THE CURIOUS SHORELINES OF GORGONUM CHAOS. A. D. Howard[1] and J. M. Moore[2], [1]Department of Environmental Sciences, University of Virginia, Charlottesville, VA 22904 (ah6p@virginia.edu), [2]NASA Ames Research Center, MS 245-3, Moffett Field, CA 94035 (jmoore@mail.arc.nasa.gov).

Introduction: Level, bench-like platforms in the interior of the Gorgonum Chaos basin appear to be shorelines associated with an ancient lake. These shorelines, however, seem to lack the typical features of shorelines associated with wave and current transport and erosion, such as crescentic embayments, spits, barrier islands, and wave-cut cliffs. Rather, the lake-facing platform edges are commonly rounded and cumulate in planform, often evenly encircling presumed islands. We interpret these shorelines to have been formed by outward growth in a quiescent environment, possibly in ice-covered bodies of water and possibly, in part, as chemical precipitates.

Gorgonum Chaos: The Gorgonum Chaos basin is an ancient, highly degraded 220-km diameter basin centered at about 37ºS and 173ºW. The basin itself lacks a well-defined rim, and probably was created through erosional integration of at least three impact basins that were subsequently mantled by thick airfall deposits during or prior to the earliest Noachian [1,2]. This basin, together with the nearby Atlantis, Newton, and Ariadnes basins have been suggested to have hosted deep lakes during part or most of the Noahian [3], and it has been suggested that at least once the lakes were deep enough to have formed an integrated basin overflowing to form Ma'adim Valles [4]. The edges of these basins exhibit linear features that have been interpreted as possible shorelines [3]. The present abstract focuses, however, on bench-like features at the bottom of the Gorgonum Chaos basin that appear to have been formed in association with a post-Noachian lake. The Gorgonum Basin is shown in Figure 1, with the general location of the post-Noachian lake outlined in cyan.

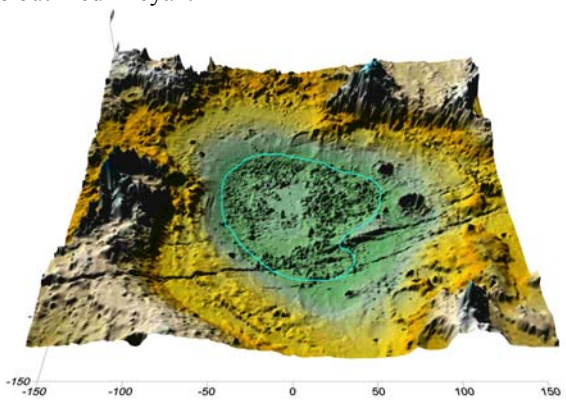

Fig. 1. Perspective view of the Gorgonum basin, looking north.

The center of the concave basin is partially occupied by the knobby "chaos". These are generally flat-topped mesas that appear at one time to have been a continuous deposit that has been dissected into isolated mesas along linear trends. We have interpreted such deposits in this and other basins in the region to be lake-related deposits, possibly evaporates that have been partially dissolved [5]. These deposits were emplaced and eroded prior to the features discussed here.

Shoreline Features: The center of Gorgonum basin is relatively free of chaos knobs (Fig. 1) and is a relatively level plain at an elevation of about -350 to -400 m. This central depression is ringed by benches that rise abruptly to an elevation of about -300 to -310 m (Fig. 2).

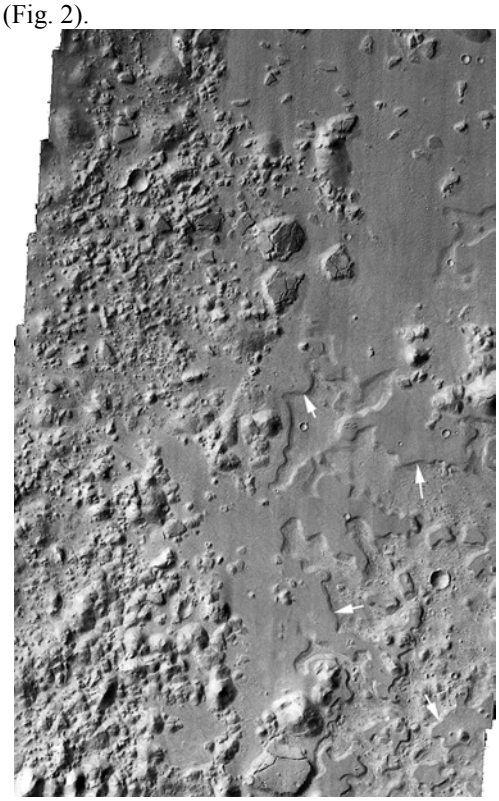

Fig. 2. Part of the Gorgonum basin floor showing flat-topped mesas (see arrows). The image is approximately 18 km from edge to edge. A portion of Themis VIS image V01904003.

These the tops of these benches are very flat and accordant across more than 90 km of basin floor (arrows in Fig. 3). This flatness and accordance is the primary evidence for the deposit being associated with a paleo lake.

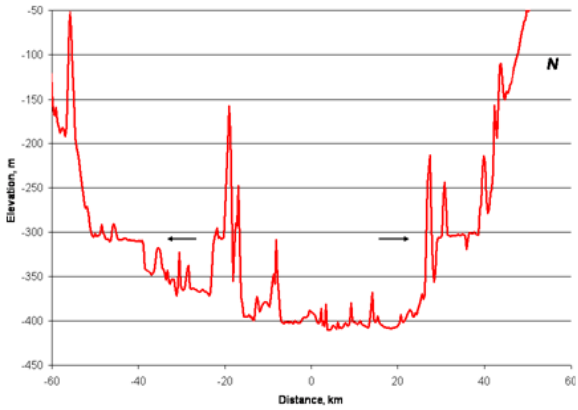

Fig. 3. Profile through the center of Gorgonum Basin, showing accordant, flat-topped benches (arrows). The higher projections are remnant mesas of the "chaos" deposit. The elevation range is -50 to -450 m, and the distance from -60 to 60 km.

The planform shape of the benches is unusual in several respects. The first is that the scarp edge is very irregular, with numerous islands, broad holes, and long reentrants and projections (Fig. 4). The second characteristic is the detailed shape of the scarp edge, which generally displays rounded edges, and where sharp beds occur, they generally are on inside rather than exterior bends. Planforms associated with erosional retreat of scarp edges generally have sharp projections and broad, shallow reentrants, whereas surfaces and scarps characterized by outward growth show rounded projections and sharp bends in the interior of reentrants [6], although some erosional scarps associated with landslides also exhibit this pattern.

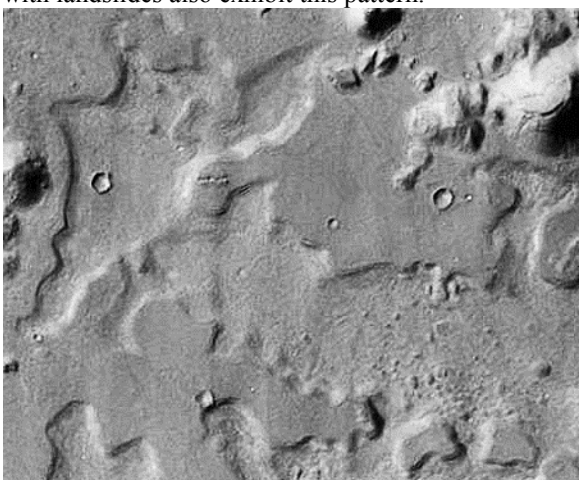

Fig. 4. A detail from Figure 2. The image is approximately 7 km from edge to edge.

Origin of the benches and scarps. The extreme degree of flatness and levelness of the benches suggests very strong gravitational control across as much as 100 km. An association with a ponded body of water is the most likely explanation. Depositon or erosion in association with eolian, volcanic, or groundwater processes are unlikely to exhibit so strong a gravitational control. A number of lacustrine scenarios have been investigated to explain the features of these benches.

1. The benches are constructional features associated with open water and shoreline processes assocated with waves and currents. The bench planform shows little similarity to typical open-water lake deposits. Waves tend to preferentially erode headlands and create a relatively smooth shoreline that often features barrier islands, spits, and offshore bars. Shorelines are generally concave between headlands due to wave refraction. These patterns are inconsistent with the observed scarp planform, and no evidence was found for the morphological and depositional features associated with open-water shorelines. Another difficulty with the open-water, wave-dominated scenario is a suitable source of sediment for constructing the benches. The extreme levelness of the benches and the lack of fluvial imprint makes it difficult to imagine a mechanism for transport of sediment across several kilometers of level bench top.

2. The benches are erosional features associated with retreat of formerly more extensive deposits. If the erosion was by waves and currents, then the same objections occur as for the previous scenario. No fluvial overprinting is seen. If erosion was by mass wasting, extensive deposits should be found on the basin floor immediately adjacent to the scarps, and for the extensive retreat necessary for forming the observed scarp planform, some mechanism for removal of the eroded sediment would have to be identified.

3. The benches are constructional features associated with sediment deposition in still water. The rounded scarp planform suggests a depositional origin of the benches. Still water might occur, for example, beneath a frozen ice cover. The greatest difficulty for this scenario is accounting for the supply of sediment from the outer edge of the platform to the growing edge of the scarp. This would presumably have to occur at the base of the ice cover by unknown mechanisms. Finding a source of sediment for lake in a frozen landscape is not obvious. Possibly eolian deposition on the lake surface and its transferal through the ice could account for the sediment.

4. The benches are constructional features associated with chemical deposition. Deposition of salts from solution might be an alternative mechanism for outward growth of the benches, either in open water or beneath an ice cover (presumably very slowly due to slow sublimation rates of ice). Because the deposits occur at the bottom of a deep basin, supply of salts by groundwater is a possiblility.

5. The benches are subsidence features due to removal of underlying deposits by solution or melting. Presumably the original surface would have been formed by lacustrine processes due to its levelness. Although this remains a possibility, few features characteristic of collapse have been noted. Scarp edges are smooth and abrupt, with no tensional cracks or arcuate scars.

References: [1] Frey, H. V. et al., *GRL 29(10),*10.1029/2001GL013832 (2002). [2] Howard, A. D., AGU Fall Meeting (2002). [3] Howard, A. D., AGU Fall Meeting (2000). [4] Irwin, R. P. et al., *Science, 296,* 2209-2212. [5] Moore, J. H. and A. D. Howard, *LPS XXXIV*, Abstract 1402. [6] Howard, A.D., *Geomorphology of Desert Environments* (Abrahams, A.D. and A.J. Parsons, eds), Chapman and Hall, Ch. 7, 1994.