

Coupled Fe, S, N, and CH₄ cycling in subsurface serpentinizing systems

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The hydration of peridotite rocks generates alkaline and hyperalkaline fluids spanning an enormous range of Eh and aqueous geochemistry depending upon the extent of water/rock reaction and Fe-oxidation. Dissolved hydrogen, formate, carbon monoxide and methane can reach micromolar to millimolar concentrations, and serve as potent electron donors for microbial metabolism when oxidants are available. We are investigating the hydrobiogeochemistry of modern serpentinite aquifers to trace the subsurface generation of H₂ and CH₄, coupled to the utilization of oxidized forms of S, Fe and N, that sustains *in-situ* biological activity. We are also exploring the molecular signals associated with such microbe/mineral interactions that might be produced and preserved in analogous ancient and extra-terrestrial environments.

In this talk, we will share our recent identification and characterization of Fe, N and S cycling, as well as methane production and consumption, in partially-serpentinized peridotites in the Samail ophiolite in Oman. We have applied a combination of mineralogical, spectroscopic, isotopic and molecular microbiological methods to minerals, fluids, and biomass collected from hundreds of meters depth in subsurface mantle rocks. From the integration of this data, we begin to infer how serpentinite-hosted ecosystems function under highly anoxic conditions, demonstrate where dynamic Fe, S and N redox transformations occur, identify key organisms distributed across the geochemical gradients, and explore abiotic vs. biotic controls on the secondary mineralization.