ON THE GEOLOGY OF THE AEOLIS MENSAE REGION, MARS. Sara Martínez-Alonso[1, 2], M.T. Mellon[2], A.S. McEwen[3], and the HiRISE Team. martinas at colorado.edu. [1]Department of Geological Sciences, University of Colorado, Boulder, CO, USA. [2]Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, USA. [3]University of Arizona, Department of Planetary Sciences, Lunar and Planetary Lab, Tucson, AZ, USA.

Introduction: We analyze a section of the Aeolis Mensae region (5°N 220°W to 15°S 200°W; ~1,200-by-1,200 km) that presents larger-than-average diversity of surface materials, as previously calculated from the global MGS-TES dataset [1]. Many relevant geological processes may result in the concentration of a large diversity of surface materials in relatively small regions (e.g., hydrothermal activity, sedimentation, volcanism, erosion). The study region is centered on a segment of the dichotomy boundary that coincides with fretted terrains developed along two distinct, strikingly linear fracture zones extending west for approximately 2,000 km (Figure 1). The Aeolis Mensae region also coincides with anomalously high water and Cl contents, derived from MO-GRS measurements [2, 3]. The large surface composition diversity, positive water and Cl anomalies, and structural setting could be consistent with volcanic, hydrothermal, or evaporitic activity. Certain types of eolian deposits could explain the elemental abundances observed, but they would produce low surface composition diversity. Volcanic, hydrothermal and evaporitic environments are of special interest because they are widely considered prime loci for the onset and development of organic activity.

Methodology: Evidence for the aforementioned geologic processes operating in Aeolis Mensae is being sought through a study of the nature of surficial materials, surface composition (mineralogy, lithology), and morphology.

Thermophysical Analysis. TES albedo and thermal inertia values (the latter derived from nighttime bolometric brightness temperatures utilizing the model described in [4]) were analyzed to determine the physical properties of surface materials (e.g., particle size, rock/bedrock exposure, and degree of induration) and constrain the character of the surface. Thermophysical classes were determined by comparison to the global units defined by [4] and [5], based on thermal inertia and albedo values.

Spectral Analysis. Data-derived spectral end members were extracted from TES and MEx-OMEGA data of the study area, utilizing the Pixel Purity Index technique [6]. End members were identified by comparison to public spectral libraries [7, 8, 9].

Morphological Analysis. MGS-MOLA, MGS-MOC, MO-THEMIS, and MRO-HiRISE data were analyzed to place the compositional and thermophysical information in its geological context.

Preliminary Results and Discussion: The thermophysical analysis indicates that the northern half of the study area, roughly corresponding to the lowlands, is (at TES scale) mostly covered by dust deposits, as well as some duricrust. In the southern half (the highlands), duricrust deposits predominate; bedrock and/or rocky deposits are found in the floor of impact craters and elsewhere, possibly due to duricrust denudation. The spectral data show dust signatures in the dust- and duricrust-covered regions, and indicate that the bedrock/rocky regions in the highlands are consistent with surface type 1 (aka Syrtis-type) materials [10], widely interpreted as basaltic in composition. We have identified olivine-rich areas in the TES data that coincide with several of the bedrock/rocky regions in the highlands, as well as in the floor of one of the troughs in the fretted terrains of the dichotomy boundary (Figure 1). The olivine is forsteritic (Mg-rich) in composition.

The imaging data indicate that this is a geologically complex region. The lowlands show evidence consistent with volcanic processes. Two main terrain types are present in the lowlands: "flat" terrains and two conspicuous lobe-shaped deposits, oriented NW-SE, part of the Medusae Fossae Formation [11] (MFF). The morphology of the former is consistent with fluid lava flows, as suggested by layering, flow-like features, wrinkle ridges like those common in maria deposits, quasi-circular features interpreted as impact craters covered by inflated lava flows, large (~2 km in diameter) bulges with central craters interpreted as volcanic shield-like edifices, and platy/polygonal features. The two MFF lobe-shaped deposits have been previously interpreted as (among others) eolian and/or pyroclastic in origin. Their flute-like surface morphology has been interpreted as yardangs, indicative of strong eolian erosion [12 and references therein]. The MFF materials are locally overlaid by inverted channels [13] the origin of which is still being debated; they are also cut by fractures located along the dichotomy boundary. We find that at MOC resolution there is a spatial transition between MFF outcrops and alignments of cones (Figures 1 and 2), some of which may be associated with fissures. This spatial relationship could be explained by volcanic materials extruded along fissures and cones, constituting the MFF outcrops in this region; in this case the flute-like surface morphology would not be due to erosion alone, but to the mechanical properties of the extruded materials. Alternatively, the rows of cones could provide a framework that would allow ridges of the MFF to resist eolian erosion. High resolution HiRISE data (~25 cm/pixel) will be examined to evaluate such scenarios.

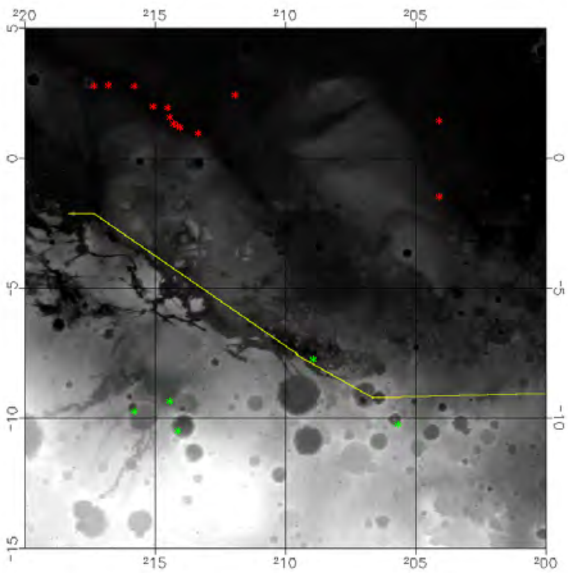

Figure 1. MOLA topography; higher elevations are shown in lighter tones. The two NW-SE lobe-shaped deposits correspond roughly to part of the Medusae Fossae Formation (MFF). Yellow: dichotomy boundary. Green: olivine detected in TES data. Red: some of the MOC images showing a continuum between alignments of cones and MFF deposits.

The presence of basaltic materials and olivine-rich outcrops in the highlands is consistent with igneous activity. HiRISE data will help discriminate among several possible origins for those basaltic and olivine-rich materials: in situ volcanic or intrusive rocks, impact materials, or sedimentary/volcano-sedimentary deposits; an eolian origin would not be consistent with the thermophysical properties observed.

No spectral or morphological evidence supporting a hydrothermal or evaporitic origin for the water and Cl anomalies has been found in this preliminary analysis; hydrothermal or evaporitic materials could, though, exist under the dust/duricrust cover.

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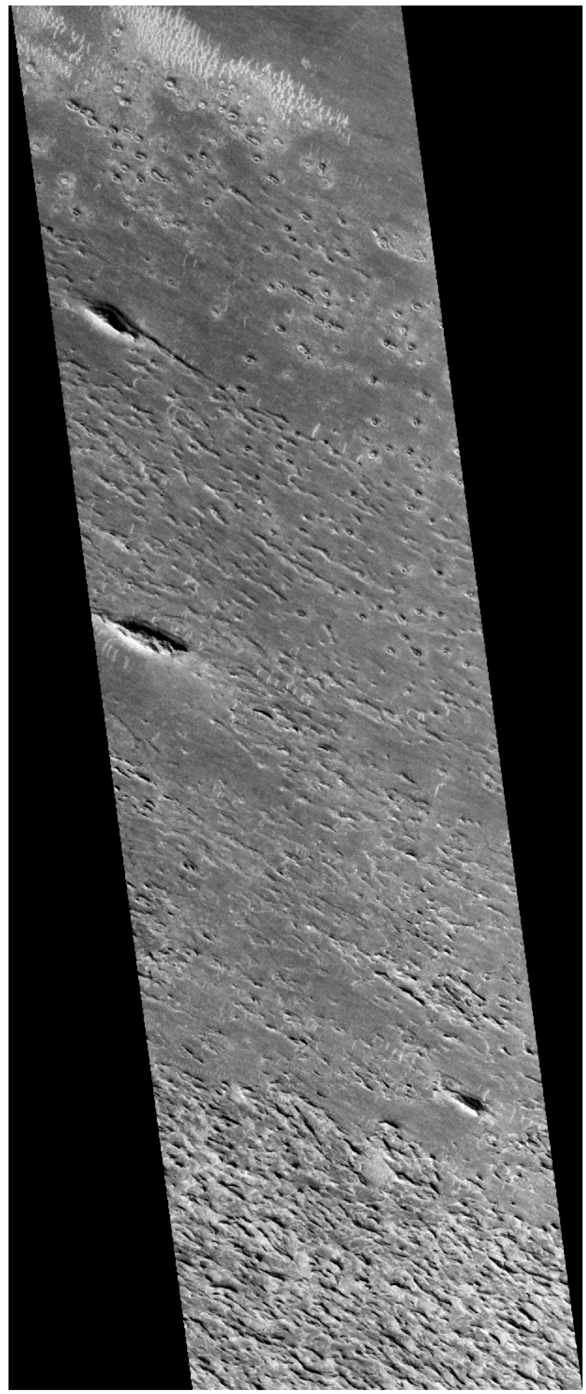

Figure 1. Subset of MOC scene R1304097 showing continuum between cone alignments and outcrops of the Medusae Fossae Formation. The image is ~3 km wide.