BIOSIGNATURE PRESERVATION VULNERABILITY ASSOCIATED WITH REDOX MODE SWITCHING IN A MARS ANALOGUE COUPLED MICROBIAL MAT FROM DEATH VALLEY. R. Archer[1] and Ralat, A.[2]ARRA Environmental[1,2] (Denver, Colorado, 80128)

Introduction:A coupled microbial mat from Death Valley was launched into the stratosphere at an altitude of 32817m for 74 minutes, in order to examine the response of an extremophilic microbial community exposed to Mars-like environmental conditions and to determine the spatial and temporal robustness of biosignatures to both internal and external forcing of boundary conditions; results are presented herein.

Coupled Microbial Mat Environment Approximating Mars Surface Conditions: UV irradiation (UV-A, UV-B, UV-C) dosing of the microbial mat at $24.25\pm0.01 KJ*m^{-2}$ was integrated over column flight (200nm-400nm, mean 270nm), atmospheric minimum pressure of 7.3mmHg, < DL ppm humidity, 230K, 3 G acceleration and Mach 1.2 acceleration.

Visible Microscopy and Viability of the Badwater Microbial Community: In contrast to Douglas *et al.*, 2002, XRD of sample from the same sight did *not* reveal any rosickyte presence. However, *Oscillatoria* sp. and cocci cyanobacteria were abundant and associated with gypsum and calcite at 0.9 cm. Recovery analysis showed canopy pH values of 9.9 in conjunction with 10% post-flight viability (BacLite). The sample postflight-preflight $\delta water*cm^{-3}{}_{(Bulk\ Sediment)}$ = +32% after passing through a saturated tropopause.

Stable Isotope Results as a Reflection of Biosignature/Diagenesis Conditions: Modeled diffusion rates for $\delta\ ^{13}C_{org,}$ $\delta\ ^{13}C_{dic,}$ $\delta^{34}S$, $\delta^{15}N_{org,}$ δD, $\delta^{18}O_{PDB}$ and $\delta^{18}O_{V\text{-}SMOW}$ are calculated in order to present a snapshot view of preflight diagenetic mechanism for this reduced microbial mat. Isotopic results, together with modeled reaction exchange values are consistent with protracted preflight microbially mediated sulfate reduction to H_2S by organic carbon. Temperature dependent $\delta^{34}S$ artifact contribution was insignificant. Results from 2015 results contrast sharply to positive rosickyte biosignatures [1] and supporting $\delta\ ^{13}C_{org}$, and $\delta^{15}N_{org}$ isotopic results [2] from the same location in from 2002. Canopy [OH] production following exposure to near-space conditions was sufficient to shift stable $\delta pH_{(preflight\text{-}postflight)}$ = +5.9 pH units (4.0pH-9.9pH), or a $\sim 1.5x10^3$-fold increase in [OH], inside of 20 minutes despite 10% total microbe population viability.

XRD and EPMA Fails to Demonstrate a Robust Rosickite Biosignature, SEM Hints Otherwise: As of March, 2015, both XRD and EPMA failed to detect rosickyte while positively detecting salts consistent with evaporative succession within a hypersaline playa environment (pore water salinity of 110ppμ). In contrast to both XRD and EPMA, SEM imagery revealed filament morphologies consistent with S^0(rosickyte) with a mean length of 4.54μM, (n=43, σ=0.37 and length/width ratio α = 0.01). Such morphologies appear embedded within possible extracellular matrix [1] and associate with dissolution pits with a mean major axis length of 1.19 μM (n=432, σ =1.41).

Viral-Bacterial Coupling as Evolved Microbial Adaptive Mechanism to Extreme Environments: Rapid redox mode-switching may be exacerbated by viral lysing of labile organic elements (CHNOPS) outside of Redfield ratios. viral:bacterial dominance in 2002 [2] was limited to thin, discreet horizons between layers. In contrast, in 2015, viral:bacterial dominance from the same site reveals more diffuse and active lytic activity under reducing conditions.

Conclusion and Implication for Mars Exploration: This study suggest that coupled microbial mats from Death Valley rapidly recover from environmental stressors such as UV irradiation and dessication through unique symbiotic adaptations conducive to cryptoendolithic survival. Perhaps, interplanetary inoculation of of genetic information may be possible for such a microbial community. Regarding exploration, negative biosignature results based upon XRD and EPMA may result from a weighted combination of factors affecting microbial endolithic niche conditions such as sustained drought of source watersheds. [3]. Microbial stress adaptive responses could hinder biosignature detection, causing high spatial and temporal variability. Biosignatures such as rosickyte are more labile than previously proposed [1]. It is inferred that Martian samples may also be vulnerable to rapid post-depositional diagenesis or during transit. Perhaps instruments should include lightweight portable minaturized apparatus; including red and green Raman spectrometers, trace-metal ICP-MS, laser ablation micromass MS, and, finally, SEM with microprobe elemental analyzer capability.

References:

[1] Douglas, S. *et al.* (2002) *Geol., 30,* 1151–1154.
[2] Archer R. *et al. AGU EOS Proc.*(2002)
[3] Aiger, E. *et. al.,* Circle of Blue, 11, (2014), 1344-1345.