The development of TEX_{86} for continental paleotemperature reconstruction: Problems and promise

LINDSAY A. POWERS[1], JOSEF P. WERNE[1], THOMAS C. JOHNSON[1] ELLEN C. HOPMANS[2], JAAP S. SINNINGHE DAMSTÉ[2] AND STEFAN SCHOUTEN [2]

[1]Large Lakes Observatory, University of Minnesota, 10 University Drive, Duluth, Minnesota 55812, USA, (powe0285@umn.edu)

[2]Royal Netherlands Institute for Sea Research, Department of Marine Biogeochemistry and Toxicology, P.O. Box 59, 1790 AB Den Burg, Netherlands, (schouten@nioz.nl)

We have developed a calibration for the TEX_{86} paleotemperature proxy from a climatically diverse suite of globally distributed lacustrine systems (N=14). The results of this calibration show a strong linear relationship between TEX_{86} values and published mean annual lake surface temperatures. The TEX_{86} index as it currently stands appears to work primarily in large volume lakes, which are typically the best integrators of regional climate variability. The "marine" crenarchaeota responsible for producing the tetraether membrane lipids used in the TEX_{86} index do not appear to be ubiquitous in lakes as previously thought, or are not in great enough abundance to be detected in the sediments of some, especially small, lakes. In addition to the aquatically derived tetraether lipids, we have found terrestrial non-isoprenoid tetraether lipids produced by bacteria, as well as non-cyclic isoprenoid tetraethers likely produced by methanogenic Euryarchaeota in all lacustrine sediments analyzed thus far. In some cases the abundance of these methanogen tetraethers confuse the TEX_{86} signal. Here we explore the relationship between surface temperature and tetraether abundance. Furthermore, we can use the presence and abundance of these terrestrial tetraethers to examine climatic and landscape changes within the watershed. We will also demonstrate the wonders of the paleothermometer with a temperature record from Lake Malawi through the LGM.

A relationship between archaeol/ caldarchaeol and salinity

COURTNEY H. TURICH[1], A. DANIEL JONES[2] AND KATHERINE H. FREEMAN[1]

[1]Department of Geosciences, [2]Department of Chemistry, Penn State University University Park, PA 16802

Broad distribution coupled with recalcitrant and unique ether-linked membrane lipids make Archaeal biomarkers potentially strong and informative proxies, applicable in innumerable geological settings. Proxy development is in its beginning stages, and tempered by analytical challenges and a rudimentary, but growing, understanding of Archaea ecology and lipid preservation. This study examines trends in Archaeal lipid distribution as a function of salinity in particulate organic matter (POM) and sediments. Results to date reveal a strong correlation between salinity and the distribution of Archaeal lipids, particularly in the ratio of archaeol, a C40 diether and caldarchaeol, a C80 tetraether. LC-APCI-MS analysis of these intact core ether lipid show an archaeol : caldarchaeol ratio close to 1 in freshwater sediments, 3 in freshwater POM, 5-8 in marine POM, and apparently increases linearly (up to 100) in hypersaline POM and sediment. Thus far, these trends appear to be insensitive to temperature (19-31ºC) or pH (4.1-7.9). The origin of this relationship may be shifting community structure, from changes in the archaeol and caldarchaeol-producing Euryarchaeota (uncultured Groups II, III, or IV) to the dominance of phylogenetically distinct diether-producing halophiles. We will continue to confirm this correlation and its possible origins in modern samples before testing this prospective proxy in a variety of ancient sediments.