GEOLOGIC MAPPING OF VOLCANIC AND SEDIMENTARY MATERIALS 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 Hellas basin (~2000 km across, ~8.2 km deep) is the largest well-preserved impact structure on Mars [1,2] and has played a significant role in the geologic evolution of the surrounding region [2-11]. The 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.

This investigation explores 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 (Figure 1). This region displays a unique confluence of ancient highland, volcanic (effusive and explosive), fluvial (channels and valles) and mass wasting features and deposits. This geologic mapping investigation examines the canyons of Dao and Niger Valles, the Tyrrhenus Mons lava flow field, the flanks of Hadriacus Mons, remnants of rugged highlands, extensive 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, and will produce a 1:1M-scale geologic map of MTM quadrangles -35262, -35267 and -35272 (Figure 2). 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 identify the occurrence and distribution of primary minerals and their alteration products within geologic materials at the surface. Relative ages are determined by compiling crater size-frequency distribution statistics and evaluating stratigraphic relationships (superposition, cross-cutting, and embayment).

This map area shares its boundaries with five other mapped MTM quadrangles along the northeast/east Hellas rim (-30262 and -30267 [12] and -40262, -40267 and -40272 [10,13]). This effort 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 the previously mapped quadrangles.

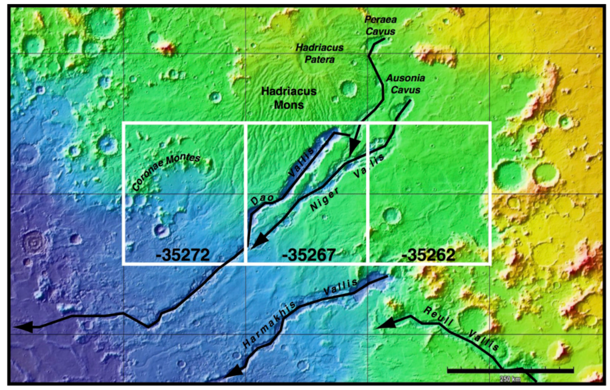

Figure 1. Regional map showing the 3-quad map area (white boxes; Figure 2) and major features; black arrows indicate flow direction through Dao, Niger, and Reull Valles.

Mapping Results: We are mapping units and features that define four prominent terrains within the map area (Figure 2), including highland massifs in the west and southeast, volcanic flow materials of the Tyrrhenus Mons flow field (TMff) in the east, the southern flank materials of Hadriacus Mons (HM), and plains materials that occupy the central part of the map area and contain Dao (D) and Niger (N) Valles.

Highland terrains (previously mapped as Noachian-aged "mountainous material" and the "basin-rim unit" [e.g., 3,4,6-8]) consist of rugged massifs and clusters of rounded knobs surrounded by smooth materials. Most peaks are mantled by deposits that appear smooth in THEMIS images. However, in CTX images the deposits on steeper slopes show evidence for viscous flow, or are dissected by narrow parallel gullies. In some areas, the deposits within inter-peak regions consist of coalescing debris aprons or are dissected by networks of channels.

Using THEMIS IR and CTX images, we have refined the types and locations of features within the TMff, including lava flow lobes, volcanic channels, erosional channels, and structures [14-16]. Flow lobes have sinuous planform shapes, typically are oriented NE-SW along the shallow southwesterly regional slope, and have elongate, broad, and digitate margins. Lobe margins range from subtle to well-defined, and variations are observed both within an individual flow and between different flows [14,15]. Some narrow channels observed in TMff display leveed margins and are associated with flow lobes,; however, many channels in TMff and all narrow channels in the plains lack these features and appear to be erosional [14-16].

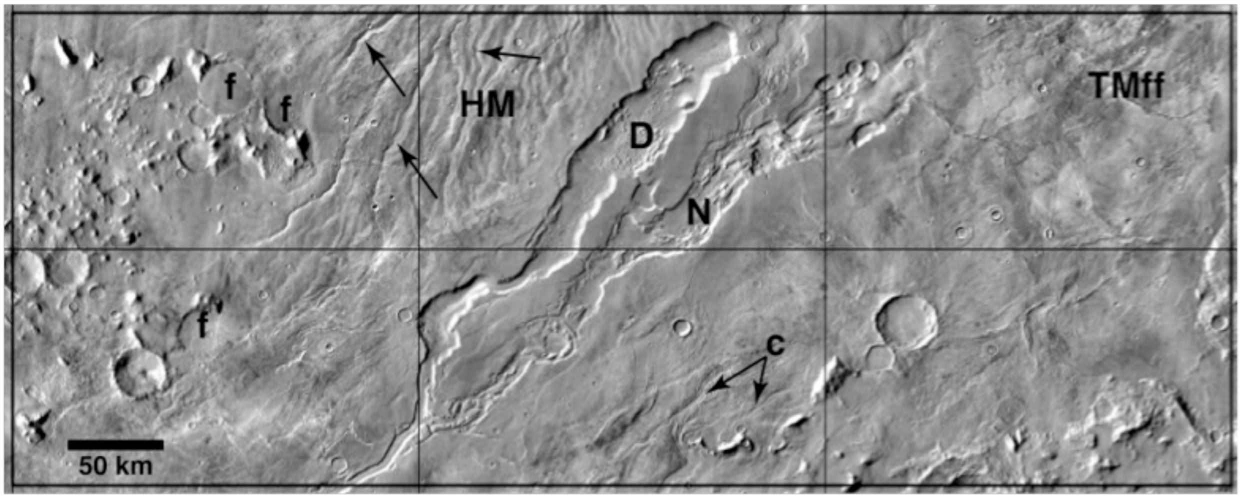

Figure 2. THEMIS dTIR mosaic (100 m/pixel) of the 3-quad map area including sections of Dao (D) and Niger (N) Valles, the channeled flanks of Hadriacus Mons (HM; arrows), channeled plains (c), the terminus of the Tyrrhenus Mons flow field (TMff), and remnants of highlands and impact craters filled (f) by plains.

The flank materials of HM occupy the north-central part of the map area. Previous studies have shown that these deposits consist of layered pyroclastic materials likely emplaced over multiple eruptive events [12,17-21]. HM flank materials 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 sinuous. Wrinkle ridges, generally oriented perpendicular to the flank slopes, deform the flank materials, and occur as either broad ridges topped with a narrow crenulated ridge or just a degraded narrow crenulated ridge [e.g., 22].

The plains within the map area generally exhibit relatively smooth surfaces, but some areas have been heavily modified by collapse and/or fluvial erosion. The most prominent evidence for collapse of plains is the presence of Dao and Niger Valles. Here sets of perpendicular graben 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]. Abundant evidence for fluvial erosion, including narrow sinuous channels and broad, flat-floored braided channels also exists throughout the plains tens to hundreds of kilometers away from the valles.

Ongoing Work: As our mapping progresses, we will be mapping contacts, especially within TMff, plains and HM flanks, 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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