Geophysical Research Abstracts,
Vol. 11, EGU2009-2387, 2009
EGU General Assembly 2009

A new membrane lipid based continental temperature proxy; constraints and application at high latitudes

J.W.H. Weijers (1,2), S. Schouten (1), F. Peterse (1), J.S. Sinninghe Damsté (1,3)

(1) Department of Marine Organic Biogeochemistry, NIOZ Royal Netherlands Institute for Sea Research, Den Burg-Texel, The Netherlands, (2) Organic Geochemistry Unit, School of Chemistry, University of Bristol, Bristol, United Kingdom (johan.weijers@bristol.ac.uk), (3) Department of Geochemistry, Utrecht University, Utrecht, The Netherlands

Increasing our knowledge on Earth's climate system is achieved by an interplay between climate models and climate reconstructions. Temperatures reconstructed for past climate events are used to verify the outcomes of computer models that simulate the same climate transition. The other way around, climate modeling results could indicate the reliability of proxy data results. Especially for the high latitudes, however, comparing model results and temperature reconstructions based on proxy data often show relative large discrepancies. Besides improving models, it is therefore essential to gather temperature data from high latitude environments using multiple proxies. Due to a lack of widely applicable proxies, however, temperature reconstructions from the continents are scarce, especially those pre-dating the Quaternary.

Here we present results from a new proxy (the MBT/CBT proxy) for annual mean air temperature that is based on the distribution of branched glycerol dialkyl glycerol tetraether (GDGT) membrane lipids derived from soil bacteria. This distribution is related to temperature and soil pH due to the fact that the bacteria have to adapt their cell membrane to these ambient conditions in order to function properly. The membrane lipids are transported via rivers and ice rafted debris to the marine realm, and therefore the terrestrial temperature signal is eventually recorded in the marine sedimentary archive. To investigate the suitability of this proxy for high latitude environments we anlysed branched GDGT distributions in soils and a fjord in Svalbard, Norway. These show that the proxy in soils reflects mean annual air temperature but also point to some in-situ production of branched GDGTs in the fjord system that has to be accounted for when reconstructing annual mean air temperatures. We applied this proxy to reconstruct temperatures of Greenland near the Eocene-Oligocene boundary. The distribution of branched GDGTs delivered by ice rafting and preserved in a core from the Greenland Basin, indicate a gradual 3-5°C cooling at the start of the Oligocene, in agreement with pollen assemblages in nearby cores and other mid-latitude climate reconstructions from North America. Finally, an application in a marine sediment core from the Lomonosov Ridge in the Arctic Ocean indicates high air temperatures in the Arctic of up to 25°C during the Paleocene-Eocene thermal maximum ($\tilde{5}5.5$ Ma). These high temperatures support an earlier reconstruction of sea surface temperatures in the Arctic Ocean from the same core using the TEX86 proxy, which shows temperatures of up to 23°C. These results show great promise for future applications which could aid in resolving the discrepancy between model and proxy temperature data at high latitudes.