Geophysical Research Abstracts
Vol. 16, EGU2014-16710-1, 2014
EGU General Assembly 2014

Dynamic drivers of a shallow-water hydrothermal vent ecogeochemical system (Milos, Eastern Mediterranean)

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Shallow-water hydrothermal vents share many characteristics with their deep-sea analogs. However, despite ease of access, much less is known about the dynamics of these systems. Here, we report on the spatial and temporal chemical variability of a shallow-water vent system at Paleochori Bay, Milos Island, Greece, and on the bacterial and archaeal diversity of associated sandy sediments. Our multi-analyte voltammetric profiles of dissolved O_2 and hydrothermal tracers (e.g. Fe2+, FeSaq, Mn2+) on sediment cores taken along a transect in hydrothermally affected sediments indicate three different areas: the central vent area (highest temperature) with a deeper penetration of oxygen into the sediment, and a lack of dissolved Fe2+ and Mn2+; a middle area (0.5 m away) rich in dissolved Fe2+ and Mn2+ (exceeding 2 mM) and high free sulfide with potential for microbial sulfide oxidation as suggested by the presence of white mats at the sediment surface; and, finally, an outer rim area (1-1.5 m away) with lower concentrations of Fe2+ and Mn2+ and higher signals of FeSaq, indicating an aged hydrothermal fluid contribution. In addition, high-frequency temperature series and continuous in situ H2S measurements with voltammetric sensors over a 6-day time period at a distance 0.5 m away from the vent center showed substantial temporal variability in temperature (32 to 46 ℃) and total sulfide (488 to 1329 μM) in the upper sediment layer. Analysis of these data suggests that tides, winds, and abrupt geodynamic events generate intermittent mixing conditions lasting for several hours to days. Despite substantial variability, the concentration of sulfide available for chemoautotrophic microbes remained high. These findings are consistent with the predominance of Epsilonproteobacteria in the hydrothermally influenced sediments Diversity and metagenomic analyses on sediments and biofilm collected along a transect from the center to the outer rim of the vent provide further insights on the metabolic activities and the environmental factors shaping these microbial communities . Both bacterial and archaeal diversity changed along the transect as well as with sediment depth, in line with the geochemical measurements. Beside the fact that it harbors an unexpected diversity of yet undescribed bacteria and archaea, this site is also a relevant model to investigate the link between ecological and abiotic dynamics in such instable hydrothermal environments. Our results provide evidence for the importance of transient geodynamic and hydrodynamic events in the dynamics and distribution of chemoautotrophic communities in the hydrothermally influenced sediments of Paleochori Bay.