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Mapping Medusae Fossae Formation materials in the southern highlands of Mars

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The Medusae Fossae Formation (MFF) is an extensive deposit (2.2 x 10^6 km^2, Bradley et al., (2002)) of wind-eroded material of widely debated origin which unconformably overlies a considerable area of the crustal dichotomy boundary on Mars.

The MFF has been mapped into five main outcrops and three geological members according to exposure and stratigraphy and away from the three main lobes are numerous outliers of MFF materials. These have mainly been reported in the northern lowlands regions but few studies have examined the possibility of MFF outliers on high ground south of the dichotomy boundary.

An intensive study of MOC NA images across the Mangala Valles region of Mars has resulted in many observations of materials with morphology strikingly similar to some examples of the MFF. These examples are typified by yardang fields and have a similar patchy and discontinuous nature to materials of the upper member of the MFF. Most have consistent lineation orientations across the wider area, which match the dominant orientation of yardangs in the main MFF outcrops. Furthermore, elevation data shows that the maximum, minimum and mean elevations of these materials are closest to those of the upper member of the MFF.

We therefore conclude that these deposits are MFF outliers and that they probably represent remnant upper member material. We suggest that there might be two possible explanations for these outliers: 1) the MFF had a much greater pre-erosional extent than previously estimated, or 2) Materials from the main outcrops were eroded and then blown south to accrue in the highland areas, where they were subsequently reworked.

We suggest that the topography of the region favours the first option. We outline an “overflowing” layer-cake deposition model, in which layers of sediment stacked up against the dichotomy boundary until they reached the topographic level of the highlands. Further materials (that went on to become upper-member MFF material and outliers) were then deposited across a wider area, including south of the dichotomy boundary. Such an onlap suggests a volcaniclastic origin for the Medusae Fossae Formation materials.