ANCIENT BURIED BASINS IN OCEANUS PROCELLARUM FROM THE FIRST BILLION YEARS. G. A. Neumann[1], A. N. Deutsch[2], and J. W. Head[2], [1]Solar System Exploration Division, Code 698, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA (gregory.a.neumann@nasa.gov), [2]Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI 02912, USA.

Introduction: Ancient, degraded basins have been identified from GRAIL Bouguer anomalies [1] and precise lunar topography. Better gravity and topography allow the existence of proposed basins to be confirmed or plausibly rejected on the basis of an anomaly produced primarily by crustal thinning and subsequent relaxation. The known relations among the diameters of basin rings and of the zone of thinning producing central Bouguer anomalies derived from well-preserved basins [2] allow inference of the approximate size of the main rim, even in some cases where no topographic rim is preserved. The impact parameters can thereby be compared in relation to the target properties and the flux of impactors.

Circular positive Bouguer gravity anomalies (PBGAs) and quasi-circular mass anomalies without discernible topographic signature can also be vestiges of impacts completely buried by subsequent mare volcanism [3]. However, the source of PBGAs is not necessarily due to impacts, given the likelihood of intrusive volcanism [4] or thorium-bearing silicic volcanism [5] giving rise to some of the anomalous gravitational signature in e.g., Compton-Belkovich or Aristarchus.

On the lunar nearside, especially in the Procellarum KREEP terrain, there are cryptic density anomalies that would increase the overall inventory of ancient impacts if their dimensions could be uniquely described. The mass anomalies proposed to be buried craters are only known by the extent of their prominent gravity gradient signatures [3] but are smaller than the 300+ km diameters traditionally ascribed to impact basins. We have focused on four PBGAs (*Fig. 1*) that are important in understanding the impact and volcanic/plutonic history of the Moon, in a region of elevated temperatures due to the Procellarum KREEP Terrane [6]. Analysis of the size of craters associated with PBGAs in anomalously thinner crust and elevated temperatures can affect the assessment of the early bombardment of the Moon since these predate the dominant 3.8–2.5 Ga pulse of mare volcanism. Forward modeling of the Northern Flamsteed PBGA, for example, incorporating the known depths of fresh lunar craters in mare regions [7], strongly suggests that mantle uplift from impact rebound or intrusive dikes controlled by impacts provides the bulk of the gravitational signal. This anomaly was earlier identified as quasi-circular crustal thickness anomaly CTA-24 [8], and was interpreted as a likely impact basin with a main ring diameter of 323 km. While our modeling based on much higher resolution data does not support quite as large a buried structure, the existence of additional basins in Oceanus Procellarum has long been proposed and may yet be determined from gravitational modeling.

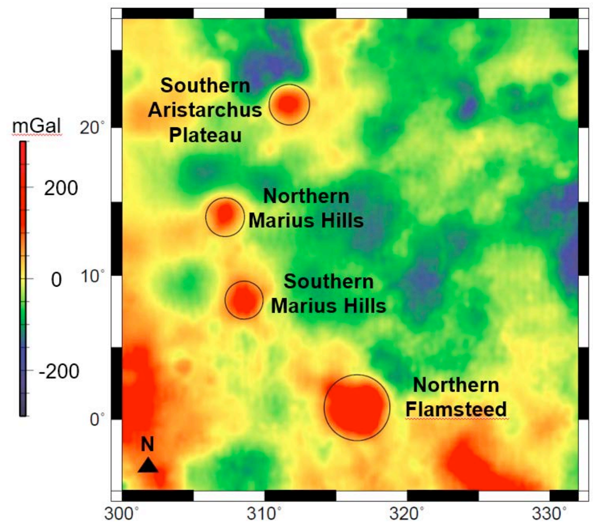

Fig. 1. Four 80–120 km diameter positive Bouguer gravity anomalies in Oceanus Procellarum. Modeling suggests they may arise from larger impacts in thin (13-16 km) crust.

Conclusions: The detection of additional buried basins on the lunar nearside may help reconcile the apparent difference in size-frequency distribution of impacts between the two hemispheres [1]. The suggested increment in the range of 150–300 km in diameter may remedy some of the discrepancy between the main asteroid belt population statistics and the lunar record, but does not address the implied deficit of very large basins [9].

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