GEOMORPHOLOGIC MAPPING AND CHARACTERIZATION OF CHANNEL NETWORKS ON THE THARSIS MONTES, MARS. M.E. Trumble[1,2], J.E. Bleacher[2], A. de Wet[1], D.J. Merritts[1], and W.B. Garry[3]. [1]Department of Earth and Environment, Franklin and Marshall College, Lancaster, PA, 17603, mtrumble@fandm.edu, [2]Planetary Geodynamics Laboratory, Code 698, Goddard Space Flight Center, Greenbelt, MD, [3]Center for Earth and Planetary Studies, Smithsonian Institution, National Air and Space Museum, Washington DC .

Introduction: The Tharsis province spans nearly a quarter of the martian surface and displays an array of volcanic features including seven partly buried shield volcanoes, lava plains, and a range of small vent morphologies [1-5]. Mars Orbiter Laser Altimeter (MOLA) data showed that small volcanic vents are more abundant than originally thought from *Mariner* and *Viking* data [6,7]. Recent studies using MOLA, Thermal Emission Imaging System (THEMIS), and High Resolution Stereo Camera (HRSC) data characterized small-vents associated with the Tharsis Montes [8-11]. The objective of this study was to map, characterize, and compare channels located within the Tharsis Montes southwest rift aprons and low shield fields. These features were differentiated from channel-fed flow fields in recent morphologic mapping [9,12], in agreement with previous observations.

Approach: *Bleacher et al.* [9] conducted morphologic mapping of portions of the Tharsis Montes main flanks, southwest rift aprons, and low shield fields. They identified two terrains that they suggested result from modification of pre-existing surface units. The channel network terrain (CNT) [see also 13] is composed of channels that lack levees and form branching networks. The CNT is located in the low shield fields and rift aprons, and tends to originate from fissures. The collapse terrain includes several sub-classes, including: 1) chasmata that make up the apex of each rift zone, 2) radial, and 3) circumferential trenches [see also 12]. This terrain is located on the main flanks, rift aprons, and low shield fields.

We conducted morphologic mapping for an isolated CNT feature on Ascraeus Mons, and two isolated collapse terrain features (hereafter sinuous channels) on Pavonis Mons. These features were chosen because each is visible from source to terminus using a combination of THEMIS (18 and 36 meter/pixel) and HRSC (16-20 meter/pixel) images. We used Canvas X software to conduct the mapping. From the maps we derived a developmental sequence based on unit relationships. Upon completion, we imported each map into ArcGIS, and geo-referenced them to the MOLA 128 pixel/degree gridded data product. While not reported here, we are currently measuring each feature's normalized width and length, as well as channel width/depth ratios for comparison with terrestrial features.

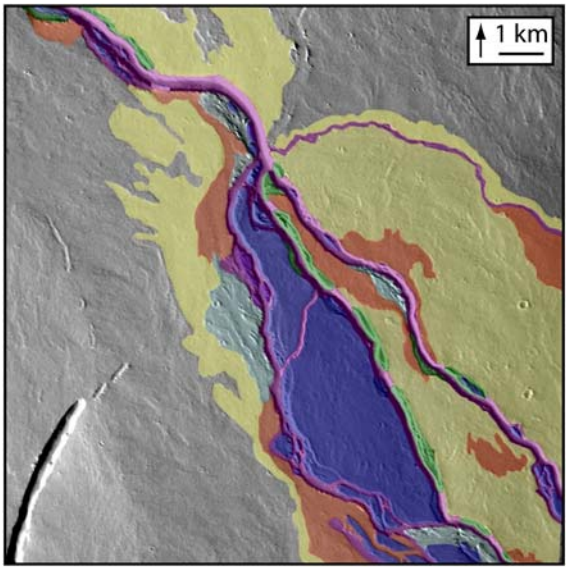

Figure 1. A portion of the channel network morphologic map showing the trench unit (purple), bench unit (green), island unit (blue), chaotic unit (light blue), smooth unit (red), and mottled unit (yellow).

Results: We mapped each channel and related surfaces excluding the source fissure and adjacent lava flow units. We defined seven morphologic units, including the 1) trench unit, 2) secondary trench unit 3) bench unit, 4) island unit, 5) chaotic unit, 6) smooth unit, and 7) rough unit.

The first four units are surfaces entirely bound by scarps. The trench unit is a depression, including its upward bounding scarps. The secondary trench unit is also a depression bound by upward scarps but this unit displays a trend perpendicular to slope, does not share the same source, and is generally a much shallower depression. The bench unit includes surfaces with one bounding, upward scarp, and a downward scarp, which is not mapped as part of the unit. The island unit is a surface that is completely bound by downward scarps, which are not mapped as part of the unit.

The remaining three units are surfaces that are not entirely bound by scarps. The chaotic unit displays a rough texture that appears to be composed of a combination of the island and bench unit at a scale that is near the detection limit of our data. The smooth unit is a texture-less surface that when unburied by younger lava flows displays a gradational boundary with older lava flows. The rough unit is typified by a hummocky surface at a horizontal scale of tens of meters. Like the smooth unit, there is often a gradational boundary.

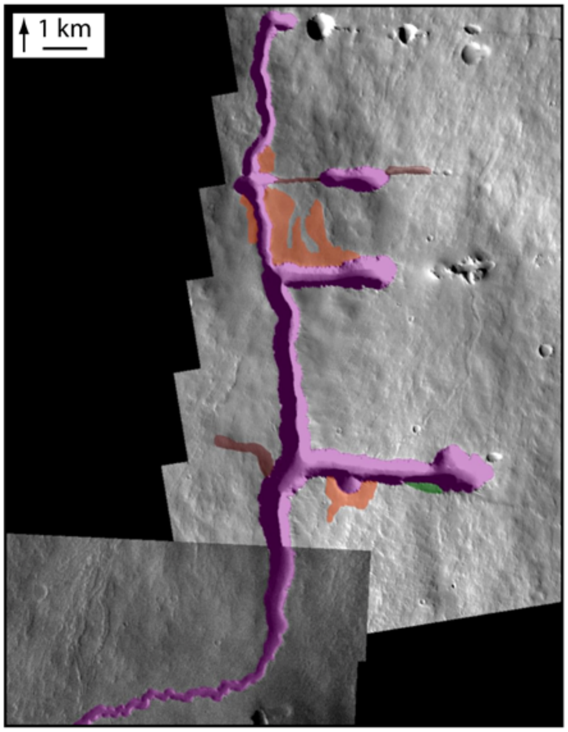

Figure 2. A portion of a sinuous channel morphologic map showing the trench unit (purple), secondary trench unit (brown), bench unit (green) and smooth unit (red).

Discussion: The CNT map (Figure 1) displays a trench trending away from the source fissure to the southeast. It bifurcates into multiple trenches in several places. The trench unit is surrounded by the discontinuous bench, island, and chaotic units. Unless buried by younger lava flows, the smooth and rough units are located between the trench, bench, island, and chaotic units and the surrounding lava flows. The trench unit decreases in width and depth until the depth is essentially negligible at the terminus.

We infer the trench unit to be an eroded channel formed by the flow of a liquid. The bench, island, and chaotic units appear to represent stranded channel surfaces. The smooth and rough units suggest modification, but little incision, of the pre-flow surface. The unit relationships lead us to suggest a four stage sequence of development, including: 1) release of a fluid as a sheet flow, forming the smooth and rough units, 2) incision into the pre-flow surface forming channels, 3) channel meandering resulting in the formation of the bench, island, and chaotic units, and 4) establishment of a primary channel.

The sinuous channel maps (Figure 2) are dominated by the trench and secondary trench units. There are multiple trench unit sources, forming rounded depressions opposed to fissures. As a result, the sinuous channel trench unit forms from the consolidation of multiple trenches at lower elevations whereas the CNT trench unit branches at lower elevations. The sinuous channel trench unit displays scalloped margins. The island and bench units are far less abundant and appear to represent mass movements opposed to stranded surfaces. The smooth unit is also less abundant, and it is unclear if this unit is related to the events that formed the sinuous channels. The chaotic and rough units are not present.

The origin of the sinuous channels remains unclear. The secondary trench unit is likely results from circumferential structural controls on the volcano. The primary channels do not appear to display stranded surfaces or adjacent units suggestive of an evolving eroded channel. The scalloped nature and interaction of multiple channels that appear unrelated to regional slope in the proximal region suggest that surface collapse was a dominant process. However, the distal channel does parallel the trend of slope, possibly indicating the role of surface flow and erosion. We suggest that the formation of sinuous channels might result from a combination of collapse and possible erosion from a flowing fluid.

Conclusions: We conducted geomorphologic mapping of channel networks associated with Ascraeus and Pavonis Mons. Results lead us to suggest that these features, at least in part, formed as a result of erosion, possibly by a flowing liquid. Larger eroded channels on Mars are suggested to form by flow of liquid volatiles or low viscosity lavas. We do not see evidence of erupted lavas related to either type of channel, nor have we identified sedimentary deposits or fans at the channel's distal margins. The existence of either would provide insight into the nature of the eroding agent.

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