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Interactive comment on "Pre-inversion normal fault geometry controls inversion style and magnitude, Farsund Basin, offshore southern Norway" *by* Thomas Brian Phillips et al.

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This manuscript focuses on the style and mechanisms of inversion in the northern margin of the Farsund Basin (south Offshore Norway) throughout Late Cretaceous and Cenozoic compressional events. The authors provide a detailed analysis of the basin bounding Farsund North Fault based on 2D and 3D seismic reflection data. In addition, the authors perform exhumation estimates from stratigraphic and compaction methods by using seismic and well data, respectively. The authors show i) how the pre-inversion structural configuration on the Farsund North Fault controls along-strike variations on the subsequent inversion-related deformation and ii) that the magnitude of uplift in-

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creases towards the Sorgenfrei-Tornquist Zone (a major lithosphere structure) which acts as a hingeline separating areas of regional uplift during the Cenozoic in the north from areas of subsidence in the south. The manuscript is well written, and the figures are of excellent quality reflecting all the points described in the text. I consider that this manuscript contributes to improve the general understanding of the mechanisms and styles of basin inversion. More specifically, this manuscript contributes with new data and observations to the knowledge of the Late Cretaceous – Cenozoic basin inversion and exhumation episodes in the Norwegian-Danish continental shelf. For that reason, I recommend publication of the manuscript after addressing few minor revisions.

1) Line 284 – "This normal compaction curve, which assumes continuous burial and hydrostatic stress conditions". Does that mean that the formation pressure of lower Cretaceous interval is hydrostatic in the 7 wells selected for this study? If so, the authors should mention it in the methodology section (subsection 3.4.2 Well-based compaction analysis). Also, have the authors performed any pre-conditioning of the sonic log curve (e.g. removal of anomalous DT readings)? I think that this should also be mentioned in the methodology section.

2) Line 347 – "Domain B is characterised by a complex zone of faulting formed during Early-Middle Jurassic strike-slip faulting (Phillips et al., 2018)". The authors mention earlier in the text (line 107) that the strike-slip fault system developed during the Jurassic takes place along E-W-striking faults and therefore, they are parallel to the Farsund North Fault. Can the authors provide further details about the geometry and orientation of the strike-slip fault zone along the Farsund North Fault? Although some details are given in the line 257 "The proposed strike-slip fault continues towards Domain A to the west, and continues to the southeast, south of Domain C, to the east." I think the manuscript could be improved by indicating the location of the strike-slip faults in the Figure 5a.

3) Line 270 – "We suggest that Domain C represents an Early Cretaceous segment of the Farsund North Fault, which propagated away from a pre-existing segment (Domain

A) during the Early Cretaceous, with Domain B situated between the two segments." I completely agree. However, I think that segmentation along the Farsund North Fault is an important point and it could be further developed in the text. Is there any evidence of fault segmentation in the throw-distance profile shown in the Fig. 5b? For example, displacement patterns in this figure show throw maxima in the central part of the domains A and C decreasing towards the domain B. Also, a similar throw pattern is observed between the domains C and D. Could these patterns reflect different kinematically linked segments? Is there any relay ramp observed between the domains A and C and the domains C and D? In the TWT structure map (Fig 5a) the authors show the Farsund North Fault as a continuous structure. Can the authors show the fault segments mentioned in the text (e.g. lines 270 and 349)? Also, can these segments be shown in the interpreted seismic sections (Figs 5a and 8a)?

4) Line 349 – "The eastern fault segment (Domain C) only initiated in the Early Cretaceous, with Carboniferous-Permian strata being isopachous across the fault (Fig. 3). The western segment of the Farsund North Fault was also active during Early Cretaceous extension and may have been active earlier during Carboniferous-Permian extension, although we are unable to confirm this due to a lack of preserved strata". I understand that whereas both segments were active at least since Early Cretaceous times, there is no evidence that the Farsund North Fault was active during Carboniferous-Permian times. Is there any other evidence of Carboniferous-Permian activity (i.e. growth of the sequences) recorded by any other E-W-striking faults in the area? I think this could be an important point to be added to the conclusions.

5) Is there a null-point observed in any of the Lower Cretaceous or older horizons along the Farsund North Fault? I think it is worth mentioning in the manuscript whether this observation is made or not.

6) Whereas the authors interpret a Late Cretaceous age for the inversion and exhumation in the Farsund Basin (Line 419) I understand that magmatic underplating is the main uplift mechanism behind the Neogene exhumation episode (e.g. paragraph start-

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ing in Line 425). However, in some parts of the manuscript the authors include both the Late Cretaceous and Neogene episodes within the term basin inversion. Some example are in the line 413: “We suggest the amplitude of the fold at shallow depths is more representative of the structural style forming during Late Cretaceous-Neogene inversion” or in the line 395: “The Farsund Basin experienced at least two phases of inversion during the Late Cretaceous and the Neogene”. As the term basin inversion implies that uplift is controlled by reverse reactivation of a pre-existing fault system (Cooper et al., 1989). This excludes any other source of uplift not caused by compressional reactivation of pre-existing faults (Chadwick et al., 1993) I think therefore that the use of the term basin inversion in some parts of the manuscript should be revised.

Other comments:

Line 38: References missing: Gontijo-Pascutti et al., 2010 and Chattopadhyay and Chakra, 2013

Line 99: References missing: Jackson and Lewis, 2013

Line 193: Reference Japsen et al., 2007a or Japsen et al., 2007b? I think it is Japsen et al., 2007a. The same in the figure 6b.

Figure 5a: Which horizon corresponds to the TWT structure map? It is not mentioned in the figure nor in the caption.

References: Cooper, M. A., Williams, G. D., De Graciansky, P. C., Murphy, R. W., Needham, T., De Paor, D., ... & Ziegler, P. A. (1989). Inversion tectonicsâĂŤa discussion. Geological Society, London, Special Publications, 44(1), 335-347. Chadwick, R. A. (1993). Aspects of basin inversion in southern Britain. Journal of the Geological Society, 150(2), 311-32

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