LINEATED VALLEY FILL SURFACE TEXTURES, NILOSYRTIS MENSAE, MARS: COMPARISON WITH ANALAGOUS GLACIER SURFACE TEXTURES IN THE ANTARCTIC DRY VALLEYS. J. S. Levy[1] and J. W. Head[1], [1] Dept. of Geological Sciences, Brown University, Providence, RI, 02912 (joseph_levy@brown.edu).

Introduction: Understanding the formation processes of deformation features originating in association with viscous flow on Mars, including lineated valley fill (LVF), is a key component in the estimation of climate conditions on Mars during its recent history [1-3]. Previous work has focused on estimating temperature conditions from temperature-dependent flow laws [e.g., 1-2]. In order to extract climate data from such features, however, we must first determine which features are structurally controlled (i.e., by flow due to internal deformation) and which are climate controlled (i.e., modification of surfaces by sublimation, aeolian processes, etc.).

Previous Work: Mangold [4] considered the evolution of surface textures of lineated valley fill, providing extensive descriptions and interpretations of LVF in Deuteronilus Mensae and interpreting the pit-and-butte texture (10 m tall, flat-topped mounds, 10s of meters wide) as sublimation residue from an ice-rich-dust mantle overlying LVF LDAs. Cracks in the underlying LVF and LDA created by viscous deformation are expressed in the mantling unit as the buried fractures lead to enhanced sublimation in the mantling layer [4].

Nilosyrtis Mensae Observations: We build on the findings of [4] and test them using observations of LDA/LVF units in Nilosyrtis Mensae (33.5°N, 68.5°E) [5]. A prominent lobate structure in the Nilosyrtis Mensae LVF (Fig. 1) is located in the center of a ~5 km wide, N-S trending valley and points down-valley towards the north. The lobe is dominated by a pit-and-butte texture similar to that described by [4]. Along the lobe margin, the pit-and-butte texture appears oriented approximately orthogonally to the margin; however, toward the lobe interior, the texture appears non-oriented (Fig. 1). As observed in [4], buttes are 10s of meters wide with troughs ~10 m wide between each butte; however, high-sun angles and short spaces between buttes prevent accurate heights to be determined by sun-angle measurements.

South (up-valley) of the lobe front (Fig, 3), the lobate LVF feature can be traced back to a confluence of four valleys. Pit-and-butte textures are observed in this area, and appear oriented in a lobate fashion along the axis of the main lobe. Along the west margin, the lobate feature transitions from pit-and-butte texture to a smooth texture. The smooth region of LVF is in a topographic low. Down-valley (north) of the lobe-front (Figure 4), the valley 5 LVF abuts valley 6 LVF [5]. The valley 6 LVF is more extensively pitted and with fewer, larger buttes than that observed in the valley 5 LVF. Several <250 m features which may be "oyster-shell" craters [4] are observed in valley 6 LVF.

Terrestrial Analog and Discussion: We compare the lobate LVF feature observed in Nilosyrtis Mensae with the Mullins Valley debris-covered glacier, located in the Antarctic Dry Valleys (Fig. 2). Cold-based glaciers in the hyper-arid, cold environments of the ADV are considered to be physical analogs for martian valley-glacial processes [6,7].

Mullins glacier is in a geometrically similar configuration to the lobate LVF feature observed in Nilosyrtis Mensae, in terms of 1) lobe position, 2) proximity to alcoves/valley-walls, and 3) down-valley confluence with similar material [8,9]. On Mullins glacier, surface fractures in the glacier ice form in response to thermal contraction [10]. Along the fastest flowing lobe fronts and margins, the cracks are oriented by the stress field generated by viscous flow of the glacier; however, in slow-flowing and stagnant areas, the cracks are largely hexagonal, and are not flow-oriented [10]. The till surface, which is largely derived from sublimation of the glacier (rather than from aeolian sedimentation) [10], responds to cracks in the glacial substrate by forming polygonal mounds surrounded by troughs. This relationship is similar to the distribution of linearly oriented and non-oriented butte structures observed in Nilosyrtis Mensae, suggesting the possibility of an "englacial" origin for pit-and-butte texture.

The presence of fresh and 'oyster-shelled" [4] superposed impact craters on the lineated surface on Mars suggest that a loss of volatiles was important in the transition from formational conditions to the present. Ongoing work will verify the angular relationships between buttes, troughs, and lineations in Nilosyrtis, as well as model the preservation of ice in positive relief features in hyper-arid cold environments to enhance the connection between pit-and-butte structure and polygonal patterning on sublimation-lag debris-covered glaciers.

References: [1] A. Colaprete and B. Jakosky, JGR, 103, 5897, 1998; [2] R. Milliken et al., *JGR*, 108, doi:10:1029/2002JE002005, 2003; [3] J. Head et al., *LPSC 36*, 1237, 2005; [4] N. Mangold, *JGR*, 108, doi:10.1029/2002JE001885, 2003; [5] J. Levy and J. Head, *LPSC 37*, 2007; [6] D. Marchant and J. Head *LPSC 35*, 1405, 2004; [7] D. Marchant and J. Head *LPSC 36*, 1421, 2005; [8] D. Sugden et al., *Nature*, 376, 412, 1995; [9] J. Levy et al., *Antarctic Sci*., in review, 2006; [10] D. Marchant et al., *GSA Bull*., 114, 718, 2002.

Figure 1 – MOC image E1300869, showing a lobate LVF feature in Nilosyrtis Mensae, Mars. Pit-and-butte textures are oriented roughly orthogonally to the lobe front along the margin, but appear non-oriented in the lobe interior.

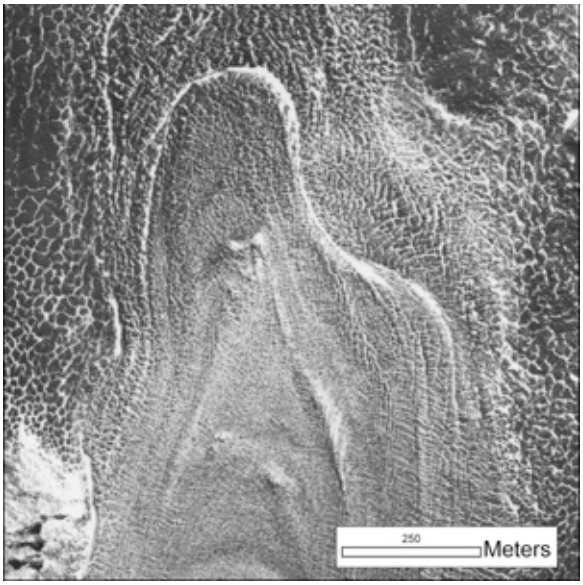

Figure 2 – Cambot air-photo of Mullins Valley debris-covered glacier, Antarctic Dry Valleys. Sublimation type polygons are oriented by stresses associated with viscous flow along the glacial margin, but are non-oriented in regions of slower moving or stagnant ice.

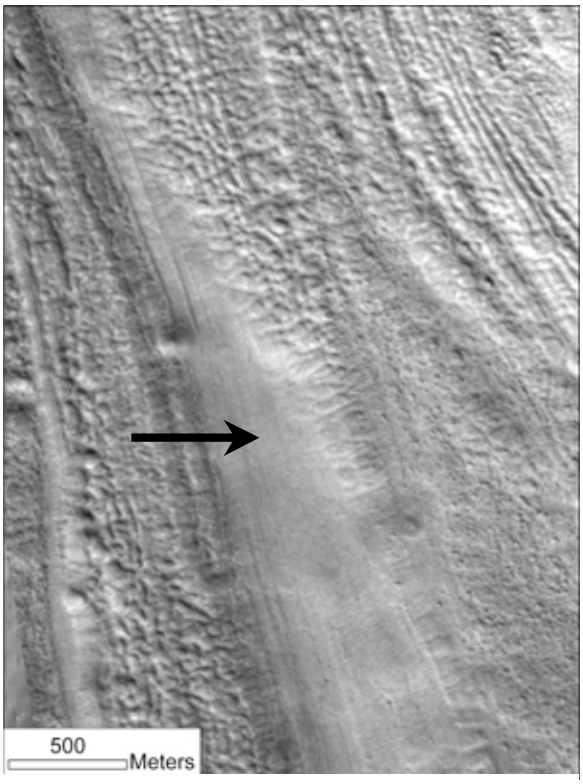

Figure 3 – MOC E1300869, up-valley of the lobe-front in Figure 1. The smooth texture occurs in a topographic low.

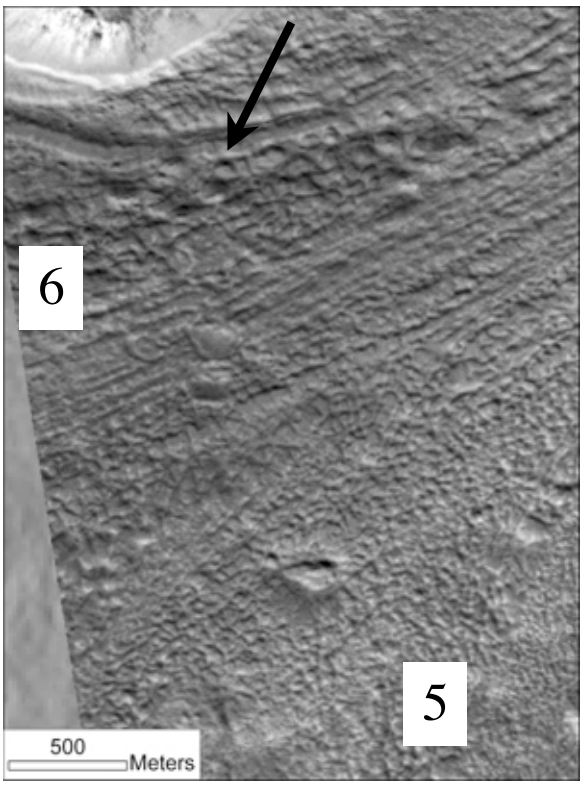

Figure 4 – MOC E1300869, down-valley of the lobe-front, showing the confluence of valley 6 LVF. Note the more degraded pit-and-butte texture of valley 6 LVF compared to valley 5 LVF.