# Characterization of Intact Polar Lipid Biomarkers from a Site of Active, Low-Temperature Serpentinization

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Several hypotheses invoke the generation of hydrogen and reduced carbon compounds during serpentinization as a sustained source of energy for the emergence of life on Earth, and possibly on other extraterrestrial bodies (e.g. Mars, icy satellites). Thus, there is a great need to determine robust biosignatures from these settings. Lipid biomarkers are of particular interest due to their strong preservation in the rock record. However, little work has been done to characterize the production of lipid biomarkers in analog serpentinizing systems, particularly under astrobiologically-relevant geochemical conditions.

Intact polar lipids (IPLs) are presumed to represent live biomass, and thus are well-suited molecules for linking lipid signatures to active microbial communities and environmental parameters. We extracted IPLs from deep, subsurface fluids hosted within the actively serpentinizing Samail Ophiolite of Oman. We are inventorying the IPL composition of these fluids within the context of microbial community composition and function as inferred by 16S rRNA gene amplicon and shotgun metagenomic sequencing, respectively, to deduce the source of lipid signatures, as well as the putative metabolisms of these source organisms. Due to the dependence of microbial diversity and abundance on energy and carbon availability, we are also investigating how IPL composition varies with fluid geochemistry. We measured highly variable fluid compositions, with potential metabolic substrates ($H_2$, $CH_4$, $NO_3^-$, $SO_4^{2-}$, inorganic C) differing in concentration considerably from sample to sample. Preliminary ordination of samples by principal component analysis on the basis of IPL composition indicates that the availability of electron donors and acceptors may help explain some of the variance observed between samples, however, clearly there are other factors driving lipid biomarker composition in this setting. We are now working to correlate the relative abundance of IPL classes with specific geochemical parameters. Results from this work will provide significant insight into the variety and sources of lipid signatures that arise in serpentizing environments and how geochemical factors influence their diversity. This is an important first step in interpreting fossil serpentinite biomarker records and will help guide future efforts to detect signatures of subsurface life.