BLOOD FALLS, ANTARCTICA: A MINERALOGICAL AND MICROBIOLOGICAL ANALOGUE SITE FOR PLANETARY EXPLORATION AND TECHNIQUE DEVELOPMENT. E. C. Sklute[1], J. A. Mikucki[2], A. Jarratt[2], M. D. Dyar[1,3], and P. A. Lee[4], [1]Planetary Science Institute, 1700 E. Fort Lowell Rd. Ste. 106, Tucson, AZ. 85719, ecsklute@psi.edu, [2]Department of Microbiology, University of Tennessee, 1311 Cumberland Ave. Knoxville, TN 37996, [3]Department of Astronomy, Mount Holyoke College, 50 College St., South Hadley, MA. 01075, [4]Hollings Marine Lab, 331 Fort Johnson Rd, Charleston, SC 29412.

Introduction: Blood Falls is an aperiodic discharge of saline effluent forming a red-tinged fan at the snout of Taylor Glacier, Antarctica - one of the coldest and driest places on Earth. This feature is a singular analogue study site for a variety of reasons. From a climatological standpoint, the cold, dry expanse of the Antarctic dry valleys come closer to extraterrestrial environments than most other places on Earth. From a mineralogical standpoint, the combination of glacial sediment with hypersaline, Fe-bearing brines provides parallels to Mars. From a microbiological standpoint, the isolated and encapsulated subglacial, sub-ice system from which Blood Falls emanates hosts an active microbial community that has been evolving in isolation for possibly thousands of years or longer [1], and thus provides insights into potential microbial communities in the Martian subsurface or on ocean worlds. From an exploration standpoint, logistically challenging access and the limited sample return from aperiodic field sessions creates a realistic sampling regime to which complementary techniques can be tailored.

Here we present the mineralogical analysis of surface environmental samples from two field seasons using a complementary set of analysis techniques and discuss how each contributes to an overall understanding of the system. We also present the results of a bioreduction experiments using a microbiological isolate from the surface discharge, *Shewanella* sp. BF02, and speculate on how such cultures interact with and are recorded in the mineral record.

Methods: Samples ES25 (11/22/06) and ES24 (11/19/18) were stored at room temperature and samples ES26 (11/19/18) and ES27 (11/28/18) were stored at 4°C prior to analysis. Samples were analyzed by Fourier transform infrared attenuated total reflectance (FTIR ATR), visible and near infrared (VNIR), Raman, and Mössbauer spectroscopies, as well as by x-ray diffraction (XRD), scanning electron microscopy (SEM), electron probe microanalysis (EPMA), and transmission electron microscopy (TEM). Details can be found in [2]. *Shewanella* sp. BF02 was grown on ferrihydrite in a minimal marine media as described in [3] and bioreduction products plus controls were analyzed by FTIR, VNIR, Raman, and Mössbauer spectroscopies, as described in [2,3].

Results and Discussion: The characteristic red-orange hue of surface sediments that fan out from Blood Falls and give the feature its name have historically been assumed iron oxide rich, supported by the fact that the discharge starts clear and reddens with time. Our detailed analysis, however, shows that this is not necessarily the case. While there is certainly iron, as can be seen in the Mössbauer analysis, there is very little of it according to multiple techniques and the iron-bearing phases do not appear to be iron (hydr)oxides. In fact, all spectroscopic analysis and XRD point towards calcite and aragonite dominating the mineralogy [2]. Both SEM EDS and EPMA analyses show sparse populations of iron-bearing grain fragments sticking to larger primary mineral grains. Fragment stoichiometries are inconsistent with (hydr)oxides. Yet the VNIR spectra show VIS Fe^{3+} spin-forbidden crystal field transitions as might be seen in an (hydr)oxide mix and the *Shewanella* species isolated from the surface grows readily on iron (hydr)oxide. The dichotomy between the spectroscopy, XRD, microbiology, and microscopy provides insight into potential mismatches and uncertainties that may exist in planetary data.

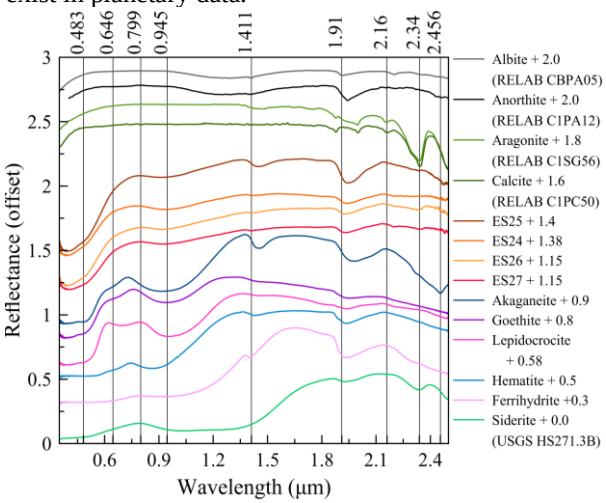

Figure 1. VNIR spectra of Blood Falls Environmental samples with references from indicated databases [4].

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References: [1] Mikucki J. A. et al. (2009) *Science, 324*, 397-400. [2] Mikucki J. A. et al. (2020) *51st LPSC*, Abstract #2018. [3] Sklute E. C. et al. (2019) *50th LPSC*, Abstract #1430. [4] Kokaly R. F. et al. (2017) *Geol. Survey Data Series 1035*, 61p.