RADIAL VARIATIONS IN LITHOSPHERIC PROPERTIES IN NORTHEAST THARSIS: FIRST RESULTS.

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Summary: As the first phase of our quantification of Tharsis tectonism, we create an MGS-referenced data set of normal faults and grabens in Northeast Tharsis. The radial slice from central Tharsis through Tempe Terra will provide a window into thermal, mechanical, and tectonic properties there as a function of time, and therefore of load and lithospheric evolution.

Introduction and Background: Radial grabens at Tharsis record crustal extension due to the load [1–3]. However their development and significance beyond 2-D strain estimates are largely unknown. For example, early Viking-based strain models required two separate phases of Tharsis loading to produce the “inner” and “outer” radial grabens [4,5]. In contrast, recent MGS-based stress models for Tharsis [6] imply synchronous development of radial graben sets over their entire length [7]. Important factors that can influence graben set development [8,9], such as lithospheric thickness and heat flow, are unconstrained at the small scales relevant to the observed external tectonic record.

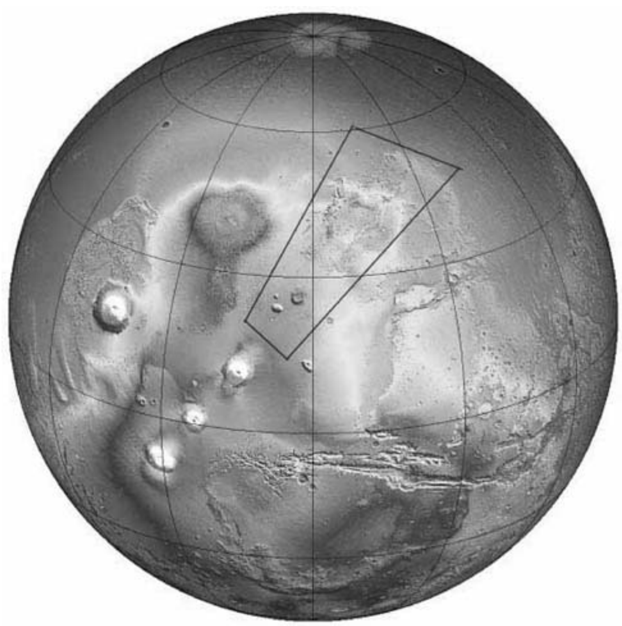

Fig. 1. Our first radial slice of Tharsis.

We evaluate the thermal, mechanical, and tectonic properties of northeast Tharsis by merging normal faults and grabens within a radial slice that runs from central Tharsis beyond Tempe Terra (Fig 1). We map and analyze fault lengths, orientations, spacing, and linkage between closely spaced fault segments in order to calculate the 3-D strains (extensional, vertical, and fault-parallel) and other relevant quantities [10–13]. Crustal thickness and the paleogeotherm at the time of faulting are obtained as a function of radial position relative to Tharsis by inverting the MOLA topography along the faults [14].

Methods: Previous compilations and data sets either were Viking-based, or lacked sufficiently precise topographic data for each fault to address the issues raised above. As a result, we have created an MGS-based, spatially referenced, MOLA-derived Digital Elevation Model (DEM) that contains all the key fault data (See Fig. 2).

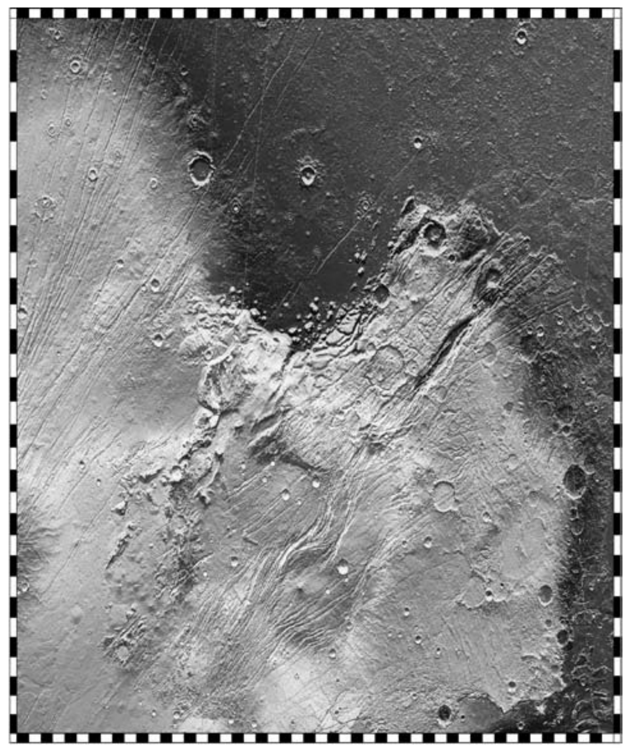

Fig. 2. Part of the radial slice of Tharsis showing the Tempe Terra region after georeferencing and database construction.

This was accomplished by first building a DEM directly from the MOLA data using the GIS software package GMT. This was then manipulated into the industry standard GIS, ArcGIS 8.3, to utilize the aml driven programming capabilities of that package [15–17]. A grid file is then built within ArcGIS 8.3 by generating ASCII files modeling the same surface area as the DEM [18,19], which allows the DEM to be georeferenced to the grid file. After georeferencing, digitizing is used to create a vector database [20] of all the faults and grabens in the radial swath. The resulting dataset is referenced spatially to the MGS-based ellipsoid of Mars, allowing for rapid overlay and analysis of multiple datasets.

The vector data set is then separated from the DEM and checked for accuracy. After verifying the data set, we can then model within the GIS to solve the science problems listed above. The final product is a data set composed of MOLA-based DEMs, geologic maps, fault maps, and relative age maps [21].

Conclusions: The dataset of northeast Tharsis quantifies the lithospheric properties along the radial slice. These give us the 3-D information that, when correlated with the relative ages of the geologic units, will provide a 4-D history of deformation and load evolution in this part of Tharsis.

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