GEOLOGIC MAPPING APPLICATIONS USING THEMIS DATA FOR THE MEDUSAE FOSSAE FORMATION, MARS. J. R. Zimbelman[1], K. C. Bender[2], and J. C. Harris[2]; [1]CEPS/NASM MRC 315, Smithsonian Institution, Washington, D.C. 20560-0315, jrz@nasm.si.edu; [2]Dept. of Geology, Arizona State Univ., Tempe, AZ 85287-1404, kcbender@asu.edu, harris@east.la.asu.edu.

Introduction: The Medusae Fossae Formation (MFF) is a regionally extensive deposit located along the equator of Mars between roughly 130° and 240° E longitude, the origin of which has stimulated a host of published hypotheses [e.g see 1, 2 for summaries]. A volcanic or aeolian origin appear most consistent with Viking [1] and MGS [2] data, but other hypotheses remain viable and new data, as from the Mars Odyssey spacecraft, is likely to stimulate additional hypotheses of origin [e.g. 3]. NASA is supporting geologic mapping of portions of the MFF deposits [4], but it is now quite clear that this on-going mapping will need considerable revision as data from the Thermal Emission Imaging System (THEMIS) on Mars Odyssey [5] become available. The daytime IR THEMIS images hold particularly strong potential for providing a new base on which geologic mapping can be carried out, as illustrated by the examples discussed here.

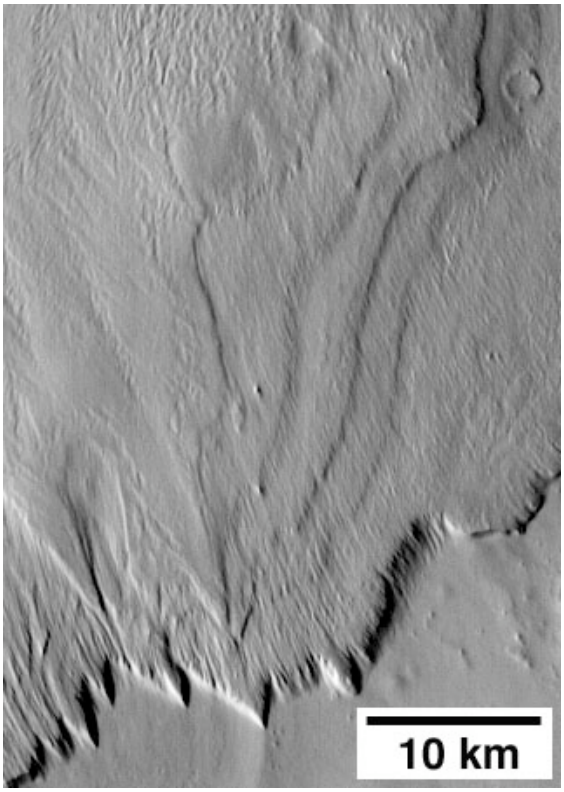

Fig. 1. Multiple layers within MFF, exposed by erosion. Portion of THEMIS daytime IR image I01280001, 3/29/02, L_s 349.9, 15.1H, centered on 6.1°S, 191.0°E.

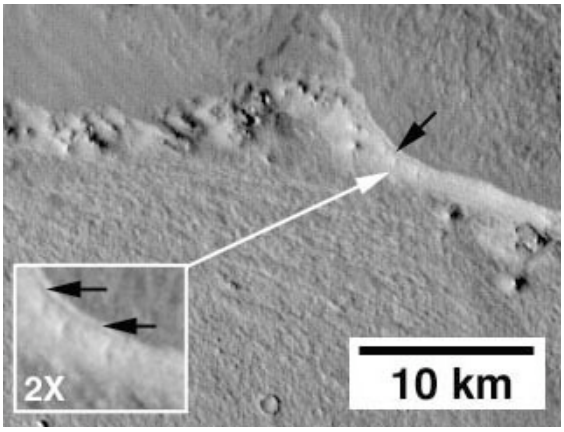

Fig. 2. Competent (cool during day) layer (black arrow) within MFF (see also 2X inset). Portion of THEMIS daytime IR image I01665006, 4/30/02, L_s 5.9, 15.4H, centered on 6.8°N, 218.2°E.

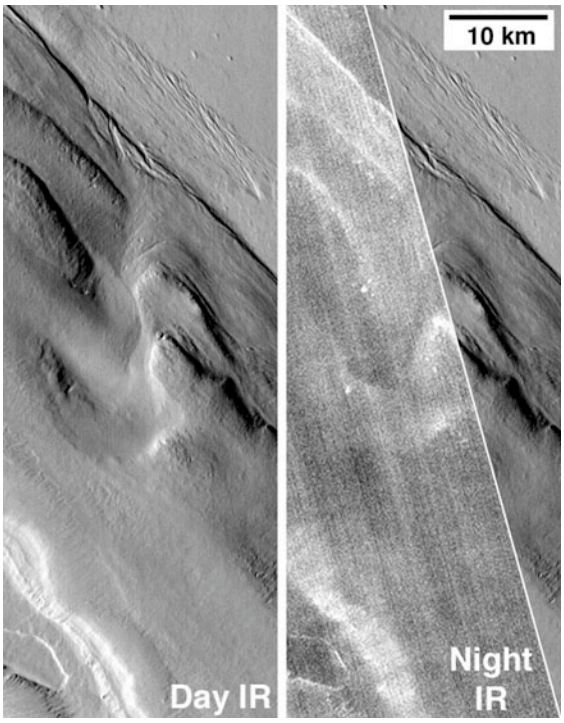

Fig. 3. Gordii Dorsum escarpment. Left: Portion of THEMIS daytime IR image I01690010, 5/2/02, L_s 6.9, 15.4H, centered on 3.1°N, 216.6°E. Right: Nighttime image over daytime image; note that only some erosional scarps are blocky (warm at night). Portion of THEMIS IR image I01859003, 5/16/02, L_s 13.6, 3.5H.

Layers Within MFF: Multiple layers exposed within MFF have been reported in previous studies [6, 7, 2] at a variety of scales. However, limited coverage of good Viking images for a mapping base (at 50 to 30 m/p) has led to considerable portions of the extensive deposit being mapped with a relatively poor Viking image base. The 100 m/pixel IR images of THEMIS cover long strips of the planet within each image. More importantly, the MFF deposits occur within the low thermal inertia region centered on the Tharsis Montes, giving the surface a uniform thermal coating that allows subtle topographic features to be detected as measurable temperature differences [e.g. see 8]. The result is a wonderful new tool for documenting 100-m-scale layering in portions of MFF not imaged well previously (Fig. 1). The thermal images also document variations in competency of internal layers within MFF exposures that face the solar insolation (Fig. 2). Combination of both daytime and nighttime IR images provide additional insight into the competency of the MFF materials (Fig. 3). While the thermal sensitivity is lower at night than during the day, nighttime IR images clearly document warm zones within the cold (low thermal inertia) dusty surface mantling MFF. The warm regions in the night image correlate with some (but not all) of the erosional scarps visible in the day image, which implies that the erosion is not everywhere exposing competent materials; this observation strengthens the likelihood that the majority of MFF deposits remain friable and weakly consolidated, except where discreet competent layers (such as in Fig. 2) may be exposed. This situation is more consistent with a volcanic (welded and non-welded zones) than aeolian origin for the deposits as a whole.

Outliers of MFF: Isolated patches of MFF occur as outliers beyond the margin of the continuous exposures of MFF. A dramatic example is the nearly complete burial of the central peak of the large impact crater Nicholson by MFF deposits, clearly documented in a mosaic of portions of three daytime IR THEMIS images (Fig. 4). The asymmetric erosion patterns around the base of the MFF deposit in Nicholson may record variations in the direction of the strongest winds, or perhaps variations in the competency of the materials. The regional view of the THEMIS daytime images can be enhanced by MOC images that can be placed within the THEMIS regional context. For example, MOC image E02-00308 gives a 4.4 m/pixel view of the southwest margin of the MFF deposit within Nicholson, revealing the presence of decameter-scale layering in the scoured MFF materials, similar to fine layering reported from MOC images of other MFF areas (Fig. 5c of 2]. V-shaped depressions are eroded into the upper surface of both eastern and western margins of the MFF deposits seen in Fig. 4, similar to features described elsewhere within MFF [Fig. 8 of 2]. The outliers may prove to display valuable exposures of MFF that are otherwise buried in the more extensive regions buried under MFF deposits.

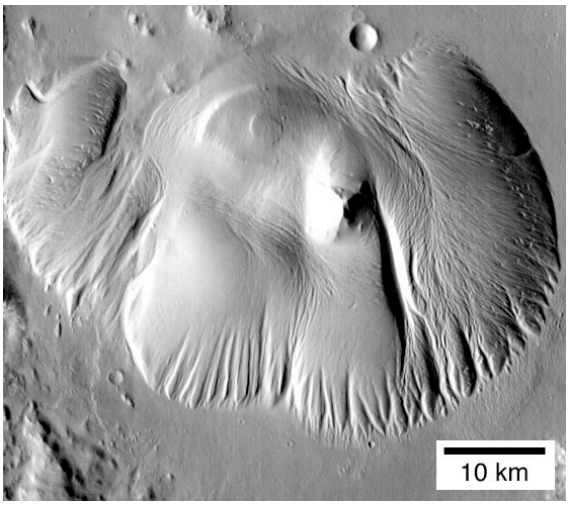

Fig. 4. MFF materials on the central peak of Nicholson crater, centered on 0.2°N, 164.7°E. Mosaic of portions of THEMIS daytime IR images (left to right) I01154002 (3/19/02, L_s 344.5, 15.1H), I01853006 (5/16/02, L_s 13.4, 15.5H), and I01491004 (4/16/02, L_s 358.8, 15.3H).

Summary: THEMIS images are revealing a wealth of new information about the MFF deposits along the Martian equator. The presence of MFF within the Tharsis low thermal inertia region means that the extensive coating of dust gives the MFF surface a uniform thermal characteristic, which allows daytime IR images to reveal subtle topographic variations. This new information will certainly change ideas about MFF, and likely will result in significant revisions being made to geologic maps based on Viking images.

References: [1] Zimbelman J.R. et al. (1997) *LPS XXVIII*, Abstract 1482. [2] Bradley B.A. et al. (2002) *JGR, 107(E8),* 10.1029/2001JE001537. [3] Head J.W. and Kreslavsky M.A. (2002) *Trans. Am Geophys. Union, 83(19)*, S221. [4] Zimbelman J.R. (2001) *Trans. Am Geophys. Union, 82(48)*, F724. [5] Christensen P.R. et al. (in review) *Space Sci. Rev*. [6] Wells G.L. and Zimbelman J.R. (1997) *Arid Zone Geomorphology: Process, Form and Change in Drylands*, 2nd Ed., (D.S.G. Thomas, Ed.), John Wiley, 659-690. [7] Sakimoto S.E.H. et al. (1999) *JGR, 104(E10)*, 24141-24154. [8] Zimbelman J.R. et al. (2003) *LPS XXXIV* (Tharsis lava flow abstract, this volume).

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