Influence of formation and early differentiation processes on long-term evolution of terrestrial planets

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Formation and early differentiation processes have consequences that may persist even after billions of years of evolution, such as compositionally layering the mantle, cumulate overturn following magma ocean solidification, superheating the core, and possible long-term melting above the core-mantle boundary (basal magma ocean). However, studies of the long-term evolution of terrestrial planetary mantles typically assume a compositionally homogeneous initial condition and ignore deep melting (e.g. Earth: Nakagawa & Tackley 2013 GRL, Venus: Armann & Tackley 2012 JGR, Mars: Keller & Tackley 2009 Icarus). Indeed, the earliest phases have typically been treated using only one-dimensional models. The author's research group is performing simulations of interior dynamics and structure in 2D and 3D going from planetary accretion and growth, to core formation, to the magma ocean phase leading to long-term evolution, thereby avoiding the arbitrary initial condition for long-term evolution; here the latter (magma ocean phase and long-term evolution) is focussed on. Our simulations incorporate recent lower mantle melting results (de Koker and Stixrude 2013). In this presentation the model details and various results will be discussed.