Towards realistic thermal-chemical-phase structures in the Earth's mantle

Takashi Nakagawa[1]

[1] Kyushu Univ.

Our previous studies on thermal-chemical-phase structures in deep mantle would be under assumption of simple visco-plastic yielding for subducting slabs that have basaltic crust that is source material for compositional anomalies in the core-mantle boundary region. Here compositional anomalies in a convecting mantle are investigated to use thermo-chemical multiphase mantle convection in 2D and 3D spherical geometry with self-consistently calculated mineral physics. Two different Rayleigh numbers (10ˆ7 and 10ˆ8 defined as the upper mantle viscosity) and three-types of yielding rheologies are assumed. When the plate-like behavior indicates episodic mode, basaltic layering develops above the core-mantle boundary and deforms by strongly downwelling slabs reaching the core-mantle boundary. In brittle-ductile transition, there is no basaltic layering above the CMB and well-mixed mantle seems to be expected because many random subductions prevent developing basaltic layering above the CMB when the yield stress is around 100MPa while basaltic layering is developed above the CMB in higher yield stress cases being around ˜300MPa. When the history-dependence is applied, compositional anomalies would be expected for lower yield stress compared to the case with brittle-ductile transition, however, such effects seem to be 'ad hoc'. On crustal thickness that is also important value for understanding thermal-chemical structures, it is not dependent on styles of yielding rheology but dependent on Rayleigh number. Higher Rayleigh number would be realistic thickness of oceanic crust (˜5km to 10km).