The Hellas Impact and the consequence

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The Hellas basin is the biggest preserved impact structure on Mars. The association of tectonic features and volcanoes (Ruj et al., 2019, 2022) in and around the basin intrigues the possibility to have an origin related to the instability within the Martian mantle, induced by the Hellas impact. Here, we used the iSALE-2D shock physics code (Elbeshausen et al., 2009; Wünnemann et al., 2006; Ivanov et al., 1997; Amsden et al., 1980) and executed impact simulations of a spherical projectile over a flat surface to estimate the temperature distribution after the impact. We then brought the temperature distribution to a time-dependent thermal convection of a fluid with an infinite Prandtl number and a temperature-dependent viscosity under the Boussinesq approximation in a cylinder. In these calculations, we assumed shallow asymmetries in the thickness of cold Thermal Boundary Layers (TBLs).
Our results show that post-shock temperatures, T_{post} (calculated by the ANEOS) reach the value of up to ~700 km penetrating to the upper mantle of Mars. The geodynamic model suggests that such asymmetry can generate >500 MPa of positive stress and trigger ascending flows which can result in volcanoes in the surroundings. This model-derived result is confirmed by the presence of normal faults (series of grabens) in the western part of the Hellas basin and a series of volcanoes in the east and southeast parts. Moreover, a positive gravity anomaly below the volcanoes confirms the presence of mantle at shallow depths.
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