ORIGIN OF MARTIAN PLAINS; Timothy J. Parker and R. Stephen Saunders, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA

The origin of plains surfaces on Mars is important to our understanding of the planet's volcanic and climatic history. The majority of plains units on Mars have been interpreted as volcanic based on similarities with lunar and Mercurian plains. While it is reasonable to expect similar extensive volcanic activity in the ancient past for all three bodies, it must also be remembered that Mars, because it has an atmosphere, has had a significant climatic history as well. Therefore, sedimentary plains-forming processes must also be considered for Mars.

The chief problem with constraining models of plains formation on Mars is that characterizing plains surface-forming processes is dependent upon the identification of distinctive landforms within the plains. Wrinkle ridges are most often cited as indicative of volcanic material. Wrinkle ridges are very common on martian plains surfaces, with the exception of northern plains surfaces above about 30° latitude and within the Argyre, Hellas, and Isidis Basins (1). The volcanic inference for martian wrinkle ridges is based on the association of lunar wrinkle ridges with known volcanic material. Plescia and Golombek (2), however, were able to demonstrate, with convincing terrestrial analogs, that wrinkle ridge formation may be independent of surface composition.

To further constrain the processes involved in the development of martian plains surfaces, we suggest a careful analysis of boundary morphology. Superposition relationships, erosional escarpments, crispness of boundary detail, and evidence of flow of plains material over adjacent terrain are characteristics of plains boundary morphology that should prove useful for inferring genesis. Plains units, whether volcanic or sedimentary in origin, are likely to be very thin at the margins, so boundary detail may not be obvious at typical Viking Orbiter image scales. For such an analysis, high resolution (<50m/pixel) seems a must. Given the necessary coverage, one might expect principle plains-forming processes to exhibit some of the following characteristics:

(I) Volcanic plains emplacement would expectedly produce a sharp contact with adjacent terrain. Individual flow fronts have irregular outlines, such that smooth, sinuous boundaries (common in the northern lowlands) would require very low viscosities and a fairly smooth extant terrain surface - still not an impossible condition (3).

Topographically conformal boundaries occur in the lunar mare and would be expected of volcanic plains on Mars. Erosion of adjacent terrain by lava, producing an escarpment in the older surface, is unlikely. Similar morphology is not found at the margins of the lunar mare.

(II) Eolian loess blankets would likely thin gradually at the margins, thus making separation from adjacent material dependent mainly on available image resolution (4). The sharp contacts at the margins of many martian plains would seem to indicate processes other than eolian mantling. Eolian deposits would not be gravitationally confined to lower elevations as would low-viscosity lavas or water, so would likely drape extant terrain rather than produce a topographically conformal boundary. Air-fall deposition if ice-rich sediment (5,6) might expectedly produce boundary morphology similar to other eolian deposits, at least prior to ice removal.

(III) Lacustrine sediment deposition may have occurred within many enclosed basins and intercrater plains regions and within the northern lowlands where small valley or outflow channel systems terminate. Lacustrine plains boundaries would be topographically conformal but, unlike volcanic plains boundaries, might exhibit both constructional (onlapping) and destructional (erosional escarpments) elements. Both types of boundary morphology can be identified within the northern lowlands (7).

High resolution images are not available for many plains units. Distinctive volcanic features within the plains (e.g., lava flow fronts, source vents) can help greatly, but may not be identifiable at low resolution. Source vents and flow fronts within lunar volcanic plains are often difficult to identify due to the flood-like style of emplacement. In areas with low resolution (>200m/pixel) coverage that exhibit numerous radial channels terminating within a basin, it may not be possible at present to determine whether the channels terminate in lake sediments or are buried by volcanic plains.

REFERENCES:

(1) Carr, M. H., 1981, The Surface of Mars: Yale University Press, New Haven and London, 232 p.

(2) Plescia, J. B., and Golombek, M., 1986, *Geol. Soc. Am. Bull.*, Vol. 97, p. 1289-1299.

(3) Basaltic Volcanism Study Project, 1981, Basaltic Volcanism On The Terrestrial Planets: Pergamon Press, Inc., New York, 1286 p.

(4) Zimbelman, J. R., 1987, *Icarus*, Vol. 71, p. 257-267.

(5) Grant, J. A., and Schultz, P. H., 1987: in Papers Presented to the Workshop on Nature and Composition of Surface Units on Mars, L.P.I., Houston, p. 46-48.

(6) Grizzaffi, P. and Schultz, P. H., 1987, *Icarus*, in press, 58 p.

(7) Parker, T. J., Schneeberger, D. M., Pieri, D. C., and Saunders, R. S., 1987, *Rept. Planet. Geol. Prog. 1986*, NASA TM-89810, p. 502-504.