Estimating the thickness of the Martian subsurface layer based on the fault pattern

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ABSTRACT

To conduct mining operations for resource extraction on extraterrestrial planets, a comprehensive understanding of the basic structural geology and civil engineering technology is important. For example, proper assessment of the risks associated with excavation and infrastructure construction under unique environments such as low gravity, surface irregularities, and the presence of regolith is fundamental. In this paper, we focus on the basic geological structure of Mars to understand the geometrical pattern of faults and subsurface formations.

The seismic activity on Mars is believed to originate from plate movements caused by the contraction-induced deformation. Surface rupture observed along rift zones suggests that the Martian crust undergoes an elongation stress field, resulting in faults visibly appearing on the Mars surface. Investigating the geological structures within the distinct and distant landscapes of Mars presents considerable difficulty. While we have insights into gravity anomalies on Mars, conducting direct seismic surveys or borehole core observations remains challenging.

We focus on the linear relationship between the fault spacing and the thickness of the mechanical layer as an approach to studying the internal structure from satellite images. A mechanical layer is a layer that is composed of the same mechanical properties and is mainly bounded by lithology. The estimation of the mechanical layer is important considering potential resource exploration on Mars and the prospective construction of civil engineering structures in the future.