

Point to point response to Reviewer 2

original comments in black, our response in green

We thank the editor and the two reviewers for their help and constructive criticism. We have considered their suggestions and updated the text and figures. Please find below the detailed point-to-point responses.

Sonu Roy and co-authors present a rather straightforward study that uses a high-quality 3D seismic dataset to decipher the evolution of faults in a portion of the northern Upper Rhine Graben (URG) in considerable detail. The analysis is mostly based on thickness variations of syntectonic strata. The results are interesting and should be published. On the the other hand, the presentation is not satisfying in several aspects of the present version:

Comment 1:

Repetition: After going through the manuscript, I had the impression to have read every observation or interpretation at least three times. For instance, a “zig-zag” fault pattern is mentioned six times in different paragraphs, the concept of “unzipping” faults five times.

Response 1:

We rewrote the text to avoid repetition.

Comment 2:

Terminology: The two terms named in (1) are never properly explained. I am still not certain what exactly they are meant to denote or what concepts are behind them. There are many other examples I marked and commented on in an annotated version of the pdf. A few cases in point: “Fault intersection traces” are also mentioned repeatedly, but both “trace” and “intersection” are normally used for lines at the intersection of two planes, e.g. a fault and the surface. One can only guess what an intersection trace could be. Or what is “geometric refraction”? Apparently simply a bend or kink in a fault trace. Another one: “...the URG acted in sinistral fashion...” That is imprecise on many levels, and these things need to be fixed. Tectonic interpretations in particular tend to be verbose and unclear, with insufficient separation between geometries, kinematics, and dynamics.

Response 2:

We introduce a section in the introduction to explain the structural elements that are associated with rift systems that underwent multiphase tectonic phases. We also addressed the usage of technical terms, clarifying this topic consistently later in the discussion section.

Section 1.4

Please refer to line no. 116-158.

Comment 3:

Lack of clarity. Sometimes I could simply not follow the descriptions. This was in some instances due to not knowing what exactly the authors were describing (always referring to specific panels of, e.g., Fig. 3 will remedy that, and arrows or numbers indicating specific elements in figures would also be helpful). In other cases I was seeing different things from those described by the authors (cf. RV 1 's note on generally southward shifting fault displacement maxima which I could not identify, either). Sometimes it appeared that the authors had got directions wrong (NE instead of NW, etc.)

Response 3:

We now systematically cross-reference the figures and tables in the text, so that the readers can easily understand the context. Corrections regarding the directions were thoroughly checked and corrected wherever necessary.

Comment 4:

Illustrations: The manuscript (and readers) would greatly benefit from better illustration. The main map in Fig. 3 is too small as already noticed. The seismic sections should be shown both interpreted and uninterpreted. I wondered anyway why the 3D block is only represented by sparse sections running obliquely to the main faults. Showing 3D images of the modelled fault planes alone would help imagination a lot, in particular for the helicoidal ones or for the interesting geometric relation between 1D and 1E. The table describing the picked horizons and their properties could easily be complemented with clips from the seismic sections showing the respective reflections. An interesting additional figure to create would be a stepwise reconstruction for one of the more complex faults and the associated growth strata. Figure 7 is presently highly schematic and not very informative. It would gain a lot in information content and accuracy if color-coded cumulative displacements were shown for every fault in each of the three periods depicted. The idea conveyed that the WNW-striking faults are most important after 24 Ma is misleading.

Response 4:

The UHY map is now enlarged. Interpreted and uninterpreted sections, perpendicular and oblique to the faults, are now provided in the main text/supplement. A new figure is provided to show the 3D view of the modelled/analysed fault planes. A representative section of the picked horizons is attached to the stratigraphic column.

We agree that a stepwise reconstruction of fault evolution and growth strata would provide additional insight. However, such a reconstruction is beyond the scope of the original workflow.

Comment 5:

Conclusions: These should present the main findings of the manuscript in a similar sequence and with similar emphasis as in the main text. This is presently not at all the case.

Response 5:

We rewrote the conclusions, as suggested by RC2, to sequentially document the findings of the paper.

Comment 6:

References: One paper that should be cited is:

Meier, L., & Eisbacher, G. H. (1991). Crustal kinematics and deep structure of the northern Rhine Graben, Germany. *Tectonics*, 10(3), 621-630.

who derive exactly the same conclusions on a two-stage kinematic evolution of extension followed by transtension based on sediment isopach maps from the 1960's.

Response 6:

We now include this reference; it is helpful.