

A STATISTICAL STUDY OF FRACTURE INHERITANCE DURING THE VOLCANO-TECTONIC EVOLUTION OF THE THARSIS REGION IN MARS

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Numerous workers have attempted to interpret the tectonic evolution of the Tharsis region of Mars utilizing the fracture patterns observed on orbital images. The two main models invoked are that of volcanism related to lithospheric uplift and fracturing, and the other, of tectonic subsidence and fracturing related to volcanic build-up (e.g., Plescia and Saunders, 1982; Solomon and Head, 1982, respectively). The ideas presented in this report do not necessarily counter either of these models but have attempted to resolve this divergence in interpretation of essentially the same fracture patterns. The premise chosen to accomplish the results of this research is that the repeated tectonism and volcanism in the Tharsis area is controlled to a greater, or lesser degree by the preexisting fractures formed during an earlier volcano-tectonic event. Later events inherit preexisting fractures to localize volcanism on favorably oriented fractures.

Fracture patterns presented in the earlier studies and those mapped during the course of this study were subjected to a rigorous statistical analysis using routine testing procedures. Fracture patterns characteristic to specific litho-stratigraphic units were separately analysed on spatially filtered azimuth maps. Each thematic map was restricted to 10° azimuth intervals. These maps were then cross-correlated with each other and the entire population of fracture traces from the four volcanic centers delineated by Plescia and Saunders (1982).

Initial analyses indicate that several statistically significant azimuth peaks (particularly near EW and NS) in the azimuth frequency (both simple numbers and length-weighted) diagrams could be correlated with confidence across several stratigraphic levels. These significant peaks are postulated

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to have repeatedly acted as volcanic conduits. These results, however preliminary, indicate that fracture inheritance has played an important role in the migration of volcanism in the general north-south direction. It appears, therefore, that existing models that have utilized structural analysis of cumulative fracture patterns in areas of long-active volcano-tectonic events are in need of revision.

Plescia, J. B. and Saunders, R. S., 1982. J. Geophys. Res., 87, p. 9775-9791.

Solomon, S. C. and Head, J. W., 1982. J. Geophys. Res., 87, p. 9755-9774.