MULTI-DATASET ANALYSIS OF SURFACE UNITS AND LANDFORMS ON THE NORTHERN PLAINS OF MARS. W.H. Farrand¹ and M.D. Lane², ¹Space Science Institute, 4750 Walnut St. #205, Boulder, CO 80301, farrand@spacescience.org, ²Planetary Science Institute, Tucson, AZ.

Introduction: The northern plains of Mars have proven to be unique in several important ways. Dark regions in the northern plains are compositionally distinct in the thermal infrared from southern dark regions [1]. The topography is generally flat and topographic analysis of putative shorelines suggest they are consistent with the presence of a past northern ocean [2,3]. The northern plains also host a number of unique surface units and landforms which will be described further below. This paper discusses a study that has been undertaken to use multiple orbital datasets to characterize and better understand unique surface units and landforms in the northern plains.

Surface cover units: A number of distinct surface cover units have been identified which are being examined in this study. These include the following:
- Flow-like surface units (Figure 1)
- Mottled terrain (Figure 2)
- Patchwork terrain (Figure 3)
- Blebby terrain (Figure 4)
Other previously identified unique surface cover units such as the thumbprint terrains [4,5] are also being examined.

Landforms: A number of landforms have also been identified and are also a subject of this study. These include the following:
- Pitted cones [6, 7]
- Terraced mesas [8]
- Sinuous troughs with medial ridges (Figure 5)
- Domes (Figure 6)

Datasets Examined: THEMIS Vis and MWIR day and night images from Utopia and Acidalia Planitiae are being entered into a GIS. Select MOC NA images are also being entered in as appropriate. TES spectra are being extracted from spatially extensive surface cover units for spectral deconvolution analysis. Atmospherically corrected THEMIS spectra will also be extracted as appropriate. Thermal inertias from TES and THEMIS are also being calculated and extracted for units of interest.

Early Results: Some of the surface cover units and landforms that are being examined have distinct apparent thermal inertia characteristics. Examples are shown in Figures 3, 4, and 6. The patchwork terrain is most conspicuous in nighttime THEMIS data indicating apparent thermal inertia differences. Apparent thermal inertia differences are also noted between blebby terrain and the background (Fig. 4) and between domes and the background (Fig. 6). Thermal inertia differences of pitted cones from the plains have also been noted by [7].

Science Issues: Among the science issues that are being addressed by this investigation are those related to whether there was a northern ocean and the role that snowfall and/or glaciation might have played in shaping the northern plains. Recent studies have presented powerful evidence for the presence of glacially formed landforms near Tharsis volcanoes and in Deuteronilus Mensae [9, 10]. Features such as the thumbprint terrains and the sinuous troughs with medial ridges have likewise been interpreted as being glacial in origin [4, 5]. Estimating the extent of glacial effects on the northern plains would help in our understanding of this unique part of the Martian surface.


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Figure 1. Subsection from THEMIS scene I02581002 showing flow-like units over smoother plains in Utopia. Note also partially buried crater rim in lower left and subdued, presumably covered, mounds. Scale bar is 10 km long. North is towards the top.
Figure 2. Subsection of MOC NA image M2101816. Example of mottled terrain in central Acidalia. Scale bar is 3 km long. North is towards the top.

Figure 3. Subsection of THEMIS night brightness temperature image I03390003 showing an example patchwork terrain in Acidalia. Scale bar is 10 km in length. North is towards the top.

Figure 4. (left) Subsection of THEMIS brightness temperature image for daytime scene I03243002 (centered on 42.9° N, 284.8° W) with arrows indicating dark “blebby” terrain. (right) Subsection of THEMIS brightness temperature image for nighttime scene I03861002 with arrows indicating bright “blebby” terrain. North is towards the top in both images and scale bar in both images is 10 km in length.

Figure 5. Subsection of THEMIS scene I02398005 from western Acidalian showing medial ridge in shallow trough. Scale bar is 10 km long.

Figure 6. (left) Subsection from I03268002 domes on smooth plains of Utopia Planitia to south of rougher, overlying unit. (right) Subsection of nighttime THEMIS scene I03861002. Black arrows in both images point to domes that are bright relative to the background in the nighttime scene. White arrow points to a dome that is neutral to dark relative to the background in the nighttime scene. Scale bars in each image are 10 km long.