Geophysical Research Abstracts
Vol. 14, EGU2012-13259, 2012
EGU General Assembly 2012

Visco-elasto-plastic rheology effects on free subduction dynamics

L. Fourel (1), G. Morra (2), and S. Goes (1)

(1) Imperial College London, United Kingdom (l.fourel@imperial.ac.uk), (2) School of Earth and Environmental Sciences, Seoul National University, South Korea

Subduction dynamics on Earth is a typical three dimensional problem. Complex mantle flow can develop around and above the slabs. In addition, the 3D geometry of slabs (curvature, dip angle) evolves with time and can often be quite complicated. This last aspect strongly depends on their rheological properties and on the force balance in the bending region. Therefore understanding how bending processes, in a lithosphere with Earth-like rheology, affect the dynamics of subduction is key to compare numerical results with Earth subduction geometries. Scaling analysis based on 2D visco-elasto-plastic models has shown that one needs to take into account both the elastic and viscous strengths in order to correctly capture the bending effects on sinking velocities and dip angles. But most 3D numerical models developed so far use a visco-plastic rheology for slabs neglecting the role of elasticity in bending.

We developed a new technique to model lithosphere-mantle interaction in 3D where lithosphere is a visco-elasto-plastic solid and mantle is a linear viscous fluid. At each iteration, a finite element solver is used to solve for creep in the oceanic plate and compute plate displacements. These displacements are then used as input in a boundary element software to calculate the full mantle circulation. New mantle tractions are then re-injected in the finite element software via a set of dashpots positioned around the oceanic plate. This technique has the advantage to calculate the full mantle drag only on the plate outer surface thus reducing considerably the computational time. We use this coupled approach to investigate the role of plate width and buoyancy on subduction behaviour.