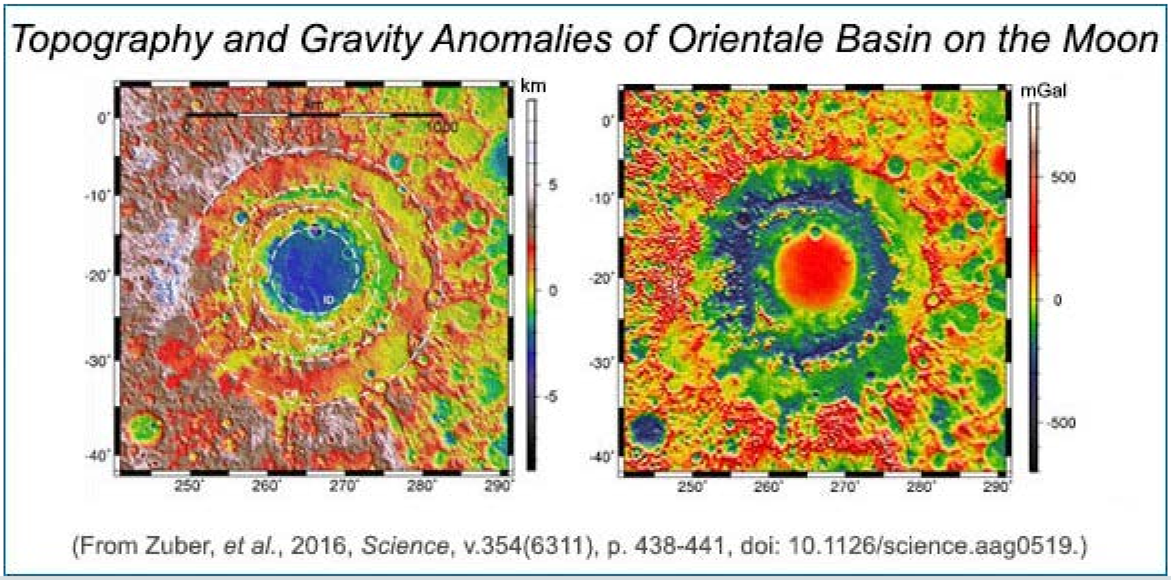
PLANETARY SCIENCE RESEARCH DISCOVERIES

CosmoSparks

Quick Views of Big Advances

Measuring and Modeling the Structure of the Best-Preserved Impact Basin on the Moon

NASA's Gravity Recovery and Interior Laboratory (***GRAIL***) mission has measured the Moon's gravitational field in exquisite detail. The data have been used, in combination with high-resolution topographic data from the Lunar Observer Laser Altimeter on NASA's Lunar Reconnaissance Orbiter (***LRO***), to study the Orientale basin in detail at a spatial resolution of 3–5 kilometers. Orientale is the youngest and best-preserved of the lunar multi-ring impact basins, making it the star of the show in studies of the formation of large impact structures in our Solar System.



Color-coded maps of Orientale basin, with color keys shown to the right of each map. [LEFT] Topography. The four white dashed circles correspond to basin rings. ***From NASA's LRO mission LOLA instrument***. [RIGHT] ***Free-air anomaly***, from ***NASA/JPL-Caltech***. 1 mGal = 1 milliGalileo = 10^{-5}m s^{-2}.

Two papers published in the 28 October 2016 issue of *Science* provide a consistent story of the structure and formation of the basin. One paper, led by Maria Zuber (Professor at the Massachusetts Institute of Technology and Principal Investigator of the GRAIL mission), provides the gravity data and structural interpretation based on the data. The other paper, led by Brandon Johnson (Assistant Professor at Brown University and former post-doctoral researcher at MIT), reports the results of quantitative computer modeling of the formation of the basin. Interpretation of the gravity data indicatse that at least 3 million cubic kilometers of the lunar crust was redistributed during formation of the Orientale basin and that a temporary hole (called the ***transient*** cavity) measuring between 320–460 kilometers formed during the impact, but was not preserved. The prominent rings are associated with steeply-dipping (50 degrees) faults that penetrate to the mantle. These observations are consistent with the impact modeling, which indicates a transient cavity of 390 kilometers forms but is not preserved, and that the flowing of warm, weak rock at depth causes formation of the faults at positions generally consistent with the locations of the basin rings.

The papers present a coherent picture of the formation of this large impact structure on the Moon. The general consistency between the interpretations of the gravity data and the results of the impact modeling indicate that planetary scientists have a solid understanding of the impact process. This has great implications for improving our insight of the accretion and early histories of the terrestrial planets.

See References:

· Zuber, M. T. and 27 others (2016) Gravity Field of the Orientale Basin from the Gravity Recovery and Interior Laboratory Mission, *Science,* v. 354(6311), p. 438-441, doi: 10.1126/science.aag0519. [***abstract***]

· Johnson, B. C. and 13 others (2016) Formation of the Orientale Lunar Multiring Basin, *Science,* v. 354(6311), p. 441-444, doi: 10.1126/science.aag0518. [***abstract***]

See also:

· Chu, J. (2016) Retracing the Origins of a Massive, Multi-ring Crater, ***MIT News Release***.

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