A COMPARISON OF TOPOGRAPHY AND SHADED RELIEF OF THE BEETHOVEN QUADRANGLE OF MERCURY.
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Introduction: Significant differences exist between a digital elevation model (DEM) of the Beethoven quadrangle of Mercury, derived from Mariner 10 stereo images [1,2], the shaded relief map [3], and the image mosaic of the region. The images of the Beethoven quadrangle, located in the equatorial region (25ºN to 25ºS, 72ºW to 144ºW) of Mercury, were acquired at high sun angles by Mariner 10 [4]. The DEM reveals numerous impact craters not identified in the shaded relief map, particularly in areas mapped as smooth plains.

Method: A DEM of the Beethoven quadrangle was derived from 180 Mariner 10 stereo pairs. The DEM does not cover the entire Beethoven quadrangle; image quality was too poor to produce good stereo pairs in much of the northern section of the quadrangle. We compared the topography to the image mosaic and the shaded relief map.

We found impact craters in the DEM that are not easily recognized in the image mosaic and shaded relief map. To better quantify this effect, we performed crater counts. Because the area of the DEM is relatively small, we included all recognizable craters, regardless of their degradation state. If a crater was cut by the boundary or a gap (lack of data) within the DEM, we adopted the policy of counting it if 50% of the crater was present in the DEM. Craters with diameters of less than 30 km are not easily seen on the DEM due to its resolution, and thus craters of these sizes were not included in the crater counts. Crater counts were also performed on the areas of the shaded relief map that overlap the coverage of the DEM.

Results: Figures 1 and 2 show examples of features identified in the DEM that are not easily recognized in the shaded relief or image mosaic maps. Each figure shows three panels. The top panel is a section of the DEM in a Mercator map projection of 1 km/pixel scale. The middle panel shows the same area in the shaded relief map; the bottom panel shows the same area in the image mosaic. The shaded relief map and image mosaic have the same map projection and scale as the DEM.

Figure 1 shows a complex impact feature identified in the DEM, and its location (indicated by pink arrows) within the image mosaic and the shaded relief map. The two internal craters can be seen on the shaded relief map, but the larger crater that they superimpose is not easily discernable. The larger crater (87.4 km in diameter) is located at 4.8ºS, 106.6ºW. The geologic map of the Beethoven quadrangle [4] classifies this region as plains and terra undivided, a unit described of as flat, highly cratered, with scarps and ridges. This geologic unit is a continuation of a unit within the Kuiper quadrangle, usually assigned to areas where the sun angle was high and prevented good image quality [4].

Figure 1. Comparison of DEM, shaded relief, and image.

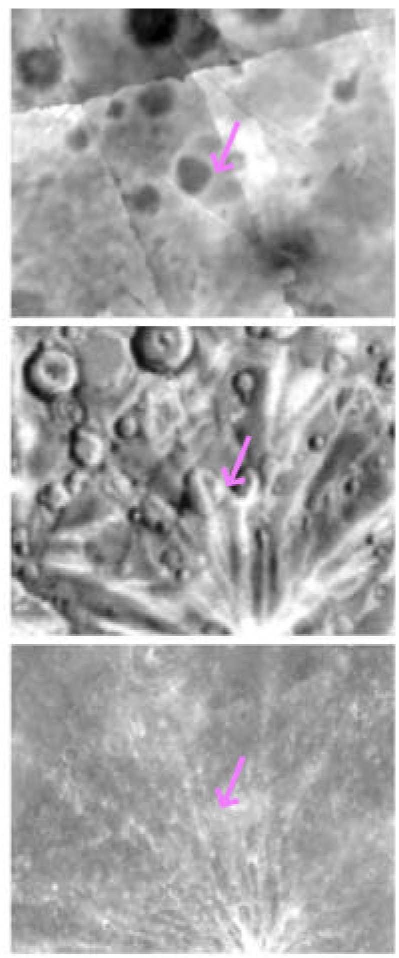


Figure 2 shows an impact crater identified in the DEM, and its location (indicated by pink arrows) within the image mosaic and the shaded relief map. The crater is seen in the shaded relief map, but the rim of the crater is difficult to distinguish and the crater appears highly subdued. The crater (38 km in diameter) is located at 0.7ºS, 123.8ºW. The geologic map of Beethoven quadrangle [4] classifies the area of this crater as a poorly defined boundary between smooth plains and intermediate plains material. The units mapped as smooth plains and intermediate plains by King and Scott [4] are classified as Calorian smooth plains and Tolstojan smooth plains respectively by Spudis and Guest [5].

Figure 2. Comparison of DEM, shaded relief, and image.

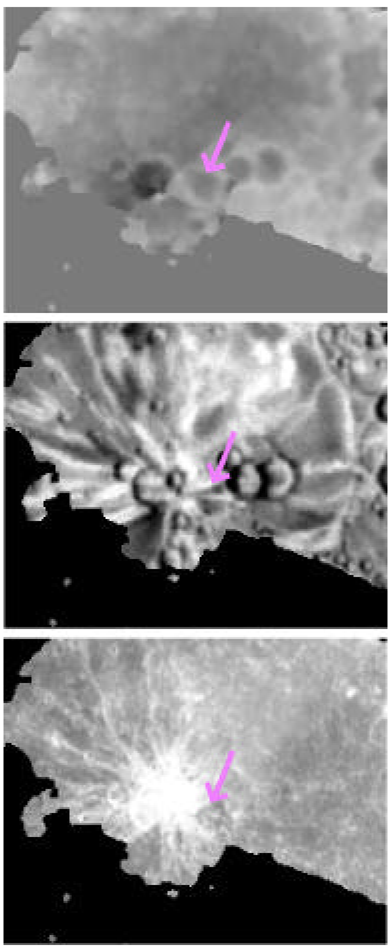
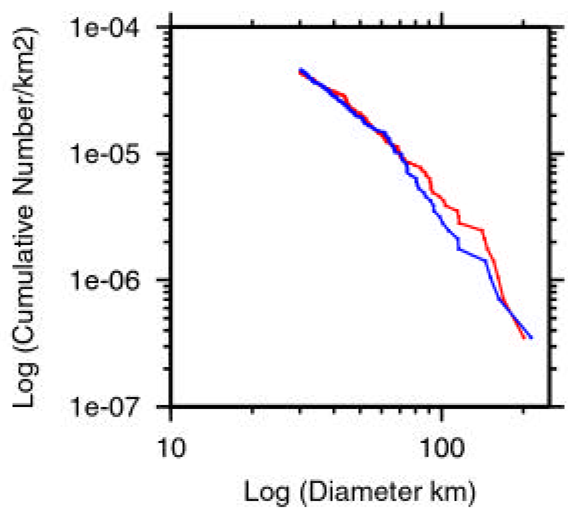


Figure 3 shows the cumulative size-frequency distribution of our crater data. The number of craters per unit area with diameters greater than or equal to a given diameter is shown. The red line represents data obtained from the DEM; the blue line represents data from the shaded relief map. The plot shows that for crater diameters from ~70 to 120 km, cumulative frequency curves diverge. The divergence reflects the presence of a greater number of impact craters in this size range that are recognizable in the DEM.

Discussion and Future Studies: The identification of previously unrecognized impact craters in the Beethoven quadrangle demonstrates that stereo-derived DEMs are a useful tool in the geological analysis of units on Mercury, particularly in areas where the lighting geometry was not optimal. Preliminary results suggest that some units mapped as Calorian smooth plains in the Beethoven quadrangle [5] may be intercrater plains. We plan to expand our study region to the topography of the Discovery and Michelangelo quadrangles, identify more subdued crater features, and perform additional crater counts. Reassessment of the aerial extent of smooth plains and intercrater plains may have important implications for understanding the tectonic and volcanic history of Mercury.

Figure 3. Cumulative size-frequency curves.



References: [1] Robinson M. et al. (1999) *JGR*, 104, 30847-30852. [2] Cook A. and Robinson M. (2000) *JGR*, 105, 9429-9443. [3] USGS (1977) USGS Report, Misc Invest. Series, I-1029. [4] King J. and Scott D. (1990) USGS Report, Misc Invest. Series, I-2048. [5] Spudis P. and Guest J. (1988) In *Mercury*, Univ. of Arizona Press, p.118-164.