IDENTIFICATION AND VALIDATION OF BIOGENIC PRESERVATION WITHIN MINERALS: COMPARING RESULTS FROM IN-SITU MARS ANALOGUE SITES AND ROVER INSTRUMENTS.

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Introduction & Motivation: Determination of potential in-situ biology in the Martian subsurface in the form of biosignatures (physical) or biomarkers (chemical) can be extremely difficult to detect due to their likely physical location within mineralogy and sedimentary outcrop. References to terrestrial extreme environments that have similar geologic and geochemical histories is necessary to distinguish between samples and sites that the Mars 2020 rover would encounter during its scientific campaigns. The purpose of this investigation is to analyze minerals within analogous geochemical settings on Earth that contain biotic samples that we can quantify growth, decay, and preservation potential. This will give us the context necessary to make proper comparisons to the upcoming biotic investigations the next rover will make as part of its astrobiological campaigns.

Methods: Preservation of organics within minerals is directly related to the depositional environment, fluvial history, distance from UV radiation, and temperature, among others [1-3]. Microbes contained within minerals precipitated alongside microbial communities can allow for preservation of intact cells (Fig. 1) allowing for detailed analyses both in-situ by a rover and from excavated samples in the laboratory.

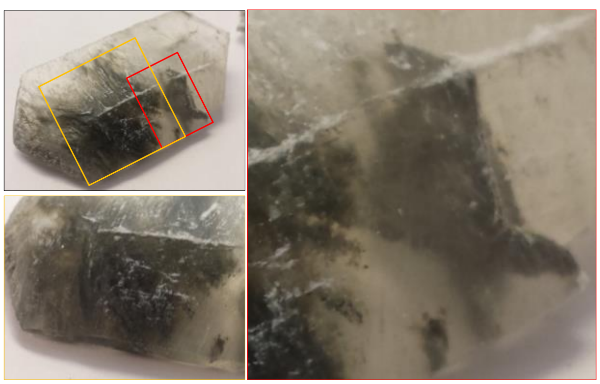

Figure 1. Gypsum crystals showing preserved microbes likely present during precipitation can provide a record of microbial communities within certain depositional environments if permeability is low enough to leave minerals intact.

Mars Analogue Sites. Samples have been collected from sites that have unique and comparable settings [4] (Fig. 2 top) to Meridiani Planum, Mars where groundwater recharge [5] was once present leaving behind secondary pore spaces within rocks [6]. While not restricted to endolithic environments, such environments simultaneously allow for protection from UV and if permeability is low enough [3] allow for the fluids to settle. After the evaporation of pore water the precipitation of halite alongside bacteria in terrestrial settings (Fig. 2 bottom) could entomb evidence of their communities [7].

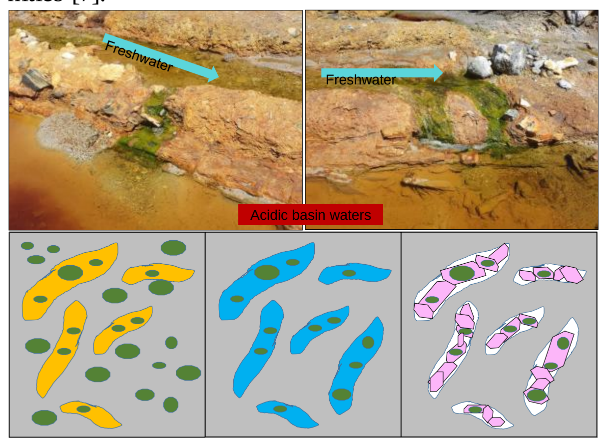

Figure 2. Top: Samples have been gathered from the NW section of Rio Tinto where the boundary between freshwater and acidic fluids interact. Bottom: Cartoon cross section showing entrapment of microbes within halite. Single crystal formation would likely take place.

Validation to the Mars 2020 Science Payload: The application of this work will be to corroborate laboratory spectra and catalogue results from deep-UV, RAMAN, and XRF instruments to build profiles of how biotic matter is observed and preserved within minerals and sedimentary rocks. Using the SHERLOC and PIXL instruments [8,9] we will correlate microbial samples contained and extracted from minerals. DNA extraction on exhumed samples will also take place to correlate SHERLOC & PIXL lab results to specific halophiles, alkaliphiles, or acidophiles present.

References: [1] Rothschild, L.J. (1990) *Icarus* 88: 246. [2] Nealson, K.H. (1997) *J. Geophys. Res*. 102:23675–86. [3] Summons, R.E., et al. (2011) *Astrobiology*, 11, 157-181. [4] Fernandez-Remolar, D.C., et al. (2005) *EPSL*, 240, 149-167 **[5]** McLennan S.M. and Grotzinger J.P. (2008) *The sedimentary rock cycle of Mars* in The Martian Surface 541–577. [6] Perl, S.M. et al. (manuscript in prep). [7] Perl., S.M. et al. (2014) AGU Fall Mtg. # P33C-4043. [8] Beegle, L.W. et al. (2014) LPSC XLV. [9] Allwood et al. (2014) IEEE Aerospace.