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The Geochemistry and Microbial Community at a Site of Active Serpentinization: the Tablelands, NL, CAN

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Serpentinization, the hydration of ultramafic minerals, is hypothesized to occur on Mars as well as other planetary bodies including Jupiter's moon Europa, and Saturn's moons Titan and Enceladus. Serpentinization also occurs terrestrially in ophiolites, sections of oceanic crust and upper mantle that have been obducted onto continental crust. The Tablelands, located in Newfoundland, Canada, is an example of an ophiolite and can be considered a Mars analogue.

Previous studies on serpentinizing fluids at the Tablelands have focused on a pool, WHC2, where ultra-basic subsurface fluids mix with oxic surface waters. To better isolate the ultra-basic subsurface fluids, a microbial observatory, referred to as Winterhouse Canyon Microbial Observatory (WHCMO), was created by drilling three boreholes into an actively discharging serpentinite-hosted spring within the Tablelands. The boreholes housed flow-through incubators that contained sterilized crushed ultramafic rock. The incubators remained in the subsurface for one year before being collected. The geochemistry of the ultra-basic subsurface fluids was analyzed, and the microbial community composition was determined through phospholipid fatty acids (PLFAs). The geochemistry and microbial community composition of WHC2 as well as the nearby brook (WHB) was also determined to compare with WHCMO.

The geochemical results suggested that while the fluid from WHCMO was ultra-basic (pH = 12.26), it was not reducing (E_h = +102 mV). WHC2, however, was ultra-basic (pH = 11.20) and reducing (E_h= -29 mV). The microbial community composition at WHCMO and WHB were almost entirely eukaryotic suggesting a large surface contribution to the samples. WHC2, the only site where the fluids were reducing, was largely composed of non-eukaryotic lipids suggesting it was likely representative of more ultra-basic subsurface fluids than anticipated. Furthermore, the total PLFA extracts suggested that the biomass at WHC2 was the highest of the sites sampled. The results of this study suggest than when searching for life on Mars, or on other planetary bodies, locations where reduced serpentinized fluids have exited the subsurface and have mixed with oxic surface fluids have the potential to support life and have higher biomass than subsurface serpentinized fluids alone.