A DISCUSSION OF MARS' WESTERN EQUATORIAL DICHOTOMY BOUNDARY ZONE; ENIGMAS, ANOMALIES AND CONTROVERSIES, Randall D. Forsythe, UNCC, Charlotte, NC 28223, and James R. Zimbelman, Center for Earth and Planetary Studies, National Air and Space Museum, Smithonian Institution Washington, D.C. 20560.

Mars' equatorial region from the western edge of the Tharsis volcanic province (approx. 135 Long.) west to Apollinaris Patera (approx. 186 Long.) is a transitional realm lying at elevations between 0 and 3000 meters that separates young, low lying, deposits of the northern hemispheres' plains, from high and old intensely cratered materials of the southern hemisphere (1). The region, which corresponds to the classical high albedo areas of Zephria and Mesogaea contains deposits of unusual morphologic, structural, and geophysical characteristics.

A morphologic enigma: Following Mariner 9 data analysis the unusual deposits of the area were characterized as rolling or undulating plains of 'layered' and/or lineated deposits that were suggested to be a succession of lava flows younger than the highlands to the south(2). Viking images permitted detailed mapping, defining a number of units within what has been called the Medusa Fossa Formation(3), and led to a suggestion that they may represent a unique sequence of ignimbrite and tuffaceous units(4,5). A recent interpretation, based on a comparison to layered deposits of similar morphological character surrounding Mars' residual ice caps has led to the suggestion that they may represent an eastward younging track of paleopole deposits, begging the corollary of Martian polar wander(6).

A structural anomaly: Maps of the Zephyria and Mesogaea region show a number of NW to NNW trending structural elements within the layered and lineated deposits that are defined as linear depressions, grabens, or scarps(3). One of these, the Gordii Dorsum, has been recently argued to represent a major left-lateral transcurrent shear zone within the Martian lithosphere(7). Our analysis of Viking imagery reveals similar secondary structures along an equally pronounced NW trending fault zone at the extreme western edge of the belt, that runs along the northern base of Apollinaris Patera. This zone is tracable for some 300 kilometers; diagonally cutting across the transitional province to NW where it disappears under undeformed cover of Elysium Planitia. The Gordii Dorsum and the Apollinaris fault bracket on the east and west sides, respectively, a province that stretches for a minimum 2300 kilometers and appear divisible into 5 to 7 major NW-NNW trending trough/swell couplets with an average wavelength of 375 km and amplitudes of 1 to 3 kilometers. From Gordii Dorsum in the east to Apollinaris Patera in the west there is also a gradual counterclockwise shift of 15 to 20 degrees from NNW to NW orientations, which is opposite that expected from Tharsis models.

An age paradox: While early mapping efforts mapped the transition or dichotomy boundary zone in this region as having materials of intermediate (Hesperian) ages(2), subsequent revisions reversed stratigraphic relations between deposits of this zone and the northern plains materials(3), making them Amazonian. The hypothesis of a layered track of paleopole deposits accepted Amazonian chronologies but argued for an east to west younging pattern(6). The structural arguments paradoxically contradict the relative ages suggested by crater statistics, and would require yet a third revision in the relative age of the province as a whole with respect to surrounding terranes. However, an analysis of crater statistics in the boundary zone to the west (8), as well as our analysis of crater statistics in the this transitional region indicated extensive resurfacing. Cumulative crater frequency v.s. log diameter curves for 200,000 sq km windows of high and low topographic regions of the transition zone suggest a positive correlation of resurfacing effects with topography, not easily modelled with the ignimbrite or paleopole deposit hypotheses.

Evidence for extensive erosion: Erosional processes that have operating in the dichotomy boundary zone include wind, mass wasting, surface runoff, and possible karst. The minimum depths of erosion are calculated from preserved erosional features in the zone, along the margin with the highlands to the south, and from features within the highlands but still within the marginal region where crater statisical analysis and morphologies document the north to south retreat of the dichotomy boundary. Within the zone mesas, cuestas, and pedestal craters document erosional down-cutting up to 1.1 km; cliffs and canyon walls, along the boundary, document an erosional base level approximately 1 kilometer below perched intercrater plains. Retreat of the highlands from north to south is further supported by the tracing of intrahighlands structural fabrics across the boundary into the transitional province.

Radar & thermal imaging: Thermal inertia of the region is low (9) and is equivalent to an average particle size of >40um for an assumed homogeneous particle surface of one particle size (10). Materials with this value of thermal inertia will completely mask any underlying material (including solid bedrock) if the layer is >2 cm thick on the surface. 3.5 cm radar measurements made during the 88 Mars opposition showed zero depolarized radar echo power in the equatorial region to the west of Tharsis, and strong echo power in the volcanic provinces surrounding the region to its south and east (11). Cursory inspection of a published version of the synthetic radar imaging centered along the 133 and 147 meridian shows an apparent correlation with the transitional zone along the dichotomy boundary(12). Also noted here were discernable echoes from the region surrounding the residual southern polar ice cap, where the modern day equivalent of the postulated paleopole deposits are found. Echo power in the RCP transmitted/LCP received signal is due to multiple surface reflections or multiple subsurface scatterers, and for the equatorial deposits has been interpreted (accommodating thermal data) as an area of fine grained deposits with the absence of volume scatterers to a depth of several meters(11).

A chemical boundary layer hypothesis: An alternative interpretation which may accommodate the combined set of observations (structural, morphologic, crater statistics, and geophysical data) is that the western equatorial region represents an elogate (2-3000 km), 300-500km wide, arch of previously deformed and cratered material that sat initially in excess of 1 to 1.5 km depth beneath the cratered highlands. Exhumation and erosional retreat of the dichotomy boundary brought the earlier intra-highlands erosional base level (?water table) with its attended salt-cemented formations to the surface. The chemical processes attendent with the paleowater table gives a mechanism for masking large craters, the formation of the apparent molds of barchan dunes(13), and explaining crypic cross-cutting layering in the 'layered' sequences. Like the salt-cemented ranges of the Atacama Salar (Chile)(14) uplift initiates a process of decementation leaving an upper fine grained residual layer upwards of 2 meters thick. Such a decemented layer would explain the concurrence of the radar "stealth" zone and low thermal inertias with the exhumed basement arch.

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