Fault scaling on the Reykjanes Peninsula (Iceland) as a Mars Analogue: Displacement-length relationship in comparison with Memnonia Fossae, Mars

Investigating geometric fault properties is essential for reconstructing the geological evolution of a tectonic region. Key parameters such as fault length, dip, and slip provide insights into the mechanical and temporal evolution of the fault systems [1, 2] and how faults accommodate strain and deformation over time. The scarcity of fault scaling studies on extraterrestrial bodies partly due to the limited number of reliable topographic datasets [3], constitutes a notable gap in current studies of planetary structural geology, necessitating additional focused research on fault scaling in extraterrestrial environments. For quantitative analyses of fault geometries on other planets, analogous investigations on Earth are an essential supporting activity. These studies help to interpret remote sensing imagery more reliably by using terrestrial observations to better understand planetary structures.

A previous fault scaling study conducted in the Memnonia Fossae region on Mars yielded valuable insights into geometric characteristics and kinematics of normal faults in this area. Memnonia Fossae is a set of long and narrow grabens radiating outward from the main volcanic region of Mars, Tharsis. We conducted a comprehensive geometric analysis, resulting in the calculation of a maximum displacement vs. length (D_{max}/L) ratio of 0.007 based on measurements taken from 100 individual faults. Normal faults on the Reykjanes peninsula, Iceland [4] were chosen as an analogue to the Memnonia Fossae region of Mars. Both locations share comparable lithologies (i.e., basalts), potentially influenced by dike-induced tectonics. Fieldwork on Reykjanes was conducted in August 2023.

During fieldwork, we got measurements of 74 faults and fractures at 180 waypoints to determine the fault characteristics in this region. Opening, shear sense, throw, and the extension vectors of the faults were recorded in the field. Moreover, for the larger faults, field measurements were supported by measurements gathered from the remote sensing data. Preliminary results show that the D_{max}/L ratio calculated as 0.005. We compare our results to previous measurements of faults on Mars, Earth, and beyond. At the conference, we will present further calculations and discuss them in the context of the comparative structural geology.

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References

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