Solid Earth Discuss.,
https://doi.org/10.5194/se-2020-127-RC2, 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.

Oriol Ferrer (Referee)

joferrer@ub.edu

Received and published: 22 October 2020

Dear authors and Solid Earth journal editor,

From the interpretation of a seismic cube, the present manuscript discuss the role played by Zechstein salt as a detachment during the development of the Danish Central Graben and its subsequent inversion. The quality of seismic data allows a careful interpretation of both subsalt and overburden structures geometry as well as their kinematic evolution providing a new case study that supports recently published ideas

Printer-friendly version

Discussion paper

about salt-bearing inverted basins, and that deserves publication in Solid Earth journal. The structural styles and responsible processes are not uncommon in other salt basins, so that this manuscript should have wide appeal.

However, the structure of the manuscript may be confusing in some parts, especially in chapter 4 where observations and interpretations are in my opinion mixed. The excellent figures nicely illustrates text descriptions. However, despite the high quality of the geoseismic sections, I find that there are underused, in particular during the description of the main structures (chapter 4) and discussions, where there is a lack of direct references to them but in contrasts maps are overused. In addition, some of the figures are referred out of order. These minor issues should be addressed before the acceptation of the manuscript for publication. Please, see general comments, suggestions and questions below. Specific comments and edits are embedded in a pdf copy of the manuscript.

Sincerely,

Oriol Ferrer

GENERAL COMMENTS:

1) ABSTRACT: In my opinion the main idea to include in the abstract is that Zechstein salt acted

2) INTRODUCTION: The introduction section (chapter 1.1) corresponds to a small review of tectonic inversion. I suggest to specify that it refers to positive inversion (extension followed by contraction). In a similar way, I would like to suggest to introduce Bally (1984) as a reference, who in fact was the first author to propose a classification of the amount of inversion related to the basin bounding fault. Few years later, Cooper and Williams (in Copper et al., 1989) suggested the terms mild, moderate, strong and total inversion to refer at the degree of inversion included in your introduction.

On the other hand, as much of the works based on physical models pointed out, this

Printer-friendly version

Discussion paper

technique is not the best one to study inversion tectonics as granular materials (sand) are used to simulate brittle rocks. This difficult the reactivation of extensional faults during inversion because they are not effective mechanical discontinuities. In fact, the experimental setups of all the references of your introduction constrained the fault geometry with a rigid block allowing its contractional reactivation during inversion. In this sense, I think you should also use the recent work of Dooley & Hudec (2020) as a reference. These authors solved this limitation using a hybrid system allowing a partial inversion of faults developed in the granular material.

3) RESULTS & INTERPRETATIONS: I fully agree with SC1 (Sia Evans) comments regarding the use of local names of the structures. This is an often-repeated issue in regional works difficult to solve. The constant use of names is critical for a reader unfamiliar with the Danish Central Graben. If in addition, these local names are only referred in few figures (e.g. Fig. 1 and some of the maps), the reader can easily become spatially disoriented. Similarly, some of the local names are just pointed in the manuscript but are not located in any figure. I also recommend to review this point. There also some inconsistencies in the names of the different structures. In some cases they are written in capital letters (e.g. Gorm-Tyra Fault), and in others in lower case (e.g. Gorm-Tyra fault). These small inconsistencies should be reviewed and modified applying the same criteria.

Why do you use maps (Figs. 9, 10 and 11) instead geoseismic sections (Figs. 4 to 8) when describing structures? This difficult to follow your descriptions. Please, use further geoseismic sections, they are practically self-explained and will make the story more readily understandable. Observations and interpretations are mixed in chapter 4, giving rise later to repetitions in the discussions chapter.

4) DISCUSSION: As occurs with the results and interpretation chapter, some points developed in the discussion chapter are difficult to follow because they are not referred to your figures or the references used are not enough to suport your sentences. This should be definitely improved. I think this paper need a restorarion illustrating the

geometries, thickness patterns, and evolution both during early extension and subseqüent shortening. Readers will greatly benefit from a new figure showing the evolution rather than having to rely only on words. I recommend use the lines of Figs. 6 and 8 for the restorations. I am sure they will entail some additional work, but they will greatly improve the paper. In a similar way, I thin this section needs a new figure with the concept of triangle zone (Stewart, 2014) adapted to the case-study. In fact, this figure will definitely help the reader.

5) REFERENCES: Review the journal style and order of references. Some of the references are not included in the final list and vice versa. Below there are some references used in my comments and suggestions:

Bally, A. W. 1984. Tectonogénese et sísmiques réflexion. Bulletin de la Société Géologique de France, 7 (2), 279-285. Buchanan, P. G.; McClay, K. R. 1992. Experiments on basin inversion above reactivated domino faults. Marine and Petroleum Geology, 9, 486-500. Dooley, T. P.; Hudec, M. R. 2020. Extension and inversion of salt-bearing rift systems. Solid Earth, 11, 1187-1204. Ferrer, O.; Roca. E.; Vendeville, B.C. 2014. The role of salt layers in the hangingwall deformation of kinked-planar extensional faults: Insights from 3D analogue models and comparison with the Parentis Basin. Tectonophysics, 636, 338-350.

Please also note the supplement to this comment:
https://se.copernicus.org/preprints/se-2020-127/se-2020-127-RC2-supplement.pdf

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

Printer-friendly version

Discussion paper