GEOLOGIC MAPPING OF WESTERN MEDUSAE FOSSAE FORMATION, MARS (MC 23-NW): REDEFINING UNIT BOUNDARIES AND FEATURES TO REVEAL A HISTORY OF TECTONISM, WIND EROSION, AND EPISODIC WATER FLOW.

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Introduction: Despite agreement among researchers of the relatively young age, abundance of fine-grained surface material, and low number of craters, when compared with the Southern Highlands, the geological processes involved in the creation of the Medusae Fossae Formation (MFF) on Mars remain elusive [1, 2]. Systematic observations of the western MFF using high resolution images provided by the Mars Orbiter Camera (MOC), the Context Camera (CTX), Mars Orbiter Laser Altimeter (MOLA), and the High Resolution Imaging Science Experiment (HiRISE) have permitted the identification of geologic features from which new map contacts were derived. The new unit margins reveal that MFF was much larger than previously reported, and that its landscape includes anticlinal structures, and a wide variety of sinuous ridges. For example, a collection of sinuous ridges located in the MFF Lower Member (Aml) suggest a paleo-delta, another grouping of broad, flat sinuous ridges display interconnecting patterns suggestive of braided streams, while a single sinuous ridge spans more than 300 kilometers across a wide Aml basin. These features suggest a paleoenvironment that includes active tectonism and episodic aqueous water. This report discusses the impetus for the new contact locations, and presents an interpretation of the paleaoenvironment for this portion of the western MFF.

Background: The focus of this study is the MC 23-NW map area within the MFF, which straddles the dichotomy boundary near the equator. The study map is located in the Elysium Planitia region at 0º to 15º S lat. and 135º to 157.5ºE long. (Fig. 1). Map base images were collected from the Thermal Emission Imaging System (THEMIS) global data sets, including MOLA roughness, and USGS base map mosaics of grayscale THEMIS daytime infrared images (TDIR) and MOLA color shaded relief images. Where available, HiRISE images were examined to provide greater detail. HiRISE images are especially useful in identifying groupings of dendritic sinuous ridges (SRs) that are too small to be seen in CTX or MOLA images (Fig. 1), but which exhibit similar morphologies and complimentary orientations to a larger fan-shaped SR (Fig. 3). Collectively these features suggest water flowed into a large basin buried by Aml deposition.

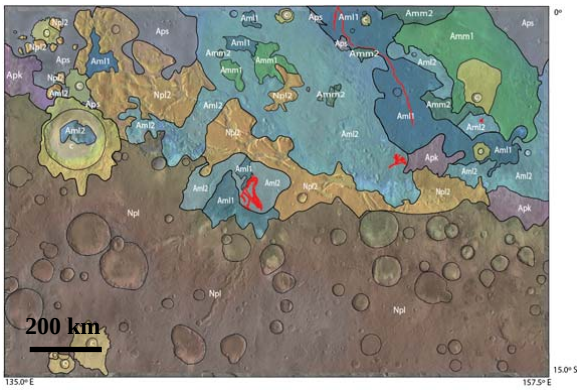

Figure 1. Geologic map of western MFF, MC 23-NW. Special features (red): curved anticline (center); single, elongate SR (NNE); two small Aml2 branching SRs located below the long Aml1 SR, on opposing sides of the basin (east).

MFF Map Contacts: A ubiquitous lack of cratering in the Northern Lowlands makes age dating using crater abundance difficult [3], therefore age determinations for the map units and the features contained within them were interpreted using textural characterization, MOLA topography, and superposition. Previous work identified three MFF components: Lower Member (Aml), Middle Member (Amm), and Upper Member (Amu) [1]. The complexity of the area required expansion of these labels to include numerical designations signifying relative age within closely related units: Aml1, Aml2, Amm1, and Amm2 (blue and green map units respectively). For example, Aml1 is older than, and superposed beneath, Aml2. (Amu is not present within the study area.) Use of these expanded labels in compliment with the high resolution images permitted greater detail than that found in earlier maps [1]. The refined map area constrains the MFF to a substantially larger area than previously reported and thereby aided in the identification of new features related to its formation. Two such features are discussed below.

Anticline: Observed surface textures similar to nearby Aml2 sections suggest the exposed lobate structure at ~ 7.5ºS and 145.0ºE, below the Aeolis Mensae Npl2 fretted channels is located within the Aml2 geologic unit and constrained by Aml1 to the south and west (Fig. 2). MOC images (M1000027 and M1901539) show south to north elevation increases on

a low angle slope of 5-7º. (No data were available for the northernmost portion). Grain textures coarsen upslope in repeating patterns consistent with eroded well-sorted bedding layers. The inclination, curved deformation, and repeating gradational layering suggest a history of tectonic folding and erosion consistent with anticline morphologies.

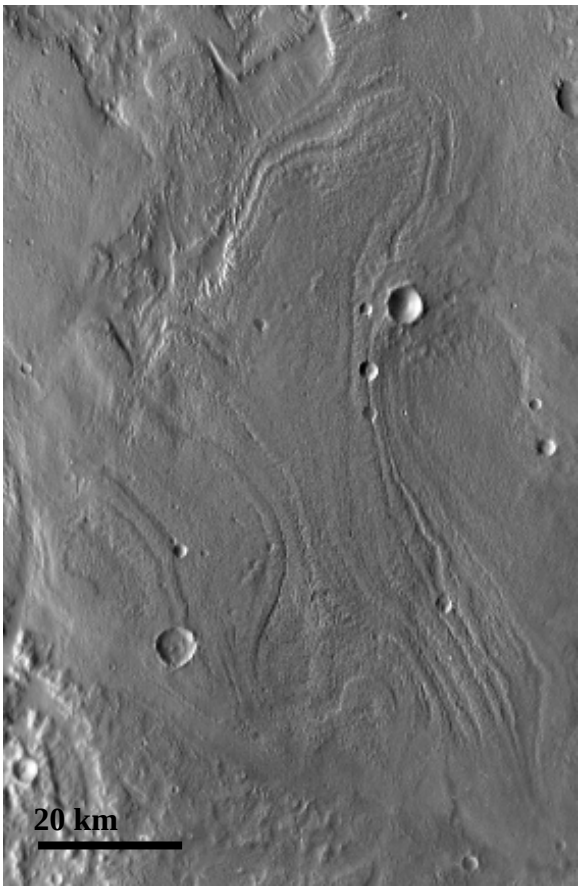

Figure 2. Anticlinal structure located within newly identified Aml2 unit outlier. Subscene ofUSGS TDIR base map mosaic.

Sinuous Ridges: SRs are elongate, positive relief landforms that occur throughout the MFF. The Lower Member, which comprises the largest areal extent and lowest elevation in the revised map area, contains SRs in varying forms, including non-branching and branching or fan deposits, each composed of broad flat and/or rounded ridges [3]. One non-branching SR extends from outside the map area (NNE) for >300 km SE through Aml1 (Fig. 1). Along the western Aml1-Aml2 contact, within the southeasternmost Aml2, is a branching SR with a greater abundance of dendrites closest to the Aml1 contact (Fig. 1, 3). A similar SR fan is located just outside the eastern Aml1-Aml2 contact (Fig. 1). This feature also displays an increase in SR branching closer to Aml1, and overprints broad flat braided SRs downslope. The low elevation of this Aml1 map section, identified using MOLA imaging, correlates well with increasing dendritic landforms at the basin's margins.

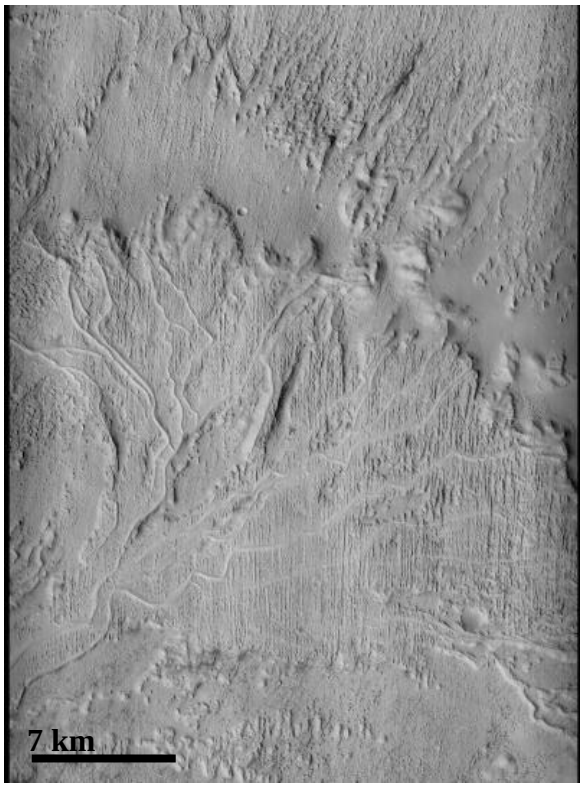

Figure 3. Dendritic sinuous ridges in Aml2 suggest a deltaic environment. Subscene of CTX Frame# P08_004336_1742_XI_05S208W, NASA/JPL/MSSS.

Preliminary Interpretations: The anticlinal structure suggests a history of tectonic activity and geologically recent erosion. The largest Aml1 unit's low elevation, the presence of the singular SR and neighboring SR fans with increased branching toward the Aml1 unit, suggest that the Aml1 was emplaced within a basin with a history of episodic aqueous water.

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References: [1] Scott D.H. and Tanaka K. L. (1986) USGS Map, *I-1802-A*. [2] Bradley B. A. et al. (2002) JGR, 107, E8, 10.1029/2001JE001537. [3] Burr D. et al., in press, Icarus, 10.1016/j.icarus.2008.10.014.