VIKING STEREO OF THE MARTIAN CRUSTAL DICHOTOMY IN SOUTHERN ELYSIUM: EVIDENCE FOR EXTENSIVE FLUVIAL AND COASTAL EROSION?

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Stereo image data is indespensible for the geomorphic interpretation of planetary surfaces [1]. Broad undulations or gentle regional topographic gradients may be completely unrecognizable in monoscopic images, because they are often dominated by albedo variations and shading associated with high-frequency topography, such as channel margins, crater rims, and fault scarps. On Mars, regional-scale features, including the crustal dichotomy, major volcanic constructs and impact basins, are readily identifiable on the current global topographic maps produced by combining S/C radio occultation data, Earth-based radar, and low-resolution stereo image data [2]. But smaller features, such as valley network drainage basins, require higher resolution topography.

Martian valley networks are often attributed to groundwater sapping without atmospheric recharge, because they appear to be very immature dendritic systems, at best, in monoscopic images. The highland margin south of Elysium Planitia, extending from Aeolis Mensae to Mangala Valles, exhibits some of the most extensive fluvial dissection of the cratered uplands found on the planet. Stereo pairs of this region at modest resolultion (~200-300m/pixel and >30° parallax), reveal many apparently disconnected valley networks to be part of much larger through-going systems separated by local depressions that can be most easily explained as sites of local sediment deposition or throughput, rather than channel incision, within a continuous fluvial system. In addition, most valley networks in this region lie within broader depressions that slope gradually inward toward the trunk channel, and many exhibit faint tributary channels that can be traced back to ridge crests (drainage divides). These relationships suggest that stream gradient profiles had time to develop and thus probably indicate atmospheric precipitation and surface runoff [3] rather than groundwater sapping.

All valley networks between Ma'adim Vallis and Aeolis Mensae (including Ma'adim Vallis and Al Qahira Vallis) terminate abruptly at about the 1km contour on the global topographic map (USGS 1991). In addition, Al Qahira Vallis, Ma'adim Vallis, and an unnamed channel between the two (16°S lat., 188° lon.) exhibit multiple terraces, that either indicate multiple flow events or changes in base level. Between the 1km level and the base of the slope in Elysium Planitia, approximately 2km lower in elevation, the cratered upland margin appears to exhibit extensive erosional reworking and terracing (Figures 1 and 2). This plainward- progressive degradation of structures and topography has been interpreted as due to coastal erosion, associated either with an "Oceanus Borealis" [4, 5] or with a large lake within the Elysium Basin [6].

However desirable stereo mapping might be, working with stereo data has presented its own special problems, particularly when acquisition of stereo images was not intentional. Such was the case with Viking, though the sheer volume of data acquired has enabled the compilation of stereo sets [7]. Recent availability of the entire Viking Orbiter image dataset on CD-Rom, in combination with the stereo catalog, means that high-quality stereo image pairs and stereo mosaics of a large percentage of Mars' surface are much more accessible to the general scientific community than they were just a few years ago.

Presenting stereo image data to large numbers of people at one time presents another problem. The first, and best, method of stereo slide presentation employs a separate slide for each eye, but requires two projectors with polarized filters, a special projection screen, and polarized viewing glasses for the audience. The second uses a single anaglyph slide and red and cyan viewing glasses. The polarized method allows viewing color stereo pairs, whereas the anaglyph method only works with grayscale images. Both methods severely limit the amount of planetary real estate that can be displayed at once (due to the film resolution), such that one can either display very small areas at optimum image scales, or large regions with much-reduced clarity. Large-format anaglyph prints probably offer the best medium for large groups of people to view a regional scene simultaneously, and allow the individual to take her or his time, stand back for the regional view, or get close for a detailed inspection.

REFERENCES: [1] Moore, H., et al., *LPS XXIV*, 1003, 1993; Schenk, P., et al., *LPS XXV*, 1205, 1994. [2] USGS, Mission to Mars: Digital Image Map (CD-ROM), Flagstaff, 1991. [3] Craddock, R., et al., *JGR*, 98, 3453, 1993. [4] Baker, V., et al., *Nature*, 352, 589, 1991. [5] Parker, T., et al., *Icarus*, 82, 111, 1989; Parker, T., et al., *JGR*, 98, 11061, 1993. [6] Scott, D., and M. Chapman, *Proc. LPS 21*, 669, 1991; Scott, D., et al., *Proc. LPS 22*, 53, 1992. [7] Blasius, K., et al., *NASA CR-3501*, 1982.

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Figure 1: Stereo mosaic pair (orbits 631a [left], 596a [right]) of sloping upland margin west of Al Qahira Vallis (center ~7°S, 200°W). Northern limit of valley network incision is at bottom left, base of slope (Elysium Planitia) at top. Scene width ~275 km. Mosaic based on ~200-300m/pixel images with separation angles from 30 to 35°.

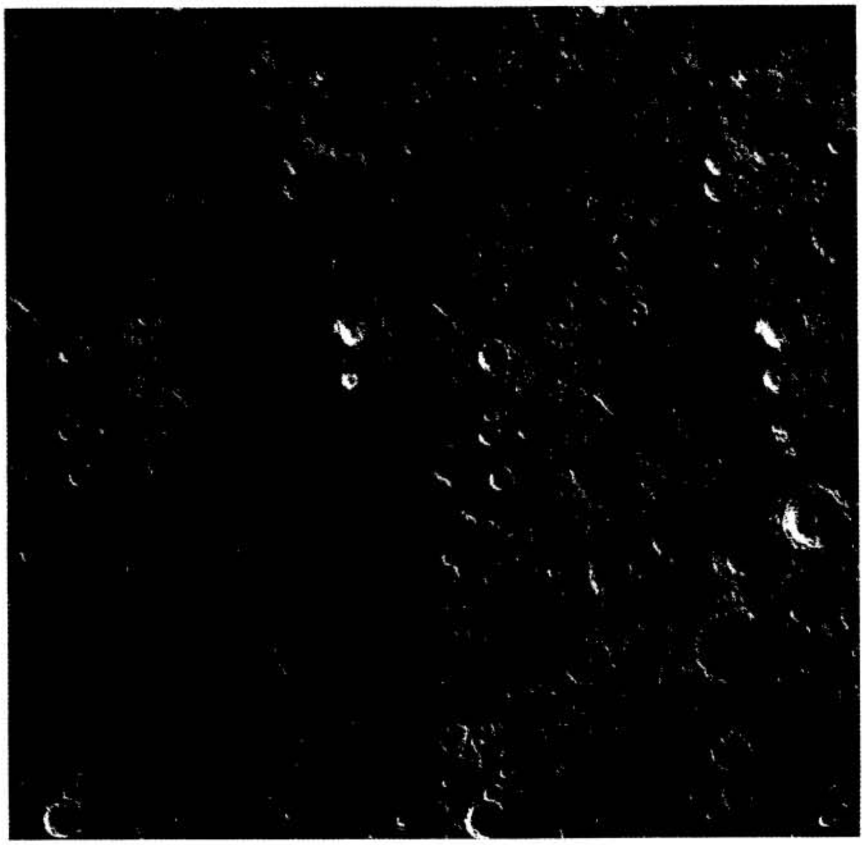

Figure 2: Enlargment, from Fig. 1, of terraced crater and fretted terrain in eastern Aeolis Mensae. At least two terrace levels can be identified in this scene. As many as five levels can be recognized in the region. Scene width ~100 km.