Exploring the Metabolic Potential of Microbial Communities in Ultra-basic Reducing Spring at The Cedars, CA: Evidence of Microbial Methanogenesis and Heterotrophic Acetogenesis

Lukas Kohl (Memorial University)

Additional Authors: Cummings E, Cox A, Rietze A, Morrissey L, Lang SQ, Richter A, Suzuki S, Nielson K, Morrill PL

Present-day serpentinization generates groundwaters with conditions (pH > 11, Eh < -550mV) favorable for the microbial and abiotic production of organic compounds from inorganic precursors. Elevated concentrations of methane, C2-C6 alkanes, acetate, and formate were detected at these sites, but the microbial or abiotic origin of these compounds remains unclear. While geochemical data indicate that methane at most terrestrial sites of present-day serpentinization are abiotic, the stable carbon, hydrogen, and clumped isotope data as well as the hydrocarbon gas composition from The Cedars, CA, USA, are consistent with a microbial origin for methane.

We report on laboratory experiments in which the microbial communities in fluids and sediments from The Cedars were incubated with 13C labeled substrates. Increasing methane concentrations and the incorporation of 13C into methane in live experiments, but not in killed controls, demonstrated that methanogens converted methanol, formate, acetate (methyl group), and bicarbonate were converted to methane. The apparent fractionation between methane and potential substrates indicated that methanogenesis was dominated by the carbonate reduction pathway. Increasing concentrations of volatile organic acid anions indicated microbial acetogenesis. Stable carbon isotope values of acetate, however, were inconsistent with autotrophic acetogenesis, thus suggesting that acetate was produced through fermentation.