

Inversion of extensional basins parallel and oblique to their boundaries: Inferences from analogue models and field observations from the Dolomites Indenter, eastern Southern Alps

Anna-Katharina Sieberer , Ernst Willingshofer , Thomas Klotz , Hugo Ortner , Hannah Pomella

General comments

This contribution attempts to explain a complex Alpine deformation zone through analogue modeling, which is a tool that allows simplifying the processes in order to understand the variables that affect the particular study case. It is an interesting study, and it is undoubtedly a contribution since continental polyphasic deformation is something that is observed in various parts of the Earth, so the variables under analysis can be applied to other case studies. The study is very complete in terms of its geological setting and deformation phases involved, so it has strong support prior to proposing the models to be developed in the following sections. However, from section 3 (analogue modeling approach) it becomes confusing, because 12 models are developed, but they are not properly grouped to be able to make an ordered comparison of the variables included in each of the 12 cases. On this, some more detailed comments are made in the following section.

As a general comment, there seem to be 2 or 3 sets of models (which include 2 or 3 models each set) comparable to each other, there are even two large sets of models (brittle only and brittle/ductile) that it is not clear that they can be comparable, since they have different scaling rati.

It is proposed that the authors reorganize their set of models in order to clarify which models are comparable to each other, and which factor is comparable (which is the variable) in each case of comparison, since the 12 models are different in different variables, but they can be grouped in pairs to compare. The proposal is to generate clear codes for each model and build a comparative table both initially (to present the models and their variables) and final (to present the results of the comparisons). Ex: models 6 and 8 are both brittle/ductile, the difference between is the angle of obliquity for inversion (0 and 20) and that is the variable to be evaluated when it is performed this comparison; so they can make a table in which that is highlighted (and models could be renamed as BD_0 and BD_20).

Later on, we talk about a "reference model", but the reference conditions are not specified, nor is highlighted the variable to be compared with the other 11 models. Better explain the reference model and against which models it is correct to use it as a reference. I think that in this case it is better to separate the 12 models into 2 or 3 large sets and compare them properly with each other, since there are many variables at stake.

I believe that by reorganizing the presentation of the models and variables under study and comparison, a good part of the following is clarified, and the work will look much better presented. Thus, it is a great contribution to the understanding of variables that affect complex polyphase deformation systems where many variables contribute.

detailed suggestions:

Line 199: I suggest listing here (this introductory paragraph to the methodology) the similarities and differences between the 12 models in order to identify the variables in each case.

Line 212: (VD) is not clear in the mentioned figure 3a-c : To clarify, is it referring to VD1 and VD2?, since in c they do not coincide. I suggest modifying Fig.3 in order to include an original set-up (pre-extension), indicate the meaning of the arrows and add some scaling details.

Line 212: "...and thus the strike of the basin axes" .. : this seems to be a hypothesis or a result. Clarify, since the direction of stress in extension (arrows in fig 3) is not aligned.

Line 213: "Pre-deformation rotation...": shortening?

Line 220: Are these values for all experiments? if so, add it in Fig.3 in the general set-up

Line 221: "...producing sedimentary basins of different size..." : seems to be a result, it should be mentioned after the development of the experiences

Line 235 to 239: This paragraph describes some characteristics of the different 12 models, however models 9 and 10 are not mentioned.

In general, the description of the models is very confusing, since they do not have any order or assigned codes that allow them to be associated with the descriptions. It is proposed to generate some coding, and a table of factors (variables) to be analyzed for each model.

Figure 4: a) MOD10 the symbology is not included in the legend of the figure. B) MOD6 and MOD8 (brittle/ductile) cannot be compared to filled basin (is that correct?).

Line 242: Explain why the difference between the speeds when extending and compressing, and between brittle/ductile or brittle-only models (EXT: 5 or 2.5 cm/h and COMP: 3 or 2.5 cm/h)

Line 249: Table1: I suggest reorganizing with codes and order that denote some characteristic of the model, and highlight the variable that allows making the respective comparisons (Ex: B_0 vs B_10 both brittle only but with differences in...)

Line 257: ..."whereas the ductile layer consists of polydimeth...": Indicate if it represents something in the real study case (o detachment layer or similar) or if it is just a device that allows you to geometrically modify where to generate the deformation

Line 275: Ductile layer in MOD 6 and 8 (brittle/ductile) has the same depth as the detachment of MOD 5-7 and 10 (brittle only), but different scale ratio, is that correct?. In addition, the thickness in both cases is the same (silicone layer and layer of glass beads in Fig. 4). Explain this scaling.

Line 290: add to table 2 (which only refers to brittle materials) the properties of the other materials used in the modeling and which are mentioned in this paragraph.

Line 320: the "reference model" : Does it serve as a reference for the other 11 models in this study? To justify.

Until this line (320) the difference, for example between models 1, 2 and 3, is not yet known, since in Fig. 3 all 3 are presented in the same conditions. It is necessary to create a table (and figure) where the conditions of the "reference model" are highlighted. If this model is compared with the other 11, then also highlight which is the variable for each case; otherwise "pair" according to whether the comparisons are made in another way in the following sections.

It is not clear why the following figures compare:

- only models 2 and 3 (Fig. 6 and 7), then models 7 and 8 (Fig. 8 and 9). Do we skip models 4 and 5?
- models 4 , 11 and 12 (Fig. 10) . Why was it decided to number that way if there are intermediate models not discussed? is confusing
- Figures 11 and 12 show plans and graphs of the 12 models. It is important to know if the 12 are comparable to each other indistinctly, otherwise it might be better to group them (pair them for example) for a better comparison considering the variables at stake (may be in the same figure but in an order that allow comparison)