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Creep parameters of post-perovskite and their influence on the deformation of slabs in the lowermost mantle

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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 the roots of the hot upwelling plumes consist of perovskite. Post-perovskite is generally believed to be deformed predominantly by the 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 even result in a viscosity 'paradox' in the lowermost mantle - viscosity in cold downwellings transformed to post-perovskite might be lower than the viscosity of warm perovskite plumes. Such a viscosity structure was indeed recently indicated by the geodynamical inversions of the geoid. Rheologically weak areas at the base of the subducted slabs may have important consequences for the slab deformation in the D''. In this study we investigate the dynamics of the cold slabs transformed to post-perovskite in the lowermost mantle. We perform the simulations of the thermal convection in a 2D cartesian model of the lower mantle with composite rheology including diffusion creep and dislocation creep. Different creep parameters are used for the perovskite lower mantle and for post-perovskite lens (or layer) respectively. While perovskite is considered to be deformed via linear diffusion creep, post-perovskite is modeled either as a constant viscosity material (with viscosity ranging from 10^{19} Pas to 10^{23} Pas) or we assume that it is deformed purely by the dislocaton creep. The presence of the rheologically

distinct post-perovskite strongly influences not only the slab deformation above the CMB but results in different dynamic regimes of the CMB region (characterised by e.g. the different length scales of the upwelling plumes) depending on the creep parameters of post-perovskite.