WHAT ARE LUNAR BASINS? Gregory A. Neumann[1], Erwan M. Mazarico[1,3], Frank G. Lemoine[1], David E. Smith[2], Maria T. Zuber[2], [1]NASA Goddard Space Flight Center, Greenbelt, Maryland 20771 (Gregory.A.Neumann@-nasa.gov); [2]Massachusetts Institute of Technology, Cambridge, MA 02129; [3]Oak Ridge Associated Universities, Oak Ridge, TN 37831.

Introduction: Hartmann and Wood [1] characterized basins as impact craters > 300 km in diameter, with a near-circular planform and no central peak, possibly floored by mare, and possibly with multiple circular tectonic features. Additional features may also include positive free-air gravity anomalies and crustal thinning [2]. The identification of basins was based primarily on geological mapping from 1971-1977 [3] supplemented by Clementine topography [4], and with few modifications persists in modern form on the web [4]. Geophysical observations from LRO, particularly the more precise topography from the Lunar Orbiter Laser Altimeter (LOLA), allow re-examination and perhaps removal of some basins that were classified as uncertain, while several circular depressions could well be added.

Constraints on Impact Processes: Mapping of closed contours and elliptical regions in topography and, crustal thickness [5], as well as maps of composition [4] has been used to study impact history and geological age. Thus an objective assessment of likeliness that some number of impacts of large scale requires care, given their small number. The table below summarizes the questionable status of basins in the compilation online [6]. This compilation lists 52 basins. Topographic data examined from LOLA provides no indication that 13 meet these criteria, in the sense of negative relief and bounding scarps. Mare flows have completely obscured topographic features in several putative basins, as opposed to one or two smaller craters with elevated floors overfilled with lava but distinct rims. In others, the apparent slightly negative relief may result from a regional slope.

Table 1:. Uncertain basins listed by location, name, and topographic characteristics.

long, lat	Rad.	Name (Wilhelms)	topography
112, 1	295	Al-Khwarizmi-King	no depression
-68, -67	165	Bailly-Newton	no depression
70, -15	250	Balmer-Kapteyn	small depression
-45, -7	285	Flamsteed-Billy	no rim
-161, -44	300	Grissom-White	no rim
-30.9, 7.5	300	Insularum	no depression
162, -10	250	Keeler-Heaviside	no depression
105, 19	310	Lomonosov-Fleming	E-W slope
-82, -56.5		Pingre-Hausen	no depression
111, -68	155	Sikorsky-Rittenhaus	min. depression, no rim
45, 83	250	Sylvester-Nansen	no depression
128, -15	350	Tsiolkovsky-Stark	no depression
12, -24	250	Werner-Airy	no depression

We exclude from consideration the nearside Australe, Fecunditatis, Marginis, Mutus-Vlacq, and Tranquillitatis maria, which have been described as age group 3 pre-Nectarian basins [1]. Some basins that have been described as questionable (Amundsen-Ganswindt) have distinct near-circular topographic depressions. To the Marginis- and Tranquillitatis-type mare basins could be added one feature in northwest Procellarum (Fig. 2, "LOLA") whose circular morphology is faintly discernible in high-resolution topography. Lastly, the postulated supergiant basin [9] should be considered owing to the circular boundary between it and the farside highlands (Fig. 3), interrupted by the South Pole-Aitken basin and bounding massifs.

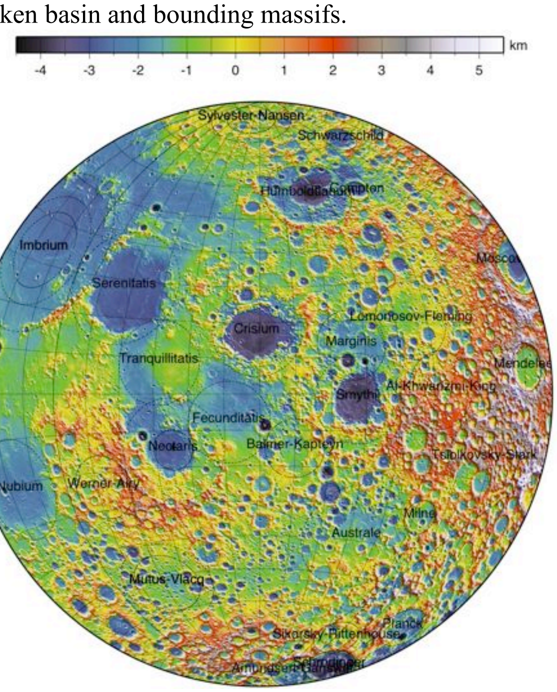

Fig. 1. LOLA nearside elevations with respect to a geoid of equatorial radius 1737.4 km [12]. Lambert Equal-Area Projection centered on 60°E longitude.

Constraints from Crustal Thickness: Assuming densities of 2800 and 3300 kg m^{-3} for crust and mantle, and by downward-continuing the recently-released SELENE gravity data [10] and reprocessed GLGM3+ [11] gravity anomalies to the lunar moho, we will geophysically evaluate the likelihood of an impact origin for the questioned features. No clear circular mascon features have been found previously, e.g., [13] to confirm these as basins.

References: [1] Wilhelms D.E. and McCauley J.F. (1971) USGS Map I-703; Wilhelms D.E. and El-Baz F. (1977) USGS Map I-948; Wilhelms D.E. (1987) *Geological History of the Moon, USGS Professional Paper 1348.* [2] Hartmann W. K. and Wood C. W. (1971) *The Moon 3, 3*-78. [3] Neumann G. A. et al. (1996*) J. Geophys. Res., 101, 16,841-16,863.* [4] Frey H. et al. (2002) *GRL, 29(10)*, 10.1029/2001GL01382. [5] Garrick-Bethell I. and Zuber, M. T. (2009) *Icarus, 204*, 399-408. [6] http://the-moon.wikispaces.com/Lunar+Basins. [7] Smith D. E. et al. (1997) *JGR*. [8] Zuber M. T. et al. (2007) *Space Sci. Rev., 131*, 105-132. [9] Byrne, C.J., (2008) A large basin on the near side of the Moon, *Earth, Moon, and Planets*. [10] Namiki N. et al. (2009), *Science (5916)*, *900 - 905*. [11] Mazarico E.M. et al. (2010) "GLGM-3 gravity field", *JGR*, in press. [12] Smith D. E. et al., this meeting. [13] Konopliv A. et al. (2001), *Icarus, 150, 1-18*.

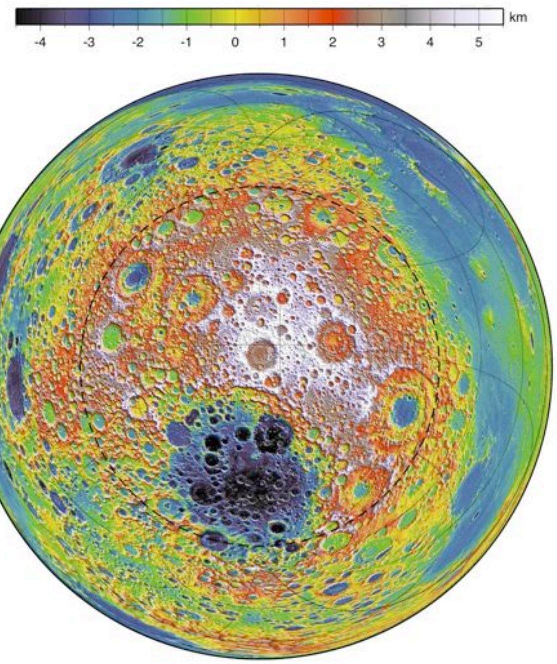

Fig. 3. Lambert Equal-Area Projection of geopotential topography of the entire Moon, centered on the antipode of a suggested large basin [9] at 22°E, 8.5°N covering 5/8 of the surface. The South Pole-Aitken Basin is superimposed on the lower half of this elevated region.