OBSERVATIONAL TESTS OF THE MARS OCEAN HYPOTHESIS: SELECTED MOC AND MOLA RESULTS.

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Introduction: We have begun a detailed analysis of the evidence for and topography of features identified as potential shorelines [1,2,3] that have been imaged by the Mars Orbiter Camera (MOC) during the Aerobraking Hiatus and Science Phasing Orbit periods of the Mars Global Surveyor (MGS) mission. MOC images, comparable in resolution to high-altitude terrestrial aerial photographs, are particularly well suited to address the morphological expressions of these features at scales comparable to known shore morphologies on Earth. Particularly useful are examples of detailed relationships between potential shore features, such as erosional (and depositional) terraces have been cut into "familiar" pre-existing structures and topography in a fashion that points to a shoreline interpretation as the most likely mechanism for their formation.

Recent results: The subject of ancient standing bodies of water on Mars has received considerable attention recently with the discovery, by the MGS MOLA team, that the northern plains are very flat over large distances, comparable to the flatness of Earth's abyssal oceanic plains [4]. Measurements of the elevations of shorelines proposed by Parker et al. [1,2] by Head [5] and Banerdt and Parker [6] appear to support the prediction that these features record a paleo-equipotential surface at some elevation above the lowest areas of the plains interior that have been modified by regional tectonism, primarily by the uplift of and crustal loading by Tharsis.

Approach: High-resolution Viking Orbiter images typically are of insufficient resolution to image narrow shore platforms, if they are present. MOC images acquired during the Aerobraking Hiatus and Science Phasing Orbit are typically better than 5-10 m/pixel, which is comparable to good quality moderate- to high-altitude aerial photography on Earth. Therefore these data, in the right localities, could be used to critically test the shoreline hypothesis. Resolutions expected during the Mapping Phase of the MGS mission will be upwards of 3 times better in resolution. If coastal landforms are there and have not been extensively modified or buried, these data should enable their recognition. MOC images have a unique potential to support or refute the shoreline hypothesis by showing how "familiar" landforms have been modified by the formation of terraces on them. MOLA profiles will allow the correlation of MOC images of what might be "the same" potential shore feature imaged at different localities, if multiple images of the same feature exist.

New results: *Northwest Arabia:* Potential shorelines identified initially in the west Deuteronilus and Cydonia Mensae regions [e.g., 2, Fig 1b.), were imaged by MOC in a few places. A dramatic example is from MOC image 49705, from SPO-2 (Fig. 1). Though partially saturated, this image clearly shows a pair of terraces winding around the inside rim and knobs within a large, degraded crater (image center = 37.85°N, 5.15°W) in northern Arabia Terra at the lowland/upland boundary. A potential shoreline was predicted to embay this crater through its breached west rim by Parker et al. [2, Fig 1b], based solely on continuity of the sharp albedo boundary at the local "gradational" expression of the planet's dichotomy boundary from the high-resolution coverage in Deuteronilus Mensae into this area. This boundary has been given the provisional name "Arabia Shoreline" [3]. There are no high-resolution images of this crater from the Viking mission. We will compare the elevation of this feature with measured elevations of the Arabia Shoreline to test for consistency, once the data is released (as of this writing, all data through orbit 459 were available).

Olympus Mons Aureole: In chaotic terrains, or other similarly jumbled structures such as the Olympus Mons aureoles, continuity of horizontal terraces around jumbled blocks, in which strata should be completely disorganized and uncorrelated from one block to another, would provide a provocative suggestion of the former presence of standing water. Subsequent emplacement of a now largely-removed sedimentary layer would have to be carefully ruled out, however.

Searches of the best available Viking Orbiter coverage of the Olympus aureole material did not show any such features. Parker et al., [2, Fig 1a] tentatively predicted that the "interior plains boundary" should continue across the base of the aureole, and the "gradational boundary" across the top, coincident with the Olympus Mons basal scarp, based on the identification of these features in high-resolution Viking images around northern Acheron Fossae, but clear evidence for shore morphology from Viking at these locations is lacking.

MOC AB and SPO images are scattered over the aureole, but at least three show potential shore terraces around blocky material along the jagged edge of a prominent "inner margin" of the aureole, at a position between the "interior plains boundary" and the "gradational boundary" locations predicted by Parker et al. [2, Fig 1a]. We will compare the elevation of these features with one another, to determine whether they might be related, once the MOLA data is released.

Conclusions: Are the Martian features consistent with the shoreline interpretation? We think so. The proposed shorelines are elevated above plains surfaces, particularly on fret valley walls, crater rims, chaotic blocks and on knobs within the northern plains. They follow topography in a fashion consistent with emplacement at an equipotential surface (Head 1998, Banerdt and Parker 1998) and can either be traced all the way around the northern plains, or their relative topographic positions and associated morphologies are repeated around the plains. They are "nested" within one another (with "interior" features lower in elevation than "exterior" features), and exhibit a wide range of preservation states, suggesting that geologic time spans were involved. The plains surfaces within the potential shorelines may show evidence of subsequent permafrost modification and/or desiccation (e.g. "pingos" and small- and giant-scale polygons) and eolian deflation (etching, modern dust storms) - all suggesting the involvement of water - but show little (if any) evidence of fluvial or glacial scour.

References: [1] Parker T. J. et al. 1989 *Icarus*, 82, 111-145. [2] Parker T. J. et. al. 1993 *J. Geophys. Res.*, 98 11,061-11078. [3] Parker T. J. 1998 *Lunar and Planet. Sci. XXIX*, 2p. [4] Smith D. E. et. al. 1998 *Science*, 279, 1686-1692. [5] Head J. W. 1998 *Spring AGU*. [6] Banerdt W. B. and T. J. Parker 1998 *Spring AGU*.

Figure 1: Inside rim of large, degraded crater in northwest Arabia Terra. Note pair of smooth, sinuous terraces on inside rim, one above the other. The higher terrace wraps separately around two knobs at left center, whereas the lower terrace curves around both knobs. MOC image SP2-49705.