The effect of phase transition and viscosity layering on the slab stagnation in spherical shell mantle

Takatoshi Yanagisawa[1]; Yasuko Yamagishi[1]; Yozo Hamano[1]

[1] IFREE, JAMSTEC

With global modeling of mantle convection in Earth-like spherical shell geometry, we carried out systematic research on the convection patterns for the wide range of Rayleigh numbers with phase transitions and viscosity layering. Seismic tomography illustrates the internal structure of the mantle. Some of the subduction slabs stagnate in the mantle transition zone while the others penetrate into the lower mantle. The aim of this study is to clarify the condition and process of the various behaviors of slabs. The negative Clapeyron slope of phase transition resists against straightforward falling of slabs into the lower mantle, and it might cause the slab stagnation. But our numerical simulations for the mantle with uniform viscosity show that the experimentally and seismologically plausible value of Clapeyron slope for 660 km phase transition is not enough to cause slab stagnation at transition zone. By further introducing both the viscosity increase in the lower mantle and yield stress near the surface, our results show that the 660 km phase transition acts as a barrier for the vertical flow. Then the flow pattern in the upper mantle is decoupled from the flow in the lower mantle, and stagnant slabs are successfully formed.