Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.27563

Biogeochemical transformations of peridotite rocks: signatures of *in-situ* biological activity and hydrogen dynamics

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Low-temperature serpentinization of peridotite rocks results in the formation of brucite, ferric serpentine, and hydroandradite in disequilibrium with relict olivine and pyroxene, as well as minor magnetite and carbonate phases. Microbial organisms inhabit peridotite rocks throughout the several stages of successive stages of hydration and oxidation, exerting important controls on the abundance of hydrogen, methane, volatile fatty acids and the production of additional secondary mineral phases, such as secondary sulfides and phosphates.

There are several open questions about the scale of the subsurface biosphere than can be sustained within peridotites during active serpentinization, and how life distributes itself within the strong geochemical gradients that are established. In addition, biological activity shapes the evolution of the mineral assemblages and their redox states in ways that have not yet been thoroughly investigated.

We have been applying numerous microscale spectroscopic and chemical imaging techniques to drill core samples from the Oman Drilling Project, such as Raman microspectroscopy, synchrotron-based microscale XRF and XANES spectroscopy, nanoSIMS and stable-isotope probing. By integrating these data sets, we are characterizing distinct mineral assemblages associated with microbial activity, and revealing dynamic changes in Fe, S and P speciation across parts of the subsurface of the Samail Ophiolite.

We will summarize some of the most recent data sets used to characterize the variable physical, chemical and biosignature properties of subsurface serpentinite rocks and fluids in the Oman Multiborehole Observatory. We will also present a conceptual model for controls on the habitability of a serpentinite-hosted biosphere, to explain how we observe such a remarkable abundance and activity of microbial organisms that strongly shapes the biogeochemistry of serpentinites and dynamic changes in the abundance of hydrogen.