

Erosion, burial, and exhumation at Ganges Mensa, Mars

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Ganges Mensa is a large mesa-like structure located near 311° E, 7.5° S on Mars within the Ganges Chasma. The slopes and surfaces of Ganges Mensa display a variety of morphologies, indicating that units of variable lithology constitute the stratigraphic stack of the mensa as observed by many previous studies. Excellent coverage by the Mars Orbiter Camera (MOC) [1, 2], the Mars Orbital Laser Altimeter (MOLA) [3, 4], and the Thermal Emission Imaging System (THEMIS) [5] shows that almost all surfaces on Ganges Mensa are heavily eroded and that there is evidence for burial and later exhumation of surfaces.

Aeolian erosion

It has been suspected that the fluted features observed on the flanks of Ganges Mensa were yardangs for some time [6], and inspection with MOC and THEMIS images indicates that these features have the inverted boat-hull shape and other characteristics indicative of yardangs (Fig. 1). The wind has left these ubiquitous yardang forms hundreds of meters long and meters to tens of meters high carved into the Ganges Mensa surface. However, it has also excavated large yardang forms out of morphologic units hundreds of meters thick, most notably on the north face of Ganges Mensa.

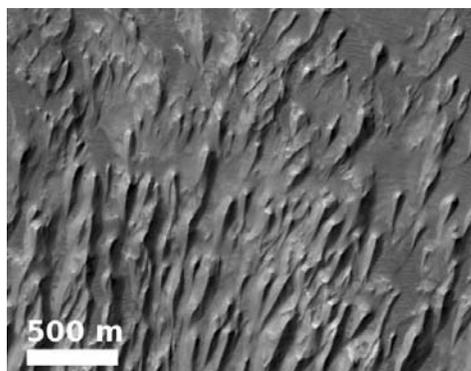


Figure 1: A variety of yardang forms on the south flank of Ganges Mensa. Portion of MOC image E02/00266.

There is a resistant layered unit at the summit of Ganges Mensa acting as an erosional cap. However, the unit stratigraphically beneath it shows examples of yardang forms, indicating that the resistant unit is being undermined by aeolian erosion of the weaker unit and was once more extensive.

Facies change due to erosional incision

On the southwestern flank of the mensa there is a resistant layered unit which crops out and forms a locally steeper section. This unit is prominent at the southwestern toe of the mensa (Fig. 4), but it becomes more difficult to discern farther east along the south face (Fig. 2).

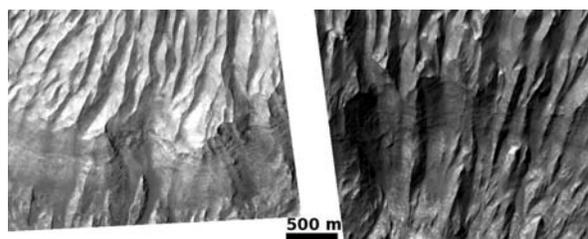


Figure 2: Left image (portion of MOC image E16/01071) shows prominent resistant unit. Right image (portion of MOC image E02/00266) shows deeper yardang erosion, and less distinction between units.

The more deeply incised yardang forms in MOC image E02/00266 show that aeolian erosion has been more severe here than farther east. The boundaries between the resistant unit and the units above and below are more difficult to discern as yardang forms cut across the unit boundaries. While the layered unit is more resistant than the surrounding units, the difference in strength cannot be too great, or the yardang forms would not cut across the unit boundaries so smoothly.

In places where the incision of the yardang forms is deeper, it can be very difficult to pick out the unit of more resistant layers. This is not necessarily because the unit pinches out, but because the overprinting of the erosion is masking the clear delineation of these morphologic units.

Burial and exhumation

At the northeastern toe of the mensa there is a 4 km diameter impact crater (Fig. 3). This crater indicates that the mensa once extended 10 or more kilometers eastwards. Its proximal ejecta armored that material and prevented it from eroding, leaving the mesa east of the crater as a marker of the previous extent of Ganges Mensa.

At the southwestern toe of the mensa there is a large circular feature about 8 km in diameter. Traditionally, this feature and its target rock were not interpreted as part of the mensa. However, inspection (Fig. 4) reveals

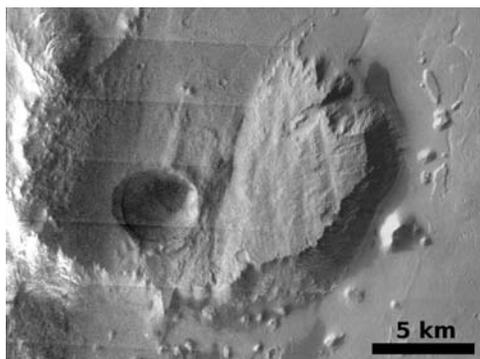


Figure 3: Proximal ejecta of this crater armors the underlying material against erosion. Mosaic of portions of THEMIS images V06631001 and V10962001.

that the rock surrounding the southern part of the crater extends underneath the southwestern toe of the mensa.

This crater shows evidence for being buried and subsequently exhumed. The northern rim shows that the interior of the crater is full of material whereas the flank has been excavated. The southern rim does not appear very circular and may still be largely buried.

The southern face of Ganges Mensa also shows evidence for burial and exhumation. Figure 5 shows a boundary between morphological units. To the north there are well-developed yardangs and a slightly steeper overall slope (based on MOLA data) than the southern section which only shows triangular facets pointing down slope that may be nascent yardangs. The boundary is only morphologic, however, as I think that both units are the same rock, but the northern section has been ex-

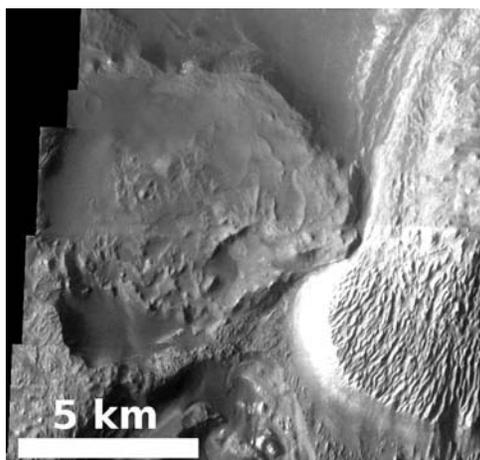


Figure 4: Mosaic of portions of THEMIS images V08154001 and V10388001.

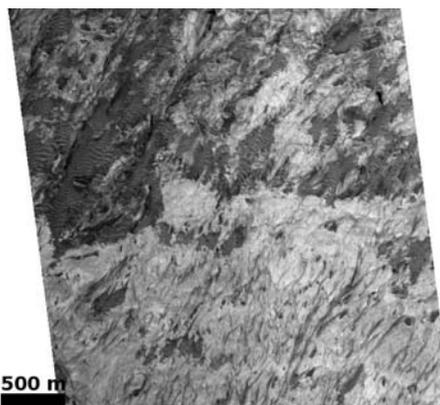


Figure 5: North half has better-formed yardangs and inter-yardang dark material deposits, while south half is less eroded. Portion of MOC image E10/04814.

posed to more aeolian erosion than the southern section, which may have been protected by a now-removed cover.

Conclusions

These observations indicate that Ganges Mensa is not a primary depositional feature, but has been heavily eroded. It once had a much greater areal and volumetric extent, unfortunately, it is difficult to determine those original dimensions. This, and the evidence for burial and exhumation on the mensa indicate that this feature may have been present in Ganges Chasma for a long period of time, long enough to be acted on by the same forces that erode, bury, and exhume terrain elsewhere on Mars.

References

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