THE VOLCANIC PLAINS RIDGES OF THE CHRYSE AND AMAZONIS DEPRESSIONS.
Thomas R. Watters, Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington, D.C. 20560.

In a recent study of the Tharsis Plateau Ridge System, Watters and Maxwell (1) compared topographic data with the areal extent of the volcanic plains ridges and concluded that a reasonable correlation exists between the outermost occurrences of ridges and the present edge of the Tharsis rise. Two regions where this correlation does not hold are the Chryse and Amazonis Planitias. Both regions are distinct topographic lows or depressions that border the Tharsis Plateau.

The Chryse depression is located on the northeastern border of Lunae Planum and is some 2 km below the Mars datum elevation and approximately 4 km below the ridged plain of central Lunae Planum (2). The western half of Chryse is dominated by volcanic plains ridges that vary in orientation from NNW to N to NNE. The NNW trending ridges are consistent with those in northern Lunae Planum and the Tharsis regional trend, while the NNE trending ridges are not. The Amazonis depression forms the northwestern border of the Tharsis Plateau and the northeastern border of Elysium Planitia. The depression is a maximum of approximately 1.5 km below the datum elevation (2). Orientations of volcanic plains ridges in the Amazonis depression vary from NNE to N to NNW. The NNE trending ridges conform to the general circumferential orientation of the Tharsis ridge system, while the NNW trending ridges do not. The deviations in ridge orientations from the regional trends in Chryse and Amazonis suggest that stresses within these depressions may have influenced the formation of the ridges.

Schultz et al. (3) identified the Chryse depression as an impact basin and suggested that extensional weakness related to the basin extend out about 2000 km. Chicarro (4) mapped a large number of "Martian ridges" that vary greatly in scale and relief. Based on a test to determine the concentric nature of the ridge orientations in the region, they concluded that the basin structurally influenced the formation of ridges as far as 1300 km from the center of Chryse. This ring of influence extends on to Lunae Planum and corresponds to a number of NE trending ridges that do not correspond to the Tharsis related ridges. The volcanic plains ridges on Lunae Planum mapped in this study indicate a set of NE trending ridges, but they are located in the southern Lunae Planum and extend south into Coprates and their orientations fit the Tharsis region trend. A small number of NNE trending ridges do occur in northern Lunae Planum, but in this area, ridges with orientations varying from NNE to N to NNW could be attributed to a center in Chryse, given a broad enough criterion. Given the extent and the strong circumferential orientation of the Tharsis ridge system, it seems more likely that the compressive stresses related to the Tharsis ridge forming event(s) on Lunae Planum dominated over influences (if any) from the Chryse basin. Further, it is not clear mechanically how a zone of extensional weakness that may extend onto Lunae Planum would effect the formation of compressional ridges, particularly since Maxwell (5) found that ridge orientation in Lunae Planum and Coprates are not similar to those of the surrounding extensional fault systems.

An alternative model to explain the variations in ridge trends in the Chryse basin is an interaction between stresses but confined to the depression itself. These two stress systems were probably coincident in time since the ridges in the western half of Chryse formed on volcanic

plains units emplaced concurrently with the plains units on Lunae Planum. This interpretation is supported by crater counts by Scott and Tanaka (6) indicating that the relative age of the surfaces of the plains units of the Chryse basin is comparable to the surfaces of plains units on the Tharsis Plateau.

Using Mariner 9 Doppler gravity data and topographic data, Phillips and Saunders (7) noted positive free air anomalies associated with the Tharsis Plateau and negative anomalies associated with the adjacent lowlands of Chryse and Amazonis. They concluded that the anomalies are coincident in time with the uplift of the Tharsis Plateau and the contemporaneous subsidence of Chryse and Amazonis depressions resulting from some form of internal redistribution of mass. Since the Tharsis ridge system formed relatively early in the tectonic history of the plateau (1, 8), the subsidence of the Chryse and Amazonis depressions, as suggested by Phillips and Saunders (7), is consistent with ridge formation in response to stresses resulting from subsidence coupled with stresses from Tharsis. Modelled compressive stresses, using an axially symmetric subsidence geometry, in combination with regional stresses form Tharsis calculated by Banerdt et al. (9), can explain most of the ridge orientations in the two depressions.

References:

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