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Thermal effects of late accretion to the crust and mantle of Mercury

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Impact bombardment on Mercury in the solar system's late accretion phase (ca. 4.4-3.8 Ga) caused considerable mechanical, chemical and thermal reworking of its silicate reservoirs (crust and mantle). Depending on the frequency, size and velocity of such impactors, effects included regional- and global-scale crustal melting, and thermal perturbations of the mercurian mantle. We use a 3D transient heating model to test the effects of two bombardment scenarios on early (pre-Tolstojan) Mercury's mantle and crust. Results show that rare impacts by the largest ($\gtrsim$100 km diameter) bodies deliver sufficient heat to the shallow mercurian mantle producing high-temperature ultramagnesian (komatiitic s.s.) melts. Impact heating leading to effusive (flood) volcanism can account for eponymous "High-Magnesium Region" (HMR) observed during the MErcury Surface, Space Environment, GEochemistry Ranging (MESSENGER) mission. We find that late accretion to Mercury induced volumetrically significant crustal melting ($\leq$58 vol.%), mantle heating and melt production, which, combined with extensive resurfacing ($\leq$100%), also explains why its oldest cratering record was effectively erased, consistent with crater-counting statistics.