REMOTE AND IN-SITU CHARACTERIZATION OF MICROBIAL LIFE AND THE GEOCHEMICAL RECORD OF LIFE IN TERRESTRIAL LAVA TUBES, ANALOGS FOR MARTIAN VOLCANIC CAVES.

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Introduction: Volcanic caves are a priority, target niche in the search for life, extant or extinct, in the Martian subsurface. BRAILLE (Biologic and Resource Analog Investigations in Low Light Environments) is a NASA-funded project centered around field research at Lava Beds National Monument (Northern California, USA), a planetary analog setting for Martian caves. The BRAILLE Team's objectives are to (1) characterize microbial life and microbial community structure in terrestrial lava caves and the nutrients in rock and water that sustain them; (2) distinguish secondary minerals associated with microbes in the caves – macroscopic, putative signatures of life and a geochemical record of life that could persist long after any life died away; and (3) practice robotic life-detection and mapping mission operations by directing remote rover activities in one of the caves, Valentine Cave, from a surface command center located at park headquarters. Here, we will summarize our findings to date and discuss relevance to the search for extant life on Mars.

Astrobiology Investigations at Lava Beds: Our interdisciplinary science effort at Lava Beds focused on 9 caves selected to encompass a range in flow age, length, depth, number of entrances, and human visitation. While our team conducted individual discipline studies of the microbial community, geochemistry, and secondary mineralogy, our collective goal was to characterize a "mineral microbe continuum" (MMC), detailing the correlation of analytical probe results moving from apparent "bare rock" (basalt) surface, through mineral crusts and coatings, secondary mineral products with small (several mm to cm), coral-like morphologies coating the cave walls, and on to biofilms and, finally, oozes. Compositionally, the mineral features consisted primarily of several forms of amorphous silica, which enhances their preservation potential. Details of our working MMC will be presented in Northup et al. (this workshop).

Robotic Operations and Mars Mission Simulation: The robotic operations aspect of our project used the NASA Ames testing rover, CaveR, which was ported manually into Valentine Cave. CaveR mapped 20m segments of one side of the cave wall autonomously using a laser scanner. CaveR then returned to interrogate, using a suite of stand-off instruments mounted on the side of the rover facing the wall, targets of astrobiological interest that were selected by a remote science team working under a mission timeline constraint. These same transects were examined by a separate group of astrobiology scientists, in the cave, in similar, timed exercises. We will report correlations between the groups in and out of the mission simulation and initial lessons learned from this planetary mission operations concept.

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