Solid Earth Discuss.,
https://doi.org/10.5194/se-2020-127-AC2, 2020

Solid Earth
Discussions
Open Access
EGU

Interactive comment on "Thick- and thin-skinned basin inversion in the Danish Central Graben, North Sea – the role of deep evaporites and basement kinematics" *by* Torsten Hundebøl Hansen et al.

Torsten Hundebøl Hansen et al.

torsten.h.hansen@geo.au.dk

Received and published: 21 November 2020

Thank you very much for your comments. I have posted your general comments followed by our replies below, one paragraph at a time:

"1) The authors need to state more clearly in the introduction and abstract what are the novel concepts of the study and its general implications. I would suggest using your main discussion points as a framework/mirror for that."

Reply: We will remark on the novelty in the revised text, mainly the fact that we have

Printer-friendly version

Discussion paper

provided an updated and dedicated case study of post-rift basin inversion which takes into account the mechanical heterogeneity of sub-salt basement, salt and supra-salt cover. We will also point out the interaction between major Zechstein salt structures and secondary Triassic salt layers during extension and inversion (as observed in the Salt Dome Province). Furthermore, we will make the general implications of the study clearer.

"2)The paper would benefit immensely from having two new figures: i) A composite section showing some of the wells used for seismic stratigraphic correlation in the methods section, which would add more confidence in your seismic stratigraphic interpretation. ii) A schematic diagram or adapted figure from Stewart (2014) illustrating the concept of a triangle zone and how that applies to your case-study"

Reply: Good suggestions. We will add a composite well section that span across the rift basin, preferable with GR and Sonic logs, as well as a figure to explain the triangle-zone concept better.

"3) My main issue with the text is that many important statements in the results and discussion lack direct references to their related figures, in special to your beautiful cross-sections (which I think are largely under-used). This makes your descriptions very hard to follow and what is worse is that this may lead some of your key statements to lose credibility. The reader does not know where to look most of the time. Also, some figures are cited out of order."

Reply: Very valid points. As per our reply to Sian Evan's comments, we will provide many more figure references to solve this issue and rearrange the order of the figures.

"4) The discussion is confusing in places. It presents some good points but others are not well explained (perhaps due to the lack of references to figures) or, in more extreme cases, unrealistic such as for example, salt flowing updip(!) during rifting. But, perhaps, I was just confused about what you were describing because I didn't know where to look at (previous comment)."

Reply: We will carefully go through the discussion to clarify our points and support these with more figure references. Up-dip salt flow refers only to the salt that must have been present initially on the down-slope side of the locations of later pillows or salt ridges/rollers as those seen in the left halves of Figs. 6 and 7. Some amounts of salt must have flown up-dip to form these, leaving welds behind them. We will clarify the text to make it clear that up-dip flow was a local phenomenon.

"5) The paper needs to describe and discuss better the whole of gravity-driven deformation and its interaction with thick-skinned extension and later inversion, and explore alternative scenarios involving these (more details in the annotated pdf)."

Reply: Sian Evans commented on this as well. To be frank, we have not thoroughly considered salt-related deformation driven only by gravity, i.e. gravity-driven deformation unrelated to movements on the major basement faults. We should definitely discuss this idea in relation to the significant dips on half-graben slopes in our study area. Still, we argue that the lack of interpreted down-slope compressional structures does not point toward a gravity-gliding scenario prior to Late Cretaceous basin inversion, i.e. syn-rift. Of course, salt flowing away from the deepest graben floor could have masked some down-slope shortening caused by gravity gliding (as indicated in Fig. 13a). This would simply enhance any hangingwall syncline above (e.g. Fig. 7). We will remark on gravity-driven deformation along these lines in our revised manuscript and take the comments from your annotated pdf into account.

We are very grateful for your helpful, thorough and constructive review of our submitted manuscript. Thank you once again!

On behalf of the authors,

Torsten Hundebøl Hansen

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2020-127, 2020.