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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.

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

——1. Figure references——

"A key issue with the paper as it stands concerns the use of given names for many of the structures, sub-basins and other local features in the area (e.g. Bo-Jens Ridge, Arne Ridge, Arne-Elin Graben, Tail-End Graben, Poul Plateau, Mads High, Roar Basin,

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Discussion paper

etc.). These names are frequently referred to in the text without a figure call-out showing their location. At times this makes it very difficult for someone unfamiliar with the area to remain spatially oriented. Whilst it may not be possible to put the location of all features on a composite map due to the different structural levels, the authors need to carefully ensure that every time a given name is referred to in the text, a corresponding figure citation shows its location. I have highlighted some examples in the attached pdf."

Reply: This is very valid point. We will include more figure references to solve this issue, as well as edit the text where it might be confusing about specific locations.

"As well as keeping the reader spatially oriented, more figure call-outs are needed generally to support observations described in the text. Any sentence that describes a structure observed in the data needs an appropriate figure call-out at the end – preferably both a cross section and map view, not just one or the other - for the reader to visualise the structure in 3D. The figures presented in this paper are well-illustrated and very informative and more use of these figures should be made in the text. Do not assume that the reader will take your word for it or will remember from a previous section which figure that structure is shown in. I would also recommend that to avoid confusion the figure numbers correspond to the order in which they are called out in the text."

Reply: Again, this critique is justified. We will make sure to support the text with many more figure references, and ensure that the figure numbers correspond to the order in which we call them out.

––2. Triangle-Zone concept–– "The key mechanism proposed to explain the decoupling between slip on thick-skinned basement faults and the thin skinned salt-detached faults involves the 'triangle zone' theory (L461 – L474). This conceptual model succeeds in explaining the formation of thin-skinned backthrusts with relatively little evidence of inversion on the basement faults. However, it is difficult to understand the

mechanism proposed in this paper without the reader already having an intimate knowledge of the work of Stewart (2014). I would recommend that either the schematic presented in Figure 13 be modified to include additional steps which explain the triangle zone theory as applied in this context, or that a simplified schematic such one taken from Stewart (2014) be added. In that case the reader is not required to revise the work of Stewart (2014) in order to understand the present paper."

Reply: This is a good point. We will include a schematic to illustrate Stewart's (2014) Triangle-Zone concept.

"I would also urge the authors to consider whether the triangle zone theory is the only way of explaining the observed relationship between hangingwall synclines and salt detached faults. The possibility of local thin-skinned gravity gliding on a dipping detachment is lightly touched upon in the paper, but it is not clear to me why the authors ultimately favour the triangle zone model over a local gravity-driven gliding model. And if the triangle zone model best fits the observations, what role did gravity driven deformation play, if any?"

Reply: 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.

——3. Misc.——

"Finally, some additional clarification would be beneficial to explain why the salt detach-

ment does not appear to decouple thin- and thick-skinned structures in the same way along segment 3 of the Coffee Soil Fault (L483-L490). This is an interesting assertion that may have wide applicability to other salt basins. The authors propose that this region may not be at a 'favourable angle' but this idea requires unpacking. Is there a mechanical explanation for the favourable orientations? Could there be other factors at play?"

Reply: We will elaborate further on this along the lines of: In the Salt Dome Province adjacent to segments 2 and 3 of the Coffee Soil Fault (CSF), we lack a basal sub-salt slope dipping towards the master fault (Coffee Soil Fault) along with a weakened (thin and faulted) cover above the upper part of this slope. This configuration of weak zones seems to have provided ideal conditions for the thin-skinned inversion ridges along the western inversion margin. This because the detachment and inverted cover faults, both antithetic to the relevant major basement fault (CSF 1 or the Gorm-Tyra Fault), approximate a plane dipping c. 20-30 degrees which is ideal for reverse slip, "backthrusting" if you will.

"Small technical corrections such as typos and other comments are highlighted in the attached pdf. I hope that my comments help the authors improve the quality of the manuscript and I congratulate them on an interesting and thorough piece of work. "

Reply: We will scour the text for typos and take your attached comments into account.

——————— We highly appreciate your helpful, thorough and constructive review of our submitted manuscript. Thank you once again! On behalf of the authors, Torsten Hundebøl Hansen

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