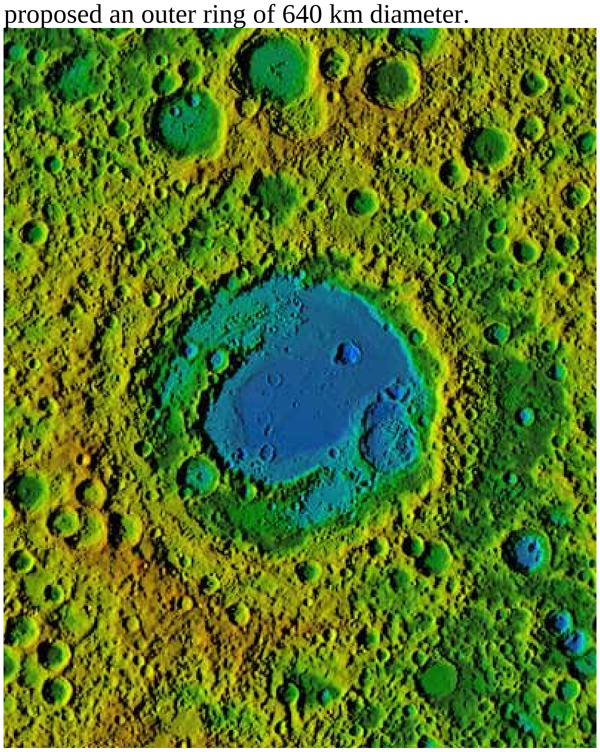
New Light on Old Basins. C. A. Wood[1] and M. J. S. Collins[2], [1]Planetary Science Institute, Tucson, AZ, and Wheeling Jesuit University, Wheeling, WV; chuckwood@cet.edu; [2]10 Cargill Grove, Palmerston North, 4414 New Zealand, mauricejscollins@hotmail.com

Introduction: Impact basins are the largest landfoms in the solar system. They dig deep holes into planetary crusts, revealing much about crusta lithologies, and they broadly scatter ejecta, defining instantaneous regional time horizons. Basins were first detected on the Moon, and as that world is undergoing a second golden period of scientific exploration, many new data sets are available to detect and refine our understanding of basins.

One of the most valuable new data sources is digital altimetry from Kaguya and Lunar Reconnaissance Orbiter which provides inputs for high resolution visualizations of the lunar surface. We use Jim Mosher's Lunar Terminator Visualization Tool [1] to prepare topographic images of basins of interest, viewed from any perspective and with any Sun elevation. We also use LRO WAC (Wide Angle Camera) mosaics released by the LROC team to investigate basins.

Appleton-Tsu Basin: The Moscoviense Basin was one of the first landmarks detected on the farside because its dark mare lavas were conspicuous against the brightness of the northern highlands. Later Lunar Orbiter images were used to define the ring structure of the multi-ring basin, and later still Spudis and Pike [2] proposed an outer ring of 640 km diameter.

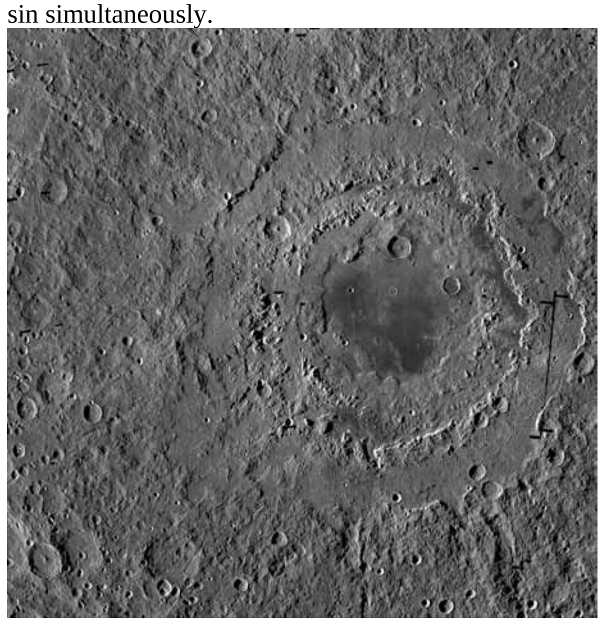


Appleton-Tsu Basin surrounds Moscoviense Basin. LRO LOLA altimetry visualization.

On Kaguya altimetery images the outer ring is seen to not be concentric with the interior rings. This was not easy to notice with previous imgery, but is now clear with overhead views constructed with the data-rich LRO LOLA altimetry. Wood [3] proposed that this offset large ring was not related to the Moscoviense Basin, but was an early basin whose interior was destroyed by the formation of the smaller Moscoviense Basin – Wood proposed calling it the Appleton-Tsu Basin (ATB) after bounding craters.

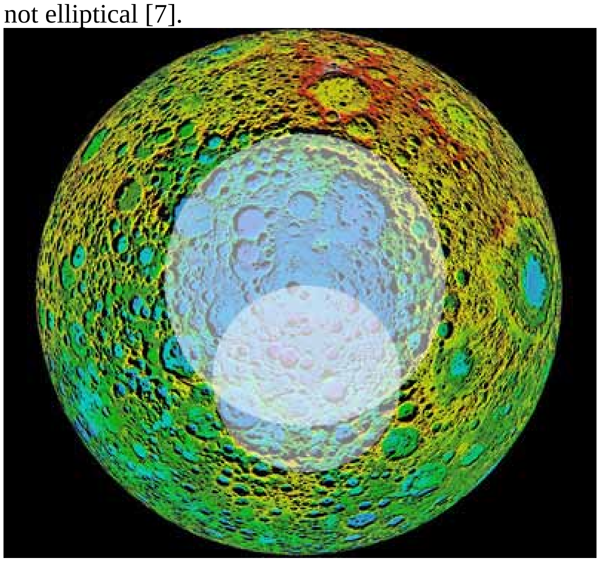
The ATB helps explain two anomalies of Moscoviense. Kaguya scientists [4] found that the thinnest crust on the Moon is at Moscoviense, deep within the otherwise thick farside highland crust. Perhaps ATB previously thinned the crust, and the Moscoviense Basin cut down deeper. The double thinning may also explain why mare lava occurs in Moscoviense, far from any other mare deposits on the farside.

Orientale Basin: A LRO WAC mosaic [5] provides the first ever high resolution view across the entire Orientale Basin. The WAC view is especially informative about the western half of the basin (because we've never seen it so well before). In particular, the southwest part of the Cordillera Rim completely breaks up, as does the nearly Outer Rook ring. The large irregularity of this part of the structure suggests a small basin, or perhaps a strongly oblique impact with fragmentation of the projectile making the smaller basin simultaneously.



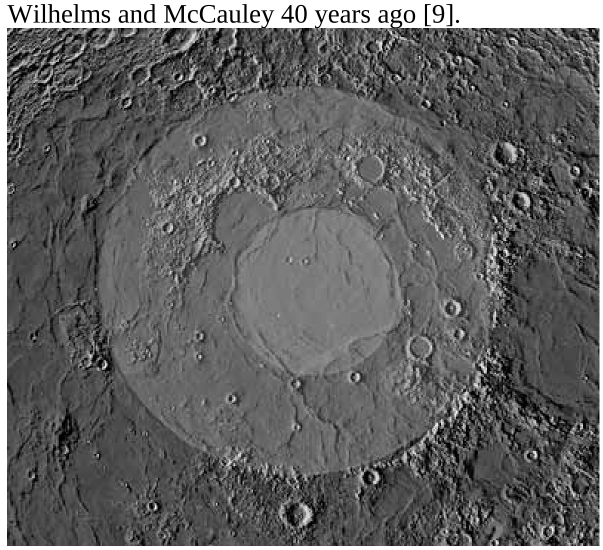
Orientale Basin from LRO WAC mosaic.

South Polar-Aitken Basin: A vertical view of LRO altimetry centered on SPA reveals the remarkable circularity of the rim, except for the side near the lunar South Pole [6]. Here, the main basin rim disappears, with apparent basin rim peaks being displaced away from the canonical circle. The familiar Leibnitz Mountains, long thought to be part of the SPA rim, may instead be part of a separate basin about 1400 km wide, with the opposite side passing through the crater Bose. If this South Pole - Bose basin is real, it would help explain the offset of the deepest part of SPA to the south of its assumed geometric center. In this speculative interpretation the deepest part occurs in the overlap area of the two basins, where the crust was already thin when SPA formed. In this case the SPA is 2100 km in diameter, smaller than usually depicteded, and not elliptical [7].



SPA Basin (large circle) and proposed additional basin (small circle) on LRO LOLO altimetry.

Imbrium Basin: This large and relatively young basin is notoriously difficult to define a diameter and ring structure for because of the incompleteness of its Apennine-Carpathian rim. However, employing an Imbrium centered LRO LOLA altimetry visualization [8] yields a homogenous depiction of all relevant mountains and mare ridges which suggests better placement of rings that previous inferior data allowed. Mare ridges in western Imbrium fall on a circle continuing the trend of the Apennines and the Carpathians, and hence bounding the east side of the Aristarchus Plateau and around to the north shore of Mare Frigoris, with ridges between Plato and Archytas carrying the rim back toward the Caucasus. An inner ring is fit almost entirely to the mare ridges; with an intermediate ring probably associated with the Archimedes Mountains and Mount Pitan but not delineated here. These ring assignments are nearly identical to those of Wilhelms and McCauley 40 years ago [9].



Imbrium Basin visualized with LRO LOLA altimetry.

Comments: Until very recently all investigations of lunar basin ring systems were based on data sets that were much lower in homogeneity and resolution than now available from LRO and Kaguya. Our preliminary perusal of these new materials has led to questioning of the dimensions and histories of three of the most important lunar basins. Multiple impacts, or perhaps oblique impacts, should be evaluated for each.

References:

[1] http://ltvt.wikispaces.com/LTVT. [2] Pike R.J. and Spudis P. D. (1987) *Earth, Moon & Planets 39*, 129-194. [3] http://lpod.wikispaces.com/November+23%2C+2009. [4] Ishihara, Y. and others (2009) Geoph. Res. Lett. 36, L19202. [5] http:// lroc.sese.asu.edu/news/index.php?/archives/247-Orientale-Basin.html. [6] http://lpod.wikispaces.com/June+22%2C+2010. [7] Garrick-Bethell, I. and Zuber, M. (2009) *Icarus, 204*, 399-408. [8] http:// lpod.wikispaces.com/June+7,+2010. [9] Wilhelms, D. E. and McCauley, J. F. (1971) *US Geol. Sirv.Map I-703.*