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Influence of combined primordial layering and recycled MORB on the coupled thermal evolution of Earth's mantle and core

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A thermo-chemical mantle convection model with both primordial compositional layering and recycling of mid-ocean ridge basalt (MORB) coupled to a parameterized core heat balance model is used to investigate how the thermo-chemical evolution of the mantle affects the thermal history of the core including primordial material proposed by early Earth hypotheses. The viscosity formulation has been improved from our previous works. The amount of MORB that accumulates above the CMB is strongly dependent on effective Rayleigh number, such that more accumulates at higher Ra (lower viscosity), but a continuous layer of MORB is not obtained here. With initial primordial layering, large-scale thermo-chemical anomalies are found in the deep mantle, which are generated mainly by the primordial material with small amount of segregated basaltic material on top of it, localized in the hot upwelling region. A successful core evolution can only be obtained when initial primordial layering is present. In conclusion, primordial material above the CMB originated from early mantle differentiation might be needed to construct a realistic model of a coupled mantle and core evolution.

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