Dear Reviewer 1,

Thank you for your comment on our manuscript. We report all your comments in red below, followed by our respective answers. The main manuscript is revised accordingly, some of the modified sentences are include below (underlined text).

Reply to RC1

Introduction:
Lines 31-32: "The classical concept assumed the European lithospheric slab subducted southeastward/southward along the entire Alpine chain (Mueller, 1982) without any fragmentation."

I would specify "Alps" rather than "the entire Alpine chain" because Mueller was referring only to the Alps sensu stricto, not to other parts of the Alpine chain which also includes the Apennines and Carpathians. The latter involve subduction of Adriatic lithosphere. It would also be appropriate to cite colleagues who previously proposed lithospheric subduction in the Alps (e.g., Laubscher 1970) inspired by the much earlier "classical" work of Ampferer and Argand.

Reply: We have modified the sentence as suggested:

The classical concept assumed the European lithospheric slab subducted south-eastward/southward along the entire Alps (Laubscher 1975; Mueller, 1982) without any segmentation.

Line 40: "…reversed polarity…" Here, I would recommend using the descriptive term "opposite dip" rather than "reverse polarity". The latter is more interpretative and implies a change in the direction of subduction.

Reply: We see your point and have modified the sentence as suggested, though "opposite" is not the exact expression and the term "reversed polarity" in sense of a change in dip direction is generally used in a broader sense than suggested in the review (e.g., Vignarolli et al., 2008). We substitute the word fragment, fragmented with more propper segment/segmented throughout most of the text.

For the first time, Babuška et al. (1990) imaged the Alpine slabs separated into two segments, one beneath the Western and second beneath the Eastern Alps, with opposite polarity and a gap in between them.

Line 43*:* "….with a gap between the two Alpine keels…" Please define what you mean by "keel". You probably mean slabs. Note that Mitterbauer et al. (2011) preferred an interpretation in which there is no slab gap between the Central and Eastern Alps.

Reply: we change word keel to slab as suggested, though the word keel is often used in many papers for dipping/thickened edge of the lithosphere (the whole lithosphere, not only crust; in that case the word "root" is usually used). We attempted to avoid frequent usage of word slab. We have seen the (vertical) slab gap even in our old studies in the 80s, which was later documented in other papers as well, e.g., Lippitsch et al. (2003).

New wording:

…. with a gap between the two Alpine slabs,……

Line 58: Nomenclature – "the south-eastern part of the BM (referred to as HV-BM throughout the paper)…" Please keep things simple by using BM = Bohemian Massif. Or if you really need this long abbreviation (HV-BM), then write it completely to make your usage clear.

Reply: Abbreviation "BM" is introduced for the Bohemian Massif as a whole in the abstract of the original submission (line 15) and Introduction (line 57). Abbreviation HV-BM is introduced as a logical expression for the "high-velocity heterogeneity beneath the southern part of the BM", i.e., only a part of the BM and at depth. Repeating "high-velocity heterogeneity beneath the southern part of the BM" throughout the text would be long and non-effective. Moreover, not all the BM mantle is fast, but rather slow (e.g., Piromallo & Morelli 2003; Amaru 2007; Koulakov et al. 2009). Using only BM for the high-velocity heterogeneity beneath a part of the BM would be confusing for those who are familiar with the slow sub-lithsopheric upper mantle beneath the BM, in general. Therefore, we will keep the abbreviation HV-BM and complement the captions.

Resolution tests:

Lines 201-205: "The above performed synthetic tests corroborate that the data from the AlpArray and EASI networks are able to image two separate northward dipping sub-parallel slabs beneath the E. Alps and southern rim of the BM. The two slabs are separate from each other, and the northern one is not connected with the shallow parts of the lithosphere (above ~100km). The flip of the subduction polarity beneath the E. Alps relative to the W. Alps is undoubtedly real and it is not produced by potential smearing due to ray geometry." I would distinguish between slab dip (the direction that the slab is presently slanted) and subduction polarity (the original direction of subduction). The steep northward dip of the slab beneath the Eastern Alps is a robust feature of all models so far, but the original direction of subduction is debatable (see comments below). For comparison of end-member models with different slab dips, e.g., resolution tests of Paffrath et al. (in rev.).

Reply: We modify the sentence as suggested,

The difference between the dip directions of the subduction beneath the E. Alps and the subductions beneath the W. and Central Alps is undoubtedly real and it is not produced by potential smearing due to ray geometry.

Connection of surface to subsurface dynamics:

Lines 226-229: "The uplift rates in the W. and C. Alps exhibit at least 50% contribution by convective processes (due to slab detachment) and dynamic contributions (due to the sub-lithospheric mantle flow), while isostatic response due to ice unloading during deglaciations dominates in the E. Alps (Sternai, 2019)." There are other modelling studies that differ from those of Sternai 2019 in both their approach and their conclusions; they warrant reading and citation in this context (e.g., Champognac et al. 2007, Fox et al. 2015, Mey et al. 2016).

Reply: We chose to delete this paragraph, which does not concern the main topic of the study. More explanation would make the ms. unnecessarily longer.

Slab polarity and the boundary between the Eastern and Central Alps:
Lines 222-224: "In recent studies, Paffrath et al. (2020) suggest the reversed slab polarity relative to the Western Alps already in the Central Alps, as opposed to the formerly documented polarity reversal further to the east - beneath the E. Alps (e.g., Babuška et al., 1990, Lippitsch 2003; Zhao et al., 2016)." This is a misunderstanding/misreading, because Paffrath et al. don't claim that there was a reversal in slab polarity below the Central Alps! Please read carefully. Rather, they refer to the part of the slab beneath the Eastern Alps when they write „The new model does not require a slab polarity switch due to the detachment from the crust and the nearly vertical dip of the eastern Alpine slab. Tectonic arguments (in Handy et al., in rev. with Solid Earth) rather suggest a European provenance of the slab".

Reply: We have read carefully both the submitted paper by Paffrath et al. as well as studied the presentation at EGU2020 (reference given), where on slide 15 the authors compare their results with results of Lippitsch et al. (2003) along slice B running through the C. Alps and show:

Discrepancy in lithospheric slab orientation, slab connected to Adria?
Dipping direction seems to be reversed (NW) in comparison, however structure of this slab is highly complex with eastern part showing tendency to dip SE

Our sentence "In recent studies, Paffrath et al. (2020) suggest the reversed slab polarity relative to the Western Alps already in the Central Alps, as opposed to the formerly documented polarity reversal further to the east - beneath the E. Alps (e.g., Babuška et al., 1990, Lippitsch 2003; Zhao et al., 2016)" refers correctly to this presentation. The reference to Zhao et al., 2016 might be deleted as they do not have sufficient resolution beneath the E.Alps. We can also delete the entire sentence in case statements in slide 15 of the presentation are no more valid, as it is not essential for our ms., in which we focus on the E. Alps and the BM. At this stage of our ms. we do not say anything about the slab provenance.

Lines 224-226: "Mock et al. (2020) pointed out the discordance between the slab geometry at depth and the boundary between the Eastern and Central Alps observed in the surface geology and, similarly to Rosenberg et al. (2018), shift the boundary between the E. and C. Alps further to the east, at the Giudicare-Brenner fault system." The authors cited do not redefine the boundary between Eastern and Central Alps, they merely note a discordance between the slab geometry at depth and the boundary between the Eastern and Central Alps observed at the surface. The boundary between the E. and C. Alps is defined at the surface in map view by the western edge of the continuous Austroalpine nappe stack located in Eastern Switzerland. This traditional definition does not take into account the effect of erosion which removed Austroalpine nappes originally exposed somewhat further to the west. The former existance of these nappes to the west is supported by the provenance of components in the Molasse Basin and by the Austroalpine Klippe in the Central Alps. Regarding the Alpine slab, the boundary between the central and eastern slab segments (as defined either by a slab gap or a change in dip direction of the slab) coincides generally with the Giudicarie-Brenner faults. In light of recent evidence for a laterally continuous Alpine slab with a change in dip (Handy et al., in review with SE), it would be clearer to avoid relating surface and subsurface boundaries between Central and Eastern Alps.

Reply: Wee see your point and chose to keep a shortened delimitation of the C./E. Alps boundary, regardless of the interpretation. The rest of the paragraph has been deleted:

Mock et al. (2020) note a discordance between the slab geometry at depth and the boundary between the Eastern and Central Alps observed at the surface. The boundary between the central and eastern slab segments of the Alps, as defined either by slab gaps, due to delamination (Handy et al., 2021) or a change in dip direction of the subductions, coincides with the Giudicare-Brenner fault system, in general (e.g, Rosenberg et al., 2018).

Lines 238-241: "Later tomography of the upper mantle which included the E. Alps from data of regional passive experiments (Dando et al., 2011; Mitterbauer et al., 2011; Karousová et al., 2013) also retrieved the northward dipping high-velocity heterogeneity of similar geometries (Fig. 5) and associated it mostly with the Adria plate subduction." It is important to avoid equating a switch in the dip direction (polarity) of the Alpine slab with a gap in this slab. In the interpretation of Handy et al. (in rev. with Solid Earth), the slab changes its dip direction along strike without evidence for lateral separation into two segments. Rather, the along-strike change in dip direction of the slab coincides generally with an eastward transition in its degree of detachment from the orogenic lithosphere.

Reply: We modified the sentence, in which we delete the last part. Reference to Dando et al. (2011) for the slab relation to the Adriatic plate was included by a mistake.

Later tomography of the upper mantle, which included the E. Alps, from data of regional passive experiments (Dando et al., 2011; Mitterbauer et al., 2011; Karousová et al., 2013) also retrieved the northward dipping high-velocity heterogeneity of similar geometries (Fig. 5) in the 250 km of the upper mantle.

To the comment segmentation vs. change in dip direction:

Along-strike change in dip direction of the slab (without a gap) is conditioned by the slab detachment to the east. In case of no or "thin" slab detachment (irresolvable at the current 30x30x30 km grid), as imaged in several tomographies including ours, the change in subductions calls for slab segmentation, or a "vertical" gap (separation) between the two subductions (regardless how they are interpreted). When interpreting results of body-wave tomography, we strongly follow principles of P- velocity perturbation images, i.e., deviations from a 1D reference velocity model. The damped deviations referes to each layer separately and do not allow direct comparison with absolute velocities in other models. One has to be careful with interprations of vertical cross-sections as well.

Lines 241-246: "….suggested three main phases in building the E. Alps keel: (1) NW translation of the Adria and its thrusting over the (subducting?) European plate in the W. Alps, (2) fragmentation of northern Adria along a deep-seated fault (possibly the Giudicarie Fault, or at least a spatially nearby structure) and (3) counter-clockwise rotation of the Adria and its subduction beneath the European plate in the Eastern Alps, with a triple-junction of three crustal terranes in its eastern rim proposed by Brückl et al. (2010), although the deformation style between the E. Alps and the Pannonian Basin is usually considered diffuse on the surface." Two points need clarification here: (1) Based on recent P-wave tomography from the newest Alp Array data (Paffrath et al. in rev), the length of slab beneath the Eastern Alps, irrespective of its dip direction, far exceeds the amount of shortening in the eastern Southern Alps. This precludes a primarily Adriatic origin of this slab, as discussed in Handy et al. in rev, Solid Earth; (2) there is no unequivocal evidence at the surface or at depth to support the idea of three "crustal terrains" with distinct Moho boundaries near the transition from

E. Alps to the Pannonian Basin. Rather, the Pannonian Basin is underlain by thinned European and Adriatic crust and lithosphere that acquired their reduced thicknesses in Miocene time (e.g., Ustaszewski et al. 2008). The decrease in Moho depth going from the Eastern Alps to the Pannonian Basin is gradual, not abrupt (e.g., Horvath et al. 2015), indicating extensional flow of the lower crust and upper mantle.

Reply: ad comment (1): we refer to our interpretation from the '90s, reflecting the LAB mapping and results of P-wave tomography, both showing differences between the Western and Eastern Alps. NW movement of Adria, its counterclockwise rotation and collision with the European plate is not questioned (e.g., Le Breton et al., 2017), including the amount of shortening (Ustaszewski et al., 2008). We modify the text as follows:

The imaged triangular shape of the LAB model (e.g., Babuška and Plomerová 1992) beneath the thickened lithosphere of the E. Alps detached from that beneath the W. and C. Alps led Babuška et al. (1990) to suggest three main phases in building the E. Alps mantle-lithosphere root: (1) NW translation of the Adria and its thrusting over the (subducting?) European plate in the W. Alps, (2) fragmentation of northern Adria along a deep-seated fault (possibly the Giudicarie Fault, or at least a spatially nearby structure) and (3) counter-clockwise rotation of the Adria resulting in a start of its subduction after a collision with the European plate in the Eastern Alps (Ustaszewski et al., 2008), potentially above a delaminated European lithosphere residing at greater depth (Paffrath et al., 2021; Handy et al., 2021).

Ad (2) triple junction (Brückl)

Reply: In tectonically complex regions, as the Alps and surrounding area, one can hardly expect that only one fixed opinion exists. We modified the end of the sentence related to the crust and complemented the references as suggested.

Complexity of this region is reflected in ambiguous views on the crust, being interpreted as a triple-junction of three crustal terranes (Brückl et al., 2010), although the deformation style between the E. Alps and the Pannonian Basin is usually considered diffuse on the surface. Instead, e.g., Ustaszewski et al.(2008) and Horvath et al. (2015) assume the Pannonian Basin underlain by gradually thinned European and Adriatic crust, which has been recently imaged by Kalmár et al. (2021).

Lines 267-277: "The north oriented dip of the EA subduction, imaged in early tomography studies…..Most of them agree in interpreting it being of Adriatic plate origin (Dando et al., 2011; Karousová et al., 2013). However, Mitterbauer et al. (2011), and similarly in recent tomography by Paffrath et al., (2021 this issue), the positive perturbations are associated with a delaminated EU slab. Kästle et al. (2020) relate the HV-EA mainly with the European plate subductions as well, and leave no or only minor role to the Adriatic subduction. The authors explain the northward subduction modelled beneath the E. Alps by imaging a combination of the short Adriatic and deep delaminated, potentially overturned European slabs." Here, the authors should mention that recent P-wave tomography based on the newest Alp Array data (Paffrath et al. in rev) supports a primarily European origin of the north-dipping slab beneath the Eastern Alps (see discussion in Handy et al., in rev. with Solid Earth). This conclusion is based on the length of imaged slab beneath the Eastern Alps (several hundred km) which far exceeds the amount of shortening (c. 50 km) in the overlying crust of the eastern Southern Alps. In this interpretation, the steep northward dip of the slab segment beneath the E. Alps is attributed to asthenospheric flow during or after Adriatic indentation (Handy et al., rev.).

Reply: The requested formulation is included in the original submission (see above)**.** We extend the sentence and add the Handy et al., 2021 this issue refence as well).

… and similarly in recent tomography based on the newest Alp Array data by Paffrath et al., (2021 this issue), the positive perturbations below 150km are associated with a delaminated European slab (see also Handy et al., 2021 this issue).

Lines 401-402: "The northward-dipping lithosphere keel is imaged down to ~200-250 km, without signs of delamination, and we associate it with the Adriatic plate subduction." As above, it is unclear what the authors mean by "keel". It appears to mean slab, but this should be clarified.

Reply: The sentence was modified (keel deleted):

The northward-dipping slab is imaged down to ~200-250 km, without signs of delamination from the Adriatic plate. Therefore, associations of the high-velocity heterogeneity with the Adriatic plate subduction seem to be obvious.

Interpretations of anomalies beneath the Bohemian Massif

Lines 281-285: "To understand the positive perturbations beneath the southern BM, we compare it with results from the large-scale Paffrath et al. (20201) tomography and with the regional tomography of the BM (Karousová et al., 2013) of similar resolution to ours (Fig. 6). The strongest positive perturbations related to that heterogeneity overlap in the models, though they are of unrealistically large extent in the Paffrath's et al. model (2021, this issue)." Why is this extent in the Paffrath et al. model unrealistic? "There, they include also the ER with the thinnest BM lithosphere, well imaged by negative perturbations in the EASI-AA and in BOHEMA models (Karousová et al., 2013)."

Reply: We modify the sentence to make it clearer and added reference Plomerova et al. (2016).

Paffrath et al. (2021) show the strong positive perturbations also beneath the north-western part of the BM (beneath the Eger Rift), where the lithosphere thins significantly (~80 km), which is well imaged by negative perturbations in the EASI-AA and in BOHEMA models (Karousová et al., 2013; Plomerova et al., 2016).

Lines 308-311: "The role of applying proper crustal corrections is significant in teleseismic regional tomography. Not applying any crustal corrections or applying inadequate ones can strongly affect velocity perturbations within the upper ~100 km of the upper mantle (e.g., Karousová et al., 2013), which is the zone, where the models discussed above differ. From this point of view, developing a uniform detailed and reliable model of the European crust is urgently needed." I agree and find the comparison of models in this chapter valuable. I've sent the authors some PPT slides of a recent talk showing the correspondence between models regarding the degree of connectivity of slabs with their orogenic lithosphere. Both the recent P-wave tomography employing 3D crustal models (Paffrath et al. in rev.) and the surface wave models of Kaestle et al. (2018, 2020) indicate slab detachment in the Western and Eastern Alps, with local slab attachment only in the western Central Alps. This coincidence of images with different methods suggests that the crustal correction of the Pwave model of Paffrath et al. is robust.

Reply: We extended the paragraph by a sentence as follows

“Overcorrecting” the travel times due to a crustal model used, regardless of a method of correcting itself, can delete/erase or substantially reduce positive perturbations in the upper 100 km, if too slow and thick crust would be considered and vice versa.

Lines 332-333: “The simplest explanation would be to consider it as a fragment of the delaminated part of the European plate subductions, as suggested in Handy et al. (2015) (Fig.7a).” This appears to be a misunderstanding: The +Vp anomaly below the BM is not the anomaly referred to in Handy et al. 2015 (their Fig. 11a), which was a European slab hanging directly below the Eastern Alps in Miocene time. Note that Handy et al. 2015 never considered a +Vp anomaly below the BM in their model. Instead, the Miocene +Vp anomaly below the Eastern Alps in their figure is torn European lithosphere that sank and no longer exists. The model of Handy et al. 2015 is actually consistent with the statement in Line 338 that “Therefore, an association of the HV-BM with the delaminated fragment of the EU subduction is not likely.”

Reply: Our formulation was not clear enough, if it lead to the idea described by the referee. We did not mean that at all. We reformulate the sentence.

The simplest explanation would be to consider it as a small fragment of the delaminated part of the European plate subductions, as suggested in Handy et al. (2015) for the heterogeneity beneath the Eastern Alps at greater depth (Fig. 7a, now Fig. 8a).

Points pertaining to rock physics:

Lines 347-348: “The Phanerozoic continental mantle lithosphere, composed of originally lighter rocks than those in the asthenosphere (Mantle lithosphere is generally denser rather than lighter than asthenospheric mantle) and becomes denser due to metamorphic phase changes as it subducts” (reference?)

Reply: The mantle lithosphere alone is on average a bit (ca. 70 kg/m3) denser then the asthenosphere. The mantle lithosphere remains above the asthenosphere as it is mechanically coupled to the crust, so the overall lithosphere density is less than the asthenosphere density. However, as soon as the upper or the full crust is decoupled from the mantle lithosphere, the lower lithosphere (denser than the asthenosphere) is able to sink. The ms. text is updated accordingly:

Updated text:

The Phanerozoic continental mantle lithosphere may mechanically decouple from the upper or the full crust, and since this lower lithosphere is denser than the asthenosphere it subducts. Densification of the lower crust through metamorphic reactions may enhance this process if the convergence is fast (e.g., 2 cm/yr in Hetényi et al., 2011).

New reference: Hetényi G, Godard V, Cattin R, Connolly JAD (2011) Incorporating metamorphism in geodynamic models: the mass conservation problem. *Geophys J Int* **186**:6-10. doi:10.1111/j.1365-246X.2011.05052.x

Lines 360-363: “The roll-back subduction of the Carpathians, accompanied by a substantial asthenospheric flow, could open a space between the E. Alpine and Carpathian slabs for the northwestward “transportation” of a purely oceanic lithosphere or a mix of oceanic and continental lithosphere fragment into the mantle beneath the BM." No reason or mechanism is provided here to explain why oceanic or mixed ocean-continent lithosphere should be "transported" northward. Please elaborate.

Reply: there is no current data to demonstrate this, like unequivocal anisotropy due to mantle flow, as such signals have been overprinted. Nevertheless, our proposal here is based on Kissling and Schlunegger (2018)'s model of the Alps, accompanied by complex asthenosphere flow in context of slab edges (e.g., Vignaroli et al., 2008, their Figure 8 for the Western Alps. (https://doi.org/10.1016/j.tecto.2007.12.012) and other examples. For the context discussed in our manuscript, such flows could have happened around the retreating and /or delaminated slabs. The manuscript text now explicitely says this.

Manuscript change, the new sentences read as follows:
The Carpathians front curved significantly and migrated to the north. Differences in the roll-back subductions of the Alps (e.g., Kissling and Schlunegger, 2018 and reference therein) and the Carpathians, northward push of Adria and European slab delamination beneath the EA could have formed complex flows in the asthenosphere (e.g., Vignaroli et al., 2008), which could "transport" a purely oceanic lithosphere or a mix of oceanic and continental lithosphere fragments through the open space between the E. Alpine and Carpathian slabs north-northeastward into the mantle beneath the BM. The rotational displacement of the Adriatic Plate indenter provided an additional driving force for modifications of the Alpine-Carpathian-Dinaridic orogenic system.

New references:
Ustaszewski et al., 2008
Kissling and Schlunegger, 2018.
Vignaroli G, Faccenna C, Jolivet L, Piromalo C, Rossetti F (2008) Subduction polarity reversal at the junction between the Western Alps and the Northern Apennines, Italy. *Tectonophys* **450**:34-50. doi:10.1016/j.tecto.2007.12.012

Lines 380 - 396: "The roll-back subduction of the Carpathians, accompanied by a substantial asthenospheric flow, could open a space between the E. Alpine and Carpathian slabs for the northwestward "transportation" of a purely oceanic lithosphere or a mix of oceanic and continental lithosphere fragment into the mantle beneath the BM." No reason or mechanism is provided here to explain why oceanic or mixed ocean-continent lithosphere should be "transported" northward. Please elaborate.

Reply: The continental mantle lithosphere is formed by domains with their own large-scale fabric, oriented generally in 3D, i.e., with inclined symmetry axes of anisotropy (e.g., Babuska and Plomerova, 2020). For example, In case of two adjacent lithosphere domains with fabrics, in which the dipping high-velocity directions face each other (i.e., they are oriented convergently), an artificial positive heterogeneity could be produce at greater depth in isotropic images of the upper mantle.

We added an explanation after the quoted sentence
"Ignoring seismic anisotropy and assuming isotropic wave propagation or considering only azimuthal and/or radial anisotropy leads to significant isotropic and anisotropic imaging artefacts that may lead to spurious interpretations (VanderBeek and Faccenda, 2021)."

In this study of the broader region around the E. Alps we have applied, in the first step, the isotropic mode of a coupled anisotropic–isotropic teleseismic P-wave tomography developed by Munzarová et al. (2018). In spite of the general good agreement with the high-resolution large-scale isotropic tomography (Paffrath et al., 2021, this issue), the images can be biased due to seismic anisotropy (Eken et al., 2012; Qorbani et al., 2015, 2016; Bokelmann et al., 2021). Lateraly varying anisotropy, which correlates with tectonics of the region, has been indicated in shear-wave splitting (e.g. Link and Rumpker, 2021). After collecting sufficient amount and well-distributed high-quality data, we will run the coupled anisotropic-isotropic mode of the code and retrieve 3D anisotropic model of the region, which will allow for laterally and vertically varied anisotropy with axes oriented generally (inclined) in 3D. This further investigation may help in deciding among the drafted scenarios for the origin of the HV-BM, or point to new ones.

New reference: Link and Rumpker, 2021, feart, doi: 10.3389/feart.2021.679887

Figures and Captions:

Fig. 1 (right side): Label the main faults and use transparent colour to mark the Alps between the Northern and Southern Alpine Fronts.

Reply: We add labels to main faults**,** but do not mask the Alps with any schematized colour symplification.

Fig. 2 (right panel): Label the Southern Alpine Front (SAF), use transparent colour to mark the Alps between the Northern and Southern Alpine Fronts. It would help to mark the outlines of the Tauern Window (TW). I would eliminate the triple junction, because there is no structural evidence for a Pannonian Plate sensu Brückl et al. (see comments above).

Reply: The same as for Fig.1. Labels added, the Tauern window contoured. The triple junction deleted.

Fig. 3: Label the Southern Alpine Front (SAF) on all cross sections. In the caption, indicate what DF means (this is not included in any of the earlier captions). Indicate the traces of all cross sections on a map or inset map. Include coordinates of the endpoints in the caption or directly on the figures. This is important for others who wish to compare their results with the authors'.

Reply: SAF Label added at all cross-sections, DF included among explanations in Figs.1 and 2, traces of all cross-section marked in the horizontal slice at 120km (new upper right inset). Geographic coordinates of endpoints of all the along longitudes crossections are complemented in the captions.

Fig. 4: Label all the faults shown in the other cross sections. Include coordinates of the endpoints in caption or directly on the figures. Again, this is important for others who wish to compare their results with the authors'.

Reply: Labels complemented, coordinates added in the caption.

Fig. 5: The labelling of the cross sections should be made clearer. Label each section only once so it corresponds to the letters of the traces on the map. The orogen-parallel cross section in a) should have the longitudinal degrees correspond to the longitudinal units on the map on the lower right.

Reply: Required change from landscape to portait destroyed the figures, which escaped my attention. Figure is redrawn with correct labelling. For better visibility of the heterogeneities we keep part (a) with a broader extent of longitudes.

Fig. 6: Add Variscan unit boundaries on the main horizontal slice of Paffrath to enable better comparison with the other slices shown. Distinguish Alpine and Variscan boundaries, either by using lines with different thicknesses (Alps thick, Variscan thin) or colours.

Reply: We prefer keeping the Paffraths et al. plots at as close as possible to their original form, the Alpine and Variscan boundaries are distinguished in the two other parts of our figure. We label all important faults and units.

Fig. 7: Check the position of the cross sections with respect to the seismic anomalies, because they look misaligned. The northern tip of the delaminated EU slab in a) is too far to the north in b) with respect to the Northern Alpine Front (NAF). Handy et al. 2015 proposed that this slab sank beneath the core of the Alps, not that it migrated to the north with respect to the front. However, if this is your idea (meaning the authors of this text), then please state this clearly.

Reply: This is probably a misunderstanding. We slightly corrected the position of the delaminated slab in the schematic cartoon plotted across backround from Handy et al. (2015) and complemented the caption.

Fig. 8: Show the end points of the cross sections on an inset map so that the location of the. anomalies and unit boundaries can be compared, otherwise the model can't be compared with other data and the reader is helplessly lost.

In b), please also consider other interpretations of Late Devonian to late Carboniferous paleogeography and subduction directions of the Rheic Ocean, e.g., Schulmann et al. 2009, 2014, Ballevre et al. (2009), Zeh & Will (2011) or in Franke et al. (2000). What effect do these scenarios have on your interpretation of the 3% positive Vp anomaly beneath the Moldanubikum?

Reply: Figure 7b is part of the schematic cartoon (not to scale) with reference on Babuska and Plomerova (2013), where details of the cross-sections are presented and other interpretations as requested are discusseed and referred in Section 6. We complement the captions.

We present some of definitely more potential scenarios, but at present stage, we do not have enough information to favour only one of them, neither dispute with other interpretation of the Reic Ocean subductions. Arguments for our model of BM we have presented, e.g., in Babuska and Plomerova (2013) and reference it in this ms.