

REVIEW 1: Stefano Tavani (University of Naples)

		agree	do not agree	comment
1	<i>page 2 line 25: 'only' = to be omitted</i>	X		We will correct the manuscript accordingly.
2	<i>page 2 line 26-27: linking sentence between two paragraphs is missing</i>	X		We will change the last two paragraphs of the 'Introduction' chapter in the revised manuscript as follows: "The focus of this work is an in-depth analysis of deformation structures in the southernmost part of a typical foreland basin system, the German Molasse Basin. A number of basin-scale structural studies were carried out in the '80s and '90s, based on a large amount of 2D seismic data acquired for hydrocarbon exploration over decades (e.g. Bachmann et al., 1982; Bachmann et al., 1987; Müller et al., 1988; Bachmann and Müller, 1992). The increasing interest in geothermal exploitation in recent years and therefore the acquisition of 3D seismic data, have allowed more detailed studies of the complexly deformed areas (e.g. Lüschen et al., 2011; von Hartmann et al., 2016; Budach et al., 2017). Nevertheless, the tectonic and stratigraphic factors controlling the evolution of the deformation structures in the German Molasse Basin have not been fully described yet. Using the 3D seismic reflection data, acquired in the area of Geretsried, 30 km south of Munich (Fig. 1), our aim is to understand the complex structure and tectonic evolution of an area proximal to the Alpine deformation front. To achieve this, we analyse the seismic data to (i) reconstruct the temporal and spatial evolution of the fault network within the Molasse sequence and its Mesozoic substratum, and (ii) evaluate the impact of the evolving stress field, pre-existing deformation structures, and mechanical stratigraphy on fault evolution, in particular style of faulting and kinematic interactions between faults."
1 Introduction				
3	<i>page 2 line 44: 'proximal' = to be omitted</i>	X		We will correct the manuscript accordingly.
4	<i>page 2 line 45: 'by the Tethys Ocean' = to be omitted</i>	X		We will correct the manuscript accordingly.
5	<i>page 3 line 68: 'terrestrial' to be replaced with 'continental'</i>	X		We will correct the manuscript accordingly.
6	<i>page 6 line 159: 'that' = to be replaced with 'and'</i>	X		We will rewrite this sentence as follows: "Unit 1 corresponds to the Upper Jurassic carbonate platform that has a heterogeneous, low-frequency seismic expression."
7	<i>page 7 line 199: terms 'synthetic' and 'antithetic' faults are misleading</i>	X		We will remove these terms from the manuscript.
8	<i>page 7 line 201: listric geometry of Fault Gartenberg N is not convincing</i>	X		We agree with the referee that due to the poor resolution at the depth of the investigated graben-bounding faults Gartenberg S and Gartenberg N, especially at the interval of top Callovian, their interpretation as listric could be not fully convincing. We will therefore refrain from this interpretation in the revised version of the manuscript.
9	<i>page 7 line 211: 'and secondary, antithetic' = to be omitted</i>	X		See point 7.
10	<i>page 7 line 211: '...the central graben switches its polarity along strike...'</i>	X		We will change the text in accordance with the suggestion of the referee.
11	<i>page 8 line 215-216: 'there is a rollover anticline towards Fault Gartenberg N' = It is hard to see this rollover anticline, particularly at the top Callovian. Suggest to remove this sentence.</i>	X		We agree with the referee that interpretation of the central graben interior as a rollover structure could be ambiguous. We therefore refrain from this interpretation and we will remove this sentence as suggested by the referee.
12	<i>page 8 line 220-222: 'The upper fault array exhibits reverse/normal fault geometry'</i>	X		We will change the text accordingly.
13	<i>page 8 line 222-223: 'lateral offset' = strike-slip faults? Clarification needed.</i>	X		We will change the sentence to clarify what was initially meant by the "lateral offset" as follows: "In the map view the traces of the upper faults at top Rupelian show considerable offset from the traces of the lower faults at top Berriasian" Also, in line 311 we will change the term "lateral offset" to "fault trace offset".
14	<i>page 8 line 223: Fig. 12 was called 10 and 11 before</i>	X		Fig. 12 shows the map view of the fault traces of both fault arrays at different stratigraphic levels to depict the fault trace offset between the faults and compare strike directions. We will remove this part of the sentence.
15	<i>page 8 line 225: 'often showing opposing dip with respect to each other' = unclear/repetition</i>	X		We will remove this part of the sentence.
16	<i>page 8 line 234: 'Its upper branch dips parallel to the lower thrust within...'</i>	X		We will change the text accordingly.
17	<i>page 8 line 246: 'cuts over the linkage zone'</i>	X		We will change this as follows: "cuts through the linkage zone".
5 Results				

18	page 8 line 247: <i>'the Geretsried Fold is extensively deformed by back-thrusts ...' - The reviewer recognizes only one back-thrust.</i>	X	Back-thrusts presented in Figs. 4 and 6 are separate faults. We therefore use the plural. We will remove the word "extensively".
19	page 9 line 256-257: <i>'Unit 1 in Figure 14a displays no significant thickness variation across major faults that offset basement' = Mention that thinning of this unit in the Gartenberg graben is a geometric artifact, due to the fact that the conjugate faults bounding the graben intersect within this unit.</i>	X	We will change the text to point out thickness reduction of Unit 1 within the central 'Gartenberg' graben as follows: "Unit 1 in Figure 14a displays substantial thinning within the central graben" However, we believe that this thickness reduction is not a geometric artefact but rather a true geological feature. To explain this, we initially we came up with the interpretation of listric graben-bounding faults that propagate into a detachment that accommodates flexure-induced extension. Such interpretation would resolve the geometric space problem associated with the thinning of Unit 1 in the absence of significant offset on graben-bounding faults at top Callovian. As mentioned in point 8, we now refrain from this interpretation and suggest an alternative scenario to explain the thinning of the graben interior. In the revised text we will suggest that this thinning could result from the sequential slip of conjugate faults Gartenberg N and Gartenberg S that offset each other (e.g., Ferrill et al., 2000, 2009).
20	page 9 line 258-260: <i>'There are however local thickness variations in form of footwall thinning and hanging-wall thickening across Fault Gartenberg S, eastern segment of Fault NE and Fault Gartenberg N, and the central segment of Fault Gelting N.'</i> = Remark that these are due to local tilting (i.e. you are considering the vertical thickness not the true one).	X	The local tilting of the beds indeed results in apparent thickening in the isochore maps. However, apart from the apparent thickening, which is related to tilting, we also observe true local thinning in the footwalls that we attribute in the 'Discussion' chapter to the ductile deformation of the clays.
21	page 9 line 265-266: <i>'In the southern part, there is a profound thickness decrease of Unit 4 associated with downthrow of the hanging-wall blocks of the upper CZ normal faults' - modify sentence as follows: 'In the southern part, there is a profound thickness decrease of Unit 4 associated with downthrow of the hanging-wall blocks of the upper CZ normal faults (affecting the overlying Unit 5), which induced compaction in Unit 4.'</i>	X	We will change the text as follows: 'In the southern part, there is a profound thickness decrease of Unit 4 associated with downthrow of the hanging-wall blocks of the upper CZ normal faults affecting the overlying Unit 5.' We believe that the thickness reduction is primary due to the listric geometry of the CZ faults as we point out in the 'Discussion' chapter on page 16, in lines 479-481.
22	page 10 line 284: <i>'An Allan map of the Geretsried Thrust depicts the distribution of its throw at top Baustein beds' instead of 'A map of the cut-off lines at top Baustein beds depicts the lateral distribution of throw on the Geretsried Thrust'</i>	X	We will change the text in accordance with the suggestion of the reviewer. We will also modify the text on page 5 in line 139 from "Juxtaposition (Allan) diagrams" to "Allan maps (juxtaposition diagrams)".
23	page 11 line 324: <i>'6.2. Controlling factors on fault evolution in the southern GMB' - suggest to remove this to avoid 4 levels of subheading, i.e. stress field evolution = 6.2; pre-existing structures = 6.3; Pre-orogenic...=6.3.1</i>	X	We will change the numeration of the subheadings in accordance with the suggestion of the referee.
24	page 11 line 338: <i>'eventually increased' instead of 'attained positive values'</i>	X	We will change the text in accordance with the suggestion of the referee.
25	page 14 line 425: <i>the occurrence of the rollover structures is not convincing</i>	X	We agree. See points 8 and 19. We will change the text accordingly.
26	page 15 line 466: <i>'thereby switching from being blind to syn-sedimentary' = to be removed on the ground that a blind fault can be syn-sedimentary</i>	X	We agree with the point of the referee that the blind faults can also be syn-sedimentary. We will write: "thereby switching from being blind to emergent."
27	page 16 line 486-487: <i>'We conclude that the fault evolution in the presence of a thick mechanical barrier resulted in a decoupled structural style' = A few readings that could help in framing this last sentence in a broader context:</i> D.A. Ferrill, A.P. Morris, K.J. Smart <i>Stratigraphic control on Extensional fault propagation folding: Big Brushy Canyon monocline, Sierra del Carmen, Texas</i> <i>Geol. Soc. Lond. Spec. Pub., 292 (2007), pp. 203-217</i> M.M. Lewis, C.A.L. Jackson, R.L. Gawthorpe <i>Salt-influenced normal fault growth and forced folding: the Stavanger fault system, North Sea</i> <i>J. Struct. Geol., 54 (2013), pp. 156-173</i> J. Deckers <i>Decoupled extensional faulting and forced folding in the southern part of the Roer Valley Graben, Belgium</i> <i>J. Struct. Geol., 81 (2015), pp. 125-134</i>	X	We will rewrite the sentence as follows: "We conclude that the fault evolution in the presence of a thick mechanical barrier resulted in a decoupled structural style, as has been previously reported for the geometrically decoupled fault systems by Ferrill et al. (2007), Langhi et al. (2011), Lewis et al. (2013), and Deckers (2015)."
28	Figure 2 could be placed within Figure 1	X	We will place the cross-section in Figure 2 as a panel in Figure 1.
29	Figures 9 and 13 are useless and could be removed.	X	We will remove these figures in the revised manuscript and modify the text accordingly.
30	Figure 4, 5, and 6 could be easily merged into a single figure.	X	Seismic cross-sections in these figures will be placed as panels in a single figure.
31	Figure 10 and 11 could be merged.	X	We will merge them.

32 Figures 8 and 12 should be merged and displayed after figures 10 and 11. Figure 19 should be presented as a plate
of figure 8.

X

We will do that.

33 Figures 15, 16 and 17 could be merged into a single figure.

X

We will merge these figures into a single figure.