Rock-Hosted Serpentinite Microbiome

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Serpentinization is a widespread geochemical process involving the alteration of ultramafic rocks in the presence of water, resulting in a high pH (>10), highly reducing environment containing large quantities of dissolved hydrogen and potentially abiogenic organic molecules, which can serve as energy sources for microbes in the subsurface. Habitability models predict that these environments can sustain microbial life, but little work has been done to directly characterize the microbial communities utilizing the energy generated from this process. Furthermore, prior studies of continental serpentinites have sampled surface seeps that represent an interface between end-member fluids and the atmosphere and may not truly represent the extreme conditions encountered deep within the subsurface.

A recent drilling project at the Coast Range Ophiolite Microbial Observatory (CROMO) in northern California has supplied rock cores from up to 40 m below the surface and provided a window into an actively serpentinizing system. Rock cores from two wells, roughly one mile apart, were sampled at various depths and analyzed for microbial community composition via metagenomics and 16S rRNA tag sequencing, allowing for the comparison of communities within and between rock cores. Additionally, fluid samples from both wells have been sequenced, allowing for the identification of rock-specific microbes within the environment. Preliminary data indicate that communities associated with rocks are lower diversity and different composition than those associated with the surrounding fluids.

To test the question of habitability within the serpentinite subsurface, microorganisms have been cultivated *in situ* within the monitoring wells, showing growth over time, and their diversity is being assessed via 16S rRNA tag sequencing. Future experiments include providing environmentally-relevant mineral substrates *in situ* to determine the extent of microbe-mineral interactions within the serpentinite subsurface environment. This work adds to our growing understanding of the role of microorganisms in this extreme environment.

Pilbara greenstones revisited: a multi-proxy geochemical perspective on Archean crust-mantle interaction

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Metabasalt (greenstone) sequences in Archean cratons provide insights into mantle melting and crust formation processes in the Early Earth. The 3.53–3.22 Ga eastern Pilbara Craton, Western Australia, contains large-scale exposures of well-preserved Palaeoarchean supracrustal vol-canic sequences, which can be correlated over considerable distances and are characterised by virtually undisturbed immobile element (REE, HFSE) systematics. Previous studies have aimed to establish a stratigraphic and chronological framework, reconstruct the tectonic setting for greenstone emplacement, and determine the composition of sources that may explain the chemical/isotopic signatures in these rocks. The recent suggestion of involvement of a Hadean crustal component, based on distinctly negative ε_{Nd} values in metabasalts and cherts within the Warrawoona Group [1], has motivated us to revisit these issues.

Here we present new high-precision trace element and isotopic (Nd-Hf) results for tholeiitic and komatiitic rocks of the Warrawoona Group, the lowermost section of the East Pilbara terrane. Trace element patterns in our samples are characterized by comparatively flat HREE distributions but wide variations in LREE abundances, with mantle-normalized ratios of $(La/Sm)_{PM}$ <1 to >4, $(Zr/Y)_{PM}$ <1 to >5, $(La/Yb)_{PM}$ <1 to >20 and $(Nb/Th)_{PM}$ significantly below 1, i.e. from values inferred for mantle-derived melts to values more typical of continental crust. By contrast, HFSE inter-element ratios (Nb/Ta ~ 16.2, Zr/Hf ~ 36.8) and initial Nd-Hf isotope values are homogeneous ($\varepsilon_{Nd} = 1.4 \pm 0.5$; $\varepsilon_{Hf} = 2.2 \pm 0.8$), yielding ~3.45 Ga isochron ages which are consistent with known emplacement ages.

Our Nd (and Hf) isotope results are consistent with those of Jahn *et al.* [2] and Gruau *et al.* [3] and do not appear to support a significant contribution from assimilated enriched Hadean proto-crust to ~3.45 Ga basaltic magmatism. Additional modeling will help to further assess the involvement of potential crustal contaminants.

[1] Tessalina *et al.* (2010), *Nature Geosci.* **3**, 214-217. [2] Jahn *et al.* (1981), *Geochim. Cosmochim. Acta* **45**, 1633-1652. [3] Gruau *et al.* (1987), *Earth Planet. Sci. Lett.* **85**, 105-116.

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