**This manuscript describes a model for the crustal (nor really lithospheric) structure of the Iberian Central Range on the basis of seismic noise analysis. The main result of the study is the resolution of the structure of the crustal root of this intraplate mountain belt as featuring a thrust fault offsetting the lower crust and Moho discontinuity. The paper is in general fairly written, although I found some points of concern.**

**1) In the introduction, although there is a lengthy description of the Variscan geology of Iberia, largely irrelevant for the purpose of the ms., little reference is given to the Alpine setting of the Iberian plate interior, in which the study is also framed.**

We agree with the reviewer, there is little explanation of the Alpine Orogeny evolution and imprint of the study area. We have modified the geological setting section accordingly. We have changed/added the following in the manuscript:

The geological framework of the ICS is marked by the footprint of two orogenies that affected the area, namely, the Variscan orogeny and the Alpine orogeny. The former, took place during the Late Paleozoic times by the collision between Laurussia and Gondwana (Matte, 2001), which closed the Rheic Ocean and amalgamated these continents along with other minor terranes like Armorica (Franke, 2000; Matte, 2001). These terrains constitute, the~~The~~ basement of the Iberian Peninsula, and are is composed by Upper Proterozoic to Carboniferous rocks deformed and intruded by granites ~~mainly as a consequence of the Variscan Orogeny. The orogeny took place during the Late Paleozoic times by the collision between Laurussia and Gondawa (Matte, 2001), which closed the Rheic Ocean and amalgamated these continents along with other minor terranes like Armorica (Franke, 2000; Matte, 2001)~~.

The IB, the Iberian outcrop of the European Variscides,...

The disaggregation of Pangea from the Triassic lead to an extensive period (Ziegler 1990; Van Wees et al. 1998) that formed new plate boundaries. During the Cenozoic, Iberia was enclosed between the African and Eurasian plates. The relative movement of the African plate in NNW direction, compressed the Iberian plate and led to the inversion of previously generate intraplate basins, and the formation of the Pyrenean-Basque-Cantabrian (Dercourt et al. 1986; Cloetingh et al. 2002). When the formation of the Pyrenees was completed, by the Mid Oligocene (Vergés et al. 1995), the deformation was absorbed by the Betic-Rift system and the interior of the Iberian Plate. By Tortonian times, the peak of intraplate deformation was reached (Dewey et al., 1989) and the ICS was generated by the reactivation of previous variscan structures.

**2) The conclusion of the lower crust imbrication was seemingly already reached by Andres et al (2019) in an earlier work, and hence the novel contributions of the ms. appear undermined.**

Certainly, the finding of the lower crust imbrication is not new, but this dataset has allowed us a better characterization of its geometry. In addition, that is just part of the results in the paper, e.g., the constraints on the lateral extension of the ICS granites, the internal structure of the crust, and the identification of a prominent reflector within the lower crust are other important conclusions that were not achieved in the Andres et al. (2019). Aside of not being a new contribution, we believe that further characterizations of the lower crustal imbrication are important as its characteristics have been long debated (from a symmetrical geometry to our models where it appears as an asymmetrical feature, typical of Alpine orogens. Finally, much of the importance of this MS resides in the fact that we have utilized a different energy source as the foundation to build the seismic model, thus supporting the findings in Andrés et al., 2019. The use of this technique to depict crustal scale models is quite new and it is, in itsef, an achievement.

**3) in Fig. 4, the authors should explain how they interpreted the picked reflections, and their uncertainties, e.g. why the crust-mantle boundary is D instead of C (and like that, the attribution of other reflectors). Why granites should be so reflective in the profile?**

As stated at the beginning of the Discussion section, we take as a starting point for our interpretation, previous knowledge provided by nearly coincident normal incidence (NI) and wide angle (WA) seismic profiles acquired further to the S also in the CIZ (e.g. Poyatos et al., 2012; Ehsan, et al., 2015, Andrés et al., 2019). These previous results constraint the crustal model in the southern part of our dataset and have proven to be a reliable source of information in order to build up our interpretation, as they rely in well stablished geophysical techniques.

Therefore, some guidelines have been used to interpret the seismic profile. In this case, the Moho arrival was expected at around 10 s TWT, because of the aforementioned previous information, thus making reflection C incompatible with it. The same reasoning goes to the other interpreted reflectors.

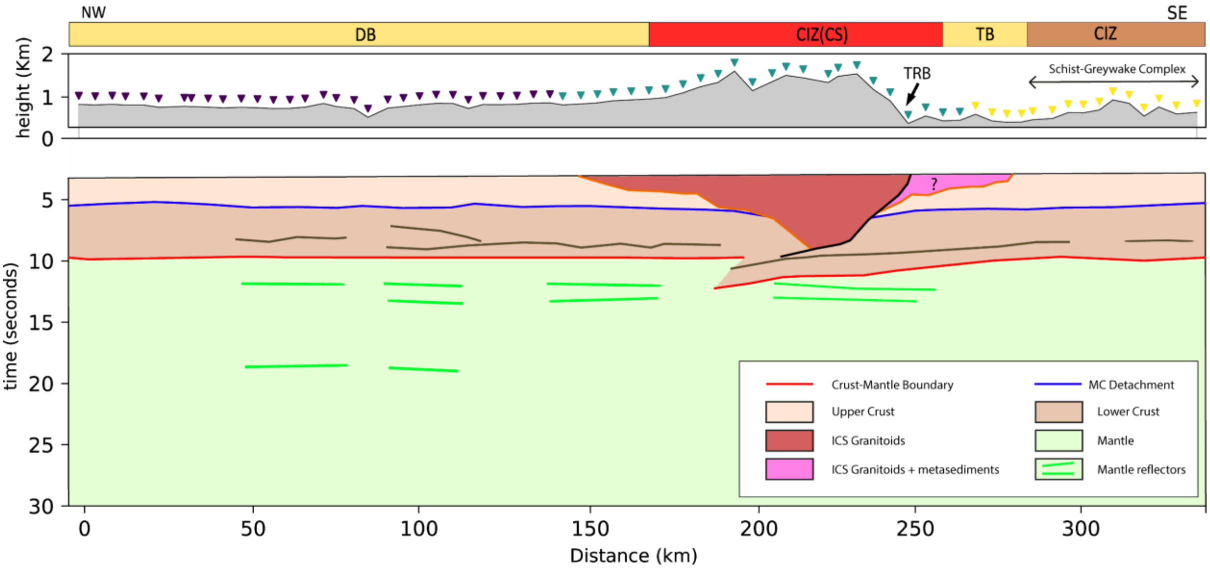
According to the high amplitude internal reflections in the lower crust, we agree with th reviewer that it is an enigmatic feature. However, if it were considered as the top of the lower crust, the thickness of this layer would agree with that to the N of the ALCUDIA NI experiment, indicating that this lower crust has been also extended and melted. Our interpretation is that, strong reflections exist at 5-6 s, 8 s and 10 s, the lower crust is partly preserved in its original Variscan thickness (from 5-6 to 10 s TWT) evidences of local extension and melting exist, thus defining new boundaries at intermediate depths (8 s TWT).

Regarding the reflectivity of the granites, we don't talk about very reflective granites in the manuscript. Instead, we use the changes in the reflectivity signature presents and correlate them with boundaries between different materials. In this case, the granites present a low frequency/high amplitude signature respect with its surrounding materials. The low frequency can be regarded as evidence of the lack of internal structure, which is consistent with the result from active seismic experiments on granitic terrains. However, we have slightly modified this part of the discussion to make it clearer.

"The upper crust presents a heterogeneous response throughout the profile, being the central segment where the highest amplitude events are localized. The outcropping rocks of the ICS are mainly Carboniferous granites (Bea, 2004). In fact, previous studies have inferred that granites below the ICS exist down to ~18 km based on the low frequency/high amplitude reflectivity retrieved above that depth (Andrés et al., 2019). Nonetheless, in our profile we found two distinctive zones within the upper crust below the ICS (Fig. 5), i) from 210-240 km, i.e., the central part, ii) the prolongation to the N and S boundary of the ICS. The latter is defined by the edge of the low frequency/high amplitude reflections (Fig. 4b, lines B and E). This signature can be regarded as the expression of a highly homogenous body and/or with little internal reflectivity. When considered as a whole, ..."

**4) I failed to understand the interpretation of the structure of the upper crust. Clarify the distinction between the ICS granitoids and the ICS granitoids and metasediments, and their boundaries. The caption of Fig. 5 should be rewritten, avoiding qualitative colour description and conforming to the actual legend of the figure (e.g. what is melted crust in a present-day section?). The relation of these bodies with "pop-up" structuring is confusing. A "staircase configuration describing smooth underthrusting" sounds contradictory. Where is the mid-crustal detachment shown, and what does it mean "assimilated by granitoids". Can the authors explain better the sentence: if the detachment has been assimilated, upper crustal fractures can find their way into the lower crust thus allowing the upper crust to sink".**

Regarding the extension of the granites, we have to apology as addressing this comment we have found an error in figure 5. _The marked granitoids + metasediments section to the North, should all be represented as granitoids_. The figure 5 presented in the submitted manuscript is an early version, we apology for this.




*- Clarify the distinction between the ICS granitoids and the ICS granitoids and metasediments, and their boundaries*

The distinction between both zones comes from the reflectivity signature below the ICS. The granitoid + metasediment part presents slightly higher frequencies, and we believe its signature is influenced by a lithology with higher a more complex and reflective internal structure than that of granites. Moreover, the fact that an outcropping fracture (TRB fault) can be continued to that boundary defining a crustal scale feature fracture is present in the limit between the two areas, led us to think that is a relevant boundary there should be some difference. However, this is an interpretation and more information is needed. We have modified the text accordingly.

"To the N, this characteristic granitic signature fades when entering the DB, as according to our section, it partly overlaps the granites. To the S, this package of reflectivity is bounded by an area of lower reflectivity that could define some sort of ICS southern thrust. The reflectivity package south of this thrust present higher frequencies and amplitude. We interpret this change in reflectivity as the seismic expression of a heterogeneous zone, composed by granites and metasediments from the Schist-Greywake Complex, which dominates the outcrops of the southern part of the CIZ. Although this is a feasible interpretation, additional geophysical information is needed to confirm this feature."

*- The caption of Fig. 5 should be rewritten, avoiding qualitative colour description and conforming to the actual legend of the figure (e.g. what is melted crust in a present-day section?)*

We have modified the legend of figure 5 as follows.

"Figure 5. Sketch of the proposed crustal structure below the Iberian Central System, and the Duero and Tajo Basins. Black solid line defines the ICS Southern Thrust. A crustal scale thrust can be defined to the S of the ICS. In its upper part it may coincide with the Tietar River Fault (TRF). It then follows the southern boundary of the ICS and reaches the lower crust, offsetting it to define a crustal imbrication."

We referred as melted crust to the extension of the granites below the ICS. We have eliminated this from the figure caption as it is not melted crust, but the resulting granites from the partial melting of the crust.

*- The relation of these bodies with "pop-up" structuring is confusing*

"It is not clear how the faults controlling the pop-up/pop-down structure (de Vicente et al., 2007) of the ICS affect its deep configuration. They probably play an important role in defining the northern and mostly the southern limit of the ICS (Fig. 4b lines B and E)."

Pop-up/pop-down structures affects the shallower part of the crust as described by de Vicente et al. 2007, but some of the faults that form them can have deep roots, such as the southern thrust as we comment on the paragraph above. As we lack information in the upper 3 s of the profile due to the sidelobes generated by the processing, we cannot discuss further.

*- A "staircase configuration describing smooth underthrusting" sounds contradictory*

We agree and therefore have removed "staircase configuration".

*- Where is the mid-crustal detachment shown, and what does it mean "assimilated by granitoids"?*

We have added to the legend in Figure 5 the mid-crustal detachment and the Moho representation. It runs across the profile but below the ICS its signal has been erased by the granites which reach the lower crust.

*- Can the authors explain better the sentence: if the detachment has been assimilated, upper crustal fractures can find their way into the lower crust thus allowing the upper crust to sink".*

If the detachment level was present below the ICS that would act as a reological boundary, i.e. a detachment, thus preventing that faults/deformation occurring in the upper crust reached, to the lower crust. The fact that the detachment is not present below the ICS means the contrarily, crustal scale fractures can go deep into the lower crust as we image the ICS Southern Thrust.

**Detailed comments: l. 90: spell granites**

Corrected

**l. 250: spell located**

Corrected.

**l. 320: meaning of "photoliths"?**

We have changed the sentence to:

"In fact, some authors have shown the major presence of I-type granites in the ICS (Villaseca et al. 2017) suggesting that they have a deep origin."

**l. 420: "Other possibilities exist and cannot be ruled out": Which are these?**

Other possibilities exist as there is not a seismic profile with enough resolution (i.e. seismic reflection data), to assess the amount of shortening that the lower crust has accommodated, although we strongly believe that some of the shortening has been absorbed by the lower crust below the Iberian Central System. For completeness we have extended this sentence as follows:

“These values suggest that the amount of shortening observed at upper crustal level is similar to that imaged at the lower crust in Figs. 4 and 5, thus supporting our model. However, other possibilities exist and cannot be ruled out. Further deep normal incidence seismic studies with higher lateral resolution are needed in order to assess the amount of shortening accommodated at lower crust levels.”