

CHEMICAL BIOMARKER ROBUSTNESS IN MARTIAN PLANETARY ANALOGUE EVAPORITE MINERALOGY. S. M. Perl^{1,2}, A. J. Celestian², B. K. Baxter³, P. Tasoff⁴

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Introduction & Motivation: Indications of extant or extinct life in the Martian shallow subsurface can be preserved alongside the evaporitic mineral record within sites where dried ancient lake systems are observed. Biological chemical markers (biomarkers) lose molecular stability over time, and detections of these over geologic time present challenges to biogenic validation.

Agnostic biomarkers and the preservation of those in-situ molecules can be aided by biological feedback to ecological stresses that have been interpreted throughout the late Noachian/early Hesperian [1,2]. Global desiccation and surface wide UV exposure are the major obstacles to in-situ biological preservation in the shallow crust [3]. Burial of sedimentary material from early Hesperian aqueous sites can provide significant protection from these damaging effects.

The purpose of this paper is to discuss the biological feedback from microbial communities preserved within Martian analogue mineralogy. Furthermore, we explore how biosignature preservation pathways can outlast the original biology in slow-changing evaporite mineral records.

Geobiological Preservation & Terrestrial Biological Adaptation: Our continued focus is evaporating and dried terrestrial lakebeds [4] since that has proven to be ideal for modern and older biogenic preservation [5]. Mineral-microbe interactions can produce nutrients and sustained μm -scale environments where nutrient cycling and metabolic processes continue to produce useful proteins that combat ecological stresses found in measured OTUs from amplification of 16S rRNA (Fig. 1). Stated differently, molecular adaptations from surviving bacteria allow for later generations to better utilize their environments thereby showing significant similarities between ancient and younger prokaryotes [6]. On Earth these similarities can yield to difficulty between relative age dating of bacteria and ruling out “modern” contamination of older mineral samples. Sedimentological relative dating of minerals can greatly assist with regard to preservation of biological material. However continued metabolic processes in preserved settings will lead to taxa differences (via neighbor joining clustering [7]) when compared to the non-preserved environment. Hence, the need for proper

baseline environmental controls and understanding of contamination either from younger fluids or rock and mineral fracture.

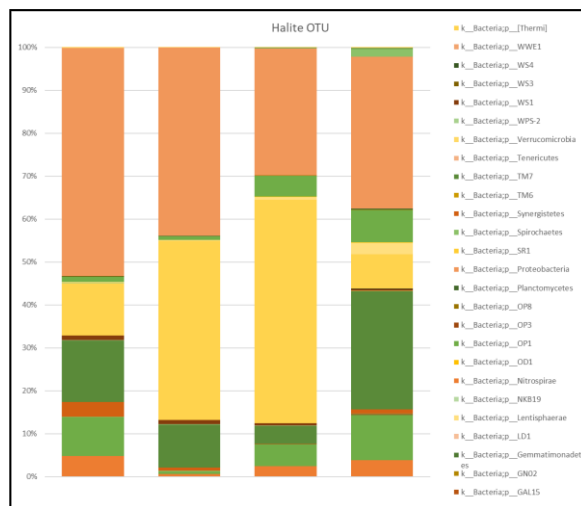


Fig. 1. Operational Taxonomic Units preserved in halite evaporite minerals showing community preference directly associated with protein production associated with ecological feedback to stressful environments.

Early Peptide Chains: If an independent origin of life on Mars and accompanying evolution pathways existed, the earliest evolved simple polypeptides may not have had the capacity for adaptation in the timeframe of climate change on Mars. Biochemically though, the very existence of these polypeptides may have been enough to provide feedback to ecological stresses. The timelines of C,H,O,N,P,S, a solvent (water), and environmental conditions overlapping would be the indicator of the duration of habitability. This duration would parallel the adaptability of organisms and the synthesis of more complex peptide chains leading to a greater ability to adapt to the changing Martian surface over geologic time.

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