Fault scaling on Memnonia Fossae, Mars: Displacement-length relationship derived from the HRSC data

I. S. Yazıcı, E. Hauber

DLR-Institut für Planetenforschung, Berlin, Germany (Isik.Yazici@dlr.de / Fax: +49-30-67055-402)

Geometric fault properties can provide insights into the mechanical and temporal evolution of fault systems [1,2], and the past and future potential for seismic energy release [3]. Since the seismic moment released during the growth of a fault is strongly connected to the fault geometry, the study of fault populations can also help to estimate the current seismicity level [4,5]. Until today, only few data on the relationships between fault displacement and length have been collected for extraterrestrial bodies [6], partly due to the limited number of reliable topographic datasets.

The InSight mission put a lander in the Elysium region of Mars in 2018. It is equipped with a seismometer [7] that has recorded several marsquakes for which the locations could be determined [8]. As a starting point for our analysis of fault geometries, we selected the Memnonia Fossae fracture systems, one of the hypothesized locations for marsquakes, which radiate outward from the Tharsis region in a southwesterly direction.

Here we use DEM and orthoimages from HRSC [9] to obtain information on the displacement distribution along fault traces. This also enabled determining the maximum displacement. We compare our results to previous measurements of faults on Mars, Earth, and beyond. Based on these analyses, we discuss the implications of fault segmentation and linkage for further interpretation. HRSC data offer high-resolution topography and spatially contiguous coverage, which are required to analyze detailed topographic characteristics of large fault systems. For structural interpretation of key locations (e.g., relay ramps), CTX images (~5-6 m px^{-1}) have been inspected. Fault length was digitized along the fault line, and multiple topographic cross-sections across the fault were drawn with a spacing of ~1 km. Fault throw (a proxy for true displacement) was visually determined in the digitized cross-sections. At the time of writing, 16 images out of 75 available images/DEM from the Memnonia Fossae region exhibiting normal faults have been measured. We find an average Dmax/L ratio of 0.007, consistent with our previous findings for other regions on Mars, where this ratio had an average value of 0.006 [10]. At the conference, we will present further measurements and discuss them in the context of the regional structural geology.

References

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