PUTATIVE WATER-RELATED FEATURES: CYDONIA MENSAE AND UTOPIA PLANITIA, MARS. E. M. McGowan and G. E. McGill, Department of Geosciences, University of Massachusetts, Amherst, MA 01003.
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Introduction: The northern hemisphere of Mars is topographically low, and consists mainly of relatively smooth plains of low relief. These northern lowlands are separated from the southern highlands by a dichotomy, in places consisting of a scarp as high as 6 km, in other places by a gradation from lowlands to highlands. In two locations the dichotomy is totally obscured by the Tharsis rise, a volcanic complex that covers approximately $1/6^{th}$ of the planet, and by the Isidis impact basin with a diameter of 1500 km. The northern lowlands contain a wide range of features believed by many to be water-related [1-27]. At two locations adjacent to the dichotomy boundary we have found similar spatial relationships among three of these features: pitted cones [5, 9, 26], giant polygonal terrain [8, 29], and putative shorelines [12-13, 22].

Pitted cones are among the most pervasive landforms in the northern plains. Within the population of pitted cones various morphologies (domes, cones, and pits [5, 23, 25]), and sizes (~800 m to ~25 m [5, 9, 26]) exist. The morphological variety of pitted cones gives rise to several interpretations [5, 9, 26, 21] of their origins.

The giant polygons range from 2-23 km across and are defined by bounding troughs 5-7.5 km wide [8, 29-30] making them larger than any polygons found on Earth. Several mechanisms for giant polygon formation have been suggested [8, 29, 30, 14, 10, 23] however modeling favors differential compaction as it can be scaled up to produce the size of the giant polygons found on Mars [23].

Putative shorelines on Mars have been the subject of debate since Parker *et al.* [12] proposed their existence. Using Viking imagery, areas where lowland plains units embay canyons along the dichotomy boundary were mapped as Contact 1 and Contact 2, later named Deuteronilus and Arabia putative shorelines [13]. Putative shoreline features (such as beach ridges and wave terraces) were also identified [12].

Methodology: The locations of pitted cones, giant polygons, and putative shorelines in both Cydonia Mensae and Utopia Planitia were digitized into a GIS database. In Cydonia Mensae the primary data source for pitted cone and giant polygon locations was the 1:1,000,000 geologic map of Cydonia Mensae-Southern Acidalia [28]. For the location of the Deuteronilus putative shoreline in the Cydonia Mensae region Webb's [22] contact A was used (an update of the Deuteronilus shoreline attained by using higher resolution Mars Orbiter Camera imagery). In Utopia Planitia a Themis Daytime IR image mosaic (100 m/pixel) [31] was used to digitize the locations of the pitted cones and the giant polygons. The Deuteronilus putative shoreline in Utopia Planitia was digitized from unpublished images provided by Timothy Parker. ARCMAP, a GIS program, was used to create maps of the locations of pitted cones, giant polygons, and putative shorelines in Cydonia Mensae and Utopia Planitia.

Observations: In Cydonia Mensae the dichotomy boundary is gradational. Extending into the lowlands is an east/west knobby ridge surrounded by contact A (Deuteronilus putative shoreline) [22]. South of this ridge, next to the putative shoreline, is an area containing a high density of pitted cones. To the north of the knobby ridge and the putative shoreline, at a lower elevation than the pitted cones, is a well-defined area of giant polygonal terrain. This relationship between elevation and the locations of the putative shoreline, pitted cones, and giant polygonal terrain (Fig. 1) is intriguing particularly because we find the same relationship at a different average elevation in Utopia Planitia.

The dichotomy boundary at Utopia Planitia is partially obscured by Isidis Basin, a giant impact crater. Here the dichotomy boundary is considered to be between Utopia Basin and Isidis Basin. The two basins are separated by a high area coinciding with the remnant of the outer ring of Isidis Basin [32]. On the Utopia side of this divide is a section of the Deuteronilus putative shoreline. Topographically below this, toward Utopia Basin's center, is an area containing a high density of pitted cones and topographically below that is well-defined giant polygonal terrain (Fig. 1).

Morphologically Cydonia Mensae and Utopia Planitia are very different. Cydonia Mensae is located adjacent to a section of the dichotomy boundary that is well defined and where many knobs and mesas exist. In contrast, the area between Isidis Basin and Utopia Basin is an area not well defined as part of the dichotomy boundary, owing to the creation of the Isidis Basin. What Cydonia Mensae and Utopia Planitia do have in common is the unusual spatial relationship between the three features discussed above (putative shorelines, pitted cones, and giant polygonal terrain). A relationship that so far is not found anywhere else on Mars. Although pitted cones and giant polygons are found extensively in the northern lowlands, they are not found at the densities or at the degree of development that they are in the study areas.

Conclusions: The similarities of the relationship between elevations of the pitted cones, giant polygons, and putative shorelines in these two areas may be more than coincidence. Subaqueous deposition of saturated sediment could have resulted in mud volcanism at both Cydonia Mensae and Utopia Planitia. The only requirement for the initiation of mud volcanism is a density inversion, which can be accomplished by rapid deposition of saturated sediment [33]. It is possible that this type of event occurred in both locations. In Cydonia Mensae the sediment source could have been the adjacent highlands where outflow channels debouch into the area of pitted cones. In Utopia Planitia the pitted cones and giant polygons occupy an arcuate-shaped area centered below the boundary between Utopia and Isidis Basins. Topographic profiles extending from the highlands into the area of pitted cones in Utopia Planitia show significant slope for this type of rapid sedimentation to occur.

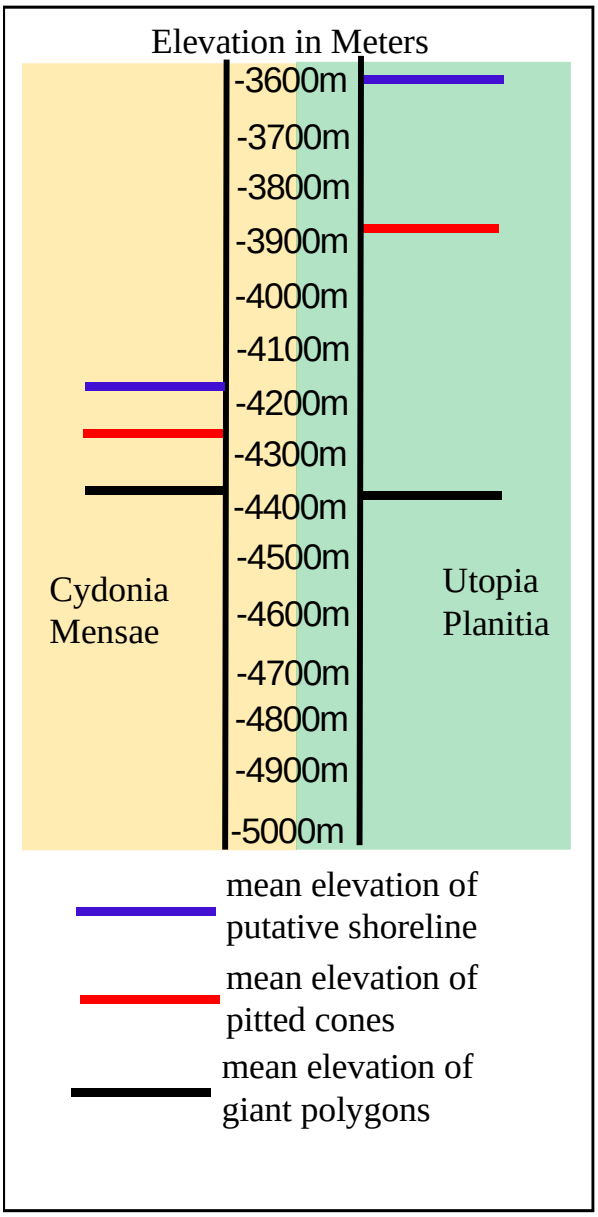

Figure 1: Mean elevations of the putative shoreline, pitted cones, and giant polygons in both Cydonia Mensae and Utopia Planitia. There is a marked difference between the ranges of the mean elevations of the three features in the two areas. This difference is due to the larger size and steeper slope of the area occupied by these features in Utopia Plaintia.

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