ARIADNES-GORGONUM KNOB FIELDS OF NORTH-WESTERN TERRA SIRENUM, MARS.

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Introduction: Fields of knobs and small mesas outcrop principally in five adjacent basins (**Fig. 1**) in northwestern Terra Sirenum (~32-43°S, 166-192°W). Several of these knob fields (the largest) have names. East to west they are: Gorgonum Chaos, Atlantis Chaos, and Ariadnes Colles. These three largest knob fields are on order of 200 km across and are roughly equant but with very irregular boundaries in plan view (e.g., **Fig. 2**). There are several smaller knob fields in smaller nearby basins; some as small as 20 km across. Knob material, where unmantled, is relatively brighter than its surroundings.

The largest individual knobs are almost invariably mesas with typical plan dimensions of ~10 km and relief > 200 m. Knob profiles transition from mesas to rounded mounds with decreasing size. Individual knobs range in size down to ~100 m in plan view and relief < 10 m where seen on some MOC NA images.

Discussion: Rather than start with hypothesizing how the knobs formed, we will propose two alternative mechanisms for their present state of erosion. Our argument that they are indeed eroded is based on several lines of evidence. The overall pattern of the knobs in a given knob field indicates that there has been no relative lateral movement among knobs. As was noted, smaller knobs are rounded and lower relative to larger, generally mesa-forming knobs. These larger mesa-knobs tend to be found in the middle of knob fields and knobs are generally more closely spaced near the middle of knob fields, which is consistent with knob material once being more continuous, extensive and thicker near the center. In MOC NA images (see stereo-pair of M0204149 and E1104499) some bounding scarps of some knobs exhibit evidence of hectometer-scale retreat from the dark, smooth inter-knob material, resulting in a ~10 m deep moat or knob-facing scarp along the contact (black arrows in **Fig. 3**).

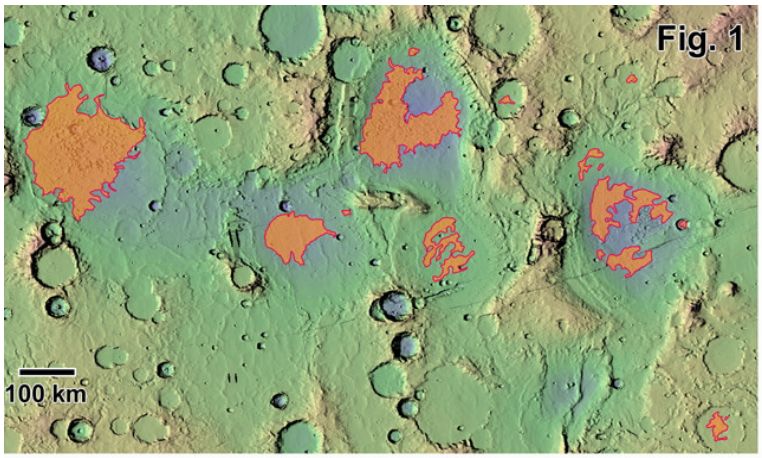
Our first hypothesis is that the knobs have been eroded by wind abrasion and plucking of structurally controlled lines or zones of weakness. The angular to faceted outlines of the larger knobs implies an original structural fabric. Erosion of the knobs has not produced obvious debris along their scarp bases (except for some limited, recent, small-scale or "Malin & Edgett-style" gullying, implying that the material, once eroded, is fine grained enough to be moved by the wind. The absence of bright dunes near the knobs may mean that the eroded material is smaller than sand-sized. The presence of "moats" along some knob scarp bases is evidence that the latest erosion has recently occurred, and thus almost certainly involves the wind. If the wind has dominated the erosion of knob material, it hasn't resulted in a preferential orientation of grooves or of yardang-like features.

Alternatively, the bulk of knob erosion could be the consequence of dissolution weathering, either subaerially or subaqueously. In this scenario, seeping water has exploited the structural fabric of the knob material, causing it to disaggregate or dissolve and thus be susceptible to removal by either wind or water. If dissolution took place under water, it would explain the missing material, but the solutes would presumably be redeposited when the lake evaporated (for which there is no evidence). If under air, the disaggregated material would have to be fine enough to be removed by the wind. Subaerial dissolution has the advantage that the flow gradient in the joint or fracture zones would likely be greater than if percolation through fractures was occurring under water, due to the topographically low position of the knobby terrain. Dike-like features are commonly seen in MOC NA images of knobs (white arrows in **Fig. 3**), which might indicate that cement has been mobilized and moved through fractures, resulting in a differential resistance to recent erosion.

More speculative is our thinking on knob material origin. We note that the knob fields largely occur within five adjacent basins and within a restricted elevation range. Thus knob-material's restricted occurrence implies that it was emplaced in a (or as a) medium that was limited in areal extent and possibly under a strong gravity-control, such as a fluid. If this material is volcanic then its susceptibility to modern wind erosion tends to disfavor emplacement by molten lava flows but doesn't entirely rule out a subaerial pyroclastic density flow that didn't significantly weld after emplacement. However, this argument is weakened by the absence of evidence for volcanic activity in the region. If the knob material was deposited in water, then its composition could either be fine-grained clastic lacustrine material or precipitates (evaporites). Such materials on Earth are relatively unindurated. All but one very small knob field occurs within and below the 1100 m high-stand of a lake proposed by Irwin *et al* [1]. The single exception is located in an isolated

crater floor just SE of this putative lake and at a few 100 m above its reported high-stand. If the knob material was indeed an evaporite, which would be consistent with its relative brightness, a good candidate material would be halite. Halite is both a very common precipitate and is spectrally featureless in the near and mid IR. If it is halite, then the apparent absence of other precipitates implies that the less soluble minerals that would be expected from a basalt-derived brine [e.g., 2, 3] were removed elsewhere or were precipitated first and are still buried.

References: [1] Irwin, R.P. *et al.* (2002) *Science*, *296*, 2209-2212. [2] Catling, D.C. (1999) *JGR*, *104*, 16453-16469. [3] Bullock, M.A., Moore, J.M., Mellon, M.T. (2003). *Icarus*, in press.



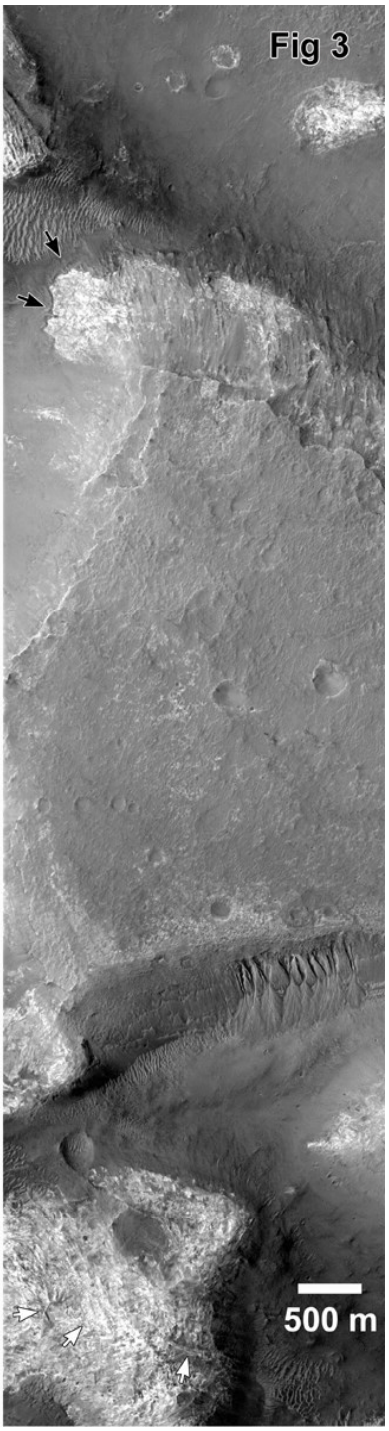


Fig. 1. MOLA-derived topographic map of the Ariadnes-Gorgonum Knob Fields (shown in Orange) of North-Western Terra Sirenum. The area covers 32-43°S, 166-192°W.

Fig. 2. MOC WA image mosaic of Ariadnes Colles, the W-most field in Fig 1.

Fig 3. MOC NA image E11-04498, centered at 34.70°S, 187.96°W, within the Ariadnes Colles knob field of individual knobs. The largest knob is a small mesa. Black arrows point to knob-facing scarp at knob material contact. White arrows point to small linear ridges crisscrossing an eroded knob in the S of this image.