LINEATED VALLEY FILL AND LOBATE DEBRIS APRONS IN THE DEUTERONILUS MENSAE REGION, MARS: IMPLICATIONS FOR REGIONAL GLACIATION. A. Kress and J. W. Head, Department of Geological Sciences, Brown University, Providence, RI, 02912 (Ailish_Kress@brown.edu).

Introduction: Mamers Valles is a fretted valley along the dichotomy boundary in the Deuteronilus Mensae region of Mars (Fig. 1). Analyses of Mamers Valles from Viking images [1-2] characterized it as a fretted channel filled with textured terrain. The channel is interpreted to have formed in the Early Hesperian or earlier [3-4], however, the terrain filling the valley is recent, as young as Late Amazonian [5-7]. Depending on the morphology of this terrain, it came to be known as either lineated valley fill (LVF), or lobate debris aprons (LDA). LDA and LVF surround massifs and fill valleys, troughs, and large craters throughout the northern and southern mid-latitudes.

More recent studies have proposed a variety of different models for the formation of LVF and LDA [1-5, 8-9], including 1) debris flow lubricated by interstitial ice, and 2) debris-covered glacier. Here we map and compare both LVF and LDA to assess their mode of origin.

Observations: We find that lobate debris aprons and lineated valley fill represent two endmember morphologies of the same material. We have observed the type morphologies of LDA and LVF as well as deposits that are apparently transitions between the two (Fig. 1, A-F). A typical LDA is lobe-shaped in map view, with lineations generally parallel to the outer lobe-shaped margin and flow direction normal to the massif or valley wall from which it emanates (e.g., Fig. 1, A and B). Typical LVF displays lineations parallel to valley walls and flow direction also parallel to valley walls; flow direction is interpreted by the orientation of lobes from alcoves in valley walls becoming entrained in the LVF (e.g., Fig. 1, E).

Figure 1 C and D show deposits that appear to be intermediate stages between LDA and LVF, having characteristics of both. C displays linear LDA [10], lobes emanating from the walls of Mamers Valles, with internal lineations parallel to the overall lobe shape. In C, in contrast to B, when the lobes meet in the center of the valley, they clearly deform and begin to flow down the local topographic gradient, parallel to the valley walls.

D, in Ismenius Lacus, ~600 km east of Mamers Valles, shows further that LDA lobes from the valley wall meet, deform, and flow down the local topographic gradient until the lobes are indistinguishable from each other, internal lineations and flow direction become parallel to the valley walls, as in LVF.

LVF can also transition back to LDA. F shows LVF from Mamers Valles (~100 km southeast of E) flowing into an old, heavily-degraded crater and forming a deposit that resembles terrestrial piedmont glaciers [10] and that is morphologically the same as the circumferential LDA seen in A.

G and H show two craters that appear to have been emplaced during the formation of the LDA/LVF. The crater in G has impacted into southern Mamers Valles; H shows a crater in LDA in Deuteronilus Mensae, north of Mamers Valles. Ejecta from the crater in G appears to have interacted with the nearby LVF, forming elongate, smooth-floored pits that are continuous with the ejecta deposit on the plateau. The same is true for H, except that further LDA emplacement appears to have erased any sign of ejecta toward the northwest. At the same time, LDA have formed inside both craters, meaning that the craters predates the end of the formation of LDA/LVF.

Discussion and Implications: The continuum of morphologies between LDA and LVF suggests that they have the same mode of origin. Morphological differences occur depending on the degree of topographic 'constriction' by valley walls, with completely unconstricted material forming circumferential LDA and completely constricted material forming LVF.

As Carr [9] noted, topography and slope do change (sometimes drastically) along-strike in Mamers Valles, and LVF and LDA do not form a continuous deposit the whole length of the valley, so it is highly unlikely that the LDA/LVF carved the original valley. In fact it is unlikely that the LDA/LVF were responsible for much of the widening of the valley in its northern parts, as the LVF/LDA deposits are continuous from the ~8-km-wide lower regions to the ~30-km-wide upper regions. The ~180-km-diameter crater that intersects the valley at this location may have been influential in the extreme widening of upper Mamers Valles.

Conclusions: LVF and LDA have the same mode of origin, which is that of the debris-covered glacier, not ice-lubricated debris flows. They are the remnants of an extensive glacial system that once occupied not only Mamers Valles, but also the Deuteronilus-Protonilus region and possibly the whole of North Arabia Terra along the dichotomy boundary, an idea supported by other recent work [11-12], including evidence for the presence of ice-sheets in the northern mid-latitudes during the Amazonian.

References: [1] Squyres S. (1978) *Icarus*, *34*, 600. [2] Lucchitta B. (1984) *JGR*, *89*, B409. [3] Sharp R. (1973) *JGR*, *78*, 4073. [4] McGill G. (2000), *JGR*, *105*, 6945. [5] Head J. W. et al. (2006) *EPSL*, *241*, 663. [6] Kress A. and Head J. W. (2008), *GRL*, *35*, L23206. [7] Kress A. and Head J. W. (2009) *LPSC 40*, this volume. [8] Head J. W. et al. (2006) *GRL*, *33*, L08S03. [9] Carr M. (2001), *JGR*, *106*, 25371. [10] Kress A. et al. (2006), *LPSC 37*, Abstract #1323. [11] Head J. W. and Marchant D. R. (2006), *LPSC 37*, Abstract # 1127. [12] Marchant D. R. and Head J. W. (2008), *LPSC 39*, Abstract # 2097.

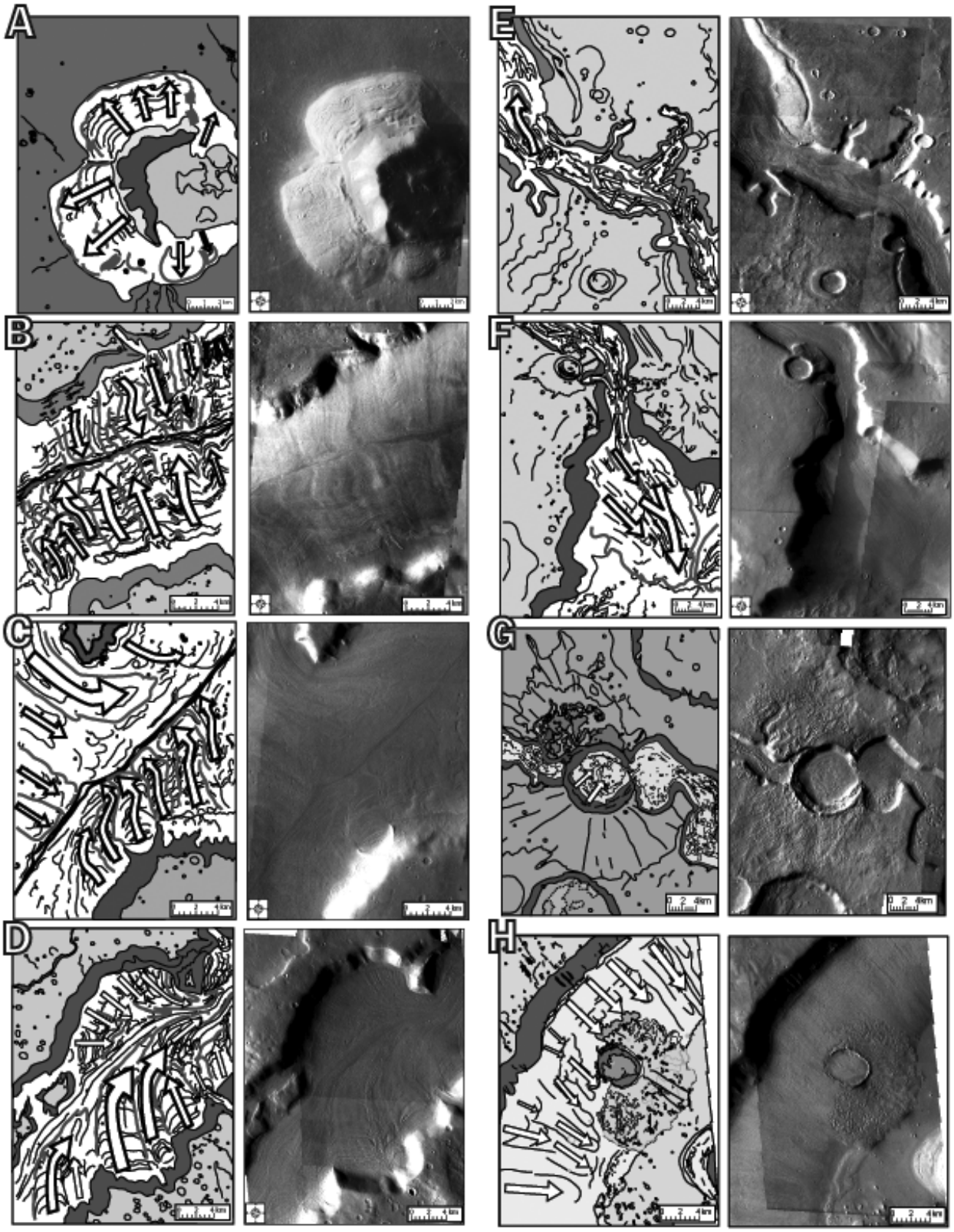

Figure 1. Sketch maps and THEMIS VIS data. (A) Circumferential LDA. (B) Linear LDA. (C) Linear LDA deforming and flowing down the local topographic gradient. (D) Linear LDA forming LVF at the bottleneck in the upper right. (E) LVF. (F) LVF forming a lobe of LDA. (G and H) Craters forming during LVF/LDA formation.