Reply to reviewers

RC1

We would like to thank reviewer 1 for the detailed and constructive feedback. Answers to the more detailed comments:

Reviewer comment:

Page 11: "Thank you for the geological map. Please, display the frame of figures 4 and 9 for an easier localization."

Answer:

Done.

Reviewer comment:

Page 23: "The term "clast-supported" should be avoided for the description of a weathered rock mass, as the terms "clast- or matrix-supported" could be misinterpreted as a sedimentary deposit. A more appropriate way to describe this type of units (from U1 to U4, at least) would be to follow the Weathering grades of rock mass suggested by the International Society of Rock Mechanics (ISRM, Commission on Standardization of Laboratory and Field Test (1981a) Suggested Methods for the Rock Characterization, Testing and Monitoring, E.T. Brown (ed.), Pergamon (ed.), Pergamon, Germany. Brown (editor), Pergamon Press, Oxford, UK, 211p.)"

Answer:

We have re-written this section according to the comments of the reviewer. We have also changed the relevant parts of the Conclusions, discussion and abstract.

Reviewer comment:

Page 23: "This type of materials, if sedimentary, should be related to a low energy deposit, which is not compatible with a slope deposit. Consider the weathering profile hypotesis."

Answer:

Done; however, this residual soil is indeed made up of clay, which is why we can not avoid this term. It is important to state that this is clayey material, because this explains why we can not see the upper termination of the fault zone in this unit. Also, even if we agree that this represents a weathering sequence, there must have been some sedimentary input from the upslope areas because we find clasts and charcoals.

Reviewer comment:

Page 23: "Could they be rest of roots instead of charcoals? or even pedogenic Mn nodules?"

Answer: Possibly a mix, but we emphasize that most of them clearly were charcoals: charred material with a black stroke and not rotten roots, albeit very small (far too small to date them). They were not as hard as Mn nodules usually are.

Reviewer comment:

Page 23: "It reallly can. Please consider the weathering profiles suggested by the ISRM as a template for interpreting the entire exposure wall trench, including U5 which envelops less weathered levels of sandy clays (U4) and U3."

Answer:

We do follow this interpretation and cite IRSM (1981).

Reviewer comment:

Page 27: "A discussion on this kind of samples (charcoal or rest of root or Mn nodules?) must be included if the weathered rock mass hypothesis prevails with pedogenic development."

Answer:

These samples were charred material with a black stroke and not rotten roots. They were not as hard as Mn nodules and they could be dated in the lab with the radiocarbon method. We do not think there is any reasonable doubt about them being charcoals. Thus, a discussion of the sample material would appear strange.

Reviewer comment:

Page 31: "As I mentioned in my first review, could U3 be the same unit labeled as U2? Could it be slighly vertically offset (20-30 cm)?"

Answer:

This is possible, but we consider it less likely. We added a few lines on that in the revised version.

Reviewer comment:

Page 35: "Review the interpretation of unit U5 as sedimentary unit. There is not a strong evidence of that. The rockmass weathering profile could be deformed, instead, and the age of the pedogenic development could predate the deformation."

Answer:

Done.

Reviewer comment:

Page 36: "As you well describe below, the downward bending of U3, U4 and U5, do not show that the SW block went down with respect to the NE one. Please, remove this sentence for a better understanding, and leave the discussion about it to explain the folding."

Answer:

Done.

Reviewer comment:

Page 37: "As I mentioned in my first revision, I agree U4 is deformed, but U5 is also deformed in the same way, since U5 includes U4 somehow (See comment above)."

Answer:

Re-phrased.

Reviewer comment:

Page 40: "This is wrong: considering the range within the 95% probability, SLO18_SK13 could be as young as 2056 cal BP, while SLO18_SK10 (dating U5) could be as old as 2140 cal BP. This fact would

support that SLO18_SK11 is an outlier. Taking SLO18_SK11 as representative for the U10 would give an unrealistic young age for the unit and the tectonic activity."
And
"This conclusion is not supported by the data. Consider the comments above.
The last tectonic event must occur before 2306 BP (the age of the fissure filling, postdated by the unit U10 in the south wall), and after 2645 BP (the oldest age obtained for the entire deposit)"

Answer:

We changed the text accordingly and also changed the abstract and the conclusions. We therefore also removed the discussion of the 1511 event as a candidate.

RC2

We would like to thank reviewer 2 for the detailed and constructive feedback. We have made all minor changes that were suggested, and which concerned wording, style, and shortening of the manuscript. Answers to the more detailed comments:

Reviewer comment:

Page 20: "do not mix tectonic interpretation and dating, the message is confused. Finally, from this description, it is not clear for me if you consider U5 pre-dating or post-dating a possible seismic event."

Answer:

We deleted the sentence that referred to the tectonics. The lowermost part of unit U5 is clearly deformed, so it must pre-date the deformation. In the upper parts of unit U5 we can not trace the deformation, because U5 is made up of plastic clays, in which we could not identify any markers. We have changed the description.

Reviewer comment:

Page 27: "I understand your reasoning and the direct observation is incontestably much clearer than a picture, so ok for preferring this interpretation. Nevertheless you do not have the 3D geometry of this sedimentary body and cannot easily exclude that laterally (perpendicularly to the trench direction) the fissure connects with a sand layer."

Answer:

There is not a single observation that points to this fissure fill being a dyke that propagated upwards.

Reviewer comment:

Page 28: "post-date or pre-date? It is not clear what you call here overlying sediments"

Answer:

We re-wrote this section.

Reviewer comment:

Page 29:

“I would suppress the last part of the phrase, I don't think that a single event explain observations better than several events or even aseismic slip.”

Answer:

Done.

Reviewer comment:

Page 29: “In the revised version, you associate U6 to the part of U5 undergoing more compaction because of the overlying road. Its formation, in terms of depositional process and 14C dating, is therefore coeval of the upper part of U5.”

Answer:

True, we changed this sentence.

Reviewer comment:

Page 31:“ yes, bulk material is definitely not ideal for dating sedimentary units. If no charcoals available is better than nothing! Just be conservative with the accuracy of the age found (it seems you did it).”

Answer:

Thank you very much!

Reviewer comment:

Page 33: “not easy to prefer a scenario with these ages...
The absence of scarp suggests an event older than few hundred years, but in a rapid evolving river valley its preservation may be quite short-lived.
Ok for not excluding the possibility of 1511 event recorded here, even if it is not the most likely to me.”

Answer:

The other reviewer insisted to treat sample SLO18_SK11 as an outlier, which results in an older age of the last surface-rupturing event. Therefore, we remove the discussion of the 1511 earthquake as a candidate.

Reviewer Comment:

Page 34: “I do not agree with this major point. You do not have any argument to say that these faults ruptured in "large" earthquakes. Morphology along the two faults studied has almost no trace of surface ruptures. So deformation could be simply accommodated by lot of small/medium earthquakes with no or little expression at surface, as the Ravne fault in 1998 and 2004. To me, this point is highly controverse, has strong implications in regional seismic hazard, and should therefore be removed here, in the abstract and in the conclusions.“

Answer:

Changed and removed also from the abstract. In the conclusions we now write much more conservatively: “From a seismic hazard perspective, it must be assumed that all of the large NW-SE tending strike-slip faults could host surface-rupturing earthquakes, although recurrence intervals on the individual faults are likely long.” We found surface ruptures in our trenches, which is a very rare find in Slovenia. None of the many known historical quakes has caused surface ruptures, except the 1511, although even this is debated (Bavec et al., 2013, Falcucci et al., 2018). Medium quakes do most likely not add up to the deformation we see. The Ravne Fault earthquakes did not rupture the surface. Therefore, we have to conclude that the quakes we found were stronger than what is known from the historical record, perhaps with the exception of 1511.

Reviewer Comment:

Page 34: “I am not sure that in trenches, and in particular in this one, one can distinguish between a slow slip event and a sudden event.”

Answer: None of our observations points to creep in the shallow parts of these faults. Anyway, we already write “indicated” and not “proven”, so we think this is OK.

Christoph Grützner

Jena, 2021-08-01