Correlated *In Situ* and Laboratory Based Analyses: Key to Understanding Taphonomic Alteration of Biosignatures in Hot Spring Sinters. S. L. Cady[1,] D. Carrizo[2], A. Davila[3], J. D. Farmer[4], V. Gulick[3], N. Hinman[5], J. Moersch[6], V. Parro[2], R. Quinn[7], P. Sobron[3], P. Sarrazin[3], K. Warren-Rhodes[3], and N. A. Cabrol[3], [1]Environmental Molecular Sciences Laboratory, Pacific Northwest National Laboratory, Richland, WA, Contact <sherry.cady@pnnl.gov>, [2]INTA-CSIC, CAB-Madrid (Spain), [3]SETI Institute, [4]Arizona State Univ, [5]Univ. of Montana, [6]Univ. of Tennessee, Knoxville, [7]NASA Ames Research Center.

Introduction: As part of the SETI NAI Team's effort to develop a roadmap to biosignature exploration, which supports NASA's decadal plan for the search for life and for the upcoming NASA and ESA rover missions that will launch in 2020, we seek to optimize the ability to identify and cache the most valuable samples on Mars. This strategy requires *an understanding of the types of communities that could thrive in specific environmental settings on Mars; the processes that facilitated biosignature preservation; the taphonomic factors that altered or destroyed possible (and bona fide) biosignatures; and the spatial and temporal scales over which those processes operated*. If life ever emerged on ancient Mars and its biosignatures were preserved in its geological record, they will surely have been altered in the near-surface regolith by UV and cosmic radiation, various oxidants, freeze/thaw cycles, weathering, diagenesis, and regolith "gardening" due to impacts. Regardless of which landing sites are selected for the NASA and ESA rovers that fly in 2020, life detection on such missions will require an exploration strategy that consists of correlated and nested measurements of increasing spatial resolution and a deep understanding of the taphonomic factors that affected possible biosignatures.

Methods: Our exploration strategy involves (1) correlating observations from the satellite to mesoscale to textural microscale with orbital data and data generated from a suite of orbital and *in situ* field instruments–some of which are versions of instruments currently operating on Mars or will be part of the 2020 rover instrument platforms for NASA or ESA–and (2) correlating observations from the textural microscale to the molecular scale with state-of-the-art laboratory instruments–a suite of technologies that are likely candidates for installation in a Mars Sample Return Laboratory. This abstract concerns the latter efforts, though in both cases, we are collecting information needed to determine the thresholds and baseline measurements necessary to efficiently characterize the geology of a site, assess habitability, select samples, and document their geological and potential habitability context.

In 2016, members of the SETI NAI team visited several Mars analog sites located in the Antiplano region of Chile, a remote high-altitude location that receives the highest flux of UV radiation recorded on Earth. Reported here are the results of our post-field trip analyses that include our *in situ* instruments and laboratory-based techniques.

Results: Field samples analyzed *in situ* and/or remotely were collected and transported back to the University of Montana for coordination and distribution of the materials for correlative analyses. Portions (aka "splits") of the samples were distributed as follows:

Sample splits were sent to the *in situ* team so that they could either repeat their field measurements (i.e., with the Visible Stereo Imager (ACIS); ASD Vis/NIR Spectrometer; Terra/CheMin Spectrometer; Laser Raman Spectrometer; Laser-induced Breakdown Spectrometer (LRS-LIBS)) under laboratory conditions or new *in situ* measurements were acquired if such data could not be collected in the field;

These same sample splits were sent for analysis to NAI SETI Team members who could not participate in the 2016 field campaign for analysis with additional instruments that will be deployed during our future field campaigns to Chile (i.e, SOLID-LD Chip);

Replicates of the sample splits (confirmed on the basis of measurements made by the two groups above) and some of the key samples measured by the two groups noted above, were sent to the laboratory teams to corroborate the i*n situ* teams findings, determine whether there were any gaps (e.g., missing spectroscopic peaks of organics, mineral/mineraloid phases or other sample materials, etc.) in detection between the *in situ* and laboratory-based techniques, and identify any new potential or *bona fide* biosignatures that were not detected by the *in situ* instrument measurements (i.e., molecular organic analysis with ESI-FTICR; bulk lipid analysis with the LA-GC-MS; morphological analysis with the HIM (Helium Ion Microscope) and SEM; and chemical imaging of organic and inorganic phases with ToF-SIMS).

Deliverables: By focusing on the capabilities required to detect organic carbon in natural analog samples, characterize molecular classes that represent "molecular fingerprints", and determine the ability to extract molecular structural information from fossilized carbonaceous remains, we seek to optimize the ability to recognize biosignatures across spatiotemporal scales and reveal challenges faced by life-seeking missions.

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