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Interactive comment on "Extension and Inversion of Salt-Bearing Rift Systems" *by* Tim P. Dooley and Michael R. Hudec

Tim P. Dooley and Michael R. Hudec

tim.dooley@beg.utexas.edu

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Many thanks for the positive review of our inversion paper. You had some specific and general comments that I will address below.

"In comparison to other published models of compressional systems with multiple "salt" décollement levels (e.g. Couzens et al. 2003 –a paper that should be referenced), Dooley and Hudec's models incorporate early episodes of extensional deformation, which feature synkinematic sedimentation to produce salt mi- gration and diapiric structures (later submitted to compression)."

In reality in these models the lower decollement is simply that, a decollement to ensure that shortening is transferred across the rift system. In models where by the thin lower

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decollement was not present across the entire system the result was a shortcut fault transferring minor shortening up to the outer edges of the suprasalt sequence (Model 3). But I agree that Couzens et al. should be referenced, along with selected other papers with multiple detachment levels, for completeness.

"The inversion models by Dooley and Hudec pro- vide inspiring images for such natural examples, if the model sand is accepted as a valid analog for crystalline or (non-horizontal) slate basements. Further challenges to the application to natural cases may come, as the authors explicitly recognize, from the tricky simulation of fault-inversion by faulted sand, which most commonly fails to reproduce fault weakening and reactivation."

Yes, I tried to temper the arguments in this manuscript as our model materials (sands) in the subsalt section may not reflect the "strength" of basement rocks in these orogens. However, we believe that, and as noted by you, that these models provide examples of possible basement deformation scenarios in areas where there is generally little or no basement exposure nor seismic data to aid interpretation.

"The authors may want to consider presenting the uncompressed profiles before actually showing the compressed ones, which in fact represent one step further of an evolution. I also wondered what would happen if there was no salt fringe out of the modeled rift, as actually happens in many natural cases. Fringes cause the post-salt extension to be more diffuse that the first- phase graben system. What happens in basement in this case?"

I pondered using a different order of presenting the 3 models when initially writing the manuscript. But I found the text flowed better when Model 1 could be described fully before delving into the details of the deformation (both pre- and post-inversion) with the use of Models 2 and 3 in a more discussion-like section. Your point on the salt fringe is well taken. Yes, this is likely to results in highly variable deformation styles across the inverted rift system – a mixture of coupled and decoupled geometries further adding to

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the complexity. We have done some work on this but more needs to be done, which could be applied to other areas in the High Atlas as you mention toward the end of your comments. A sentence or two will be added on this topic in the revised manuscript. One thing we noted is that without a significant salt fringe it was difficult to produce diapirs on the flanks of the segmented graben systems.

"Note that minibasins are not always flanked by outward-vergent thrusts as written in line 367 (Fig. 9), which is interesting. Another interesting result is that after shortening, fault footwalls remain broadly inflated (beyond local diapirs). If applicable to nature, this suggests that, counterintuitively, some minibasins may be actually underlain by highest subsalt relief."

For the most part minibasins are flanked by outward-vergent thrusts but you correct there are a few locations along the main rift system that are not. The text will be revised accordingly. Yes, the highest subsalt structural topography lies below the minibasins which is fascinating. I think the height-change maps showing the relief development during inversion quite spectacularly illustrate this with the minibasin system being elevated by this subsalt inversion, and with quite a low degree of rotation of the minibasin strata – more on that below.

"The Azag minibasin as drawn looks indeed tilted in a post-depositional stage (although the analog models do not get that much rotation), but note that cases like that are lagged by the absence of subsurface data: there is little control about the stratal geometry at depth and one tends to complete sections in a conservative way. Again, analog models may help in showing the viability of geometric interpretations that may be adopted."

Yes, the models give possible answers to subsurface geometries and the processes that went into making them the way they are. But, they are just that, models. But there are sections from Model 1 that do illustrate significant rotation and Figure 16 will be altered to include an example of this. The original talk I gave on this model series had

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such a model example and you reminded me of that. Thanks!

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