Light element distribution produced by convection due to CMB heterogeneity in the outer core of the Earth

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Recent seismological observations suggest longitudinal heterogeneity of seismological wave velocity of the inner core of the Earth, which stimulates a discussion that phase change at the inner core boundary (ICB) does not occur uniformly in the horizontal directions. It is simply supposed from this suggestion that temperature is lower and concentration of light element is higher just above the solidification hemisphere at ICB, and vice versa. The heterogeneous structure of the inner core and thermodynamic properties just above ICB in the outer core is expected to be correlated, however, more recent analysis shows that distribution of seismological wave velocity anomaly does not correspond to longitudinal heterogeneity of the inner core.
One of the mechanisms explaining heterogeneous growth of the inner core is that the heterogeneous thermal condition at the core mantle boundary (CMB) drives horizontal thermal convection which induces non-uniform temperature distribution at ICB. However, since this study uses co-density, which combines density variations by temperature and light element concentration, it cannot find distribution of the light elements just above ICB.
In this study, we perform numerical experiment of thermal and compositional convection driven by CMB heterogeneity using a convection model in a rotating spherical shell in which temperature and light element concentration are independent variables. Obtained distributions of light element concentration are compared with the distribution of seismological wave velocity anomaly, and plausible dynamical regimes of thermal and compositional convection in the outer core are discussed.

Keywords: Heterogeneity, Inner core, Core-mantle boundary

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