

Interactive comment on “The Subduction Dichotomy of Strong Plates and Weak Slabs” by Robert I. Petersen et al.

Anonymous Referee #1

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In this article the authors have modelled 2D subduction by varying the strength of both the plate and the slab segments. The major finding is that, according to the authors, most observations at subduction zones are reproduced for a combination of strong plates and weak slabs.

However, I find that, as it is, the article presents some physical assumptions which are difficult to reconcile with the nature: 1) first of all, slab weakening is imposed 10 km below the base of the horizontal plates. As far as I know, there is no diffuse weakening mechanisms occurring at these depths, with the exception of slab dehydration that on the one side can induce dehydration embrittlements, but on the other side dries up the slab and make it stronger after the fluids have percolated away from it. Another weakening mechanism often invoked is grain-size reduction due to phase transformation, but this occur around the transition zone, that is much deeper than 60 or 90 km used

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in the calculations. 2) could the authors explain why a mantle cohesion = 150 MPa is needed in the Byerlee's law?

The authors state that a weak slab is needed to reconcile models with observations. In my opinion this is not entirely true, as tomographic image from Tonga, for example, show that what appear the tip of the slab is dipping into the lower mantle (similar to their model 18). And there we know that the slab must be very old and stiff because of the very fast subduction rate.

In general, I feel that the conclusions relative to the role of the rheology of subducting plates are too superficial and not strongly supported by observations.

However, I have really appreciated the part of the article where different fitting methods used to measure the plate curvature were investigated, and which among them gives the better estimates and the sense of the non-steady state subduction. Hence, in conclusion, I would suggest to reshape the article toward this part of the results, emphasizing also how other studies using the spline method may have wrongly estimated the plates' radius of curvature.

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