GEOLOGIC MAPPING OF MTM -35137 QUADRANGLE: DAEDALIA PLANUM REGION OF MARS.

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Introduction: This geologic mapping investigation explores the geologic and volcanic history of the southernmost extent of the Tharsis region on Mars. SW Daedalia Planum includes volcanic flows and plains that embay and fill low-lying regions in the highlands. Detailed geologic and flow field mapping is designed to a) characterize the styles of volcanism in southern Tharsis, b) identify potential local and regional sources for the observed flows and plains, c) determine the timing of flow emplacement and overall volcanic chronology, d) examine interactions between volcanic and tectonic processes, and e) evaluate the degradational history of the highlands.

Study Area: MTM -35137 quadrangle [32.5°-37.5°S, 135°-140°W] is dominated by flat-lying volcanic flows and plains units that embay degraded remnants of Terra Sirenum. Previous mapping identified the Tharsis Montes Formation, mountains, and highland terrain [1] and Arsia Mons flow units, older flows, smooth plains, and highlands [2] along the southern margin of Tharsis in this region.

Geologic and Flow Field Mapping: For this investigation, traditional geologic mapping of the 1:500K-scale MTM quadrangle is combined with detailed flow field mapping at 1:50K-scale to take full advantage of new high-resolution datasets for Mars and to document observations important for interpreting volcanic processes. Context Camera (CTX; ~5 m/pixel) images imported into ArcGIS form the primary image base; also used are the Thermal Emission Imaging System (THEMIS) global mosaic and infrared multi-band images (~100 m/pixel), High Resolution Imaging Science Experiment (HiRISE; ~1 m/pixel) images, and Mars Orbiter Laser Altimeter (MOLA; 128 pixel/deg) DEMs and profiles.

Mapping Results: Preliminary mapping of MTM -35137 quadrangle has been completed (Fig. 1) [3-4]. Highlands occur as locally highstanding and rugged remnants of heavily cratered terrain that has been extensively degraded. Highland surfaces display numerous fluvial channels and erosional troughs. Distinct embayment relationships are evident between degraded highlands and adjacent plains and flows. Two plains units are observed: 1) a smooth unit with mottled appearance in THEMIS IR images covers a low-lying region at the SW corner of the map; the origin of this unit is unclear and its surface textures suggest the presence of mid-latitude mantling deposits; and 2) a smooth-surfaced unit that also exhibits numerous small impact craters as well as some wrinkle ridges and graben; this unit is covered by younger flows but clearly embays the highlands and is interpreted to be volcanic in origin.

The majority of the quadrangle consists of young lava flows forming large sheets that inundate the region [3-4]. Sheet flows typically have strongly ridged surfaces but also locally display knobby, platy, and smooth textures. Impact craters on the pre-flow surface influence flow emplacement as indicated by changes in surface ridge patterns. Formation of sheet flows partly by coalescense of large lobes is suggested in local zones where flow converges. Prominent, single or paired, curvilinear ridges that disrupt local textural patterns are found on the sheet flows. Some of these curvilinear ridges are sinuous and "channel-like" and may appear to branch or merge together. Others are less sinuous and presumably related to modification of the flow crust due to differential flow; these ridges can be associated with "islands" of knobby texture.

Sheet flow margins display various morphologies. Sheet flows that embay highlands develop complex frontal shapes due to topographic irregularities in the degraded terrain. Sheet flows emplaced over older volcanic plains exhibit lobate margins suggesting lobe coalescence or differential flow at the front. A series of smooth plateaus is observed along sheet flow margins. The plateaus have steep sides and some appear to have small breakout flows at their edges. These smooth plateaus are interpreted to be due to flow inflation as the front stagnates. This is consistent with their smooth surfaces, as low-velocity emplacement may limit the ability to form surface ridges.

Age Constraints. Using CTX images, populations of small impact craters superposed on lava flow surfaces and other geologic units have been analyzed. Crater size-frequency distribution statistics have been calculated using established methodologies [5-7]. All impact craters (primaries and isolated secondaries) on a given surface are counted while avoiding areas of obvious secondary chains or clusters. These data are then plotted on the isochrons defined by [6-7] to assess relative age and estimate absolute age.

Preliminary results for sub-regions of the major geologic units show the following: a) eroded Noachian cratered terrain (highlands) that stabilized in the Early Hesperian Epoch, b) an early episode of volcanism (volcanic plains) that embayed the highlands in the Early Hesperian (~3-3.5 Gy), and c) recent volcanism emplacing vast sheet flows during the Middle Amazonian Epoch (0.5-1 Gy) [4].

References: [1] Scott, D.H. and K.L. Tanaka (1986), *USGS Map I-1802A*. [2] Scott, D.H. et al. (1981), *USGS Map I-1275*. [3] Crown, D.A. et al. (2011), *AGU*, abstract V31A-2514. [4] Crown, D.A. et al., this issue. [5] Berman, D.C. and Hartmann, W.K. (2002), *Icarus*, 159, 1-17. [6] Hartmann, W.K. (2005), *Icarus*, 174, 294-320. [7] Hartmann, W.K. (2007), *Icarus*, 189, 274-278.

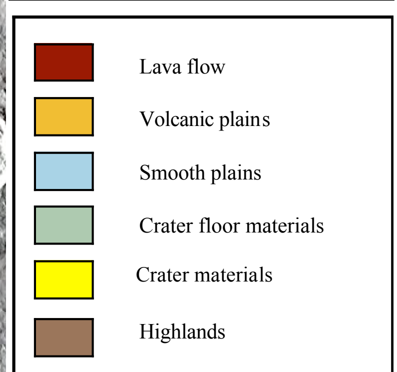

Figure 1. Left) Simplified geologic map of MTM -35137 quadrangle. Black boxes indicate sheet flow crater count areas. Bottom left) CTX image showing flow embaying highlands. Note highly ridged flow surface with smooth plateau (p) attributed to inflation as front stagnated. Bottom) Crater size-frequency distributions for highlands and volcanic plains in map area (see [4] for data for sheet flows).