Solid Earth Discussions

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Comment on se-2020-217

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Referee comment on "Buoyancy versus shear forces in building orogenic wedges" by Lorenzo G. Candioti et al., Solid Earth Discuss.,
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The manuscript presented by Candioti et al. uses 2d petrological-thermomechanical models to study the dynamics of orogenic wedge. They mainly investigate the influence of three pairs of parameters on the evolution of orogenic wedge: density (simplified linear EoS vs. phase diagram generated from Perplex), serpentine rheology and upper crust rheology. Several distinct wedges have been observed due to those parameters and they attribute them to the balance of buoyancy force and shear resistance. Finally they discuss the potential application of the models on the Pyrenean and Alps orogenies.

The manuscript is generally well written with a very fair discussion. However, I have very minor comments and some clarification is needed, for example, the abstract is really long, some parameters are not well described. Therefore, I recommend it to be published in Solid Earth after some minor modifications.

Comments:

Line 23: “the increase of horizontal driving force”, why results in subduction halting but not vice versa?

Line 62: remove “lithosphere”

Line 82: “buoyancy forces” -> “density contrast” because buoyancy forces might result in misunderstanding (to negative buoyancy force due to the slab).

Line 84: “at the topo of the mantle”, a bit vague, the strength is only changed at the surface? You may rephrase it.

Line 97: the “thermal softening” = shear heating? If so, you may bracket with shear heating, otherwise additional explanation is needed or at least a reference is needed.

Line 112-123: as for the boundary conditions, it’s better to show the details in this paper rather than referring to another paper. For example, I feel abrupt to see 1 cm/yr of total absolute extension in the later part, and the occurrence of calcite, mica is also very abrupt. But I do understand them only after checking your previous paper.

Line 146: “except that …” could be rephrased to, for example “except that a feldspar-dominated upper crust is replaced with a weaker rheology of quartz-dominated upper crust”

Line 342-343: it’s not easy to understand, please rephrase

Line 350: which model shows the first-order feature? Put (Fig. xx) behind “Pyrenees”

Line 406: as for the overestimated topography, what’s the erosion rate used (and observed from literature)? The overestimated topography is probably mainly due to the large subducted crustal volume, especially the upper crust. BTW, what’s the justification for the upper and lower crust thickness with 25 and 8 km, respectively?

In the model configuration part, it’s better to explicitly describe the correspondence of flow law (dry, wet olivine) vs. density (bulk DMM, hydrate peridotite). For example, feldspar (table 1) uses wet anorthite (table A1)? Quartz uses ‘wet quartzite’?

Line 418-423, just a comment for future study: the resolution used here is fairly high, the large amount of crustal material subducting to mantle depth might be attributed to the boundary condition, if the inflow is only imposed on the lithospheric domain, while outflow for the asthenosphere, I suspect that the slab is probably free to advance or rollback, in this case, much less crustal material could be entrained to the mantle depth due to its buoyancy.

Eq. (A9): isn’t it ½ rather than 1/3?

Line 491, as for the second invariant strain rate, do you miss ½?

Fig. 3: do you correctly show the phase diagrams for the MORB, Hydr Peridotite, Andesite, Serpentinite, pelite? You may have to reshape the matrix

Fig. 4: though the effective viscosity is shown, the most important part: the viscosity around the channel is not shown which inhibits better understanding, moreover, the relative strength of feldspar and quartz used (for example, no such description at Line 146) is not well known for readers (I suggest to plot either of the viscosity around the channel, or strength profile for different flow laws).

Fig. 10: using different shading zones separating the timeline for those 5 stages may look better.

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