GEOLOGIC MAPPING OF THE MEDUSAE FOSSAE FORMATION ON MARS. K. M. Shockey[1], J. R. Zimbelman[1], S. J. Friedmann[2], and R. P. Irwin[1]; [1]Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, MRC 315, 6th St. and Independence Ave. SW, Washington, DC 20560-0315, shockeyk@nasm.si.edu, jrz@nasm.si.edu, Irwinr@nasm.si.edu, [2]University of Maryland Department of Geology, College Park, MD 20742, juliof@geol.umd.edu.

Introduction: To better understand the origins of the Medusae Fossae Formation (MFF), we are mapping the Gordii Dorsum escarpment in the eastern part of MFF between 210° and 218° E longitude. The MFF is a friable, extensive Amazonian deposit that overlies the crustal dichotomy boundary and adjacent lowlands between approximately 130° and 240°E longitude [1], between the Tharsis and Elysium volcanic provinces. Yardangs and pedestal craters attest to considerable aeolian deflation of the MFF in recent geologic time [1,2]. Although diverse explanations for the MFF have been proposed (summarized by [1]), recent work has focused on deposition of loess or ignimbrite by aeolian processes [1,3–6]. The origins of MFF are still controversial; the current mapping should provide new constraints for testing the many hypotheses of origin.

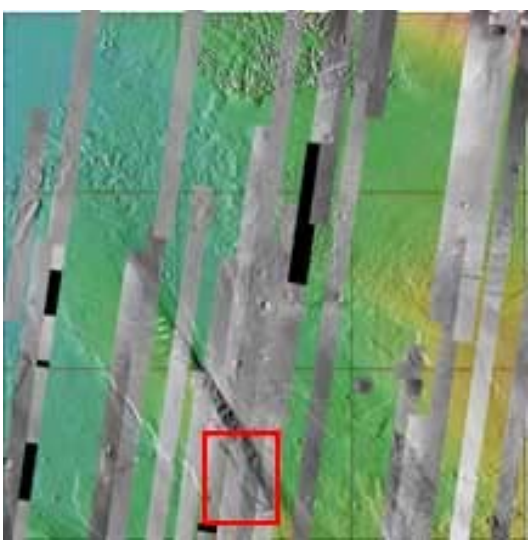

Figure 1: THEMIS daytime IR data (as of December 2003) co-registered with MOLA data for the region from 15°N to the equator and 210° and 225° E longitude. The Gordii Dorsum escarpment is near the bottom of this view. Box shows location of Fig. 2.

Description: Recent planetary missions have provided several data sets that are of great use to mapping projects. The Mars Odyssey Thermal Emission Imaging System (THEMIS) [7,8] operates in the thermal infrared. Owing to the uniformly low thermal inertia of the dust-mantled study area encompassing MFF, the 100 m/pixel daytime THEMIS imaging effectively shows subtle variations in slope along with other properties [7]. The daytime infrared (IR) is the image base for this mapping project, as the nighttime IR imaging predominantly shows the effects of homogeneous thermophysical properties [7]. Gaps in the THEMIS coverage are filled by the 231 m/pixel Mars Orbiter Camera (MOC) Geodesy Campaign Mosaic, which highlights variations in albedo across the study area, and Mars Orbiter Laser Altimeter (MOLA) [9] topography at 430 m/pixel (Fig. 1). Earlier mapping used Viking Orbiter data with only visible wavelengths and a low spatial resolution.

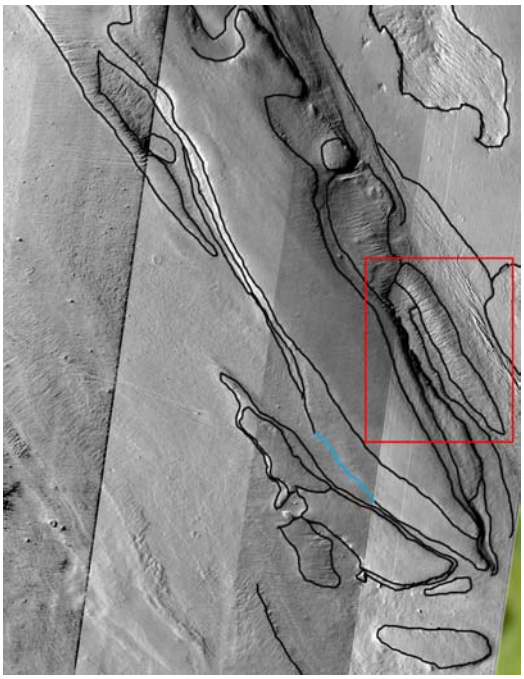

Figure 2: The southern region of Gordii Dorsum with geologic unit boundaries. Black lines are definite borders and blue is approximate. Box shows location of Fig. 3.

Discussion: The origins of the MFF are still controversial, but the three primary hypotheses are [1]: ash flow, ash fall, and aeolianite (i.e., loess). Detailed mapping should provide constraints for evaluating the various alternatives. Ash fall and aeolianite origins may

be difficult to distinguish from one another, unless diagnostic volcanic characteristics can be identified within MFF [4]. However, topographic relief should provide strength constraints that reduce the range of likely MFF materials.

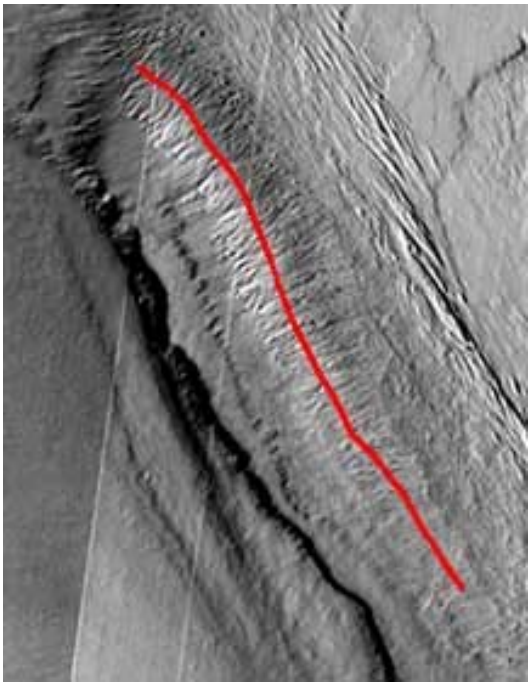

Figure 3: A fold within Gordii Dorsum (indicated by the red line) is revealed in the THEMIS daytime IR data. The fold appears to plunge to the south.

During detailed mapping at Gordii Dorsum (Fig. 2), we discovered compelling evidence for young deformation in the form of faults and folds that deform MFF strata (Fig. 3). A range of structural styles, including normal faulting, fault-propagation folding, and structural relays are present. Of special interest, it appears that some faulting and folding was synchronous with deposition of MFF components, providing constraints on the magnitude and relative timing of deformation. Such evidence includes potential relative age relationships like onlapping and cross-cutting structures and depositional units. This could be *prima facies* evidence of very young faulting and folding at the Martian surface.

Conclusions: The area mapped by Zimbelman [10] from 15° N to 15° S latitude and from 202.5° to 225° E longitude using Viking data is currently being re-mapped using the recent THEMIS data. When this is complete, a comparison will be made between the two maps in order to reformulate previous conclusions drawn on the origins of MFF.

References: [1] Bradley, B.A. et al. (2002) *JGR107*(E8), 10.1029/2001JE001537. [2] Ward A. W. (1979) *JGR*, *84*, 8147–8166. [3] Scott D. H. and Tanaka K. L. (1982) *JGR*, *87*, 1179–1190. [4] Zimbelman J. R. (2003) GSA Abs. Prog. *35*(6) 107-7, 128. [5] Hynek B. M. et al. (2003) *JGR*, *108*(E9), doi: 10.1029/2003JE002062. [6] Head J. W. and Kreslavsky M. A. (2001) Conf. Geophys. Det. Water on Mars, LPI. abst. 7083. [7] Christensen, P.R. et al. (2003) *Science*, 300. [8] http://themis.asu.edu [9] http://ltpwww.gsfc.nasa.gov/tharsis/mola.html [3] [10] Zimbelman, J. R. et al. (2003) *Mappers meeting*.