MAPPING LATERALLY EXTENSIVE PHYLLOSILICATES IN WEST MARGARITIFER TERRA, MARS.
K. D. Seelos, F. P. Seelos, D L. Buczkowski, and C. E. Viviano-Beck, JHU Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel, MD 20723; kim.seelos@jhuapl.edu.

Introduction: Clay minerals found in stratigraphic sequences have been used to support the idea of widespread precipitation and pedogenic weathering during a warmer, wetter climate era on early Mars [e.g. 1-2] These sequences have been identified in several geographic provinces, including along the walls and on the plains surrounding Valles Marineris [3-5], in Mawrth Vallis [1,6], Meridiani [2,7-8], and Nili Fossae [9]. The intent of this study is to map and characterize an additional laterally extensive layer of near-surface phyllosilicate-bearing material exposed on the plateaus in West Margaritifer Terra (WMT), centrally located between exposures along Valles Marineris to the west and Mawrth Vallis and Arabia Terra to the E/NE (Fig 1). If WMT phyllosilicates are genetically related, this combined area represents a large, nearly contiguous portion of the currently exposed Noachian/Hesperian crust with broad implications for an active hydrologic cycle [10] during that time period. Our aim is to distinguish between possible emplacement mechanism(s): pedogenic and/or groundwater alteration, diagenesis, hydrothermal alteration, or fluviolacustrine deposition.

Datasets and Methodology: We use multiple remote sensing datasets to delineate units in an ArcGIS framework at ~1:250K scale, followed by finer scale characterization on individual outcrops. Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) mapping and targeted data (180 m/pix and ~20 m/pix, respectively) serve as the primary dataset in which distinct minerals are identified. Mapping data are processed to remove photometric and atmospheric effects as well as instrument residuals prior to the calculation of summary parameters (e.g., band depths) that are then mosiacked in 5°x5° tiles. All or part of 16 tiles cover the study area, which extends from 325°E to 345°E, 0°N to -15°N. High spatial and spectral resolution targeted observations are processed as Map-projected Targeted Reduced Data Records (MTRDRs) [11], comprising a suite of fully corrected spectral data, summary parameter cubes [12], and visual products that facilitate spectral analysis. For this effort, D2300 was the primary parameter used to locate Fe/Mg phyllosilicates.

Other datasets instrumental to outcrop identification include Thermal Emission Imaging System (THEMIS) daytime IR controlled mosaics [13] and THEMIS qualitative thermal inertia [14], as well as Mars Orbiter Laser Altimeter (MOLA) 128 pix/deg gridded topography. Supplementary data also include Context Imager (CTX) data processed through the Projection on the Web (POW) utility [15] and High Resolution Imaging Science Experiment (HiRISE) data. CTX and HiRISE images are used primarily for morphologic assessment.

Results: WMT phyllosilicate outcrops are broadly distributed across the plateau region (Fig. 1) and are not constrained geographically by outflow channels, chasma, chaos terrain, or by any obvious elevation threshold. Outcrops exhibit higher thermal inertia than surroundings, signifying a relatively consolidated nature, and appear light-toned with polygonal fracturing. Three main types of exposures are evident: a) surface outcrops on plains (e.g., Fig 2), b) in fracture/chaos walls, and c) in crater rims and ejecta. Outcrops are consistently cross-cut by chaos and fractures, indicating the phyllosilicate layer predates outflow and chaos formation. Where exposed vertically, outcrops have variable thickness on the order of a few to several 10s of meters, sometimes with visible internal layering. Hyperspectral data show the phyllosilicates to be consistently dominated by Mg-smectite (e.g., saponite), which is consistent with phyllosilicates found to the west and southwest [3-5]. In contrast, however, no spectral indication of overlying Al-phyllosilicates has been observed in WMT despite some color differences at HiRISE spatial scale.

Conclusion and Future Work: Preliminary mapping and characterization of phyllosilicate outcrops in WMT suggests a continuation of the regional layer observed to the west along the walls and plains surrounding Valles Marineris and in NW Noachis Terra. However, the WMT layer appears thinner with less spectral variability, perhaps indicating a less mature pedogenic profile and/or more extensive erosion/redeposition. The next steps in our analysis include a refinement of map units in concert with systematic evaluation of high resolution morphology and topography to look for any diagnostic layering trends (e.g., thickness variation), stratigraphic relationships with other geologic landforms, or other clues that may further inform emplacement mechanism(s) and broaden our understanding of the Noachian climate history.

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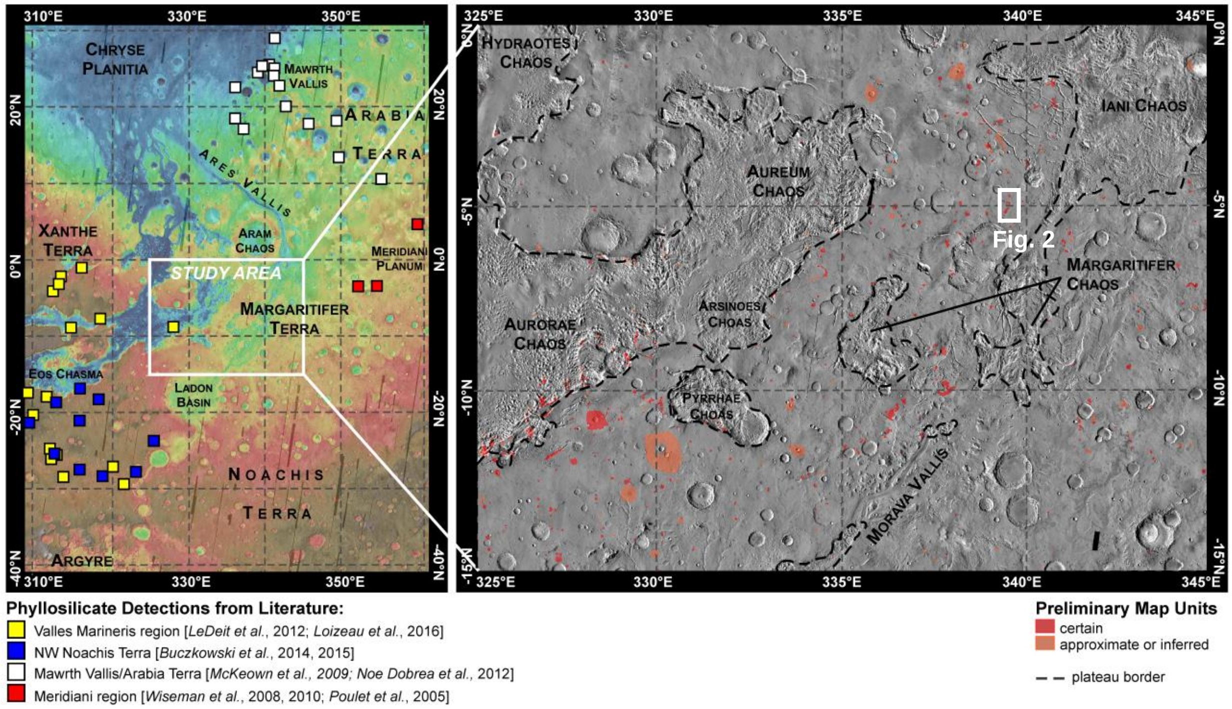

Figure 1. Regional context and preliminary mapping results. Left panel shows MOLA elevation with geographic provinces labeled; previous identifications of phyllosilicates in surrounding regions are represented by colored symbols. Right panel shows phyllosilicate outcrops identified in CRISM data overlain on THEMIS daytime IR mosaic; highstanding plateau terrain is demarcated from lower elevation channel and chaos terrains by the dashed line. Location of Figure 2 is indicated.

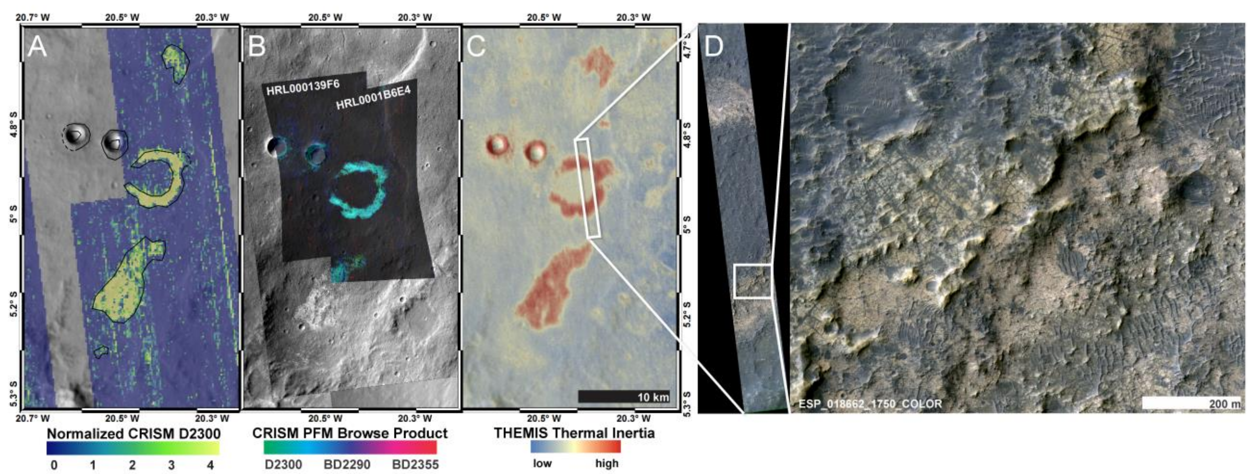

Figure 2. Typical phyllosilicate outcrops in the study region and the primary datasets used for unit delineation and characterization. (A) CRISM 180m/pix mapping data over THEMIS daytime IR, colorized so that green-yellow tones represent positive values of the D2300 parameter, which encodes the absorption at 2.3 µm suggestive of Fe/Mg smectites. Contacts are shown in black. (B) Two CRISM ~40 m/pix targeted images overlain on CTX; the Fe/Mg Phyllosilicate (PFM) browse product provides distinction between Fe/Mg smectites in green-cyan tones and chlorite-/prehnite-bearing materials in yellow-red tones. (C) Elevated qualitative THEMIS thermal inertia is positively correlated to phyllosilicate outcrops. (D) Morphology from HiRISE reveals a light-toned appearance and ubiquitous polygonal fracturing. Superposed lower albedo material often exhibits aeolian bedforms.

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