Transformations and Fates of Lipid Biomarkers in Microbial Mat Ecosystems

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The study of well-preserved evaporitic microbial assemblages and silicified stromatolites have contributed substantially to Precambrian paleobiology. Over two decades of research at Guerrero Negro have created an extensive database on the biogeochemistry, diversity and organic biomarkers of these mats. Cyanobacterial mats differ from typical marine sediments in ways that can affect organic diagenesis. Mats typically have less available iron, higher rates of sulfur cycling and more abundant cyanobacterial sheaths and other EPS. Heterotrophs degrade biomolecules and provide smaller compounds to other biota, but functionalized biomarkers are also sequestered in macromolecules and thus protected from further diagenesis. The application of hydropyrolysis (HyPy) can identify biomarkers in these macromolecules and help characterize the processes involved in their preservation.

In this study we have attempted to characterize the solvent-extractable biomarkers in the mat and underlying sediments to link this work with previous studies of microbial diversity and by using HyPy to characterize lipid biomarkers bound to the insoluble biopolymer fractions.

Cyanobacterial mats are one of the most diverse ecosystems known, which is further reflected by their highly diverse lipid composition. Solvent extractables include intact polar lipids characteristic of the viable community. Changes in fatty acid community structure were apparent with depth. Abundant sterol (C29>C27>C28) was present in the surface 2mm. With depth, sterol abundance and molecular variation increased, and formation of sterenes became prevalent. Only small amounts of hopanoids were recovered from the surface. Free hopanes and hopanic acid increased with depth but methylated compounds were rare. By contrast, HyPy released relatively high amounts of extended hopanes, including methyl forms, with roughly equivalent hopane to sterane ratios. These preliminary observations indicate that hopanoids are more readily sequestered during diagensis as a potential consequence of early binding of their polyol side-chains.