

Interactive comment on “Oblique reactivation of lithosphere-scale lineaments controls rift physiography – The upper crustal expression of the Sorgenfrei-Tornquist Zone, offshore southern Norway” by Thomas B. Phillips et al.

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Received and published: 5 March 2018

Oblique reactivation of lithosphere-scale lineaments controls rift physiography – The upper crustal expression of the Sorgenfrei-Tornquist Zone, offshore southern Norway
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Solid Earth MS No.: se-2017-97
Reviewer 1 – Anonymous referee
We thank the referee for their overall positive review and for their constructive comments that will undoubtedly improve the manuscript. We now detail our responses to the individual comments raised in the review (highlighted in italics). These changes have been included in the

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Discussion paper



attached tracked-changes document.

Original review

In this paper, the Authors present a detailed analysis of the development and evolution of the Farsund Basin, offshore southern Norway, an E-trending basin believed to represent the upper crustal expression of a major lithosphere-scale lineament, the Sorgenfrei-Tornquist Zone. The analysis is based on borehole-constrained 2D and 3D seismic reflection data; it documents complex activations of faults, which reflect a multistage tectonic evolution in turn controlled by interactions between the variable regional/local stress field and the long-lived pre-existing lithospheric fabric. The results of this analysis offer insights into the role of inherited lithosphere-scale structures on the architecture of deformation at upper crustal levels. Overall the paper is very interesting; the analysis of the dataset is very detailed and the results support the interpretations, with the complex evolution of the basin controlled by the presence of the inherited lithosphere-scale structure and the variable stress field. The only doubt I have is with the idea of this basin representing a pull-apart (at least a 'classic' pull-apart). Indeed, many of the structures typically associated with these strike-slip basins do not seem to be present in the Farsund Basin (at least in the investigated area). For instance, basin sidewall faults or cross-basins faults seem to be lacking; similarly, offset segments of the major strike-slip faults (principal deformation zones, see Dooley and Schreurs 2012) are not very clear (for instance from Fig. 15). Deformation as illustrated in Fig 15 (or even in the more regional sketch of Fig 16) seems to be more similar to a 'distributed transtension' (Dooley and Schreurs 2012) than to a typical pull-apart. Anyway, I think the Authors should address this in more detail throughout the manuscript. Author response - We agree that the main characteristic features of a pull-apart basin (e.g. clear principal displacement zones and basin sidewall faults) cannot be determined in this area. As such, we have removed the reference to a pull-apart basin and also to transtension (Line 589-593; 575-578). Instead, we now use the term "oblique reactivation of the fault", and expand upon our previous points by stating that

the dominant motion is extensional, but with an oblique component of displacement (Line 587-588) (see also, changes to the arrows depicting the regional stress field in Figure 15).

The stress field indicated in Fig. 15B (Early Jurassic) as also portrayed in Fig. 16 should involve some extensional displacement along the roughly E-W faults.

Authors response - Although there may be some extensional displacement along the faults during the Early Jurassic, we are unable to identify this due to erosion at the Base Jurassic Unconformity. However, we have now adapted the arrows in Figure 15 to indicate the wide range of potential stress fields.

Also, in Fig 15C there is no widening of the basin associated to the dextral transtension (i.e. it could be better to increase the distance between the two systems of faults bounding the basin to the North and South passing from panel B to panel C)

Authors response - We have incorporated this change into the figure.

Other technical corrections 115. The 'Tornquist fan' does not seem to be indicated in Figure 1a

Authors response - The location of the Tornquist Fan has been noted in the text and reference to the figure has been removed (Line 164). Due to the super-regional nature of this structure, we feel that its exact location is not relevant to this study

220. Cheng et al 2017 - reference not needed here

Authors response - Reference to Cheng et al. (2017) has been removed. (Line 262)

385. last lines not clear to me

Authors response - This section of the text has now been made clearer (Line 436-438)

740. n/a-n/a - please check this

Authors response - References have been updated accordingly throughout

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Fig. 1 Panel A. The rectangle indicating the location of Fig1c seems to be too large.

Authors response - Agreed, box size has been corrected

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2017-97>, 2017.

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