The Size of Lunar Impact Basins Determined by Gravity and Topography Data. Gregory A. Neumann[1] and the LRO/LOLA/GRAIL Teams. [1]Planetary Geodynamics Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA (Gregory.A.Neumann@nasa.gov)

Introduction: Lunar impact basins [1], large circular structures characterized by two (peak-ring basins) or more (multiring basins) concentric topographic rings, are the predominant geologic features visible on the surface. The mineral resources to be found near the surface of the Moon are intimately connected with the scale, depth of excavation of basin impacts and their subsequent evolution. Imaging and topographic mapping have permitted the determination of basin ring dimensions, but controversy persists to this day as to the size of the main topographic rim crest. The correspondence between gravitational signature and basin morphology provides a basis for the characterization of the diameter of the main ring, particularly where obscured by subsequent crater formation.

Previous studies: As an example, the diameter of the Serenitatis Basin has been characterized as 740 km [2], 658 km [3] and 920 km [4], with proposed rings as large as 1800 km. The diameter of Crisium is uncertain as well; there is a clearly defined topographic rim crest at ~800 km, while mapping of short mountain arcs believed to be remnants of the main ring provides an estimate of ~1090 km [3]. The complete topographic mapping by the Lunar Orbiter Laser Altimeter does not completely resolve this ambiguity, nor does topography alone constrain many more degraded basins on the lunar far side. The diameter of an impact crater is a basic parameter in the energy scaling and numerical modeling of the cratering process [5] and is relevant to studies of the early evolution of the solar system, yet consistent measurements are still lacking. The GRAIL Discovery Mission has provided an essentially error-free gravity field for the Moon, from which studies of the Bouguer anomaly and crustal thickness variation have provided more insight into the structure and evolution of impacts [6].

Results: This paper presents a catalog [7] of the lunar impact basins with an assessment of the main ring diameters, using the known relations among the diameters of a peak ring, the central Bouguer anomaly, and the main basin rim. We confirm a larger (1076-km-diameter) main ring for Crisium as well as a multiring structure and a proposed previous impact basin to the east. Originally considered to be larger than 300 km, the new inventory of basins begins with diameters > 200 km, including structures that lack confidently measurable topographic rings but which have Bouguer anomaly signatures that are typical of peak-ring basins, stands at 73. Several large basins such as Cruger-Sirsalis, for which the main ring has been buried by ejecta from later impacts, have dimensions estimated chiefly from gravitational expression of the central Bouguer anomaly high.

Conclusions: The catalog will provide greater confidence in the construction of size-frequency distributions and age sequences, particularly for the earliest history of the Moon. The data highlight disparities with impactor populations proposed to have arisen from the main belt asteroids.

References:

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