

ANALOGUE SAMPLE DEVELOPMENT FOR SIMULATION OF MARS PALEOLAKE ENVIRONMENTS: ASSESSING SPECTRAL EFFECTS E. K. Hara^{1,2}, R. Bhartia², W. J. Abbey², B. L. Carrier², G. Wanger^{1,2}, L. W. Beegle² ¹University of Southern California (ehara@usc.edu) ²Jet Propulsion Laboratory (rohit.bhartia@jpl.nasa.gov)

Introduction: Remote observational data from missions such as Viking, Mariner 9 and Mars Reconnaissance Orbiter suggest early Mars once supported lakes and oceans. More recently, analysis of MSL data from Gale Crater further supports the theory of an ancient, wet Mars by identification of key minerals and fluvio-lacustrine sedimentary structures [1].

SHERLOC (Scanning Habitable Environments with Raman and Luminescence for Organics and Chemicals) is one of seven instruments on the upcoming Mars 2020 rover. It uses a 248.6 nm deep UV resonance Raman and fluorescence spectrometer with a 100 micron spot size to analyze and map a 7 x 7 mm area. On Mars, SHERLOC will assess the habitability of sample sites, analyze any potential biosignatures, and provide assistance in selecting samples for a future sample return mission. These goals will be accomplished by analyzing the concentration and type of organics detected, and mapping these concentrations over the substrate surface [2].

The analytical capabilities of SHERLOC have been demonstrated on a test bed instrument (MOBIUS) that included crystalline organics mixed at various concentrations into Mars basalt analogues (Mars Mojave Simulant) (e.g. [3]). While these samples aid in development of instruments and performance models, they idealize spectra and limit the effectiveness of spectral matching algorithms. For the formation of paleolakes, the slow evaporation of water in a salt and organic mixture (may lead?) leads to organics that are adsorbed to mineral precipitates.

To generate a spectral library that includes adsorbed organics that incorporate spectral position, ratios, and intensity we are (i) developing a method for creating samples that mimic naturally occurring samples, and (ii) obtaining spectra of adsorbed organic molecules to compare to spectra of crystalline organic standards. Here, we present preliminary data and methods in creating sample types that can approximate real-world lake evaporation.

Methods: The Mars Mojave Simulant (MMS) [4], Bishop Tuff (BT), gypsum and kaolinite were powdered and cleaned of intrinsic organics with a 9:1 dichloromethane/methanol extraction in Teflon tubes. Two sample creation methods were tested. For the first, 9 mL of 0.5 M, 0.05 M, 0.005 M, and 0.0005 M of a histidine/water solution were added to approximately 0.2 g of cleaned substrate into an ashed pyrex dish to create a simulated “lake”. The filled dish was then

placed in a heated orbital shaker set to 35 °C and 75 rpm and left to evaporate overnight. The remaining sediment was then pressed into pellets using a mechanical press to create a smooth surface for analysis. For the second sample creation method, a 0.0005 M Histidine solution was airbrushed onto pressed MMS pellets with varying pressure and airbrush nozzle settings. Pellets were analyzed on SEM/EDS and MOBIUS.

Results: Both the evaporative and airbrush produced samples were analyzed by Deep UV fluorescence and Raman spectra in addition to SEM/EDS imaging. As observed in the SEM/EDS images both deposition methods resulted in the formation of organic crystals interspersed with the mineral grains. As expected, the spectral features were consistent with spectra of the organic crystals.

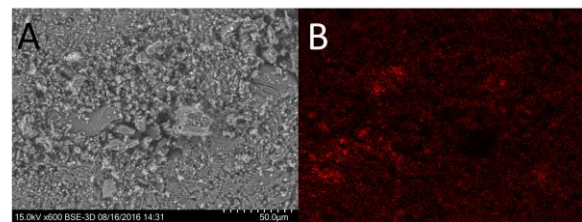


Figure 1: 2A shows the surface of the 0.0005M Histidine/BT pellet. 2B shows the EDS image where red represents carbon. The small grains in 2A are thus identified as histidine.

Future Work: The initial methods used did not promote the adsorption of organics onto the sediments. Future efforts will include additional organic components or co-precipitation with minerals (i.e. sulfates, carbonates, halides) to promote adsorption.

References: [1] Grotzinger et al. (2015) *Science*, Vol. 350, Issue 6257 [2] Beegle, L.W., et al. (2014) *LPSC*, Abstract #2835 [3] Carrier et al. (2016) *LPSC*, Abstract #2660 [4] Peters, G. H. et al. (2008), *Icarus* 197,470-479