On the 1-D radial convective structure of the Earth’ s core inferred from a coupled core-mantle evolution model

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A coupled core-mantle evolution model in the global heat and mass balance of the Earth’ s mantle and core is to reveal the 1-D radial convective structure of the Earth’ s core over the geologic time-scale. Since tracking the convective structure of the Earth’ s core over the geologic time-scale is not still available for numerical geodynamo simulations, the assessment with the global heat and mass balance model of Earth’ s core and mantle is quite powerful. Regarding the global heat balance of the Earth’ s mantle, the global heat balance approach incorporating with the heat transport by the partial melting is assumed, which is the parameterized mantle convection based on the modified version of Driscoll and Bercovici (2014). The heat flow across the core-mantle boundary computed from this parameterized convection model is used to compute the thermal and chemical structure of the Earth’ s core based on the global heat balance of the Earth’ s core with the realistic material properties of the Earth’ s core provided from Labrosse (2003; 2015) However, on the assessment of convective structure, the effects of compositional convection caused by releasing the light elements associated with inner core growth and/or the metal-silicate partitioning are included (e.g. Takehiro and Sasaki, 2018). As indicated in Takehiro and Sasaki (2018), the effects of compositional convection are essential for understanding the convective structure of the Earth’ s core even if the realistic density structure of the Earth’ s core is included in the energy flux computations. On the magnetic field generation caused by geodynamo actions, again, the compositional convection plays a significant role under the high thermal conductivity expected from the high-pressure physics. In the presentation, I will indicate the evolution of the convective structure described as the entropy flux of the Earth’ s outer core over 4 billion years as a function of the evolution of the heat flows across the core-mantle boundary and oceanic lithosphere.

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