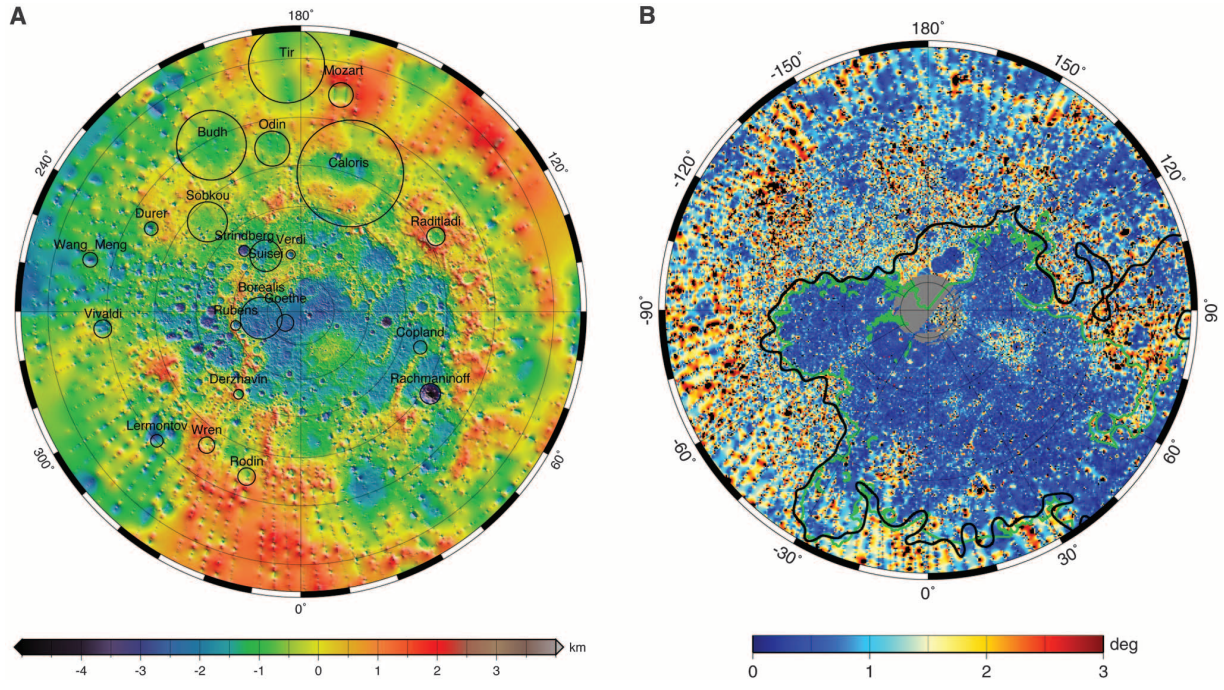

Fig. 1. (**A**) Polar stereographic projection of topography (local radius minus the radius of the HgM002 geoid, the gravitational equipotential referenced to the mean equatorial radius) (*4*) from the north pole to 5°S. The locations of selected major impact structures are shown as black circles. (**B**) Polar stereographic projection of median differential slope (*15*) on a baseline of length 3.2 km, from the north pole to 50°N latitude. The green line shows the mapped boundary of the northern smooth plains (*16*); the black line corresponds to the topographic contour of −1.24 km. Both maps include data collected through 24 October 2011.

if the topography associated with Tharsis and Valles Marineris is excluded, the dynamic range of the remaining topography on Mars can be approximated by the rim-to-floor depth of the Hellas basin. This figure is comparable to the dynamic range of topography on Mercury and is consistent with a gravitational influence on topographic relief for terrestrial planetary bodies.

A spherical harmonic fit of planetary shape (*12*) (table S1) confirms an elliptical form of the equator, with a long axis close to the prime meridian (*12*) (fig. S1), as well as an offset between the center of mass and center of figure in the equatorial plane (*5*, *13*). This distinctive feature of the planetary shape reflects a hemispheric difference in internal structure that could potentially arise from large-scale variations in crustal thickness or density, mantle density, or topography along Mercury's core-mantle boundary.

A north-polar projection of topography (Fig. 1A) shows irregular lowlands at high northern latitudes that are ~2 km deeper than the surrounding terrain. Portions of the boundary of the northern lowlands appear to follow segments of rims of degraded impact basins, but the large extent of the lowlands and the irregular shape of the remainder of the boundary suggest that additional processes were involved in the formation of relief. The northern lowlands are marked by a negative free-air gravity anomaly and are in a state of approximate local compensation (e.g., underlain by thinner than average crust) (*4*), although the area is likely not in strict local mass balance because of contributions to topographic support from flexural and membrane stresses. Barring some sort of offsetting structure near the south pole, the large area of low topography at high latitudes raises the prospect that the region may have migrated to the pole during a reorientation of the planet's principal inertia axes driven by the shallow mass deficit (*14*). If the present location of the northern lowlands is a consequence of polar wander, then the implied planet-scale reorientation must have occurred at a time when the outer portions of Mercury were sufficiently cool and mechanical-

Table 1. Geodetic parameters for Mercury derived from MLA topography.

Parameter	Value
Reference radius (km)	2440
North polar radius (km)*	2437.57 ± 0.01
Equatorial mean radius (km)†	2439.83 ± 0.05
Northern hemisphere mean radius (km)‡	2439.59 ± 0.05
Shape dynamic range (km)	9.848
Shape accuracy (m)	±25
High point (km)§ 11.222°N, 164.752°E	+4.024
Low points (km)§	
Rachmaninoff, 27.417°N, 57.215°E	−5.815
Polar crater, 85.446°N, 62.440°E	−5.824
Hypsometric mean (km)§	−0.589
Hypsometric median (km)§	−0.616
Hypsometric mode (km)§	−0.700
$(a - b)/a$ ‖	$(514 \pm 52) \times 10^{-6}$
ϕ_2 (°E)#	−18.6 ± 4
CoF-CoM x (km)**	0.133 ± 0.052
CoF-CoM y (km)**	0.193 ± 0.051

*Average of all MLA observations within 10° of north pole. †Average of all MLA observations within 15° of equator. ‡Mean planetary radius from a spherical harmonic least-squares fit to all observations with a Kaula constraint applied. §Relative to the reference radius. ‖a and b are, respectively, the semimajor and semiminor axes of the ellipse fit to shape measurements within 15° of the equator. #Longitude of the equatorial semimajor axis of the ellipse fit to near-equatorial shape. Longitude 0° coincides with one of the hot poles of Mercury, which is on the axis of minimum moment of inertia, and 90° on the equator is in the direction of the intermediate axis of inertia. **CoF-CoM is the offset of the center of figure (CoF) from the center of mass (CoM), the origin of the coordinate system for gravity and topography; x and y are the components of offset in Mercury's equatorial plane in the direction of 0° and 90°E, respectively.