Answer to RC#1

The authors have made several changes in both the manuscript and the figures following the suggestions of the reviewers. The article has significantly improved. My comments, at least, have been addressed by the authors and the suggestions have been answered and/or applied. I really appreciate their response. The authors propose a new geodynamic model that explain the deformation of the Betic Cordillera, focused on the central and eastern Internal Zones, which is supported by new and previous data. This model is a good contribution to the discussion of the evolution and deformation of this complex zone, and it is also suitable for other regions in the world.

I just want to add two suggestions.

First, there is a spelling mistake in the figure caption of figure 7, line 397. I guess that PF is Palomares Fault, not P Fault.

Corrected.

Second, the authors have added an explanation of the magmatism in the Alboran Sea, mainly focused on the Eastern Alboran basin. In lines 702-704, they speak of voluminous magmatic intrusions and refer it to Duggen et al. (2004), a well-known work of the Alboran magmatism. However, this work is based on samples that may correspond (or not) to voluminous intrusions; I think they should also refer to geophysical data that can provide information about the scale of those intrusions, like magnetic anomaly data. Then, if authors considered to add another reference to that sentence, I would appreciate if they added Tendero-Salmerón et al. (2022), where magnetic anomalies of Alboran Sea are displayed and discussed in relation to crustal-scale magmatic intrusions (Tendero-Salmerón, V., Galindo-Zaldivar, J., d'Acremont, E., Catalán, M., Martos, Y. M., Ammar, A., & Ercilla, G. (2022). New insights on the Alboran Sea basin extension and continental collision from magnetic anomalies related to magmatism (western Mediterranean). Marine Geology, 443, 106696).

We added the suggested reference.

Finally, except for these suggestions, I think the article is suitable for publication.

Answer to RC# 3

I thank the authors for reviewing this manuscript. However, I still have difficulties understanding the proposed model. As I mentioned in my first review, my main concern is the comparison of different crustal domains that have different origins and original thicknesses as a consistent, homogeneous domain. In my opinion, this issue has not been solved in the review.

We note that reviewer#2 (anonymous), who had previously considered the manuscript to be rather good-fair and required major corrections, now considers that the manuscript should be rejected. We understand that the reviewer does not agree with some of our interpretations because she/he certainly has another.  This does not mean that our interpretation is not supported by the analysis of the data. Below we answer point by point to the reviewer's comments.

One of the results that support the conclusions of this manuscript is a crustal section from SE Iberia, crossing the Betics and the North Alboran Basin to the East Alboran Basin. The authors interpret the changes in crustal thickness as the result of processes thinning the margin. However, this disagrees with previous data about the crustal structure of the area, formed by three different domains:

1) The Betics crust, formed by the Alboran Domain stacked over the SE Iberian margin, thus, the crust is thickest in this area (García-Dueñas et al., 1992; Platt et al., 2013).

We agree with this, nowhere in the paper we say the contrary. We don't see in our Figure 17 which part is in contradiction with this statement.

2) The North Alboran crust, probably formed by the Alboran Domain (Comas et al., 1999; Gómez de la Peña et al., 2018). The crust could or not be thinned in this area, but it is not comparable with a crust thickened by stacking processes as in the Betics. Also, although the timing of the possible thinning of the continental crust in the North Alboran Basin is not well constrained, the sedimentary sequence offshore is not deformed (e.g., Gómez de la Peña et al., 2021). Thus, the thinning of this crust must have occurred prior to the deposition of these sediments, earlier than Langhian times (Gómez de la Peña, 2021), which disagrees with the Serravallian-Tortonian extension proposed in this manuscript.

Not sure to understand what the reviewer means by "the crust could or not be thinned". But Moho is shallowing here based on geophysical data so a direct implication is that the crust is thinner. Also what do you means by " it is not comparable with a crust thickened by stacking processes" ? Do we agree that the Alboran metamorphic basement in the Betics and in Alboran basin is an orogenic basement (thickened crust) that has been thinned during the Miocene ?  According to our knowledge all the recent research agrees with this. Structure and evolution of the North Alboran Basin is constrained by line MSB08 and Andalucia-1 well. It is true that deformation is modest. Sedimentary succession are not affected by large offset normal faults, but normal faulting is documented. It is not because you don't see the Langhian sediments affected by normal faulting that thinning did not occur at this time. High-angle brittle normal faulting is certainly not the only process to thinned a crust so the absence of major high-angle normal faults does not imply absence of crustal thinning. Looking at thickness variations below top Langhian reflector (Fig. 14) it is true that this cryptic thinning may have started earlier than the Langhian and this would be consistent with the onset of extension in Alboran indicated by a number of previous studies. Here we document the main extensional event associated with normal faulting and basin subsidence which is Serravallian-Tortonian in age. We are not meant to argue on the age of onset of extension which is certainly related to more ductile deformation condition. The extension certainly started before. Our model presented in Fig. 18 is not in contradiction with this.

3) The magmatic arc crust of the EAB was newly created during the middle-late Miocene (Duggen et al., 2008, Booth-Rea et al., 2018). Thus, it is not the southern continuation of the continental crust. Its thickness is not controlled by extensional processes, but by the magmatic activity (Duggen et al., 2008; Gómez de la Peña et al., 2020).

The geophysical signature of EAB is consistent with Ca-K geochemistry of lavas and therefore to a basement largely made a magmatic arc crust but this does not mean it is a newly formed crust. In subduction zone, typical suprasubduction Ca-K magmatic arc intrudes a former continental crust, oceanic crust or newly formed fore-arc oceanic crust. Only forearc crust can form a real new crust at subduction initiation by decompression melting of the asthenosphere. So it is clear to us there was a crust before EAB here before. And considering the tectonic context and age of magmatic ca. 10 Ma it makes more sense to us to consider it is emplaced on thinned continental crust potentially also transformed by magmatic underplating. We wrote "the magmatic arc crust of the EAB could represent voluminous magmatic intrusions (e.g. Al Mansour dacite, Alboran Ridge rhyolite dated to ca. 9 Ma; Duggen et al., 2004; **Fig 17**) formed on the distal rifted margin of Alboran".  Note that the same similar calc-alkaline lavas with higher-K signature however have been emplaced onshore in the Nijar basin (El Hoyazo volcanoes) in Alboran basement that do belong to EAB. Similar Ca-K volcanic centers are also found to the north African margin (Duggen et al., 2004) and event farther west in WAB (eg. Booth-Rea et al., 2018). We conclude that interpretation of Ca-K volcanism is a debatable issue and models can't be restricted to one single "subduction arc" interpretation.

Thus, the crustal section shown in Figure 17 can not be interpreted as a consistent crustal domain thinning from north to south, because it is a juxtaposition of different crustal domains, with different compositions, origins and evolutions.

Well, we have a different perception of the same observation probably. Different crustal domains characterised by different geophysical signatures are expected across a rifted margin that has involved variable amount and types of magmatism. The main thinning direction is not N-S but rather EW considering the dominant W-directed retreat. Because stretching is very oblique to the strike of the section in Figure 17, and associated with variable of crust and manse-derived magmatism, the observation of contrasting types of crustal domains now juxtaposed in the NS direction should not be a surprise.

There are several studies explaining the crustal configuration in this area, supported by different data such as magmatism (Duggen et al., 2005, 2008), seismic data (Booth-Rea et al., 2007, 2018; Gómez de la Peña et al., 2018, 2020, 2021), or tomographic data (e.g., Wortel and Spakman, 2004; Chertova et al., 2014). The interpretation proposed in this manuscript is inconsistent with these previous results, and I don't think it is justified based on the data that the authors presented.

We are very much aware of the previous researches. About Duggen et al. the notion that Ca-K results from melting of subducted sediments of the subducted Tethys ocean and is comparable with intra-oceanic Izu-Bonin geochemical signature is debatable. First this maybe incompatible with some of the many kinematic reconstructions proposed for the region. Second in classical arc setting like Izu-Bonin the subduction initiation is marked by a

forearc stage and characteristic boninite that are not observed here. Then several other unanswered questions may arise. For instance, why subduction would occur 10 to 5 myrs after the onset of extension in the Betic-Alboran region which is Burdigalian or Langhian (see answer to the comment above). We would also expect to have a thick arc crust rather than a thin arc crust in perfect continuity with the crustal thinning from the Betics to EAB. As we wrote, those Ca-K melts could alternatively formed "we suspect it reflects post-subduction arc magmatism induced by remelting, during extension and delamination, of a metasomatized wedge of mantle lithosphere formed during a previous subduction event (e.g. Richards, 2009)"
The reviewer's interpretation maybe different from our but the seismic and tomographic data published in previous researches are not in contradiction with our interpretation.

My other main concern is the offshore interpretation. In the EAB, unit IV is interpreted, which is Serravallian in age. However, based on the age of the volcanism (Serravallian-Tortonian, e.g., Duggen et al., 2008) and the ODP results (Comas et al., 1999), the oldest sediments found in this area are Tortonian in age. The age of this unit has larger implications for the discussion of the timing of the fault activity, and thus, should be better justified.
In agreement with the age of the sediments, the age of the faults interpreted in figure 13b between 45000-60000 should be revised. Also, in previous works, no faulting or tectonic deformation of the sedimentary units of the EAB is described (Booth-Rea et al., 2007; Gómez de la Peña et al., 2021). I do not see these faulting clearly in the uninterpreted Figure 13a, either. As these faults are quite relevant for the proposed model, a close-up of this figure and further discussion on its interpretation and timing is needed.

We do not question the age of the volcanic intrusions. However, both ODP 977 and 978 wells reached Plio-Quaternary and Messinian series only and didn't reach the lower series. Comas et al. (1999) interpreted a seismic sequence numbered IV (Serravallian-Tortonian) in a seismic line crossing the EAB below the intervals drilled. Those deep series have never been reached by any wells so no one can be sure about their ages. An unconformity separate them from upper sequences making a Serravallian age consistent. Additionally, Gomez de la Peña et al. (2021) also documented a sequence numbered IV south of the EAB. Faults interpreted in seismic line MSB-7 are marked by normal offset of few tens of meters high. We provide a zoom of the seismic section in which we show detailed of the normal faults and filing pattern. It's true that Booth-Rea et al. (2007) didn't document such extensional event. This is because the seismic line they use in the EAB is E-W oriented, som mainly parallel to the main fault system we evidence here.

I agree that oblique rifting may have played a role in the crustal extension in the Betics area, but the data shown are not enough to support that an oblique-rifting model explains the entire Alboran Basin region formation and evolution.

The proposed model is taking different data in consideration not only offshore data which the reviewer seems to focus on. Other data include onshore faulting analyses, field structural data, temporal constraints and discussion of previous kinematic and modelling results.

Some minor comments are listed below:
Line 729 (tracked changes manuscript) it is stated "and structural data offshore, confirm that brittle extension…". Could you please add a reference or a figure citation for this data?

Reference to figures have been added.

Lines 740-743: The intramontane basins were uplifted during the Serravallian-Tortonian, while magmatic processes were creating the EAB. Subsidence in both regions is not comparable directly, as they were evolving independently.

We think this comment is confusing. Sierras got uplifted during the Serravalian-Tortonian and the basins formed during this same time period. Uplift of the intermontane basins did not occur before the late Tortonian. Today EAB is colliding with the Betics along the Cabo de Gata and Aguillas arc and Carboneras fault. This shortening is probably late Miocene to Pliocene and limited in magnitude. When the little amount of shortening is removed extension in the Betics and EAB appears to be continuous. We don't see the reason why they couldn't not be compared. Probably the reviewer is referring to a different kinematic reconstructions but as always they are also highly debated.

Line 545 and Figure 13: I see the Carboneras Fault as a negative flower structure forming a negative relief, rather than a positive flower, as described in the text.

You are right we changed in the text.

Suggested references:

Booth-Rea, G., R. Ranero, C., & Grevemeyer, I. (2018). The Alboran volcanic-arc modulated the Messinian faunal exchange and salinity crisis. Scientific Reports, 8(1), 1–14. https://doi.org/10.1038/s41598-018-31307-7

Booth-Rea, G., Ranero, C. R., Martínez-Martínez, J. M., & Grevemeyer, I. (2007). Crustal types and Tertiary tectonic evolution of the Alborán sea, western Mediterranean. Geochemistry, Geophysics, Geosystems, 8(10). https://doi.org/10.1029/2007GC001639

Chertova, M. V., Spakman, W., Geenen, T., van den Berg, A. P., & van Hinsbergen, D. J. J. (2014). Underpinning tectonic reconstruction of the western Mediterranean region with dynamic slab evolution from 3-D numerical modeling. Journal of Geophysical Research, 119, 1–26. https://doi.org/10.1002/2013JB010500.Received

Comas, M. C., Platt, J. P., Soto, J. I., & Watts, A. B. (1999). 44. The origin and tectonic history of the Alboran Basin: Insights from leg 161 results. Proceedings of the Ocean Drilling Program, Scientific Results, 161, 555–580.

Duggen, S., Hoernle, K., Klügel, A., Geldmacher, J., Thirlwall, M., Hauff, F., Lowry, D., & Oates, N. (2008). Geochemical zonation of the Miocene Alborán Basin volcanism (westernmost Mediterranean): geodynamic implications. Contributions to Mineralogy and Petrology, 156(5), 577–593. https://doi.org/10.1007/s00410-008-0302-4

Duggen, S., Hoernle, K., van den Bogaard, P., & Garbe-Schönberg, D. (2005). Post-collisional transition from subduction-to intraplate-type magmatism in the westernmost Mediterranean: Evidence for continental-edge delamination of subcontinental lithosphere. Journal of Petrology, 46(6), 1155–1201. https://doi.org/10.1093/petrology/egi013

García-Dueñas, V., Balanyá, J. C., & Martínez-Martínez, J. M. (1992). Miocene extensional detachments in the outcropping basement of the northern Alboran Basin (Betics) and their tectonic implications. Geo-Marine Letters, 12(2–3), 88–95. https://doi.org/10.1007/BF02084917

Gómez de la Peña, L. G., Ranero, C. R., & Gràcia, E. (2018). The Crustal Domains of the Alboran Basin (Western Mediterranean). Tectonics, 37(10), 3352–3377. https://doi.org/10.1029/2017tc004946

Gómez de la Peña, L., Grevemeyer, I., Kopp, H., Díaz, J., Gallart, J., Booth-Rea, G., Gràcia, E., & Ranero, C. R. (2020). The Lithospheric Structure of the Gibraltar Arc System From Wide-Angle Seismic Data. Journal of Geophysical Research: Solid Earth, 125(9). https://doi.org/10.1029/2020jb019854

Gómez de la Peña, L., R. Ranero, C., Gràcia, E., & Booth-Rea, G. (2021). The evolution of the

westernmost Mediterranean basins. Earth-Science Reviews, 214(November 2020). https://doi.org/10.1016/j.earscirev.2020.103445
Platt, J. P., Behr, W. M., Johanesen, K., & Williams, J. R. (2013). The Betic-Rif Arc and Its Orogenic Hinterland: A Review. Annual Review of Earth and Planetary Sciences, 41(1), 313–357. https://doi.org/10.1146/annurev-earth-050212-123951
Spakman, W., & Wortel, R. (2004). A tomographic view on Western Mediterranean Geodynamics. The TRANSMED Atlas, The Mediterranean Region from Crust to Mantle, 31–52. https://doi.org/10.1007/978-3-642-18919-7_2

Answer to RC#3

The manuscript "Oblique rifting triggered by slab tearing: the case of the Alboran rifted margin in the eastern Betics" sets the extensional and strike-slip structures in the Southeastern Betics in a context of slab tearing during the Middle to Late Miocene. The manuscript has improved after its first round of corrections, although I still find some aspects that can be improved, which I list below. Furthermore, I uploaded an edited PDF file.

Thanks for your comments Guillermo, there are very much useful.

Abstract: I insist, using back-arc in the sense of formed behind the orocline is confusing. The overriding plate has forearc, arc and back arc domains. STEP faults propagate into the Forearc domain (Govers and Wortel, 2005). I would simply eliminate it here.
1 Tear faulting….

We removed back-arc here.

Lines 34 and 35, eliminated back-arc or substitute by overriding

Done.

Line 46: The margin continues below sea level, and thus thins to 16-6 km in the Eastern Alboran arc to back-arc region, respectively (Booth-Rea et al., 2018; de la Peña et al., 2020)
Gómez de la Peña, L., Grevemeyer, I., Kopp, H., Díaz, J., Gallart, J., Booth-Rea, G., ... & R. Ranero, C. (2020). The lithospheric structure of the Gibraltar Arc System from wide-angle seismic data. Journal of Geophysical Research: Solid Earth, 125(9), e2020JB019854.

We modified the text and added references accordingly.

Line 53: This sentence is not clear. In the previous revision I made I indicated that there are two different types of strike-slip faults in the Betics, and also, two different interpretations. Some work interprets all of them as conjugate faults formed in an E-W to NW-SE shortening context (Including Carboneras, Alhama de Murcia, Palomares, etc) Bousquet et al., 1979; Montenat et al., 1990; Sanz de Galdeano et al., 1985, among many others, please search and cite). Meanwhile, other work differentiates transcurrent like the above (Giaconia et al., 2012; 2013) from transfer strike-slip faults related to extension and slab tearing (Martínez-Martínez, 2006; Martínez-Martínez et al., 2006; Giaconia et al., 2014). In this later group, Martínez-Martínez et al., 2006 show a 3-D model explaining coeval strike-slip dextral deformation, extension and domal ductile exhumation of Sierra Nevada, followed by later tectonic inversion of the system from East to West.

We understand your point but we think there must a misunderstanding here. In this section, we are dealing with interpretations of the EW trending transfer strike-slip deformation (ductile or brittle) parallel to slab retreat only (i.e. t tear faulting) which are those assumed to accommodate differential extension. We also discuss their timing which is actually unclear as some authors suggest they are middle Miocene and related to slab tearing although slab tearing is assumed to be late post-8/9 Ma feature. Our intention is not to present the different types of strike-slip faulting in the Betics, especially faulting related to shortening like Carboneras, Palomares and conjugate faulting.

Line 55: Frasca et al interpreted that the system stopped advancing westwards at 20 Ma. So this is not the best reference for the Torcal fault zone, which is still active. Please reference Barcos et al., 2015.
Barcos, L., Balanyá, J. C., Díaz-Azpiroz, M., Expósito, I., & Jiménez-Bonilla, A. (2015). Kinematics of the Torcal Shear Zone: Transpressional tectonics in a salient-recess transition at the northern Gibraltar Arc. Tectonophysics, 663, 62-77.
We have changed the reference.

Line 57: Please contrast your modest displacement with Crespo-Blanc et al., 2016. They publish more than 100 km dextral displacement and 53º clockwise rotation along the Torcal fault since 9 Ma.
Crespo-Blanc, A., Comas, M., & Balanyá, J. C. (2016). Clues for a Tortonian reconstruction of the Gibraltar Arc: Structural pattern, deformation diachronism and block rotations. Tectonophysics, 683, 308-324.
We added the reference for comparison.

Line 58: "stalling of westward slab rollback" should be confronted by Westward slab rollback still induces 4.5 mm/yr and clockwise rotations in the Western Betics and Rif (e.g. González-Castillo et al., 2015; Fadil et al., 2006) respect to stable Iberia
Fadil, A., Vernant, P., McClusky, S., Reilinger, R., Gomez, F., Ben Sari, D., ... & Barazangi, M. (2006). Active tectonics of the western Mediterranean: Geodetic evidence for rollback of a delaminated subcontinental lithospheric slab beneath the Rif Mountains, Morocco. Geology, 34(7), 529-532.
Gonzalez-Castillo, L., Galindo-Zaldivar, J., de Lacy, M. C., Borque, M. J., Martinez-Moreno, F. J., García-Armenteros, J. A., & Gil, A. J. (2015). Active rollback in the Gibraltar Arc: Evidences from CGPS data in the western Betic Cordillera. Tectonophysics, 663, 310-321.
The onset of tectonic inversion in the Gibraltar Arc was not coeval in the whole region. Please, see for example Giaconia et al., 2014 or Gómez de la Peña et al., 2022.
Towards the W, the inversion started later.

Agreed. We now refer to these works that emphasized the ongoing slab rollback but move them to the next section devoted to geodetic data.

Line 65: Please cite "synchronously (Martínez-Martínez et al., 2006).

done.

Line 211: Neither Montenat and Ott d´Estevou nor Sanz de Galdeano and Vera mention extensional low-angle detachments nor domes. Pedrera et al, only mention extensional detachments when citing others, but according to their reconstruction there is full shortening since the Serravallian, the same as Martínez-Martos et al., 2017) The only reference that describes what you say in the sentence before is Martínez-Martínez and Azañón, 1997; Martínez-Martínez et al., 2002; 2004.
Martínez-Martínez, J. M., & Azañón, J. M. (1997). Mode of extensional tectonics in the southeastern Betics (SE Spain): Implications for the tectonic evolution of the peri-Alborán orogenic system. Tectonics, 16(2), 205-225.
Martinez-Martinez, J. M., Soto, J. I., & Balanyá, J. C. (2004). Elongated domes in extended orogens: A mode of mountain uplift in the Betics (southeast Spain). SPECIAL PAPERS-GEOLOGICAL SOCIETY OF AMERICA, 243-266.

We agreed. We changed references.

Line 218: Notice that low-temperature thermochronology in western Sierra Nevada gives younger ages than 6 Ma (2,7 Ma, Johnson et al., 1997). Furthermore, extension is clearly still active (e.g. Azañón et al., 2004; Madarieta-Txurruka et al., 2021)
Azañón, J. M., Azor, A., Booth-Rea, G., & Torcal, F. (2004). Small-scale faulting, topographic steps and seismic ruptures in the Alhambra (Granada, southeast Spain. Journal of Quaternary Science, 19(3), 219-227.
Madarieta-Txurruka, A., Galindo-Zaldívar, J., González-Castillo, L., Peláez, J. A., Ruiz-Armenteros, A. M., Henares, J., ... & Gil, A. J. (2021). High-and low-angle normal fault activity in a collisional orogen: The Northeastern Granada Basin (Betic Cordillera). Tectonics, 40(7), e2021TC006715.

Here we are referring to the main exhumation phases identified by thermal modelling not to low-T ages themselves that can be much younger or older than recognised in model cooling phases.

Line 231: This reference is 2004b:
Booth-Rea, G., Azañón, J. M., & García-Dueñas, V. (2004b). Extensional tectonics in the northeastern Betics (SE Spain): case study of extension in a multilayered upper crust with contrasting rheologies. Journal of Structural Geology, 26(11), 2039-2058.

Done.

Line 238: Add ; 2015 Giaconia, F., Booth-Rea, G., Ranero, C. R., Gràcia, E., Bartolome, R., Calahorrano, A., ... & Viñas, M. (2015). Compressional tectonic inversion of the Algero-Balearic basin: Latemost Miocene to present oblique convergence at the Palomares margin (Western Mediterranean). Tectonics, 34(7), 1516-1543.

done.

Line 334: I think you mean EW-trending faults or NS-directed faulting.

Modified

Line 357: Please revise the geological time table. Burdigalian 20.44-16 Ma coincides with HP metamorphism according to some authors (e.g. Platt et al., 2006). Even younger 15 Ma are determined for zircon growing in HP-eclogites (López Sánchez-Vizcaino et al., 2001). Ductile mineral growth lasted at least until 12,5 Ma according to Rb/Sr data (Andriessen et al., 1991; de Jong, 2003)
Andriessen, P. A. M., Hebeda, E. H., Simon, O. J., & Verschure, R. H. (1991). Tourmaline K? Ar ages compared to other radiometric dating systems in Alpine anatectic leucosomes and metamorphic rocks (Cyclades and southern Spain). Chemical Geology, 91(1), 33-48.
de Jong, K. (2003). Very fast exhumation of high-pressure metamorphic rocks with excess 40Ar and inherited 87Sr, Betic Cordilleras, southern Spain. Lithos, 70(3-4), 91-110.
Sánchez-Vizcaíno, V. L., Rubatto, D., Gómez-Pugnaire, M. T., Trommsdorff, V., & Müntener, O. (2001). Middle Miocene high-pressure metamorphism and fast exhumation of the Nevado-Filábride Complex, SE Spain. Terra Nova, 13(5), 327-332.
Platt, J. P., Anczkiewicz, R., Soto, J. I., Kelley, S. P., & Thirlwall, M. (2006). Early Miocene continental subduction and rapid exhumation in the western Mediterranean. Geology, 34(11), 981-984.

Thanks for pointing this. Those young ages for HP metamorphism imply a two stage subduction and exhumation/cooling events. It is true that the development of domes of NFC might have occurred just after the peak HP metamorphic event. Here we suggest that strike-slip faulting and transtension might be the main process of exhumation of these NFC HP rocks before the Tortonian. This event might be distinct from the ductile extension that has occurred for several authors during the Burdigalian. It must be envisaged that both ductile extension, HP subduction and exhumation to the surface occurred during the same oblique oblique extensional event associated with slab retreat to the north and west. This would certainly require more data to be fully assessed. We have tried to made improvement of the section to account for this complexity.

Line 371: Notice that NW-SE directed normal faults produce SW-NE directed faulting.

Modified

Line 607: Langhian Serravallian is 15.9-11.3. There is no evidence of NF ductile rocks exhumation in this period. Metamorphic domes where exhuming more shallower levels of the thrust stack. For example, the Alpujarride in Sierra de las Estancias (Platt et al., 2005) with apatite FT between 17 and 16 Ma. Sierra Alhamilla 17-10 Ma.

Here we disagree. Low-T ages must be modeled before inferring a cooling phase. Where this has been done in the NF in our region (e.g. Vázquez et al., 2011) it can be demonstrated that NF exhumed to crustal levels starting at ca. 13 Ma.

“slab steepening”: ??? Slab steepening would inhibit arc magmatism that continued well through the Tortonian and Messinian, no? (Duggen et al., 2008).
Duggen, S., Hoernle, K., Klügel, A., Geldmacher, J., Thirlwall, M., Hauff, F., ... & Oates, N. (2008). Geochemical zonation of the Miocene Alborán Basin volcanism (westernmost Mediterranean): geodynamic implications. Contributions to Mineralogy and Petrology, 156, 577-593.

In our view slab steepening induced lithospheric mantle melting below Alboran that can produce Ca-K magma dated from 13 to 10 Ma in the EAB see e.g. Conticelli et al. (2009) who linked to Ca-K volcanism with high-K Ca-K, shoshonites and lamproites.

Line 612: “mantle slab detached with no further westward slab retreat”: What do you mean with this, instantaneous slab detachment at 8 Ma? According to García-Castellanos and Villaseñor this process took from 7.8 under the Lorca basin to 5.3 at the straits of Gibraltar. Other works suggest an older slab tearing process between approx. 10 Ma to Present, along a distance of approximately 400 km (Mancila et al., 2015). Recent work by Moragues et al., 2021 suggest slab tearing initiated under the Balearic promontory in the Serravallian (approx. 14 Ma).

We do not provide new data on the age of slab detachment and as such we don’t want to have a discussion of the models proposed. We rephrase the sentence to focus on the possible time interval for the onset of slab detachment in the eastern Betics.

Line 615: Do you mean there is no active extension in the Betics at Present, and since 8 Ma? Please check references on this matter.
We modified these sentences, reorganisation and removed one reference.

Further, grammatical errors are marked in the PDF file.

In the pdf file we didn’t the marked grammatical errors only one comment already listed the body of the report.

Best wishes,

Guillermo Booth Rea