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Massive deposits in the Amazonis Planitia region of Mars, distributed within 12°S to 18°N latitude and 125° to 220°W longitude, have been mapped regionally as the Medusae Fossae Formation (MFF) [1]. They have been subdivided locally into from three [1] to seven [2] separate units. Several hypotheses have been published concerning the possible formation mechanism for these unique deposits [summarized in 3]. Recently four Mars Transverse Mercator (MTM) sheets at 1:500,000 scale were approved by NASA for systematic geologic mapping, with the goal of obtaining constraints on the hypotheses of formation of these materials. Base map materials were only recently received, but here we report on an initial investigation of the excellent Viking images (orbits 462 to 473 of the Survey Mission, with 30-33 m/pixel resolution) available for large portions of the Medusae Fossae materials. Digital processing and mosaicing of selected images reveals remarkable evidence of intense aeolian erosion; the Medusae Fossae materials apparently are extremely friable and easily removed by the wind. Several exhumed surfaces, exposed once MFF materials have been partially to completely stripped away, show apparently pristine morphology of lava flow fronts and impact craters. The preservation of these delicate morphologies after both burial by and exhumation from beneath the MFF place some useful constraints on the physical properties of these materials. Photoclinometry of several partially exhumed impact craters and and erosional scarps of MFF indicate minimum thicknesses of 200-300 m for these materials SE of the Gordii Dorsum feature. Efforts are under way to compare the MFF to the Los Frailes ignimbrite in Bolivia [4] as a test of the ignimbrite hypothesis of origin for the Martian materials.

The several hypotheses proposed for the formation of the enigmatic MFF include ignimbrites [1,2,5], massive accumulations of variably indurated aeolian materials [1,6,7], paleopolar layered deposits emplaced when Mars' rotation axis was at a different position than at present [8], and exhumed transcurrent faulting along the Gordii Dorsum escarpment [9, 10]. Initial analysis of the Viking images does not provide any conclusive evidence for any single hypothesis, but we are optimistic that continued study may provide some stratigraphic constraints that might eliminate some of the hypotheses. Our initial efforts have focused on obtaining thickness constraints for the MFF. Photoclinometric profiles of partially exhumed impact craters indicate that a minimum of 200-300 m of material is preserved within the craters, with smaller amounts preserved closer to the margin of MFF (as compared to fully exhumed units near the eastern side of Gordii Dorsum). It is significant that no evidence of internal layering has yet been noted in our study of the digitally processed Viking data; some hypotheses (e.g., the ignimbrite origin or the paleopolar origin) might be expected to predict that layering of some form could be preserved in MFF. We remain optimistic that the optimal illumination conditions and excellent resolution of the Viking images may yet provide some information on the details of MFF internal organization.

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A parallel effort to the digital processing of Viking images is an assessment of possible details present within the Los Frailes ignimbrite in Bolivia as a means of testing the ignimbrite hypothesis, probably the most widely accepted explanation for MFF at present. A digital mosaic of Landsat TM data of the Los Frailes deposits (at 30 m/pixel resolution) produced by DC provides an excellent basis for comparison with the Viking images of MFF at a similar spatial resolution. In addition, the spectral characteristics of the Los Frailes materials [11] may prove to be a significant remote sensing tool for testing the ignimbrite hypothesis for MFF, if sufficiently dust-free exposures of MFF can be identified for spectroscopic investigation.

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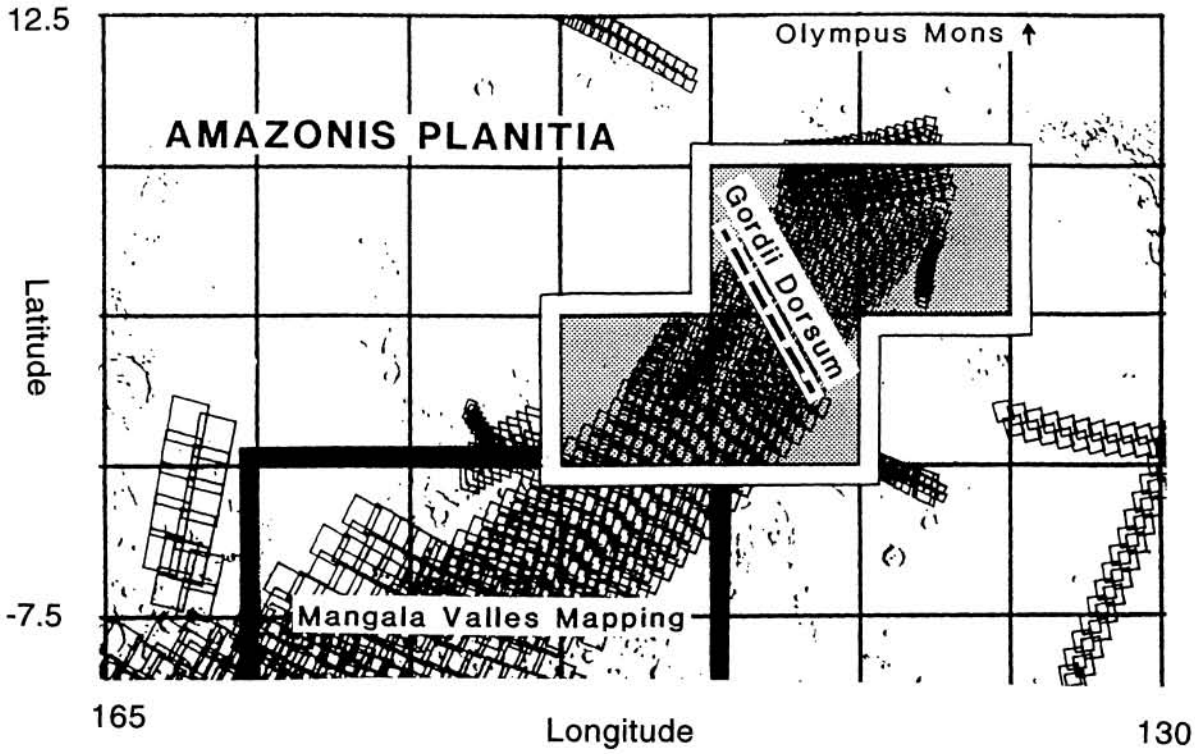

Figure 1. Footprint map of high-resolution Viking Orbiter images of the southeast portion of Amazonis Planitia [12]. Grid is individual MTM sheets. Small squares are individual Viking images with a spatial resolution <50 m/pixel. Heavy black line outlines MTM sheets already mapped as part of an investigation of Mangala Valles. Heavy white line and stippled pattern shows the four MTM sheets that cover part of MFF; the Gordii Dorsum escarpment is indicated by a dashed line.