Organic matter alteration due to high heat flow in the northern Gulf of California

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Studies in the northern Gulf of California have discovered high heat flow anomalies related to intensive gas discharge in the Wagner and Consag basins. The basins present a thick sediment cover of at least 5 km and bathymetry data show a maximum depth of 200m. Both basins have intense seismic activity and they are similar to other tectonically active basins in the Gulf of California plate border system. Intense gas discharge has been reported along the Wagner Fault, which is a continuation of the San Andreas transform fault. Chemical studies of the sediments from the Wagner Basin show that they have been subject to alteration of the sediment organic matter due to hydrothermal activity, similarly to what has been reported in the Central Gulf of California (Guaymas Basin), where high heat flow has been related to hydrocarbon generation and thermogenic methane abundance. Identification of the isoprenoid (PM1) related to the phylum Crenarchaeota is evidence of high temperature (75 to 105 °C) as this is the optimal temperatura for those organisms. High variability was observed in the maturity of organic matter in the sediments of the basins in correlation with the presence of hydrothermal activity.

Microbial community development and mineral-organic matter interactions in an artificial soil incubation experiment

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Artificial soils with 8 different mixtures of illite, montmorillonite, ferrihydrite, boehmite, charcoal and quartz sand, and manure as organic matter (OM) source were inoculated with the same microbial extract and incubated up to 18 months. The artificial soils were incubated under constant environmental conditions so that the effect of microbial activity on OM-mineral interactions alone could be studied.

The amount of organic carbon (OC) associated with minerals and microaggregates was determined by density fractionation. Solid state ^{13}C nuclear magnetic resonance (NMR) spectroscopy was used to characterize OC composition. Development of the microbial community in the first 90 days was followed by denaturing gradient gel electrophoresis (DGGE) analysis of 16S rRNA gene fragments amplified from total community DNA.

Density fractionation showed that significant microaggregation took place within 3 months of incubation and up to 24% of the OC present was associated with microaggregates and minerals in all mixtures at the end of incubation. This indicates that a fast development of OM-mineral interactions took place, providing microbial habitats. This is supported by the development of the bacterial community structure in the artificial soils, which depended on the mineral composition. Charcoal was shown to strongly influence the reassembly of bacterial communities. Effects of montmorillonite, illite and iron oxide on microbial communities were observed at day 90.

The results clearly show that mineral composition shaped the microbial community structure. This experiment therefore allows for the study of the development of organic matter-mineral associations, facilitated by micro-organisms, from clean model materials to soil-like systems.