Archaeal lipids in transition: Characterization of lipids and sequences in the Orca Basin, Gulf of Mexico

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The temperature proxy, TEX_{86}, has become a popular tool for reconstructions of past sea surface temperatures due to its ubiquitous temporal and spatial coverage [1] [2]. TEX_{86} is based on the ratio of cyclopentyl moieties in the glycerol dibiphytanyl glycerol tetraether (GDGT) membrane lipids of some Archaea. It is unclear whether multiple clades contribute significantly to the production of GDGTs, or if non-thermal effects contribute to GDGT distributions in the water column and sediments.

A high resolution suspended particulate matter dataset from the deep-sea hypersaline Orca Basin and the overlying water column in the Gulf of Mexico allow for the characterization of marine archaeal populations and associated lipids within very specific chemical gradients [3]. A pronounced pycnocline at ~2200m acts as a particle trap [4] and allows for the comparison of in-situ microbial populations at the sediment-water interface with in situ and transported populations entrained over the hypersaline brine. Characterization of organisms and lipids throughout the water column was pursued by combining measurements of core GDGTs sampled for proxy SST reconstructions, as well as intact polar GDGTs and rRNA sequences of resident Archaea and Bacteria.

Our data support Thaumarchaeota as the dominant producers of GDGTs throughout the water column and in the brine layer, suggesting the presence of either multiple metabolic strategies or multiple GDGT-producing clades. For example, the abrupt disappearance of GDGTs 0-2 (lipids upon which TEX_{86}-temperature calibrations depend) at ~400m implies a change in biosynthetic pathways or producing organisms. Variability in the relative abundances of individual GDGTs with depth, and their associated clades, indicate the need for a revision of present assumptions regarding archaeal lipid synthesis.

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