**Response to specific comment of Reviewer 1  (Francesco Iezzi)**

L41 - a reference to a figure?

  *Ok, we add "Fig.1".*

L 43 - the latter

  *Ok.*

L51-52 - the seismic histories derived by trenches may also suffer from non-preservation of coseismic surface ruptures due to erosional processes or sedimentary hiatuses.

  *The reviewer is right, so we specified it: "For instance, the seismic histories derived by trenches may also suffer from non-preservation of coseismic surface ruptures due to erosional processes or sedimentary hiatuses."*

L57 - and related expected magnitude?

  *Yes, we now specified it.*

L 60-61 - At first I thought that the new trenches were located on different portions of the fault, but they are instead all located near Roccacasale?

  *Yes, all the trenches are located near Roccacasale, in the central sector of the fault as we also specified in the abstract (line 18). We rephrased the sentence to clarify this point.*

L133 - May help to clarify the scale of these local variations. Hundreds of meters? A few km? They are not visible in Fig. 2

  *Ok, we now specified in the text.*

L156 - Is this earthquake constrained only by the damaged weighing house described in the previous sentence? I assumed that more information was used to reconstruct the shaking scenario, or perhaps I have misinterpreted.

  *Ceccaroni et al. (2009)  performed a comparison of the damage distribution and of the intensities with the archaeological evidence they found in the Sulmona basin. They demonstrated that the damage suffered by the ancient settlements of the area was consistent with the activation of the MMF with an earthquake of magnitude of up to 6.5-7.*

L171 - the Palena and Mt. Porrara active normal faults. It would help to label these faults in Fig. 1.

  *The faults are already labeled as PWPF (Palena - Western Porrara Faults). We specified the reference acronym in the text.*

L171 - Bordoni et al. (2023). Not present in the reference list.

  *Ok, we added it.*

L172 - How was it calculated? Is this supported by evidence or only on the assumption of their coeval rupture?

  *The possibility that the MMF and the Palena and Porrara active normal faults ruptured together is supported by the proximity of the tectonic structures (the Palena and Porrara faults represent the SE prolongation of the MMF) and by the evidence of post-Bronze age activation of the Palena fault (Gori, 2010) consistent with a historical episode of activation of the fault.*

L182- something is missing here I presume.

  *Yes, the reviewer is right: we fixed the mistake.*

L215-217 - To clarify, the same samples were sent to two different labs, so to obtain two indipendent ages of the same sample?

  *We acknowledge the reviewer for this comment. We adjusted the sentence to avoid misunderstanding: we chose to lab for dating, but we did not send the same sample twice (to  Cedad and Beta), but we sent some samples to cedad and some (different) samples to Beta.*

L225 - is somehow counter-intuitive to number oldest-to-youngest the stratigraphic units and youngest-to-oldest the fissures, it generates some confusion.

  *The numbers of the fissures had been made consistent with that of the paleoevents that would have generated it: Fi4-->Eq4 etc, as specified on lines 228-229.  Therefore, to make the numbering clearer we specified as follows in the text: "We also identified and labeled the sediments filling the paleofissures as "Fi" which, as discussed below, we associated with subsequent fault activation events (e.g., Fi4*

*associated with paleoearthquake Eq4 and so on)". We hope that now the criteria of unit numbering is clear.*

L260-263 - I understand the process. I find it slightly odd to describe an unit that does not appear on the stratigraphic logs of either TA and TB. Perhaps talk about it only when describing the fissures and not include with units?

*We have to describe this stratigraphic unit that was once present, as remnants of it are testified from what has remained trapped within the coseismic fissure. The necessity to describe the unit appears from the palinspastic restoration shown in Figure 7.*

L267 - It would help to show also the conventional radiocarbon ages and the % of probabilty of the calibrated radiocarbon ages, so to understand the quality of the measured ages.

*Ok, we added the value in Table 1.*

L270 - It would help to say in which trench and in proximity of which fault you observe the fissures

*Ok, we specified it.*

L272 - what is the temporal relationship between these fissures? I assume Fi4 is the youngest of the three, what about FiX and FiY?

*We have already specified on lines 229-230 that, unfortunately, for the FiX and FiY fissures no organic deposits (or anything else) useful to constrain their age have been found, so we preferred not to speculate.*

L274-276 - see above, perhaps this is enough to describe the parent material of dark colluvium in Fi3

*That's correct.*

L282 - mention the figure where it can be find.

*Ok, we added "Fig. 6".*

L290-291 - better to specify that it is the yellow line in figure 6? I was confused at first with the clast mentioned in line 286.

*Ok, we specified it in the caption and on L309.*

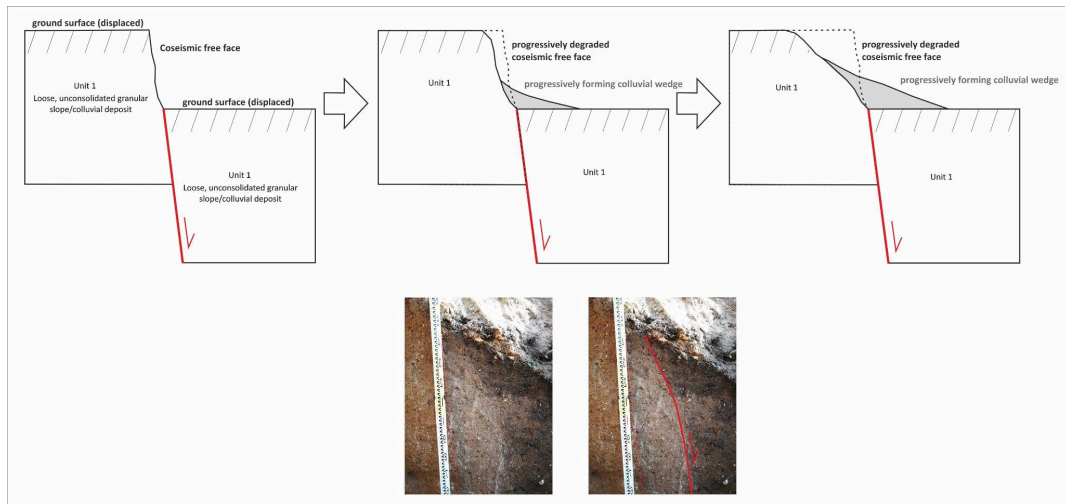
L320-321 - what does this mean?

*We have modified the sentence to try to make it clear.*

L333-336 - the triangular shape may be well due to the erosional surface that limits the upper part of Fi2. Hence, the original deposit before ES2 may be an infilling of the fissure and not a wedge per se.

*We understand the reviewer's criticism. However, If it was the infilling of a fissure, we would have expected to find the deposit mixed with the others representing the flanks of the fissure. Instead, it seems that this unit uncomfortably overlaid the older units that were filling the fissure, being subsequently faulted itself.*

L339-340 - If you think that Fi2 was indeed a colluvial wedge, than the vertical contact between U5 and Fi2 may be a free face buried by the deposition of the wedge, i.e. this vertical contact may not be an earthquake.

*As shown in the provided supporting figure, the uphill flank of the colluvial wedge is straight and perfectly matches the fault plane. Within this light, it must be considered that the fault displaced unconsolidated sediments so that it is very unlikely that the free face remained perfectly straight and aligned with the fault, even at its base, while undergoing erosion after its formation. Erosion in such loose deposits cannot just affect the upper part of the free face. The free face as a whole retreats after its formation (as loose materials progressively collapse), so that the uphill side of the colluvial wedge cannot be perfectly aligned with the fault, as it instead appeared in the trench.*

L343-345 - Why you did not show also these two more recent events in Figure 7? the reader needs to go back at figure 6 and have to reconstruct them on its own, something that it was not needed for the previous two events.

> *We thank the reviewer for this suggestion. However, as indicated in the caption we have drawn this restoration to outline what we think was the structural-stratigraphic evolution of what is observed in the southern wall of trench A. Unfortunately, the evidence of the last two events is only recognizable in the northern wall; therefore, we wanted to remain faithful to the real representation of the southern wall which for the reader could perhaps be more complex.*

L361- this trench is parallel to TB, so it should have the same direction, NE-SW

> *Thanks for this observation, we have now corrected the orientation of the figure.*

L366 - The thickness of U4 here becomes much larger than what it was in TA. Although thickness of sedimentary units like these may sensibly vary, I wonder whether that body could be defined as fault core or as another fissure. It seems the same situation as FiX in TA (Figure 6).

> *Unit U4 is composed of very coarse calcareous sand that is nuanced from orange to hazelnut. A 10 cm-thick coarse layer, thinning eastward, marks the contact with the unit below. Based on the similar characteristics of the deposits, and on the sequence of sedimentations, we defined the unit U4 in both trenches TA and TB. While we did not exclude the possibility of faulting as an explanation for the significant thickness of the unit, the absence of evidence for sedimentary infilling—such as portions of the unit above and below being mixed within the main deposit or dragged clasts—supports our interpretation. However, we added a sentence in the main text to explain this evidence in order to avoid misunderstanding.*

> L372 - I presume that Fi4 here is the same as in TA?

> *Yes, we specified it.*

L387-389 - where is this in Figure 8? If the CU1 and CU2 are found in the trench, these should be shown.

> *The rock masses were found at the end of the northern wall that we did not show in a log because no relevant stratigraphic contacts were shown and none of the dating samples were taken from that wall. We added the picture in the supplementary material for completion of the information.*

L403 - all the surroundings of CU2 is made of CU1?

> *Yes, as far as we observed in the excavation.*

L418-420 - So this is valid also for the boulder in TA?

> *Yes, it may be, We specified this observation in the text.*

L426 - In the previous trench the numbering proceeded in the opposite direction. Perhaps it would be better to be consistent with it

> *Ok, we changed it.*

L426-428 - what about U2 and U1?

> *We have now added that the fault brought into contact U3 with U2 and U1.*

L429 - in TC or TD?

*we specified it.*

L461 - I do not understand what this means.

*It means that the retrieved (4) activation events were caused by the same number of seismic events along the fault that caused surface faulting.*

L482 - Do you relate these two evidence because they are coeval? I have perhaps missed it somewhere.

*We relate these two events because in both trenches they occurred after the Eq3 and are the penultimate event retrieved in both trenches. The two events were dated, post* 4985- 4862 yrs BP *and* post 4430- *4490 yrs BP, respectively for TA and TC. We rephrased the sentence a bit to make this point clearer.*

L485 - I do not understand well what this means.

*We agree with the reviewer and we have now removed this part of the sentence.*

L586 - It should represent a minimum in any case I assume.

*Yes, the reviewer is right. To make the point clear we rephrased the sentence.*

L529 - which trench?

*Trench TA, we now specified it.*

L541 - This is not clear.

*We have now added what we refer to. Hoping that now it is clear.*

L548-549 - which evidence are you referring at here? those of your trenches? better to clarify it.

*Here we are referring to the newly-presented paleoseismological evidence (from TA - TB - TC and TD) and the paleoseismological evidence observed in the Galli et al. (2015) trenches. We rephrased the sentences, hoping that now it is clear.*

L557 - could this be related to your FiX?

*We do not have any chronological constraint for the FiX event. So it could be related to Eq4g but it could also be much older. Since the relation Fix-Eq4g is too speculative ( because of the total lack of time constraints), we prefer not to attempt any comparison.*

L573 - I would stress that this is an averaged recurrence interval - fault activity may be clustered and so recurrence intervals variable through time. Trenches may not have enough resolution to picture such slip-rate fluctuations.

*Here we agree with the reviewer, we added the term "average" for the recurrence interval.*

**Response to comment of Reviewer 2 (Nasim Mozafari Amir)**

L42 -"generated by adjacent seismogenic sources" It would be beneficial to expand this section by briefly explaining the distances to the nearby faults that are likely responsible for the historical earthquakes impacting the region.

*The Sulmona basin is located in a portion of the Abruzzo region that is close less than 10-15 km to the main fault systems that are responsible for the strongest historical events (i.e., M > 6) in the area (e.g., Fucino Fault System). Hence, the Sulmona basin has experienced several seismic events over time, and not all of them are related to the MMFS. The spatial relationship between the Sulmona basin and the related neighboring systems can be observed in Fig.1.*

L62 - In this paragraph, I think it is necessary to refer to Fig. 1 and ensure Roccacasale is included, even though it is also depicted in Fig. 2.

*We indicated the reference to Fig. 2 to avoid misunderstanding.*

L72- I suggest you expand your paragraph by providing more information regarding subduction, especially by adding the subduction rate (if available).

*We have already indicated in the text an exhaustive list of authors who studied the evolution of the Apennines chain, including the subduction phase. The paper aims to investigate the activity of one of the normal faults in the Apennines and to unravel information about the present-day extensional phase. So we think that specifying which is the subduction rate as well as enlarging this paragraph would be unnecessary. We refer to the already-cited bibliography for further details*

L117 - reference missing.

*ok we added Gori et al., 2011 and Puliti et al., 2024.*

L142- Is there any possibility to show this on a map or in a field photograph? Including such visuals could greatly assist the reader in gaining a clearer understanding of the fault characteristics.

*We acknowledge the reviewer for this comment. We decided to not show the Late Pleistocene- Holocene displaced deposits on the figure because the resolution of the map did not allow a distinction among the different displaced bodies. Moreover, we referred in the text to an exhaustive literature dedicated to the offset analysis of topographic surfaces and quaternary deposits, such as Puliti et al., 2024, Gori et al., 2007, 2010 or Miccadei at al., 2004. We refer the reader to the dedicated literature for this topic.*

L143 - It would be helpful to verify whether this slip rate (0.4 mm/yr) is typical for similar fault branches in the Apennines or if it reflects distinct behavior in this specific area. If any additional references are available that provide comparative slip rates for nearby faults, please consider including them for a broader regional context.

*The slip rate of 0.4 mm/yr is consistent with slip rate estimates defined for all of the central Apennine active extensional faults (e.g. Galadini and Galli, 2000; Galli et al., 2008)*

L145 - You can provide a brief explanation of the evidence they have found to support the occurrence of earthquakes.

*Ceccaroni et al. (2009) compared the damage distribution and intensities with the archaeological evidence they found in the Sulmona basin. They demonstrated that the damage suffered by the ancient settlements of the area was consistent with the activation of the MMF with an earthquake of magnitude up to 6.5-7. We now specified it.*

L182 - I suppose there is a typo here, and part of the sentence has been accidentally deleted.

*Ok, we fixed the mistake.*

L193-194 - could not follow this part. Please rephrase.

*Ok, we rephrased the paragraph, hoping that now it is clear.*

L215 - please review my comment on Table 1.

*Ok, we directly anser this comment at Table 1.*

L220 - This title does not indicate that the dating results are included in this section. I suggest modifying it to 'Stratigraphic Setting and Paleoseismology' or something similar to clarify the content. Do the same for section 3.3.1.

*Ok, we added "and chronological constraints" in the title, and slightly modified the first paragraph.*

L266 - (Table 1) I would suggest you add a paragraph at the beginning of this session mentioning that radiocarbon ages are presented in Table 1, rather than by just suddenly mentioning it as a specific sample.

I also wonder if all the samples were sent to two labs for measurements, why only the measurements from one lab are reported here. If this is not the case please revise sentences on line 205-207. However, if this is correct, all measurements should be reported, at least in the supplementary data, along with an explanation of the criteria used to determine which age estimate is more accurate (at the beginning of this section).

> *We have followed the reviewer's suggestion by highlighting, both in the section title and in the first sentence, that the results of the 14C datings performed will be presented here. Regarding your observation of the 14C datings being performed in two different laboratories, we have now explained in detail for which samples and why this was done, at lines 280-285.*

L 267 - (Table 1) It would be great if you could add a column reporting the ages before calibration.

> *Ok, we added the value in Table 1.*

L288 - Please clarify what the dashed yellow line represents?

> *The yellow line represents the outlined boulder's position that we found during excavation. We follow the reviewer's suggestion, sso we specified it in the caption and on L309.*

L429-430 - Please double-check which age corresponds to each sample, as the text here contradicts the information in Table 1, with the ages listed in reverse order.

> *The reviewer is right. We have corrected the mistake.*

L460 - Does the fault scarp involve colluvial deposits, or are the deposits part of the hanging wall that covers the lower part of the fault? Please clarify.

> *The fault involved Holocene deposits, as testified by the number of shear planes that affected and displaced stratigraphic units aged by radiocarbon dating.*

L461 - "The fault scarp involves late Holocene colluvial deposits and records at least 4 fault activation events associated with as many surfaces rupturing seismic events along the MMF."The sentence isn't clear about what it's trying to say. Please rephrase.

> *Ok, we rephrased like this: Paleoseismological trenching across this fault scarp has identified the presence of at least four surface faulting paleoevents involving Late Holocene colluvial deposits.*

L499 - The publication should be cited correctly with the year included. L500 - Were these of Galli et al. (2015)? L513 - It is not again clear if you refer to Galli et al. (2015).

> *We have now specified that is Galli et al.(2015).*

L529 - Please specify which trench you are referring to, as the reader may not remember it.

> *Ok, we specified that is Trench TA.*

L541-542 -Please provide a clearer explanation; it is vague.

> *We have now added what we refer to. We hope that now it is clearer.*

L549- Please clarify which study this estimation is from, as the source is unclear. If from this study, how was the magnitude calculated?

> *We have now cited the source that is Galli et al. (2015).*

L569 - You should clarify how you arrived at this magnitude and which empirical relationship was used. Please include the reference, such as Wells & Coppersmith (1994) or another relevant source.

> *Ok, we specified that is from the linear regression of Wells & Coppersmith (1994).*

L585 - Which studies?

> *It is the paper of Galadini and Galli (2003). We have now cited the paper.*