COORDINATED LAB, FIELD, AND AERIAL STUDY OF THE PAINTED DESERT, AZ, AS A POTENTIAL ANALOG SITE FOR PHYLLOSILICATES AT MAWRTH VALLIS, MARS.

N. K. McKeown[1], E. Z. Noe Dobrea[2], J. L. Bishop[3], and E. A. Silver[1], [1]Earth and Planetary Sciences, UC Santa Cruz (Santa Cruz, CA, 95064, nmckeown@pmc.ucsc.edu), [2]CalTech/JPL (Pasadena, CA, 91109), [3]SETI Institute (Mountain View, CA, 94043).

Introduction: Mawrth Vallis contains one of the largest exposures of phyllosilicates on Mars [1-3] with positive identifications occurring over a 1×10^6 km^2 area [4]. Two main units have been identified: a nontronite-bearing unit and an Al-phyllosilicate-bearing unit [4-6]. The Al-phyllosilicate unit contains two subunits: a montmorillonite plus hydrated silica layer and a kaolinite plus hydrated silica layer [5, 6].

One possibility is that these units altered from an ash-fall deposit, similar to bentonites on Earth [6]. To investigate this hypothesis, we have done some preliminary field studies in the Painted Desert, AZ, which contains extensive bentonites (figs. 1,2). Coordinated lab, field, and aerial studies provide validation for mineralogic identification in remote sensing data. We propose that the Painted Desert may be a good analog site for investigating and validating the CRISM mineral detections at Mawrth Vallis, Mars (see companion abstract [7]).

Methods and Data: Field data was collected using a handheld Analytical Spectral Devices (ASD) FieldSpecProFR spectrometer calibrated to reflectance. In some cases, measurements of the subsurface were also taken by scraping off the top 0.5-1 cm of the bentonite to remove weathering textures. Laboratory measurements of field samples were taken using the same handheld ASD with the contact probe of samples sieved to <125 µm and of the natural clumps. Airborne measurements were taken by HyMap, that were then atmospherically corrected and georeferenced.

Fig. 1. Layered bentonites in the Painted Desert, AZ.

Fig. 2 Layered bentonite mound in the Painted Desert showing variable thicknesses of the individual clay units.

The ASD has a spectral range of 0.35-2.50 µm with 2 nm sampling. HyMap has a spectral range of 0.45-2.48 µm with a sampling of 13-17 nm per channel, and a spatial resolution of 4 m per pixel.

Results: *Short-Wave Iinfrared (SWIR) results.* The aerial and field data give similar results in the SWIR (1.0-2.5 µm). Both identify mixtures of montmorillonite and calcite in varying proportions by diagnostic absorptions at 1.41, 1.91, 2.21, and 2.34 µm (fig. 3). The 1.91 µm feature in the aerial data is offset from the others because the instrument—in order to avoid atmospheric water features—has no channels between 1.81 and 1.95µm. A shoulder at 2.34 µm due to calcite is observed in all spectra, although it is much stronger in the field data than either the aerial or lab data. The calcite absorption at 1.88 µm is not observed in the aerial data because there are no bands in that region due to the large atmospheric water band at 1.91 µm. There is sometimes a hint of a shoulder at 2.0 µm that may be due to calcite. Additionally, there is a small feature at 2.25 µm in the lab and field spectra that is not observed in the aerial data, possibly because the spectral sampling of HyMAP is too coarse in this region.

Visible/Near-infrared (VIS/NIR) results. Some variation occurs in the VIS/NIR (0.4-1.0 µm) due to differences in iron content and vegetation. We avoided measuring plants in the mineralogic field spectra but the aerial data includes contributions from vegetation due to its coarser spatial resolution. Spectra of vegetation were collected in the field separately in order to facilitate discrimination of mineral and vegetation componentes in the aerial images. Variations in iron content are shown in a visible-wavelength aerial image (fig. 4) and variations in silicate and carbonate mineralogies are prsented in a false-color IR image (fig. 5).

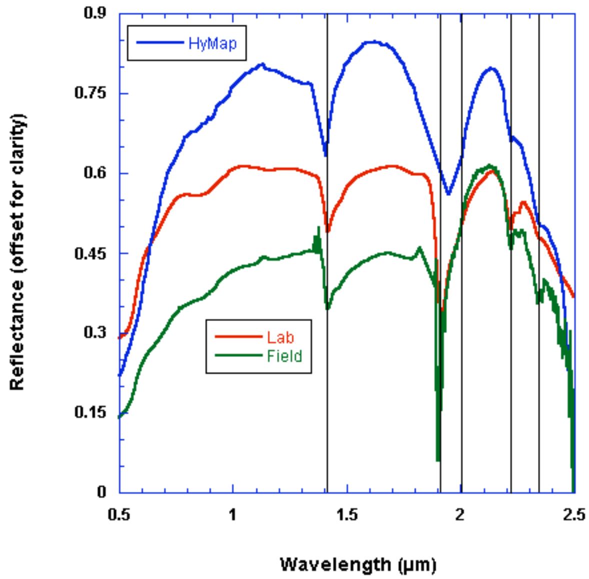

Fig. 3. Hymap, Lab, and Field spectra (from top to bottom) from stop 1. Vertical lines at 1.41, 1.91, 2.0, 2.21, and 2.34 µm.

Conclusions: The features in the aerial data are weaker than those in the lab or field data, but the aerial spectrum still captures the critical components with no shift in position. Therefore, it is likely that the spectra collected by CRISM, with a higher spectral resolution than HyMap, are an accurate representation of the silicate mineralogies at Mawrth Vallis. Ongoing work includes coordinating multiple specific mineral features from the lab, field and aerial spectra.

Acknowledgements: Thanks are due to the National Park Service for providing a research permit and helpful guidance and to the Naval Post-graduate school at Monterey for support for NKM.

References: [1]Bibring, J.-P., et al. (2005) *Science*, *307*, 1576-1581. [2]Poulet, F., et al. (2005) *Nature*, *438*, 632-627. [3]Loizeau, D., et al. (2007) *JGR*, *112*, E08S08. [4]Noe Dobrea, E. Z., et al. (2008) *LPS XXXIX* 1077. [5]McKeown, N. K., et al. (submitted) *JGR- Planets*. [6]Bishop, J. L., et al. (2008) *Science*, *321*, 830-833. [7]Noe Dobrea, E. Z., et al. (2009), this meeting. [8]Geology and the Painted Desert (2006), National Park Service.

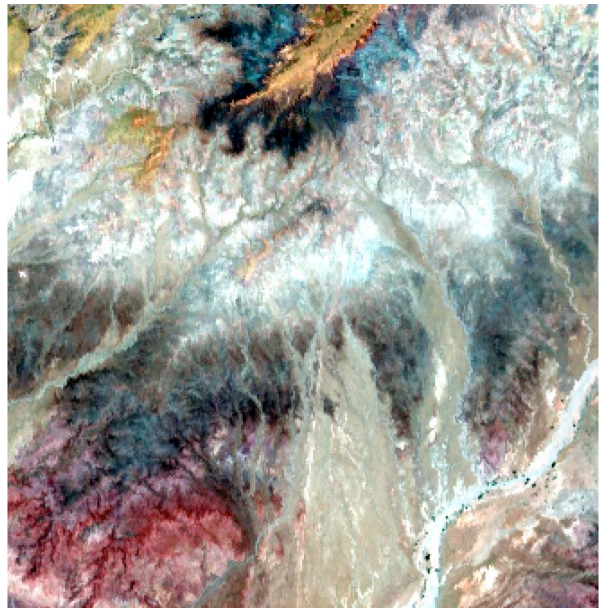

Fig. 4. Visible HyMap image (R: 0.65 µm, G: 0.55 µm, B: 0.45 µm) that highlights variations in iron content in the lower-left corner (red and purple).

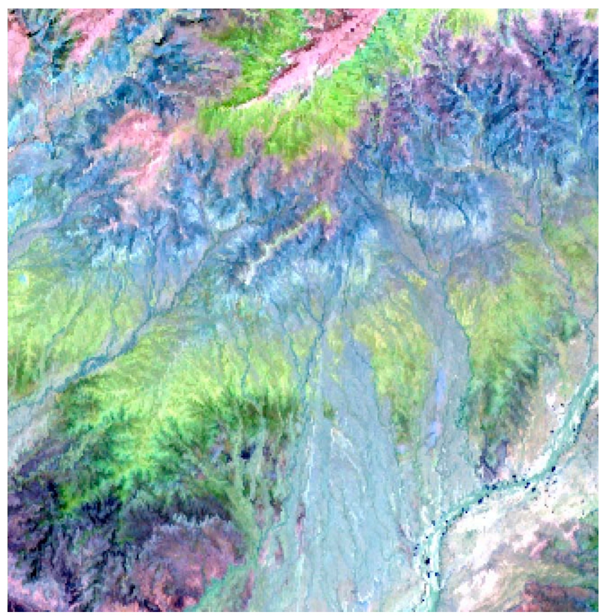

Fig. 5. SWIR HyMap image (R: 2.48 µm, G: 1.50 µm, B: 1.01 µm) that highlights variations in mineralogy in the upper half of the image (blues and purples). This area appears homogenous (white) in the visible wavelengths.