ESTERIFIED GLYCEROL DIALKYL GLYCEROL TETRAETHERS DERIVED FROM LOW TEMPERATURE THERMAL DIAGENESIS OF MICROBIAL LIPIDS

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Microbes (algae, Bacteria, and Archaea) contribute most of the biomass in marine source rocks that eventually generates hydrocarbons (HC) through thermal diagenesis. Thermal maturity of buried organic matter predicts the over all formation of oil. Commonly used thermal maturity indicators (e.g., vitrinite reflectance, HC biomarkers) are inadequate and often conflict in low maturity marine sediments. Developing better pre-oil thermal indicators will decrease risks in petroleum system assessments. Tracing the diagenetic pathways of specific microbial lipids and deciphering their kinetics can provide sensitive thermal indicators in low maturity (pre-oil) sediments.

Glycerol dialkyl glycerol tetraethers (GDGTs) are significant components of microbial lipids preserved in marine sediment, which can be attributed to their relative recalcitrant feature compared to other lipids. Previous studies have shown that GDGTs are usually bound into macromolecules in immature sediments (e.g., Pancost et al., 2008 and paper cited therein), but the mechanism has not been addressed. Becker (2015) identified fatty acid-substituted GDGTs (FA-GDGTs) in various marine sediments, and their data pointed to a diagenetic origin of FA-GDGTs. In order to understand the diagenetic pathways of GDGTs we conducted a lab based simulation experiment by heating the organic rich Salt Pond sediment under anoxic condition.

Most labile compounds, such as intact phospholipids, carotenoids and respiratory quinones, exhibited dramatic degradation under 90 °C after 4 days. Hopanoids and GDGTs are relative recalcitrant, and therefore become the more dominant components of extractable lipids over time. Notably, both isoprenoidal and branched FA-GDGTs are detected after 8 days' cooking but are not present in the original sediment. Fatty acids esterified with GDGT are dominated by C_{16} and C_{18} fatty acids, which is consistent with the observation of Becker (2015) in marine sediments. FA-GDGTs are diagenetic products formed during the initial diagenesis of microbial lipids, and therefore can be used as the indicators of low temperature diagenesis.

Pancost, R.D., Coleman, J.M., Love, G.D., Chatzi, A., Bouloubassi, I., Snape, C.E., 2008. Kerogen-bound glycerol dialkyl tetraether lipids released by hydropyrolysis of marine sediments: A bias against incorporation of sedimentary organisms? Organic Geochemistry 39, 1359–1371.

Becker, K.W., 2015. Biogeochemical significance and biomarker potential of novel glycerolipids and respiratory quinones in the marine environment. PhD. thesis, University of Bremen, Germany.