Review of “Basin inversion: reactivated rift structures in the central Ligurian Sea revealed by OBS” by Thorwart et al.

First I would like to thank the authors for taking into account and replying to my comments during the first round of review. The uncertainties on the data and method section are now presented and discussed in more details. The manuscript is thus significantly improved. I have however some remaining points regarding the presentation/formulation especially of the amount of rotation of Corsica-Sardinia and in the discussion of the fault planes (4.1) and of the rheology/temperature/seismicity (4.3; see comments listed below) that would require some additional minor revision of the text.

l. 19: Oligo-Miocene rift basin
l. 21: Slightly different striking directions of presumed rift-related faults in the basin centre
l. 23-24: I find confusing to compare present-day S-wave velocities and Vp/Vs ratio to strengthening of the lithosphere during a rifting event that happened more than 16 Myrs ago. I would rephrase slightly here, following comments below on Section 4.3.

l. 25: which is no longer active and located in a plate interior.

l. 74: Careful here, there was a slight misunderstanding on the amount of rotation. Speranza et al. (2002) and Gattacceca et al. (2007), based on paleomagnetic data from Sardinia, suggest a rotation of ~23° to 45°, respectively, between ~21-16 Ma. In Le Breton et al. (2017), I estimated the total amount of divergence between southern France and Corsica-Sardinia since rifting started at about 35 Ma (so between 35-16 Ma, total amount of CCW rotation relative to Europe). This suggests a total rotation of at least 53° between 35-16 Ma (not only 21-16 Ma). So please remove “or” and rephrase for example as:
“a counter-clockwise (CCW) rotation relative to Europe (…) of ~23° (Speranza et al. 2002) to 45° (Gattacceca et al. 2007) between ~21-16 Ma, and of ~53° between 35-16 Ma (Le Breton et al. 2017), with …”.

Figure 2: Either you remove the 53° from the Figure and keep the caption as it is, describing the CCW 23 degrees of rotation in Miocene times from Speranza et al. (2002). Or you should modify the caption accordingly to previous comment (53 degrees are for Oligo-Miocene times).

l. 206-207, Table 1 and Figure 5: Reading Table 1, C1/F1 are slightly shallower (~15 km) than C1/F2 (~16 km) not the other way around as mentioned in the text and colored on Figure 5. This should be double-checked.

l. 207: Please precise the main strike of the two planes (NE-SW to ENE-WSW) and that you cannot identify which of the two was the actual fault (activated/ruptured) plane as it didn’t rupture the surface.

l. 207-209: “For the second fault plane …. For the first fault plane…” These sentences are not clear and should be rephrased. Do the authors mean rather the second / first family of events (and not fault plane)? An event location cannot coincide with a direction of plane…

l. 211-212: “therefore we use the term ‘rupture area’ in the further discussion”, this part of the sentence could be removed as you don’t really discuss the rupture area after that.

l. 232-233: “If we project C1 and C2 on line A-B that follows the push direction (based on the rake of Table 2 I suppose?) of the thrust events, they map in a slightly tilted vertical plane dipping north-westwards (Fig. 5d).”
I’m not sure to get what you want to say here: do you suggest then that this could indicate potentially the orientation of the ruptured fault plane? Would then the second nodal plane (Table 2), which has a higher dip (around 60°) and dip towards the NW (Table 2 and Figure 4) as along this A-B profile, be then the ruptured fault plane? Interestingly, this dip angle of 60° is typical for normal faults and you suggest in the following sentence that the earthquakes occurred along a pre-existing normal fault that was reactivated into a thrust. However, it could be quite steep for normal faults reaching down to lithospheric mantle.

l. 251: C1 (ENE-WSW to NE-SW)… 2011 events (NE-SW to NNE-SSW)

l. 257-258: I would either remove “that was estimated with ~23° to ~53° in total amount of rotation between 35-16 Ma” to avoid confusion as mentioned above in previous comment, or rephrase accordingly (23° is between ~21-16 Ma, 53° is for the entire rifting/spreading period ~35-16 Ma). You mentioned already the amount before so it might not be necessary to write it here again.

Section 4.3: In my opinion, it is important to clarify in this section processes that happened during rifting (35-16 Myrs ago) and the present-day state (thermal and rheology) that is important to understand present-day seismicity.
Most of the discussion - till line 301 - focuses on what happened during rifting. Indeed, it is important to mention it, to explain possible pre-existing weaknesses (rift-related normal faults) in the lithosphere and within the upper mantle, due to former rifting processes. These zone of weaknesses may be reactivated today due to regional compressional stress.

I would rephrase the sentence l. 272-273 to “Stretching of the lithosphere brings crustal rocks to lower pressure and temperature, and thus the lower part of the crust into brittle domain (Perez-Gussinyé and Reston, 2001)”. Otherwise, it is confusing because during rifting, the thinning of the lithosphere rather increases, not cools, the overall temperature and high temperatures are usually associated with weakening of the lithosphere, not strengthening. But since rifting stopped, it must have cooled down since then (minus the effect of thermal blanketing from the thick sediment package that reduce lithospheric heat loss as mentioned).

This brings me to my last point, the last paragraph (l. 301-305) on heat flow and temperature is confusing/contradictory. Heat flow reflects the present-day thermal state, and this is crucial to understand depth of seismicity. Therefore, this part of the discussion should be improved.
The first sentence indicates that present-day heat flow is high in the basin centre, which may indeed contradict a cool CMB. The following sentence starts with “However” so we expect something explaining why the temperature may still be “cold” in the basin centre, but it finishes by “… allow for a temperature maximum at the CMB beneath the basin centre”. So what is meant exactly here? Please clarify this paragraph.
Bethoux et al. (2008) is quoted at the end but is not discussed. But actually, this paper provide very good argument to explain the depth of seismicity. Indeed, their thermal modelling (their Figure 5) in the Ligurian Basin, although located more to the north and assuming oceanic crust in the basin centre, indicates depth of the isotherm 320°C, interpreted as seismogenic zone, ranging from 5 to 20 km across the basin. They mention the “occurrence of deeper (up to 20 km deep) earthquakes near the center of the basin, more likely favored by contrast in rheology”, rheology contrast most likely due to the above mentioned pre-existing rift-related faults reaching the lithospheric mantle. Similarly, the recent work of Spooner et al. 2019 (Thermal field in the Alps and

its relation to seismicity; there's also Spooner et al. 2020 currently in revision in the same special issue of Solid Earth) discuss the link between thermal field and seismicity distribution in the Alpine area. They show a clear link between location of seismicity and depths of important isotherms within the continental crust/lithosphere (interpreted as mineral phase changes). Most seismic events occur between the 275°C and 450°C isotherms, which fits with the proposed seismogenic depth range in the modelling of Bethoux et al. (2008).