EVIDENCE OF LOW NORTHERN MIDLATITUDE (~33°N) VALLEY GLACIER DEPOSITS ALONG THE DICHOTOMY BOUNDARY: NILOSYRTIS MENSAE, MARS. J. S. Levy¹ and J. W. Head¹, ¹Dept. of Geological Sciences, Brown University, Providence, RI, 02912 (joseph_levy@brown.edu).

Introduction: Lineated valley fill (LVF) and lobate debris aprons (LDA) form in association with fretted terrain and fretted channels in the northern part of Arabia Terra [1-3]. Geologic mapping in the region [4] shows that LVF and LDA represent Amazonian-aged modification of the fretted topography, which itself formed prior to middle Hesperian. Expanding on [1-11], we report observations of LVF in a multiple-trIBUTARY valley system at the eastern end of the Arabia Terra-Terra Sabea portion of the dichotomy boundary, near Nilosyrtis Mensae (68.5°E, 33.5°N (Fig. 1). Questions about LDA/LVF include: 1) the direction of flow in LDA/LVF; 2) the extent and continuity of flow in LVF [5]; 3) relationships between LDA and LVF; and 4) the origins of the LDA/LVF [2-11]. Recent analyses of LVF in northern Arabia Terra [10-11] have shown evidence for local sources of LVF in alcoves in valley walls, down-valley flow, merging of flowlines into trunk valleys, along-valley flow, and termination in lobate deposits; all features similar to valley glacial systems on Earth. The unique physical setting and relatively low latitude of the region under study (Fig. 1) provides information on lobate LVF, the confluence of multiple sources of LVF, potential LVF stratigraphy, stages of evolution of LVF, and LDA/LVF origin. Our observations point towards an improved understanding of the origins of LVF deposits in the context of terrestrial debris-covered glacier analogs [e.g., 12,13] and of their surface textures [9,14].

Description of Nilosyrtis Mensae LDA/LVF: The valley system in Nilosyrtis Mensae (Fig. 1) is composed of four radially linked valleys with a common exit valley, which is in turn linked to the Nilosyrtis Mensae valley system. The valleys are ~5-10 km long, ~5 km wide, and ~1.5 km deep. In the southernmost valley terminal alcove (Fig. 1), an LDA with pitted distal margin is observed extending down-slope at the head of the valley (Fig. 1); this appears superimposed on LVF in the flatter part of this valley floor. We interpret these observations to mean that the most recent deposit is the LDA, but at earlier times, the LDA expanded and deformed into LVF as is seen elsewhere along the dichotomy boundary [e.g., 15-17]. Closely spaced lineations interpreted as convergence of flow material are observed at the juncture of the radially linked valleys (Figs. 1-2). Here flow extending out of valley 2 is compressed by flow emerging from valley 1; this then merges with material from valleys 3 and 4 to form LVF in valley 5. At the main confluence (Figs. 1-2), the surface is characterized by a pit-and-bute texture similar to that described by [9]. A depressed region ~0.5 km wide and oriented N-S may be a region characterized by less debris and more sublimation than the adjacent linear ridges. A relatively fresh 500 m impact crater is visible in this region (Fig. 2, upper right), which shows no signs of distortion, implying cessation of flow in this valley prior to the present. A second group of LDA-like lineated features oriented roughly orthogonal to the exit valley axis (Fig. 2, lower right) is associated with a < 100 m high wall in the valley center. This second LDA texture cross-cuts the primary LVF texture, suggesting a second LDA-forming event on a smaller scale.

The lobate feature dominating LVF in valley 5 (Figs. 1, 3) is ~1 km wide and located axially near the valley center. Along the margin, pit-and-bute textures are oriented largely orthogonal to the rounded lineations that define the lobe; however, the texture becomes non-oriented in the lobe interior [e.g., 9]. Several curved lineations are visible in the lobe interior, suggesting continuity of the lobe structure up-valley of the lobe front. The lobe is slightly sinuous, suggesting flow response to valley topography. Several small (≤500 m) craters and features interpreted as degraded, “oyster shell”-like craters [9] are visible in the LVF along the valley floor in this area.

North of the lobate feature (Figs. 1, 4), the LVF morphology again changes, suggesting the confluence of lobate LVF material from valley 5 with that from valley 6. LVF from valley 6 has larger pits and buttes than that from valley 5. Several <250 m round depressions are visible on the valley 5 LVF, which are interpreted as degraded impact craters, similar to “oyster shell” craters [9].

Summary and Implications: These observations show: 1) the rapid transition from LDA to LVF in small alcove valleys, 2) the processes involved in the confluence of tributaries to produce trunk valley LVF, 3) the development of LDA and LVF at low latitudes (~33°N), and 4) the details of surface texture and crater evolution [e.g., 14].

Fig 1. Area map of the valley system in Nilosyrtis Mensae, (68.5°E, 33.5°N) composed of four radially linked valleys (1-4) and a common exit valley (5), which connects to an adjacent valley (6), before linking with the Nilosyrtis Mensae valley system to the North (towards image top). Boxes delineate areas of interest. 100 m contours.

Fig 2. Confluence of valleys 1-4 as indicated by lineation interaction near Fig. 1. a. A second LDA-like unit roughly orthogonal to the N-S oriented unit is visible to the lower right. MOC E1300869 on MOLA topography.

Fig 3. Lobate LVF feature in valley 5 (Fig.1 b). Orientations of pit-and-butte texture may suggest flow followed by stagnation (e.g. [14]). A smooth depression is visible at the center of the lobe (lower center). MOC E1200869 on MOLA topography.

Fig 4. Confluence of valleys 5 and 6 at Fig. 1. c. Valley 6 LVF is coarser in texture with larger pit-and-butte structures. It is morphologically distinct from the valley 5 LVF, suggesting a similar, but distinct history. MOC E1300869 on MOLA topography with THEMIS V09834018.