Dear Editor,

We thank you, and the reviewer, for your comments on our manuscript. We detail below our responses to the reviewers comments (in blue, bold text). I would particularly like to thank the reviewer for their assistance with the Spanish version of the abstract, and for providing what I assume is a more local perspective on the selection of names for Guatemalan earthquakes – this is really helpful.

Your sincerely,

Tim Craig

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This work focuses on two earthquakes that occurred in the deepest region instrumentally observed in the subduction of the Cocos Plate under the Caribbean Plate in Guatemalan territory: the Mw 6.4 earthquake of 2023 and another one that occurred in 1997 with Mw 5.5.

The source parameters are analyzed using an inversion technique that estimates a probabilistic moment tensor, assuming a source of double-couple pure. While the estimated parameters are equivalent to those estimated by other seismological agencies, the information is enriched by the use of radial and transverse components of seismic records at teleseismic distances. On the other hand, the exceptional depth of the earthquakes and the conditions for the nucleation of these events require an explanation that is not entirely understood at present, but is addressed clearly and consistently by the authors (the technique for obtaining Figure 4 is particularly noteworthy), representing a significant advance in understanding the processes involved in the generation of these earthquakes in the studied region.

I consider the publication of this work very appropriate, but I propose some minor suggestions that I believe will enrich the manuscript.

**Comments:**

**Title, line 4:** Zacualpa is a small community; using this name for the 2023 Mw 6.4 earthquake could suggest a shallow earthquake with local effects, like others in the area (e.g., the Uspantán Earthquake). Additionally, the location with many local and regional stations places the epicenter slightly to the west, outside of Zacualpa. As this earthquake was felt throughout the Republic of Guatemala, I suggest identifying it as the Quiché, Guatemala earthquake, and changing the name throughout the manuscript.

**We thank the reviewer for their insights on this, and have followed their suggestion of the name of Quiché.**

**Line 14:** Similar to Zacualpa, Santa Catarina Mita may not be the best way to identify this earthquake. It could be called the Jutiapa (the name of the department) earthquake.

**As with the previous suggestion, we thank the review for their suggestion, and have adopted this accordingly.**

**Lines 27 and 28:** Change "con mecanismos consistentes con la extensión hacia abajo" to "con consistentes mecanismos de extensión hacia abajo."

**Changed as suggested.**

**Line 30:** Change "pequena seccion de la placa que va hacia abajo" to "pequeña sección de la placa descendente."

**Changed as suggested.**

**Line 31:** Change "fragil" to "frágil."

**Changed as suggested.**

**Line 34:** While seismicity is prolific, it is scattered in some regions within the Cocos Plate (see Xue, et al., 2023; https://doi.org/10.1130/G51403.1).

***We add "(although unevenly distributed)". The line now reads: "The oceanic Cocos plate subducts beneath Central America along the Middle America Trench, giving rise to both widespread seismicity on the subduction megathrust and to prolific (although unevenly distriubted) seismicity within the Cocos slab as it descends into the upper mantle"***

**Line 35:** Add references for this assertion (e.g., Guzman-speziale and Zuñiga, 2016; http://dx.doi.org/10.1016/j.jsames.2015.10.002).

***This statement is already support on the following sentence, where we discuss a number of the largest and most damaging examples of such earthquakes, complete with references to the the relevant studies.***

**Lines 50 to 54:** Could you add bibliographic references for this?

***We add example references to Manea at al., 2006 and Bailey et al., 2012. Other related references are provided in the next sentence.***

**Line 59:** Was this preliminary depth obtained from a specific agency?

***We add "(as reported by the NEIC; please see Table 1)" for clarity.***

**Line 67:** In both cases, the earthquakes are away from the edge of the subducting slab according to the Slab2 model. In fact, the epicenters are between depth contour lines of 160 and 180 km, while both earthquakes are almost 100 km deeper than those levels. On the other hand, some models suggest that the slab in the region reaches greater depth, although it does not generate earthquakes (e.g., Zhu, et al. 2020; https://doi.org/10.1038/s41467-020-15492-6, Xue, et al., 2023; https://doi.org/10.1130/G51403.1).

***The reviewer touches on two points here:***

- ***First, that the earthquakes considered here are substantially deeper than the depth of slab2 at the same latitude/longitude. This is a result of the steep deep of the slab at this stage, as demonstrated on Figure 5c, meaning the closest point on the slab surface is actually to the northeast of the earthquake epicentre, but at only slightly shallower depths.***
- ***Second, there is the question of the slab reaching to "greater depths". The two papers the review mentioned propose that the slab is "fragmentary", and subject to through-going mantle flow. This view contrasts with the previous views of Rogers et al., 2002, who suggested a "slab window" below ~250 km at beneath southern Central America. We have added to both the introduction and "Dynamics of the Central American Slab" sections to clarify this. In either case, we make the case that the slab below about 250-300 km depth is unlikely to be capable to transmitting significant stress, although we note the potential for future refinements in slab imagine beneath Central America to change this Interpretation.***

**Line 86:** How is this improvement verified?

***The inclusion pf pS results is a slight narrow of the PDF's for the mechanism orientation parameters.***

**Line 93:** There is a good local network now (see Yani-Quiyuch, et al. 2023), but no detailed studies have been conducted yet.

***Yes – the Yani-Quiyuch study nicely demonstrated the capabilities of the modern local network, and we will be interested to see what can learnt from the local data in the future.***

**Line 102:** Another reason not to define the epicenter in Zacualpa.

***Following the reviewers suggestion, we have altered the name to be Quiché.***

**Line 103:** This could be a subsection of Section 2.

*For simplicity, we follow the reviewers suggestion, and remove the separation between sections here, merging Section 3 into Section 2.*

**Line 110:** To avoid relying on visual inspection, are there any parameters obtained from cross-correlation of measured and synthetic seismograms to quantify this?

*The point here was more to direct the readers to the figures, and point out the clean-ness of the waveforms. A more quantitative mechanism of demonstrating that no non-DC component is needed is already implicit in the inversion results under discussion here, and we do not add an additional metric. We add "which shows clear, relatively noise-free phase arrivals".*

**Line 115:** By global seismological agencies, with seismic source information.

*We add "using global seismic data".*

**Line 147:** The area of 100 square kilometers seems low. Did you use any specific empirical relationship?

*All available empirical relationships are derived from shallow, crustal faults, and are perhaps not completely applicable to intermediate-depth earthquakes like Quiché. We use 100 quare km as a generall ball-park figure, and have altered the manuscript to make clear that this is very approximate. The manuscript now reads "on the order of ~100 km$^2$".*

**Lines 170 to 173:** At these depths, do dehydration processes of the slab on faults predisposed to reactivate become relevant?

*Quite possibly, they do. We add a mention of this to the manuscript, which now reads: "…suggests that a similar interplay of stress field and relict structure continues to control the orientation of faulting throughout the slab, potentially modulated by the availability of a brittle rheology dependent on localised hydration along pre-existing structure".*

**Figure 1a:** Include a box locating Central America relative to a continental map.

*We thank the reviewer for this suggestion, and have added an inset location map.*

**Figures 1 and 4:** Indicating the direction of North would be helpful.

*Following the addition of a regional location map, we don't feel that a north arrow is required on Figure 1. We follow the reviewers suggestion, and add a north-indicator to Figure 4.*