BIOSIGNATURES AT THE SURFACE INTERFACE DEPOSITED BY SUBGLACIAL BRINE. S. Mitchell[1], E. C. Sklute[2], B. Boles[1], K. Holbrook[1], A. Jarratt[1], J. Shaffer[1], L. Smith[1], P.A. Lee[3], M.D. Dyar[2], J. A. Mikucki[1], [1]Dept. of Microbiology, University of Tennessee, M409 Walters Life Sciences, Knoxville, TN, 37996, [2]Planetary Science Institute, 1700 East Fort Lowell, Tucson, AZ 85719, [3]Hollings Marine Laboratory, College of Charleston, 331 Fort Johnson Rd., Charleston, SC, 29412

Blood Falls, Antarctica is a unique iron and salt deposit feature at the terminus of the Taylor Glacier in the McMurdo Dry Valleys, Antarctica. The dry valleys have long been considered an important Martian analogue due to its unique cold and dry conditions [1]. Blood Falls forms when episodic discharge of suboxic, iron-rich brine from an aquifer below the glacier reaches the surface. The microbial community within the subglacial brine that feeds Blood Falls outflow is chemosynthetic and contains phyla known to be involved in iron and sulfur transformations [4,5]. This brine routes through a conduit in the glacier to the surface where it is exposed to changes in pressure, UV radiation, oxygen and other surface stressors. How this impacts the subglacial microbial community is currently unknown. This unique system is also an ideal analog for Ocean Worlds since it provides a rare opportunity to study a subsurface-surface brine network through ice and allows us to ask questions about how brines transform as they move through ice interfaces with drastically different physicochemical properties. We use the Blood Falls ecosystem to study how microorganisms may interact with subterranean liquid environments, alter mineralogy, and produce metabolic biosignatures that may be detectable as subsurface brines emerge.

Figure 1. Blood Falls, Antarctica. Visible mineral transformations occurring at a surface-subsurface interface following an active discharge event through glacier ice.

Subglacial brine episodically discharges to the surface at Blood Falls and contains high concentrations of sulfate (~50 mM), chloride (~1375 mM), and iron (0.47- 3.5 mM) [3,4]. Limited mineralogical analysis, conducted several decades ago, shows surficial brine discharge precipitates are dominated by halite and aragonite [2]. Indications of mineral transformations are visible on surface features coated with brine outflow and provide evidence of interaction occurring at the subsurface-surface interface (Fig.1). Elucidating biosignatures that arise as subsurface brine interacts with surficial environments is critical towards advancing life detection methods in astrobiology. In this study, we employed advanced mineral analysis of environmental samples from Blood Falls materials. Results of these analyses provide evidence of biotic mineral transformation occurring at the surface. Enrichments of environmental samples from the subsurface-surface interface indicate the presence of a microbial community capable of performing community-driven transformation of iron (Fig. 2).

Figure 2. Microbially mediated mineral transformation. Evidence of iron transformation to magnetite by *Shewanella* sp. Strain BF02_Schw (BF02), an isolate collected from the surface discharge at Blood Falls, Antarctica.

Proton Transfer Reaction – Mass Spectrometry (PTR-MS) was used to explore the potential for volatile production from materials collected at Blood Falls. Preliminary analysis of the volatile compounds produced by a natural sample collected from the surface discharge revealed a number of spectral features with masses ranging from m/z 30 to m/z 120. Potential identifications for these features include ketones, alcohols, non-methane hydrocarbons and sulfur-containing VOCs.

Fourier-transform infrared spectroscopy results show that these samples contain primarily carbonate and/or phosphate. Neither phase appears in our spectral libraries, ruling out the more common minerals. Interestingly, the carbonate does not show up in the Mössbauer spectra, indicating that it is not an iron-bearing carbonate. The ferrous distribution in the Mössbauer spectrum could be consistent with a phosphate. XRD and Raman are currently underway to clarify this mystery. Results from this study provide insights into the application of spectral analysis to detect biosignatures from the subsurface-surface brine network.

Acknowledgments: NASA proposal # 16-EXO16_2-0163 (NASA 80NSSC17K0243)

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