Modern peridotite alteration in Oman hyperalkaline aquifers and implications for microbial habitability

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Subsurface hyperalkaline fluids (pH >10), rich in Ca^{2+}, H_2 and CH_4, accessed from 300m deep wells situated in the Samail ophiolite in Oman were studied to investigate their geochemistry, gas concentrations, isotopic signatures and microbial community composition. This data was integrated with analyses of recovered rock chips from several depths in the wells to elucidate alteration processes affecting ultramafic rocks in the subsurface of Oman as they undergo modern water/rock reactions. Analyzing the geochemistry of subsurface fluids and the rocks they are in contact with provides much greater insight into the operative reactions in serpentinizing aquifers than solely studying surface seeps.

The subsurface fluids hosted in partially-serpentinized Oman peridotite contain 0.17-0.67mM H_2 , with a δD H_2 of -680 to -685.7‰. The isotopic fractionation between the dissolved H_2 and water gives rise to a predicted formation temperature of ~50°C. CH_4 is also variably present in the fluids (0.04-1.44 mM). The methane exhibits notably heavy $\delta^{13}C$ CH_4‰ values (2.4-3‰) coupled with δD CH_4‰ from -205 to -232‰ that together would be interpreted as abiotic. However, high-throughput sequencing of DNA recovered from filtered fluids reveals an abundance of *Meiothermus*, *Clostridia*, and candidate phyla OP1, as well as detected sequences of known methanogens and methane oxidizers such as *Methanobacterium* and *Methylococcus*.

We will discuss how these gas-rich fluids have evolved through low temperature oxidation and hydration of reduced Fe-species present in the peridotite. The extensive magnetite formation and Fe(III)-rich serpentine both may contribute to H_2 generation at low temperatures and thereby sustain an active subsurface biosphere.