Lobate Scarp Modeling with Lunar Reconnaissance Orbiter Camera Digital Terrain Models

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Lobate scarps are a type of contractional tectonic landform expressed on the Moon's surface in both highlands and maria. Typically only tens of meters in relief, these linear or curvilinear topographic rises are interpreted to be low-angle thrust fault scarps resulting from global radial contraction. Radial contraction of the Moon can be inferred from shortening across the population of lobate scarps and is estimated at ~100 m. However, the geometry and depth of the underlying faults and mechanical properties of the near-surface lunar crustal materials are not well constrained. The Lunar Reconnaissance Orbiter Camera (LROC) Narrow Angle Cameras (NACs) acquire 0.5 to 2.0 m/pixel panchromatic images and digital terrain models (DTMs) with spatial resolutions of 2 m are derived from NAC stereo pairs. Topographic data are being used to constrain models of the lobate scarp thrust faults. DTMs are analyzed for relief and morphology of the Slipher (48.3°N, 160.6°E), Racah X-1 (10°S, 178°E), and Simpelius-1 (73.5°S, 13°E) scarps. Profiles are extracted, detrended, and compared along strike. LROC Wide Angle Camera (WAC) 100 m/pixel image mosaics and topography provide regional contexts. Using elastic dislocation modeling, the fault dip angles, depths, slip, and taper are each varied until the predicted surface displacement best fits the DTM profiles for each lobate scarp. Preliminary best-fit dip angles vary from 30-40°, maximum fault depths extend to several hundred meters, and the amount of slip varies from 10 to 30 meters for the three scarps. The modeled maximum depths suggest that the thrust faults are not deeply rooted.