Reviewer 1

We would like to thank Nemanja Krstekanic for his constructive comments and suggestions. They helped us improve the clarity of the manuscript and to develop the discussion on both the orientation of strike-slip faults and the role of the amount of deformation. Our replies to the specific comments (in italics) are given point by point below:

General comments

In this manuscript, the authors use crustal-scale analogue modelling to study a complex tectonic system in which indentation-driven and extrusion-driven deformation overlap in space and time and result in different coeval tectonic regimes. The topic of this research is very welcome as there is still a lack of knowledge on various controlling factors of such processes' interplay. The manuscript is well structured and written, scientifically very valid, with a clear description of the methodology, results, interpretations and conclusions. The title is informative and reflects the content of the manuscript, while the language is good. Taking all of that into account, I consider it a nice contribution to Solid Earth.

I have a few moderate to minor comments that I'll point out below. Also in the attached annotated pdf of the manuscript, I have smaller comments that I hope will help the authors clarify a few minor things in the text.

Specific comments

1) *Referencing existing publications is generally very good in the manuscript. However, I would suggest to slightly expand the comparison with existing studies of the complex interplay of different tectonic regimes, both in the Introduction when introducing the studied problem and in the Discussion when comparing to the novel results of this paper. Several relatively recent papers deal with indentation and extrusion or interplay of different tectonic regimes, using both analogue modelling and field data. See also annotated pdf.*

Reply: We now refer to additional modeling studies in the Introduction, in particular those by Duarte et al. (2011), Rosas et al. (2012, 2015) on thrust-wrench interferences, by Krstekanić et al. (2021, 2022) on backarc-convex orocline formation, by Philippon et al. (2014) on the indentation of Arabia, lateral escape of Anatolia, and backarc extension in the Aegean region, by van Gelder et al. (2017) on the lateral escape and extension in the eastern Alps, and by Corti et al. (2006) on strain distribution along the Maghrebides-Apennines accretionary prism and the Sicily Channel rift. In the discussion section, we have included additional comparisons of our experiment results and set-up with previous studies by Corti et al. (2006), Duarte et al. (2011), Rosas et al. (2011,2015) as suggested by the reviewer, and also with 3D numerical models by Le Pourhiet et al. (2014).

2) *Section 4.1: While I generally agree with the content of this section I think it is too long and can be shortened. Also, this section would apply more to the homogeneous system, while in all models in this study there is a rheological and/or structural heterogeneity, which, in my opinion, significantly influences the deformation. It is not only the distance to the model margins (i.e., indenter and extrusion-related pull). I think the limitation of the modelling setup (i.e., relatively low amount of total shortening) has an impact on the evolution of thrusting, as thrusts will form after a certain accumulation of shortening. I think it is not only the extension/shortening ratio but the total accumulation of strain that plays an important role. This issue should be discussed more in this section. Another factor that should be taken into account is the compressional wedge that forms close to the indenter. This wedge increases the vertical load in the model, therefore increasing the vertical stress, which significantly affects the distribution of stress and strain in the model. I think all these factors should be considered and better discussed in this section. So, my suggestion is to modify section 4.1 to make it more concise and focused, while discussing all factors that affect the tectonic regime(s) in the models.*

Reply: We agree with the Reviewer that the accumulation of strain can play an important role on the distribution of deformation within models. To be fair, we already indicated the possible role of the limited amount of shortening that we are able to impose in the model to explain the lack of thrust faults for brittle-ductile models. We now also indicate that it could be the case for brittle models with high V_e/V_s ratios. We also discuss how the accumulation of material in the wedge during deformation may modify the distribution of stress and location/type of structures over time:

"Progressive increase in the southern wedge thickness accompanying N-S shortening in the absence of erosion would imply an increase of the vertical stress. As a consequence, thrust faults would propagate toward the north (as evidenced between 4.2 and 7.7% of shortening for model BI05; Figs. SM1C and 4C) and could possibly reach places where strike-slip faults and normal faults were previously active. Therefore, the redistribution of stress resulting from deformation could drive temporal variations of the tectonic regime at a specific location."

"However, we cannot preclude that thrust faults could also develop at later stages for these models with high V_e/V_s ratios, as experimental limitations prevent us from imposing large amounts of N-S shortening. In model BI07 for instance it is at maximum 3.6%, which may be insufficient to locate deformation along an E-W thrust fault."

3) *Orientation of strike-slip faults: I made several comments in the annotated pdf about the change of strike-slip fault orientation as this is one of the important results of this study. Please consider that some of them can be boundary effects, or that some of them are indentation-driven or extrusion-driven. This last terminological distinction can be considered, but it is just a suggestion, authors do not have to accept it. Anyway, I think a bit more discussion about what controls the strike-slip fault orientation is needed in section 4.2.*

Reply: We completed section 4.2, now adding a discussion on the parameters that may control the formation of the high angle strike-slip faults that develop at model boundaries, including boundary effects. However, we still think that the orientation of these faults is also controlled by the formation or pre-existence of a graben in the center of the model, as indicated by the variability in orientation of these strike-slip faults within the same model, or between models with or without a former stretching phase:

"These anomalously oriented strike-slip faults could result from a combination of factors. As they nucleate from the edge of the model, we cannot exclude that they result from some unwanted boundary effects associated with the high friction wall-sand interface. As a result of the applied stretching and boundary effects, the maximum principal stress σ_1 may have rotated from a N-S direction toward a NE-SW direction in the eastern part of the model and NW-SE direction in the western part of the model, possibly explaining why these strike-slip faults do not lie at 30° with respect to the imposed N-S shortening. However, one can also notice that not all of these strike-slip faults have the same exact orientation (Figs. 4D and 4E), some of them being directed toward the northward termination of the normal faults bounding the central graben. Their orientation therefore could also be controlled by the graben structure that forms in the center of the model above the crustal seed."

" While we cannot preclude some boundary effects here too, these faults with a larger than expected angle with respect to σ_1 also connect with the normal faults bounding the central graben formed during the initial stage of stretching. In comparison, model BI05, which shares the same stretching/shortening ratio and almost the same amount of total stretching (~10%) does not show any anomalous strike-slip faults in the southern part of the model (Fig. 9A). Pre-existing structures may also exert a control on the geometry of subsequent structures even for areas close from where shortening is applied. "

" In particular, at model corners, strike-slip faults bend with angles that become larger with respect to the N-S shortening direction, possibly indicative of some boundary effects. More interestingly, some strike-slip faults are oriented almost parallel to the shortening direction in areas that were previously affected by normal faulting (Figs. 6 and 9C). "

4) *Referring to figures should be stronger in the text. I suggest to authors to refer to figures more often. This will make the connection between the text and figures much stronger and will help readers to follow the text more easily.*

Reply: We followed the reviewer's suggestion and refer more often to figures in the manuscript.

5) *Figures are generally good and informative. However, I have a few suggestions on how to improve them:*

   Maybe it would be good to have an additional figure (maybe new Fig. 1) to accompany the problem statement and to illustrate the processes and some natural examples mentioned in the Introduction.

Reply: We have added a new introductory figure (new Fig. 1) with maps highlighting zones of active or past coeval activity of tectonic regimes.

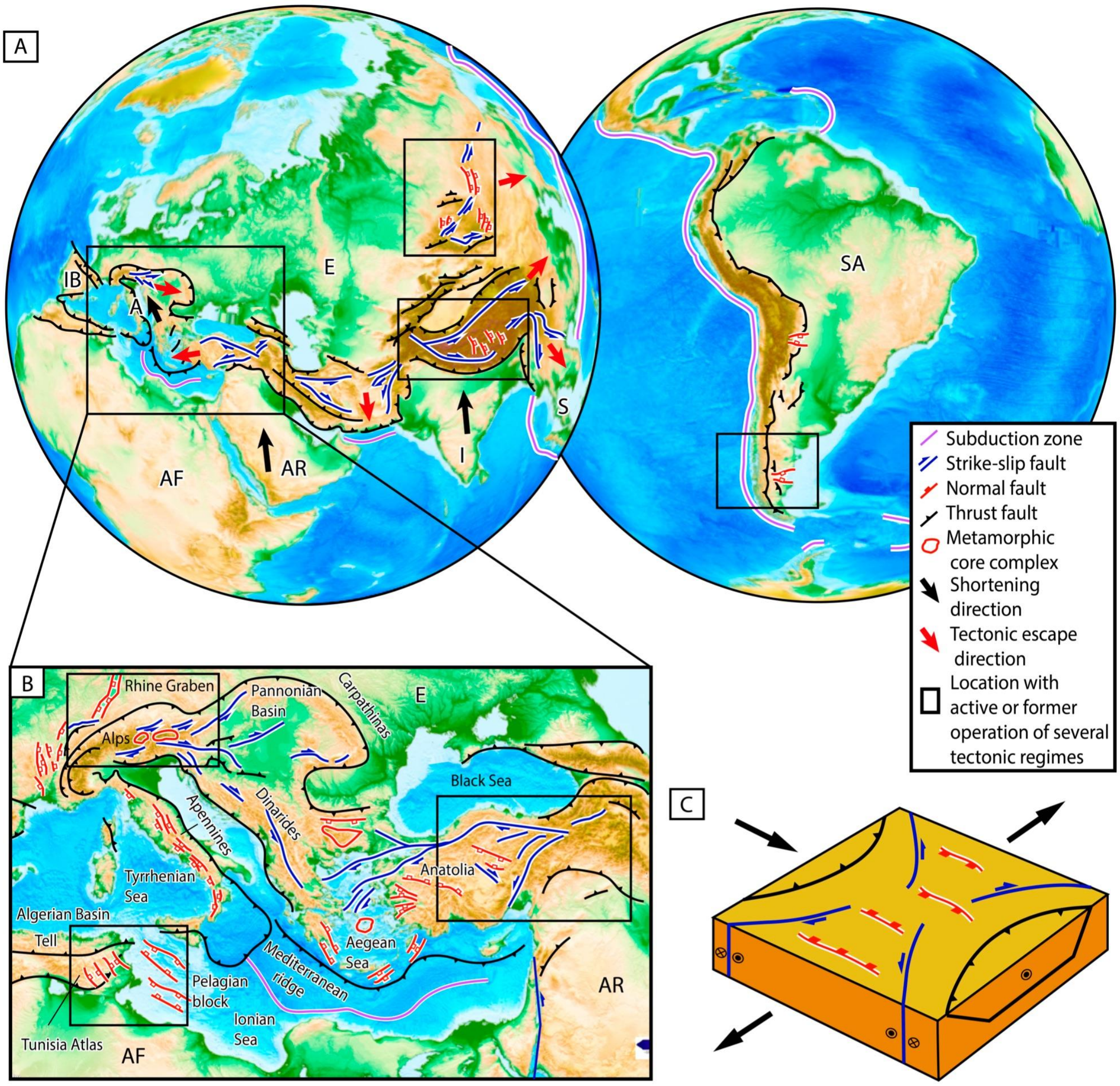

Fig. 1. A) Geological sketch maps showing locations with active or past multiple coeval tectonic regimes (Tapponnier et al. , 1982, 2001; Davy and Cobbold , 1988; Martinod et al. , 2000; Fournier et al. , 2004; Scharf et al. , 2013; Sengör , 1976; Dèzes et al. , 2004; Corti et al., 2006; Gianni et al. , 2015). B) Close-up map showing the tectonic setting of the Alpine-Mediterranean region. Structures are modified from Faccenna et al. (2014). C) Block diagram illustrating typical structures formed in settings involving coeval shortening and extension. Abbreviations are SA: South American plate, I: Indian plate, E: Eurasian plate, AF: African plate, AR: Arabian plate. IB: Iberian plate, and A: Adria plate.

6) *When a figure has more than one panel, I suggest putting a letter on each panel to make it clear which part of the figure authors refer to in the text (e.g., Fig. 3c). Panels in figures 3, 4, 5, 8 and 13 are too small and it is difficult to read them. Try to make panels larger.*

Reply: We followed the reviewer's suggestions and lettered panels in the revised figures. We also modified figures in order to make them as readable as possible without losing information.

7) *I understand why it is important to show plots of principal stretches because they are used to derive strain type. However, these plots are not necessary here and are not discussed in the text. They also take space that can be used to make other panels larger. I suggest moving principal stretches plots from figures 3, 4, 6, 7 and 9 to Supplementary Material and maybe combining figures 3 and 4 and also figures 6, 7 and 8. This will reduce the number of figures (which is already large), while no information will be lost.*

Reply: We followed the reviewer's suggestions by only showing interpreted pictures and strain type maps. Plots of principal stretches now appear as supplementary figures SM2 and SM3. We also reorganized figures by combining figures 3 and 4 into the new figure 3, as well as figures 6, 7 and 8 into the new figure 5.

8) *Other smaller comments about figures I added in the annotated pdf.*

Reply: We also took into consideration the other comments given in the annotated pdf.

Technical comment

1) *There are just a few typos and some technical errors I managed to see. I marked them in the annotated pdf. Otherwise, the text is technically very good.*

Reply: We took into consideration the corrections suggested by the reviewer.

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- van Gelder, I.E., Willingshofer, E., Sokoutis, D., and Cloetingh, S.A.P.L.: The interplay between subduction and lateral extrusion: A case study for the European Eastern Alps based on analogue models, Earth and Planetary Science Letters, 472, 82-94.