Response letter for EGUSPHERE-2025-1826 titled
"Seismicity and thermal structure of the St. Paul Transform System, equatorial Atlantic: Insights from focal depth analysis" by G. de Melo, I. Grevemeyer, S. Liu, M. Maia, and L. Rüpke.

Please find attached an improved and revised manuscript according to the suggestions of the two reviewers. We also prepared an annotated version of the manuscript showing all modifications (new text is underlined, deleted text canceled).

The reviewer comments are in ***italic font*** and our replies are in **normal font**.

Reviewer # Pavla Hrubcová

This study investigates the seismically active St. Paul Transform System on the equatorial Mid-Atlantic Ridge by relocating focal depths of 35 earthquakes (Mw 5.3-6.9) along three Transforms (A, B, and C) with the use of regional surface waveform modelling. Results show that the seismogenic zone extends from 5 to 18 km depth, with the deepest events occurring in cooler central parts of the strike-slip segments and shallower events near ridge-transform intersections. The study is generally well- structured and presents results that are of interest to the Solid Earth community. I appreciate that the authors support their interpretations with thermal modeling and compare their findings to other Atlantic transform faults. However, there are some issues that require clarification and revision before the manuscript is suitable for publication. I recommend moderate revisions as outlined below.

R: We are grateful to you, referee, for reviewing our manuscript and are grateful for appreciating that our study. All issues raised and indicated by you were replied to and solved.

Major points
The authors relocate 35 earthquakes using ISOLA through surface waveform modeling, which is not a standard approach for earthquake relocation. Could the authors clarify why they chose this method over more commonly used and less time-consuming techniques such as NonLinLoc or HypoDD? If ISOLA was used solely to refine event locations based on waveform fits without inverting for moment tensors, this should be clearly stated in the methodology and justified, as it differs from typical usage of the relocation codes.

R: Many thanks for your considerations and questions. We agree that other techniques such as NonLinLoc (Lomax et al 2000), Bayesloc (Myers et al 2007), or HYPOCENTER (Lienert et al 1986) are better techniques to earthquake location, while others like HypoDD (*Waldhauser 2001*) or COMPLOC (Lin and Shearer 2006) are to relative relocation. Epicentroid relative relocation of oceanic earthquakes also has been done using teleseismic surface wave cross correlation techniques (McGuire 2008; Cleveland et al 2018; Howe et al 2019). However, we did not do earthquake relocation in this manuscript. We focus in investigate the seismogenesis of the St. Paul transform system, and from that, we go deep in focal depth information using surface waveform modeling with the ISOLA. For obtain the focal depth, moment tensor inversion was applied yes, and we clarify that in first paragraph of the 4.1 chapter. More details about the inversion are explained in detail along following paragraphs.

The velocity model plays a key role in accurate depth determination. I recommend that the authors present the 1D velocity model used in the relocations, as it is critical for evaluating the reliability of the depth estimates.

R: Thanks for your suggestion. We have included the CRUST1.0 velocity model used in new Table S2.

In lines 148–158 and Fig. 2, the authors attempt to reduce lateral uncertainty by fixing one horizontal coordinate and adjusting the other. However, this approach raises concerns touching limitations of the approach and potentially introducing artificial constraints or bias into the solution. The relocation method appears primarily sensitive to depth rather than to lateral position. Without strong azimuthal coverage or near-source stations, the resolving power in latitude/longitude is limited. To more robustly assess and potentially reduce lateral uncertainty, the authors might consider synthetic resolution tests (e.g., checkerboard or spike tests) or keep the original lateral locations.

R: The events were moved because most of the original GCMT locations were outside the transform fault. This differs from the epicenter locations of networks such as GFZ, NEIC, or ISC, which should already be closer to the original on the Atlantic transform fault than the GCMT location. This was demonstrated in the location of the 2016 Mw 7.1 Romanche earthquake (Hicks et al. 2020). Therefore, we decided to move the epicenters to the transform fault, following the multibeam and transform fault mapping done by Maia et al. (2016). We did not move the longitude, only the latitude. To improve the understanding of our change, we included bathymetry in the updated Figure 2. We are unable to use testing methods such as checkerboard or spike, since we are not performing seismic tomography.

Additionally, the quality and resolution of Figures 1 and 8 should be improved.

R: Thanks for your suggestions. We have been improved both two figures.

Further points

l. 16 – catalog with 5.33Mw36.9 occurring -> correct it

R: Thanks for information. It was a formatting error, and the correction is done.

l. 43 – with both strike-slip faulting -> also normal? Not mentioned. It should be both … and …

R: No. The normal faulting events occur at the mid-ocean ridges, no at the transform segments as informed in text. We removed the “both” terms. Thanks for observation.

l. 44 – thrust faulting earthquakes -> I do not see any thrust faulting earthquakes in fig. 1, are they part of the interpreted dataset?

R: We show in figures only earthquakes of the GCMT catalog since 1990, as described on caption of the Figure 1. The thrust faulting earthquakes occurred in 1980s, and they are detailed in reference indicated at the same phrase or GCMT catalog.

l. 74 – prominent topographic feature along transform A is the Atobá Ridge -> Not seen in Fig. 1, put it along with other geographical names (like Saint Peter and Saint Paul Archipelago) in Fig. 1

R: We included the name of the island on new Figure 01 and the Figure S01-S03.

l. 101 – Seismotectonic of the St. Paul Transform System -> Seismotectonics of the St. Paul Transform System

R: Correction applied.

l. 117 – Data acquisition -> better to use only Data (no field acquisition was done) or event combine two sections together into "Data and Methodology" since data from stations are discussed in following section 1

R: Thanks for suggestion. We changed the section name to just "Data".

l. 120 – Include number of stations for each network

R: We prefer to keep the same, the network affiliations of each station is already provided on TableS1!

l. 118 – (MW)>5.3 -> MW >5.3 and be consistent throughout the ms
R: The correct is M_W and we already have applied the change in all manuscript.

l. 139 – on Isola -> in Isola

R: Done. Thanks.

l. 147 – across a grid e of sources -> within/across a source grid

R: Correction applied.

l. 157 – values below 5 indicate -> where values <5 indicate

R: Correction applied.

l. 162 – in Figure 3-5 -> in Figures 3-5

R: Thanks for correction.

l. 178-179 – use italic for description of variables x, z

R: Thanks for your suggestion.

l. 232 – (Shi et al 2021). However, the author did -> (Shi et al 2021). However, these authors did

R: We applied a change along the whole phrase to a better understanding for the reader.

l. 232 – they did not consider the transform segmentation along the transform fault system neither -> they consider neither … nor …

R: We applied a change along the whole phrase to a better understanding for the reader.

l. 247 – The focal depth distribution along the transform faults -> indicate that all this concerns transform faults along the Mid-Atlantic rift zone (either in the title of the section or with the individual transform faults)

R: We included the name of the respective transform faults referred.

l. 269 – 10 kilometers -> 10 km

R: Changing applied. Thanks.

l. 282 – with maximum depth until the 600°C isotherm -> with maximum depth related to 600°C isotherm

R: We applied the correction. Thanks.

l. 308 – Ocean-Bottom seismometer -> OBS seismometer or ocean-bottom seismometer

R: Correction applied.

l. 336 – include Mid-Atlantic rift zone

R: We think better keep the current, since that we do use the term "rift zone" commonly to oceanic transform fault.

l. 339 – 3-Compared with the thermal model, -> 3. According to thermal model,

R: Done.

l. 882 – (see Figure XX) -> which Figure?

R: The correct figure mentioned if the Figure S01. Thanks for identify the error.

Fig. 1 – needs improvement for clarity and readability. The overall size should be increased to allow visibility of details. This is the main figure for the reader, thus it needs more information to introduce the problem. The spreading rates (arrows) in individual segments would help to find out more about the tectonic setting; together, include motion along the transform zones.
I would also suggest excluding the ray path coverage in this figure since it blurs the setting. This can included in some further figure or in SI
(a) – The station names in (a) are illegible.
(b) – Also, this subfigure would benefit from enlarging.
The transform faults and rift zones should be clearly marked, and the beach ball symbols enlarged to distinguish them from white dots (presumably earthquakes without focal mechanisms).
The red and black focal mechanisms are difficult to differentiate; they should be displayed with more distinct contrast, maybe size.

R: Thanks for your rich suggestion. We have created a new figure 01 including a first subplot a) showing the geographical location, b) showing the regional area with the name of the transforms, seismic stations presented in black triangles, and without the ray paths. The ray paths coverage and data histogram area now in Figure S04. The new c) shows the bathymetry of the St. Paul system and the events.

Fig. 2 – include description of segments and geographical/geological features Fig. 7 – maybe include the earthquakes locations?

R: We included the bathymetry in gray to better description of the epicenter location change applied. Thanks for suggestion.

Fig. 8 – indicate (a) and (b) rather than upper and lower
Labels of age are too small to read
I do not see black dashed lines in upper panel
There seem to be different earthquakes compared to Fig. 1 (e.g. I do not see any reverse in Fig. 1). Why do they differ? Explain, how they relate to Fig. 1 and include them there

R: We do not include the black dashed age lines too big because the labels is already highlighting the age. At the same time, there is the age map shown on Figure S1. We increased the font size of the labels to improve the view. As described in text, the different earthquakes presented in gray color are the events analyzed by Wolfe et al 1993. In addition, we included the same earthquakes in new Figure 1.

Figs S01-S03 – include description of segments and geographical/geological features

R: Thanks for suggestion. Labels of the Transform A, B, C, and the St. Peter and St. Paul islets were included in both figures. Also, we included a globe showing the geographical location.

Table S02 – correct the timing and make it consistent for all events (exclude PM and dop.)

R: Correction in time applied.

I hope my suggestions help to improve the ms. Pavla Hrubcova
Prague 07/2025

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