Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SIT004-P08 Room:Convention Hall Time:May 26 14:00-16:30

Improvement of a semi-dynamical numerical model of a subduction zone in a 3D sphere and its applications

Manabu Morishige[1*], Satoru Honda[1], Paul J. Tackley[2]

[1]Earthquake Research Institute, [2]ETH Zurich

In this presentation, we present a semi-dynamical subduction zone model in a three-dimensional spherical shell and its applications. The approach we take to enable one-sided subduction at a given angle is to impose velocity on the top surface and in a small three-dimensional region around the shallow plate boundary. The velocity imposed in the region around the plate boundary is determined based on the idea that mass conservation inside the region is satisfied. We can also easily incorporate trench migration kinematically in the model. The advantage of the model is that it allows us to use constraints from as many as possible observations, such as surface plate velocity, shape of the trench and subduction angle in the shallow part, which makes it easier for us to compare the results with observations. Therefore, the model is useful for studying a specific subduction zone where the plate kinetics are well constrained.

As applications of the model, two cases are considered. First, mantle flow around a slab edge is considered, and we find that the effect of Earth curvature on mantle flow is small by comparing our model with a similar one in a rectangular box. If, however, we model a broader area or deeper processes, the effect of Earth curvature may become large and hence important. Second, the case with non-Newtonian rheology is considered using the improved model. One difficulty that may arise in considering non-Newtonian rheology is the treatment of the singularity near the edge of the region around the plate boundary. The effect of the singularity is, however, suppressed by ramping the velocity imposed around the region. The calculation with non-Newtonian rheology may be useful particularly if we study seismic anisotropy.

Keywords: subduction zone, non-Newtonian rheology, 3D sphere, mantle flow