A revisit on initial temperature at the core-mantle boundary in a coupled core-mantle evolution model

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An initial temperature at the core-mantle boundary (CMB) is an important constraint for thermal evolution of Earth’s mantle and core because this temperature strongly affects the size and onset timing of growing inner core, primordial heat in early Earth’s core and thermal and chemical state in the deep mantle. In a previous study, we found ~6000 K as the initial CMB temperature in a coupled core-mantle evolution model to match constraints of thermal evolution of Earth’s core [Nakagawa and Tackley, 2010]. However, in recent suggestions from high P-T physics and theoretical model of thermal evolution of Earth’s core, the initial CMB temperature seems to be less than ~5000 K [Andrault et al., 2016; Nakagawa, in revisoin]. Since our core evolution model is based on a simplified analytical formulation [Buffett et al., 1992; Buffett et al., 1996] and more complicated formulation that can fit the density structure derived from seismological analysis and applicable for high thermal conductivity of iron alloy is proposed [Labrosse, 2015], we reassess the initial CMB temperature that can find the best-fit core evolution scenario. Because of thermostat effects on thermal evolution [e.g. Nakagawa and Tackley, 2010; Nakagawa and Tackley, 2012], the initial CMB temperature may not be sensitive to the scenario of thermal evolution of Earth’s core and mantle but the heat flow across the CMB found in this study (9 to 10 TW) is slightly lower than the lower-bound value (11 TW). On the magnetic evolution, the low thermal conductivity is still more preferable than high thermal conductivity due to existence of adiabatic shell with high thermal conductivity that suppress a convective region of Earth’s core. In the presentation, we will attempt to an implication for detectability of geoneutrino based on thermal and chemical evolution modeling of Earth’s mantle and core.

Keywords: core-mantle boundary temperature, thermal evolution, Earth's metallic core

