Middle Size Lunar BGA Mascon Basins Identified By Using CE-1 LAM & Gravity Data

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Overview: Lunar mascon basins have been identified using lunar topography and gravity model by means of both of the free air[1-3] and Bouguer gravity[4-5]. In an early study, we calculated the terrain correction using an average crust density of 2650kg/m^3 for lunar free-air gravity anomaly (FAGA), based on the global topography model CETM-s01 detected by the laser altimeter (LAM) on Chang'E-1 (CE-1)[6]. The obtained lunar Bouguer gravity anomaly (BGA) reveals density irregularities of the interior mass, where the South Pole-Aitken (SPA) basin was found to be the largest mascon basin on the Moon[4]. Due to the lunar impact mascon basins have been dominated by an isosdetic processing of the mantle uploading and balsalt filling at basin bottom, this evolution is directly connect with igneous activity. Identifying the mascon basins of various features will give more informations to uncover the lunar dynamical evolution history.

Preparing work: To search the possible new mascons, we updated the lunar DEM and lunar gravity using the data of CE-1 and SELENE. To update the LAM measurements by CE-1, a short term drift in time tag was removed, s/c new orbits database with far-side gravity information was adapted[5], a long term drift in LAM counting frequency standard was calibrated. The lunar gravity model was also improved as CEGM02 by merge the tracking data of CE-1 together with historical data[7]. The updated lunar gravity model and DEM model were used to obtain the Bouguer gravity. From the BGA map, we found an early identified ancient middle scale far-side basin, Fitzgerald-Jackson by CE-1 DEM is a mascon basin[5]. An ancient mascon basin was found at southern pole area with half size impacted by Shordinger basin. Including them, some middle scale lunar ancient mascon basins were discovered[8].

Hidden impact mascon basins: Usually, the type I~II mascon basins can be clearly identified by combining the lunar large positive FAGA with DEM depression directly[1-3]. However, some environments may hide the mascon or basin. An ancient basin is difficult to identify as an independent on using image or DEM data only, if it was destroyed by a similar size second impact, or by many small size second impacts; this ancient impacting might take place in the era of magma ocean, only mantle uploading under the impacting area happened without obvious depression and kept till now. Also for an obvious depression area, if its FAGA at center area is flat or very weak positive, it may be classified as common type depression basin. For the middle size basins of a couple hundreds kilometers in diameter, new lunar missions may give us a chance to check the DTM, DEM, FAGA and BGA of lunar surface, so as to find hidden ancient mascon depressions as basins.

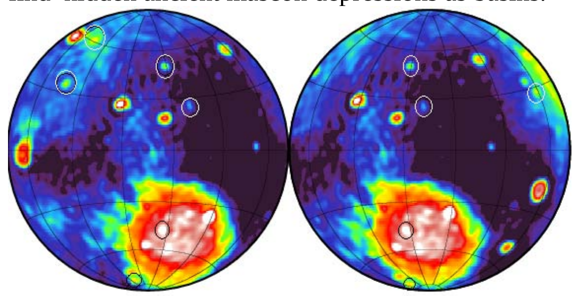

Figure 1. 7 Newly identified Lunar Far-side BGA basins.

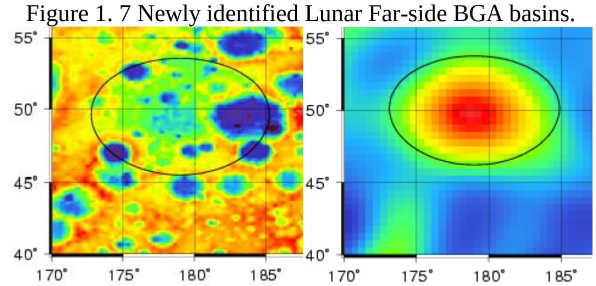

Figure 2. CEFC01 Basin: LAM Topography and BGA.

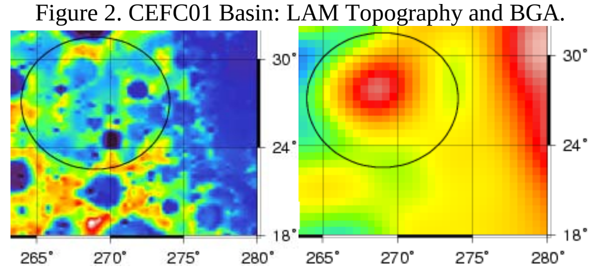

Figure 3. CEFC02 Basin: LAM Topography and BGA

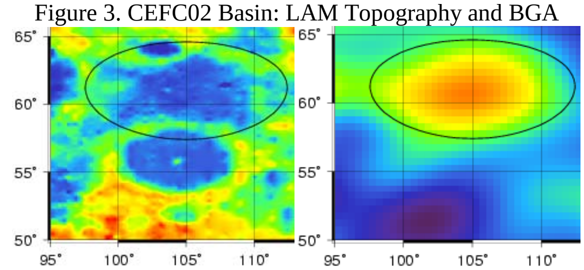

Figure 4. CEFC03 Basin: LAM Topography and BGA

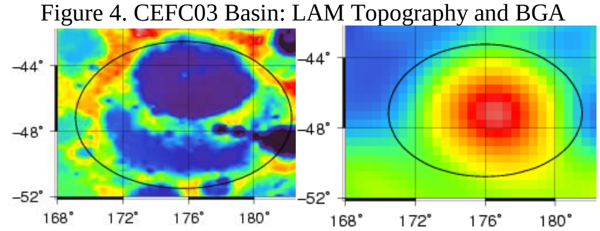

Figure 5. CEFC04 Basin with 2/3 size broken at the north part by the Von Karman Basin: LAM Topography and BGA

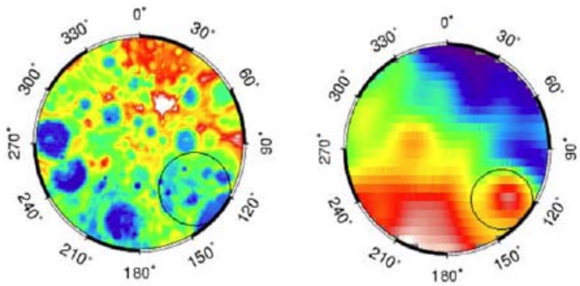

Figure 6. Amundsen-Ganswindt at South pole area beside Shödinger Basin: LAM Topography and BGA.

New identified Mason Basins by CE-1: CE-1 mission obtained the lunar global DTM, DEM and gravity successfully. Even without super high resolution, these data are powerful enough to support the lunar dynamical and physical studies. Taking the advantages of these CE-1 results, we obtained BGA of the moon, and compared above data degree by degree. From the results, 8 mason basins are newly identified and listed in Table 1. The basins of Fitzgerald-Jackson, Amundsen-Ganswindt and Cruger-Sirsalis have been discovered by using Clementine DTM data[10-11] as average lunar basins with large error of sizes. treated as common basins; all of these basins show strongly positive BGA; 7 basins appear at far-side, see Figure 1; 3 basins are type II FAGA mascons; 5 basins are BGA mascons; 5 basins are located at northern hemisphere and 3 basins at southern hemisphere; 6 basins are lower than average reference sphere. CEFC02 and CEFC03 show No obvious topographic depression of flat background DTM; CEFC04 and Amundsen-Ganswindt have been impacted and hidden by neighbor basins, part circle depressions and strong positive BGAs make then out as mascon basins; CEFC01 and Cruger-Sirsalis show flat or weak positive FAGA, obsvious topographic depressions in CE-1 DEM data. New identified CEFC01, CEFC02 and CEFC03 mascon basins might appear before other Pre-Nectarian basins. Combing DTM, DEM, FAGA and BGA data together, is giving us a new chance to identify the middle scale ancient mascon basins. Detail studies of these hidden ancient basins will be carried out in the near future.

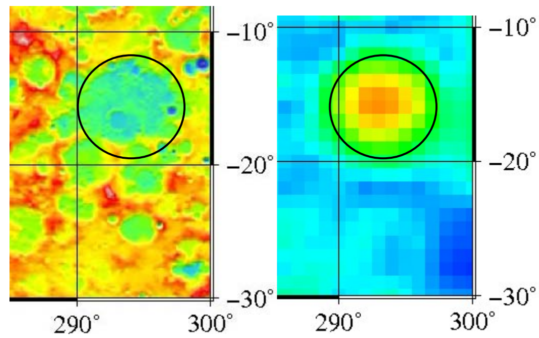

Figure 7. Cruger-Sirsalis Basin: LAM Topography, BGA and LRO image.

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References: [1] Konopliv, A. S. et al. (2001) Icarus 150, 1-18; [2] Namiki, N. et al. (2009) Science, 323, 900-905. DOI:10.1126/science.1168029. [3] Matsumto, K. et al. (2010) JGR, 115, E06007, DOI: 10.1029/ 2009JE 003499. [4]Liang, Q. et al. (2009) Sci China Phys Mech Astron,52, 1867–1875. [5] Ping, J. et al. (2011) Sci China Phys Mech Astron, 54, 2130-2144. DOI: 10.1007/s11433-011-4561-0. [6]Huang, Q. et al. (2009) Sci China Phys Mech Astron, 52: 1815–1823. [7]Yan, J.G. et al. (2011) Sci Sin Phys Mech Astron, 41, 870–878, doi: 10.1360/132010-868.[8]Ping, J.S. et al. (2012), in 6th Kaguya Science Symposium.[9] Cook, A. C. et al. (2002), LPSC XXXIII, #1281. [10] Konopliv A.S. and Yuan D.N. (1999) *LPSC XXX*, #1067.

Table 1. List of newly identified middle scale lunar BGA mascon basins by Chang'E mission

Basin Name or Suggested Code	Location (E°, N°)	Diameter (KM)	Height(KM)		BGA(mGal)		Type
			RIM	Bottom	RIM	Bottom	
Szilard	105. 7, 34.0	122	-1.1	-4.1	50	256	II
Fitzgerald -Jackson	191, 25	470	3.2	-0.6	-226	84	III
CEFC01(unnamed)	178, 50	230	2.2, 0.4	-0.3	-130	220	III
CEFC02(unnamed)	269, 26	310	-0.5	-1.5	24	266	III
CEFC03(unnamed)	105, 61	290	-3.0	-4.4	140	291	III
CEFC04(unnamed)	176, -44. 8	190	-4.5	-7	560	722	III
Amundsen-Ganswindt	130,-81	348	-1.0	-3.0	110	370	II
Cruger-Sirsalis	293,-15.5	310	0.3	-2.5	-90	260	II

Note: type II is defined same as Namike et al. (2009), type III basin indicates strong positive BGA at center area with weak FGA and less obvious signal in image data, can be partly identified by high resolution DEM data.