The effect of post-perovskite rheology on the deformation of slabs in the lowermost mantle

Hana Čížková[1], Ondřej Čadek[1] and David A. Yuen[2]

Recent evidence on perovskite to post-perovskite phase change in the lowermost mantle suggests, that post-perovskite piles or lens should be present in the relatively cold downwelling areas, while hot upwelling plumes consist of perovskite. It has been suggested by Carrez et al. (2007), that rheology of post perovskite is dominated by dislocation creep and there are some indications that the activation parameters of dislocation creep in post-perovskite induce lower viscosity than is the viscosity of perovskite at the same pressure and temperature conditions. That can result in a viscosity inversion in the lowermost mantle – viscosity in cold downwellings transformed to post-perovskite might be lower than viscosity of warm perovskite plumes. Such a viscosity structure was indeed recently reported by Čadek and Fleitout (2006). Here we further investigate the dynamics of the cold slabs transformed to post-perovskite in the lowermost mantle. We perform simulations of thermal convection in a 2D cartesian model with composit rheology including diffusion creep, dislocation creep and power-law stress limiter. Different creep parameters are used for upper mantle material, lower mantle material and for post-perovskite respectively. We concentrate on the effect of post-perovskite rheological weakening, on slab-plume interaction and possible consequences for seismic anisotropy in the D''.

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