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Activity : Abstract

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Title:

Microbial Lipid and C Isotopic Biosignatures of a Unique Community at Grand Prismatic Spring, Yellowstone National Park

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Topic:

N04 Biogeochemistry and Geomicrobiology ; N05 Molecular Microbiology Ecology: Communities and Organisms

Keyword:

lipids ; hot springs ; Chloroflexus

Abstract:

The microbial communities found in modern hot springs are considered analogs to ones that may have existed in hydrothermal systems on the early Earth and possibly Mars. Our goal was to characterize the microbial biosignatures and to assess the preservation of organic matter in the silica-depositing Grand Prismatic Spring in Yellowstone National Park. This study combines 16S rRNA surveys, lipid biomarkers, and C isotopes to query, "Who's there and what are they doing?"

On the edge of the ~90 m diameter blue vent pool (56.1°C, pH 8.5), a floating green streamer community grew over a benthic pink community. The membrane lipids in the green streamers and pink mat were composed of unusual ester-linked fatty acids, indicating the presence of novel bacterial groups. In particular, we discovered a series of 2-methyl and 2,X-dimethyl phospholipid fatty acids (C₁₈₋₂₂). We are attempting to use the 16S rRNA surveys to link these compounds to source organisms. Wax esters, biomarkers for Chloroflexi, were present in both communities, but displayed different profiles. A higher proportion of branched wax esters were found in the green streamers, and were associated with a relatively high concentration of long-chain di- and trienes (C₂₉₋₃₁). This suggests that *Chloroflexus* primarily grew in the green streamers, while a pink mat of *Roseiflexus* grew on the sinter substrate underneath. Cyanobacterial alkanes were found in the green streamers (*n*-C₁₇, 7-, 6- and 5-monomethyl-C₁₇, 7,11-dimethyl-C₁₇, *n*-C₁₉, *n*-C_{19:1}). We also detected a series of monoalkylglycerylethers and geologically relevant hopanoids in both communities.

Carbon isotope analyses indicated that *Chloroflexus* was growing photoheterotrophically using cyanobacterial photosynthate. *Roseiflexus* also traditionally grows photoheterotrophically, but the C isotopic signatures of the lipids in the pink mat were ~10 ‰ lighter than the cyanobacterial and *Chloroflexus* lipids, indicating a potentially

novel metabolic mechanism or prior secondary reworking of substrates before reaching *Roseiflexus*. This arrangement of *Synechococcus-Chloroflexus* green streamers floating over a benthic pink community of *Roseiflexus* is different from the classical laminated *Synechococcus-Chloroflexi* mats at Octopus Hot Spring.

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