EPSC Abstracts,
Vol. 4, EPSC2009-635, 2009
European Planetary Science Congress,

Preliminary Stratigraphic Assessment of Massif-Debris-Apron Terrain in Western Phlegra Montes, Mars

A. Kress (1), J. W. Head. (1), A. Safaeinili (2), J. Holt (3), J. Plaut (2), L. Posiolova (4), R. Phillips (5), R. Seu (6), and the SHARAD team.

(1) Brown University, Providence, RI 02912 USA, (2) Jet Propulsion Laboratory, Pasadena, CA 91109 USA, (3) University of Texas Institute for Geophysics, Jackson School of Geosciences, University of Texas, Austin, TX 78758 USA, (4) Malin Space Science Systems, San Diego, CA, USA, (5) Planetary Science Directorate, Southwest Research Institute, Boulder, CO 80302 USA, (6) InfoCom, University of Rome, "La Sapienza" 00184 Rome, Italy. (ailish_kress@brown.edu, 401-863-2526).

Introduction

Recent work has been done to re-evaluate the flow features identified in Viking data as lineated valley fill (LVF), lobate debris aprons (LDA), and concentric crater fill (CCF) [1-2]. Morphometric and morphological analyses of image, topography, and radar data [3-5] show evidence for large reservoirs of Amazonian non-polar, nearly pure ice in these deposits. Many studies have focussed on the dichotomy boundary in northern Arabia Terra and Eastern Hellas, but many other locations in the northern and southern mid-latitudes of Mars also contain LVF, LDA, and CCF, including the Phlegra Montes region. SHARAD has recently returned data from this area that strongly supports the hypothesis that LDA are debris-covered glaciers [6].

LDA in the Phlegra Montes Region

The Phlegra Montes range run from the northeast part of the Elysium rise at ~30° N to the northern plains at ~50° N, coincident with the latitudes (35° – 55° [7]) within which LDA, LVF, and CCF are found. LDA deposits occur in the valleys of and on the flanks of these mountains. Safaeinili et al., 2009 [6] focussed on a certain group of massifs ~ 36.5° N, ~162° E that are surrounded by LDA (Fig. 1, Fig. 2).

We began an analysis of the morphological features and stratigraphy of this area in order to understand how it fits into the history of global climate change on Mars. The main morphological units identified are: 1) the massifs, often showing pits and small ridges and usually having several steep-sided alcoves cutting back into them; 2) the marginal, smooth unit, which often shows a small scarp where it abuts the massifs, lineations emanating away from the massifs, and occasionally lobate features that seem continuous with nearby LDA patterns; and 3) LDA (Fig. 1, Fig. 2).

LDA morphology and flow patterns

LDA in the Phlegra Montes region exhibit the same surface characteristics as do LDA deposits in other locations: lineations both along flow and sub-parallel to the lobe margin; ridge-and-trough and pit-and-butte texture; smaller lobes within the larger deposit, of which many can be traced back to source alcoves; and a surface crater population comprised of bowl-shaped and ring-mold craters [2,4,7,8] (Fig. 2).

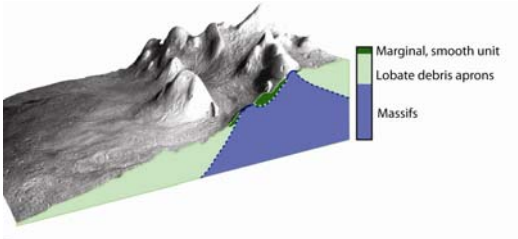

Figure 1: Perspective view of the massifs and the LDA; CTX mosaic overlain on HRSC DTM h1423. Colours show the schematic stratigraphy of this region as inferred from morphology and SHARAD data [6]. 5x vertical exaggeration.

Flow patterns indicate that flow was generally away from the group of massifs (Fig. 1, Fig. 2) but more complex than simply radial outward flow (as in the *circumferential LDA* of [9]). Flow patterns are integrated within the deposit, lobes clearly

EPSC Abstracts,
Vol. 4, EPSC2009-635, 2009
European Planetary Science Congress,

flow around massifs, and some appear to be deflected by other lobes, as is the case in the upper right of Figure 2.

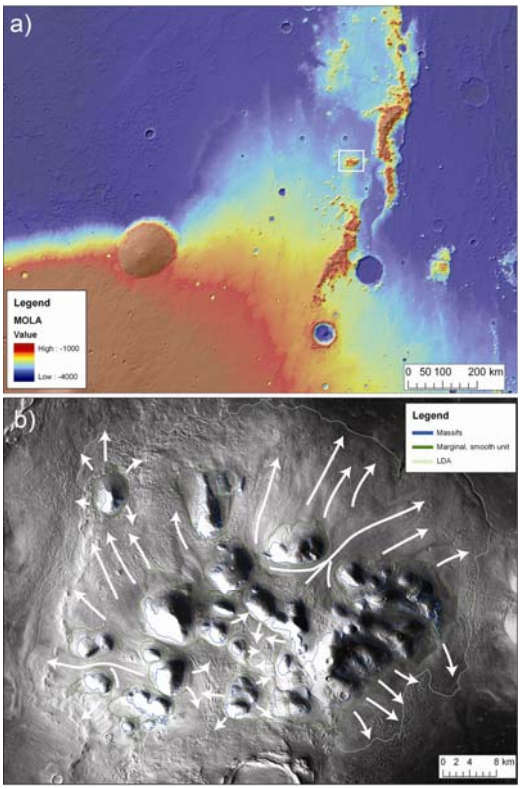

Figure 2: a) The Elysium rise and Phlegra Montes; MOLA gridded data over MOLA-derived hillshade. b) CTX mosaic of a group of massifs near Phlegra Montes and associated LDA. Units are delineated by color: light green is LDA, dark green is the marginal, smooth unit, and dark blue is the massif unit.

Crater populations and implications for climate history

Crater counts on CTX data yield ages of middle-late Amazonian, consistent with LDA deposits along the dichotomy boundary [4,7,8], and this may be an overestimation of the age, as detailed in [10]. Ring-mold craters are interpreted to indicate impacts into nearly pure ice buried below a debris layer [8], consistent with SHARAD data [6]. Estimates on the debris layer thickness, derived from the bowl-shaped crater diameters (as in [8]), gives an average of ~20 m, which roughly the same as the vertical resolution of SHARAD (15 m in free space [11]).

Conclusions

LDA near Phlegra Montes shows integrated flow patterns, typical LDA surface textures, crater populations, and surface age, and SHARAD detections that correspond with debris-covered glaciers [4,12] as a model for LDA formation. Further analysis is warranted in order to understand the stratigraphic relationships of the LDA deposits with several nearby large (10-15 km in diameter) craters, with the pre-existing terrain, and with the global climate history of Mars.

References

[1] Squyres, S. (1978), *Icarus*, 34, 600-613.

[2] Lucchitta, B. (1981), *Icarus*, 45, 264-303.

[3] Li, H. et al. (2005), *Icarus*, 176, 382-394.

[4] Head, J. W. et al. (2006), *EPSL*, 241, 663-671.

[5] Holt, J. et al. (2008), *Science*, 322, 1235-1238.

[6] Safaeinili, A. et al. (2009), *LPSC XL*, #1988.

[7] Mangold, N. (2003), *JGR*, 108, 8021.

[8] Kress, A. and Head, J.W. (2008), *GRL*, 35, L23206.

[9] Kress, A. and Head, J.W. (2009), *LPSC XL*, #1632.

[10] Kress, A. and Head, J. W. (2009), *LPSC XL*, #1379.

[11] Seu, R. et al. (2007), *JGR*, 112, E05S05.

[12] Head et al. (2006), *GRL*, 33, L08S03.

Acknowledgments

The authors would like to thank the MOLA, CTX, SHARAD, and HRSC teams, as well as support from NASA.