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Interactive comment on “Subduction to the lower mantle – a comparison between geodynamic and tomographic models” by B. Steinberger et al.

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Review of the manuscript ‘Subduction to the lower mantle – a comparison between geodynamic and tomographic models’ by Steinberger et al.

Paper presents geodynamic models of mantle evolution based on the history of subduction in last 300 Myr and compares the obtained thermal structure of the lower mantle with the structural information from seismic tomography. It is a follow-up and update of earlier works of the authors’ team. The authors report improved correlation between their geodynamic model and structures based on seismic tomography as compared to the previous models with slabs sinking vertically with constant speed. They also point out that the presence of a basal chemically distinct layer improves the fit. The good correlation is however only found at relatively long wavelengths and the sinking speed

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of the slabs in the lower mantle is higher than the recently reported value of van der Meer et al. (2010).

I find this paper a very useful contribution to the discussion about the fate of the subducted lithosphere despite its limitations (mainly the relatively simple depth dependent viscosity) and I certainly recommend it for publication. I have however two comments, one concerning the model description and the other one concerning the sinking velocities.

1. The model description. In general, I would prefer at least a short model description in the text (or supplementary material). Here the reader is referred to a recent paper of Steinberger and Torsvik (2012) for the model details. It may however make it easier for the reader, to give here at least the basic information – governing equations, model resolution and possibly also the radial profiles of viscosity and thermal expansivity. I would also suggest to explain clearly the difference between the models st12den-1, st12den-2 and st12den-7 in the model (methods) section. Furthermore, I don't understand completely, how the density model of the upper mantle is constructed. The authors state, that 'Between their time of initial subduction and 14 Myr later, slabs are not included in the density anomalies that drive the mantle flow.' (page 855, par.5). Does it mean that the upper mantle density anomalies are kept zero and the slabs in the lower mantle are in fact 'detached'? If this is the case, why do they need to 'extrapolate alpha to the surface' (page 854, par. 20)?

2. Sinking velocities. The authors admit that the slab sinking speeds in their models are rather high and cause the discrepancy between the depth extent of the cold anomalies in their geodynamic model and in the tomographic one. The authors state that the sinking velocities could possibly be reduced by assuming higher viscosity in the lower mantle. They are however afraid that the additional lower mantle viscosity increase may be difficult to reconcile with the geoid constraints (page 870, par. 20). Did they try to (slightly) increase the viscosity in the whole mantle? Such a shift of a viscosity profile towards slightly higher viscosities throughout the whole mantle should reduce

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the velocities while the geoid would not be affected.

Minor comment: Figures. The labels in some figures (especially 5 and 7) are too small – unless the figures will appear larger in final version.

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Interactive comment on Solid Earth Discuss., 4, 851, 2012.

SED

4, C381–C383, 2012

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