DISSECTION OF VOLCANIC AND SEDIMENTARY PLAINS AROUND UPPER DAO AND NIGER VALLES, NORTHEAST HELLAS, MARS. Scott C. Mest[1], David A. Crown[1], Joseph Michalski[1], Frank C. Chuang[1], Katherine Price Blount[2], and Leslie F. Bleamaster[3], [1]Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, AZ 85719; [2]Texas A&M University-Commerce, Commerce, TX 75428; [3]Trinity University, San Antonio, TX, 78212. (mest@psi.edu)

Introduction: The eastern rim of Hellas and the surrounding highlands have been modified by numerous processes that provide a record that spans most of the Martian time-scale [1-10]. Through geologic mapping and morphologic and spectral analyses, this investigation is exploring the geologic and hydrologic histories of the eastern rim of Hellas basin, where important spatial and temporal relationships between volcanic and volatile-driven processes are preserved (Fig. 1). This region displays a unique confluence of ancient rugged highlands, the effusive and explosive volcanic terrains of the Tyrrhenus Mons lava flow field and flanks of Hadriacus Mons, the canyons of Dao and Niger Valles, channelized plains, and geologically young volatile-rich mass wasting and mantling deposits.

Data and Methods: We use ArcGIS to compile image, topographic, and spectral datasets in order to map geologic units and features in the study region. This effort will produce a 1:1M-scale geologic map of MTM quadrangles -35262, -35267 and -35272 (Fig. 2), which will complete the geologic mapping of most of Hadriacus Mons and all of Dao and Niger Valles at 1M scale, providing a critical link to previously mapped adjacent quadrangles [9,11,12].

A THEMIS daytime thermal infrared (dTIR) brightness temperature mosaic (~100 m/pixel) is the primary mapping base. CTX images (~5 m/pixel) and THEMIS VIS (~18 m/pixel) multi-band images provide complementary spatial coverage and serve as context for high-resolution images. High-resolution HiRISE (<1 m/pixel) and MOC-NA (~1.5-12 m/pixel) images allow detailed analyses of mapped units and features. We use THEMIS dTIR images to distinguish between units with different thermophysical properties, and CRISM multispectral (~100-200 m/pixel) and hyperspectral (~18-36 m/pixel) data to map the occurrence and distribution of primary minerals and their alteration products within surficial materials. Crater size-frequency distribution statistics and stratigraphic relationships are used to determine relative ages.

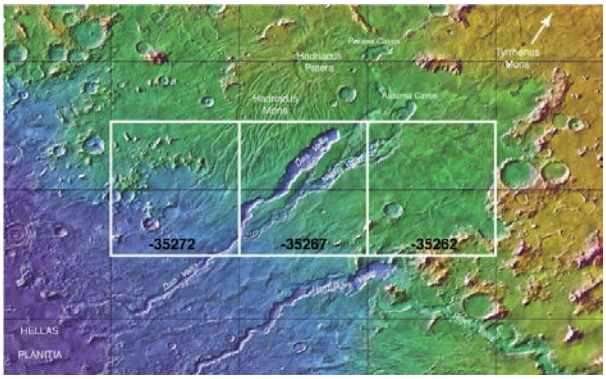

Figure 1. Regional map showing the 3-quad map area (white boxes; Fig. 2) and major features.

Mapping Results: We are mapping units and features that define four prominent terrains within the map area (Fig. 2), including highlands in the west and southeast, volcanic materials of the Tyrrhenus Mons flow field (TMff) in the east and the southern flank

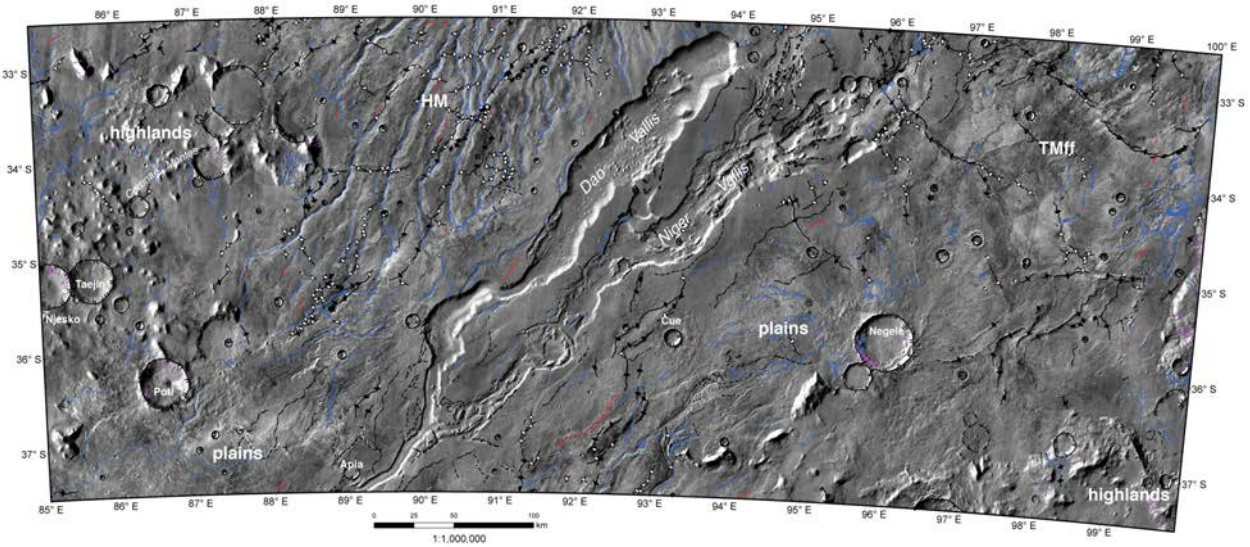

Figure 2. THEMIS dTIR mosaic (100 m/pixel) of the map area showing the major terrain types (highlands, plains, Hadriacus Mons (HM), the Tyrrhenus Mons flow field (TMff)), and the upper sections of Dao and Niger Valles. Currently mapped linear features are shown.

materials of Hadriacus Mons (HM), and plains that occupy the central part of the map area.

Mapping is showing that almost every surface in the map area has been modified to some degree by fluvial dissection ranging from small gullies within the highland terrains, along crater rims, and valles walls to single channels and valley networks incised within the volcanic and plains materials.

Gullies: Gullies include features that form straight, parallel sets of narrow valleys; some gullies display alcove heads and fan-shaped deposits at their termini. Gullies generally form on steep slopes such as on massifs and knobs within the highland terrains, along the inner walls of several large craters (such as Negele), and along the walls of Dao Vallis. The highland gullies are incised within the materials that appear to mantle the highlands, whereas crater and valles gullies appear to be incised within talus or bedrock. Some crater and valles gullies appear to head along a distinct layer, and others extend to the rim crest.

Fluvial Channels: Fluvial channels are found throughout the map area, but are morphologically distinct depending on the terrain in which they occur. Relatively flat terrain, such as the plains and TMff [13,14], contain channels that are sinuous, shallow, and generally narrow. Some channels consist of complex systems of dissection confined within a broader valley. These systems exhibit several parallel single or branching channels, braided or anastomosed channels within the valley, distributary systems that terminate at areas of smooth materials occur along their lengths, and scouring of the surface forming sets of short (a few kilometers long) parallel channels. Some fluvial channels are associated with areas of collapsed plains. Channels are observed to flow into and out of these collapsed areas, and the shapes of some collapse blocks have been modified by subsequent fluvial erosion. The most prominent evidence for collapse of plains is the presence of Dao and Niger Valles. Here sets of perpendicular fractures define boundaries of large tilted slump blocks, and clusters of collapsed plains. It is likely that collapsed plains, combined with fluvial erosion, formed the canyon systems of Dao and Niger Valles [5].

Fluvial channels are also found on steeper terrains, such as on the flanks of HM and within low-lying areas of the highlands. The flank materials of HM are characterized by numerous valleys that radiate from the volcano's summit. Channels incised within the valleys tend to be narrow and straight, but some channels within broader valleys are more sinuous. Channels within the highlands tend to be narrow and short due to their confinement, and unlike gullies, highland channels are more sinuous.

Ongoing Work: As our mapping progresses, we will be mapping contacts, measuring the diameters of impact craters, and evaluating the origins of valley features and their relationship to the units in which they formed. We will also continue to examine the nature of materials in the map area using CRISM. We plan on using our geologic map and subsequent analyses to evaluate the geologic and hydrologic histories of this area, and evaluate the distribution, relative roles, and interactions of volcanism and volatiles in this area.

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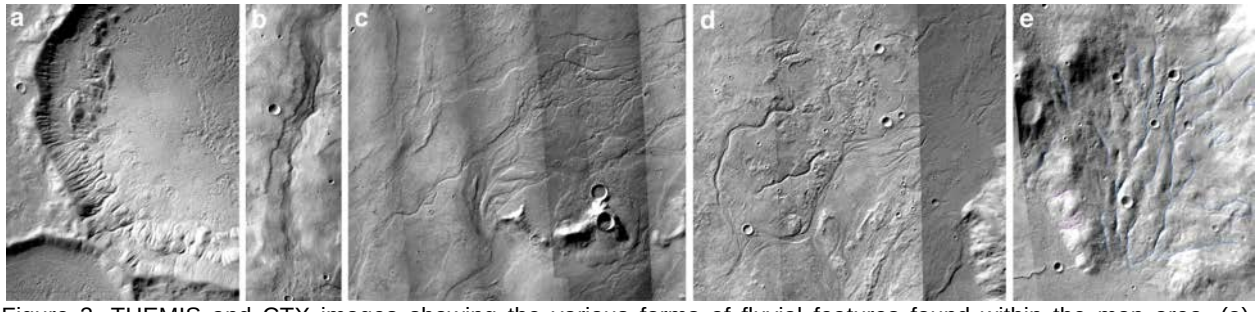

Figure 3. THEMIS and CTX images showing the various forms of fluvial features found within the map area. (a) Gullies incised along the western wall of crater Negele. Channels within the plains (b) and TMFF (c) exhibit single channels, areas of collapse, braided channels, and erosion within a broader valley. (d) Narrow channels are incised within broader layered valleys on the flanks of HM. (e) Low areas of the highlands contain short, narrow valleys.