The possibility of compositional stratification in the lower mantle

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We have conducted the thermo-chemical convection in a 2D cylindrical geometry with a variable viscosity and an endthermic phase transition at 670km to examine the possibility of compositional stratification in the lower mantle. The controlling parameter of our study is considered by the viscosity structure of mantle, which we assume the four viscosity structures. We have found that an endothermic phase change is influenced that it is difficult for dense material from D" layer to transport into the upper mantle. The dense material of D" layer is remained in the lower mantle with convective mixing. The influence to the seismological structure in the mantle is reproduced from the view of different structure of characteristic wavelength between the upper and lower mantle.

One of main problem to study the convection in the mantle is the influences to the structure of the Earth's mantle. This problem can be replaced whether the mantle convection is one layer or two layer. According to the constraint from the geochemistry, the double layered structure has been expected by the analysis of trace elements. In contrast, the thermal evolution studies are assumed to be the one layered structure from the constraint of the surface heat flux. The heterogeneous structure in the mid-lower mantle and the D" layer is assumed to be the compositional origin by the global tomography model. In this study, we examine whether the generation of compositional stratification in the lower mantle due to the interaction between the D" layer and convection in the mantle is possible in the mantle convection system.

The model we use is the numerical model of thermo-chemical convection with a variable viscosity and an endothermic phase transtion at 670km. The chemical composition is represented by the ratio of iron and magnesium. The initial condition is set to be the well-developed solution without a chemical and phase effect, and a thin chemical layering at the base of mantle. The controlling parameter is used the viscosity structure. We use four viscosity structure in the mantle from the simplest structure to realistic ones.

The results are described as follows. The main result is found that the dense material from D" layer included in the upwelling flow cannot be tranported into the upper mantle because of the density difference duo the transition zone. However the upwelling flow can penetrate into the upper mantle owing to the dense material dropped into the lower mantle. The influences to the seismological structure in the mantle is found that we reproduce to the different structure of characteristic wavelength between the upper and lower mantle obtained by the global tomography in our model. The effect of iron-rich perovskite is played an important role in the conpositional structure in the Earth's mantle.