Interactive comment on "Ionian Abyssal Plain: A window into the Tethys oceanic lithosphere" by Anke Dannowski et al.

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Review of the manuscript "Ionian Abyssal Plain: A window into the Tethys oceanic lithosphere" by Dannowski et al.

Dannowski et al. present a newly acquired seismic refraction/reflection seismic profile through the abyssal plain of the Ionian Basin. The nature of the crust (oceanic vs thinned continental) under this basin has long been debated and has major implications for tectonic/geodynamic reconstructions of the Central Mediterranean area. The authors modelled seismic velocities and gravity along this profile and characterized a 5-6 km-thick sedimentary sequence lying on a 6-7 km-thick oceanic crust beneath the Ionian Abyssal Plain. The deformation front of the Calabrian wedge is also imaged along their multichannel seismic profile. Their results support the idea that the Ionian Basin is an old oceanic basin that opened in late Palaeozoic/early Mesozoic time during breakup of the Pangea.

I find this paper very interesting and well suited for publication in Solid Earth, however some precisions/clarifications especially in the methodology and discussion would considerably improve the manuscript, as commented below.

- The authors wish to express their thanks to the reviewer for her insightful questions and detailed comments which allowed for significant improvement of the original version of the manuscript. Changes to the manuscript may be followed by track changes in the word document. We provide our answers to the comments directly in the PDF document. Below please find our discussion for every single major paragraph addressed by the.

Detailed comments are annotated directly on the manuscript (please see attached PDF).
General comments:

1. Method and limitations
The modelling method is very shortly described in section 3.3 (see comments on the text p5). This should be improved and limitations/uncertainties of the model should be discussed, otherwise it is difficult to assess its validity.

- We addressed this lack of transparency and added several sentences in the methodology section 3.3.

2. Seismic velocities / oceanic nature of the crust
The authors refer well to previous studies but it was not clear to me after reading section 5.3 (especially lines 11-16 p10), what were the exact arguments to "univocally confirm" the oceanic nature of the crust, as said in the abstract, and to refute a possible continental crust with intruded mantle material? It would help if the authors could clearly compare what are the seismic velocities in case of thinned continental crust, including possible exhumed serpentinized mantle or lower continental crust if the continental margin was hyper-extended, and in case of oceanic crust, and present more clearly what's new and univocal in their results.

- We updated sections 4.3 (we broken up section 4.2 into 4.2 and 4.3)
- We rewrote section 5.3 as well as updated Figure 4b to clarify our arguments that the IAP is constructed of oceanic lithosphere:

continental-VS-oceanic: The seismic velocities within the basement of our study (profile DY-05) plot into the velocity-depth field typical for oceanic crust, while being too fast for continental crust (Fig.

4b). Extended continental crust is slower than normal continental crust [Christensen and Mooney, 1995]. In a seismic refraction study in the Gulf of California [Lizarralde et al., 2014], the authors showed that seismic velocities decrease as the continental crust becomes thinner towards the continent-ocean transition zone.

serpentinised mantle-VS-magmatic crust: In Figure 4b we show the velocity-depth ensemble for serpentinised mantle found in the Tyrrhenian Sea [Prada et al., 2016]. At shallow depth (~2 km into the basement) the profile fits both ensembles, for magmatic crust and serpentinised mantle. Based on seismic p-wave velocities only it is not possible to discriminate between upper crust and highly serpentinised mantle. At greater depth lower crust velocities typical for gabbro are observed. The data fit the ensemble for magmatic crust as observed by Grevemeyer et al. [2018] and we exclude to have serpentinised mantle on top of gabbroic crustal rocks.

3. Description and interpretation of the sedimentary units and their deformation

- The description of phases/picks in section 3.3 is difficult to follow and should be improved. The quality of Figure 3 was too low, the names of the phases are difficult to read. It would help to add a clear list of the phases names and colours on the side of the seismic sections. Table 1 should also come here in the text.

➢ Table 1 has now also includes colour code of the picks. We moved the table up between sections 3 and 4. We enlarged the labels in Figure 3 and adjusted colours for better readability. The figure should also be in higher quality once it is processed as PDF.

- The authors mentioned Tortonian "syn-tectonic" reflectors on Figure 2 but do not refer to this tectonic event later in the text. I suppose they refer to the tectonic inversion mentioned by Gallais et al. 2011, as they draw the thrusts of Gallais et al. on Figure 1. Could the authors identify those thrusts on the profile and/or relate them with the contractional deformation observed in the northern part of the profile?

➢ We added section 5.4 to discuss more deeply the role of the IAP in the framework of plate tectonics. In this frame we also added text on the findings and interpretation of Gallais et al. (2011) and relate it to our findings.

- The paragraph on those folds (section 5.1) is not clear and should be improved. I think the authors could exploit much more Figure 2 and describe very nicely the deformation front of the Calabrian wedge there (see comments on the text p 9), which for me was a surprise. I didn't expect it to be visible so much south on the abyssal plain.

➢ As suggested by the reviewer, we improved the discussion section 5.1 in adding two more references to compare with our data and we rephrased some sentences.

4. Tectonic implications

There is confusion in the text when the authors mention a "rigid" connection between Adria and Africa. In the abstract and conclusion, the authors wrote that if the crust would be thinned-continental (rather than oceanic), it would imply a "strong" or "rigid" connection of Adria with Africa, but it's the other way around.

The oceanic lithosphere shows (almost) no deformation and is therefore considered to be "rigid" compared to the continental lithosphere (especially thinned). So the interpretation that the Ionian crust is oceanic goes in the direction that Adria has a "rigid" connection with Africa since the end of oceanic spreading, so since the early Mesozoic. This has implications for the reconstructions of the past motion of the Adriatic plate relative to Africa, as a "rigid" connection does not allow for (much) relative motion between the two plates and therefore would imply that Adria was a "rigid" promontory of Africa. Nevertheless, the contractional deformation affecting the crust observed by Gallais et al. 2011 (mentioned above), is very interesting as it shows that the Ionian crust – even if oceanic – has deformed/is deforming and is therefore not that "rigid" after all, at least in Neogene time due to the approaching subduction zones (see discussion in Le Breton et al. 2017 and Gallais et al. 2011; similar deformation along the Indian oceanic lithosphere have been described by Delescluse et al. 2008). Such tectonic implications should be better discussed in the text.

- We added section 5.4 and discuss the oceanic IAP in the frame of plate tectonics. We corrected the wrong text passages and updated the conclusions, introduction, and geology as well.

- We feel that the manuscript has tremendously profited from the reviewer's comments. In particular, the discussion section and geology segments have been revised thoroughly to better include and discuss these aspects in the light of our seismic findings.