A TOPOGRAPHIC ANALYSIS OF BEETHOVEN BASIN, MERCURY. S. L. André[1], T. R. Watters[1], and M. S. Robinson[2], [1]Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington, D.C., [2]Center for Planetary Sciences, Northwestern University, Evanston, IL.

Introduction: Beethoven Basin (Figure 1) is a subdued impact basin (diameter 625 km) located at 20°S, 124°W within the Beethoven Quadrangle (25°N to 25°S, 72°W to 144°W) of Mercury. Images of the Beethoven Quadrangle were acquired by Mariner 10 under high sun angles, making it difficult to observe the morphology of features within the images [1]. Previous studies concluded that Beethoven Basin was resurfaced with a unit interpreted to be Tolstojan smooth plains material [2,3,4]. Beethoven Basin has an extremely subdued rim and no other observable rings [2,3,4]. We analyzed the long wavelength topography of Beethoven Basin using digital elevation models (DEMs) generated from Mariner 10 stereo pairs in an effort to characterize the interior structure of the basin. Topographic profiles across Beethoven Basin indicate that it is a relatively shallow basin with a broad interior topographic rise near the northwest margin, ~200 km from the center of the basin. To better understand this feature, we compare the long wavelength topography of Beethoven Basin to that of similarly-sized basins on the Moon, Serenitatis (~600 km diameter) and Orientale (~900 km diameter).

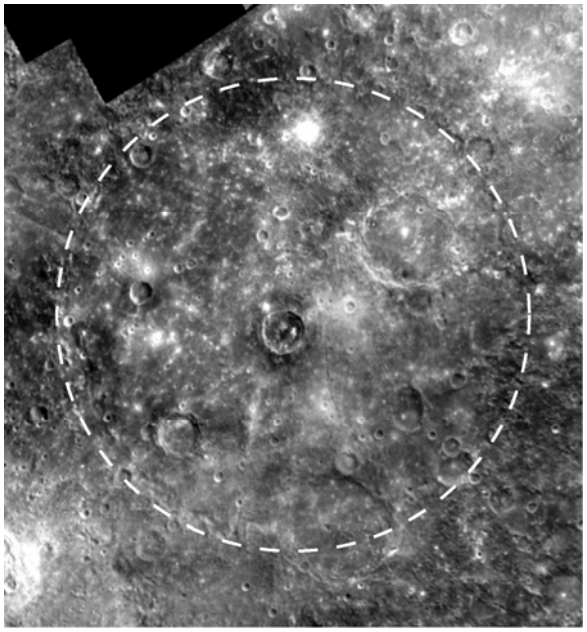

Figure 1. Mariner 10 image mosaic of Beethoven Basin (11°S to 31°S, 114°W to 134°W). The dashed circle indicates the subdued rim of the crater.

Methods: A DEM of the Beethoven Basin (Figure 2) area was generated from 15 Mariner 10 stereo-pairs [5,6] using stereo-matching software, SMTK [7,8]. Topographic profiles were then extracted from the DEM. Profiles of Serenitatis and Orientale were obtained from the global lunar DEM generated by data collected from the Clementine laser ranging instrument (LIDAR) [9]. Examples of profiles across all three basins are shown in Figures 3 and 4.

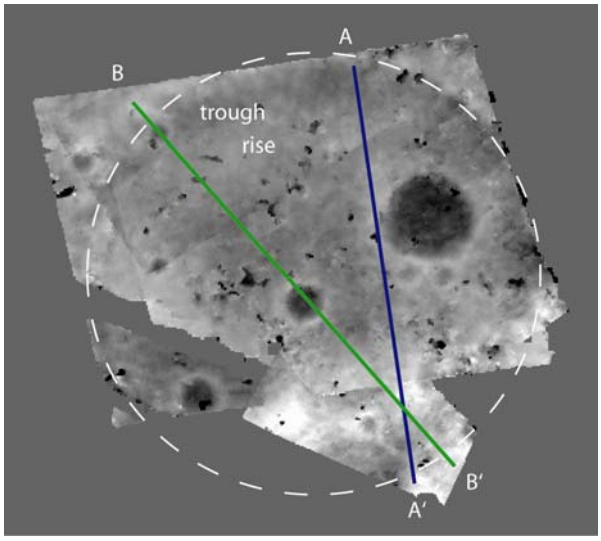

Figure 2. DEM of Beethoven Basin, created from 15 Mariner 10 stereo pairs. The correlation box size used in the stereo matching process was 21x21 pixels. Black spots throughout the DEM indicate areas that were not matched (due to noise within the images). The green and blue lines are the locations of profiles shown in Figure 3.

Results: The topographic profiles through Beethoven Basin (Figure 3) indicate an interior trough (1 km deep) inside the northwestern basin rim. Beyond the margin (between 50 and 200 km distance along the profile A-A', and between 100 and 225 km distance along B-B'), there is a broad topographic rise. The rise extends for ~120 km along the profiles, and the elevations again lower at the center of the basin. It is difficult to determine if the pattern is symmetric with the other side of the basin: a series of small impact craters obscure the southeastern rim of the basin.

Figures 3 and 4 illustrate the differences and similarities in topography between the lunar and mercurian

basins. The long wavelength topography of Serenitatis Basin indicates that the center of the mare is higher than that of the margins [i.e. 10]. Orientale has prominent rings that exhibit an asymmetric step profile. The topography of Orientale indicates that the lowest elevation occurs within the center of the basin. Beethoven has more relief (~4 km) than Serenitatis (~2 km), but much less relief than Orientale (~7 km). Of the two lunar examples, the long wavelength topography of Beethoven more closely approaches that of Serenitatis; Beethoven, like Serenitatis, has low elevations near the margins and a topographic rise in the interior. Unlike Serenitatis, the center of Beethoven is lower than the topographic rise.

Discussion: Mare Serenitatis is one of the near side lunar mascons [cf. 11]. The long wavelength topography of Serenitatis reflects a history of subsidence and deformation due to a non-Gaussian-shaped, superisostatic load from the mare basalts that resulted in flexure of the lunar lithosphere [cf. 10]. We suggest that after Beethoven Basin was flooded by smooth plains [2] it underwent subsidence; the lower elevations near the margins and the center of the basin may have been caused by differential subsidence of the smooth plains. The topographic rise could be an area that experienced less subsidence than the margins or basin center, possibly due to the presence of a preexisting basin inner ring. In Serenitatis, the edge of the interior rise of the mare surface corresponds to basin-concentric wrinkle ridges that may have been localized by an interior basin ring [see 10, Fig. 3]. Tectonic features in Mare Serenitatis (i.e. basin-interior wrinkle ridges and rilles or extension troughs at the margin) are not obvious in Beethoven Basin. However, these landforms may not be visible within the Mariner 10 images. Gravity data collected by MESSENGER will help determine if Beethoven is similar to a lunar mascon.

References: [1] Strom R. et al. (1975), *JGR*, *80*, 2345-2356. [2] Spudis P. and Guest J. (1988) in *Mercury*, Univ. of Arizona Press, p.118-164. [3] King J. and Scott D. (1990) *USGS Report Misc. Invest. Series* I-2048. [4] Spudis P. and Prosser J. (1984) *USGS Report Misc. Invest. Series* I-1659. [5] Robinson M. et al. (1999) *JGR*, *104*, 30847-30852. [6] Cook A. and Robinson M. (2000) *JGR*, *105*, 9439-9443. [7] Andre S. et al. (2003). *AGU EOS*, *84*, F964. [8] Andre S. et al. (2004) *LPSC 35*, Abstract #2057. [9] Smith D. et al. (1997) *JGR*, *102*, 1591-1611. [10] Watters T. and Konopliv A. (2001) *Planet. Space Sci.*, *49*, 743-748. [11] Solomon S. and Head J. (1980) *Rev. Geophys. Space Phys.*, *18*, 107-141.

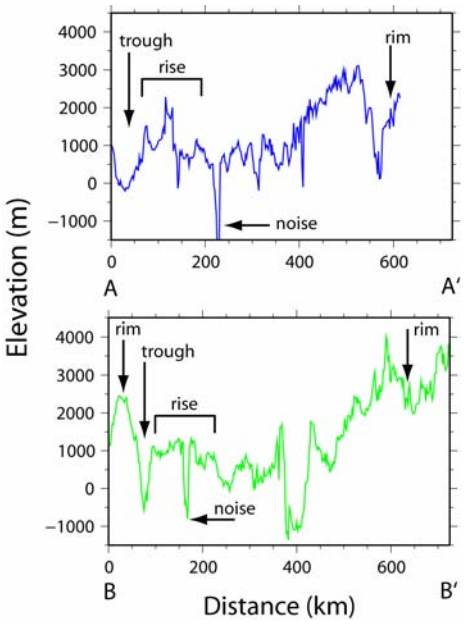

Figure 3. Topographic profiles crossing Beethoven Basin as seen in Figure 2. A 1 km deep trough can be seen at the northwestern margin which then increases in elevation into a topographic rise that extends for ~120 km along each profile.

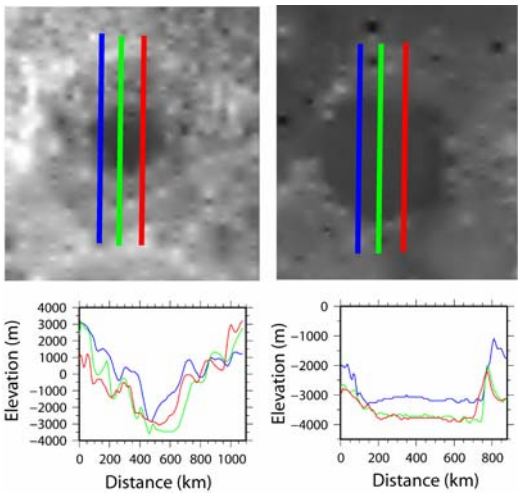

Figure 4. The left panel shows the DEM (upper) and topographic profiles (lower) of the Orientale Basin. The right panel shows the DEM (upper) and topographic profiles crossing (lower) the Serenitatis Basin. Vertical lines (north to south) represent the locations of the topographic profiles. Elevations are in meters above an ellipsoid of radius 1738 km.