THE DISTRIBUTION AND DIVERSITY OF LAYERING WITHIN THE MEDUSAE FOSSAE FORMATION. L. Kerber, Laboratoire de Météorologie Dynamique, 4 Place Jussieu, Paris, France (kerber@lmd.jussieu.fr).

Introduction:

The Medusae Fossae Formation (MFF) is a widespread and voluminous formation which covers 2.1 x 10^6 km^2 between 130-230ºE and 12ºS-12ºN [1-3]. As a fine-grained, friable deposit, its surface is dominated by aeolian features such as yardangs [3-6] and a large number of both fresh and indurated transverse aeolian ridges (TARs) [6]. Many hypotheses have been proposed for the formation of the deposit, including ignimbrites, volcanic ash fall, and wind-deposited aeolian loess [7-9]. The deposition of the MFF began at the latest in the Hesperian [10], and, by virtue of its fine-grained nature and gentle emplacement, the MFF may preserve an important record of Martian history, most directly as a result of the burial and exhumation of channels found in its western regions [11]. While layering is not ubiquitous in the MFF, examples of layering of different kinds are geographically widespread (**Fig. 1**). The identification and characterization of this layering is important for three reasons: (1) for determining the mode of formation of the deposit (2) for identifying differences in composition, structure, and erosive state across the deposit, and (3) for identifying places where layering may preserve ancient features. Layering was not seen by the SHARAD (Mars SHAllow RADar sounder) instrument, meaning that any tens-of-meters layers that do exist either do not have high permittivity contrasts or are discontinuous [12]. In order to better document the occurrence of layering within the MFF, we examined 427 High Resolution Imaging Science Experiment (HiRISE) images spread across the formation, during which the occurrence of layering was mapped [13]. HiRISE images were supplemented by Mars Reconnaissance Orbiter Context Imager (CTX), Mars Express High Resolution Stereo Camera (HRSC) and Mars Global Surveyor Mars Orbiter Camera (MOC) images where needed. Here we describe the results of this survey as it relates to the distribution and diversity of layering within the MFF.

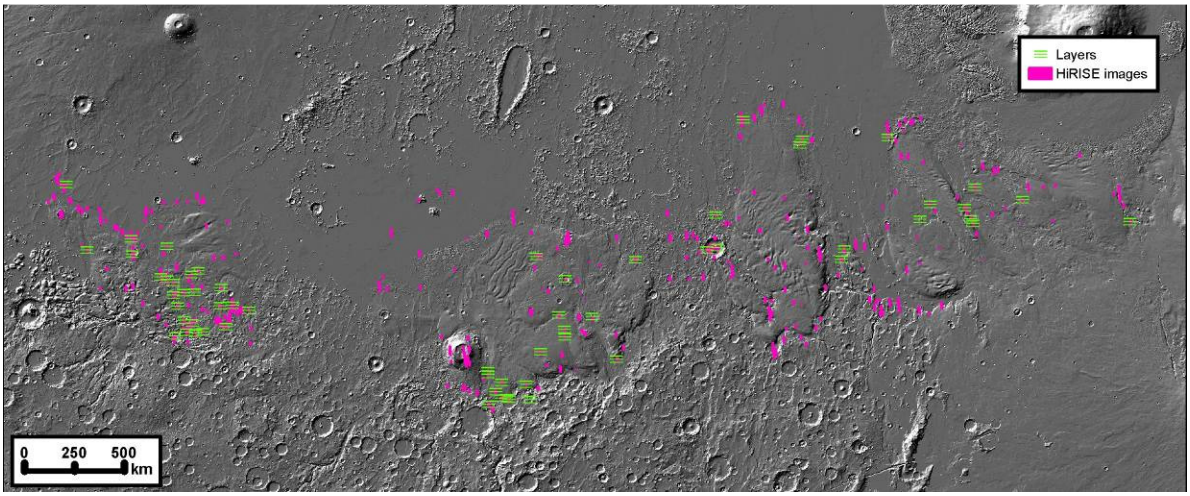

Figure 1. The distribution of visible layers throughout the Medusae Fossae Formation. In the majority of cases there are only one or two massive layers, though in certain areas there are dozens of thin, meter-scale layers. Layers in the MFF are often discontinuous. In the eastern portions of the Medusae Fossae Formation, thick layers of dust lie on top of the formation.

Observations: Layering was observed across the formation, though many HiRISE images showed no evidence for layering, and in others only one or two layer boundaries were apparent in small parts of the scene. Layers are most common in the Western MFF near inverted fluvial channels [11], where they form regular, stair-step benches (**Fig. 2a**). Their shapes in planform depend highly upon topography. Just south of Apollinaris Mons, what appear to be layers form swirling, occasionally intersecting banding, which does not appear to follow topography (**Fig. 2b**). These areas are heavily jointed, with some layer boundaries coincident with joints. In some regions, such as northern Lucus Planum, layered material which appears to be continuous with the MFF actually consists of dust-covered lava layers (**Fig. 2c**).

One exceptional exposure of layering occurs at the edge of Memnonia Planum, where <5 m layers can be

observed in a cliff face (**Fig. 2d**). A capping layer dominated by erosional landforms (top of the frame) masks the layered nature of this deposit, meaning that if the cliff were not present, these layers would not be detected. Finally, in the Eastern MFF, many outcrops are capped with a layer of dusty material, especially where the MFF meets the southern edge of the Olympus Mons aureole (**Fig. 2e**). Aeolian fluting of yardangs often creates pseudo-layers, such as those in **Figure 2e** (bottom half of frame). These can be found throughout the formation and often confuse the identification of true layers. Layers are less commonly seen in the Eastern MFF, but it is possible that they are being obscured by the thick dust mantle. Additional work is needed to distinguish between possible primary layering and layers formed by fluvial and aeolian reworking, which are likely to be more geographically discontinuous.

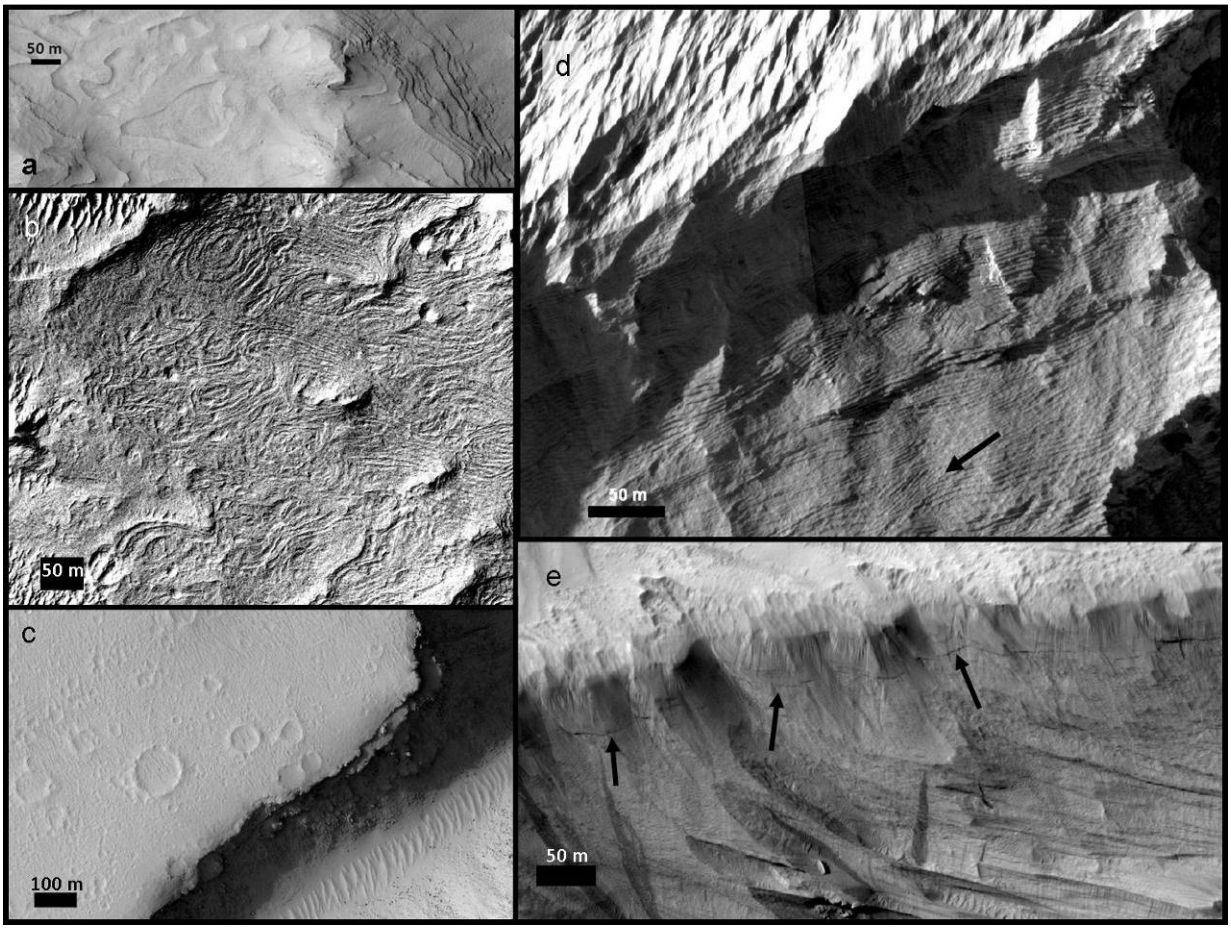

Figure 2. a) Stair-step layers in the Western MFF. These are often associated with inverted fluvial systems, and may be a result of fluvial reworking. b) Galdakao Crater, south of Apollinaris Mons. Unlike the Western MFF layers, the banding visible here is not linked to topography. Bands form circles and teardrops, and frequently cross other bands. c) Dust-covered lava layers in northern Lucus Planum. d) Layers at the edge of Memnonia Planum. Thin, <5 m-scale layers are exposed in a cliff. A black arrow indicates possible cross-bedding. e) In the Eastern MFF, yardangs are capped with a layer of dusty material, in this case more than 50 m thick. Black arrows point to the unconformity separating the MFF and capping dust layer. Portions of HiRISE images PSP_006815_1780, PSP_007816_1665, PSP_010875_1785, ESP_017058_1905, ESP_019617_1705, respectively.

References: [1] Greeley, R., Guest, J. (1987) *USGS Misc. Invest. Ser. Map* I-1802-B. [2] Scott, D.H., Tanaka, K.L. (1986) *US Geol. Surv. Misc. Invest. Ser. Map* I-1802-A. [3] Bradley, B.A. and Sakimoto, S.E.H. (2002) *JGR, 107,* E8. [4] Ward, A.W. (1979) *JGR, B14*, 8147-8166 [5] Zimbelman, J.R. et al. (2010) *Icarus 205*, 198-210. [6] Kerber, L., Head, J.W. (2011) *ESPL 37*, 422-433 [7] Scott, D.H., Tanaka, K.L. (1982) *JGR 87*, 1179-1190. [8] Mandt, K.E., et al. (2008) *JGR 113*, E12011. [9] Kerber, L., et al. (2011) *Icarus 219*, 358-381. [10] Kerber, L. et al. (2010) *Icarus 206*, 669-684. [11] Burr et al. (2009) *Icarus 200*, 52-76. [12] Carter, L.M. et al. (2009) *Icarus 199*, 295-302. [13] Kerber et al. (2012) *3rd Planet. Dunes Work*. Abs. 7016.