Microbial and Biogeochemical Characterization of Hydrothermal Plumes on the Mid-Cayman Rise

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One of the main goals of the Outer Planet Flagship Mission to Europa is to characterize the subsurface ocean and ultimately determine whether it harbors life. In October 2009 we systematically characterized the extent and distribution of hydrothermal activity along the previously unexplored Mid-Cayman Rise, Earth's deepest mid-ocean ridge as part of a NASA-funded ASTEP program. An overview of the mission and technology used will be presented in the Special Topics Session "Results from ASTEP and other Astrobiology Field Campaigns."

While hydrothermal vent-sites typically occupy very small areas of the seafloor vent fluids mix with cold deep ocean seawater and can rise hundreds of meters before reaching a level of neutral buoyancy. The resulting hydrothermal plumes, enriched in dissolved chemical species, mineral particles and microbes relative to seawater, are dispersed laterally and can be detected over tens of kilometers from their source. Using Conductivty-Temperature-Depth (CTD), Eh and optical profiling combined with chemical and microbial analysis of discrete water samples, we have found evidence for three distinct styles of venting on the Mid-Cayman Rise. Detailed data from water samples from two sites at ~2200m and ~4900m will be presented in the context of life detection and characterization of the type of seafloor venting. Initial results indicate the presence of a large methane plume (up to 30 nM) at the shallow site with parallel increases in cell concentrations (up to 4 x 10^4 cells/ml), while the deeper site has smaller methane anomalies, but still an increase in cell concentrations.

Data analysis is on-going and microbial cell counts and bacterial and archaeal community composition data will be integrated with optical backscatter, methane concentration, Eh, and other chemical indicators of hydrothermal activity. Because hydrothermal circulation may arise on any planet that has, or has experienced, liquid water and a source of heat, our research will provide new insights into the possible origins and evolution of Earth's biosphere and the conditions under which such systems might also have given rise to life on Europa.