BIOLOGICALLY INDUCED MINERALIZATION, SITE SELECTION, AND ORGANIC DETECTION IN MARS-ANALOG FIELD SITES. E.Z. Noe Dobrea[1,2], A.D. Aubrey[3], D.P. Glavin[4], F. Calef[3], M.R. Hamersley[5], A.C. McAdam[4], C. Freissinet[4], H. Franz[4], C.R. Stoker[2], and B. Parker[6], [1]Planetary Science Institute (eldar@psi.edu), [2]NASA/ARC, [3]NASA/JPL, [4]NASA/GSFC, [5] SOKA University, [6]Petrified Forest National Park.

Introduction: The current wave of Mars exploration focuses on the search for past habitable environments and the detection of organics. Landing site selection relies on the identification of a locale that may have been habitable, and where biologically derived organics could have been concentrated and rapidly buried. We have performed an in-depth investigation of the Painted Desert of northern Arizona as a potential martian analog, using remote-sensing spectral data to identify target locations for sample collection.

The Painted Desert of northern Arizona forms part of the ca. 215 My old Triassic Chinle formation, and consists of thick (ca. 100 m) layers of colorful bentonitic mudstones interbeded with sandstones and limestone formed by fluvial and lacustrine deposition [1]. Black and purple mudstones have been postulated to be enriched in organic carbon derived from Late Triassic flora and fauna that were rapidly buried in the prograding beds and floodplains of the fluvio-lacustrine system present at the time [2,3].

Organic compounds show high affinities to clay minerals, in which interlayer binding acts as a sequestration mechanism for the sorption of organics onto phyllosilicate surfaces. Amino acids in particular demonstrate extremely strong sorptive properties with clay minerals [4,5]. With respect to organic preservation in clays, the primary controls are the depositional environment and the level of microbial activity [6]. Low O_2 concentrations at the time of burial are conducive to preservation over long timescales [7]. Smectites from the Painted Desert experienced rapid burial after deposition, and O_2 concentrations are thought to have been low. Hence, the preservation in these layers is expected to be high.

The spectral and morphological character of the Painted Desert appear analogous in many ways to that of the Al-phyllosilicate bearing units identified in Western Arabia Terra, Mars. Both regions present evidence for fluvial activity and have thick Al-phyllosilicate deposits containing Al-smectites, kaolins, hydrated silica, and jarosite [8-12]. These similarities make the Painted Desert a potential geological and compositional analog of the Mars sites. In this study we characterize the preservation potential of organics in the clay sediments of the Painted Desert.

Site selection and analyses: Previous field work by the team identified strata where organics had been highly preserved by hitherto unknown mechanisms [13]. These organics were found in bentonite beds and were associated with jarositic rinds, which we hypothesized to be the result of biologically mediated mineralization. Remote sensing observations using the Airborne Visible / Infrared Imaging Spectrometer (AVIRIS) were acquired and the spatial distribution of jarosite was mapped and found to be associated with specific stratigraphic units. We therefore targeted our investigation to collect samples from these jarosite-bearing units as well as adjacent units in order to test this hypothesis.

Our team then conducted a study to detect organics and their isotopic composition from samples within sequential depositional layers and also within and outside the jarosite-bearing units. The analytical experimental suite included (1) quantification of total organic carbon and nitrogen by micro-Dumas combustion, (2) carbon and nitrogen stable isotope determination ($\delta^{13}C$, $\delta^{15}N$), (3) detection of aromatic and aliphatic hydrocarbons *via* thermal volatilization / mass spectrometer analyses, and (4) characterization of host mineral compositions. Experiments (3) and (4) used instruments analogous to SAM and CheMin on the Mars Science Laboratory (MSL).

Here, we report a relationship between bulk organic carbon with mineralogy and grain size, and note a stark contrast between adjacent beds where sandstone units show extremely low levels of organics and clay-rich facies contain preserved organics. As with our previous work, we found significantly higher (~100x) concentrations of organics in carbonate nodules that were encased in a jarosite rind. This rind is intriguing because it implies acidification (pH = ca. 1) was prevalent during the time of nodule formation. Together, these findings can serve as a cautionary example to the Mars community that localized jarosite deposits can be consistent with enhanced organic preservation, despite the general association of acidic conditions with poor organic preservation.

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