

Review Report

MacDonald et al., Fingerprinting Fluid Source in Calcite Veins: Combining LA-ICP-MS U-Pb Calcite Dating with Trace Elements and Clumped Isotope Palaeothermometry, TEKTONIKA, 2024.

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1st Round of Revisions

Decision Letter

From: Renata da Silva Schmitt <schmitt@geologia.ufrj.br>

Sent: 15 March 2023 20:30

To: John MacDonald <John.MacDonald.3@glasgow.ac.uk>; Jacob VanderWal <jacobtvanderwal@gmail.com>; Roberts, Nick <nirob@bgs.ac.uk>; Ian Winkelstern <winkelsi@gvsu.edu>; John Faithfull <John.Faithfull@glasgow.ac.uk>; Adrian Boyce <Adrian.Boyce@glasgow.ac.uk>

Subject: [tektonika] Editor Decision

John MacDonald, Jacob VanderWal, Nick Roberts, Ian Winkelstern, John Faithfull, Adrian Boyce:

We have reached a decision regarding your submission to tektonika, "Fingerprinting fluid source in calcite veins: combining LA-ICP-MS U-Pb calcite dating with trace elements and clumped isotope palaeothermometry".

Our decision is to: Resubmit for Review

We reached this decision after analysing two reviews. The manuscript presents robust data, but more work on the presentation and interpretation of the data is needed.

Specially regarding the lack of many references on deformation of calcite veins, pointed out by one of the reviewers. Another subject is the interpretation that should be better adjusted according to the results from the paper. Please take a look at the reviews here attached.

I apologise for the late review, but we had one reviewer that extrapolated the due time and I had to ask for a third reviewer.

Let me know please if you need any additional information. We are looking forward to your resubmission.

Regards,

Renata Schmitt

Comments by Reviewer 1 & Authors' Reply

Authors' responses are in green.

Review of MacDonald et al.

Tektonika

December 14, 2022

John P. Craddock

Overview: This feels like a paper that was the result of a trip to the beach where a complex vein set was discovered in the nearby cliff. **Not quite a trip to the beach, but a bachelors dissertation!** The veins were collected and analyzed, and it was all justified by getting one U-Pb age (328 Ma; add "Carboniferous" to the title, and on line 345?). The age gives a context and allows for an interpretation of the fluid source: Far-field deformation and fluid flow is common in the forelands of orogenic systems (Oliver, 1986; Craddock et al. 2017; Craddock et al. 2022). I'll bet your Lunan Bay veins are Variscan-Hercynian-Caledonian, and I'll bet there are data sets on other late Paleozoic veins around Europe. *I think there is a robust data set here, but the manuscript needs to be cleaned up into a more succinct presentation.* **Many thanks - I hope we have done this through our changes detailed below and in response to the 2nd reviewer.** The first 3 sentences of the Abstract should be removed as this only sells geochemistry techniques (start the Abstract on line 28: "Calcite..."). **I would have to respectfully disagree with the reviewer / While we are "selling" geochemistry techniques, It Is very much pitched as a way to answer research questions about veins, which we felt would be of wider Interest to readers of Tektonika.** Similarly, the Introduction should be the first and last paragraphs, and all the text between lines 59-127 should be woven into the Discussion. **I think I would have to respectfully disagree with the reviewer here. The paragraphs In question are key to setting up the research question and so I would argue they are essential In the Introduction.** Take all the text from lines 171-204 and put this in the "Results" section. **I guess It Ids a stylistic thing but I prefer to present geological history / petrographic data in a earlier section than the Results, as It sets the scene for the numerical data presented In the Results. None of the other papers out In Tektonika yet are comparable really but based on other manuscripts of the sort I have had published In other journals (e.g. 10.1007/s00410-019-1599-x), I hope the way It Is currently presented In acceptable.** *Tektonika* is an international journal so please broaden the scope of the geological setting of the field relations, then make the grander interpretations in the Discussion. **Given the International scope, I didn't want to dwell on the geological setting as the paper Is Intended to simply use the location as a case study to address a broader research question. The focus of the paper is not to understand the geology of this small**

part of Scotland, or Indeed a wider area, hence the grander Interpretations In the Discussion are more focused on answering the research question around vein-forming fluid sources.

Table 1 summarizes all the geochemical data. This would be easier to read in a “landscape” format. That makes sense - I presume the copy editor will format It this way at the proofing stage (If the paper Is accepted!)? U-Pb dating in calcite is a miracle: 1 age from 5 samples is good. Many thanks! Why did 2 clumped C samples not work (9 and 11), which also didn't produce 18O fluid results?? Its not that these didn't work, its just that funding/time constraints precluded analyses on all samples unfortunately. The fluid inclusion “Methods” section was brief.....the ¹⁸O measurement was on entrapped water? Clarified this but also Is brief as procedures In the cited paper (Gleeson et al, 2008) were followed. What other fluids were present in the inclusions? Did you get any homogenization temperatures? This was not analysed due to the scope of the project.

I see mechanical twins in samples 17-1 and 17-2. I'm one of two remaining people on the planet who measures 3D stress and strain from twins in calcite. There's a lot you can learn about a vein system with twinned calcite, especially with a U-Pb age (Craddock and van der Pluijm, 1988; Nuriel et al. 2019; Weinberger et al. 2021; Craddock et al. 2019, 2021). While this sounds interesting, I think it is maybe a bit beyond the scope of where we are going with this paper. Any paper about veins should include a reference to Ramsay's work (see below). It felt a bit contrived but I have added the Ramsay citation on line 58.

Figures:

1-(a) Why is there a Shetland Island insert?? Not needed. Fair point - have removed. Why is Scotland an island....draw some lines to connect it back to the UK. It is, although the lines are grey rather than black - a copyediting issue? (b) Add the ages of the 3 units. Done. What type of fault is present?? These were just copied from the published geological map where the type of fault Is not stated. They are minor and distract from the overall figure so I have removed them. (c) What is Buckie Den?? A geographic feature on maps to aid navigation to the site for anyone wishing to see the veins/ repeat the study. No scale?? Oops! Scale added. Why is the railroad important? Same as with Buckie Den. (d and e) Can these be bigger, full field photos?? Good Idea - I have made the figure portrait now, so that d and e can be bigger.

2-Yellow is hard to see. Changed to blue. This caption is REALLY long. There's quite a lot on it and its important to explain everything no?

Supplements:

1-Nice, but why was the red line data (what was the data?) not used? **Not really sure what Is meant here? There is no data in any of the sheets in red or with a line through it.**

Tables: So many fonts; S-5 has columns that overlap. **Done.**

Minutia (by line):

The font used is messy. There are overlapping parentheses, hyphens and letters.

Fair point, but I'll let the Tektonika copy editors change the font to their preferred one.

34: light on the fluid

Done

35: ...rules out..

Done

86: is a scope...where the genetic....

Done

113: delete here

Done

114: delete likely

Done

122 and 127: what is bond reordering? In carbon? Why is this important?

Note added to clarify this

146: lavas are coeval with

I've left "suggested with" so as to satisfy the general comments of the other reviewer to be a bit more tentative In Interpretations

146: U-Pb zircon andesite age...

Done

148: Add Devonian in here. Few know stage names.

Done

175: different

Done

185: What is an iron-rich vein? Iron-rich calcite or a hematite vein??

Clarified as reddish calcite

202: amygdules

I would suggest not - but I'll leave this to the editors to decide on American vs British English!

504: Delete Simply.

Done

524: Nitrogen isotopes are also good tracers of fluid flow (Lynch et al. 2019)

An interesting point but unfortunately beyond the scope of this work!

References

Craddock, J.P., and van der Pluijm, B., 1988, Kinematic analysis of an en-echelon-continuous vein complex: *Journal of Structural Geology*, v. 10, p. 445–452, [https://doi.org/10.1016/0191-8141\(88\)90032-6](https://doi.org/10.1016/0191-8141(88)90032-6).

Craddock, J.P., Malone, D.H., Porter, R., Luczaj, J., Konstantinou, A., Day, J.E., and Johnston, S.T., 2017, Paleozoic reactivation structures in the Appalachian-Ouachita-Marathon foreland: Far-field deformation across Pangea: *Earth-Science Reviews* 169, p. 1-34.

Craddock, J.P., Malone, D.H., Wartman, J., Kelly, M.J., Liu, J., Bussolotto, M., Invernizzi, C., Knott, J., and Porter, R., 2019, Calcite twinning strains from syn-faulting calcite gouge: Small-offset strike-slip, normal and thrust faults: *International Journal of Earth Sciences*, v. 109, p. 1–42, <https://doi.org/10.1007/s00531-019-01783-x>.

Craddock et al. *Geosciences* 2022, 12, 254. <https://doi.org/10.3390/geosciences12060254>

Craddock, J.P., P. Nuriel, A.R.C. Kylander-Clark, B.R. Hacker, J. Luczaj & R. Weinberger, 2021, Long-term (7 Ma) Strain Fluctuations within the Dead Sea Transform from High-resolution U-Pb Dating of a Calcite Vein: *GSA Bulletin* <https://doi.org/10.1130/B36000.1>.

Nuriel, P., Craddock, J.P., Kylander-Clark, A.R.C., Uysal, T., Karabacak, V., Kadir Dirik, R., Hacker, B.R. and Ram Weinberger, 2019, Reactivation history of the Bolu-Gerede segment of the North Anatolian Fault Zone based on calcite age-strain analyses: *Geology*, doi.org/10.1130/G45727.1

Oliver, J., 1986. Fluids expelled tectonically from orogenic belts: their role in hydrocarbon migration and other geologic phenomena. *Geology* 14, 99–102.

Ramsay, J.G., and Huber, M.I., 1983, *The Techniques of Modern Structural Geology*,

Volume 1: Strain Analysis: Cambridge, Massachusetts, USA, Academic Press, 305 p.

Lynch, E.A., Mulch, A., Yonkee, A., and van der Pluijm, B.A., 2019, Surface fluids in the evolving Sevier fold-thrust belt of ID-WY indicated by hydrogen isotopes in dated clay minerals: Earth and Planetary Science Letters, v. 513, p. 29–39, <https://doi.org/10.1016/j.epsl.2019.02.003>.

Weinberger, R., Nuriel, P., Kylander-Clark, A.R.C., and Craddock, J.P., 2020, Temporal and spatial relations between large-scale fault systems: Evidence from the Sinai-Negev shear zone and the Dead Sea Fault: Earth-Science Reviews, v. 211, no. 103377, <https://doi.org/10.1016/j.earscirev.2020.103377>.

Comments by Reviewer 2 & Authors' Reply

Authors' responses are in green.

Everton Bongiolo (UFRGS- BRAZIL) – completed March 14th, 2023
THIS REVIEWER COMPLETED USING THE TEKTONIKA REVIEW FORM
(SEE BELOW) AND PROVIDED A COMMENTED PDF.

Dear Editor,

This manuscript report field/textural descriptions, mineralogical, geochemical, thermometric, geochronological and isotopic data about calcite veins from Lunan Bay area, Scotland. The authors use this dataset to reconstruct fluid temperature, compositions and source, and age/timing of calcite veins formation.

The theme has scientific relevance, the data have good quality and the manuscript is well written. However, in my opinion, the text need some adjustments before acceptance for publication, based on inconsistency between conclusions/interpretations and the obtained data. Please, find attached the main points that need attention during review by the authors.

Based on my comments attached, I recommend MAJOR REVISIONS.

Section A: Overview of manuscript

A1) Overall evaluation, general comments & summary

A1.1) Reviewer's comments

A1.1.1) General evaluation and publication suggestion – Required:

Dear Editor,

This manuscript report field/textural descriptions, mineralogical, geochemical, thermometric, geochronological and isotopic data about calcite veins from Lunan Bay area, Scotland. The authors use this dataset to reconstruct fluid temperature, compositions and source, and age/timing of calcite veins formation.

The theme has scientific relevance, the data have good quality and the manuscript is well written. However, in my opinion, the text need some adjustments before acceptance for publication. Please, find below the main points that need attention during review by the authors.

A1.1.2) What does the submission need to be publishable? (select as needed; comment for all cases)

- No changes required
- Rewriting

- Reorganising
- More data/figures
- Condensing
- Reinterpretation
- Other

Comments:

Needs a reinterpretation of fluid sources. See below.

A1.1.3) Can the submission be improved by reducing/adding any of the following? (select as needed; comment for all cases)

- Text
- Table
- Figures
- Supplementary material

Comments:

No suggestions here.

A1.1.4) Please complete the following section if you recommend that the submission is NOT appropriate for publication (select as needed; comment if a box is selected)

- Quality is poor
- Research is not reproducible
- Other

Comments:

It would be appropriate for publication after few improvements.

A1.2) Author(s) Responses:

The reviewer is thanked for their generally positive review and helpful and constructive comments 😊

Please note I have acted on their comments in the commented version of the MS supplied. These are summarised in the relevant section below.

A2) Summary of main merits and main points of improvement

A2.1) Reviewer's comments

The main merits I have found are...

The obtained database in calcite veins using different techniques.

The main points of improvement I have found are...

The interpretation of fluid sources and timing for calcite vein crystallization. See comments in the attached word file. See Bongiolo et al. 2011 (Precambrian Research) for an example of how meteoric water input may be identified, as well as associated paleogeographic interpretations using stable isotopes (O-D). In my opinion, the data obtained by the authors cannot clearly point to meteoric fluid input. Also, one argument against magmatic water influence is the age of veins vs the host rocks. However the age of the host rocks are only inferred to be coeval with another volcanic succession elsewhere. Thus, the interpretations and conclusions are not supported by the data shown.

A2.2) Author's responses:

We have made various changes, particularly in the Discussion and detailed below, to address this main point of improvement.

Section B: Detailed evaluation of manuscript

B1) Title and abstract

B1.1) Reviewer's comments

*These statements are a **guide** to what good Titles and Abstracts include. Please select YES or NO to the statements below if you wish and detail in the free form box below your reasons for any box checked with NO, or to comment on any other matter.*

The *Title* describes the main topic of the manuscript **accurately** — [YES]

The *Title* describes the main topic of the manuscript **succinctly** — [YES]

The *Title* includes **appropriate key terms** — [YES]

The *Abstract* includes a **clear aim and rationale** — [NO]

The *Abstract* supports the rationale with **sufficient background information** — [YES]

The *Abstract* includes a **well-balanced description of the methods** — [YES]

The *Abstract* describes the **main results sufficiently and adequately** — [NO]

The *Abstract* clearly describes the **importance/impact of the study** — [NO]

The *Abstract* clearly states the **conclusions of the study** — [NO]

The *Abstract* is **clear and well structured** — [NO]

Comments:

Please reorganize the abstract to be clear, concise and to a wider audience.

B1.2) Author's responses

We have made some tweaks throughout the Abstract to reflect the reviewers main points throughout their review, particularly in lines 33-37.

B2) Introduction

B2.1) Reviewer's comments

The *Introduction* provides **sufficient background and context** for the study — [YES]

The *Introduction* describes the **aim/hypothesis/rationale** clearly, providing **sufficient context** — [YES]

The *objective/hypothesis/rationale* **flows logically from the background** information — [YES]

The *Introduction* describes the study's **objective and approach** (last paragraph) — [NO]

The *Introduction* contains **relevant, suitable citations** — [NO]

The *Introduction* is **organized effectively** — [YES]

Comments:

Please insert additional references about calcite veins and stable isotope data in vein-systems.

B2.2) Author's responses

Response to general comment above: we have quite a lot of references on calcite veins and stable isotopes in veins in the Introduction but I have added a few more to the opening paragraph of the Introduction, including some of those mentioned by the other reviewer.

Response to comment bubbles:

Line 55 "Palaeo fluid flow" – done

Line 113 “in these contexts may be complex” – **done**

B3) Data and methods

B3.1) Reviewer’s comments

The *Methods* are described **concisely and with enough detail** for reproducibility — [YES]

Necessary information about **data sources/acquisition/processing** is included — [YES]

Data used are accessible via either supplementary files or links in the data availability statement — [YES]

The *Dataset and/or Methods* are **organized effectively** — [YES]

Comments:

See additional comments in the attached word file.

B3.2) Author’s responses

Response to comment bubbles:

Line 147-148 “there are no dating of the study rocks? This is a problem since you compare age of calcite veins with the volcanics, been the age difference the main argument to rule out the magmatic fluid contribution.” – **the MVF lavas are lavas and therefore extrusive and are contained within the Devonian sedimentary rock stratigraphy and so are indisputably Devonian in age, so I would argue this is not necessarily a problem.**

Line 153 “Where is it? It is the sole mention throughout the manuscript” – **reworded to be clearer**

Line 222 “Low reproducibility? Or these are the values obtained in a given standard?” – **this was clumsily worded so I have adjusted this paragraph to make it clearer.**

B4) Results

B4.1) Reviewer’s comments

*These statements are a **guide** to what good Result sections include. Please select YES or NO to the statements below if you wish and detail in the free form box below your reasons for any box checked with NO, or to comment on any other matter.*

The *Results* findings are **supported by data** — [NO]

The *Results* findings are presented **clearly and succinctly** — [NO]

The text in the *Result* section **cites tables and figures appropriately** — [YES]

The *Results* directly **relate to the study objectives** — [NO]

The *Results* present **data for all the approaches** described in the *Methods* section — [YES]

The *Results* **text belongs to the Results section**, not to *Introduction, Methods, or Discussion*. — [NO]

The *Results* section is **organised effectively** — [NO]

Comments:

See additional comments in the attached word file.

B4.2) Author's responses

There aren't actually any comments in the Results section in the commented MS version supplied by this reviewer. I think though with the adjustments made to the Introduction and Discussion sections then the statements they have answered NO to above have hopefully been addressed.

B5) Discussion and conclusions

B5.1) Reviewer's comments

*These statements are a **guide** to what good Discussions and Conclusions include. Please select YES or NO to the statements below if you wish and detail in the free form box below your reasons for any box checked with NO, or to comment on any other matter.*

The *Discussion* is **focused on the objectives** of the study — [YES]

The *Discussion* **addresses all major results** of this study, which are shown in *Results* — [YES]

The *Discussion* section makes **comparisons with other studies** that are relevant and informative — [NO]

The *Discussion* section properly identifies all **speculative statements** — [NO]

The *Discussion* section presents the **implications of the study** persuasively — [NO]

The *Discussion* section **highlights novel contributions** appropriately — [NO]

The *Discussion* section **addresses the limitations** of the study appropriately — [NO]

The *Discussion* section is **organised effectively** — [NO]

The *Conclusions* are **consistent** with and **summarise** the rest of the manuscript — [NO]

The *Conclusions* are **supported by the data** in *Results* and **follow logically** from the *Discussion* — [NO]

The *Conclusions* are **clear and concise** — [NO]

Comments:

See additional comments in the attached word file.

B5.2) Author's responses

Response to comment bubbles:

Lines 378-391 “Think to move it to the methods section” – I would argue that this isn't really Methods, and is more placing the findings in the context of the literature, hence it is in the Discussion. Placing of equivalent type of text in the literature can be found in MacDonald et al 2019 (10.1007/s00410-019-1599-x). I have left it in its current position but can move it if the editor feels strongly about this.

Lines 413-416 “Unclear but it suggests several stages for calcite vein crystallization, which is also suggested by different vein textures.” – this comment seems to agree with what we say in this sentence, i.e. that there may have been precipitation in different veins at different stages of time; no changes made as a result.

Lines 436-440 “I agree meteoric water may have contributed for the fluid circulation system. However, in my opinion you don't have enough evidence of meteoric fluids such as a couple of analyses with unequivocal depleted oxygen value to propose that. I know all fluids may be reequilibrated but without any evidence, (in my opinion again) it is difficult to argue against magmatic/metamorphic fluids.” – It may just be the way the Discussion is structured (presenting difference lines of evidence one after another in order to arrive at a conclusion) but I think I would have to disagree with the reviewer here as we go on to present evidence later in the Discussion in favour of our interpretation, in the form of trace elements and calcite geochronology.

Lines 445-446 “Again, if it's not conclusive, why argue in favour of meteoric waters?” – I am slowly building up the evidence here, presenting evidence from different analyses successively; this is still early in the Discussion so I wouldn't expect to be conclusive yet!

Line 450-451 “Well, it depends on the data you have (geological, geochemical etc). In some systems yes, in other complex systems no... For example: if you have

additional analyses that falls closer to the GMWL and goes towards the metamorphic/magmatic field (there are several examples in the literature on epithermal deposits) you can trace the source and the % of interaction between different fluid sources. Please rephrase indicating/discussing why you cannot have those informations for your system. I suggest to take a look in papers (e.g., Bongiolo et al. 2011 – Precambrian Research) that clarify these points and show how meteoric vs magmatic waters can be traced in hydrothermal systems using O-D isotopes” – my fault, I poorly worded this sentence and it makes it sound like I am making a blanket statement about stable isotopes, whereas I only mean to refer to this particular study; I have updated the wording accordingly. [Bongiolo et al. 2011 was an interesting read though 😊]

Lines 463-473 “Ok but it requires a constant REE concentration in the reservoir, which may be tricky if you have more than one stage of infilling calcite (suggested by your vein textures), as observed for example in magmatic-driven hydrothermal systems, among others. Alternatively, not always successive vein infilling are located in its core during crack and seal as generally expected. You may rise different options to explain your data.” – in hindsight, I think I agree with this comment and what I have written doesn’t really make any sense. I have removed this paragraph.

Line 478 “Could not be linked with a different Mn-bearing fluid source given by successive vein infilling? What is the Mn concentration in the host rocks?” – MnO content of the whole rock is quoted in wt% so supports our interpretation; text updated to reflect this.

Line 486-487 “Agree with that” – OK thanks

Line 503-504 “For your data I agree, but look at the previous comment” – reworded to account for this

Line 509-510 “Thus, the MVF was not yet formed during metamorphism” – added.

Lines 518-519 “Thus you don’t have the age of your host rocks, but it is inferred from another volcanic exposures/successions. Additionally, do you have indications of younger intrusions in the MVF succession? These may be source of younger calcite veins.” – I have added text and citations here to beef up this section, to make it unequivocal and that the host rocks are ~100 Ma older than the age from the calcite vein.

Lines 521-525 “So what’s your proposition in terms of fluid sources that crystallized calcite veins?” – this is now clearly stated in the second sentence of the next paragraph.

Line 530 “We suggest the fluid source...” – changed.

Line 533-535 “What about latitude?” – added.

Line 560 “You did not discuss this information in terms of latitude, which would yield different isotopic composition for meteoric fluids.” – I added this, see comment above. Given Scotland was at low latitude (equatorial and near the coast) at the age of vein formation, the meteoric water composition would have been less negative on the GMWL, thus making it easier to get the d18O values we calculate through water rock interaction

B6) Figures, tables and citations

B6.1) Reviewer’s comments

*These statements are a **guide** to what good Figures and Tables include and how they are presented. Please select YES or NO to the statements below if you wish and detail in the free form box below your reasons for any box checked with NO, or to comment on any other matter.*

*Tables and Figures are **ordered logically** and **numbered sequentially** — [YES]*

*Tables and Figures have **captions that explain** all their major features — [YES]*

*Tables and Figures have **captions that complement** the information in the main text — [YES]*

*Tables and Figures present data that **relate** to the study objective — [YES]*

*Tables and Figures present data that are **consistent** with and support the description of results — [YES]*

*Tables and Figures have **succinct and informative titles** — [YES]*

*Figures are **accessible** (elements are clearly labelled, accessible colour palettes, colour contrasts, font size legible, etc....) — [YES]*

Please, check our [[Figure guidelines](#)]

*Figures with **maps or cross-sections** contain all **elements to be understood** (north arrow orientation, scale, visible coordinates, sufficient coordinate grid intercepts) — [YES]*

*Figures with **maps** have **sufficient location information** (in the map or caption) — [YES]*

*Cross-sections have clear labels for **scale and coordinates** at ends and within-section kinks — [YES]*

All georeferenced elements are provided in common format (.shp, .geotiff, .kml)
[in an open-access repository] — [NO]

Citations throughout are relevant, suitable, and comprehensive — [YES]

Comments:

See additional comments in the attached word file.

B6.2) Author's responses

Can I just ask a point of clarification regarding the answer of NO above in relation to georeferenced elements. This manuscript doesn't have any such files – I presume this is OK?

Section C: Additional comments

C1) Minor/line-numbered comments

C1.1) Reviewer's comments

C1.2) Author's responses

C2) Other remarks

C2.1) Reviewer's comments

C2.2) Author's responses

Section D: Feedback to improve Tektonika's review process

We kindly ask reviewers and authors to provide any feedback that can help improve this review form, or other aspects of the review process.

Feedback can also be emailed at any time to jtektonika@gmail.com

Authors' Reply to EDITOR

Completed Jun 8th, 2023

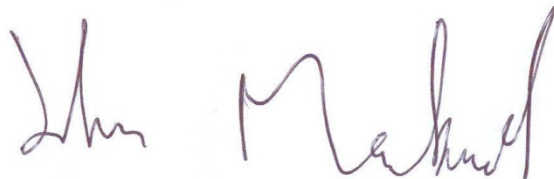
Dr John MacDonald
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02.06.2023

Dear Professor Schmitt,

Please find enclosed our revised manuscript entitled "Fingerprinting fluid source in calcite veins: combining LA-ICP-MS U-Pb calcite dating with trace elements and clumped isotope palaeothermometry". Additionally, responses to the two reviews are enclosed. Note that Reviewer #1 provided a 'traditional' style review and I have provided inline responses to his comments in green text. Reviewer #2 provided a marked copy of the manuscript and the Tektonika review form – I have copied their comments from the marked manuscript into the appropriate part of the review form and provided a response, again in green text. I hope this makes your editorial job easier!

With best wishes,

A handwritten signature in purple ink, appearing to read "John MacDonald". The signature is written in a cursive style with a large initial 'J' and 'M'.

Dr. John MacDonald
Senior Lecturer in Earth Science

2nd Round of Revisions

Decision Letter

Dear authors,

Thank you for sending the revised manuscript and answering the two reviews. I sent the second submission to the two reviewers and obtained a response only from Reviewer 2. He was satisfied with your revision. Since Reviewer 1 did not respond, I reviewed the manuscript carefully, to avoid recruiting a third reviewer.

I have some minor issues that I ask you to meet before accepting the manuscript which is in a very good shape now.

I think that even though you didn't want to dwell on the geological setting as the paper is intended to simply use the location as a case study to address a broader research question, more information on the local geology is needed in order to evaluate your interpretations and conclusions. Therefore, I recommend that authors improve figure 1 by: (i) providing a simple insert on where Scotland is located globally, or at least adding the lat/long grid; (ii) in 1a, adding the main geological terranes of Scotland, since they are cited in the text, i/e. Mid Valley Terrane; (iii) in fig 1b, adding the kinematics of the Highland fault improving the legend adding the type of rocks of the Dalradian Supergroup (gneisses?). It would be interesting to have an outcrop picture on the paper itself, so we can have an idea of the network of the veins, from the two pictures of the samples is really difficult.

Minor corrections:

Line 119 – eliminate “in these contexts”

Line 146 – Add period.

Line 153 – Do you mean 15 m.y.r? Duration?

Lines 154 and 155 – The age you presented is from an andesite or a chert? It is not clear. This is important since it's one of the arguments you use to say that the ca. 100 m.y.r difference on the vein age and the host rock eliminates the magmatic origin for the fluids.

Lines 195 to 197 – There is no tectonic control of the veins, right?

Paragraph of lines 328-342 – Large and wide or narrow veins means xxx cms?

Lines 485 and 506 – please provide the full name of the acronyms ORS and MVF.

Line 489 – “are” instead of “and”.

Lines 573 and 574 – could you provide numbers for this age?

I hope you can respond to these minor requests, so we can proceed with acceptance and production. I apologize again for late answering.

Sincerely yours,
Renata Schmitt

Comments by Reviewer 2

Everton Bongiolo (20th June 2023)

For author and editor

Dear Editor,

I found the authors have incorporated mostly of our suggestions in their revised text.

Thus, I recommend acceptance of the MS in its present form.

Your sincerely,

Everton Bongiolo

Editor's Comments & Authors' Reply

Authors' responses are in green.

I recommend that authors improve figure 1 by:

(i) providing a simple insert on where Scotland is located globally, or at least adding the lat/long grid; **Latitude-longitude lines added**

(ii) in 1a, adding the main geological terranes of Scotland, since they are cited in the text, i/e. Mid Valley Terrane; **Done, and figure caption updated accordingly**

(iii) in fig 1b, adding the kinematics of the Highland fault improving the legend adding the type of rocks of the Dalradian Supergroup (gneisses?). **Dalradian dominant rock type (schists) added to the legend. However, the movement on the Highland Boundary Fault is complex, variable and very controversial, with no one accepted movement sense so I have not added kinematic indicators as I wouldn't like to oversimplify an old and complex geological structure!**

It would be interesting to have an outcrop picture on the paper itself, so we can have an idea of the network of the veins, from the two pictures of the samples is really difficult. **This is now added to Fig. 1, the new panel c, replacing the previous panel c which was not very informative!**

Minor corrections:

Line 119 – eliminate “in these contexts” **Done**

Line 146 – Add period. **Done**

Line 153 – Do you mean 15 m.y.r? Duration? **Yes - corrected**

Lines 154 and 155 – The age you presented is from an andesite or a chert? It is not clear. This is important since it's one of the arguments you use to say that the ca. 100 m.y.r difference on the vein age and the host rock eliminates the magmatic origin for the fluids. **Clarified – it is indeed an andesite**

Lines 195 to 197 – There is no tectonic control of the veins, right? **There does not appear to be so, no. The outcrop photo requested and added to Fig. 1 shows this a bit more clearly.**

Paragraph of lines 328-342 – Large and wide or narrow veins means xxx cms? **Vein diameters now specified in text**

Lines 485 and 506 – please provide the full name of the acronyms ORS and MVF.

Done

Line 489 – “are” instead of “and”. **Done**

Lines 573 and 574 – could you provide numbers for this age? **Done – specific age added**

Acceptance Letter:

November 27th, 2023

John MacDonald, Jacob VanderWal, Nick Roberts, Ian Winkelstern,
John Faithfull, Adrian Boyce:

We have reached a decision regarding your submission to *tektonika*,
"Fingerprinting fluid source in calcite veins: combining LA-ICP-MS U-
Pb calcite dating with trace elements and clumped isotope
palaeothermometry".

Our decision is to: Accept Submission