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Putting your ideas on ice: a novel palaeo sea-ice proxy

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A novel organic 'chemical fossil' proxy for palaeo sea-ice diatoms is reported.

Sea-ice formation is a vital factor in climatic feedback. Indeed, sea-ice:atmosphere interactions have meterological and topographical influences and effects on polar cyclonic activity. It is thus crucial to consider sea-ice in reconstructions of the climatic evolution of the geological past and fundamental that the extent of winter and summer sea-ice is reconstructed with high temporal resolution in samples from the geological past. Because sea ice greatly restricts the exchange of energy between ocean and atmosphere, and its high albedo reflects much of the incoming solar radiation, changes in sea ice extent impact local climate, pole-to-equator pressure gradients, and can influence thermohaline ocean circulation. Direct global estimates of sea-ice cover derived from satellite observations have only been possible since the 1970's. Analysis of data derived from early ship records have proved interesting but contentious; the reliability of these historical records inevitably decreasing the further back they are extended. Other studies have analysed sea ice parameters beyond the observational record using proxy data sources. Each of these proxies has advantages and limitations. Many of the most widely used proxies involve quantitative estimates of sea-ice diatoms. Such an approach uses the modern analogue technique, whereby comparisons of the floral assemblage from each sample are made with modern core-top analogues. Production rates of >1 g C m^{-2} d^{-1} have been estimated from some sea-ice diatom communities yet very few, if any, organic chemical proxies for sea-ice diatom contributions to sediments have been devised to date. This is perhaps surprising given the usefulness of some other organic chemical proxies such as the so-called UK^{37}alkenone index for sea surface temperature and the TEX 86 index based on ethers. Here we describe the culturing of individual Arctic sea-ice diatom species which biosynthesise a unique and specific organic chemical. The identity of the chemical has been confirmed by labo-

ratory synthesis. The chemical is present in Arctic sea-ice and Arctic sediments dated by radiocarbon methods to at least 9000y.

The chemical promises to be a useful complementary sea-ice proxy for palaeo-reconstruction studies of past polar fronts.