The manuscript "Seismo-tectonics of Greater Iberia: An updated review" provides a comprehensive analysis of the seismo-tectonic characteristics and stress regimes in the Iberian Peninsula, based on an extensive compilation of 542 moment tensor focal mechanisms. The study employs various methodologies, including focal mechanism classification, stress inversion techniques, and Slip Model analyses to assess contemporary tectonic deformations and stress distributions. In conclusion, this updated review enhances knowledge about seismo-tectonics in Iberia by providing detailed insights into active stress regimes and their implications for seismic risk assessment in this geologically complex region.

This is an up to date seismic contribution to stress distribution in the Iberian peninsula and worth to be published.

I have annotated the manuscript by pen, hopefully the author can decipher my hand writing. Of course, there are some flaws, typos and use of "poor" english. Interestingly the quality varies during the manuscript, seems like different chapter have been writing by individual authors, and nor "stream-lining" has been carried out. This is a pity! As the quality of data and illustrations are excellent and clear.

Dear Dr. Reicherter,

We greatly appreciate your valuable review and your kind words. Your suggestions have improved significantly the quality of the original manuscript. We have implemented your comments in the original document.

Please, find below our responses in red

Best regards,

Antonio Olaiz

Some more general comments:

"Greater Iberia" - is not existing. It´s short Iberia or Iberian Peninsula. Avoid that term. Iberia has 4 nations since more than 300 years, and nobody refers to Spain as "Smaller Iberia".

Rock units are upper and lower, time (ages) is Early and Late. Correct this throughout the ms.

Sorry, but according to the international chronostratigraphic chart, the correct terms for age are lower, middle, and upper. (www.stratigraphy.org)

The introduction and objective chapter (1) needs to be re-written in terms of plate tectonics the review and status are sometimes not correct. Partly Iberia is considered as an individual plate (line 38), sometimes African Plate is Nubian Plate and v.v. It should be consistent. Done (yellow labelled). If I wrote "ref" a reference is missing. The introduction needs a clear separation of plate tectonics and stresses induced by different sources.

Done. The new Introduction separates Iberian Peninsula from the Iberian microplate and plate-related stresses from those with a more local origin:

1 Introduction and objectives

The Iberian Peninsula, and the former Iberian microplate, shows evidence of an intense and distributed Alpine deformation that occurred over geologic time scales (de Vicente and Vegas, 2009) (Fig. 1). After the Variscan orogeny, and during the Mesozoic, numerous extensional structures developed, in which thick sedimentary deposits accumulated, with one exception, on the Iberian Massif to the west. At the northern edge of the Iberian microplate, this extension even reached the stage of oceanic crust generation (Montadert et al., 1971; Nirrengarten et al., 2018; Sibuet et al., 2004), albeit during a very short time (Aptian-Albian) (Srivastava et al., 1990). According to tectonic reconstructions, the Iberian microplate moved independently relative to Africa and Eurasia until it collided with Eurasia to form the Cantabrian-Pyrenean Orogen. From the beginning of the Eocene, the Iberian microplate underwent significant compression, not only at its northern border, where an incipient subduction zone was located (Gallastegui and Pulgar, 2002; Fernandez-Viejo et al., 2012), but also in its interior.

The result of Alpine compression in the interior of the Iberian microplate was the inversion of the Mesozoic aulacogen of the Iberian Basin (Iberian Chain, IC), and the development of a series of ranges characterized by crustal thickening along the Iberian Massif, including the Spanish-Portuguese Central System (SPCS). This set of intra-plate ranges can also be considered as an incipient and aborted orogen (de Vicente et al., 2022). It has also been suggested that the Iberian microplate accommodated shortening by forming lithospheric folds (Cloetingh et al., 2002). Accompanying these large thrusts, major strike-slip faults and deformation belts were activated at the crustal scale, such as the South ("Castilian") and North ("Aragonese") Branches of the IC, and the Messejana-Plasencia fault (more than 500 km long), which nucleated on an end-Triassic basic dyke related to the Central Atlantic Magmatic Province (Cebriá et al., 2003; Villamor, 2002; de Vicente et al., 2021). The age of the main deformation event for these fault systems is Oligocene to Lower Miocene. However, in the

westernmost sector, the SPCS and the left-lateral strike-slip faults of Regua and Vilariça display significant deformation during the Middle to Upper Miocene. They are still considered active structures (Cabral, 2012).

Today, extensional structures dominate the easternmost part of the Iberian Peninsula, dating back to the Upper Miocene, due to back-arc extension related to a subduction zone located below Corsica and Sardinia, which were initially part of the Iberian microplate (van Hinsbergen et al., 2014). A very recent normal faulting stress regime, unrelated to plate tectonics, also affects the Pyrenees, where a post-orogenic collapse process has been suggested (Asensio et al., 2012). Thus, the active plate boundary would have migrated from the north, when Iberia was an independent microplate, to the south of the Iberian Peninsula (Terceira Ridge - Gloria Fault – Alboran - Tell Atlas), when Iberia became a part of the Eurasian Plate, where the emplacement of the Alboran Domain and the subduction of the southern edge of the Iberian Peninsula, have produced a diffuse plate boundary that encompasses the Betics, where shortenings and extensions occur almost simultaneously. In the complex deformation setting of the Cenozoic and neotectonic periods, it is not surprising that the present tectonic stresses in the Iberian Peninsula exhibit significant variations in both the stress regime and the orientation of the principal stress axes (de Vicente et al., 2008) over relatively small areas.

The estimation of earthquake focal mechanisms in recent years, performed by seismic institutions in Spain and Portugal (IGN, IAG and IPMA), has generated a large amount of information that adds to scientific publications resulting from different projects, such as TopoIberia (e.g. Matos et al., 2018; Martín et al., 2015), or significant earthquake crisis (e.g. Cesca et al., 2021; Villaseñor et al., 2020).

In this study, we will exclusively use well-fitted moment tensor focal mechanisms to study the contemporary deformation pattern in the Iberian Peninsula. We analyse the rupture characteristics of focal mechanisms populations for defined tectonic subareas and use the Slip Model described by Reches (1983) and de Vicente (1988) to assess which of the two nodal planes was the rupture plane. This information, along with the focal mechanism populations, is then used to perform a stress inversion to determine the orientation of the maximum horizontal stress (SHmax) and the tectonic stress regime. We also derive the SHmax orientation from the individual focal mechanism and integrate these results with those from the stress inversion into a revised dataset for the World Stress Map project, based on borehole logs, overcoring measurements, and geological stress indicators.

References

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migrated seismic sections and geodynamical implications. Journal of Geology, vol. 120, n.º 3, pp. 315-31, https://doi.org/10.1086/664789., 2012

Martín, R., Stich, D., Morales, J and Mancilla F.: Moment tensor solutions for the Iberain-Maghreb region during the IberArray deployment (2009-2013). Tectonophysics, 663, 261-274, [Dataset] https://doi.org/10.1016/j.tecto.2015.08.012, 2015.

Montadert, L., B. Damotte, J. P. Fail, J. R. Delteil, and P. Valéry, Structure géologique de la plaine abyssale du Golfe de Gascogne, in Histoire Structurale du Golfe de Gascogne, edited by J. Debysier, X. Le Pichon, and M. Montadert, VI.14.1-VI.14.42, Technip, París, 1971.

Nirrengarten, M., Manatschal, G., Tugend, J., Kusznir, N. and Sauter, D. Kinematic Evolution of the Southern North Atlantic: Implications for the Formation of Hyperextended Rift Systems. Tectonics, https://doi.org/10.1002/2017TC004495., 2018

Sibuet, J. C., Srivastava, S. P. and Spakman, W. Pyrenean orogeny and plate kinematics. J. Geophys. Res. 109:B08104, doi:10.1029/2003JV002514., 2004

Srivastava, S. P., Roest, W. R., Kovacs, L. C., Oakey, G., Levesque, S., Verhoef, J. and Macnab, R. Motion of Iberia since the Late Jurassic: Results from detailed aeromagnetic measurements in the Newfoundland Basin, Tectonophysics, 184, 229 – 260, https://doi.org/10.1016/0040-1951(90)90442-B 1990

Line 39: compression in Iberia started as early as Late Cretaceous (there is an old paper by - sorry by myself- Reicherter and Pletsch, 2000, Terra Nova, already discussing this)

Ok. We have added:

A pronounced change in the tectonic framework has been suggested to have occurred around 84 Ma, when an incipient collision between the Iberian microplate and Africa may have begun (Reicherter and Pletsch, 2000).

Reicherter, K.R. and Pletsch, T.K. Evidence for a synchronous Circum-Iberian subsidence event and its relation to the African-Iberian plate convergence in the Late Cretaceous. Terra Nova 12, 141-147, https://doi.org/10.1046/j.1365-3121.2000.123276.x 2002

Line 61: seismic institutions? Better Seismic Obsersatories or Geophysical Institutes...

Done, we changed to Geophysical Institutes

Line 69: SHmax should be written consistently in the ms.

Done. We changed to S_{hmax}

Fig.1. Some structures are missing, Gafarillos Fault? Palomares Fault is cutting the Carboneras (better: the Carboneras Fault is ending at the Palomares). Why difference between Post-Orogenic and Late Miocene extension? It is basically in the Betics identical?

We have added the names of the cited faults in the manuscript according to Reviewer 1

Post-orogenic extension is related to the Pyrenees, whereas Late Miocene extension is due to different causes, discussed in the text

Line 99: 30 km focal depth means in the oceanic realm --> it is in the mantle lithosphere?

Yes. It is written: The events are shallower than the Moho proposed by Diaz et al. (2016), except for some events located in oceanic crust (depth < 30 km), where the rheology of the upper mantle may be assumed to be similar to that of the crust.

Line 116: please sort like the description before...

Done. We have changed to: Conversely, when we deal with stresses, we use thrusting stress regime, strike-slip stress regime, and normal faulting stress regime.

Figure 3: what about the gaps, in Mallorca or central Spain.

We have implemented a search radius of 150 km, which may determine lacks in the final interpolation.

We have included “Search radius 150 km” in the figure caption.

4 Tectonic zonation chapter: this can be organized better, some descriptions are missing

We have reviewed the text and including Granada Basin that was missing.

Table 4 and 5: descriptions are varying? Why?

Tables 4 and 5 summarize the results of different approaches. We have homogenized including Betics > 20 km

Popultaion Betics >20 km was missing in the Supplementary material. Now is included.

Line 394: In 5.5 El Camp Fault was already mentioned in 5.3? Reduce redudancy.

The Camp fault can be considered as belonging to both the western Valencia trough and the northern Catalan coastal range. Moreover, it has the importance of having been one of the first faults studied with palaeoseismological methods in Iberia. We believe that it is not redundant to mention it in both cases.

Line 420: sentence incomplete

Completed

Line 484 and others: N070°E-N090°E is rather bulky, why not N070-090°E much simpler and easy, and please consistent throughout the manuscript.

Done

Line 499: I find the SVT here a bit displaced in your listing? It does not fit here.

We have listed the areas roughly from N to S, so SVT is explained here.

Line 589: confusion 5.14 was already called WAA? Should be Granada Basin?

It is true. Corrected

Chapter 5.15: I was wondering if the authors ignore geological work done? My own (sorry again, but this was the reason I reviewed the ms) work from 2005 (Reicherter and Peters Tectonophysics) already describes radial extension and a recent stress field including active faults. What about the Arenas de Rey earthquake 1884? This paragraph can be improved significantly. The intrabasinal deformation is compared with the margins of the GB different. Also the Jabaloy et al paper has not been considered. I know the paper are "old" but according to your new data, they already mentioned several facts.

We have added: extensional basin within the orogen, which is dominated by the presence of NW-SE normal faults related to radial extension (Reicherter and Peters, 2005).

Reicherter, K.R. and Peters, G. Neotectonic evolution of the Central Betic Cordilleras (Southern Spain). Tectonophysics 405,191-212. https://doi.org/10.1016/j.tecto.2005.05.022, 2005

Line 739: remnant effect of the slab? This should be expleaind better and reference is missing? Is this really mechanically possible? Why 20 km depth? The earthquakes there (Malaga region) are usually much deeper? Is there mid-crustal detachment?

It is written: likely influenced by the remnant effect of the slab (Gea et al., 2023). In this paper, the remnant effect of the slab is explained.

the 20 km division is for comparison with the results of Ruiz-Constán et al. (2012)

Line 832: "As it can been seen in Fig....." this is really poor English, and degrades the quality of the manuscript. This refers to the entire chapter 7 Discussion, please consider a re-writing, as the quality does not meet international standards.

Rewritten: As shown in Fig. Discussion. All the text has been reviewed.

Line 966 It should be chapter 8 Conclusions, not 7...

Sorry, yes.

Fig. 15 - this is not an Alpine tectonic map of Iberia.... It is a map of recent stress in Iberia, please change text (Line 945) accordingly.

Done

I didn´t check the references for completeness, this is editors work. Supplementary maps are very nice, but directly outline the problems: where there is no earthquake .... and especially for the GB I have major doubts, as marginal faults do not appear as seismically active.

I hope this review helps improving the manuscript, if you cannot decipher my hand-writing in the ms, let me know. Good luck.

Aachen, 25/3/2025 Prof. Klaus Reicherter