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初期地球における深部マグマオーシャンを伴うコアーマントル熱化学進化モデリング
On the core-mantle thermo-chemical evolution with the basal magma ocean in the early Earth

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On the recent progress of melt phase relationship such as the density structure of silicate melt in the deep mantle [e.g. Stixrude et al., 2009], the density of silicate melt would be much denser than the silicate solid near the core-mantle boundary (CMB), which has been already proposed from high pressure experiments [e.g. Ohtani and Maeda, 2001]. As a result, the basal magma ocean hypothesis for thermo-chemical structure in the early Earth has been proposed in several years ago, which is based on the concept for the density cross-over between silicate melt and solid in the deep mantle [Labrosse et al., 2007]. In this study, we attempt to include melt-phase relationship in the mantle minerals into a coupled core-evolution model based on numerical mantle convection simulations, which can generate the basal magma ocean in the early Earth. The preliminary outcome from this modeling is that the survival time-scale of the basal magma ocean in the mantle convection system is around 2.0 Gyrs as well as low CMB heat flow (~5 to 10 TW) at the present time compared to the expected from theoretical core evolution model including the basal magma ocean. On the survival time of basal magma ocean obtained here, the origin of ultra-low-velocity-zone is difficult to generate the partial melting survived over the geologic time-scale, which seems to be explained as the compositional difference (effects of iron) suggested from recent seismological data analysis [e.g. Brown et al. 2015]. On the heat flow across the CMB, it is similar results to cases without assuming the effect of basal magma ocean suggested that the early Earth hypothesis would be still difficult to explain the various diagnostics of Earth's core-mantle evolution over the geologic time-scale.

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