SYMMETRY OF INFERRED STRESS FIELDS IN THE THARSIS REGION OF MARS. Thomas R. Watters and Michael J. Tuttle, Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington, D.C. 20560, and Francis J. Kiger, Department of Geology and Astronomy, West Chester University, West Chester, Pennsylvania, 19383

Understanding the origin of the stresses that generated the radial fracture system and circumferential wrinkle ridge system on the Tharsis Plateau is key to unraveling the tectonic evolution of the region. Banerdt et al. (1,2) and Sleep and Phillips (3) have proposed models for the origin of the stresses and calculated stress trajectories that can be compared to the observed tectonic features. The stress fields predicted in these models are strongly radial to an area near Pavonis Mons. If these models are correct, the stress inferred from the structures should be strongly radial to this area.

The radial nature of the inferred stresses has been analyzed using a stereonet in a number of studies (4,5,6,7). In a recent study, Golombek (8), using graben data compiled by Plescia and Saunders (5) and ridge data subsampled into length-weighted vector means compiled by Watters and Maxwell (6), concluded that the graben and wrinkle ridges define a significantly radial system. With respect to the wrinkle ridges, this conclusion is in contrast to the findings of Watters and Maxwell (6) and is not the result of a net manipulation error as reported by Golombek (8). The method used by Golombek (8) involves fitting great circles with the correct angular relationship on the net to the vector normals. The resulting great circles are then geographically correct traces of the inferred principal stress on the surface. Watters and Maxwell (6) used the azimuth of the vector normals to fit the great circles. This method does not generate geographically correct traces of the inferred stresses, but can be used to test radial symmetry.

In an effort to address the question of the significance of the radial symmetry of the system of structures, a wrinkle ridge data set consisting of 1845 ridge segments and a graben data set consisting of 6841 fault segments is used in a beta analysis. Great circles that are geographically correct traces of the inferred principal stresses (8) are fit to each graben segment and the normals to each ridge segment. The 1.7 million intersections of the ridge data are distributed in a broad girdle with a maximum concentration of 5% per 1% area centered at approximately 5°S, 110°W (fig. 1). The 32 million intersections of the graben data are distributed in a symmetric pattern, elongated in a N-S direction with a maximum concentration of 12% per 1% area roughly centered at 3°S, 110°W (fig. 2).

The agreement between the locations of the maximum concentrations of intersections for the two systems of structures supports models where isostatic and flexural loading stresses result from the observed topography and gravity (1,2,3). However, in the isostatic case of Banerdt et al. (2), the predicted compressional stresses would result in a strongly radially symmetric ridge system (maximum concentration of 45% per 1% area located at roughly 5°N, 105°W). Even when the predicted stress trajectories are varied by as much as 10°, the maximum concentration does not approach 5%.

A possible explanation for the difference between the predicted stresses and those inferred from the observed structures is that some component of the total stress responsible for the wrinkle ridges is not accounted for in the models. Additional components of stress may have resulted from: 1) gravitationally induced down-surface slope stresses (9) generated when the

regional topographic slope was greater than at present, and 2) local and/or regional subsidence.

References Cited: (1) Banerdt, W.B., R.J. Phillips, N.H. Sleep, and R.S. Saunders, *JGR, 87*, 9723-9733, 1982. (2) Banerdt, W.B., M.P. Golombek, and K.L. Tanaka, submitted to *Mars*, University of Arizona Press, Tucson, 1989. (3) Sleep, N.H. and R.J. Phillips, *JGR, 90*, 4469-4489, 1985. (4) Wise, D.U., M.P. Golombek and G.E. McGill, *Icarus, 38*, 456-472, 1979. (5) Plescia, J.B. and R.S. Saunders, *JGR, 87*, 9775-9791, 1982. (6) Watters, T.R. and T.A. Maxwell, *JGR, 91*, 8113-8125, 1986. (7) Schultz R.A., *JGR, 90*, 1985. (8) Golombek, M.P., *LPSC XX*, 345-346, 1989. (9) Elliott, D., *JGR, 81*, 949-963, 1976.

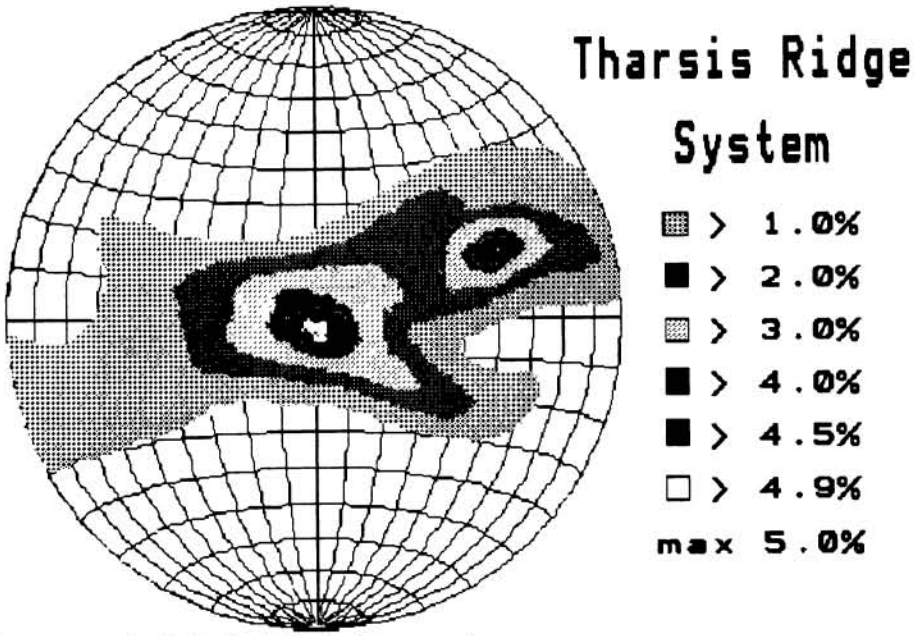

Fig. 1. Contours 1-2-3-4-4.5-4.9% per 1% area.

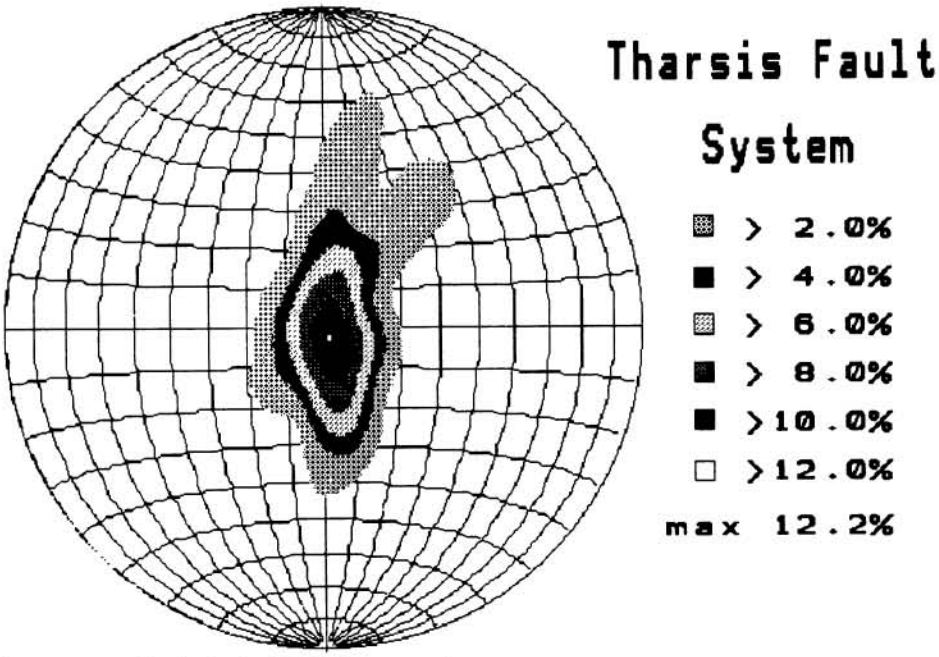

Fig. 2. Contours 2-4-6-8-10-12% per 1% area.