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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, University of Plymouth, Drake Circus, Plymouth, Devon PL4 8AA, UK, (2) Antarctic Climate & Ecosystems Cooperative Research Centre, University of Tasmania, Hobart, Tasmania, Australia, (3) Department of Biological Sciences, Faculty of Science and Engineering, Macquarie University, North Ryde, NSW, 2109, Australia, (4) Department of Geology, Colgate University, Hamilton, New York, 13346,USA, (5) British Antarctic Survey, High Cross, Madingley Rd, Cambridge, CB3 0ET, UK

C25 highly branched isoprenoid (HBI) are lipid biomarkers biosynthesised by a relatively small number of diatom genera, but are, nonetheless, common constituents of global marine sediments. The occurrence and variable abundance of certain C25 highly branched isoprenoid (HBI) biomarkers in Antarctic marine sediments has previously been proposed as a proxy measure of paleo sea-ice extent in the Southern Ocean and a small number of paleo sea-ice reconstructions based on the variable abundances of these HBIs have appeared in recent years. However, the development of HBIs as proxies for Antarctic sea ice is much less advanced than that for IP25 (another HBI) in the Arctic and has been based on relatively small number of analyses in sea ice, water column and sediment samples.

To provide further insights into the use of these HBIs as proxies for Antarctic sea ice, we here describe an assessment of their distributions in surface water, surface sediment and sea ice samples collected from a number of Antarctic locations experiencing contrasting sea ice conditions in recent years.

Our study shows that distributions of a di-unsaturated HBI (diene II) and tri-unsaturated HBI (triene III) in surface water samples were found to be extremely sensitive to the local sea-ice conditions, with diene II detected for sampling sites that experienced seasonal sea ice and highest concentrations found in coastal locations with longer-lasting ice cover and a recurrent polynya. In contrast, triene III was observed in all of the samples analysed, but with highest concentrations within the region of the retreating sea ice edge, an observation consistent with significant environmental control over the biosynthesis of diene II and triene III by sea ice diatoms and open water phytoplankton, respectively. However, additional local factors, such as those associated with polynya formation, may also exert some control over the distribution of triene III and the relative concentrations of diene II and triene III, in particular. This may have important implications for the use of these biomarkers for paleo sea ice reconstructions.

Sedimentary distribution showed significant variation in abundances of diene II and triene III between different regions of Antarctica, but also on a more local scale, potentially reflecting a high degree of sensitivity towards individual sea ice dynamics that favour the individual species responsible for their biosynthesis. However, highest concentrations of diene II were generally observed in near coastal locations, consistent with the identification of elevated abundances of this HBI in first year or land fast ice in these settings. The identification of the sea ice diatom source of diene II will likely be significant in interpretations of the occurrence of this biomarker in paleo sea ice records.