FAULT DISLOCATION MODELING OF TECTONIC LANDFORMS IN MARE FRIGORIS

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Abstract:

Previous work suggested that large-scale nearside basin-localized extensional tectonism on the Moon ended ~3.6 billion years ago and mare basin-related contractional deformation ended ~1.2 billion years ago. Lunar Reconnaissance Orbiter Camera (LROC) Narrow Angle Camera (NAC) high resolution (50-200 cm/pixel) images enable the detailed study of lunar tectonic landforms and further insight into the evolution of stresses. Populations of landforms are now observed at scales much smaller than previously recognized, and their morphology and stratigraphic relationships imply a complex deformational history.

The most common tectonic landforms in mare basins are sinuous wrinkle ridges that have up to hundreds of meters of relief and are interpreted as folded basalt layers overlying thrust faults. They consist of a narrow, asymmetric ridge atop a broad arch and sometimes occur radial to or concentric with the centers of some mare basins. Wrinkle ridges with these patterns have previously been associated with mascons – dense concentrations of mass identified by positive gravity anomalies. Loading of the crust by lunar mascons causes flexure and subsidence to form wrinkle ridges. However, some basins including western Mare Frigoris are not associated with mascons, yet wrinkle ridges deform the mare. The origin of compressional stresses in non-mascon environments remains an outstanding question.

A key step to better understanding the occurrence of wrinkle ridges in non-mascon basins is characterizing the behavior of the underlying faults. We expand upon methods used in Williams N. R. *et al*. [2013] and apply fault dislocation modeling to estimate geometries and displacements for selected wrinkle ridge faults in Mare Frigoris. Digital terrain models (DTMs) derived from LROC NAC stereo pairs are used to constrain fault models. Using the system of analytical equations for deformation of a half-space defined by Okada [1985, 1992], we apply inverse methods to model ridge relief for fault geometry. Preliminary results suggest maximum depths of faulting within the upper ~1-2 km and shallow (<40°) dip angles. These preliminary modeled values are comparable to estimates for other lunar and martian wrinkle ridges, and suggest this faulting is likely confined to within the mare fill and not rooted deeply in anorthositic crust.