Geophysical Research Abstracts
Vol. 20, EGU2018-16447, 2018
EGU General Assembly 2018

Isotopic composition of highly branched isoprenoids (HBIs) in diatoms as a proxy for ice thickness

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Sea ice is a key component of the Earth's climate system. It affects the exchange of heat, gases and water between the polar oceans and the atmosphere. Even though changes in sea ice extent and thickness in recent decades are well documented, understanding processes that control climate in the polar regions back in time and over longer time scales requires proxy-based paleo reconstructions. Novel approaches that integrate organic geochemical data with modelling of sea ice structure and morphology may significantly enhance our ability to study ice dynamics in the polar regions over time.

Several highly branched isoprenoids (HBIs) and related compounds have been used previously to investigate changes in sea ice extent. However, the potential of these biomarkers – particularly their isotopic composition – to provide information about other parameters of sea ice such as ice thickness and/or snow cover have not been explored.

This study focuses on investigation of isotopic composition of HBIs isolated from the diatom Pleurosigma intermedium. We cultured this diatom to test the hypothesis that isotopic content of HBIs would reflect different levels of irradiance. The culture was grown at different levels of light intensity in laboratory. These initial results were then used to interpret the difference in the isotopic values of HBIs from algal biomass in the Arctic and Antarctica. Our preliminary data suggest that the diatoms recovered from sea ice in Antarctica were subjected to a lower level of light intensity (thicker ice/snow pack) in comparison with those sampled in the Arctic.

Improved understanding of the magnitude and the underlying mechanisms responsible for the isotopic differences observed in the diatom Pleurosigma intermedium may provide key insights for interpreting isotopic composition of HBIs environmental samples from the polar regions. The main outcome of this research is a new methodological approach that could potentially be used to estimate ice thickness or/and snow cover. This type of organic geochemical data could be used by modellers studying physical and biogeochemical characteristics of sea ice during periods of key climate changes in the polar regions.