Geophysical Research Abstracts
Vol. 17, EGU2015-15236, 2015
EGU General Assembly 2015

Evolution and structure of Mercury's interior from MESSENGER observations

Nicola Tosi (1,2)

(1) Department of Planetary Physics, German Aerospace Center (DLR), Berlin, Germany, (2) Department of Astronomy and Astrophysics, Technische Universität Berlin, Germany

During the past four years, the MESSENGER mission (MErcury Surface, Space Environment, GEochemistry and Ranging) has delivered a wealth of information that has been dramatically advancing the understanding of the geological, chemical, and physical state of Mercury. Taking into account the latest constraints on the interior structure, surface composition, volcanic and tectonic history, we employed numerical models to simulate the thermo-chemical evolution of the planet's interior [1]. Typical evolution scenarios that allow the observational constraints to be satisfied consist of an initial phase of mantle heating accompanied by planetary expansion and the production of a substantial amount of partial melt. The evolution subsequent to 2 Ga is characterised by secular cooling that proceeds approximately at a constant rate and implies that contraction should be still ongoing. Most of the models also predict mantle convection to cease after 3-4 Ga, indicating that Mercury may be no longer dynamically active. In addition, the topography, measured by
laser altimetry and the gravity field, obtained from radio-tracking, represent fundamental observations that can be interpreted in terms of the chemical and mechanical structure of the interior. The observed geoid-to-topography ratios at intermediate wavelengths are well explained by the isostatic compensation of the topography associated with lateral variations of the crustal thickness, whose mean value can be estimated to be $\sim$35 km, broadly confirming the predictions of the evolution simulations [2]. Finally, we will show that the degree-2 and 4 of the topography and geoid spectra can be explained in terms of the long-wavelength deformation of the lithosphere resulting from deep thermal anomalies caused by the large latitudinal and longitudinal variations in temperature experienced by Mercury's surface.

[1] Tosi N., M. Grott, A.-C. Plesa and D. Breuer (2013). Thermo-chemical evolution of Mercury's interior. Journal of Geophysical Research - Planets, 118, 2474-2487.
[2] Padovan S., M. Wieczorek, J.-L. Margot, N. Tosi, and S. Solomon (2015). Thickness of the crust of Mercury from geoid-to-topography ratios. Geophysical Research Letters. In press.