Tracking the fate of carbon in serpentinite-hosted systems

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The reaction of ultramafic mantle rocks with water to produce serpentinite at moderate- to low-temperatures results in alkaline fluids, which characteristically have elevated concentrations of abiotically produced hydrogen, methane, and low molecular weight hydrocarbons. These highly reactive systems have major consequences for lithospheric cooling, global geochemical cycles, carbon sequestration, and microbial activity. The continuous flux of reduced compounds provides abundant thermodynamic energy to drive microbial chemolithoautotrophy but – paradoxically for systems characterized by large carbonate deposits and high methane concentrations – a lack of carbon availability may limit microbial growth. We focus here on tracking the source and fate of both organic and inorganic carbon in serpentinization systems, and incorporate recent data from mineralogical and petrographic studies with geochemical and isotopic characterization of fluids, rocks, and deposits from multiple serpentinization environments.

The primary goals of this work are to (1) identify potential zones of microbial activity along the entierty of hydrothermal fluid circulation pathways and (2) characterize the differing fates of mantle carbon and inorganic carbon in these environments. We highlight the central role of the sulfur cycle in these processes.