Effects of the post-perovskite phase transtion in the mantle dynamics

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Recent progresses on high pressure and temperature experiments and first principle calculation for mantle material have indicated that the perovskite that is main mineral in the lower mantle transforms into the different crystal structure (post-perovskite) under the temperature and pressure in the core-mantle boundary region. This phase transition is found as a strongly exothermic transformation that has +7 to +10MPa/K of Clapeyron slope.

Taking into account for this phase transition in numerical mantle convection model, there have been several important results so far: (1) the post-perovskite phase change corresponds to the fast velocity anomalies due to deep subducted slabs. However, there is no post-perovskite phase change under the Pacific and Africa, which is known to slow velocity anomalies due to compositionally-distinct material. (2) The horizontal scale of upwelling plume occurring to the instability of hot thermal boundary layer with the post-perovskite phase change is shorter than the case without the post-perovskite phase transition. Since the latent heat due to the strongly exothermic phase change causes to increase the temperature of thermal boundary layer for shorter length scale when the instability occurs. However, there are no effects of post-perovskite when the mantle is approximated as the Boussinesq fluid that ignores the effects of latent heat release.

In this presentation, the effects of the post-perovskite phase change will be glanced by showing several results obtained from two- and three-dimensional numerically thermo-chemical mantle convection model with anelastic and compressible approximation.