Editors Comments

[EC1]
Reference to Ruh is 2020 on page 3 and 2020a on page 4

[Response EC1]
We thank the editor for bringing this to our attention. The manuscript has been corrected and now both the references read Ruh, 2020.

[EC2]
Method section: please add explanations of vx, vy and alpha. P for pressure and T for temperature are explained 3x. The overdots on the strain-rate symbols are slightly displaced.

[Response EC2]
We thank the editor for bringing this to our attention. V_x and V_y have been defined as well and the redundant T and P explanations have been removed. Additionally, the overdots have been also corrected. The coefficient of thermal expansion ξ (denoted as alpha in the previous manuscript) has been also explained.

[EC3]
Equation 4: is density also here a function of T, P, C and M?

[Response EC3]
We have corrected the equation to show the density changes in our model. Now the relevant sentences reads "*where ρ is rock density and depends on rock type, temperature, and pressure as ρ(T,P)= ρ_0 (1-ξ(T-T_0))(1+ς(P-P_0)) where ξ is the coefficient of thermal expansion taken to be 3×10^(-5) K-1 for all rock markers and 0 for air/water, ς is the coefficient of compressibility is taken to be 1×10^(-5) MPa-1 for all rock markers and 0 for air/water, ρ_0 is the reference density at reference temperature (T_0=298.15 K) and reference pressure (P_0=10^5 K).*" We hope this clarifies the manuscript.

[EC4]
Please add how strain softening (mentioned in Table 1) is determined

[Response EC4]
As per the editor's request, we have added the motivation for the strain softening as well as the rationale for using the specific threshold of 0.5-1.5. This is now explained in L307-312 and reads "*Strain-softening has been modeled as a linear decrease of the angle of friction (φ) and cohesion between the cumulative strain of 0.5 and 1.5. Sediments used in the model have an angle of friction (φ) of 30° before the cumulative strain of 0.5 and a strain-softened value of 20° after a threshold of 1.5 cumulative strain. Strain softening has been used in wedges to mimic the weakening of faults and shear zones due to lubrication with values threshold taken from previous numerical studies (Hickman et al., 1995 , Ruh et. al. 2014).* "

[EC5]
Table 1: I assume that the density values are for a reference temperature and pressure.

[Response EC5]
We thank the editor for pointing this out. We have now added one line in the Table that density values have been taken at the average temperatures of the rock type and have provided the reference taken for the rock densities.

[EC6]
Table 1: The cohesion of 1 MPa is rather low. Please add a motivation for this value and a reference

[Response EC6]
We thank the editor for pointing out this typographical error. The cohesion for all rock types is 10 MPa, except for sediments which is 1/0.05. We have corrected these values in Table 1 accordingly. The lower cohesion for sediments is in line with the low cohesion values observed for sediments in the Nankai accretionary wedge (Schumann et. al. 2014).

[EC7]
Table 1: An angle of internal friction of 31 is highish, though not exactly for dry rocks. Please add a motivation for this value.

[Response EC7]
We use the values of internal friction of 31 (0.6), in line with multiple numerical studies previously conducted such as Ruh et. al 2014, Gerya & Meilick, 2011.

[EC8]
Table 1: Please add the original references to the flow laws.

[Response EC8]
We thank the editor for pointing this out, and we have now added the reference for the flow laws.

[EC9]
Table 2: symbol alpha is used for thermal expansion and for surface slope. Please use a different symbol for one of them.

[Response EC9]
We thank the editor for pointing this out. We have now used the symbol ξ for the coefficient of thermal expansion.

[EC10]

Figure 1: the application of the boundary conditions is not entirely clear to me. Is the convergence applied to the top of the box, that is, on air? What do the converging arrows on the vertical sides represent?

[Response EC10]

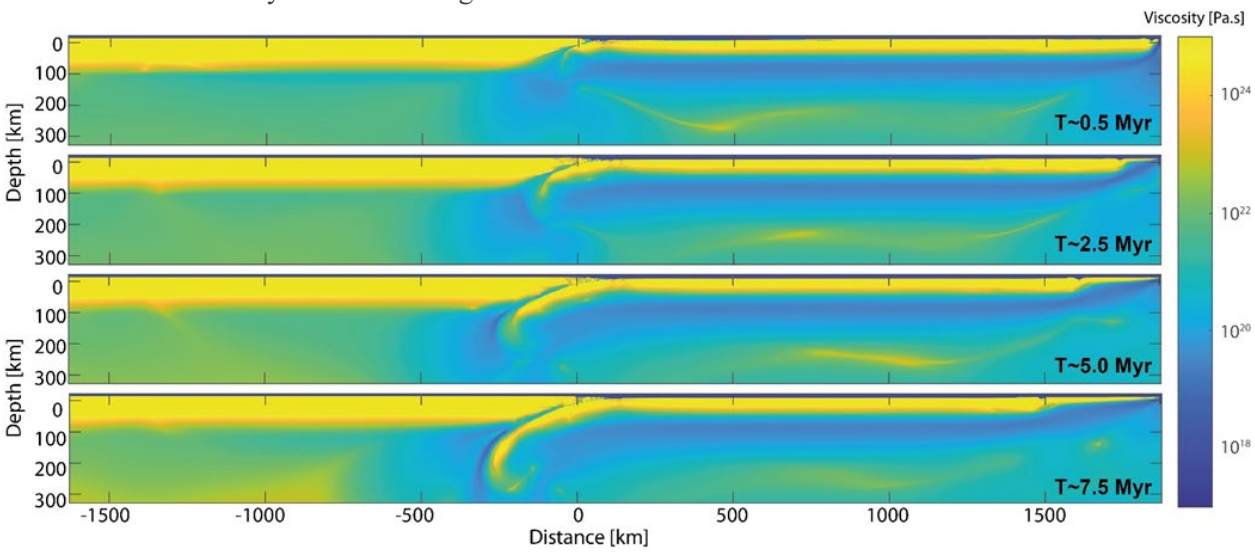
We would like to inform the editor that convergence is applied inside the plates, using highly viscous nodes placed near the boundary of the model. We acknowledge that this was not mentioned in the earlier manuscript and now we have added Line 272 in the manuscript clarifying this which reads "*The convergence is prescribed internally using highly viscous nodes inside the oceanic and continental plates near the boundary of the models.*"

[EC11]

Would it be possible to include a plot of the effective viscosity for a representative model?

[Response EC11]

We agree with the request of the editor and have now added a supplementary figure (Fig S 21) showing the distribution of viscosity in the modeling domain.



Reviwer1 Comments

[R1C1]
First of all I would like to thank the authors for carefully having integrated and answered all raised comments from the first round of revision. In my opinion, the manuscript improved drastically both in structure and content. I have no particular major comment. However, several minor flaws came to my attention whilst reading through the current version of the manuscript. I suggest to accept the article for publication after having taken into account the points listed below.

Best wishes
Jonas

[Response R1C1]

We are pleased to hear that the revisions have met the reviewer's satisfaction. We extend our heartfelt thanks for their valuable feedback, which has significantly improved our manuscript, making it a more engaging and impactful read for our audience.

[R1C2]
L56: maybe this reference should either be replaced or added by a natural general study that supports this statement. Especially, because in Ruh (2020), temperature is defined by a vertical gradient without a sophisticated implementation of temperature.
??

[Response R1C2]
We agree with the reviewer's feedback and have changed the reference to indicate a natural study supporting the statement. The line(L54-56) now reads "*Low-temperature, high-pressure metamorphic rocks in the subduction wedge are often attributed to the pressure maxima that typically predate the temperature maxima in accreted sediments undergoing diagenesis in the wedge (van Gool and Cawood, 1994).* "

[R1C3]
L73: correlate

[Response R1C3]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C4]
L89: what do you mean with final location within the wedge? At which moment? A wedge remains usually dynamic until closure of an ocean and collision, where most wedges get highly deformed due to their relative weakness compared to internal basement zones.

[Response R1C4]
We agree with the reviewer's feedback that the word final is vague and does not convey meaningful information. To this end, we have dropped the word "final" and now the line reads "Our assessment identifies a primary gap in existing research: the prediction and mapping of the initial sediment influx to their location in the orogenic wedge"

[R1C5]
L112: maybe thick, or similar, instead of extensive?

[Response R1C5]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C6]
L119: no comma after reference

[Response R1C6]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C7]
L121: out-of-sequence thrusting

[Response R1C7]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C8]
L135: SI units are missing related to conductivity values

[Response R1C8]
We agree with the reviewer's feedback and have corrected the typographical error. Now the sentence reads "*For instance, in our simulations, the sediment thermal conductivity within our wedge steadily increases with depth from 0.96-4.0 Wm−1K−1, which is within the range of thermal conductivity estimates for comparable depth in other subduction zones, such as the Hikurangi subduction margin, Japan Trench, and Taiwan subduction zone (Fig. S1, Henrys et al. 2003, Lin et al. 2014, Chi and Reed, 2008).*"

[R1C9]
L156: Stokes capital letter

[Response R1C9]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C10]
L158: Pressure derivate divided by y derivate

[Response R1C10]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C11]
*L164: sigma_xy * epsilo_xy. And twice, or adding yx as well*

[Response R1C11]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C12]
L165: time derivate is Dt, not DT

[Response R1C12]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C13]
L168: but H_r and H_l you don't introduce

[Response R1C13]
We the thankful to the reviewer for pointing this out. We have dropped the mention of Latent heat(H_l) as no phase changes happen in our model. We have also mentioned the values of radioactive heat production (H_r) in Table 1 for different rock types.

[R1C14]
L186: indicate that Z is depth

[Response R1C14]

We agree with the reviewer's feedback and have replaced all Z with Y, to avoid confusion.

[R1C15]
L190-198: The h (grainsize) can be deleted from the disl creep equation. Especially, because a diffusion creep law is introduced that has a stress factor and not a grain size component. On the other hand, I cannot find any information of the value of S.
Furthermore, table 1 should list all parameters related to viscous flow for both dislocation and diffusion creep for reproducibility (S, A_D_disl, A_D_diff, E_a_disl, E_A_diff, V_A_disl, V_A_diff, and h, if applicable.

[Response R1C15]
We agree with the reviewer's feedback and have dropped h from the dislocation creep equation. We have also mentioned the value of flow law parameters and have mentioned in the table that we have assumed the dislocation and diffusion creep parameters to be the same.

[R1C15]
L198: should there be a point instead of a multiplication sign?

[Response R1C15]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C16]
L205: either define here the value for fluid pressure ratio applied or list it in table 1.

[Response R1C15]
We agree with the reviewer's feedback and have mentioned the value of λ the fluid pressure ratio to be 0 in all the simulations. The sentence now reads "*where c is cohesion and φ is an effective internal angle of friction or μ=tan φ where is the coefficient of internal friction and λ the fluid pressure ratio assumed to be 0 in all the simulations.*"

[R1C17]
L207: rephrase "passable"

[Response R1C17]
We agree with the reviewer's feedback and have replaced the word with permeable. The sentence now reads "*A free-slip boundary condition is implemented on all boundaries, except on the lower boundary, which is permeable in the vertical direction*"

[R1C18]
L208: where we implement needs rephrasing

[Response R1C18]
We agree with the reviewer's feedback and have corrected the grammatical error.

[R1C19]
L211: where not capital and no coma after where

[Response R1C19]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C20]
L218: tectonic deformation instead of changes?

[Response R1C20]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C21]
L233: same as in line 211

[Response R1C21]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C22]
L236: point

[Response R1C21]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C23]
L266: setup

[Response R1C23]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C24]
L267: It is rather the equations that are discretized, not the modelling domain

[Response R1C24]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C25]
L280: any reference that supports that crustal and lithospheric thicknesses from Japan?
[Response R1C24]
We are thankful for this suggestion. As per the receiver function study of Akuhara(2018) the moho-depth in the neighbourhood of Kii peninsula transitions from 10 km to 50 km from the Phillipean sea plate to the Amurian plate. Thus the crustal thickness is in the range of values assumed by us. We have now added this reference in our model setup.

[R1C26]
L295: maybe 10 simulations of the same model is more correct

[Response R1C26]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C27]

L307: it decreases linearly from X to X at strains between 0.5 and 1.5. As now, it seems that there are different thresholds used in different simulations.

[Response R1C26]

We agree with the reviewer's feedback and have rephrased this section to make the language clear. The sentences now read "*Strain-softening has been modeled as a linear decrease of angle of friction (φ) and cohesion between a cumulative strain of 0.5 and 1.5. Sediments used in the model have an angle of friction (φ) of 30° before the cumulative strain of 0.5 and a strain-softened value of 20° after a threshold of 1.5 cumulative strain. Strain softening has been used in wedges to mimic the weakening of faults and shear zones due to lubrication with values threshold taken from previous numerical studies (Hickman et al., 1995 , Ruh et. al. 2014).* "

[R1C28]

L308: decreases I suppose. Either way, the sentence is redundant and means the same as the one before

[Response R1C28]

We agree with the reviewer's feedback and have corrected the typographical error.

[R1C29]

L333: both mentioned studies are analogue models, but you mention numerical and analytical. Maybe write numerical,analogue, and analytical models and add references for numerical (Ruh et al., 2012) and analytical (Davis et al., 1983). And references to the end of the sentence.

[Response R1C29]

We agree with the reviewer's feedback and have corrected the typographical error.

[R1C30]

L488: extend the sub-section title. Implications of .....

L488-ff: The entire Implications section is in my opinion largely a repetition of results. Maybe try to put it more into perspective to previous studies exploring these factors and highlight the importance of your findings in relation to them.

[Response R1C30]

We have modified the title of the section to "Implications of thermal maturity evolution in a subduction wedge", however we have not reformulated the paragraph as the following two sections "5.3 Comparisons to previous numerical studies " and "5.4 Comparisons to natural wedges " discuss individual studies in comparison to the present study. We believe any change in the section 5.2 would lead to major overhaul in the following sections too. Hopefully, this is acceptable to the reviewer.

[R1C31]
L774 (Table 1): Angle of friction for asthenosphere should be 31. From where are those flow laws? There are many wet quartzite flow laws and they are different. Add all necessary parameters for viscous flow laws. T is temperature in Kelvin

[Response R1C31]
We agree with the reviewer's feedback and have corrected the typographical error.

[R1C32]
L780 (Table 3): Are there no values for models 2 - 20? Then use "-" or similar, otherwise 0's.

[Response R1C32]
We agree with the reviewer's feedback and have corrected the typographical error.

Notification to the authors:

[NC1]
Please ensure that the colour schemes used in your maps and charts allow readers with colour vision deficiencies to correctly interpret your findings. Please check your figures using the Coblis – Color Blindness Simulator (https://www.color-blindness.com/coblis-color-blindness-simulator/) and revise the colour schemes accordingly.

[Response NC1]
Checked and found our colourmaps are compliant.

[NC2]
*Your *.pdf manuscript file contains the supplement figures. Please note that a supplement is an additional file that is meant to complement your paper. It can be submitted either as a *pdf or a *zip file. This file will be linked to your paper after publication. See more: https://www.solid-earth.net/submission.html#assets / Supplements /. The appendix is part of the *.pdf manuscript file and will be inserted as the last section. See more: https://www.solid-earth.net/submission.html#manuscriptcomposition / Appendices /. For the next revision, please rename the support materials accordingly.*

[Response NC2]
We now have no appendixes and just supplementary files. During submission, I will make sure of this instruction.

[NC3]
Please make sure that the supplement contains only additional research materials. At the next revision, remove from the supplement the files already duplicated in the MS Records system. Please see more: https://www.solid-earth.net/submission.html#assets / Supplements /.

[Response NC3]
We now have no appendixes and just supplementary files. During submission, I will make sure of this instruction.

[NC4]
Your tables contain coloured cells or/and coloured values. Please note that this will not be possible in the final revised version of the paper due to HTML conversion of the paper. When revising the final version, you can use footnotes or italic/bold font.

[Response NC4]
Tables corrected.

[NC5]
*The title page of *pdf. manuscript file must include the full institutional addresses of all authors. Please add them for the next revision.*

[Response NC5]
Address added.