Inverse Modeling of Wrinkle Ridge Structures on the Moon and Mars
Williams *et al*.

Sinuous wrinkle ridges are common tectonic landforms on Mars and in lunar mare basins. They have up to hundreds of meters of relief on the Moon and up to over a kilometer of relief on Mars, 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 mass concentrations (mascons). 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 mascons causes flexure and subsidence to form wrinkle ridges. However, some basins on the Moon including western Mare Frigoris are not associated with mascons, yet wrinkle ridges deform the mare. On Mars, gravity data is coarser, but wrinkle ridges are sometimes observed in terrains that are not expected to have a significant mascon. 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 environments 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. On the Moon, we use a digital terrain model (DTM) derived from Lunar Reconnaissance Orbiter Camera (LROC) Narrow Angle Camera (NAC) stereo images to constrain fault models for a wrinkle ridge in Mare Frigoris. On Mars, we use a DTM derived from High Resolution Stereo Camera (HRSC) stereo images for a wrinkle ridge in Oyama Crater. Different from our previous work, we apply inverse methods on a triangular mesh [Shirzaei & Bürgmann, 2013] to model ridge relief for curved fault geometries. Preliminary results suggest maximum depths of faulting within the upper few km and shallow (<40°) dip angles. These preliminary modeled values are comparable to previous estimates for other lunar and martian wrinkle ridges, and suggest this faulting is likely confined to within the upper crust.