

Interactive comment on “Emplacement of “exotic” Zechstein slivers along the inverted Sontra Graben (northern Hessen, Germany): clues from balanced crosssections and geometrical forward modelling” by Jakob Bolz and Jonas Kley

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Dear editors, dear authors,

I read the manuscript "Emplacement of "exotic" Zechstein slivers along the inverted Sontra Graben (northern Hessen, Germany): clues from balanced cross sections and geometrical forward modelling" with much interest. This manuscript provides new information on the occurrence of exotic (in this case Zechstein) blocks within an otherwise very different stratigraphy. Comparable complexities can be likely found in many other

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regions; the work presented is a good scholarly example for applying (synthetic) forward modelling and geometric retro-deformation to solve the “Zechstein sliver puzzle” of the Sontra Graben, Central European Basin. The study will be of interest for structural geologists, stratigraphers and regional geologists, and of general importance for geoscience education in this classic fieldcourse area frequently visited by university groups.

The manuscript forms with its modelling component a substantial contribution to scientific progress; the scientific approach and applied methods are valid; the scientific results and conclusions are presented in a clear, concise and well-structured way. As such I see the manuscript generally suitable for Solid Earth.

I have however 3 specific comments on the manuscript (see below) addressing two scientific questions and one formal aspect that will require further work but can potentially strengthen the paper. An annotated ms with corrections and suggestions is attached.

Specific comments

1 Timing of deformation The ms proposes in the abstract that “based on regional correlation, extension most likely occurred in Late Triassic to Early Cretaceous time while the contraction is of Late Cretaceous age”. The first sentences of the introduction provide some background for the regional tectonic framework of the Central European Basin (“Triassic to Early Cretaceous extension”; “mostly Late Cretaceous contractional deformation”) supported by 4 references. One of the few other places in the ms where some information on the timing of deformation is mentioned is on page 10 (line 295 ff) where compression is seen in relation with the exhumation of the Harz mountains (1 reference). Chapter 4.4 of the discussion “Timing of the Deformation Phases” does not provide any further information on the timing of deformation in an “absolute” age framework.

I fully understand that in the study area much of the once existing sedimentary record has been removed (was never deposited?), and that it is today very difficult to make

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inferences on the timing of deformation from the outcrops presented. However, if age dating is this difficult, and if specific times need to be assigned to specific tectonic intervals (which I agree with), more regional background information on the timing of deformation should be presented. The paper would benefit very much from including and discussing further (maybe even contrary) references on the deformation record of the Central European Basin, set in relation to the study area (in the discussion section "Timing of the Deformation Phases").

2 Steepness of faults The boundary faults presented in the balanced cross section are very steep. The ms comments on the steepness of faults, e.g. line 260 (comments on the model). Figure 6b (or section B-B') yet shows an initial normal fault as geometric retro-deformation result with its steep segments dipping almost 80°. I am not an expert to judge if such faults can be reactivated by pure compressional stress – however, could it be that some oblique movement happened during inversion?

You rule out strike-slip tectonics influencing the study area (line 335ff) because you did not collect field evidence for strike-slip faulting. However, in the absence of field data, couldn't it be simply the steepness of the reactivated faults suggesting some strike-slip/oblique slip motion along the studied border faults?

3 Formal aspects The ms is in places over-structured. I don't see a point in using different sub-headers on page 8, "Summary of structural interpretation", please remove. In addition, many of the order numbers for the chapters are wrong. Please check particularly the results chapter (e.g. page 6 is chapter 3.3, page 7 is again chapter 3.1, page 8 shows chapters 3.2, 3.4 and 3.5).

Figure 7 is mis-cited on page 3, line 89. This causes a significant problem for the following text, since a reference to "real" Figure 8 is missing. Real figure 8 belongs with its content probably after Figure 5. You will have to check all figure references after page 3 for referencing in correct order.

In summary, I am very happy with this contribution. I would be looking forward to see

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this paper published in a revised form.

Aachen, 31.08.2020

Stefan Back

Please also note the supplement to this comment:

<https://se.copernicus.org/preprints/se-2020-133/se-2020-133-RC2-supplement.pdf>

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2020-133>, 2020.

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