Characterizing ancient impact basins discovered by GRAIL gravity data

J. W. Conrad[1], F. Nimmo[1], G. A. Neumann[2], S. Kamata[3], and C. I. Fassett[4]

[1] Department of Earth and Planetary Science, University of California Santa Cruz, Santa Cruz, CA 95060
[2] NASA Goddard Space Flight Center, Greenbelt, MD 20771
[3] Dept. Natural History Science, Hokkaido University, Hokkaido, Japan
[4] Dept. Astronomy, Mount Holyoke College, South Hadley, MA 01075
Contact. jwconrad@ucsc.edu

Abstract. Lunar impact basins have received great research interest in the past few years thanks to the GRAIL mission[1]. Many large basins on the Moon are not significantly relaxed. Some of these basins, however, can be identified based on their Bouguer gravity signature[2], but do not correspond strongly with any topographic features. Such basins have potentially undergone relaxation, which requires a relatively hot ancient lunar crust[3]. In order to study the relaxation of these proposed basins relative ages need to be found. Many of these candidate basins have had other, younger material superposing the material excavated during that basin's formation. To that end, the buffered crater count method as outlined in Fassett 2008[4] was used to date the impact basins. An example of one of these counts is shown in fig. 1. Relatively ancient ages were derived for these basins. Yet this is not really a surprise due to the lack of topographic expression which arises from the slow erosive nature of impacts. Now that we have their relative ages their degree of relaxation can be used to place constraints on the early thermal evolution of the Moon. A reasonable proxy for the degree of relaxation can be obtained by finding the ratio of the crustal thickness at about 2-3 radii to the thickness at the center, where the crustal thickness values of Mark Wizoerick 2013[5] are used. When the basins with reasonable counts are compared with the known basin catalog they show properties similar to others of the same age.

[1] M. Zuber, et al. *Science*, 339, 668-671 (2013).
[2] G. Neumann, et al. *Science Advances*, 1, e1500852 (2015).
[3] S. Kamata, et al. *Icarus*, 250, 492-504. (2015).
[4] C. Fassett, J. Head, *Icarus*, 195, 61-89 (2012).
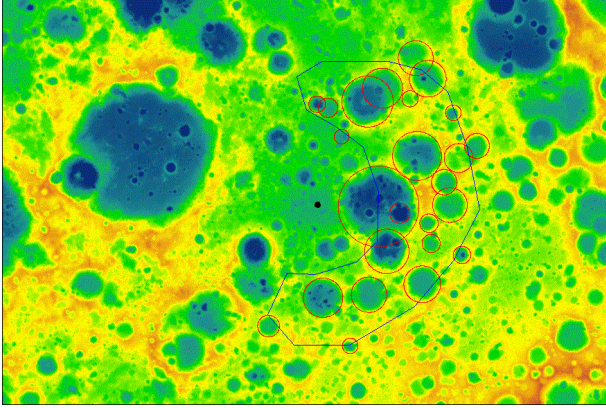[5] M. Wizoerick, *Science*, 339, 671-675 (2013).

Figure 1: Identification of craters for the proposed TOPO-22 basin. Note the buffered crater counting technique allows a single geologically consistent unit to be counted, in this case a ridge to the east of the basin center, which is taken to be associated with the original basin-forming event.