GEOMORPHIC ANALYSIS OF NORTHERN MERIDIANI PLANUM USING HIRISE IMAGING

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Introduction: The High Resolution Imaging Science Experiment (HiRISE) onboard the Mars Reconnisance Orbiter (MRO) has acquired five images of northern Meridiani Planum at resolutions up to ~28 cm/pixel. In a previous study [1], Mars Orbiter Camera (MOC), Mars Orbiter Laser Altimeter (MOLA), Thermal Emission Imaging System (THEMIS), and Observatoire pour la Minéralogie, l'Eau, les Glaces et l'Activité (OMEGA) data were compiled and coregistered for analysis of a ~1 km vertical section of hematite-bearing smooth plains, etched plains, and cratered units in the northern portion of Meridiani Planum. Five units were mapped in the study area (-2.25°E to 0.75°E, 0.25°N to 4°N) based on distinct geomorphology and signatures in OMEGA hyperspectral data. Here we use the new HiRISE data to characterize the morphology of these geologic units at submeter resolution, in order to determine whether sulfates recognized in OMEGA data in and near the bottom of the valley [1] are at the base of the section or a younger mantling deposit, e.g. late-stage lacustrine deposit.

Previous Geomorphic and Stratigraphic Mapping: Mapping [1, 2] (Fig. 1) indicates the base of the stratigraphic column is the Cratered Plains -- a low-albedo intercrater plains unit, which is part of the Noachian-aged Dissected Cratered Terrain found over much of Terra Meridiani [3,4]. Etched terrain materials to the south disconformably overlie the Cratered Plains. The Lower Etched Plains unit, where OMEGA has detected hydrated sulfates, is found within a broad, southeast-northwest-trending, enclosed valley, which is ~120 km long. The Upper Etched Plains unit is topographically and stratigraphically higher than the Lower Etched Plains unit and borders the valley to the south and east. Knobby terrain and mesas also characterize the Upper Etched Plains unit. The fourth unit is the Hematite-Bearing Plains, defined by [5], which cap the sequence over much of the southern portion of the study area. Finally, the uppermost unit consists of mantled Cratered Terrain materials, which overlie the the Hematite-Bearing Plains in the northeastern section of the study area. This unit is interpreted as an indurated aeolian deposit superimposed on etched and cratered terrains. Overall, ~1 km of subhorizontal layered deposits were emplaced on top of the cratered terrain.

HiRISE Results: The five HiRISE images sample a variety of previously mapped units (Fig. 2). Image PSP_001559_1825 covers the western edge of the plateau, where hydrated sulfates have been detected by OMEGA, as well as the boundary between that plateau and the valley floor (Fig. 2). Using Compact Reconnisance Imaging Spectrometer for Mars (CRISM) data in this area [6], it is inferred that the light-toned deposits on the valley floor are polyhydrated sulfates. These deposits are topographically lower than the darker-toned kieserite ($MgSO_4 * H_2O$) (Fig. 3), both of which occur within the Lower Etched Plains unit. Previously we were unable to resolve the detailed stratigraphy between the sulfate outcrops, but from primary analysis of the HiRISE data, it appears that the bright deposits are part of the section (and not a later stage deposit) and are exposed as the darker deposits are eroded back. Further studies of images elsewhere in the study area should provide a more comprehensive look at these sulfate-rich layers in the valley floor.

Image PSP_001692_1825 covers the western side of the valley and the contact with overlying units, including an area of the Hematite-Bearing Plains unit (Fig. 2). This image also shows the polyhydrated sulfates as a bright deposit on the valley floor, with the darker kieserite-rich deposit topographically higher [4]. Image PSP_001625_1815 (Figure 2) covers the Upper Etched Plains and shows a lots of mesas and polygonal fractures at the HiRISE scale, which are suggestive of dessication.

Conclusions: HiRISE is of particular interest for examining the detailed texture of geologic units in this area. Using HiRISE together with CRISM spectral data, we can determine the stratigraphic placement of thin beds with distinct spectral signatures. As more HiRISE data become available, a more detailed characterization of the plains and etched terrain units will be made to better define their depositional environment, and whether these sulfate deposits are at the base of the section or a late-stage lacustrine deposit.

References: [1] Griffes J. L. et al. (2006) *JGR, in press.* [2] Arvidson R. E. et al. (2005) *Science, 307,* 1591–1593. [3] Scott D. H., Tanaka K. L. (1986), *U. S. Geol. Surv. Map I-1802-A.* [4] Greeley R., Guest J. E. (1987) *U.S. Geol. Surv. Map I-1802-B.* [5] Christensen P. et al. (2000) *JGR,* 105, E04,

9623–9642. [6] Wiseman, S. et al (2007) LPSC, this issue.

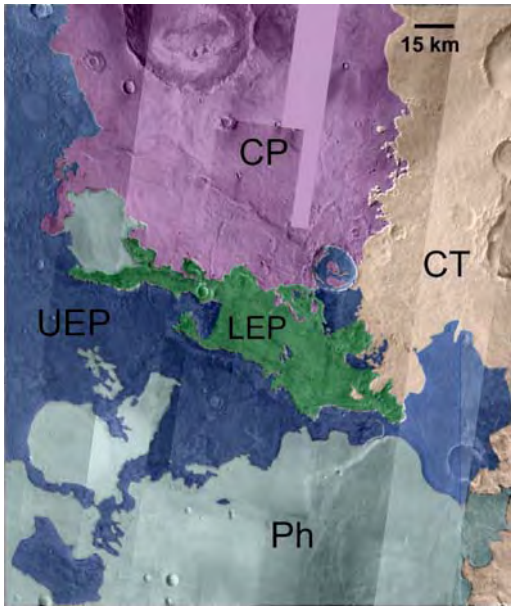

Figure 1: THEMIS daytime infrared image mosaic overlain by geologic units defined in this study. Oldest unit is CP, followed by LEP and UEP, Ph, and the youngest is the CT unit.

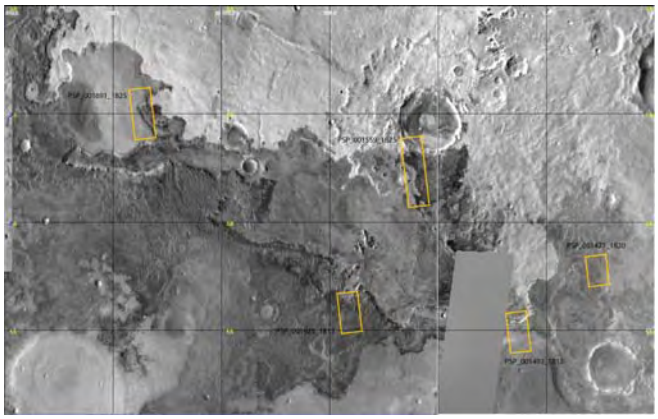

Figure 2: THEMIS daytime infrared image mosaic overlain with footprints of HiRISE images that have been acquired as of January 2007.

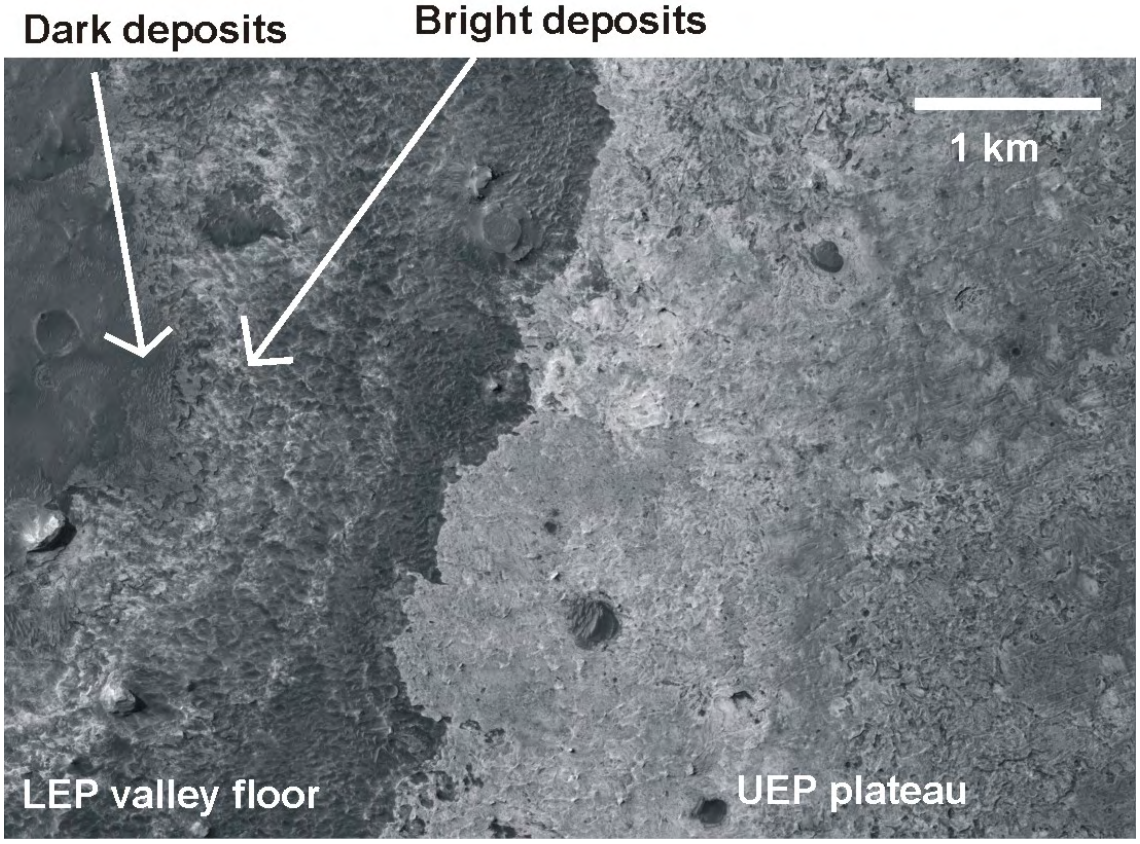

Figure 3: Subset of HiRISE image PSP_001559_1825 showing contact between the Lower Etched Plains valley floor and the Upper Etched Plains plateau. The bright deposits in the Lower Etched Plains correspond to where the polyhydrated sulfates have been detected and the dark deposits are topographically higher and where the kieserite has been detected. Image width is 6 km.