Viability of Coupled Microbial Mat From Death Valley Exposed to Transient Environmental Stress Approximating Mars Surface Conditions.

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Introduction:
We exposed a prokaryotic extremophile community from Bad Water, California in order to determine the survival capacity of a coupled microbial mat evolved to exist in desiccated and extremely saline environments, in order to determine to what degree, if any, coupling of a microbial system may afford symbiotic survival mechanisms under Mars-like environmental conditions. Extrapolations into ancient biomes as well as the search for life on Mars make many assumptions and inferences regarding life modes and environmental boundary conditions which affect possible biosignatures. Life actively manipulates energy flow across chemical disequilibrium gradients in order to harvest energy necessary for survival and propagation. Structured microbial communities leave, in turn, specific chemical/isotopic fingerprints related to available energy along the oxidative-reductive gradient[1]. Our research is inspired by mounting evidence from Mars missions which have detected remnants of salty aqueous environments in Mar's geological past. Cryptic endolithic microbial communities may still exist below the Martian regolith surface.

Hypothesis:
Biosignatures imposed by microenvironmental biogeochemical coupling should reflect within porewater isotope ratios as well as within mineral assemblages. We therefore investigate response of an extremely halophilic microbial mat from Death Valley to stratospheric transient ultraviolet (UV) radiation, atmospheric pressure (<0.01 surface) and low temperature (below -40°C), approximating contemporary Martian surface conditions. We examine our hypothesis that coupled microbial mats may afford increased viability under Martian analogue conditions due to symbiotic protection and recovery, functioning as a coupled system wherein each horizon may provide protective mechanisms against compounded environmental insult, most likely driven by UV radiation damage to DNA. Influence of external transient stress on the coupled microbial mat environment, specifically addressing to what degree does mortality of a microbial mat affect the oxidative-reductive gradient at pore-water scale and is a biogenic geological signature robust conserved within a mineralogical assemblage under altered reductive environments will be addressed. Finally, an assessment will be made as to what degree and by what mechanisms could coupled microbial mats from Death Valley recover from Mars-like conditions?

Implications:
We then conclude our project by determining pre and post-flight oxidative-reductive gradient through pore water stable isotope analysis as well as reviewing host mineral diagenisis of potential biomarker evaporate mineral assemblage (rosickyite)[2]. the presence of which could serve "as markers of past or present existence of life on extraterrestrial bodies bearing evidence of ancient seas or lakes" (*ibid*). Working towards a more complete profile of external and internal conditions within a coupled microbial mat during exposure and recovery from Mars-like transient stress allows for approximating expected values indicating biogeochemical markers of life and may help to determine incidents of false-negative hits during future planetary missions to Mars.

References:
[1] I. Hewson e*t al*., (2002) AGU, Abstract# B71B-0738.
[2.] S. Douglas and H. Yang, Geo. 30, 1075-1078.

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