

Author response to editor comments

We would like to thank the Editor, Elias Lewi, for his useful comments that helped to improve the manuscript. We have tried to answer all comments and questions as best as we could and incorporated them into the manuscript accordingly.

In the following, we give a detailed overview of the editor comments and our corresponding answers.

The highlighted changes (tracked changes) can be found in the attached PDF 'LatexDiff__Geophysical analysis of an area affected by subsurface dissolution_no2'.

Comment number: 1

Comment by: Topical editor

Comment: The authors have mentioned that they have used the result of the seismic survey, surface geology and published density values of lithologic units to constraints the gravity modeling. This, being accepted for the upper part of the gravity model, the constraint for the deeper part of the model is not yet clear. The seismic model is only to 500 meters depth and the gravity is more than 1300m. How have you managed to constraint the rest 800m.

Answer: It is true that the seismic data does not provide structural information from the deeper subsurface. This information comes from a published cross section included in the geological map. The original map was published by Schriel and Bülow in 1926 and updated by Huckriede in 2013. This geological cross section also takes into account various boreholes, some of which are up to one kilometre deep. However, these additional boreholes are located outside our small study area, which is why we have not included them in our maps. We did mention the use of this cross section as a constraint for the modelling in chapter "Data processing – Gravimetry" on page 11 in line 238.

However, we have now adapted this text passage in order to clarify which input parameters were used for the corresponding depth ranges.

Comment number: 2

Comment by: Topical editor

Comment: Apart from this, the seismic model shows a single layer at the right-hand side of the fault (Figure 7). In contrary, the gravity model (Figure 10) shows multiple layers. As gravity method is blind for vertical variations, how have the authors managed to model the different layers in the gravity survey or what constraint do they have?

Answer: We have omitted to mention this information so far. Detailed information about the stratigraphy and the layering within the Zechstein formations, especially north of the Kyffhäuser Southern Margin Fault, comes from the stratigraphic cross section of the geological map, which we also mentioned in our response to the previous comment. The cross section, which runs parallel to the gravimetric profile, incorporates information from geological surface mapping as well as various shallow but also deep boreholes within and outside our study area. This cross section was projected onto the gravimetric profile, which allowed us to include different layers within the Zechstein formation for the gravimetric modelling, which could not be resolved by the seismic data due to resolution limits.

We now mention this at the end of the last paragraph in the chapter "Data processing – Gravimetry".

Comment number: 3

Comment by: Topical editor

Comment: In the right-hand side of the model after the fault, there is a layer having a green colour M. Permian (anhydrite) with a density of 2700 kg/m³, sandwiched in between the L. Permian and U. Permian layer. This layer is not observable in the left side. In the left side the layer is sandwiched in between the L. Permian and U. Permian layer is the M. Permian salt. Is the salt derived from the anhydrite? In that case it will be good to discuss about possible cause for the conversion from one form to the other.

Answer: The salt is not derived from the anhydrite. As described in the chapter “Geological evolution” the Zechstein formations originate from the former Zechstein Sea, which covered the study area during the Permian. During this time conglomerates, carbonates, sulphates, and rock salt were cyclically deposited.

These deposits are formed by chemical precipitation in marine basins and according to solubility, carbonates (calcite, dolomite) precipitated first, then sulphates (gypsum) and finally chlorides (rock salt, potassium salt and magnesium salt). The latter is extremely soluble and therefore absent in some parts of the study area, and regarding the sulphates, dehydration, e.g. during burial, can transform gypsum into anhydrite, but in the case of hydration, e.g. during exhumation, the reverse transformation is also possible. To the south of the KSMF salt and sulphates can be found, but to the north of the KSMF the salt is completely dissolved. This is because in the north the Zechstein formations are closer to the surface due to the uplift of the Kyffhäuser hills and are therefore more susceptible to leaching due to the southward draining mountain range and the contact with shallow aquifers, and because the increased fluid flow along the fault has further enhanced the dissolution processes.

In our manuscript we mention the absence of salt, especially north of the KSMF due to dissolution and the resulting locally-varying densities at several occasions: in the chapter “Results – Interpretation of ERT & TEM” on page 17 line 380, in the chapter “Results – Interpretation gravimetry” on page 20 lines 419 to 421 and lines 423 to 424, and in the chapter “Discussion - Conceptual subsurface dissolution model of the Esperstedter Ried” on page 23 lines 476 to 479.

We incorporated some additional information in the chapter “Geological evolution” to clarify the origins of the different Zechstein deposits.

With best regards,

Sonja Halina Wadas - on behalf of all Co-Authors