Comments on "Distributed right-lateral strain at the northern boundary of the Quito-Latacunga microblock" by Harrichhausen et al (egusphere-2025-4329)

The manuscript presents new geomorphological mapping, remote sensing, and dating results (radiocarbon and cosmogenic exposure ages) to investigate active faulting north of the Quito-Latacunga block (Northern Andes), offering valuable data that improves understanding of regional seismic hazard in a populated area. The authors provide neotectonic investigations and slip rate estimates for two faults, and they compellingly suggest that volcanic inflation from the Chiles-Cerro Negro volcanic complex may contribute to neotectonic activity by studying a recent 2023 earthquake. However, the study currently falls short of delivering a comprehensive analysis of the entire regional fault system, and several key morphotectonic features lack sufficient clarity or documentation to fully support the authors' regional assertions, ultimately restricting the scope and robustness of their final proposals. Please refer to my detailed comments below.

I recommend that the article undergo major revisions prior to publication.

General comments

1. Introduction: this section is well-structured. The only thing missing is more detail in the second paragraph (the state of the art). Please include more about the Neotectonics work done in Southern Colombia/Northern Ecuador over the last 20 years. (You already mention these papers later in the Tectonic Setting and the Discussion sections).
2. Tectonic Setting: My suggestion here is to make the material more accessible and easier to digest for the reader that is not familiar with the study area by using subsections to clearly delineate the topics covered (tectonic framework, GNSS, InSAR, instrumental and historical seismicity). For example, the recurring mention of historical seismicity in several paragraphs is redundant and should be streamlined.
3. Geologic Setting: The last two paragraphs discussing volcanic and glacial activity are too long and should be simplified and made more concise.
   Importantly, the manuscript omits discussion of the Romeral Shear Zone (RSZ) (or Romeral Fault System). This system is considered a reactivated suture zone with an origin distinct from the Cayambe-Afiladores-Sibundoy fault system. Since the RSZ is active in the study area through structures like the Buesaco and Aranda Faults. The authors should be clearer about this system and its neotectonics implications throughout the paper.
4. Methods: As with the Tectonic Setting section, I would recommend the authors split this section into subsections given the numerous techniques they used. Also, more details about cosmogenic dating should be provided (See comments below).
5. Results: The structure of this section is generally good, but the following points require revision:
   a. I have difficulty identifying the claimed offset moraines or channels based on the DTM and external imagery. Please provide more detailed information on the topography analysis to validate these estimates.
   b. To reflect the dating of multiple structures, move the Dating subsection outside of the Reservoir Fault section.
   c. Include additional details on the Polylepis Fault and the surrounding lineaments, as these features are important for future structural interpretations and neotectonic works.

6. Discussion: This section lacks an analysis of all the different fault systems present in northern Ecuador and southern Colombia. For example, some of the conclusions about the role of the reactivated suture zones (like the Romeral Fault System) are simplified by citing a paper that describe the tectonics of southern Ecuador, far from the study area.
    a. The authors propose volcanic inflation as a potential conditioning factor (or triggering mechanism) for the occurrence of the July 2022 earthquake. Nevertheless, no further explanation is provided. A schematic figure would be of great help to strengthen your hypothesis.

Detailed comments line by line

Line 15. The right name is Chiles-Cerro Negro volcanic system (there is two volcanoes in this system: Chiles and Cerro Negro). Please revise the manuscript to ensure consistent usage of Chiles-Cerro Negro Volcanic System (or CCN-VS if you prefer) throughout. For example, in line 153 you refer to it as the Cerro Negro-Chiles Volcano while in line 157 is called the Chiles-Cerro Negro volcanic complex.

Line 28. Remove “it” after “…whether deformation…”

Line 34. Can you be more specific on these boundaries?

Line 40. Please make sure the epicenter of the July 25, 2022, earthquake is added to Figure 1. This location is crucial as it highlights part of the motivation for the study and represents the source area for the InSAR analysis you present.

Line 60 ("These studies highlight...") feels out of place or disconnected from the preceding text. You attempt to emphasize your motivation, but you should use a better transition or connector at the start of the sentence to improve the logical flow of the paragraph.

Lines 62-63 Please rephrase to be more concise.

Lines 79-80 The area between Ibarra (Ecuador) and Pasto (Colombia) has experienced several historic earthquakes. Please consult the historic seismicity project led by the Colombian Geological Survey (https://sish.sgc.gov.co/visor/). It would be useful to add these additional historic events to Figure 2.

Line 93. Why is it important or not to identify a sharp gradient in velocities? What would be the implications for the seismic hazard?

Line 121. Make sure Inter-Andean Valley is consistent throughout the paper (you used Interandean valley in line 6 or Inter Andean Valley in line 129)

Lines 128-132. You mentioned three oceanic plateaus but only two terranes: San Juan and Guaranda. Is there a terrane missing? Were not all of them accreted?

Lines 137-138. This tectonic interpretation may be valid for Ecuador, but the situation in southern Colombia is complicated by the active suture zones. These zones display extensive evidence (geomorphological, historical, and instrumental) of recent activity, resulting in complex interaction with the NE-SW structures. The Romeral Shear Zone (or Romeral Fault) is the best illustration of this complexity (see Ego et al., 1995; Paris et al., 2000; Vinasco, 2019; Garcia-Delgado et al., 2022). The Buesaco and Aranda faults that are mentioned in lines 77-78 for the first time are part of the Romeral system and represent reactivated segments of the sutures zones between oceanic and continental blocks (see Paris et al., 2000; Tibaldi and Romero, 2000).

Line 144. Remove the extra parenthesis when calling Fig 2.

Line 176. Please Correct Colmbia.

Line 177. The provided URL leads to the webpage of the Colombian Geological Survey, not the specific data repository for the DTM. Please provide a direct link to the data service or repository so that the metadata can be properly verified.

Lines 196-199. Was this issue related to the way the Pleiades DTM is modeled? Were the moraines too small?

Lines 203-206 The description of the exposure dating techniques is insufficient, especially considering their importance in supporting the manuscript's interpretations. Please expand this section to provide details, including the fundamental assumptions underlying the exposure dating method (e.g., nuclide production rates (spallogenic and muonic), shielding, erosion history). Specifically, the authors must clearly outline the assumptions, the mathematical formulations, and the sources and magnitude of uncertainties behind the reported ages.

Lines 205-206. Did you consider complex burial/re-exposure history? What field evidence do you have to reject this scenario?

Lines 219-220. Please provide more details about this assumption. What corrections are needed if all measured He4 is magmatic in origin?

Lines 284-294. The offset moraines and channels mentioned are not visually apparent in Figure 5 or verifiable using independent satellite imagery (like Google Earth Pro). Please provide more detailed information on the methodology used to project the moraine ridges onto Figure 5c so that these features can be verified.

Figure 5. Can you color the slope maps in panels C and D?

Figure 7. This is a really nice Figure!

Line 375 Grammar "…of the of the fault exposures…"

Section 5.4 After carefully inspecting Google Earth, one can notice that the area of the Polylepis Fault is made by more than one structure that would be worth including in your Figure 8. The new imagery provides a better contrast to aim in the identification of the fault traces.

Satellite image from Google Earth (image © CNES / Airbus)

Line 399. Remove "…more…" to avoid redundancy

Line 400. Why are these structures considered fault systems? Also, uou mention three fault systems but only two faults: Polylepis and Reservoir.

Line 403. Shouldn't the two faults be one fault system if that's the case?

Line 404. How did you define the width of the fault zone?

Line 405. What do you mean by right-lateral strain?

Lines 406-407. As mentioned above, please consider my comments on the offset features and the uncertainty around the interpretation of recent displacements along the Reservoir Fault.

Line 416. This is the first time you mention the July 25 fault in the main body of the manuscript. Please ensure the fault is named and described consistently upon its first relevant mention. Furthermore, I suggest replacing this name with a geographically significant name to facilitate referencing.

Line 418. You didn't calculate strain rate but slip rates. Please review the article to avoid mixing concepts such as slip rate and strain rate, which are not the same.

Lines 420-423. An examination of the mapped structures and your interpretation (Fig. 2) suggests a plausible southern extension of the Romeral Shear Zone (Buesaco and Aranda faults). Specifically, lineaments southwest of the Galeras volcano (potentially belonging to the Cauca-Patía system?) appear to show a southward prolongation, possibly merging with the Reservoir and Polylepis Faults. Given that both the Cauca-Patía and Romeral structures are right-lateral faults, their regional kinematics align well with the mapped structures in the study area.

If this is true, it poses a significant tectonic implications: this extended zone may delineate either a separate, unmapped microblock or represent the northern boundary/extension of the QL microblock.

Lines 428-430. This interpretation is out of place because it hasn't been developed before. Only in section 6.2 you discuss the potential influence of the CCN-VC.

Lines 437-443. The role of volcanic inflation should be more elaborated since it's a key conditioning factor for the triggering of the July earthquake. It'd be helpful to see that on a map or a new schematic figure.

Lines 441-442. I'd recommend to remove this interpretation about the 1868 earthquake since its speculative.

Line 456-458. The presence of thick volcaniclastic deposits inherently presents significant difficulty in observing recent faulting. Consequently, the lack of clear surface expression through the sedimentary cover does not preclude the underlying structure from being active. For example, you didn't observe a rupture for the July 25 earthquake. So the same reasoning should be valid for the N-NE suture zones.

Line 458. Please refer to my recommendation and include in your analysis the Romeral and Cauca-Patia fault systems which in southern Colombia are considered tectonically active. The Buesaco and Aranda faults are part of the Romeral fault system (or shear zone depending on the authors).

Lines 462-465. Please rewrite this section as the current discussion is unclear. Furthermore, to support the proposed earthquake conditioning factors, please add a figure showing the modeled horizontal stress field from the CCN-Vc and its orientation relative to your mapped fault structures.

Line 470 Avoid contractions (don't)

Lines 488-494. I'd recommend to keep only the radiocarbon-based paleoearthquake estimates for the Reservoir Fault. The moraine and cosmogenic ^{3}He estimates are too vague; their 2σ uncertainty (2 kyr) is too large to constrain the recurrence interval defined by the radiocarbon dating.

References

Ego, F., Sebrier, M., Yepes, H., 1995, Is the Cauca-Patia and Romeral fault system left ot rightlateral? Geophysical Research Letters, v. 22, p. 33-36.

Garcia-Delgado, H., Velandia, F., Bermudez, M., Audemard, F., 2022. The present-day tectonic regimes of the Colombian Andes and the role of slab geometry in intraplate seismicity. International Journal of Earth Sciences, v. 111, p. 2081-2099.

París, G., Machette, M.N., Dart, R.L., Haller, K.M., 2000, Map and Database of Quaternary Faults and Folds in Colombia and Its Offshore Regions. Open-File Report 2000–284. USGS.

Tibaldi, A., And Romero, J., 2000, Morphometry of late Pleistocene-Holocene faulting and volcanotectonic relationship in the southern Andes of Colombia. Tectonics, v. 19, p. 358-377.

Vinasco, C., 2019, The Romeral shear zone. In: Cediel F, Shaw R (eds) Geology and tectonics of Northwestern South America: the Pacific-Caribbean-Andean junction. Front Earth Sci 833–876. https://doi. org/10.1007/978-3-319-76132-9_12