

## **Subject: Comment on se-2020-214**

Review of “Complex rift patterns, a result of interacting crustal and mantle weaknesses, or multiphase rifting? Insights from analogue models”

### **Summary:**

This manuscript addresses the problem of understanding the effects of inherited weaknesses on rift evolution. The authors produce 3D analogue models to test the interaction between differently oriented in the crust and upper mantle. The main result is that crustal and mantle weaknesses can simultaneously localize rift structures leading to intricate fault patterns that could be interpreted as a result of multiphase extension. The authors conclude that multiphase extension is not required to explain different structural orientations in rift basins, and suggest that the tectonic history of natural examples should be reevaluated.

### **General Comments:**

This is an interesting manuscript that aims to solve an important problem in the evolution of rift basins. I think that the manuscript is well-written, explains clearly the methods used, and arrives at reasonable conclusions. The implications are well-received and useful for interpreting deformation patterns in rift basins.

- **REPLY:** We thanks reviewer 1 for taking the time to go trough out work, and for submitting this positive review.

One component that I think is missing is the comparison and contrast of the resulting models with natural rift patterns. For example, the comparison with the Malawi Rift would be interesting because it is a young rift with low extension (just as the set-up of the models) and inherited crustal weaknesses with varying orientations. The trend of the Malawi Rift is perpendicular to the extension direction but it meets the Shire Rift to the South with an oblique orientation. Do the rift structures show a pattern recognizable in the analogue models in this manuscript? The addition of this component would increase the impact of the manuscript.

**REPLY:** We understand the request to expand the comparison between our model results and nature. However, the goal of this work is not to directly compare our model results with nature. Instead, the analogue models presented in this manuscript aim to explore the general impacts of these parameters (hence we also included a comparison with previous analogue and numerical modelling efforts). We hope that our model results will inspire our colleagues to reevaluate the tectonic history of various natural rift systems (and rifted margins). We believe however, that adding a detailed comparison with a number of natural examples would distract from the main, more general, results and would significantly lengthen the text, which we deliberately kept as to-the-point as possible. Adding such model-nature comparisons would also be challenging, as the presence and character of crustal and mantle weaknesses are often not very well known in nature.

- However, since also reviewer 2 has requested the inclusion of more natural examples, we decided to mention a number of natural examples that could be useful for further studies and comparisons. In future work, we plan to go one step further and compare our results with natural examples, however, this will require another approach and a careful analysis of the natural examples which is, as said before, not possible in the frame of this contribution

**Grammatical and orthographical errors on lines.**

Paragraph 500: Fix “)parallel”

- **REPLY:** Thanks for noticing, the word “(sub-)parallel” is spread over two lines, and word automatically cuts it this way. We will double-check the final paper.