**QUANTIFYING THE THRESHOLD OF ORGANIC DETECTION IN EVAPORITES: CONSTRAINING MARTIAN BIOSIGNATURE PRESERVATION.** S. M. Perl[1,2], F. A. Corsetti[2], P. A. Vaishampayan[1], W. M. Berelson[2], D. Bottjer[2], D. Caron[2], A. Seuylemezian[1], B. K. Baxter[3], J. Butler[3], M. L. Tuite[1], B. L. Ehlmann[1], K. W. Williford[1], M. Ahmed[1], D. T. Flannery[1]. [1]California Institute of Technology / NASA Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109 (scott.m.perl@jpl.nasa.gov) [2]Department of Earth Sciences, University of Southern California, Los Angeles, CA 90089 (scott.perl@usc.edu) [3]Westminster College, Salt Lake City, UT

**Introduction:** The purpose of this investigation is to understand how biosignatures and their in-situ preservation medium can be interpreted from planetary mission data using terrestrial Mars analogue samples and utilizing rover instrument observations. The methodology [1] focuses on entombed biology within natural and synthetic evaporates and will employ techniques for 1) understanding the minimum amount of organics (DNA, TOC, among others) necessary for in-situ detection, 2) quantifying shallow subsurface preservation metrics for biosignature preservation within artificial mineral columns, and 3) determining remaining DNA quantities within preserved minerals. These objectives will be supported by microbiology laboratory experiments (DNA extractions and qPCR), rover instrument quantification (RAMAN, XRF, D-UV), and optical techniques (SEM-EDS).

**Methods:** Independent microbiological analyses conducted on the evaporate samples will quantify the preserved microbial communities through their DNA compared against synthetic evaporite minerals that have no organics preserved. Using fieldsite evaporites that have biogenic entombment already established, synthetic minerals will be generated alongside known halobacterium to quantify the attachment frequency of organics and thereby establish baseline preservation metrics [2] at the time of entrapment. The minerals (Fig. 1) used have long since been observed by CRISM [3,4] and in-situ by rover geochemical and visual data.

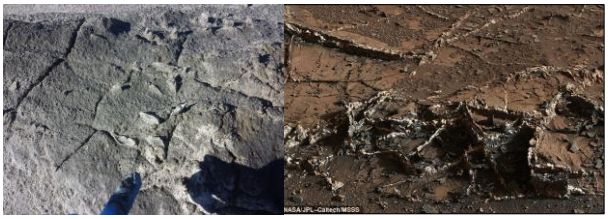


***Fig. 1. (L) Gypsum crystals precipitated from our hypersaline fieldsite nearby receding lakebeds. Crystals contain clays and sediments entombed alongside mm non-opaque sections. (R) Sulfate veins discovered by MSL within Gale crater.***

*DNA extraction and validation:* Due to the high salt concentration of halite and gypsum a modified filtering procedure has been established to powder and dissolve the evaporite crystals. Nanopore filters are used to collect the DNA which will be validated via qPCR & QuBit analyses to obtain expected volumes of DNA (Fig 2).

*Total Organic Carbon (TOC):* TOC measurements for fieldsite samples, artificial evaporite minerals, and lake waters will be measured to understand how hypersaline preservation of organics takes place with comparisons between synthetic mineralogy and in-situ samples.

*Organic detection limits:* Controlled halobacterium will be the input into our mineral precipitation environment utilizing a fluid/organic mixture known to provide conditions that are tolerant to chosen biogenic matter. Precipitation of evaporites would occur based on mineral kinetics and measured input variables to the experiment (salinity, temp, duration, etc.). After partial or complete formation, biotic and abiotic sections of crystals will be examined by RAMAN, XRF, and D-UV with an evaporite blank for comparison. Powdered and unaltered version of these minerals will also be measured to determine if intercrystalline and/or intracrystalline compaction, orientation, or distribution have any negative impact on quantified in-situ detection.

*DNA and TOC breakdown:* Halobacterium will also be used in artificial Mars UV examinations. Organics will be place in powdered minerals separated by mm depth differences from the UV source and measured via qPCR over varied times. Relationships between the different mineral matrices as well as depth will establish metrics on extremely shallow subsurface biosignature preservation on Mars.

**Preliminary Results:** Our successful proof-of-concept tests have shown that hypersaline mineral preservation of organics is possible but also has revealed extreme salt inhibition as interference to spiked samples.

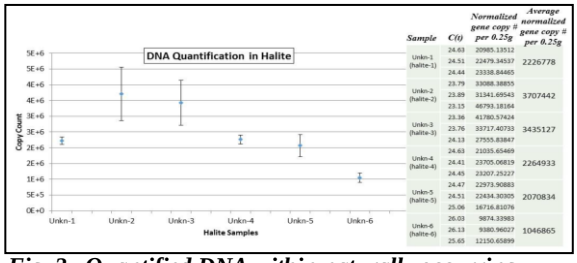


***Fig. 2. Quantified DNA within naturally occurring halite showing a moderate bioburden and normalized to the original evaporite sample input.***

**References:** [1] Aubrey et al. (2005) doi:10.1007/s11084-008-9153-2. [2] Summons et al. (2011) Final report of the Mars Biosignature Working Group. Astrobiology [3] Ehlmann et al. (2011) Nature, 479, 53-60, doi: 10.1038/nature10582, 2011. [3] Murchie et al. (2009) JGR 114, doi: 10.1029/2009JE003342 [4] Viviano-Beck et al. (2014) JGR 119, 1403–1431, doi:10.1002/2014JE004627.