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Highly branched isoprenoid biomarkers as indicators of sea-ice diatoms: implications for historical sea-ice records and future predictions

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Polar oceans are important contributors to the Earth's climate systems. In particular, sea-ice influences the exchanges of heat and moisture between polar oceans and atmosphere, and its high albedo means that it reflects much of incoming solar radiation. In addition, when melting, the outflow of low-salinity surface water impacts on the global deep oceanic circulation, which can influence the climate to a large extent. Therefore, increasing our knowledge about how changes in past sea-ice extent contributes to our understanding of the actual changes in climate is critical if we aim to succeed in predicting future changes (Thomas and Dieckmann, 2003).

Direct global estimates of sea-ice cover derived from remote sensing observations are now routine but have only been possible since the 1970's (Stroeve *et al.*, 2005). Previously, analysis of data derived from early ship records have been carried out, providing an observed sea ice record for the 20^{th} century and earlier. Such records have been based on archive materials including lighthouse diaries, ships logs, travellers journals and newspaper reports. However, only the most recent direct estimations of sea-ice cover are believed to be reliable and therefore, longer time scales studies are only possible using proxy data sources.

In the current project, we are investigating the potential to use chemical biomarkers of sea-ice associated diatoms to serve as a proxy of sea-ice cover in the Arctic (Belt *et al.*, 2007) To date, our investigations have revealed that a restricted number of diatoms biosynthesise a class of secondary metabolite chemicals termed highly branched isoprenoids (HBIs). These chemicals are ubiquitous to marine sediments, but only one

structural form of the HBIs exists in Arctic sea-ice. In turn, this chemical (a C_{25} HBI mono-unsaturated alkene – IP_{25}) can almost certainly be associated with some *Haslea* spp. which are known to occur in Arctic sea-ice. Indeed, we have identified three such species in our work and now have them in culture.

In order for the HBI biomarker to be useful as a historical indicator of past sea-ice, its behaviour in sediments also needs to be understood. Therefore, we have obtained sediment cores from the East-West Canadian Arctic (ArcticNet 2005) and analysed them for their biomarker content. We have detected the same HBI mono-unsaturated HBI alkene found in sea-ice in sediments collected from Lancaster Sound, Barrow Strait, Victoria Strait, the Amundsen Gulf, Franklin Bay and the North Icelandic Shelf. This has been achieved using extremely small sample sizes and with rapid turnaround times (< 1 g sediment; > 10 samples per day). The HBI biomarker has been readily detected in sediments covering the entire Holocene. These data, together with analyses from sediments obtained from the North Icelandic shelf (MD99-2275) will be discussed, as will the potential to use the HBI biomarkers for sea ice reconstruction in the Antarctic.

Belt, S.T., Massé, G., Rowland, S.J., Poulin, M., Michel, C. and LeBlanc, B. (2007) A novel chemical fossil of palaeo sea ice: IP_{25}. *Organic Geochemistry* **38**, 16-27.