

## **Offshore seismicity clusters in the West Iberian Margin illustrated by two decades of events.**

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### **Comments:**

L45-47: If the "W-E thrusts" refers to the Gorringe Bank, change it to "NE-SW thrusts"

L59: The Africa-Europe plate boundary continues east of the Strait of Gibraltar. I suggest to rephrase the expression

L62: Add space "theWIM"

L62: what is the "WIM abyssal plain"? If it exists, locate it in figure 1.

L63: Add "." after "("

L70: Ramos et al., 2016 focused on the Algarve basin, southern Portugal... nothing related to structural domains along the WIM.

L78-80: Sallarès et al., 2013 and Martínez-loriente et al., 2014 presented geophysical evidence suggesting that the Gorringe Bank and the neighbouring abyssal plains are composed mainly of exhumed mantle rocks and presented a new model for the opening of the North Atlantic. I suggest including these references.

L87-114: I highly recommend adding a map with the domains referenced in this section, and the delimitation of the different segments of the WIM. It is very difficult to follow the (messy) description of the authors. Therefore, I also suggest rewriting the section.

L90-92 & Fig 2: "The OCT extends between 12°10'W and 12°30'W in the IAP (Whitsmarsh et al., 1990) and it would extend N°10 for 130 km until Extremadura Spur (...)" It is very difficult to correctly locate the COT with the map coordinates. I highly recommend adding more subdivisions between coordinates. How can readers locate longitude 12°10'W if all the information they have is the location of longitudes 12°W and 16°W?

L91: 10°N, Sure?

L94: "The exhumed mantle domain has been drilled at a serpentinite ridge (Boillot et al., 1988b)" Where?

L95-98. Add reference

L100: DGM? It is not located on the map and the abbreviation is not described

L102: "The GB is 15-20 km thick"... and? Made of?...

L107: What is "THD" y "dZ"? where are these maps?

L111-114: Let's see, if the WIM is divided into 3 segments, and the authors say that there is a segment further south than what they call "South WIM", wouldn't it be more logical to call it Central WIM or something similar?

L116-120: when? it should be specified to which period the authors refer

L135-136: when? At present? At the beginning? Has it been constant over time?

L138-142: I suggest the authors include some arrows in figure 1 that indicate the kinematics along the plate boundary.

L142: Again, Ramos et al. only investigate a small portion of the SW Iberian Margin, the Algarve basin south of Portugal. There are many other works that propose the reactivation of thrusts throughout SW Iberia at a regional level, such as Martinez-Loriente et al. 2013 (but there are many others). Ramos's work is very local and their conclusions quite debatable.

L144: The Gloria Fault is the source of one of the largest earthquakes occurred in the North Atlantic, 1941 Mw 8.3-8.4 (e.g., Baptista et al., 2016)

L146-152: In this section the authors mix nanostrain/yr and mm/yr... for non-experts, it is difficult to compare the different geodetic velocities.

L179: Why have you included historical seismicity but not the instrumental seismicity available prior to 2003? What's the point of including the first and ignoring the second? I would like to know what these 10 historical earthquakes are, and if there is any relevant aspect, that it be recorded in the figures, text, in a table (somehow).

L182: "The 9 focal mechanisms considered in this work have been obtained from the CMT Catalogue". Figure 2 includes 14 focal mechanisms (not 9 as mentioned by the authors)

L185: "(ii) geological structures mapped in the continental platform (Somoza et al., 2021)". Why only those included in the continental shelf?

L195: "Further up towards the MAR, there is some isolated events.". Could this lack of seismicity be associated with the distance to the onshore stations?

L196: "The orientation of these bands is about N80°W". In my opinion, the southern alignment has a clear E-W orientation and it is related to the Estremadura Spur and the Tore Seamount (it is not located on figure 1).

L202: "This density band of events is oriented N75°W from the coast until 17.5°W". I disagree with the interpretation of this alignment. There is an E-W alignment from the coast until 12°N related to the Galicia Bank and a second cluster of seismicity to the northwest related to another ridge/relief (without name in Figure 1). Between both clusters of seismicity there is a gap of more than 100 km without seismicity, so there is no evidence to indicate a relationship between them.

L211: "The number of events is larger at the transition between hyperextended crust and exhumed mantle" As it is not indicated in figure 3, I do not know what the authors consider to be the hyperextended crust and the exhumed mantle domains. According to my consideration (which coincides with that of Granados et al., where the profiles come from), there is exactly 1 earthquake in this segment (Profile 1). Therefore, I think the authors' statement is wrong.

L211: "There is an arguably but noticeable 50 km wide gap in event distribution west of the Galicia Bank". Why this gap is "arguably"? In 150 km there are exactly 2 earthquakes.

L2014-2015: "especially within the transition between the hyperextended and exhumed mantle domains". Same as in the comment of Line 211.

L215-216: "A particular set of south-dipping earthquakes can be observed in profile 5". This is highly debatable. The seismicity could be vertically aligned, or even dip to the southwest but with a lower dip than that interpreted in figure 3 by the authors.

L218: "Some of the focal mechanism in this area...". There is a lot of distance between the few focal mechanisms shown in figure 2 and this seismicity. By the way, why are some focal

mechanisms represented in red and others in blue? It is not indicated in the legend or in the figure caption.

L219-221: As I mentioned before, I see this seismicity aligned E-W from the coast up to 14 or 15°N (? = it is difficult for me to be precise with the low coordinate discretization of figure 2)

228-230. In this case, I agree that there is an amount of seismicity in the transition between hyperextended crust and exhumed mantle, but I disagree with “a lack of them in the oceanic crust until the western termination...” the seismicity decreases, but there are 15 or 20 earthquakes.

L231: It would be interesting to know which segment of profile 5 of Figure 2 is represented in Figure 3, since it would allow to locate on the map these possible vertical seismicity alignments.

L234-235: “... the highest magnitude earthquakes in this area occur in the subcrustal mantle and below two seamounts...” What??? In profile 4 the seismicity is projected (100 km). If we look at the map (figure 2), these 2 earthquakes that the authors refer to are located far from these two seamounts or volcanic edifices.

235-236: “The referred vertical alignment would be consistent with a volcanic origin for those particular events.” Are the authors referring to the vertical alignment mentioned in the previous paragraph (231-233)? If so, it is difficult for me to understand the relationship that the authors see between this seismicity of the Estremadura spur that is seen in the southern part of profile 5 with these two earthquakes that are seen in profile 4 and that the authors say are related to two volcanic edifices (which actually aren't)?

L254-256: Geissler et al. 2010 already showed that in SW Iberia the majority of seismicity occurred between 40-60 km depth, and with strike-slip or inverse focal mechanism solutions. Bartolomé et al. (2012) associated the strike-slip seismicity with the Lineament North and Lineament South strike-slip faults. Martínez-Loriente et al. (2021) associated the deep inverse seismicity as well as the largest seismic events occurred in the region with the HAT.

L256: “?” Delete it

279: “Seismicity almost abruptly stops around the area of undisputed oceanic crust. Nonetheless, there is still a few events westward toward the MAR, and they follow the N80°W direction too.”. In the north, the seismicity stops just before the COB (around 12°W), more than 50 km before the oceanic crust. In the south, seismicity does not stop at any point and continues from one domain to another

L290: in figure 2 it does not include the AGFZ, so I cannot get a visual idea of what the distance is between it and the southern alignment.

L310: “GAP”? Describe the abbreviation

L343-346: There are a lot of scientific publications showing strike-slip faults with MCS data. I can include 10 or 15 references only in the SW of Iberia. I know that the authors have access to seismic profiles acquired in the WIM. If they don't see the strike-slip faults, could it be that these structures don't really exist?

L408: “NE-SW thrust systems extending 300 km along the WIM accommodate the arc-orthogonal convergence (Gutscher et al., 2012)”. What are these fault systems??? Specify them and add references. Gutscher et al., investigated the possible subduction under the Gibraltar Arc, nothing related to the WIM or any “thrust system” there.

L409: “and younger thrust faults are nucleating along the west Portuguese passive margin or in the Tagus Abyssal plain”. Which ones? Specify them and add references where the existence of

these structures can be verified. The work of Duarte et al. (2013) does not count as a reference since they only presented a theory without a single real data to support it.

L416-428: I am surprised that the authors do not consider the Gorringe Bank and/or the HAT as possible structures hosting this possible subduction initiation. It would be much easier to explain (and in fact has already been proposed) than is suggested here.

## **FIGURES**

### **Figure 2A**

- the legend does not fit the map - green and blue lines.
- P-2 is missing (or I don't see it); P-3 is indicated 2 times; P-1 is wrongly indicated according to Fig 3 and the text...
- I highly recommend adding more subdivisions between coordinates.
- I suggest to indicate in figure 2 the two segments of profile 5 shown in figure 3.

### **Figure 3**

- Figure caption: It is not clear to which profile they refer in each case. This occurs for two reasons: 1) wrong nomenclature in Figure 2 (mentioned above); 2) mixes two nomenclatures “profile” and “a, b, c...”, the latter not used in the figure 3.
- Figure caption: “Profile 1) Depth profile of seismicity along alignment North (Galicia) b) Profile along alignment south c)”. According to Figure 2, these profiles are located to the south of both alignments.
- A complete legend is missing. For example, it is not indicated what the dark brown corresponds to, the two blues of the oceanic crust, the small red and purple dots.
- I also recommend indicating the extension of each segment (hyperextended, exhumed mantle...) in each profile since much reference is made to it in the text.
- Profile 4: there are 2 earthquakes in the water.

### **L268 & Figure 4a:**

- If the Moho is the crust-mantle boundary and there is the ZECM (zone of Exhumed Continental Mantle) along the WIM, how can Figure 4 show the depth of the Moho in this zone if there is no Moho?

### **Figure 5c:**

- By what name are the N-S thrusts represented in the central part of the WIM and in the SWIM known? and the long marine strike-slip fault at the latitude of Lisbon?

Sincerely,

Sara Martínez Loriente

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