Self-consistent generation of tectonic plates in compressible mantle convection simulations in a 3D spherical geometry

Takashi Nakagawa[1]

[1] Kyushu Univ.

Many of previous numerical simulations of mantle convection inducing self-consistently generating tectonic plates have been studied under Boussinesq approximation. However, considering realistic situation of mantle phase transition investgated from high pressure experiments, the Earth's mantle seems to be compressible essentially. Here numerical simulations of compressible mantle convection with realistic phase relationship calculated by free energy minimization in a 3D spherical geometry are used to see what happens with different styles of yielding rheology, which are simple visco-plastic, brittle-ductile transition and history-dependence. The episodic behaviors are found in all yielding rheology but sustainable plate-like behaviors are found in brittle-ductile and history-dependence rheologies while the position of subduction is not quite stable because these models are not assumed for continental lithosphere that anchors the stress gathering at the margin between continental and oceanic lithospheres. In addition, the episodic behavior caused by an endothermic phase transition is not found in those cases. Since mantle temperature seems to be too high to appear spinel-perovskite phase transition determined from free energy minimization. That would help to implement 'dislocation creep' effects and phase-dependent activation energy for diffusion and dislocation creeps to get more realistic situation of mantle dynamics regulated from plate-like behavior.