Geophysical Research Abstracts
Vol. 19, EGU2017-6582, 2017
EGU General Assembly 2017

Volcanic Infillings of Large Basins on Mercury as Indicators of Mantle Thermal State and Composition

Sebastiano Padovan (1), Nicola Tosi (1,2), Ana-Catalina Plesa (1), Thomas Ruedas (1,3)

(1) DLR - German Aerospace Center, Planetary Physics, Berlin, Germany (sebastiano.padovan@gmail.com), (2) Department of Astronomy and Astrophysics, Technische Universität, Berlin,Germanz, (3) Institute of Planetology, University of Münster, Germany

The crust of Mercury is mostly the cumulative result of partial melting in the mantle associated with solid-state convection [1]. The details of how the surface composition represents the result of dynamical processes in the interior are difficult to elucidate. Explanations for the observed geochemically varied surface include a heterogeneous mantle, the effects of ancient giant impacts, an evolving mantle composition, or a combination of these processes [e.g., 2]. Here we explore the effects of large impacts on mantle dynamics and associated melt production. With the convection code GAIA we compute thermal evolution histories of Mercury compatible with the expected amount of heat producing elements in the mantle and with the crustal thickness inferred from gravity and topography data. We estimate the thermal anomalies in the mantle generated by large impacts using scaling laws [3]. Impactors have a velocity of 42 km/s and an impact angle of 45°, as appropriate for Mercury [4]. Their size is varied in order to produce basins with diameters in the range from 715 km (Rembrandt) to 1550 km (Caloris). Depending on the timing of the impact, the melt erupting in the basin interior is a combination of convective melt generated at depth and shallow melt resulting from shallow impact-induced convective currents. The volcanic infillings following an impact happening early in the evolution of the planet, when convection is still vigorous, are dominated by convective melt. Later in the evolution, the erupted melt shows the signature of the impact-induced shallow melt. We show that the properties of melt sheets within the young large basins Caloris and Rembrandt depend on the mantle thermal state and composition. In particular, we predict the source depth of the volcanic plains within large young basins to be different from the source depth of older surface units, a result that can help explaining the peculiar composition of the volcanic plains inside Caloris [2, 5].

[1] Tosi N. et al. (2013), JGR-Planets, 118, 2474—2487. [2] Weider S.Z. et al. (2015) EPSL, 416, 109—120. [3] Roberts J.H. and Barnouin O.S. (2012), JGR-Planets, 117, E02007. [4] Le Feuvre M. and Wieczorek M.A. (2008), Icarus, 197, 291—306. [5] Namur O. and Charlier B. (2017), Nature Geosc., 10, 9—13.