USING A NEW CRUSTAL THICKNESS MODEL TO TEST PREVIOUS CANDIDATE LUNAR BASINS AND TO SEARCH FOR NEW CANDIDATES. H.M. Meyer, Geology & Environmental Geosciences, College of Charleston, Charleston, SC 29424, hmmeyer@g.cofc.edu, and H. V. Frey, Planetary Geodynamics Lab, Goddard Space Flight Center, Greenbelt, MD 20771, Herbert.V.Frey@nasa.gov.

Summary: A new crustal thickness model was used to test the viability of 110 candidate large lunar basins previously identified using older topographic and crustal thickness data as well as photogeologic data. The new model was also used to search for new candidate lunar basins > 300 km in diameter. We eliminated 11 of 27 candidates previously identified in the older crustal thickness model, and found strong evidence for at least 8 new candidates.

Introduction: Frey [1] used ULCN topography and a crustal thickness model [2] based on Clementine and Lunar Prospector data to search for previously unrecognized large lunar basins. His inventory of 98 candidate basins included 33 named features from the compilation by Wilhelms [3] (but only those showing basin-like topographic structure), 38 additional Quasi-Circular Depressions (QCDs) and 27 Circular Thin Areas (CTAs) not associated with the named and QCD candidates. Not all of these are viable candidate, as described elsewhere [4,5]. Here we describe the use of a new crustal thickness model [6] based on Lunar Orbiter Laser Altimeter (LOLA) topography and a gravity model derived from Kaguya data. The new model not only has significantly improved spatial resolution, but also shows in places substantial change in the pattern of crustal thickness variations. Figure 1 shows an example for the area near the Schrodinger impact basin and Figure 2 shows an example for the Lorenz basin area.

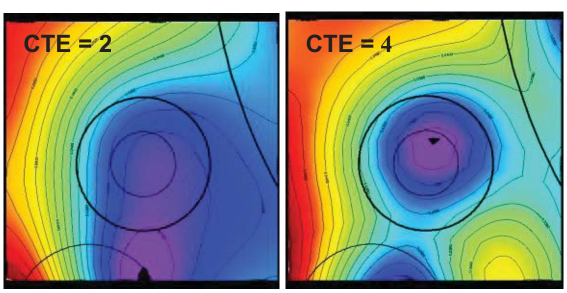

Figure 1: Crustal thickness from the older Wieczoreck et al. model [2] (left) and the newer Wieczorek et al. model [6] right. Blues represent thin crust, reds are thicker crust. Contour interval is 2.5 km. Double circle is the known 320 km wide Schrodinger 2-ring basin located at 75S, 226W. A Crustal Thickness Expression (CTE) score of 2 (out of a possible 5) was assigned to Schrodinger on the basis of the old model because the crustal thickness signature lacks the circular pattern expected for impact basins. In the new model, the Circular Thin Area (CTA) signature is very obvious, and Schrodinger was given a CTE score of 4.

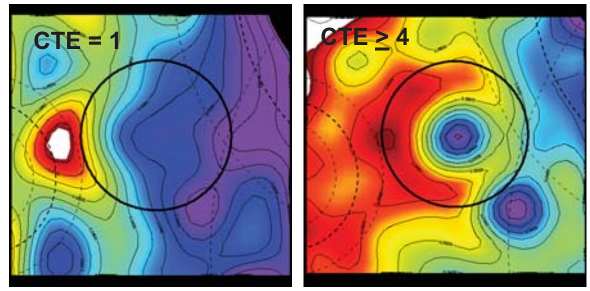

Figure 2. Older [2] (left) and more recent [6] (right) model crustal thickness data for the area around the Lorenz Basin. The old model had a very weak Circular Thin Area (CTA) signature and Lorenz was given a CTE score of 1 [1]. The more recent model shows a very well-developed CTA centered on the basin that earns a CTE score of ≥4.

Testing the viability of previously found candidate basins. For each candidate basin (including 12 new candidates found from a preliminary search of LOLA data; see [7]), we determined a new "Crustal Thickness Expression" (CTE) score as had been previously done using the older model. CTE scores (and corresponding "Topographic Expression" (TE) scores based on LOLA data; see companion abstract [5]) were on a scale from 0 (no obvious depression or thinned crust) to 5 (very strong circular signature). Figure 2 compares the newer CTE scores from both of us with those from the earlier work by HF[1].

Generally both HM and HF find the same new CTE score within +/- 1. For **named features**, the new CTE scores are mostly equal to or higher than those previously determined, and where the new scores are lower they are only lower by ~1. Six basins with very low old CTE scores (Lomonsov-Fleming, Aamundson-Gaswhindt, Planck, Schrodinger (see Figure 1), Poincare, and Lorentz (see Figure 2) now have significantly higher CTE scores. Among **additional QCDs**, some scores rose and some dropped, mostly by ~1. Several candidates had scores drop from 4 to 3 or 2, and at least 5 former 3's are now rated 2 or below (i.e. not a convincing signature). On the other hand, at least 5 candidate basins had their scores rise by 1 or more, including one that went from 1 to 3 and another that went from 2 to 4 (HF) or 5 (HM). Candidate basins first identified as **other CTAs** in the older model data [1] do not fare so well: most have new CTE scores lower than before, but generally by only ~1. But at least 9 still retain new CTE scores ≥ 3.

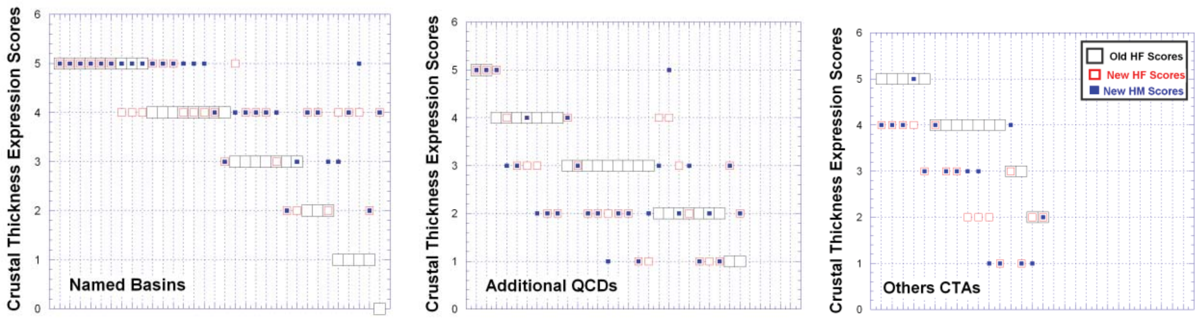

Figure 2. Old and new Crustal Thickness Expression (CTE) scores compared for the candidate inventory suggested by Frey [1] of named basins (left), additional QCDs (middle) and other CTAs (right). Large black squares = scores from [1] based on the earlier crustal thickness model [2]. Smaller open red squares and solid blue squares are scoring by HF and HM respectively using the newer crustal thickness model. The new CTE scores, along with corresponding new Topogrpahic Expression (TE) scores (combined into a summary score) were used to eliminate weak candidates.

On the basis of CTE scores combined with new Topographic Expression (TE) scores based on LOLA data (see [5]), we eliminated one more named feature (Sikorsky-Rittenhouse, because LOLA data show that its diameter is actually < 300 km), 11 additional QCDs and 11 other CTAs. With new candidates found in the LOLA data (see [5,7]) and the new crustal thickness model (described below), the current inventory of candidate basins with a total summary score (CTE + TE score) $\geq$3 is 95.

New Candidate Basins: We searched the new crustal thickness model [6] for additional CTAs not previously recognized [1] in the older model [2]. Several new candidate basins were found. Two examples are shown in Figures 4 and 5.

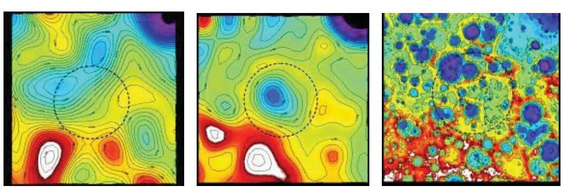

Figure 4. Crustal thickness from the old model [2] (top) and the new model [6] (middle) centered on 39N, 141W. The contour interval is 2 km. The newer model shows a well-developed Circular Thin Area (CTA) with a diameter of ~ 327 km that is not obvious in the older model and was not recognized by [1]. The Crustal Thickness Expression (CTE) score for the feature in the middle panel is 4. This CTA has little obvious expression in the LOLA topographic data (right). Low elevations in blue, high elevations in red. Contour interval is 500 m. The area has abundant impact craters but only a hint of the larger circular structure, which, if real, may be an old buried basin.

HM originally found 18 candidates not previously recognized by [1], though some of them should have been obvious in the older model data (see Figure 5). Not all of these have survived detailed study, but 8 new CTAs have been added to the inventory based on their high CTE scores. Most are small (< 400 km diameter) and have little to no topographic expression (see Figure 4).

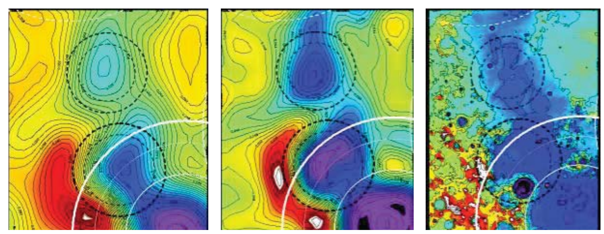

Figure 5. Old (left) and new (middle) crustal thickness for the area centered on 2S, 336W, NW of Nectaris (white rings). The CTAs (dashed black circles) were not identified by [1] in the older data, but are clearly present and especially obvious in the newer data. Though not well indicated in the LOLA topographic data (right), the larger CTA appears to have affected the ring structure of Nectaris.

Summary. The new crustal thickness model [6] has helped test the validity of candidate basins previously suggested [1], resulting in deletion of 1 more named basin, 11 additional QCDs, and 11 other CTAs. But the new data also provide strong support for 8 new CTAs which have been added to the working inventory, now at 95 candidate basins > 300 km in diameter.

References: [1] Frey, H.V. (2010) Chapter 2, GSA Special Publication *Recent Advances and Current Research Issues in Lunar Stratigraphy*. [2] Wieczorek, M.A. et al. (2006) New views of the Moon: Reviews in Mineralogy and Geochemistry, vol. 60, 221-364, 2006. [3] Wilhelms, D.E, (1987) The Geologic History of the Moon, USGS Professional Paper 1348. [4] Frey, H. V., H. M. Meyer and G. C. Romine (2012) *Early Solar System Impact Bombardment II,* Abstract #4005. [5] Frey, H.V., H.M. Meyer and G.C. Romine (2012) LPSC 43 (this meeting). [6] Wieczorek, M.A., private communication. [7] Frey, H. and G. Romine (2011) LPSC 42 abstract #1190.