Development of source specific diatom lipids biomarkers as Antarctic sea ice proxies

Lukas Smik [1], Simon T. Belt [1], Thomas A. Brown [1], Jan L. Lieser [2], Leanne K. Armand [3], Amy Leventer [4] and Claire S. Allen [5]

(1) School of Geography, Earth and Environmental Sciences, Plymouth University, UK; email: lukas.smik@plymouth.ac.uk; web: www.research.plymouth.ac.uk/pegg/
(2) Antarctic Climate & Ecosystems Cooperative Research Centre, University of Tasmania, Australia,
(3) Department of Biological Sciences, Faculty of Science and Engineering, Macquarie University, Australia,
(4) Department of Geology, Colgate University, Hamilton, NY, USA
(5) BAS, Cambridge, UK

For further reading see: **Smik, L. et al., 2016. Organic Geochemistry, 95, 71-80.**

Introduction

The presence and variable abundance of certain di- and tri-unsaturated C_{25} highly branched isoprenoid (HBI) biomarkers in Antarctic marine sediments has recently been proposed as a useful proxy indicator of paleo sea-ice extent in the Southern Ocean (e.g. Barbara et al., 2010; Massé et al., 2011; Etourneau et al., 2013). However, development of HBIs as proxies for Antarctic sea ice is much less advanced than for the Arctic (see Belt and Müller, 2013) and has relied almost entirely on their analysis in a small number of sediments, rather than within their source environments.

In this study, two specific HBIs (diene II and triene III) as proxies for Antarctic sea ice were investigated in near-surface (ca. 0 – 10 m) water samples, collected from locations in East Antarctica (Fig 1).

Specific questions

1) **diene II** = sea ice?

2) **triene III** = open water?

Study area

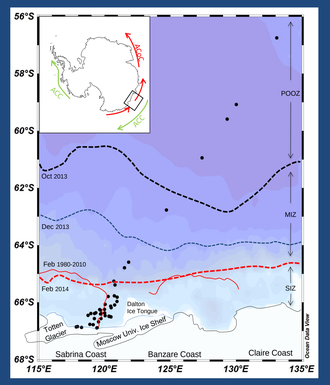


Figure 1

Water samples were obtained as part of the NBP1402 cruise aboard the RVIB *Nathaniel B Palmer* in February–March 2014.

Sampling was carried out at 47 sites, with 38 locations within the polynya region (Seasonal Ice Zone(SIZ)), and a further 9 locations representing a transect to ca. 56°S in the Marginal Ice Zone (MIZ) and the Permanently Open Ocean (POOZ) (Fig 1). Extraction and analysis followed previously published methodology (Brown et al 2011) (Fig 2).

Extraction Process

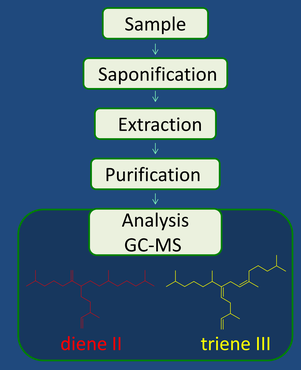
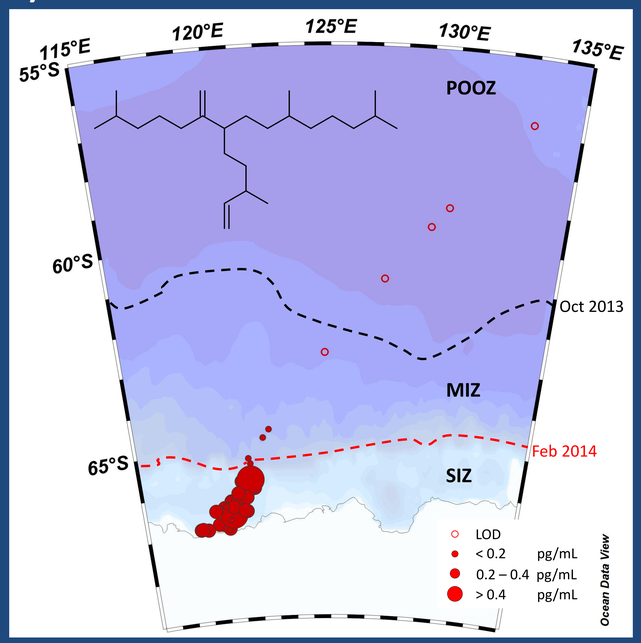


Figure 2

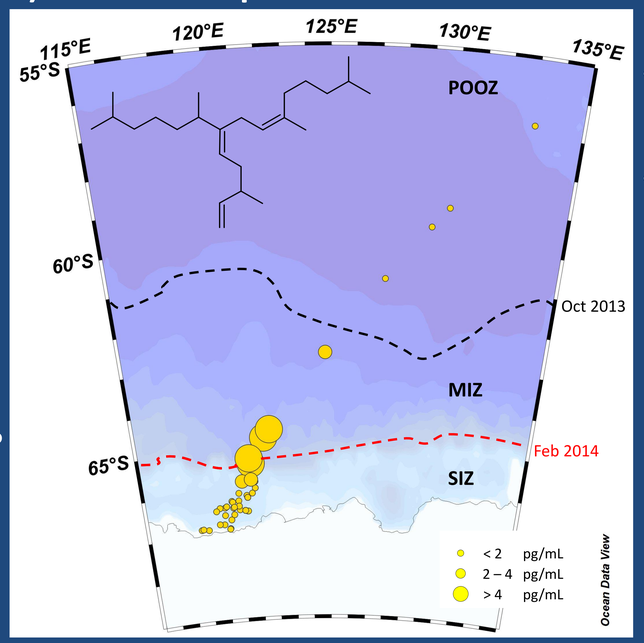
1) diene II = sea ice ?



- Diene II identified in all of the samples from (SIZ)
- Not detected in any of the samples from POOZ!
- General off-shore drop in diene II abundances from SIZ-MIZ-POOZ (0.25 – 0.10 – 0 pg/mL): More favourable settings for sea-ice diatom growth?

good support of sea ice origin

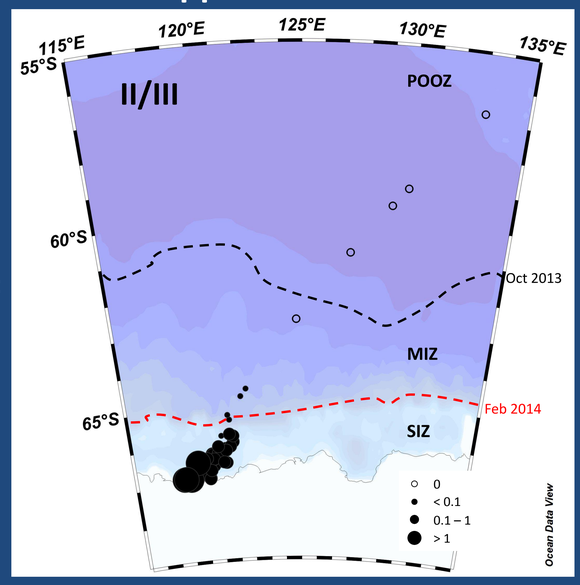
2) triene III = open water?



- Triene III identified in all of the samples analysed
- Distribution pattern different to diene II – SIZ – MIZ – POOZ (1.06 - 6.00 – 0.07 pg/mL): Polynya + MIZ influence?

consistent with biosynthesis by phytoplankton ($\delta^{13}C$ = -35 ± -1.5‰)

Combine approach



- low II/III - characteristic of the MIZ
- high II/III - longer seasonal sea-ice cover(SIZ)

Conclusions

Distributions of an HBI diene (II) and triene (III) in surface waters from an offshore transect west of the Dalton Iceberg Tongue (East Antarctica) were found to be extremely sensitive to the local sea-ice conditions. Outcomes here generally support various previous deductions, especially the presence of diene II as an indicator of seasonal sea-ice extent. The occurrence of triene III at all sites is consistent with the use of this biomarker as an open water indicator, while enhanced concentrations within the MIZ supports the view of a more specific indicator of increased productivity adjacent to the sea-ice edge (Collins et al. 2013). However, additional local factors, such as those associated with polynya formation, may also exert significant control over the distribution of triene III and the relative concentrations of II and III.

References

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Acknowledgments

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