Thermo-chemical evolution of Earth’s core in a coupled core-mantle evolution –Stably stratification or light element precipitation

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Two possible resources for thermo-chemical convection of Earth’s core occurred in the core-mantle boundary region have been proposed, which are dissolution of light element working for the negative feedback of cooling rate and age of the inner core [O’Rourke and Stevenson, 2016; Badro et al., 2016] and diffusive processes for reactant caused by core-mantle chemical reaction [Buffett and Seagle, 2010; Gubbins and Davies, 2012]. In this investigation, we make an assessment for those two mechanisms in a coupled core-mantle evolution model based on numerical mantle convection simulations plus core energy balance model based on formulations provided from Labrosse [2015] as a function of melting temperature of iron alloy, initial CMB temperature and thermal conductivity of Earth’s core such that several constraints of evolution of Earth’s core can be satisfied (Continuous generation of magnetic field for instance). With diffusive processes caused by core-mantel chemical reactions, the initial CMB temperature should not be quite high plus high CMB heat flow because the heat transfer system is dominated by the isentropic effects. Whereas, with dissolution of light elements, the initial CMB temperature should not be quite high either but the heat flow across the CMB would be quite low. On the thermal conductivity of Earth’s core, for the best-fit parameter set found in both processes, it would not be quite high value that would not be consistent with thermal conductivity measurements based on electrical resistivity [Gomi et al., 2013; Ohta et al., 2016]. Further discussions will be done in the presentation.

Keywords: thermo-chemical evolution, core-mantle chemical coupling

