Reviewer Comments

Reviewer A

For author and editor

This study documents the first paleoseismic excavation in the western Québec Seismic Zone (WQSZ), eastern Canada. Although a zone of relatively low seismicity compared to a plate boundary region, the proximity of Montréal to the WQSZ implies high exposure to this seismicity and hence there is a clear need to characterise its seismic hazard using techniques such as paleoseismology. Ultimately, the trench did not reveal a offset geologically young sediments; however, this study provides an important account of the scientific and legal hurdles to excavating trenches in Quebec. I fully endorse the reporting of null results from paleoseismology; this happens far more than we like to admit, and by documenting these cases, then at least we can learn from each other's experience.

I do have a couple of minor suggestions (see below) to help round out the discussion, and a few other line-by-line comments. I have not commented on the geophysical data collected around the scarp as I am not very familiar with those techniques. In summary though, there is a clear merit to publishing this work; and it's a great fit to Seismica's 'Null Results Report' section.

I hope the authors find this review useful

Best, Jack Williams

Comment #1

There are a couple of features of the Saint Liguori scarp that (with the benefit of hindsight not available to the authors!) would have led me to question whether this represented a fault scarp. Firstly, Rimando and Peace (2021) report a reverse fault stress state in the western Québec Seismic Zone with a NE trending maximum principal compressive stress. Hence, what would have been the rationale for forming the ENE trending Saint Liguori normal fault scarp?

Secondly, the scarp of the Saint Liguori is reported as '>5' km long (Line 215). Presumably, the length is being reported in this way as the mapped length is ~5 km; it could be longer but there is no evidence from the lidar for this (?). Anyway, taking a length between say 5-10 km and empirical length-magnitude scaling for dip-slip intraplate faults (Leonard 2014), the scarp would have likely formed from a Mw ~5-5.5 rupture, and magnitudes of such size have only a ~30% chance of producing surface rupture (Wells and Coppersmith 1993, Biasi and Weldon 2006). In summary, I wonder if it could be worth discussing if NW trending reverse fault scarps (as suggested at Line 149) and/or scarps with longer lengths (say >10 km) should be prioritised for future paleoseismic sites in Québec?

- *Leonard, M. (2014). Self-consistent earthquake fault-scaling relations: Update and extension to stable continental strike-slip faults.Bulletin of the Seismological Society of America, 104(6), 2953-2965.*
- *Biasi, G. P., & Weldon, R. J. (2006). Estimating surface rupture length and magnitude of paleoearthquakes from point measurements of rupture displacement.Bulletin of the Seismological Society of America, 96(5), 1612-1623.*
- *Wells, D. L., & Coppersmith, K. J. (1993). Likelihood of surface rupture as a function of magnitude.Seismological Research Letters, 64(1), 54.*

Comment #2

Paleoseismology is of course a powerful and well-used technique to obtain records of prehistoric earthquakes, as neatly discussed in the manuscript. However, there are also other techniques for obtaining records of prehistoric earthquakes. For example, dating fault gouges (Vrolikj et al. 2018) and offset geomorphic surfaces (e.g., Morell et al. 2020), or fragile geologic features to constraint ground motions (e.g., Rood et al. 2020). I am aware that preciously balanced erratics dropped during ice retreat from the last glacial are being used to constrain ground motions on the east coast of the US (though apologies, can't find any refs for this). I would therefore suggest including in the discussion (around Lines 442-447) a few sentences suggesting if/how these techniques could be applied to understand pre-historic earthquakes in eastern Canada.

- *Morell, K. D., Styron, R., Stirling, M., Griffin, J., Archuleta, R., & Onur, T. (2020). Seismic hazard analyses from geologic and geomorphic data: Current and future challenges. Tectonics, 39(10), e2018TC005365.*
- *Rood, A. H., Rood, D. H., Stirling, M. W., Madugo, C. M., Abrahamson, N. A., Wilcken, K. M., ... & Stafford, P. J. (2020). Earthquake hazard uncertainties improved using precariously balanced rocks. AGU Advances, 1(4), e2020AV000182.*
- *Vrolijk, P., Pevear, D., Covey, M., & LaRiviere, A. (2018). Fault gouge dating: history and evolution. Clay Minerals, 53(3), 305-324.*

Minor comments:

Line 113: Cox et al (2012) is a useful reference here for describing how fault scarps are rarely preserved in glacial environments

Cox, S. C., Stirling, M. W., Herman, F., Gerstenberger, M., & Ristau, J. (2012). Potentially active faults in the rapidly eroding landscape adjacent to the Alpine Fault, central Southern Alps, New Zealand. Tectonics, 31(2).

Line 168: What is the timing of this maximum marine incursion, it can’t have been associated with the last glaciation (right?)

Line 181-182: I find this sentence a bit disingenuous as it appears to suggest that the estimate for 28-160 surface rupturing earthquakes in eastern Canada since ice sheet recession comes from geologic evidence (e.g., debris flow, landslides etc.). It’s only when you look at the references at the end of the sentence, you realise this estimate is based on extrapolating rates of global stable craton seismicity. Indeed, Brooks and Adams 2020 find there are far fewer post-glacial scarps in eastern Canada than you would expect from global rates of seismicity.

Personally, I would also be very wary of extrapolating rates of instrumental stable craton seismicity over such long time scales. It’s very difficult to say much about the spatial-temporal distribution of earthquake in low strain rate regions/stable cratons from instrumental catalogs, as typically the number of recorded events is low and earthquake rates may be non-stationary anyway (Stevens and Avouac 2021, Iturrieta et al 2024).

- *Iturrieta, P., Gerstenberger, M. C., Rollins, C., Van Dissen, R., Wang, T., & Schorlemmer, D. (2024). Accounting for the variability of earthquake rates within low-seismicity regions: Application to the 2022 Aotearoa New Zealand National Seismic Hazard Model.Bulletin of the Seismological Society of America, 114(1), 217-243.*
- *Stevens, V. L., & Avouac, J. P. (2021). On the relationship between strain rate and seismicity in the India–Asia collision zone: implications for probabilistic seismic hazard.Geophysical Journal International, 226(1), 220-245.*

Line 222: Mark the Ouareau River on Figure 2

Lines 270-283: In this description of the GPR interpretation, what was the basis for drawing the normal fault as shown in Figure 5c? I recognise the "need" for a fault in this interpretation is implied by the how the different units are juxtaposed, but it could be worth being more explicit about this in the text.

Line 356: What was the orientation of the bedding planes? More significantly, did it match the SW dip inferred from the GPR survey.

Line 369: Apologies for being *that* reviewer, but what convention are the join orientations being reported in (dip direction, RHR, etc?).

Line 375-390: Suggest cross-referencing the unit names in Table 2/Figure 8 into this section describing the trench sediments

Figure 1: Is it possible to add locations from instrumental and/or historic earthquakes in this map too? It would be useful for a reader to be able to visualise the extent of the western Québec Seismic Zone.

Figure 3a: Suggest using a different font colour and/or size for the ‘2 m’ offset indication. It’s quite difficult to see in its current format

Figure 8: What were the soil samples shown in this figure used for? I can’t find an explicit mention of them in the text?

Reviewer B

For author and editor

I recommend “accept” & this paper be published substantially “as is”. Note that I did not review any of the supplementary material, as they were not provided in the reviewer’s link.

I think that publication of this null result is important to move the science forward, and also that the legal, practical engineering and other obstacles that were overcome provide useful guidance for future investigations. The multi-discipline investigations are appropriate, and appear to have provided useful scientist and student training.

I have some high level comments on the pre-excavation tools ((perhaps easier in hindsight than when being planned/executed). The interpretation of the seismic refraction line as indicating a normal fault (and with very shallow dip) could have been a red-flag for less dedicated researchers, because exceedingly few confirmed postglacial faults have normal slip, and normal faulting is not a common contemporary earthquake style in the region.

As an opinion, I think the presumption of looking for the 1732 surface rupture in particular is not warranted. I consider it rather unlikely the first similarly-placed similar-sized scarp to be found would be that of the 1732 earthquake, based on a) rates of similar-sized or larger earthquakes since deglaciation (there should have been many more and bigger ones than 1732), b) no faulting from 1944 Cornwall earthquake (too deep for its magnitude-inferred rupture area to break surface), c) depths of nearby western Quebec/Montreal earthquakes over the last 50 years, and d) estimated magnitude of the 1732. All suggest 1732 would be unlikely to have a surface rupture - but earlier larger earthquakes would have.

Paper & book mentioned below are:

Steffen H, Olesen O, Sutinen R, eds. In: *Glacially-Triggered Faulting*. Cambridge University Press; 2021: https://doi.org/10.1017/9781108779906

Stevens, A., 1991. "Damage associated with three early Eastern North American earthquakes", 6th Canadian Conférence of Earthquake Engineering, Toronto. 807-814. (this volume is available on the CAEE website) I can probably get a copy if the authors can’t.

Review points

- Is the paper of value and interest to a significant position of the potential readers of Seismica? Yes
- Is the study timely and of current interest? Yes
- Is the manuscript clear and easy to follow? Yes
- Is the manuscript's title adequate and accurate? Yes
- Is the abstract adequate? Yes
- Are the methods appropriate and described in sufficient detail to be transparent and reproducible? Yes
- Are the conclusions adequate and supported by the data? Yes
- Is the paper unnecessarily long? Does it include too many materials that can be found in other sources? No
- Is the paper significantly different to those already published by this author(s) or any other paper in this field of study? Yes
- If the study disagrees significantly with the current academic consensus, is there a substantial case? If not, what would be required to make their case credible? N/A

- If the paper includes tables or figures, what do they add to the paper? Do they aid understanding, or are they superfluous? Sufficient and necessary

Some minor points that could be fixed before publication:

“meter” please use the international spelling “metre”

“Departement” French spelling has crept in here?

Units separated by a space (not 50km)

Line

51

“Ville-Marie” do you mean “Quebec (City)”? Ville-Marie is the old name for Montreal which you have just mentioned.

54

M6+ is about since 1920 for the whole country; Arctic was the most recent to achieve that

56

reference misplaced in sentence: Atkinson and Tuttle is more liquefaction than witness accounts;

57

reference misplaced in sentence: Put Brooks + after “landslide”

110

You should cite the Steffan book “Glacially-Triggered Faulting” here as a important reference; might want to update some citations to more recent papers in it?

115

There are newer papers that might be cited here. Old paper to credit early discovery, plus recent paper to give current state of understanding and guide to literature

135

Not strictly “in” the proposed fault; either “near the proposed fault” or “in the proposed fault zone”??

168

Is 230 m correct for Saint-Liguori, or is it generic?

170

In many places, the period of wave erosion would be quite short, because the land uplift rate was so fast

178

Consider also Stevens' 1991 conference paper

181

Fenton et al. was a statistical argument based on global stable craton seismicity not on identification of paloeoseismic event records

189

Why was 315 degrees chosen? Does this mean scarps trending 315 degrees were less visible? Note that NW is the predominant trend for modern focal mechanism planes

210

I think it should be maple *syrup* production & later "syrup" rather than "maple"

211

Brooks has illustrated how eastern Canadian farming smooths out the land; Fig 2 caption says "cropland"; farming or ploughing would be better verbs

222

There is no 2f

229

Maple can be replaced by syrup

Fig3

Thinner white lines mark….

244

Ambiguous "downsection" - is it "down slope", or "downward"

Fig 4

"red" is actually reddish-brown on the figure

262

Fig 5b is actually 2b?

262

Suggest ” We ran *that* non-perpendicular transect due to heavy vegetation and deep snow surrounding the area (purple line on Fig. 2b).

Fig 5

Might be clearer if 5b and 5c used a colour other than grey for the air; white would be appropriate

283

the preceding discussion does not mention the fault shown on Fig 5c. Please mention it as “interpreted as a normal fault with dip xxx” Also, say somewhere how the Fig 5c interpretation influenced later investigations

298

Not “meters”

Fig 6

At “page size” the dots’ colours are hard to distinguish. Labels for the spectra would be easier to read if placed in the insets’ boxes, or add thin arrows joining the insets to their sample point. (these are minor comments, just to make things easier for the reader)

398

It would be helpful to summarize with something like “ less than x% of the clasts were from the local Paleozoic bedrock, the rest were Canadian Shield erratics” e.g. words like near line 426

409

I don’t think the description “steep” is justified

411

I wouldn’t argue with the words here, but see above comments about 1732 rupture likelihood

signed

John Adams

Emeritus Seismologist, Canadian Hazards Information Service

Séismologue émérite - Service d'information sur les dangers naturels au Canada

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June 10, 2024

Prof. Åke Fagereng
Editor, Seismica
Cardiff University

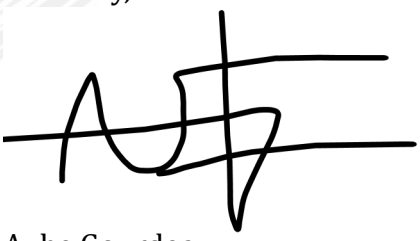
Dear Editor,

We thank you for the reviews and instructions for revisions for our manuscript. We have copied yours and the reviewer comments below and highlighted the actionable questions and comments with **bold text**. Our responses follow each actionable comment in *blue italics*.

Note that since I've received my master's thesis examination comments (where one of the chapters represented this paper's submission) at the same time as editorial and review comments from Seismica, I've made minor improvements to Figure 1 (added coordinates), to the caption of fig.5, to line 109, 178, and 420. These are detailed in the track changes version of the article alongside the changes made responding to the reviewer comments.

We appreciate your time and attention to our article and look forward to your positive response!

Sincerely,



Aube Gourdeau,
McGill University
aube.gourdeau@mail.mcgill.ca

I hope this email finds you well. I have reached a decision regarding your submission to Seismica, "Investigation of suspected Holocene fault scarp near Montréal, Québec: The first paleoseismic trench in eastern Canada". Thank you once again for submitting your work to Seismica.

Based on reviews I have received, your manuscript may be suitable for publication after some revisions. These revisions are very minor, as the paper is already easy to read and clearly presents all the results and conclusions of the study. Both reviewers have some suggestions that would improve the paper - mainly, **with the benefit of hindsight, commenting on what data could have been a red flag, and associated advice for future projects**.

See response to individual comments below.

I similarly found it a very clear read, that objectively presents a lot of varied data, and conclusions others can learn from. One small note is that a reviewer did not find the supplementarty material, which I think is all linked in the data availability section - so maybe **signpost this more clearly than referring to 'supplementary material' within the text.**

Each time the supplementary material is mentioned in the main text, we have added a note to see Section 7 for links to all repositories.

When you are ready to resubmit the revised version of your manuscript, please upload:

A 'cleaned' version of the revised manuscript, without any markup/changes highlighted.
A pdf version of the revised manuscript clearly highlighting changes/markup/edits.
A 'response-to-reviewers' letter that shows your response to each of the reviewers' points, together with a summary of the resulting changes made to the manuscript.
While not required at this stage, I recommend you ensure the files are publication-ready, as given the minor nature of the revisions, we may be able to accept your paper after this round of revisions.

We will need the following before proceeding to publication:

- The final, cleaned manuscript using the Seismica template in Microsoft Word, OpenOffice or LaTeX file format (found on the Templates page) with figures included in the text. If using LaTeX, please also include your bibliography .bib file.

- Separate publication-ready figure files in .png or .pdf format at a minimum of 300 dpi resolution

- Supplementary material should be uploaded as a separate pdf file that will not be formatted. Supplementary material should not be included in the main paper.

Once I have read your revised manuscript and rebuttal, I will decide whether the manuscript either needs to be sent to reviewers again, requires further minor changes, or can be accepted. If you deem it appropriate, please check that the revised version of your manuscript recognises the work of the reviewers in the Acknowledgements section.

We added the reviewers to the acknowledgment. They provided very helpful and actionable comments that improved the overall quality of the paper.

Please note that Seismica does not have any strict deadlines for submitting revisions, but naturally, it is likely to be in your best interest to submit these fairly promptly, and please let me know of any expected delays.

Kind regards,

Ake Fagereng

Reviewer A:

This study documents the first paleoseismic excavation in the western Québec Seismic Zone (WQSZ), eastern Canada. Although a zone of relatively low seismicity compared to a plate boundary region, the proximity of Montréal to the WQSZ implies high exposure to this seismicity and hence there is a clear need to characterise its seismic hazard using techniques such as paleoseismology. Ultimately, the trench did not reveal a offset geologically young sediments; however, this study provides an important account of the scientific and legal hurdles to excavating trenches in Quebec. I fully endorse the reporting of null results from paleoseismology; this happens far more than we like to admit, and by documenting these cases, then at least we can learn from each other's experience.

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I hope the authors find this review useful

Best, Jack Williams

Comment #1

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Rimando et al.'s prediction of favorable activity on NW trending faults is based on modern stress directions, but the stress state has probably changed significantly during the post-glacial period. Therefore we defer to observation and investigate all potential fault orientations. This is now addressed in the first paragraph of the Background section (line 152).

Secondly, the scarp of the Saint Liguori is reported as '>5' km long (Line 215). Presumably, the length is being reported in this way as the mapped length is ~5 km; it could be longer but there is no evidence from the lidar for this (?). Anyway, taking a length between say 5-10 km and empirical length-magnitude scaling for dip-slip intraplate faults (Leonard 2014), the scarp would have likely formed from a Mw ~5-5.5 rupture, and magnitudes of such size have only a ~30% chance of producing surface rupture (Wells and Coppersmith 1993, Biasi and Weldon 2006). **In summary, I wonder if it could be worth discussing if NW trending reverse fault scarps (as suggested at Line 149) and/or scarps with longer lengths (say 10 km) should be prioritised for future paleoseismic sites in Québec?**

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Wells, D. L., & Coppersmith, K. J. (1993). Likelihood of surface rupture as a function of magnitude.Seismological Research Letters, 64(1), 54.

Great point, we have added a few sentences to the end of the first paragraph of the discussion (line 430-435) addressing this – given the risk of incomplete scarp mapping, due to recent land use changes and erosion, we did not rule out this scarp based on mapped length alone as the mapped length should be considered a minimum constraint. We thank the reviewer for providing helpful references! This will be explored more fully in our next paper which presents regional mapping of many potential fault scarps.

Comment #2

Paleoseismology is of course a powerful and well-used technique to obtain records of prehistoric earthquakes, as neatly discussed in the manuscript. However, there are also other techniques for obtaining records of prehistoric earthquakes. For example, dating fault gouges (Vrolikj et al. 2018) and offset geomorphic surfaces (e.g., Morell et al. 2020), or fragile geologic features to constraint ground motions (e.g., Rood et al. 2020). I am aware that preciously balanced erratics dropped during ice retreat from the last glacial are being used to constrain ground motions on the east coast of the US (though apologies, can't find any refs for this). **I would therefore suggest including in the discussion (around Lines 442-447) a few sentences suggesting if/how these techniques could be applied to understand pre-historic earthquakes in eastern Canada.**

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Vrolijk, P., Pevear, D., Covey, M., & LaRiviere, A. (2018). Fault gouge dating: history and evolution. Clay Minerals, 53(3), 305-324.

Excellent suggestion! I've added a paragraph at line 467-475 where I've expanded thoughts regarding the importance of paleoseismology for PSHA. I've also added text regarding the papers you've mentioned, and what/how information could be retrieved from different observations made in the field using paleoseismology.

Minor comments:

Line 113: Cox et al (2012) is a useful reference here for describing how fault scarps are rarely preserved in glacial environments

Cox, S. C., Stirling, M. W., Herman, F., Gerstenberger, M., & Ristau, J. (2012). Potentially active faults in the rapidly eroding landscape adjacent to the Alpine Fault, central Southern Alps, New Zealand. Tectonics, 31(2).

Added!

Line 168: What is the timing of this maximum marine incursion, it can't have been associated with the last glaciation (right?)

We added a clarifying sentence explaining that marine incursion followed the ice sheet melting (line 167)

Line 181-182: I find this sentence a bit disingenuous as it appears to suggest that the estimate for 28-160 surface rupturing earthquakes in eastern Canada since ice sheet recession comes from geologic evidence (e.g., debris flow, landslides etc.). It's only when you look at the references at the end of the sentence, you realise this estimate is based on extrapolating rates of global stable craton seismicity. Indeed, Brooks and Adams 2020 find there are far fewer post-glacial scarps in eastern Canada than you would expect from global rates of seismicity.

Personally, I would also be very wary of extrapolating rates of instrumental stable craton seismicity over such long time scales. It's very difficult to say much about the spatial-temporal distribution of earthquake in low strain rate regions/stable cratons from instrumental catalogs, as typically the number of recorded events is low and earthquake rates may be non-stationary anyway (Stevens and Avouac 2021, Iturrieta et al 2024).

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Stevens, V. L., & Avouac, J. P. (2021). On the relationship between strain rate and seismicity in the India–Asia collision zone: implications for probabilistic seismic hazard.Geophysical Journal International, 226(1), 220-245.

The reviewer is correct, we have modified the sentence at line 187-192 to report the estimate with appropriate context and uncertainty.

Line 222: Mark the Ouareau River on Figure 2 *Done!*

Lines 270-283: In this description of the GPR interpretation, what was the basis for drawing the normal fault as shown in Figure 5c? I recognise the "need" for a fault in this interpretation is implied by the how the different units are juxtaposed, but it could be worth being more explicit about this in the text.

I've added a single sentence at line 289 to explain how the presence of the chaotic reflectors made us hypothesize a normal fault at this location.

Line 356: What was the orientation of the bedding planes? More significantly, did it match the SW dip inferred from the GPR survey.

The measured strike/dip for the bedding planes of the bedrock was 340/17W, which is consistent with the interpretation from the GPR. I've added the measurement at line 372 .

Line 369: Apologies for being that reviewer, but what convention are the join orientations being reported in (dip direction, RHR, etc?).

The reported joints are vertical, so there is no dip direction to report.

Line 375-390: Suggest cross-referencing the unit names in Table 2/Figure 8 into this section describing the trench sediments

You are fully right! I forgot to update the orthophoto unit names after updating the units in the table. Table 2/Figure 8 are now matching!

Figure 1: Is it possible to add locations from instrumental and/or historic earthquakes in this map too? It would be useful for a reader to be able to visualise the extent of the western Québec Seismic Zone.

We've added the instrumental earthquakes to the map, but note that the seismicity isn't well located in national databases, and the data only goes back to 1985 for this area. Justin Chien is working on a paper about earthquake relocation in the area of Montreal. A different map for historical seismicity inspired by the work of Lamontagne, 2018, will be added to our next publication, where we are presenting regional seismicity rather than local.

Figure 3a: Suggest using a different font colour and/or size for the '2 m' offset indication. It's quite difficult to see in its current format

Done!

Figure 8: What were the soil samples shown in this figure used for? I can't find an explicit mention of them in the text?

The soil samples were collected for subsequent color and grain size analysis, as reference. This detail was added to the orthophoto caption (figure 8).

Recommendation: Revisions Required

Reviewer B:

From: Adams, John Sent: Tuesday, March 19, 2024 7:53 AM To: Adams, John <john.adams@NRCan-RNCan.gc.ca> Subject: FW: review of Seismica paper Gourdeau et al.

I recommend "accept" & this paper be published substantially "as is". Note that I did not review any of the supplementary material, as they were not provided in the reviewer's link.

The supplementary materials were actually provided at the end of the text, but we realized that they might not have been referenced enough in the text. We added references in the text at line 213, 269, 299, 306, 318, and 366, to make it more obvious.

I think that publication of this null result is important to move the science forward, and also that the legal, practical engineering and other obstacles that were overcome provide useful guidance for future investigations. The multi-discipline investigations are appropriate, and appear to have provided useful scientist and student training.

I have some high level comments on the pre-excavation tools ((perhaps easier in hindsight than when being planned/executed). The interpretation of the seismic refraction line as indicating a normal fault (and with very shallow dip) could have been a red-flag for less dedicated researchers, because exceedingly few confirmed postglacial faults have normal slip, and normal faulting is not a common contemporary earthquake style in the region.

You are right, normal faulting is not as common in deglaciated environments, although not absent. That's the reason why we went forward. Also, the pictures taken in the hand-dug pit made us optimistic before trenching.

As an opinion, I think the presumption of looking for the 1732 surface rupture in particular is not warranted. I consider it rather unlikely the first similarly-placed similar-sized scarp to be found would be that of the 1732 earthquake, based on a) rates of similar-sized or larger earthquakes since deglaciation (there should have been many more and bigger ones than 1732), b) no faulting from 1944 Cornwall earthquake (too deep for its magnitude-inferred rupture area to break surface), c) depths of nearby western Quebec/Montreal earthquakes over the last 50 years, and d) estimated magnitude of the 1732. All suggest 1732 would be unlikely to have a surface rupture - but earlier larger earthquakes would have.

We agree that the 1732 earthquake would have had to be quite shallow to rupture the surface, and this is not likely to have happened given that most moderate earthquake hypocentres in the region are deeper in the thick crust. We have modified the referenced line to indicate that the proximity to the city was reasonable but include explanation of the unlikelihood of surface rupture from 1732.

Paper & book mentioned below are:

Steffen H, Olesen O, Sutinen R, eds. In: Glacially-Triggered Faulting. Cambridge University Press; 2021: https://doi.org/10.1017/9781108779906

Stevens, A., 1991. "Damage associated with three early Eastern North American earthquakes", 6th Canadian Conférence of Earthquake Engineering, Toronto. 807-814. (this volume is available on the CAEE website) I can probably get a copy if the authors can't.

Review points

Is the paper of value and interest to a significant position of the potential readers of Seismica? Yes

Is the study timely and of current interest? Yes

Is the manuscript clear and easy to follow? Yes

Is the manuscript's title adequate and accurate? Yes

Is the abstract adequate? Yes

Are the methods appropriate and described in sufficient detail to be transparent and reproducible? Yes

Are the conclusions adequate and supported by the data? Yes

Is the paper unnecessarily long? Does it include too many materials that can be found in other sources? No

Is the paper significantly different to those already published by this author(s) or any other paper in this field of study? Yes

If the study disagrees significantly with the current academic consensus, is there a substantial case? If not, what would be required to make their case credible? N/A

If the paper includes tables or figures, what do they add to the paper? Do they aid understanding, or are they superfluous? Sufficient and necessary

Some minor points that could be fixed before publication:

"meter" please use the international spelling "metre" *Done!*

"Departement" French spelling has crept in here? *Oupsi! Done!*

Units separated by a space (not 50km) *Done!*

Line 51

"Ville-Marie" do you mean "Quebec (City)"? Ville-Marie is the old name for Montreal which you have just mentioned. *Unfortunately, many places in the province are called Ville-Marie. Here, Ville-Marie refers to a tiny town in Témiscamingue. I've added "(Témiscamingue)" after Ville-Marie at line 51 to remove the confusion.*

Line 54 M6+ is about since 1920 for the whole country; Arctic was the most recent to achieve that *I imagine you are referring to line 94? We found a new citation that says that the complete instrumental record for M5+ earthquakes for the WQSZ is 1928. We changed line 94 to make it more precise.*

Line 56 reference misplaced in sentence: Atkinson and Tuttle is more liquefaction than witness accounts; *Done!*

Line 57 reference misplaced in sentence: Put Brooks + after "landslide" *Done!*

Line 110 You should cite the Steffan book "Glacially-Triggered Faulting" here as a important reference; might want to update some citations to more recent papers in it? *Steffen's book is an excellent resource that we hadn't cited somehow. I've added his 3rd chapter to line 110. This resource will also be added to our in prep. paper, which focuses on a methodology to identify scarps, inspired by Muir Wood and Fenton, and on the regional mapping of Southern Québec.*

Line 115 There are newer papers that might be cited here. Old paper to credit early discovery, plus recent paper to give current state of understanding and guide to literature *I've added Steffen's book at line 117 since his chapter about the "geomechanics of glacially triggered faulting" covers the failure of post-glacial faults under different stress regimes, how stress can migrate, and how pre-existing faults can be reactivated.*

Line 135 Not strictly "in" the proposed fault; either "near the proposed fault" or "in the proposed fault zone"?? *We changed "in the proposed fault" to "sediment-bedrock contact which constitutes the proposed fault".*

Line 168 Is 230 m correct for Saint-Liguori, or is it generic? *It is a generic marine incursion height for Southern Québec, associated to the lake Candona episode. From the reconstructions I've seen, the lake Candona didn't reach St-Liguori. I've added a sentence at line 168 to specify that this estimate was generic for Southern Québec and Southeastern Ontario.*

Line 170 In many places, the period of wave erosion would be quite short, because the land uplift rate was so fast *We agree this is probably the case, but as this is an assumption we are not including it in the manuscript.*

Line 178 Consider also Stevens' 1991 conference paper *We were unable to locate this reference and have made no edits answering this comment.*

Line 181 Fenton et al. was a statistical argument based on global stable craton seismicity not on identification of paloeoseismic event records *See response to same comment by Reviewer 1.*

Line 189 Why was 315 degrees chosen? Does this mean scarps trending 315 degrees were less visible? Note that NW is the predominant trend for modern focal mechanism planes *We used 315 by convention. That's the illumination angle that was chosen by default on the ministry hillshade. However, we had access to the original DEMs as well, to vary the angle if needed. Your concern is relevant and could have added to our detection bias in the regional mapping. It will definitely be considered and added in the discussion of our regional map in our in prep. paper. I've added a few more details at line 196-199 to explain why we used 315 degrees.*

Line 210 I think it should be maple syrup production & later "syrup" rather than "maple" *Done!*

Line 211 Brooks has illustrated how eastern Canadian farming smooths out the land; Fig 2 caption says "cropland"; farming or ploughing would be better verbs *Fair point. I've changed the 4 instances of the word "cropland" by "farming" or "farmed land", including figure 2*

Line 222 There is no 2f *I've changed it to 2b, and added the name of the river "Ouareau" on the map to make it clearer.*

Line 229 Maple can be replaced by syrup *Done!*

Fig3 Thinner white lines mark…. *Done!*

Line 244 Ambiguous "downsection" - is it "down slope", or "downward" *Downward is more accurate, I've changed it!*

Fig 4 "red" is actually reddish-brown on the figure *I've changed red to reddish-brown.*

Line 262 Fig 5b is actually 2b? *Good catch! It was supposed to be 2b indeed, I've changed it!*

Line 262 Suggest " We ran that non-perpendicular transect due to heavy vegetation and deep snow surrounding the area (purple line on Fig. 2b). *Done!*

Fig 5 Might be clearer if 5b and 5c used a colour other than grey for the air; white would be appropriate *Done!*

Line 283 the preceding discussion does not mention the fault shown on Fig 5c. Please mention it as "interpreted as a normal fault with dip xxx" Also, say somewhere how the Fig 5c interpretation influenced later investigations *A similar comment was brought up by our first reviewer. We clarified that the reflectors were interpreted to represent a potential normal fault at line 286. I've also added at the end of the paragraph (line 296) that the GPR interpretation lead us to pursue the investigations.*

Line 298 Not "meters" *Done!*

Fig 6 At “page size” the dots’ colours are hard to distinguish. Labels for the spectra would be easier to read if placed in the insets’ boxes, or add thin arrows joining the insets to their sample point. (these are minor comments, just to make things easier for the reader) *I’ve made the dots twice as big, and added a little transparent layer behind the spectras to make sure that the writing stands out.*

Line 398 It would be helpful to summarize with something like “ less than x% of the clasts were from the local Paleozoic bedrock, the rest were Canadian Shield erratics” e.g. words like near line 426 *All the clasts observed in the matrix were plutonic or metamorphic, meaning that they were not representative of the local geology. No local Paleozoic clasts were identified. This information got added to line 419.*

Line 409 I don’t think the description “steep” is justified *Removed!*

Line 411 I wouldn’t argue with the words here, but see above comments about 1732 rupture likelihood *As mentioned above, line 411 got modified to highlight that the possibility of finding the 1732 rupture on a first attempt was very unlikely.*

signed

John Adams