APPLICATION OF THEMIS DATA TO AN INVESTIGATION OF A LONG LAVA FLOW IN THE THARSIS MONTES REGION OF MARS.

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Introduction: The Tharsis region of Mars has long been known for the numerous lava flows radiating from the Tharsis Montes shield volcanoes [1,2]. A 480-km-long flow southwest of Ascraeus Mons (Fig. 1) has been the subject of previous investigations using Viking [3] and MGS [4] data. The new data currently being obtained with the Thermal Emission Imaging System (THEMIS) on the Mars Odyssey spacecraft [5] can shed new light on the volcanology of Martian lava flows, illustrated here by two THEMIS images of the previously studied flow near Ascraeus Mons.

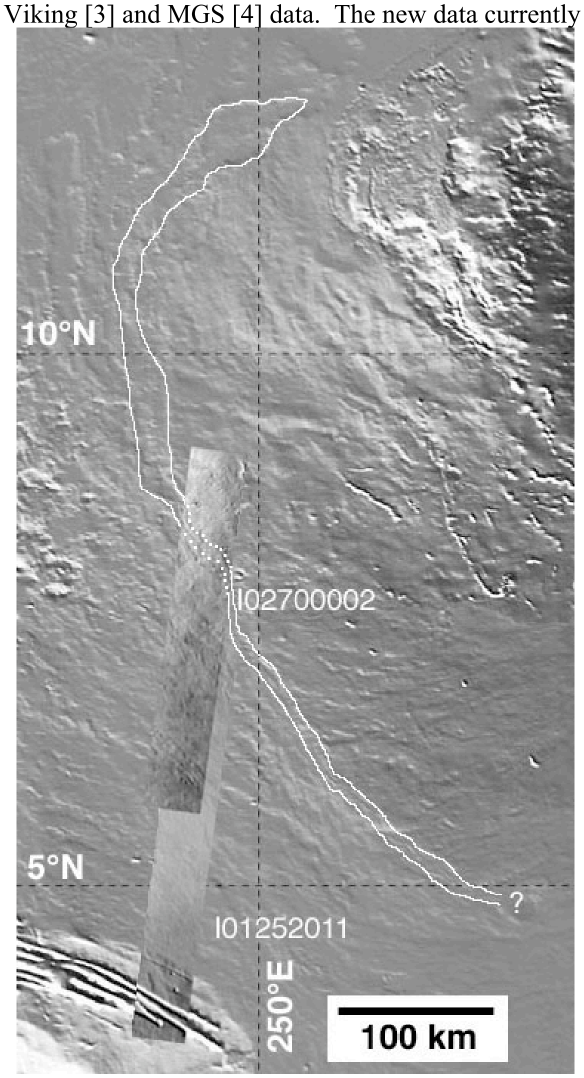

Fig. 1. Flow margin (white line) superposed on portion of MOLA shaded relief map MC-9 [8]. Source of flow (indicated as “?”) is not obvious in the topography. Portions of two THEMIS daytime IR images are registered to topography. Margins of subject flow (in upper image) are indicated by dotted lines; see image in Fig. 2. THEMIS IR images I02700002 (7/24/02, 16.1H) and I01252011 (3/27/02, 15.2H).

Regional Setting: The lava flow examined here is on the western flank of the topographic saddle between the Ascraeus Mons and Pavonis Mons shield volcanoes. The flow extends initially to the northwest, following the slope of the topographic saddle area, but gradually turns north and finally northeast (Fig. 1). There are numerous flows in this region, but the flow under consideration here is superposed on all adjacent features and thus is one of the last effusive events in the area. The trend of the distal portion of the flow was interpreted to indicate the presence of a topographic depression not evident in Viking topography [6]; the presence of this depression is now confirmed by MOLA data [e.g. 7], which can also be shown in shaded relief that make excellent base maps [8] for regional studies. The excellent MOLA data still do not reveal the specific source of the flow, although the source is logically on the west slope of the topographic ridge between Ascraeus and Pavonis Montes. The lava flow lies within the broad low thermal region centered on the Tharsis Montes [9], interpreted to be the result of aeolian dust deposited here to a depth that likely exceeds one meter [10, 11].

THEMIS Data: Three THEMIS images provide insight into the wealth of information available for volcanological studies through these new data. The dust blanketing the Tharsis region has sufficiently uniform albedo and particle size to mask the underlying terrain with a uniform coating that can in fact accentuate subtle topographic features, analogous to the enhanced structural detail revealed in satellite images of snow-covered terrain [12]. Daytime IR images obtained by THEMIS typically have ~0.2 K thermal resolution [5], sufficient to reveal subtle topographic changes that induce small (but measurable) temperature changes through slightly altered solar incidence. Portions of two overlapping daytime IR THEMIS images were mosaiced and then matched to features seen in the MOLA shaded relief map (Fig. 1), providing good control on the positioning of the image data. The northernmost of the two images crosses the lava flow of interest, revealing a wealth of detail not visible in either Viking or MOC images of the area. The THEMIS images show the margin of the flow, and its relationship to surrounding flows and other terrain features, far more clearly than previous imaging data. The central channel of the flow lacks evidence of any constructional process, such as leveed margins. Instead, the morphology of the channel seen in the image is much more suggestive of collapse as the dominant process active in its formation. THEMIS also can obtain images at visual wavelengths coincident with the IR images; Figure 3 is an example of such as VIS image obtained during the same orbit as the IR image in Fig. 2. The 19 m/pixel spatial resolution of the VIS image reveals a significant textural difference between the flow surface and the surrounding terrain. The numerous knobs and blocks visible on the flow surface suggest the dust mantle is insufficient to bury features on the decameter scale, unlike the surrounding terrain. The channel in the VIS image similarly supports the dominance of collapse over constructional processes.

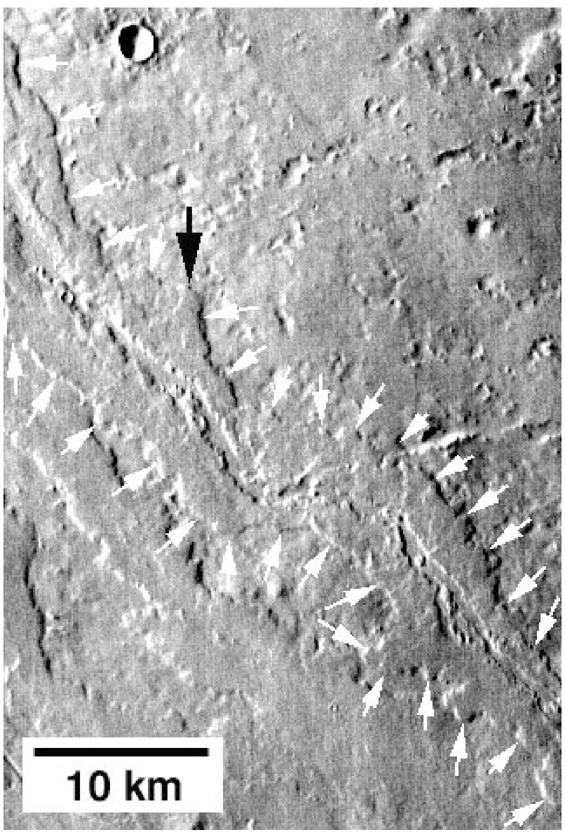

Fig. 2. Portion of THEMIS daytime IR image showing margins of subject flow (white arrows). Central channel of flow does not appear constructional in this image. Black arrow indicates same flow lobe shown in Fig. 3. THEMIS image I02700002 (7/24/02, 16.1H, 100 m/pixel).

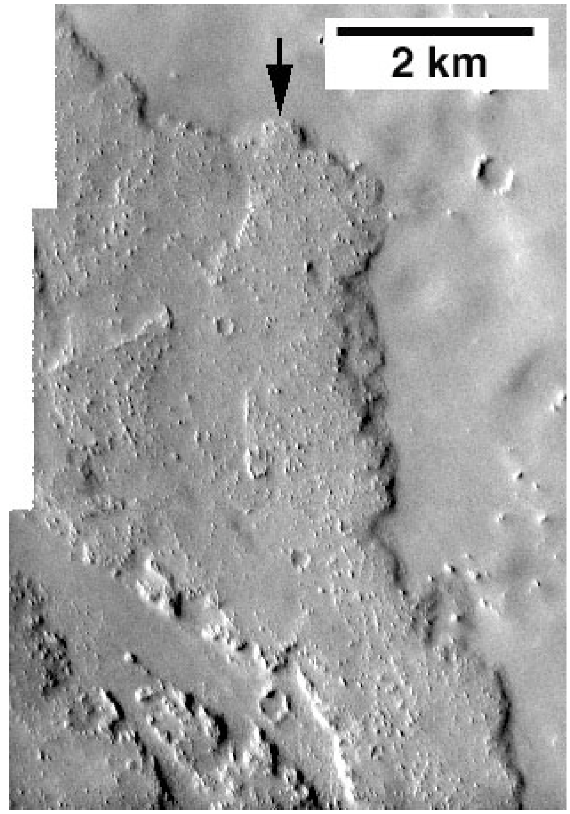

Fig. 3. Portion of THEMIS VIS image showing the same flow lobe (black arrow) indicated in IR image in Fig. 2. Flow surface is mantled, but not to the extent of the surrounding surface. Central channel of flow (lower left) appears more related to collapse than to constructional processes. THEMIS image V02700003 (7/24/02, 16.1H, 19 m/pixel).

Summary: Flow morphology in the dust-covered Tharsis region is revealed in exquisite detail in daytime IR and VIS images from THEMIS, which will aid in documentation and analysis of lava flow features on Mars and improve constraints for volcanic modeling.

References: [1] Carr M.H. et al. (1977) *JGR*, *82*, 3985-4015. [2] Schaber G.G. et al. (1978) *Proc. LPSC 9th*, 3433-3458. [3] Zimbelman J.R. (1998) *JGR, 103*, 27503-27516. [4] Peitersen M.N. et al. (2002) *LPS XXXIII*, Abstract #1026. [5] Christensen P.R. et al. (in review) *Space Sci. Rev.* [6] Zimbelman J.R. (1984) Ph.D. dis., Arizona St. Univ., p. 56. [7] Smith D.E. et al. (1999) *Science, 284(5419),* 1495-1503. [8] MOLA web site, valles.wr.usgs.gov/mcmolashaded. [9] Kieffer H.H. et al. (1977) *JGR, 82*, 4249-4291. [10] Zimbelman J.R. and Kieffer H.H. (1979) *JGR, 84*, 8239-8251. [11] Christensen P.R. (1986) *JGR, 91*, 3533-3545. [12] Sabins F.F. (1978) *Remote Sensing Principles and Interpretation,* W.H. Freeman & Co., p. 107.

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