**A SEDIMENTARY PLATFORM IN MAGARITIFER SINUS, MERIDIANI TERRA, AND ARABIA?**

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**Introduction:** The Margaritifer-Meridiani-Arabia highlands-lowlands (H-L) transition has long been recognized as the most fluvially dissected region of Mars [*1-4*]. However, the geomorphic evolution of this region remains enigmatic, particularly the origin of the layered deposits of Meridiani Terra and Arabia. We suggest that a portion of this regional slope served as a fluvial depositional platform during the late Noachian.

**Background:** Grant [*3, 5*] recognized the long history of fluvial dissection and mantling in the Margaritifer Sinus region, the integrated drainage systems, and fluvial infilling of ancient impact basins. Hynek and Phillips [*1*] noted the unique topography of a zone centered at about -1 to -2 km, in which isolated "inliers" of heavily cratered terrain rise above generally smooth plains. They attributed this topography to intensive fluvial denudation resulting in a near peneplain/pediplain. Superimposed on this topography in the vicinity of 0°N and 0°E are the Terra Meridiani layered deposits, postulated to be altered pyroclastic deposits [*6, 7*] or lacustrine sediments [*8*]. Results from the Opportunity Rover support lacustrine involvement [*9*]. The unchanneled nature of these deposits and the disappearance of valley networks beneath the deposits [*7*] indicate their deposition subsequent to the late Noachian and early Hesperian fluvial dissection [*3, 5*].

**Data Analysis:** We constructed a generalized topographic map of the central portion of the H-L transition between 20°W to 40°E by noting elevations of upland surfaces (primarily intercrater plains), ignoring crater rims and floors as well as incised valleys (Figure 1). In the region of the incised valleys and chaotic terrain of Valles Marineris we utilized apparent unchanneled and undisturbed remnants to define the upland surface. In addition an elevation histogram was constructed for the H-L zone for 20°W to 20°E (Figure 2a). We also digitized the planform and elevations of the major drainages of the Margaritifer Sinus region (Parana, Evros, Loire, Samara Valles etc.) to produce a histogram of valley floor elevations (Figure 2a). For comparison we also prepared elevation histograms for the 20°E to 60°E H-L transition (Figure 2b) and for the Isidis rim and its incised valleys between 80°E to 100°E (Figure 2c). Finally, based upon MOLA topography and THEMIS IR (day and night) images, we mapped apparent paleochannels of Loire Valles, which we interpret in Figure 3 in terms of an age sequence (1 oldest, 4 youngest). All mapped valley segments exhibit downstream gradients.

**Interpretation:** A prominent feature of the generalized topographic map is a bench-like feature, about 750 km across, ramping at a slope of about $1x10^{-3}$ from the base of more steeply dipping highlands at an elevation of about -1000 m to the edge of the Valles Marineris depression at about -1700 m. This feature, informally termed the ***Meridiani Bench*** (MB), drops about 300 m rather abruptly at its northwestward boundary into the Valles Marineris depression, which was a depression prior to erosion from Uzboi flows and chaotic terrain development. This bench roughly corresponds to the smooth unit (Ns) of [*1*]. The bench also corresponds to a prominent peak in the elevation histogram centered at -1300 m, with valleys incised 100-300m below the bench (Figure 2a).

Topographic benches can form from a variety of depositional, erosional, or structural processes. The lack of obvious faulting or straight scarp boundaries disfavors a structural origin. The erosional planation postulated by [*1*] requires an explanation for why the erosion was concentrated in a narrow elevation band. A constructional (depositional) origin is favored by the narrow elevation range of the bench. Eolian and pyroclastic sedimentation, however, are unlikely to have produced a smooth surface with a nearly uniform gradient. Similarly, inundation by lavas is made unlikely by the absence of obvious sources (since the bench slopes away from the highlands) and the ready erosion of the bench surface by later fluvial incision. Totally lacustrine/oceanic sedimentation is disfavored by the paucity of fine sedimentary layering and the overall slope of the bench. We provisionally favor an origin of the bench through fluvial deposition by sediments eroded from the adjacent cratered highlands.

A variety of supplemental observations is concordant with this hypothesis: 1). The earliest paleochannels of Loire Valles flow just slightly below the level of the MB (Figure 3), and may have been involved in deposition of the bench; 2). A number of barely visible ghost craters occur on the intercrater plains defining the MB. They are probably buried craters visible only due to fill consolidation; 3). Some valley networks, particularly Loire Valles, exhibit pronounced incised meanders where crossing the MB. These may be superimposed from the MB surface; 4). Where valleys like Loire Valles incise into the MB, valley sides and ridge crests often exhibit low, nearly horizontal scarps that may be the expression of sedimentary layering; 5). Although we have not yet quantified this, the MB displays a paucity of 50+ km impact crater basins compared to adjacent terrain at higher and lower elevation; 6). The density of valley networks diminishes greatly on the ancient cratered terrain remnants below the MB level.

**Discussion:** If MB is a sedimentary platform, the abrupt ~300m scarp on the northwest edge suggest either a base level control (standing water) or deposition against deposits subsequently removed (lateral control), such as ice or fine sediment. The presence of an incised bench at about this level on the Isidis rim (Figure 2c) is supportive of a regional base level control, but main histogram peak in the intervening 20°E to 60°E region (Figure 2b) is about 400 m lower than the MB, perhaps indicating lateral control. A "Meridiani shoreline" was proposed by [*10*] which crosses the MB but which does not define a level surface.

The MB is of late Noachian age, and was dissected prior to deposition of the Meridiani Planum layered deposits. The lacustrine origin of at least part of these deposits might indicate a long history of base level fluctuation within the elevation range of the MB.

**References:** [1] Hynek, B. M., Phillips, R. J. (2001) *Geology, 29*, 407-10. [2] Grant, J. A., (1987) *Adv. in Planet. Geol.*, NASA TM89871, 268 pp. [3] Grant, J. A., Parker, T. J. (2002) *JGR, 107*, doi:10.1029/2001JE001678. [4] Goldspiel, J. M., Squyres, S. W. (1991) *Icarus, 89*, 392-410. [5] Grant, J. A. (2000) *Geology, 28*, 223-6. [6] Arvidson, R. E. *et al.* (2003) *JGR, 108*, doi:10.1029/2002JE001982. [7] Hynek, B. M. *et al.* (2002) *JGR 107*, doi:10.1029/2001JE001891. [8] Christensen, P. R., Ruff, S. W. (2004) *JGR 109*, doi:10.1029/2003JE002233. [9] Squyres, S. W. *et al.* (2004) *Science, 306*, 1709-14. [10] Clifford, S. M., Parker, T. J. (2001) *Icarus, 154*, 40-79.

**Figure Captions:**

**Figure 1.** Generalized topographic map of the Margaritifer-Meridiani-Arabia region showing the postulated "Meridiani Bench". Red box shows location of Figure 3.

**Figure 2.** Elevation histograms of the highlands-lowlands transition in several longitude bands. Red line at elevation peak at -1300m in 20W to 20E.

**Figure 3.** Map of lower Loire Valles showing interpreted paleochannels in sequence from 1 to present channel, 4.