Long-wavelengths subductions in the lower mantle

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According to seismic tomography (see e.g. Bijwaard et al. 1998, Karason and van der Hilst 2001), the subducting litospheric slabs have plate-like character in the upper mantle. However, the wavelength of the fast seismic anomalies increases in the lower mantle and slabs have blob-like rather than plate-like shape (Ribe et al. 2007). The wavelength of the lower mantle seismic velocity anomalies is closely related to the viscosity structure of the lower mantle and has important implications on the global geodynamics, geoid, etc.

Here we try to find the rheological model, which would produce slabs with plate-like character in the upper mantle and forming blobs in the lower mantle. We present the results of the numerical modelling of subduction process in a 2-D Cartesian box. We use extended Boussinesq approximation and our numerical code is based on the method of Gerya and Yuen (2003). We employ the composite rheology including diffusion creep, dislocation creep and power-law stress limitor. The effects of phase transitions at the depths 410 km and 660 km are taken into account. We concentrate on the shape of the slab in the lower mantle depending on the viscosity increase between the upper and lower mantle, on the value of the yield stress and on boundary conditions. We are trying to find the conditions under which the blobs appear in the lower mantle. We found that for relatively low yield stress value (10^8Pa) and for the viscosity jump $10-30$ at 660km the blob-like features can indeed be observed (see illustration figure).

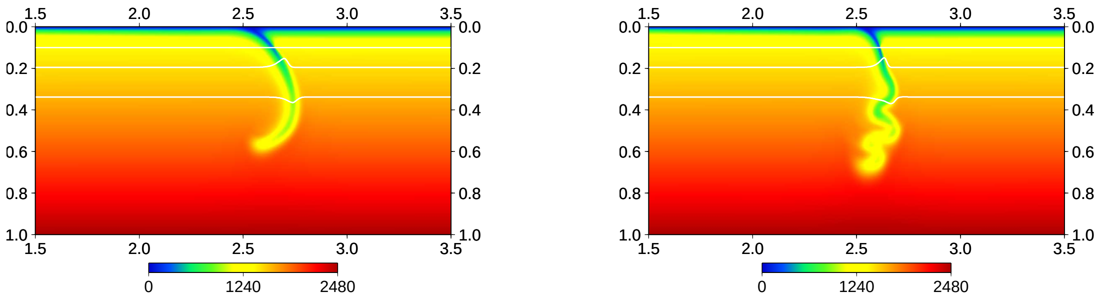

Figure 1: Illustration figure, temperature [°C] for models with viscosity increase 10 at 660km, yield stress limit 10^9Pa (left plate) and 10^8Pa (right plate), at time 30My.

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