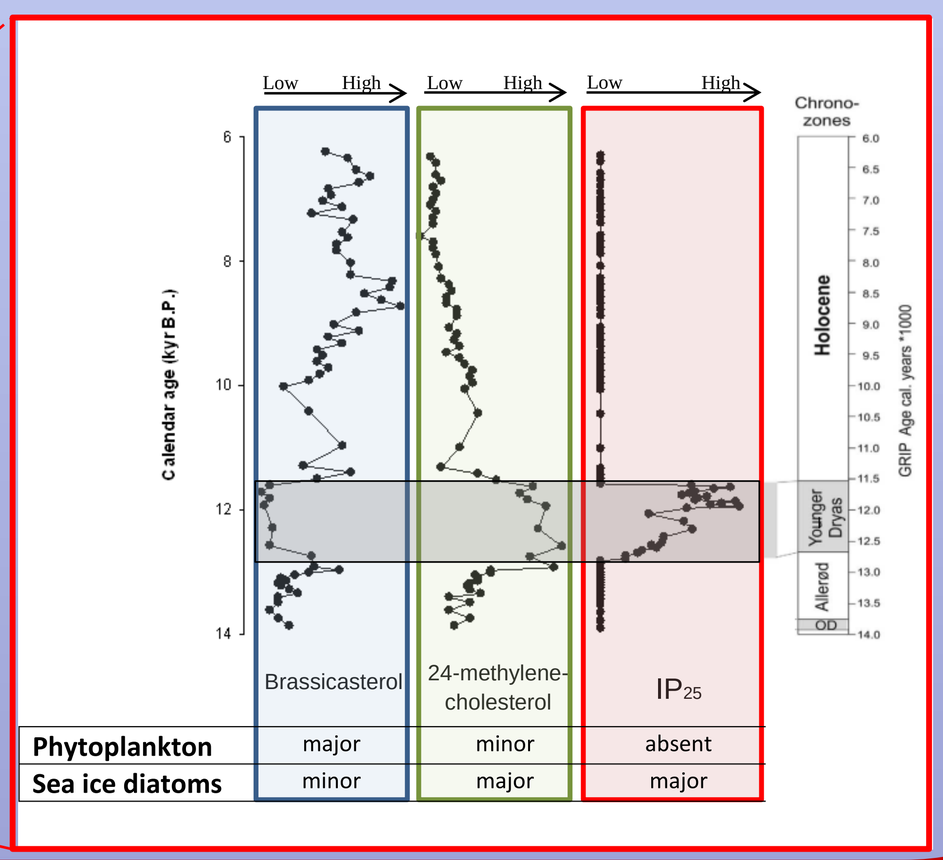
High resolution surface sediment analysis of IP_{25} revealed a strong correlation of the sea-ice biomarker with the position of seasonal sea ice obtained from NSIDC database showing maximum sea ice extent (March) for the last decade (blue line)

- Both the presence and concentration of IP_{25} correlates to the sea ice margin
- Where sea ice was absent, no IP_{25} is detected
- IP_{25} absent from glacial fjords



Results (b) Application

- In the application of IP_{25} to palaeoclimatic reconstructions this sea ice biomarker is absent during the relatively warm Holocene and Allerød periods
- During the colder Younger Dryas period IP_{25} is present
- The presence and absence of IP_{25} provides more convincing evidence for variable sea ice conditions indicated previously from other biomarkers (Knies 2005)
- High 24-methylenecholesterol concentrations and the presence of IP_{25} during the YD both indicate sea-ice diatoms and therefore the presence of sea ice



4) Conclusions

- ✓ The near surface calibration of IP_{25} in the Nordic Seas area has revealed a remarkably close correlation of this highly specific sea ice biomarker to the contemporary marginal sea ice zone
- ✓ Similarly, the historical application of IP_{25} to the palaeo sea ice conditions of the Nordic Seas reveals a further correlation to past changes in the sea ice marginal zone further confirming the useful application of this sensitive sea ice biomarker over longer timescales
- ✓ Previous applications of IP_{25} have shown variable, but consistent, sea ice cover throughout all sediment horizons. However the absence of IP_{25} in this core suggests the complete absence of sea ice excluding the YD period
- ✓ The study of IP_{25} together with other geochemical proxies can be a powerful tool for palaeo sea-ice reconstructions

5) Acknowledgements

This work was conducted with funding of the "European Community's 7th Framework Programme FP7 2007/2013, Marie-Curie Actions, under Grant Agreement No. 238111 – CASE ITN.

We thank Jochen Knies and Geological Survey of Norway (NGU) for providing sediment samples from piston core JM99-1200 as well as biomarkers data related to this core. Also for providing all the surface samples from Barents sea which are part of the MAREANO project and aims to create a database for Norwegian coastal settings.