A *MESSENGER* LOOK AT BASIN ANTIPODES ON MERCURY. David T. Blewett[1], Brett W. Denevi[2], Mark S. Robinson[2], Carolyn M. Ernst[1], Michael E. Purucker[3], Jeffrey J. Gillis-Davis[4]. [1]Johns Hopkins Univ. Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel, Maryland, 20723 USA (david.blewett@jhuapl.edu), [2]Arizona State Univ., Tempe, Arizona, 85287 USA. [3]NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA. [4] Univ. of Hawaii, Honolulu, HI 96822 USA.

Introduction: On the Moon, regions antipodal (diametrically opposite) to major impact basins exhibit several interesting characteristics. First, crustal magnetic anomalies are found at some basin antipodes, including those of Imbrium, Orientale, Crisium and Serenitatis [1-3]. Second, enigmatic curvilinear high-reflectance markings known as lunar swirls are associated with many crustal magnetic anomalies [2, 4-6], including those found at basin antipodes. Third, a type of unusual strongly grooved terrain is found at the antipode of the Imbrium basin, and similar grooves are found at the antipodes of Orientale, Serenitatis, and Crisium [e.g., 7]. Fig. 1 shows the swirls and grooved terrain at the Imbrium antipode.

The Caloris basin (1550-km diameter [8]) is the youngest large basin on Mercury. "Hilly and lineated" terrain is found at the Caloris antipode (30° S, 341.5° E, Fig. 2) [9]. This unit is similar to the grooved and broken-up terrain at the antipodes of the lunar basins mentioned above [10-12]. This landform may have been formed by converging seismic waves [10, 13] or ejecta [11] from the basin-forming impacts. The similarity of the antipodal terrain at Imbrium and Caloris suggests that similar processes accompanied the formation of these two basins. We are studying the regions antipodal to basins on Mercury to determine if they exhibit features characteristic of basin antipodes on the Moon.

Caloris: The area of the Caloris antipode has been imaged at both high- and low-Sun illumination (Fig. 2). Several high-reflectance crater rays cross the area of the Caloris antipode, which together with the unusual texture of the terrain makes recognition of anomalous albedo patterns difficult. However, no markings with the complex geometry of the lunar swirls are apparent at the available resolution.

Other Mercurian Basins: Other large, relatively young basins on Mercury include Rembrandt (715-km diameter, Calorian age [14]), Tolstoj (510-km diameter, Tolstojan age [15]), and Beethoven (625-km diameter, Tolstojan age, intermediate between Caloris and Tolstoj [15]). The Rembrandt antipode (33° N, 268° E) is covered by only poor-resolution Mariner 10 images and data near the terminator obtained during the first MESSENGER flyby approach sequence. For the Beethoven antipode (20° N, 56° E), favorable views were returned from MESSENGER's third flyby approach. Tolstoj's antipodal region (16° N, 16° E) was visible in MESSENGER second flyby departure images at high-Sun illumination (Fig. 3). The area of the Beethoven antipode has been heavily modified by smooth plains flooding and ejecta from a relatively recent newly discovered 290-km diameter double-ring basin. The Rembrandt and Tolstoj antipodal regions appear to lack both swirl-like albedo anomalies and "hilly and lineated"-type terrain.

Although the available imaging for the antipodes of Rembrandt and Tolstoj basins is less than complete, these basins may be too small to produce major effects on the antipodal geology. Table 1 lists the diameters of the main rims of the four lunar basins with antipodal grooves, and comparable basins on Mercury, along with the ratio of the basin diameter to the diameter of the target object. The table shows that Rembrandt, Beethoven, and Tolstoj are smaller relative to the size of their target body than are the four lunar basins for which characteristic antipodal terrain has been documented. The greater volume and surface gravity, and the different interior structure of Mercury compared with the Moon, could be other factors that inhibit generation of antipodal effects by these smaller basins.

Conclusions: Basin antipodes on the Moon are known to correlate with the presence of swirl-like albedo markings. The antipodes of several large impact basins on Mercury, in contrast, appear to lack unusual markings. A consensus for the actual mechanism of swirl formation on the Moon has not been reached.

The "hilly and lineated" terrain found at the antipode to Caloris appears to be absent at the Rembrandt and Tolstoj antipodes. These basins may be too small to produce resolvable surface disturbances at their antipodes. The antipodes of all Mercury basins mentioned here can be imaged with different lighting during the orbital phase of the MESSENGER mission to test the preliminary assessment given here.

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Fig. 1 (below). Grooved terrain and lunar swirls in the vicinity of the Imbrium antipode. *Clementine* color composite with north toward the top, centered at ~33° S, 164° E. Figure from [16].

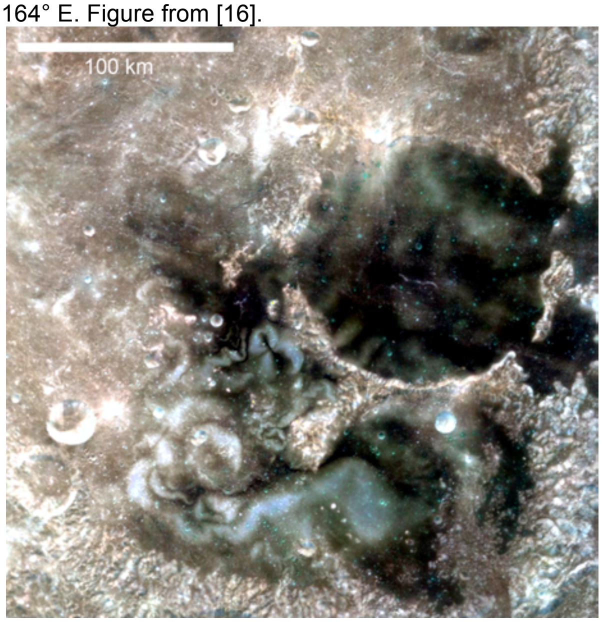
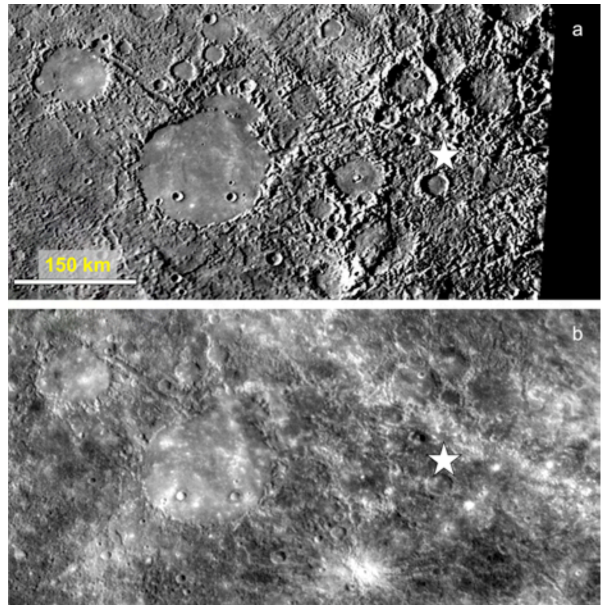


Fig. 2 (2nd column). The area of the Caloris basin antipode, Mercury. Both images cover 25°–35° S, 327°–347° E, north toward the top. The geometrical location of the antipode is marked by the star. (a) *Mariner 10* clear-filter view [17]; low-Sun illumination emphasizes topography. The surface in the "hilly and lineated" terrain has been broken up into hills 5-10 km wide and 0.1-1.8 km high. (b) *MESSENGER* image; high-Sun illumination emphasizes albedo differences. High-reflectance patterns are attributable to crater rays and topography, with no definitive examples of the morphology characteristic of lunar swirls. From [16].



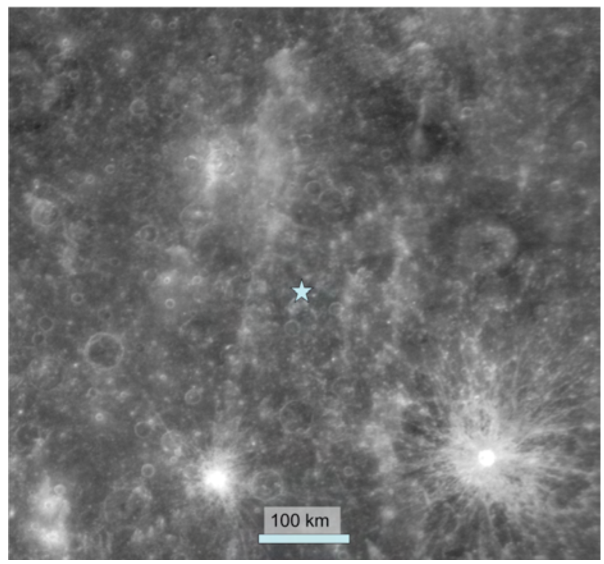


Fig. 3 (above). The area antipodal to the Tolstoj basin, Mercury. *MESSENGER* image with north toward the top, covering ~9°–24° N, 8°–24° E. The star is at the basin's geometrical antipode (16° N, 16° E). No obvious albedo anomalies are present. The texture characteristic of the Caloris antipode's "hilly and lineated" terrain is not apparent. Figure from [16].

Table 1 (below). Selected large impact basins on Mercury and the Moon. *For Mercury basin diameter references, see text. Lunar basin diameters from Table 2.1 of [18]. +Target-body diameters: Mercury, 4880 km; Moon, 3476 km. Table from [16].

Basin Name	Basin Diameter, km*	Basin Diam./Target Diam.+
Caloris	1550	0.32
Rembrandt	715	0.15
Beethoven	625	0.13
Tolstoj	510	0.10
Imbrium	1160	0.33
Orientale	930	0.27
Serenitatis	920	0.26
Crisium	740	0.21