TITLE: Investigating the Tectonics of Mare Crisium with Topographic Data

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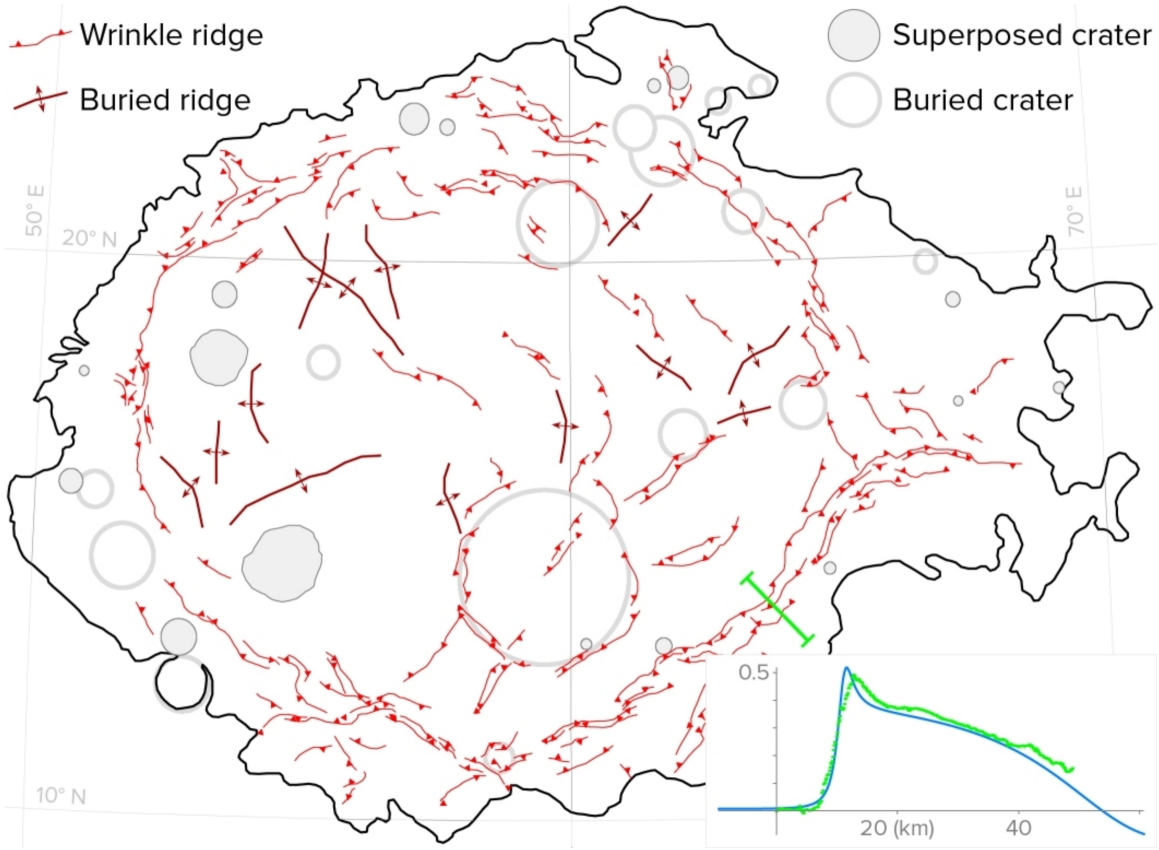
ABSTRACT BODY: Mare Crisium is a 560-km-diameter lunar mare, 170,500 km2 in area. Like other lunar maria, Crisium has been tectonically deformed by wrinkle ridges. Early studies of the tectonics of Crisium were hampered by poor resolution or illumination conditions, however. The recent availability of high-resolution digital topographic models (DTMs) from Lunar Orbiter Laser Altimeter (LOLA) data enables a fresh assessment of lunar tectonics, including those in Mare Crisium. LOLA DTMs show that the basin is replete with wrinkle ridges, consistent with previous observations; we observe over 170. The largest such structures follow the basin outline and verge towards the interior, most notably from 30°–180° and 270°–330° azimuth (measured clockwise from north). Artificially illuminated hillshade maps derived from the DTMs, for solar azimuth angles of 0° and 180°, reveal ~east–west-orientated structures that are not readily visible in photogeological data. We identify 10 partially buried craters within Crisium, but we note a further five demarcated only by wrinkle ridges, the largest of which is ~95 km in diameter, that have no other surface manifestation. Moreover, LOLA topographic data reveal subtle ridge-like changes in relief across the mare that are virtually impossible to detect otherwise. We interpret these 13 ridges, ~30–100 km in length, as additional shortening structures that have no surficial faulted component. Surface displacement models can be fit to topographic profiles across structures to estimate displacements and geometries of the underlying faults. Models fit to one such profile (see accompanying figure) across an inward-verging ridge with 500 m of relief in the southeast of Crisium indicate that its fault dips 22°, penetrates to a depth of ~20 km (far beneath the base of the mare deposits), and accumulated ~1 km of along-slip displacement. This result, given the other large structures and inferred buried ridges in Crisium, implies that this mare experienced substantial shortening. Lunar wrinkle ridges are ascribed to some combination of mare subsidence and global contraction; if representative of lunar maria in general, our findings for Crisium suggest that these processes have shaped lunar tectonics to an extent greater than previously recognized.

KEYWORDS: 5475 PLANETARY SCIENCES: SOLID SURFACE PLANETS Tectonics, 5480 PLANETARY SCIENCES: SOLID SURFACE PLANETS Volcanism, 6250 PLANETARY SCIENCES: SOLAR SYSTEM OBJECTS Moon.



Structural map of Mare Crisium showing wrinkle ridges (flags give down-dip direction), buried ridges (arrows give down-slope direction), buried craters, superposed craters >5 km in diameter, and the location of the topographic profile (green line); inset shows topographic (green) and model (blue) profiles. Graticule has 10° increments in latitude and longitude.

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