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Subducted material at the bottom of the mantle

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The fate of the subducted material in the upper mantle has been widely discussed in the recent decades and numerous numerical and analogue models of the slab deformation have been constructed. The lower mantle on the other hand has received much less attention. The rheological description of the lower mantle material still remains rather elusive, despite the efforts spent on constraining it experimentally or theoretically. It is generally believed, that the lower mantle deformation is controlled primarily by the diffusion creep, its activation parameters are however only badly constrained. Their amplitude in combination with the lower mantle geotherm is crutial for the determination of the lower mantle viscosity that controls the slab deformation. Some theoretical calculations even suggest the non-monotonic activation energy that may result in the existence of the local minima in the depth viscosity profile of the lower mantle. Further complexity is due to the possibly rheologically distinct postperovskite present in the lowermost parts of the cold subducted slabs.

Here we present a set of numerical experiments investigating the slab deformation in the lower mantle. We concentrate especially on the effects of the rheological parameters and depth dependent thermal expansivity. The latter has a prominent influence on the slab ability to reach the bottom of the lower mantle and thus also limits the effects of the rheologically distinct postperovskite. We will demonstrate how the rheological parameters, thermal expansivity and diffusivity may influence not only the slab deformation in the lower mantle but also how are they reflected in stresses developped in the shallower parts of the slab, sinking velocities or phenomena like slab break-off.