

IP₂₅-based sea ice reconstruction from Baffin Bay and evaluation highly branched isoprenoid $\delta^{13}\text{C}$ as a sea ice proxy

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Abstract

This proposal seeks funds to generate a 30,000-year-long record (30,000 yrs BP to present) of sea ice extent in northern Baffin Bay. The Arctic sea ice cover has been thinning and retreating rapidly for at least the past half century (Comiso et al., 2008; Stroeve et al., 2011) and modeling results suggest ice-free summers in the near future, as early as 2040 (Wang and Overland, 2009). In order to put the recent changes in sea ice into a longer-term perspective, and to develop a better understanding of the ways in which sea ice variations feedback into the Earth's climate system requires much longer records of sea ice variability than are provided by historical and instrumental records. Organic matter from seasonal sea ice environments contains a unique monounsaturated highly branched isoprenoid (HBI) called IP₂₅ that is ^{13}C -enriched relative to co-occurring molecular compounds and is unique to sea-ice algae, therefore providing a biomarker for identifying the seasonal sea ice edge. The planned work will generate a 30,000-year-long record of the position of the sea ice edge relative to a sediment core in northern Baffin Bay.

As a mono-unsaturated HBI, IP₂₅ is probably subject to diagenetic alteration, including sulfurization, in even relatively immature sediments. Therefore the utility of IP₂₅ for sea ice reconstructions prior to the past 30,000 years is not known. This proposal will test the hypothesis that carbon isotopes of sulfur-bound HBIs (diagenetic products of IP₂₅ and other HBIs) carry a measurable signal of sea ice-derived material and can be used for chemostratigraphy and in reconstructing patterns of sea ice variability through time. The proposed work will examine how biomarkers and isotopic signatures become preserved in sedimentary organic material and will directly test the feasibility of a new approach for chemostratigraphy. The project will result in a new record of sea ice for Baffin Bay and will potentially provide new approaches for developing sea ice records from immature to mature arctic sediments. In addition to publishable datasets, the research will provide numerous preliminary data to be used for writing full NSF proposals.