Organic Geochemistry of Lost City Hydrothermal Fluids

Susan Lang*, David Butterfield, Marvin Lilley

The Lost City is a peridotite-hosted vent field distinctly different from other known hydrothermal systems. Fluids from Lost City are warm (40 to 90°C), reducing, highly alkaline (pH 9 to 11), and enriched in hydrogen, methane and other hydrocarbons [1]. Tall carbonate chimneys host dense microbial communities which have been implicated in methane and sulfur cycling [1]. The concentration and composition of organic matter in this environment has important ramifications for resident microbial communities as both a potential carbon source and as a potential electron donor.

Water samples were collected from the Lost City vent field in the summer of 2003 and analyzed for dissolved organic carbon (DOC) concentrations. Across the field, concentrations fell primarily along a single mixing line between the hydrothermal endmember fluids and local background seawater. Endmember fluids contain up to 95 µM DOC, more than twice the concentration in local background seawater. The presence of a single, field-wide mixing line suggests that the majority of the excess carbon is added at depth, with minimal interaction from the carbonate chimneys. To constrain its source, we analyzed the stable carbon (δ13C) isotopic composition of the DOC, which ranged from typical seawater values of -22 ‰ (VPDB) to -10 ‰ in the most hydrothermally pure samples. The excess DOC has a similar isotopic composition to both the methane in the fluids [2] and the lipids of methane-cycling archaea isolated in the chimney [1].

The abiological formation of low molecular weight organic acids has been shown to be thermodynamically favorable under conditions of serpentinization, and the reduction of carbon dioxide to formate has been confirmed in laboratory experiments [3]. Fluids were analyzed for the presence of organic acids; both formate and acetate were present in significantly higher concentrations than deep seawater. Isotopic evidence and the relative concentrations of organic acids compared to DOC are consistent with an abiotic origin for the formate. After methane, these organic acids are the most prevalent carbon species in the fluids. The thermodynamic energy provided by these reduced carbon species may help support the dense microbial life in the interior of the carbonate chimneys.

**Presenting Author: Scripps Inst. Oceanography, La Jolla, CA, USA*