Peer Review Report

Gómez-Romeu et al., Inverted Magma-rich Versus Magma-poor Rifted Margins: Implications for Early Orogenic Systems, TEKTONIKA, 2023.

This document contains:

1/

1st Round Decision Letter Followed by AE Comments and 2 Reviews:
Sent: 7th September 2022

Dear Dr. Gómez-Romeu

We have now received two reviews on your manuscript, "Inverted Magma-rich Versus Magma-poor Rifted Margins: Implications for Early Orogenic Systems" submitted to Tektonika. The two reviews, along with our own assessment, are relatively consistent, namely that this is an interesting contribution that will likely make a good paper for Tektonika, but that it needs some additional work, and as such, we are recommending that the paper undergo revisions and another round of review after such revisions.

Our decision is to: Resubmit for Review

The reviewers have used our compulsory review form to provide their comments and may also have annotated a pdf. We ask that when submitting revisions authors use the review form to answer all reviewers' comments, point-by-point, including submitted and modified versions of text passages, and any other relevant information to allow assessing how reviewers' comments have been addressed. In addition, authors may provide feedback to Tektonika about this form, and the overall peer-review process using Section D (or by email, to jtektonika@gmail.com). We ask you to submit both a copy of your revised manuscript with changes clearly marked and a clean version.

For your guidance, we append the editor's and reviewers' comments below.

Thank you for giving us the opportunity to consider your work.

Yours sincerely,

Adam Forte, PhD, Associate Editor - Tektonika
Janine Kavanagh, PhD, Executive Editor - Tektonika

Associate Editor Comments:

There are a few major themes that stand out from the two reviews and my own assessment of the manuscript:

1) Both reviewers highlight that there is not really a methods section for the manuscript, but that it would benefit from one and that effectively what is in your supplement in this version should be incorporated into a methods section describing the modelling in more detail.

2) Reviewer 1 highlights that at present there is an imbalance between what amounts to the two portions of the manuscript, i.e., the description of your two exemplar rifted margins and the modelling. I would largely agree with this assessment and with the general implication of reviewer 1's thoughts in terms of needing to provide significant additional details on the results of the modelling and the interpretation of the implications. Ultimately, you need to clarify your purpose with this manuscript, i.e., is it a case study of two different margins or is it a modelling paper where those two case studies are simply used as inputs for the model. My sense is that the intent is more the latter, but you focus more on the details of the case studies to the point where the modelling seems almost like an afterthought. If the intent is to focus more on the modelling, and the implications thereof, as highlighted by Reviewer 1, more analysis of these model results are warranted.

3) Reviewer 1 opens the possibility of including more models. I don't think that's necessarily a bad suggestion, but there is definitely a path forward that does not require more modelling, but instead just more interpretation of the existing modelling and consideration of the limitations of the limited set of conditions. In that latter scenario, what is needed more than the detailed descriptions of your two exemplar margins that exist right now is an indication of how representative these are of the two broad types of margins. Ultimately, the results of your models are strongly controlled by the assumed structure of the margins based on your two exemplars, but without an assessment of how representative these are, it's hard to know how to interpret the applicability of your model results.

4) A final point, which is also reflected in some of the comments by Reviewer 1, is that considering the broader implications of your modelling would make this paper have much more of an impact. For example, you present an interesting, but limited, set of expectations for what we would see in orogens built from magma-poor vs magma-rich margins focusing on whether we would expect to see pre-rift strata incorporated into the orogen or not, but based at least on your modelling, there appear to be a wide range of additional differences that are left uninterpreted. For example, the two models have very different final structures with the magma-poor model looking more like a traditional bivergent wedge and the magma-rich looking a bit more like singly-vergent wedge. Do you think that's meaningful? Is it an artifact? In general, more guidance for readers as to how they should interpret your results will make this paper much stronger.

I include a few specific line-by-line comments below to supplement those already made by the two reviewers:

L37-38: The logic here would be easier to follow with maybe just a bit more connection between the first and second observations here, i.e., maybe break the second observation into a second sentence to make it clear that you're shifting from extant margins to those preserved in orogenic systems.

L105-106: There is no reference information for this under review paper in the reference list. Is there a preprint available? While this was not clarified in the original author guidelines (our apologies), after conferring with other Tektonika editors and core team, we have decided that In Review literature for which there is no pre-print available should not be cited. Thus, for this reference, you either need to remove it or change this to a citation of a preprint.

L174: Should be "pre-reactivated"

Associate Editor – Adam M. Forte

Reviewer 1 Comments:

Recommendation: Resubmit for Review

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:
Please use this space to describe, in your own words, the core subject of the submission and your overall assessment of its suitability for publication.

- The authors present a study in two parts it seems (?).
    - The first part is a description of a magma-rich and a magma-poor rifted margin (i.e. the Western Demerara Plateau and the Basque-Cantabrian Basin).
    - The second part presents two numerical models of magma-rich and a magma-poor inverted margins, showing some interesting differences in inverted margin evolution.
    - The authors use the model results to explain the lack of magma-rich margin units in orogens to the impact of a detachment layer at different layers if
    - The results and ideas are quite interesting and relevant I think, and I enjoyed reading the manuscript.
    - However, I believe there are a number of important issues with the manuscript that need to be solved:
        - The goal of the paper is not very clear from the main text. In Line 39-40 a first question seems to be presented (why are there no magma-rich margins found in orogens), then a second question is presented in lines 70-71 (how do magma-rich margins evolve?), which is in fact the main question it seems? Then in lines 84-46, there seems to be another goal (to identify magma-rich margins in orogens)? And also in lines 161-166 another aim is presented? (impact of a décollement?)
        - **There is no methods section it seems?** So it is not really clear what is done for this study. For instance, is section 2 a new analysis preformed for this paper, or simply a literature summary? (If the latter is true, it seems that about half of the paper is in fact introduction, and very little new data is presented). How relevant is the rather detailed description of the two natural examples?
        - Then there is a very short section 3 presenting the modelling results. Here the reader can be sure that this is new data. However, due to the lack of methods (even the supplementary materials is very short), it is difficult to assess what is exactly done. Note that the fact that parts of the methods are presented in the results section, the description of results is even shorter.
        - The discussion is interesting, but very limited. There should be much more consideration of previous (modelling) works, and how the new results fit in the context of these works. Another thing that the paper seems to be ignoring is the broad variety of possible margins. How representative are the two natural

examples introduced as end-members? The text seems to moves towards a specific interpretation without considering the boarder context sufficiently well I think. See also detailed comments below.
        - Note that also in the discussion, there seems to be description of results that should be part of the results sections
        - Overall, it seems that the paper is not very much in balance: very long intro, no methods, very short results and discussion, with various part being mixed up to a degree.
    - Another issue I found is that the text contains various textual and grammar errors. In some cases, this hampers readability to quite a degree.

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:

- The structure should be revised: include a clear method section, more results, and a broader discussion (See also comments further down)
- I think that the model results are interesting, but not sufficient to make a case, and additional models may have to be included.
- The readers should carefully check the text for grammar and textual errors.

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:

- The paper should be expanded, and there should probably be made a choice between focussing on the natural examples, or on the numerical models, since the authors themselves state that there is no direct link between them.
- If the authors wish to focus on the natural case, it will be important to make sure the work will differentiate from the Gómez-Romeu et al. (in review) manuscript, which seems to present an

interpretation of the Western Demerara Plateau (as far as I can tell from this manuscript, it seems that the paper is missing in the reference list?).

- If the numerical part will be the focus, there will have to be more models to explore the effects of various parameters. Otherwise, I fear the results are to few and to low-resolution to be of interest. Detailed analyses of strain, displacement, topography evolution etc. could perhaps be done to expand the impact of the numerical models. Also additional models could be done to test the effects of for instance different rheological layering and other parameters (see other comments further in the review)

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:

[Free form box]

A1.2) Author(s) Responses:

A2) Summary of main merits and main points of improvement

A2.1) Reviewer's comments

Please describe below in a few sentences (100 to 300 words) the main merits of the submission and suggestions for improvements.

The main merits I have found are...

- I believe that the topic is very interesting and relevant, and the numerical approach is in principle a very good one for the study.

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

- The structure
- The lack of methods
- The limited amount of new results

A2.2) Author's responses:

[Free form box]

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** — [NO]

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** — [YES]

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** — [YES]

The *Abstract* clearly describes the **importance/impact of the study** — [YES]

The *Abstract* clearly states the **conclusions of the study** — [YES]

The *Abstract* is **clear** and **well structured** — [YES]

Comments:

- I like the abstract quite a lot in fact, it seems to summarize the study quite well.
- Something to consider for the abstract: specifying where in the world the natural examples are, not all readers will know.
- The title should probably include a mention of the numerical models though, for instance:
    - Modelling Inverted Magma-rich Versus Magma-poor Rifted Margins: Implications for Early Orogenic Systems

B1.2) Author's responses

[Free form box]

B2) Introduction

B2.1) Reviewer's comments

*These statements are a **guide** to what good* Introductions *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 *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) — [YES]

The *Introduction* contains **relevant, suitable citations** — [YES]

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

Comments:

- **NB:** In general, I answered YES to the above questions, but there are some important nuances as detailed below.
- Line 39-40: I believe that this sentence (question) causes confusion as it interrupts the flow of the text. I suggest removing it here. The text can then simply state that there are rifted margins, of which there are magma-poor and magma-rich versions, that there is an issue (why are magma-poor margins not represented in orogens?) and that the authors apply numerical models based on two natural cases to try and solve this problem.
- In line 58, I believe a new paragraph should start (before the text is about mange-poor margins, afterwards it is about magma-rich margins). This would enhance the readability of the text (it is now one big block)
- Line 71: what is meant with a more mature collisional stage? I believe that in the western Demerara plateau is not a collisional system? And how well does the large-scale subduction used in the model apply to the Demerara plateau? (there is no subduction zone?).
- Line 84-86: see previous comments on how this looks a bit like a new aim of the study.
- Fig. 1: I was wondering if it is a good idea to include the schematic depictions of the magma-poor and magma-rich margins. Surely, these are not the only margin configurations possible, so it feels a bit like a simplification, especially since in section 2, a detailed analysis of actual passive a margins is presented. Then, it is not that clear what is exactly simulated in the models: the schematic margins, or the two natural cases. Perhaps the schematic drawings in Fig. 1 could be best left out to avoid confusion.
    - Another thing: the transform margin colour is very similar to that of the magma-poor margin colour. Would it be possible to use another colour instead?

- **NB: The above comments refer to section 1. I believe section 2 is also still introduction (geological background), so here are the comments regarding section 2:**
    - Line: 87: by having "observations" in the title, the authors seem to suggest that new observations are made (if so, this needs to be detailed in both the introduction and in the methods). If this is not the case, I would strongly suggest to use something like "tectonic setting"/"geological background" or so.
        - I guess also the inclusion of a methods section would help to make a clear distinction between introduction and results.
    - Lines 88-92: I believe these sentences should be swapped to be more logical.

- Line 109: here a reference would be needed to support the claim about typical structures at distal margins.
- Line 124-125: it seems that the authors present a new hypothesis for compression through incipient subduction. This seems something that should perhaps be discussed in the discussion instead.
    - Does the age of the inversion not contradict this hypothesis? (if subduction would have started, should it not have continued? Or did the tectonic setting in the Atlantic change drastically? Would the seafloor also have been old and dense enough for subduction this early after break-up?
    - Presenting this hypothesis brings up quite some questions here, it may be better to avoid it? Otherwise, I really think a map-view sketch of the evolution of the margin is needed to illustrate things here.
- Figure 2: This figure may need some attention. In general, it seems a bit hastily crafted (see how text and annotation is colored and outlined, or has different font sizes from panel to panel. This can be easily improved I think)
    - In panel (a), the green line and text are poorly visible to me (I have slight red-green colour-blindness) using another colour would be better. Also the bathymetry colour scheme looks a bit off. Perhaps the authors could try some other colors instead?
    - In panel (c) “DMT” is poorly visible, consider using another color than red (also for the reactivated faults). “DSR” in the left lower corner of the section should be “SDR”? What is “gravity extension”? (I believe it also appears in the main text, it should probably be explained there. Is it perhaps salt tectonics?
- Figure 3: this figure look a bit messy to put it a bit harsh. The different panels are not properly aligned, font sizes differ, as do line thicknesses. I believe this can be easily improved with a little attention.
    - I am not sure if the seidmic profiles really bring anything extra, they are hard to understand. Some annotation would be welcome (especially in panel c)
    - Is panel (e) representing the same section as panel (d)? I think the extent of panel (e) should be indicated in panel (d). Or, perhaps panel (d) can be cropped to be the exact same scale and size as panel (e).

B2.2) Author’s responses

[Free form box]

B3) Data and methods

B3.1) Reviewer’s comments

*These statements are a **guide** to what good* Method *sections include and good practices for* Dataset *accessibility. 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 *Methods* are described **concisely and with enough detail** for reproducibility — [NO]

Necessary information about **data sources/acquisition/processing** is included — [NO]

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

The *Dataset and/or Methods* are **organized effectively** — [NO]

Comments:

- There is no methods section, and such a section should be inserted. Furthermore, the text should be written in such a way that the key aspects of the natural examples are highlighted, so that a clear link can be made to the model set-up that is intended to incorporate these aspects.
- There is information on where the seismic lines come from, but the details on the numerical models in the supplement is limited it seems.
- What is very much needed is a set-up figure to illustrate the various parameters and settings used for the study.

B3.2) Author's responses

[Free form box]

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** — [YES]

The *Results* findings are presented **clearly and succinctly** — [YES]

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

The *Results* directly **relate to the study objectives** — [YES]

The *Results* present **data for all the approaches** described in the *Methods* section — [NO]

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

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

Comments:

- Some of the methods are presented in the results section 4.
- As a matter of fact, only Lines 179-195 seem to contain the actual results of this study...

    - This is really not sufficient. It may be true that the results are quite nice as they are quite different between both cases. However, it must be noted that both models differ in various aspects (see Fig. 4, bot the overall rheological profile as the location of the detachment are different), and as such direct comparisons may not be too reliable. How sure can we be that the results are valid? The authors should present various models with varying parameters to show how they may affect the model results.
    - If the authors intend to only present 2 models, a much more detailed analysis of the models should be done. For instance, what is the strain evolution showing the active faults and shear zone (rather than the lines on the sections)? And could the authors not present a version of the models with a higher resolution? I believe the blocks are quite large, which may have an important impact on model results?
- Fig. 4: what are the dark blobs rising up from the subducting plate? What is the unit of viscosity in the strength profiles? I now see that strain rates are in fact presented in (b)? It may be good to split the figure in 2: one page-filling image for each model so that such details are better visible.

B4.2) Author's responses

[Free form box]

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** — [YES] / [NO]

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

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

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

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

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

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

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

Comments:

- I seems that some new model descriptions are included in the discussion. These must be moved to the results section.
- It seems that the discussion is very much focussed on the impact of magma on the system. And although the authors cite some other works at the start, it seems that the results are not properly put into (modelling) context. Even if there are limited or no relevant modelling studies of magma-rich margin inversion available, there are surely a number of relevant inversion models of magma-poor margins. The results from this study should be compared to these previous works, to understand the impact of the various parameters involved, before moving to the comparison to natural examples. Such comparison not only helps to put the new work in context, but also provides the reader with useful citations for further reading.
- A big question I have is how well the natural examples compare to the model results. The natural examples have undergone only very limited inversion (perhaps for a couple of millions of years?) By contrast, the numerical models undergo tens of millions of years of inversion.
- The location of the detachment is not that clear in Fig. 2 and 3. I suggest making it very obvious (perhaps also by using the same colours for the principle units as used in Figs. 1 and 5, doing so would really help making the link between these various images)
- Fig. 5: I suggest swapping the order --> first magma-poor, then magma-rich, as is done in Fig. 4)
    - Note that the order of magma-poor and magma-rich margins varies in different parts of the whole manuscript. It would be good to choose an order and stick to it to enhance clarity.
- The authors suggest that the location of the detachment causes the subduction of the synrift SDRs in magma-rich systems, whereas the detachment would be below the syn-rift units in the magma-poor system. Sounds like an interesting hypothesis. However, does the interface between the post and syn-rift units in the magma-poor setting not have about the same geometry as the same interface in the magma-poor system? As such, should we not expect the décollement to have the same shape/be at the same place in both systems?
    - In other words, how much is the model influenced by the pre-programmed location of the décollement, and what would happen if one would have a décollement at the synrift-postrift interface in the magma-poor system? This would be something to explore in additional models, and finding out the effect would help improve the impact of this study
    - Another hypothesis is that may be of interest could be that the weight of the SDRs causes them to subduct much more easily. This is another thing that could be tested in numerical models, and would enhance the impact of the study.
- I wonder how representative the natural cases are. They are presented as end-members, but how sure are we of this? Can the location of the décollement be a coincidence in both cases? It would in fact be much more interesting to explore a broader variety of margins and build a discussion around it. Just presenting two examples and putting these as explanations for all margins (as it is now presented in the conclusions) is a bit of a stretch at this point I feel.
    - NB: this does not mean that the results are not valid, I quite like the two examples and the story, I just think that there are more things that need to be considered in order to make a strong case here.

B5.2) Author's responses

[Free form box]

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 — [NO]

Tables and *Figures* have **captions that complement** the information in the main text — [YES] / [NO]

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] / [NO]

Figures are **accessible** (elements are clearly labelled, accessible colour palettes, colour contrasts, font size legible, etc.…) — [YES] / [NO]
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] / [NO]

Figures with **maps** have **sufficient location information** (in the map or caption) — [YES] / [NO]

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] — [YES] / [NO]

Citations throughout are relevant, suitable, and comprehensive — [YES] / [NO]

Comments:

- I have added some comments on the figures earlier on in the reviewe
- One thing to consider is that the font types are different in the various figures (sometimes even within figures). I recommend using a standard font and stick with it.
-

Reviewer 2 Comments:

NOTE: Minor comments were included as annotations on a PDF, these are not included in the review report.

Recommendation: Revisions Required

For author and editor
The authors produced numerical models to simulate the mechanical behaviour of magma-rich and magma-poor rifted margins. Their main result is that reactivated magma-rich rifted margins do not easily end up in the accretionary prism compared to magma-poor rifted margins, because of the coupling between the upper and lower plates along the subduction plane. I think the modelling exercise is well-executed and provides very interesting insights in the tectonic activity and evolution of reactivated passive margins, both magma-poor and magma-rich.
In the annotated pdf, I have provided some textual suggestions (up to the authors to decide what to do with them) and minor questions to clarify certain wording. These are really minor points, I didn't find anything big, but I think addressing these points will make the article easier to read, even though the article is already very well readable.
One set of figures that could help are figures that show how the strain or strain-rate evolves over time, especially because the authors mention strain in their results.
I would like to congratulate the authors with their work. I very much enjoyed reading their manuscript and I think the insights we got from this study on the reactivation of passive margins will help us to better identify them in the field and understand the dynamics behind their evolution. I look forward to the published version of this manuscript.

Dr. Anouk Beniest
Assistant Professor, Vrije Universiteit Amsterdam

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:
Please use this space to describe, in your own words, the core subject of the submission and your overall assessment of its suitability for publication.

The authors produced numerical models to simulate the mechanical behaviour of magma-rich and magma-poor rifted margins. Their main result is that reactivated magma-rich rifted margins do not easily end up in the accretionary prism compared to magma-poor rifted margins, because of the coupling between the upper and lower plates along the subduction plane. I think the modelling exercise is well-

executed and provides very interesting insights in the tectonic activity and evolution of reactivated passive margins, both magma-poor and magma-rich.

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:

In the annotated pdf, I have provided some textual suggestions (up to the authors to decide what to do with them) and minor questions to clarify certain wording. These are really minor points, I didn't find anything big, but I think addressing these points will make the article easier to read, even though the article is already very well readable.

One set of figures that could help are figures that show how the strain or strain-rate evolves over time, especially because the authors mention strain in their results.

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:

I think the article is already quite concise, and so I wouldn't make it shorter.

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:

[Free form box]

A2) Summary of main merits and main points of improvement

A2.1) Reviewer's comments

Please describe below in a few sentences (100 to 300 words) the main merits of the submission and suggestions for improvements.

The main merits I have found are...

I like how the authors answer a very concrete question with 2D thermos-mechanical modelling. I really think their models show nicely how magma-poor rifted margins respond differently when reactivated by compression compared to magma-rich rifted margins. This nicely explains why we do not find magma-rich rifted margins on land, or on other word, why we don't find SDRs on land. This is very insightful.

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

In their introduction the authors refer to 'transform margins' to the passive margins that extend from the transform faults at the mid-oceanic ridge to the continent. I wonder if the term 'transform' is misleading, as this implies tectonic activity. The tectonically active transform fault extends into the non-tectonically active fracture zone, perhaps a term can be found that implies this passiveness, for example 'fracture zone margin' or maybe just 'fault(ed) margin' or 'fossil transform margin' if the authors would like to keep the word 'transform'.

In the discussion the authors provide reasons for why the magma-rich rifted margins are subducted and they provide the following explanation: 'due to its volcanic composition leading to an increase of the subducting plate buoyancy as well as the coupling between the upper and lower plates along the subduction plane'. First, I wonder to what extend the internal strength/rheological composition of the magma-rich margin contributes to the subduction, and second, I wonder if the volcanic material (SDRs, presumably mafic) makes the passive margin heavier and therefore easier to subduct. If I look at the models, the SDRs don't seem to have any trouble going down. Can authors comment on this?

A2.2) Author's responses:

[Free form box]

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** — YES

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** — YES

The *Abstract* clearly describes the **importance/impact of the study** — YES

The *Abstract* clearly states the **conclusions of the study** — YES

The *Abstract* is **clear** and **well structured** — YES

Comments:

I think the abstract is well written, the introduction-part of the abstract (line 9 – 15) could perhaps be shortened a bit, but in general I think the abstract is contains the main elements.

B1.2) Author's responses

[Free form box]

B2) Introduction

B2.1) Reviewer's comments

*These statements are a **guide** to what good* Introductions *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 *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) — YES

The *Introduction* contains **relevant, suitable citations** — YES

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

Comments:

[Free form box]

B2.2) Author's responses

[Free form box]

B3) Data and methods

B3.1) Reviewer's comments

*These statements are a **guide** to what good* Method *sections include and good practices for* Dataset *accessibility. 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 *Methods* are described **concisely and with enough detail** for reproducibility — NO

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:

In the table I miss the references of the rheological parameters. They probably come from empirical studies and it would be good to include those references.

B3.2) Author's responses

[Free form box]

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** — YES

The *Results* findings are presented **clearly and succinctly** — YES

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

The *Results* directly **relate to the study objectives** — YES

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.* — YES

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

Comments:

Perhaps section three can be divided into a ‘methods’ and ‘results part. Now they are stuck together and the results get a bit lost.

B4.2) Author’s responses

[Free form box]

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 — YES

The *Discussion* section properly identifies all **speculative statements** — YES

The *Discussion* section presents the **implications of the study** persuasively — YES

The *Discussion* section **highlights novel contributions** appropriately — YES

The *Discussion* section **addresses the limitations** of the study appropriately — YES

The *Discussion* section is **organised effectively** — YES

The *Conclusions* are **consistent** with and **summarise** the rest of the manuscript — YES

The *Conclusions* are **supported by the data** in *Results* and **follow logically** from the *Discussion* — YES

The *Conclusions* are **clear and concise** — YES

Comments:

[Free form box]

B5.2) Author’s responses

[Free form box]

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.…) — NO
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] — n.a.

Citations throughout are relevant, suitable, and comprehensive — YES

Comments:

In figure 2 and 3 the font size of the legend could be a but larger.
In figure 4 the axis-numbers are quite small and could be larger.
In figure 2 and 3 the labels on the maps are sometimes covering structural features, which means that it is not so well readable. Also the font size of the labels in figure 3a are quite small.

B6.2) Author's responses

[Free form box]

Section C: Additional comments

C1) Minor/line-numbered comments

C1.1) Reviewer's comments

I have added these comments in the annotated .pdf.

C1.2) Author's responses

[Free form box]

C2) Other remarks

C2.1) Reviewer's comments

I would like to congratulate the authors with their work. I very much enjoyed reading their manuscript and I think the insights we got from this study on the reactivation of passive margins will help us to better identify them in the field and understand the dynamics behind their evolution. I look forward to the published version of this manuscript.

Dr. Anouk Beniest
Assistant Professor
Vrije Universiteit Amsterdam

C2.2) Author's responses

[Free form box]

2/

Authors Response to Editorial Comments:

There are a few major themes that stand out from the two reviews and my own assessment of the manuscript:

1) Both reviewers highlight that there is not really a methods section for the manuscript, but that it would benefit from one and that effectively what is in your supplement in this version should be incorporated into a methods section describing the modelling in more detail.

We understand this issue and have added a new section 2 that details the research strategy of our work including the aims, the approach and the modelling strategy. In addition, the revised section 5 includes a sub-section that focuses on the input data and modelling setup which partly covers the methodology. Incorporating the supplementary material in the manuscript would interfere with the message of the paper and thus we prefer to leave it in the supplementary material section. However, note that this section has been expanded and thus more detail on the model background is given.

2) Reviewer 1 highlights that at present there is an imbalance between what amounts to the two portions of the manuscript, i.e., the description of your two exemplar rifted margins and the modelling. I would largely agree with this assessment and with the general implication of reviewer 1's thoughts in terms of needing to provide significant additional details on the results of the modelling and the interpretation of the implications. Ultimately, you need to clarify your purpose with this manuscript, i.e., is it a case study of two different margins or is it a modelling paper where those two case studies are simply used as inputs for the model. My sense is that the intent is more the latter, but you focus more on the details of the case studies to the point where the modelling seems almost like an afterthought. If the intent is to focus more on the modelling, and the implications thereof, as highlighted by Reviewer 1, more analysis of these model results are warranted.

We fully understand this issue and have addressed it by adding the new section 2 where we describe our research strategy. This consists of using a thermo-mechanical model to investigate how magma-rich and magma-poor rifted margins reactivate during early orogenesis to obtain insights on the identification of magma-rich rifted margins within orogens. In particular, we investigate the mechanical behaviour of these two end-member rifted margins during early orogenesis. To achieve our research aim, we use two natural laboratories that underwent first rifting and then early orogenesis consisting of the western Demerara Plateau and the Basque-Cantabrian Belt. The analysis of seismic data of our natural laboratories allows us to determine key observations such as the location of the main convergence décollement level. Our modelling strategy consists of using large-scale present-day observations from our study-cases to constrain our modelling experiments. The revised section 5 gives first the input data and modelling setup (5.1) followed by an expanded section of our modelling results (5.2) (including the strain-rate for each model stage as asked by reviewer 2) focused on the subducted-accreted units and the evolution of the location of the convergence décollement level during early orogenesis. In addition, the new section 6.2 argues about the applicability and limitations of our modelling results giving an extended analysis our modelling results while the main results

implications are given in section 6.1. This is focused on insights to recognize magma-rich rifted margins within orogens based on the stratigraphic content of the early orogenic wedge.
The detail of the case studies has been revised and shortened (new section 3) and now the geological setting (3.1) is clearly distinguished from the key observations used as input for our modelling experiments (3.2). In addition, the new section 4 focuses on the particularities and strengths of our study-cases and why they are good natural laboratories to answer the aim of our manuscript.

3) Reviewer 1 opens the possibility of including more models. I don't think that's necessarily a bad suggestion, but there is definitely a path forward that does not require more modelling, but instead just more interpretation of the existing modelling and consideration of the limitations of the limited set of conditions. In that latter scenario, what is needed more than the detailed descriptions of your two exemplar margins that exist right now is an indication of how representative these are of the two broad types of margins. Ultimately, the results of your models are strongly controlled by the assumed structure of the margins based on your two exemplars, but without an assessment of how representative these are, it's hard to know how to interpret the applicability of your model results.

We fully understand this point and have revised it. As we have answered Reviewer 1, while adding more models may be interesting this is out of the scope of this work. However, we agree that adding the model limitations as well as how representative our case-studies are is necessary and thus we did so in the revised version of the manuscript. A new section 4 is added which addresses the particularities and strengths of our study-cases. The common factor of both study-cases (magma-poor and magma-rich rift systems) is that they underwent a particular and local kinematic setting that led to the record of early orogenesis but failing to achieve late orogenesis (i.e. mature subduction and continent-continent collision) and thus preserving the former rift history. This new section describes how representative our two study-cases are in the broad types of margins. The revised 6.1 section details the main results of our modelling results. The new section 6.2 argues about the applicability and limitations of our modelling results and in particular the role of syn-rift sedimentation rate, the presence of an oceanic domain and the nature of the upper plate in the resulting architecture of the early orogenic wedge (see details in the revised manuscript).
We suggest that the learnings from our modelling results apply to both distal magma-rich and magma-poor rifted margins reactivated during early orogenesis but also to more mature orogenic systems that resulted from the closure of wide oceanic domains (see the detail of this in section 6.2.2).

4) A final point, which is also reflected in some of the comments by Reviewer 1, is that considering the broader implications of your modelling would make this paper have much more of an impact. For example, you present an interesting, but limited, set of expectations for what we would see in orogens built from magma-poor vs magma-rich margins focusing on whether we would expect to see pre-rift strata incorporated into the orogen or not, but based at least on your modelling, there appear to be a wide range of additional differences that are left uninterpreted. For example, the two models have very different final structures with the magma-poor model looking more like a traditional bivergent wedge and the magma-rich looking a bit more like singly-vergent wedge. Do you think that's meaningful? Is it an artifact? In general, more guidance for readers as to how they should interpret your results will make this paper much stronger.

As answered above, additional implications of our modelling results have been added in the revised version of our manuscript (new section 6.2). Also, a new section addressing the particularities and strengths of our study-cases has been added (new section 4).
We understand the interest of giving more interpretation of our modelling results however that would require the introduction of additional orogenic topics, that have not been introduced so far, and then address them in the discussion. While this is important for the orogen as well as rifted margin communities, the aim of this paper is to ask a very specific question which allows us to provide insights on the identification of magma-rich rifted margins in orogens. To stick with the purpose of the paper as well as with its short format, we prefer to not introduce additional orogenic topics neither discuss the modelling results further. Our message, based on modelling results, is short and simple: the stratigraphic content of an early orogenic wedge is key to determine whether an orogenic system resulted from an inverted magma-rich or magma-poor rifted margin. Therefore, we believe that addressing further the interpretation of our modelling results would interfere with the message of our manuscript. Carrying out additional models to further explore how magma-rich and magma-poor rifted margins evolve during late orogenesis and their implications for finding magma-rich rifted margins within orogens is out of the scope of our work and potentially considered for another manuscript (see section 6.2.4 focus on future perspectives).

I include a few specific line-by-line comments below to supplement those already made by the two reviewers:

L37-38: The logic here would be easier to follow with maybe just a bit more connection between the first and second observations here, i.e., maybe break the second observation into a second sentence to make it clear that you're shifting from extant margins to those preserved in orogenic systems.

Thanks for this. We have revised this paragraph and clarified the logic so that is easier to understand the two different observations. The revised sentence: "Almost half of the worldwide rifted margins are magma-rich (Figure 1a and c). However only a very few relics of magma-rich rifted margins within Paleozoic orogens have so far been reported (in the Caledonides mountains as shown by Jakob et al. (2019, 2022)."

L105-106: There is no reference information for this under review paper in the reference list. Is there a preprint available? While this was not clarified in the original author guidelines (our apologies), after conferring with other Tektonika editors and core team, we have decided that In Review literature for which there is no pre-print available should not be cited. Thus, for this reference, you either need to remove it or change this to a citation of a preprint.

This paper (Gómez-Romeu et al., 2022) is now accepted in Tectonophysics and cited accordingly. The link to the paper: https://www.sciencedirect.com/science/article/abs/pii/S0040195122004188

L174: Should be "pre-reactivated"

Thanks, this has now been edited.

Authors Response to Reviewer 1 Comments:

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:
Please use this space to describe, in your own words, the core subject of the submission and your overall assessment of its suitability for publication.

- The authors present a study in two parts it seems (?).
    - The first part is a description of a magma-rich and a magma-poor rifted margin (i.e. the Western Demerara Plateau and the Basque-Cantabrian Basin).
    - The second part presents two numerical models of magma-rich and a magma-poor inverted margins, showing some interesting differences in inverted margin evolution.
    - The authors use the model results to explain the lack of magma-rich margin units in orogens to the impact of a detachment layer at different layers if
    - The results and ideas are quite interesting and relevant I think, and I enjoyed reading the manuscript.
    - However, I believe there are a number of important issues with the manuscript that need to be solved:
        - The goal of the paper is not very clear from the main text. In Line 39-40 a first question seems to be presented (why are there no magma-rich margins found in orogens), then a second question is presented in lines 70-71 (how do magma-rich margins evolve?), which is in fact the main question it seems? Then in lines 84-46, there seems to be another goal (to identify magma-rich margins in orogens)? And also in lines 161-166 another aim is presented? (impact of a décollement?)
        - We believe that the structure of the introduction is useful and clear as it contains three parts: why the topic of the manuscript is important, state of the art and the outstanding questions that need to be addressed on the topic of our research. In addition, the precise questions that we aim to answer to contribute to the advancement of knowledge on the topic addressed in the manuscript are also given.
          The first question presented in the introduction (lines 39-40) is a general and long-standing question about the topic addressed in this manuscript. Why do we not find magma-rich rifted margins in orogens? We believe that this sentence at the very beginning is very helpful for the reader as it provides the context and the main problem that this manuscript addresses. Nevertheless, this is a very broad question and our manuscript's aim is a bit more precise (lines 70-71): gain insights on how magma-rich rifted margins invert and evolve during collision leading to orogen formation and lines 72-73 state how we do so (investigating the mechanical behaviour of reactivated magma-rich rifted margins). Trying to answer this question partially helps to unravel the long-standing generic question stated at the very beginning of the manuscript (lines 39-40). Lines 84-86 have been removed. Lines 161-162 provide the main aim of our modelling approach; investigate the mechanical behaviour of inverted magma-rich rifted margins (the same question as in the introduction, lines 70-73). A new section 2 has been added which addresses the research strategy of our work which clearly includes

the aim of the paper. Line numbers given above refer to the first submitted version of our manuscript.

- **There is no methods section it seems?** So it is not really clear what is done for this study. For instance, is section 2 a new analysis preformed for this paper, or simply a literature summary? (If the latter is true, it seems that about half of the paper is in fact introduction, and very little new data is presented). How relevant is the rather detailed description of the two natural examples?
  A new section 2 has been added. This describes the research strategy which clarifies what is done in this study. The former Section 2 is now Section 3 and contains: (i) a short geological setting and (ii) our analysis from the literature together with our observations. This provides the orogenic architecture of our study-cases which is partly used as input data of our modelling experiment (see new Section 2 for detail on this).

- Then there is a very short section 3 presenting the modelling results. Here the reader can be sure that this is new data. However, due to the lack of methods (even the supplementary materials is very short), it is difficult to assess what is exactly done. Note that the fact that parts of the methods are presented in the results section, the description of results is even shorter.
  The former Section 3 is the new Section 5. New Section 5 is longer than the former Section 3 and focuses on the numerical modelling experiments including two sub-sections, one on the input data and modelling setup and the other on the modelling results. New Section 5 does not include methods as this is now in new Section 2 and in the Supplementary material. The supplementary material is now longer and describes the background of the numerical model in more detail while the new Section 2 details the purpose of this manuscript including the research and modelling strategy. We hope that this clearly states what is done in this work.

- The discussion is interesting, but very limited. There should be much more consideration of previous (modelling) works, and how the new results fit in the context of these works. Another thing that the paper seems to be ignoring is the broad variety of possible margins. How representative are the two natural examples introduced as end-members? The text seems to moves towards a specific interpretation without considering the boarder context sufficiently well I think. See also detailed comments below.
  To our knowledge, no previous modelling work on reactivated magma-rich rifted margins exist. Please may you point out towards it if we are wrong. Indeed, previous modelling work on reactivated magma-poor rifted margins exist however discuss this is out of the scope of our work. The revised discussion is now longer and includes first the main implications of our modelling results (6.1) and then the applicability and limitations of our modelling results (6.2). In addition, a new section 4 has been added which details how representative our natural laboratories are.

- Note that also in the discussion, there seems to be description of results that should be part of the results sections
  This has been revised and the results are all in the results section (5) not in the discussion.

- Overall, it seems that the paper is not very much in balance: very long intro, no methods, very short results and discussion, with various part being mixed up to a degree.
  We have revised and corrected this. The manuscript has been restructured (see the detail below) avoiding repetition between the different parts.

  We fully understand this issue and have addressed it by adding the new section 2 where we describe our research strategy. This consists of using a thermo-mechanical model to investigate how magma-rich and magma-poor rifted margins reactivate during early orogenesis to obtain insights on the identification of magma-rich rifted margins within orogens. In particular, we investigate the mechanical behaviour of these two end-member rifted margins during early orogenesis. To achieve our research aim, we use two natural laboratories that underwent first rifting and then early orogenesis consisting of the western Demerara Plateau and the Basque-Cantabrian Belt. The analysis of seismic data of our natural laboratories allows us to determine key observations such as the location of the main convergence décollement level. Our modelling strategy consists of using large-scale present-day observations from our study-cases to constrain our modelling experiments. The revised section 5 gives first the input data and modelling setup (5.1) followed by an expanded section of our modelling results (5.2) (including the strain-rate for each model stage as asked by reviewer 2) focused on the subducted-accreted units and the evolution of the location of the convergence décollement level during early orogenesis. In addition, the new section 6.2 argues about the applicability and limitations of our modelling results giving an extended analysis our modelling results while the main results implications are given in section 6.1. This is focused on insights to recognize magma-rich rifted margins within orogens based on the stratigraphic content of the early orogenic wedge.

  The detail of the case studies has been revised and shortened (new section 3) and now the geological setting (3.1) is clearly distinguished from the key observations used as input for our modelling experiments (3.2). In addition, the new section 4 focuses on the particularities and strengths of our study-cases and why they are good natural laboratories to answer the aim of our manuscript.

  Incorporating the supplementary material in the manuscript would interfere with the message of the paper and thus we prefer to leave it in the supplementary material section. However, note that this section has been expanded and thus more detail on the model background is given.

- Another issue I found is that the text contains various textual and grammar errors. In some cases, this hampers readability to quite a degree.
  We have revised and improved the English of the whole manuscript.

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:

- The structure should be revised: include a clear method section, more results, and a broader discussion (See also comments further down).
  We have revised and corrected this. The manuscript has been restructured (see the detail below) avoiding repetition between the different parts.

  We fully understand this issue and have addressed it by adding the new section 2 where we describe our research strategy. This consists of using a thermo-mechanical model to investigate how magma-rich and magma-poor rifted margins reactivate during early orogenesis to obtain insights on the identification of magma-rich rifted margins within orogens. In particular, we investigate the mechanical behaviour of these two end-member rifted margins during early orogenesis. To achieve our research aim, we use two natural laboratories that underwent first rifting and then early orogenesis consisting of the western Demerara Plateau and the Basque-Cantabrian Belt. The analysis of seismic data of our natural laboratories allows us to determine key observations such as the location of the main convergence décollement level. Our modelling strategy consists of using large-scale present-day observations from our study-cases to constrain our modelling experiments. The revised section 5 gives first the input data and modelling setup (5.1) followed by an expanded section of our modelling results (5.2) (including the strain-rate for each model stage as asked by reviewer 2) focused on the subducted-accreted units and the evolution of the location of the convergence décollement level during early orogenesis. In addition, the new section 6.2 argues about the applicability and limitations of our modelling results giving an extended analysis our modelling results while the main results implications are given in section 6.1. This is focused on insights to recognize magma-rich rifted margins within orogens based on the stratigraphic content of the early orogenic wedge.

  The detail of the case studies has been revised and shortened (new section 3) and now the geological setting (3.1) is clearly distinguished from the key observations used as input for our modelling experiments (3.2). In addition, the new section 4 focuses on the particularities and strengths of our study-cases and why they are good natural laboratories to answer the aim of our manuscript.

  Incorporating the supplementary material in the manuscript would interfere with the message of the paper and thus we prefer to leave it in the supplementary material section. However, note that this section has been expanded and thus more detail on the model background is given.

- I think that the model results are interesting, but not sufficient to make a case, and additional models may have to be included.
  While including more models may be interesting this is out of the scope of this work. However, we added the model limitations (the revised section 6.1) as well as how representative our case-studies are (the new section 4).

The aim of this paper is to ask a very specific question which allows us to provide insights on the identification of magma-rich rifted margins in orogens. To stick with the purpose of the paper as well as with its short format, we prefer to not add additional models. Our message, based on modelling results, is short and simple: the stratigraphic content of an early orogenic wedge is key to determine whether an orogenic system resulted from an inverted magma-rich or magma-poor rifted margin. Therefore, we believe that carrying out additional models and having to address their interpretation would interfere with the message of our manuscript. Additional models to further explore how magma-rich and magma-poor rifted margins evolve during late orogenesis and their implications for finding magma-rich rifted margins within orogens is out of the scope of our work and potentially considered for another manuscript (see section 6.2.4).

- The readers should carefully check the text for grammar and textual errors.
  We have revised and improved the English of the whole manuscript.

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:

- The paper should be expanded, and there should probably be made a choice between focussing on the natural examples, or on the numerical models, since the authors themselves state that there is no direct link between them.
  This has been clarified in the new Section 2 which focuses on the research strategy of our work. We see our contribution as a combination of natural examples with numerical models to answer a very specific question. As described in the new Section 2, our research strategy consists of using a thermo-mechanical model to investigate how magma-rich and magma-poor rifted margins reactivate during early orogenesis. To do so, we use two natural laboratories that underwent first rifting and then early orogenesis consisting of the western Demerara Plateau, located in eastern South America, and the Basque-Cantabrian Belt in northern Iberia. The analysis of seismic data of our natural examples, allows us to determine key orogenic elements, such as the location of the convergence décollement level as well as the shortened and preserved units and those subduction-related. Our modelling strategy consists of using large-scale present-day observations from our study-cases to obtain the input data, characterized by the pre-orogenic rifted margin architecture and the location of the convergence décollement level, for our modelling experiment.

- If the authors wish to focus on the natural case, it will be important to make sure the work will differentiate from the Gómez-Romeu et al. (in review) manuscript, which seems to present an interpretation of the Western Demerara Plateau (as far as I can tell from this manuscript, it seems that the paper is missing in the reference list?).
  The work presented here differs from the work by Gómez-Romeu et al (in review) which is now accepted and referenced accordingly (Gómez-Romeu et al., 2022 recently accepted in Tectonophysics:

https://www.sciencedirect.com/science/article/abs/pii/S0040195122004188?via%3Dihub). The work shown here uses the Western Demerara Plateau as a case-study however does not discuss the origin neither the formation of the deep basement of the magma-rich rifted margin of the Demerara Plateau which is the case of the work by Gómez-Romeu et al., 2022.

- If the numerical part will be the focus, there will have to be more models to explore the effects of various parameters. Otherwise, I fear the results are to few and to low-resolution to be of interest. Detailed analyses of strain, displacement, topography evolution etc. could perhaps be done to expand the impact of the numerical models. Also additional models could be done to test the effects of for instance different rheological layering and other parameters (see other comments further in the review).
  While we are aware that exploring the effects of other parameters in our modelling experiments may be interesting this is out of the scope of this work. Higher-resolution model results have been carried out and included in the revised version of the figures (new Figures 4 and 5). The strain-rate deformation of each model stage has now been included and described in the results section (5.1). The aim of our modelling experiment is to use as input data the rheological layering obtained from our study-cases, a magma-rich and a magma-poor rifted margins, from which the location of the convergence décollement level is determined and then its evolution is investigated during early orogenesis using a modelling approach.

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:

[Free form box]

A1.2) Author(s) Responses:

A2) Summary of main merits and main points of improvement

A2.1) Reviewer's comments

Please describe below in a few sentences (100 to 300 words) the main merits of the submission and suggestions for improvements.

The main merits I have found are...

- I believe that the topic is very interesting and relevant, and the numerical approach is in principle a very good one for the study.
  Thanks.

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

- The structure
- The lack of methods
- The limited amount of new results
  These points have been addressed in the revised version of the manuscript.

A2.2) Author's responses:
[Free form box]

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 — [NO]

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** — [YES]

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** — [YES]

The *Abstract* clearly describes the **importance/impact of the study** — [YES]

The *Abstract* clearly states the **conclusions of the study** — [YES]

The *Abstract* is **clear** and **well structured** — [YES]

Comments:

- I like the abstract quite a lot in fact, it seems to summarize the study quite well.
  Thanks.
- Something to consider for the abstract: specifying where in the world the natural examples are, not all readers will know.
  Thanks, this has been added in the revised manuscript.
- The title should probably include a mention of the numerical models though, for instance:
  - Modelling Inverted Magma-rich Versus Magma-poor Rifted Margins: Implications for Early Orogenic Systems

We prefer to not mention modelling in the title and only refer to the generic topic addressed in the manuscript rather than the approach used.

B1.2) Author's responses

[Free form box]

B2) Introduction

B2.1) Reviewer's comments

*These statements are a **guide** to what good* Introductions *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 *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) — [YES]

The *Introduction* contains **relevant, suitable citations** — [YES]

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

Comments:

- **NB:** In general, I answered YES to the above questions, but there are some important nuances as detailed below.
- Line 39-40: I believe that this sentence (question) causes confusion as it interrupts the flow of the text. I suggest removing it here. The text can then simply state that there are rifted margins, of which there are magma-poor and magma-rich versions, that there is an issue (why are magma-poor margins not represented in orogens?) and that the authors apply numerical models based on two natural cases to try and solve this problem.
  We believe that this sentence at the very end of the first paragraph of the introduction is key as it provides the importance of the topic addressed in this manuscript. In other words, how is it possible that half of the margins worldwide are magma-rich nevertheless have not yet been recognized within orogens in contrast with its end-member magma-poor?
  We have created a new Section 2 where we described the research strategy and modelling approach just after the introduction. We prefer to have an introduction section where we describe the generic problem, state of the art and why answer to the problem is important and then address the approach in Section 2.

- In line 58, I believe a new paragraph should start (before the text is about mange-poor margins, afterwards it is about magma-rich margins). This would enhance the readability of the text (it is now one big block)

Thanks, we have done this in the revised version of the manuscript.

- Line 71: what is meant with a more mature collisional stage? I believe that in the western Demerara plateau is not a collisional system? And how well does the large-scale subduction used in the model apply to the Demerara plateau? (there is no subduction zone?).
  The new Section 2 describes the meaning of mature versus immature collisions. Early orogenesis, or immature collision results from the inversion of distal rifted margins while late orogenesis, or mature collision, consists of shortened proximal rift domain leading to crustal thickening. The Demerara Plateau records an immature collisional system due to a local specific kinematic setting described in the new Section 4.1. In addition, in the same section we argue that the crustal-scale shortening already described in the Demerara Plateau by several authors may be a failed and incipient subduction. However, we do not use this as an input data of our modelling approach but rather the location of the convergence decollement level observed above the syn-kinematic volcanic SDRs. Then our modelling results show that they subduct while the post-rift sediments are incorporated in the early accretionary wedge which is the same orogenic architecture observed in the Demerara Plateau case-study.

- Line 84-86: see previous comments on how this looks a bit like a new aim of the study.
  The last sentences of the former introduction have been deleted in the revised version of the manuscript.

- Fig. 1: I was wondering if it is a good idea to include the schematic depictions of the magma-poor and magma-rich margins. Surely, these are not the only margin configurations possible, so it feels a bit like a simplification, especially since in section 2, a detailed analysis of actual passive a margins is presented. Then, it is not that clear what is exactly simulated in the models: the schematic margins, or the two natural cases. Perhaps the schematic drawings in Fig. 1 could be best left out to avoid confusion.
  The key question addressed in this manuscript is how magma-rich and magma-poor rifted margins reactivate during early orogenesis. The schematic depictions of magma-poor and magma-rich rifted margins in Figure 1 show how these two end-member margins look like before their reactivation. We think is important to leave them as in Figure 6 we show how they reactivate so an easy correlation between the two can be done.
  The new Section 2 describes the research strategy and our modelling approach clarifying how we use our study-cases and how our modelling results relate to them (for detail on this see previous answers above).
  The former Section 2 is now Section 3 however has been carefully edited and improved. Section 3 gives the geological context of the two study-cases used but also their orogenic architecture. It is important to note that the divergent maturity between the schematic depictions in Figure 1 and our study-cases differ. This is discussed in section 6.2 that addresses the applicability and limitations of our modelling results, which consider a full mature rift system (i.e. an oceanic domain) in contrast with our study-cases. The main parameters discussed in section 6.2 are the role of low syn-rift sedimentation rate, the presence of an oceanic domain and the nature of the upper plate in the resulting architecture of an early orogenic wedge.

    - Another thing: the transform margin colour is very similar to that of the magma-poor margin colour. Would it be possible to use another colour instead?
      We have considered and tried to edit the transform margin colour however we realized that the one that stands out best in respect to the blueish-oceans and yellowish-

continents background is the purple. We believe that the blue magma-poor colour is clearly distinguished from the purple transform colour.

- **NB: The above comments refer to section 1. I believe section 2 is also still introduction (geological background), so here are the comments regarding section 2:**
    - Line: 87: by having “observations” in the title, the authors seem to suggest that new observations are made (if so, this needs to be detailed in both the introduction and in the methods). If this is not the case, I would strongly suggest to use something like “tectonic setting”/”geological background” or so.
      We agree and edited this. As already said above, the former Section 2 is now the new Section 3 entitled “Geological setting and orogenic architecture of two natural laboratories”. Section 3.1 refers to the magma-rich Demerara Plateau example while 3.2 to the Basque Cantabrian Belt. Within these two sections there are two sub-sections; the first one refers to the geological setting of the study-cases while the second one to their orogenic architecture. The latter is obtained from the literature together with our own analysis to fit with the purpose of this study and thus distinguish the location of the convergence décollement level together with the preserved versus subducted units (see sections 3.1.2 and 3.2.2 for detail).

        - I guess also the inclusion of a methods section would help to make a clear distinction between introduction and results.
          We agree that this was lacking and has now been included in the revised version of the manuscript. We have created a new Section 2 where we describe the research and modelling strategy clarifying the link between the introduction and our study-cases with the modelling results. Then in the discussion a new sub-section (6.2) has been added to address the applicability and limitations of our modelling results in comparison with our study-cases.

    - Lines 88-92: I believe these sentences should be swapped to be more logical.
      We have deleted this paragraph and re-write it as: “A brief geological setting of both study-cases followed by key orogenic observations obtained from literature and based on our own assessment are given below.

    - Line 109: here a reference would be needed to support the claim about typical structures at distal margins.
      This section has been re-written to improve the writing style and clarify the message and consequently this sentence does not longer exist.

    - Line 124-125: it seems that the authors present a new hypothesis for compression through incipient subduction. This seems something that should perhaps be discussed in the discussion instead.
      We agree and have revised this. In the new version of the manuscript this has been moved into the revised section 4 (section 4.1).

        - Does the age of the inversion not contradict this hypothesis? (if subduction would have started, should it not have continued? Or did the tectonic setting in the Atlantic change drastically? Would the seafloor also have been old and dense enough for subduction this early after break-up?

The age of the inversion is late Lower Cretaceous and strongly supports this hypothesis. The new text for this is: “Shortening in the Demerara Plateau (DMT) occurred due to a change of plate kinematics characterized by the anticlockwise rotation of Africa in respect to South America (Trude et al. 2022). Note that shortening in the Demerara Plateau took place simultaneously with the onset of the Caribbean mature subduction in the north. The orientation of the DMT (Figure 2) is the same as the regional Jurassic transform that occurred due to the NNW-SSE kinematic event (Trude et al., 2022). Based on this, we propose that the DMT resulted from a reactivated former Jurassic transform structure leading to a forced incipient and failed mature subduction. Subduction initiation at former fracture zones, where flooding of oceanic plates by melt is likely, was already proposed by Hynes (2005) and Zhou et al., (2018).”
As explained, the failed subduction in the Demerara Plateau occurred due to a change of plate kinematics which led to the recorded and observed shortening. Indeed, a key question is why subduction stopped and we believe that is likely because plate convergence stopped too early.

- Presenting this hypothesis brings up quite some questions here, it may be better to avoid it? Otherwise, I really think a map-view sketch of the evolution of the margin is needed to illustrate things here.
  We believe that the revised text for this hypothesis (see above) is clearer and states the possible origin of the recorded shortening in the Demerara Plateau, already reported by many. This consists of a reactivated former Jurassic transform due to a change of plate kinematics. We are aware that providing more insights on this may be interesting however this is out of the scope of this work. Therefore, we prefer to only mention it in the revised manuscript (we believe it is important for people working on this area) in a way that does not interferes with the aim of this manuscript which focuses on the reactivation of magma-rich versus magma-poor rifted margins during early orogenesis. We think that the lineaments (subduction, Cretaceous margin and seismic profile used here) shown in the map of Figure 2a are sufficient to communicate the message.

- Figure 2: This figure may need some attention. In general, it seems a bit hastily crafted (see how text and annotation is colored and outlined, or has different font sizes from panel to panel. This can be easily improved I think)
  We have edited this figure in the revised manuscript. Font size of the text has been increased and the figure is now landscape and bigger.

  - In panel (a), the green line and text are poorly visible to me (I have slight red-green colour-blindness) using another colour would be better. Also the bathymetry colour scheme looks a bit off. Perhaps the authors could try some other colors instead?
    The green and red colours should remain as they area as this is done in purpose to match with the colours used in panel c). The green colour refers to the Cretaceous margin and the red to the convergence decollement. We are sorry but cannot change the bathymetry colour scheme as we do not have access to this parameter anymore.

- In panel (c) “DMT” is poorly visible, consider using another color than red (also for the reactivated faults). “DSR” in the left lower corner of the section should be “SDR”? What is “gravity extension”? (I believe it also appears in the main text, it should probably be explained there. Is it perhaps salt tectonics?
  DMT has now been increased and is clearly visible. We believe that the red colour is adequate to illustrate convergence tectonics and as such we colour the decollement level in red in all the figures for consistency. DSR in the left lower corner is correct and refers to an observation from Gómez-Romeu et al 2022. SDRs are not in the basement but above coloured by blue. We have changed gravity extension for gravity-driven extension. We believe that this term is clearer to indicate extension related to instable uncompacted post-rift sediments due to a slope produced by the convergence tectonics.

- Figure 3: this figure look a bit messy to put it a bit harsh. The different panels are not properly aligned, font sizes differ, as do line thicknesses. I believe this can be easily improved with a little attention.
  We have revised and edited this figure. The panels are now aligned and the different font sized are the same. Line thickness differ in purpose to distinguish thick-skin from thin-skinned deformation (this is indicated in the figure caption).

  - I am not sure if the seidmic profiles really bring anything extra, they are hard to understand. Some annotation would be welcome (especially in panel c)
    The seismic profiles are interpreted in Lescoutre et al 2021 and this is indicated in the figure caption. Here we prefer to show them uninterpreted for the reader to see the observations used to constrain the geological section of panel e).

  - Is panel (e) representing the same section as panel (d)? I think the extent of panel (e) should be indicated in panel (d). Or, perhaps panel (d) can be cropped to be the exact same scale and size as panel (e).
    Thanks, we have considered this and edited accordingly. The old panel d) is now panel b) and on it is shown the extent of the seismic profiles (c and d) as well as the extent of panel e) (the geological cross-section).

B2.2) Author’s responses

[Free form box]

B3) Data and methods

B3.1) Reviewer’s comments

*These statements are a **guide** to what good* Method *sections include and good practices for* Dataset *accessibility. 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 *Methods* are described **concisely and with enough detail** for reproducibility — [NO]

Necessary information about **data sources/acquisition/processing** is included — [NO]

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

The *Dataset and/or Methods* are **organized effectively** — [NO]

Comments:

- There is no methods section, and such a section should be inserted. Furthermore, the text should be written in such a way that the key aspects of the natural examples are highlighted, so that a clear link can be made to the model set-up that is intended to incorporate these aspects.
  As mentioned above, a new section 2 focused on the research strategy of this work has been added in the revised manuscript. This provides at the very beginning the purpose/aim of this work which is closely related with the methodology used in this work consisting of a combination between observations from natural laboratories and modelling. In the revised version, the key aspects of the natural examples are given in sections 3.1.2. and 3.2.2. In addition, the new section 5.1 provides the input data and modelling setup so that is clear how these observations are used for the modelling experiment.

- There is information on where the seismic lines come from, but the details on the numerical models in the supplement is limited it seems.
  The numerical model used in this work has been already used and published by others (e.g. Poliakov et al., 1993; Tan et al., 2012; Svartman Dias et al., 2015). Nevertheless, the supplementary material has been expanded and thus more detail on the model background is now given.

- What is very much needed is a set-up figure to illustrate the various parameters and settings used for the study.
  The new section 5.1 provides the input data and modelling setup details corresponding with Figures 4a-b and 5a-b together with the table in the supplementary material. These figures and text provide the initial parameters and set-up of our modelling experiments.

B3.2) Author's responses

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** — [YES]

The *Results* findings are presented **clearly and succinctly** — [YES]

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

The *Results* directly **relate to the study objectives** — [YES]

The *Results* present **data for all the approaches** described in the *Methods* section — [NO]

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

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

Comments:

- Some of the methods are presented in the results section 4.
  We have revised and edited this. The former section 4 is now the new section 5 and contains two sub-sections one that focuses on the input data and modelling setup and the other on the modelling results. No methods are presented in the revised section 5 as they are now in the new section 2 and in the supplementary material.

- As a matter of fact, only Lines 179-195 seem to contain the actual results of this study...
  This has been edited and the results are now longer (see the new section 5.2). Also the implications of our results are given in the revised sections 6.1 and 6.2.

    - This is really not sufficient. It may be true that the results are quite nice as they are quite different between both cases. However, it must be noted that both models differ in various aspects (see Fig. 4, bot the overall rheological profile as the location of the detachment are different), and as such direct comparisons may not be too reliable. How sure can we be that the results are valid? The authors should present various models with varying parameters to show how they may affect the model results.
      We are aware that presenting additional models varying different parameters may be interesting however this is out of the scope of this work. Again, the new section 2 details the research strategy, including the modelling strategy, and thus how the results should be considered. In addition, the new section (6.2) describes the applicability and limitation of our modelling results.

    - If the authors intend to only present 2 models, a much more detailed analysis of the models should be done. For instance, what is the strain evolution showing the active faults and shear zone (rather than the lines on the sections)? And could the authors not present a version of the models with a higher resolution? I believe the blocks are quite large, which may have an important impact on model results?
      A more detailed description of the models is given in section 5.2 and implications of our results are also given in the discussion. The strain-rate deformation is now included in Figures 4 and 5 as well as a higher resolution version of our models.

- Fig. 4: what are the dark blobs rising up from the subducting plate? What is the unit of viscosity in the strength profiles? I now see that strain rates are in fact presented in (b)? It may be good to split the figure in 2: one page-filling image for each model so that such details are better visible.
  The dark blobs are melt. The former figure 4 has been splitted in two (new Figures 4 and 5) showing each model stage associated with the strain-rate deformation.

B4.2) Author's responses

[Free form box]

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** — [YES] / [NO]

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

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

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

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

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

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

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

Comments:

- I seems that some new model descriptions are included in the discussion. These must be moved to the results section.
  This has been revised and moved to the results section.

- It seems that the discussion is very much focussed on the impact of magma on the system. And although the authors cite some other works at the start, it seems that the results are not properly put into (modelling) context. Even if there are limited or no relevant modelling studies of magma-rich margin inversion available, there are surely a number of relevant inversion models of magma-poor margins. The results from this study should be compared to these previous works, to understand the impact of the various parameters involved, before moving to the comparison to

natural examples. Such comparison not only helps to put the new work in context, but also provides the reader with useful citations for further reading.
The discussion is now focused in two aspects; (i) insights to recognize magma-rich rifted margins within orogens and (ii) applicability and limitations of our modelling results. Modelling work on the fate of magma-rich rifted margins into orogens does not exist so far. Indeed, there are previous work on inversion models of magma-poor rifted margins however discussing this is not the aim of this work but rather comparing the resulting architecture of early orogenic wedge between magma-rich and magma-poor rifted margins as it is addressed in the revised discussion.

- A big question I have is how well the natural examples compare to the model results. The natural examples have undergone only very limited inversion (perhaps for a couple of millions of years?) By contrast, the numerical models undergo tens of millions of years of inversion.
  This is now described in section 6.2 together with section 4 where we argue about the particularities and strengths of our study-cases. We use the observations of the natural examples as input data of our modelling experiment.

- The location of the detachment is not that clear in Fig. 2 and 3. I suggest making it very obvious (perhaps also by using the same colours for the principle units as used in Figs. 1 and 5, doing so would really help making the link between these various images)
  The thickness of the detachment has been increased in both Figures 2 and 3 making it easily visible. Unit's colours are the same in all figures.

- Fig. 5: I suggest swapping the order --> first magma-poor, then magma-rich, as is done in Fig. 4)
  - Note that the order of magma-poor and magma-rich margins varies in different parts of the whole manuscript. It would be good to choose an order and stick to it to enhance clarity.
    This figure is now split in revised Figures 4 and 5. We first show magma-rich and then magma-poor. We have revised that this is the case for the rest of the figures as well as the text. Except in Figure 1 where we first show magma-poor to introduce to the reader the most known end-member margin, i.e. magma-poor.

- The authors suggest that the location of the detachment causes the subduction of the synrift SDRs in magma-rich systems, whereas the detachment would be below the syn-rift units in the magma-poor system. Sounds like an interesting hypothesis. However, does the interface between the post and syn-rift units in the magma-poor setting not have about the same geometry as the same interface in the magma-poor system? As such, should we not expect the décollement to have the same shape/be at the same place in both systems?
  The location of the detachment above and below the syn-rift for the magma-rich and magma-poor rift systems respectively is observed in the two case-studies. Thus, these observations are used as input data of our modelling experiment in a pre-reactivated magma-rich and magma-poor rifted margins. Our seismic observations show a different location for the convergence detachment level.

  - In other words, how much is the model influenced by the pre-programmed location of the décollement, and what would happen if one would have a décollement at the synrift-postrift interface in the magma-poor system? This would be something to explore in additional models, and finding out the effect would help improve the impact of this study

As answered above, the location of the convergence detachment level is determined from the two study-cases used. As a consequence of the margin architecture setup and the rheological characteristics (parameters of the viscous flow law) of the material used in the model (see supplementary material), the main rheological contrast (MRC in Figures 4 and 5) is located at the base of the post-rift sediments (i.e. top magmatic SDRs) for a magma-rich rifted margin and at the base of the sedimentary unit for a magma-poor rifted margin.

- Another hypothesis is that may be of interest could be that the weight of the SDRs causes them to subduct much more easily. This is another thing that could be tested in numerical models, and would enhance the impact of the study.
  The subduction of the SDRs occurs because the location of the convergence decollement level is above them and thus leads to their subduction. This is shown by our modelling results.

- I wonder how representative the natural cases are. They are presented as end-members, but how sure are we of this? Can the location of the décollement be a coincidence in both cases? It would in fact be much more interesting to explore a broader variety of margins and build a discussion around it. Just presenting two examples and putting these as explanations for all margins (as it is now presented in the conclusions) is a bit of a stretch at this point I feel.
  A new section 4 has been added. This argues about the particularities and strengths of our study-cases. Indeed, further additional models and comparison with other study-cases worldwide may be interesting however this remains out of the scope of this study. Our results and conclusions are based on our modelling approach (detailed in Section 2) and so far, this is the first study looking at this issue. We believe that our conclusions are relevant and insightful. Future studies on this topic may be able to provide further conclusions/details.

  - NB: this does not mean that the results are not valid, I quite like the two examples and the story, I just think that there are more things that need to be considered in order to make a strong case here.
    Indeed, additional models may be interesting but this is out of the scope of this study.

B5.2) Author's responses

[Free form box]

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 — [NO]

Tables and *Figures* have **captions that complement** the information in the main text — [YES] / [NO]

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] / [NO]

Figures are **accessible** (elements are clearly labelled, accessible colour palettes, colour contrasts, font size legible, etc.…) — [YES] / [NO]
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] / [NO]

Figures with **maps** have **sufficient location information** (in the map or caption) — [YES] / [NO]

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] — [YES] / [NO]

Citations throughout are relevant, suitable, and comprehensive — [YES] / [NO]

Comments:

- I have added some comments on the figures earlier on in the reviewe
  Comments above have been addressed/answered.

- One thing to consider is that the font types are different in the various figures (sometimes even within figures). I recommend using a standard font and stick with it.
  This has been revised and edited.

B6.2) Author's responses

[Free form box]

Section C: Additional comments

C1) Minor/line-numbered comments

C1.1) Reviewer's comments

[Free form box]

C1.2) Author's responses

[Free form box]

C2) Other remarks

C2.1) Reviewer’s comments

[Free form box]

C2.2) Author’s responses

Author’s responses are provided in red below of each reviewer comment for facilitating the revision process. I found very difficult to response to a substantial number of comments in a section in two pages later as it is impossible to make the link to the comments made by the reviewer.

Authors Response to Reviewer 2 Comments:

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:
Please use this space to describe, in your own words, the core subject of the submission and your overall assessment of its suitability for publication.

The authors produced numerical models to simulate the mechanical behaviour of magma-rich and magma-poor rifted margins. Their main result is that reactivated magma-rich rifted margins do not easily end up in the accretionary prism compared to magma-poor rifted margins, because of the coupling between the upper and lower plates along the subduction plane. I think the modelling exercise is well-executed and provides very interesting insights in the tectonic activity and evolution of reactivated passive margins, both magma-poor and magma-rich.
Thanks.

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:

In the annotated pdf, I have provided some textual suggestions (up to the authors to decide what to do with them) and minor questions to clarify certain wording. These are really minor points, I didn't find anything big, but I think addressing these points will make the article easier to read, even though the article is already very well readable.
Thanks. The comments by reviewer 2 have been addressed.

One set of figures that could help are figures that show how the strain or strain-rate evolves over time, especially because the authors mention strain in their results.
We have realized that this was an important point and have added the strain-rate for each model stage in the revised Figures 4 and 5.

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:

I think the article is already quite concise, and so I wouldn't make it shorter.

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:

[Free form box]

A1.2) Author(s) Responses:

A2) Summary of main merits and main points of improvement

A2.1) Reviewer's comments

Please describe below in a few sentences (100 to 300 words) the main merits of the submission and suggestions for improvements.

The main merits I have found are...

I like how the authors answer a very concrete question with 2D thermos-mechanical modelling. I really think their models show nicely how magma-poor rifted margins respond differently when reactivated by compression compared to magma-rich rifted margins. This nicely explains why we do not find magma-rich rifted margins on land, or on other word, why we don't find SDRs on land. This is very insightful.
Thanks.

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

In their introduction the authors refer to 'transform margins' to the passive margins that extend from the transform faults at the mid-oceanic ridge to the continent. I wonder if the term 'transform' is misleading, as this implies tectonic activity. The tectonically active transform fault extends into the non-tectonically active fracture zone, perhaps a term can be found that implies this passiveness, for example 'fracture zone margin' or maybe just 'fault(ed) margin' or 'fossil transform margin' if the authors would like to keep the word 'transform'.

We agree that the terminology is misleading as we believe that “transform margins” are not simply the result of transforms bounding an ocean and a continent. However, this is the so far published terminology to refer to these margins (please see Basile et al., 2015; Mercier de Lépinay, 2016). We believe that introducing a new terminology for these margins, and especially in the introduction, would probably cause unclarity about the purpose of our manuscript which is not to provide a new terminology for transform margins. Therefore, we prefer to use the so far published terminology and refer to “transform margins” as it states in the current manuscript.

In the discussion the authors provide reasons for why the magma-rich rifted margins are subducted and they provide the following explanation: ‘due to its volcanic composition leading to an increase of the subducting plate buoyancy as well as the coupling between the upper and lower plates along the subduction plane’. First, I wonder to what extend the internal strength/rheological composition of the magma-rich margin contributes to the subduction, and second, I wonder if the volcanic material (SDRs, presumably mafic) makes the passive margin heavier and therefore easier to subduct. If I look at the models, the SDRs don’t seem to have any trouble going down. Can authors comment on this?

In the revised version of the manuscript this sentence does not longer exist and the discussion has been improved hoping that now is clearer.
Indeed, the SDRs do not have any problem to subduct as our model results show and we state in the conclusions. However, to our knowledge, this has not been described so far. Both the composition of the SDRs and their mechanical coupling with the underlying basement is what explains why they are subductable and the impact that this has on the stratigraphic content of the accretionary wedge (being only made of post-rift sediments). One of the main take-home messages of our manuscript is to show why SDRs and/or relics of magma-rich rifted margins may not be identified so far in orogenic systems (i.e. volcanics are not expected to be accreted).

A2.2) Author’s responses:

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** — YES

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** — YES

The *Abstract* clearly describes the **importance/impact of the study** — YES

The *Abstract* clearly states the **conclusions of the study** — YES

The *Abstract* is **clear** and **well structured** — YES

Comments:

I think the abstract is well written, the introduction-part of the abstract (line 9 – 15) could perhaps be shortened a bit, but in general I think the abstract is contains the main elements.
We have considered to shorten lines 9-15 but we felt that all the information given was necessary and thus left the paragraph as it was.

B1.2) Author's responses

[Free form box]

B2) Introduction

B2.1) Reviewer's comments

*These statements are a **guide** to what good* Introductions *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 *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) — YES

The *Introduction* contains **relevant, suitable citations** — YES

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

Comments:

[Free form box]

B2.2) Author's responses

[Free form box]

B3) Data and methods

B3.1) Reviewer's comments

*These statements are a **guide** to what good* Method *sections include and good practices for* Dataset *accessibility. 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 *Methods* are described **concisely and with enough detail** for reproducibility — NO

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:

In the table I miss the references of the rheological parameters. They probably come from empirical studies and it would be good to include those references.
We have realized about this missing information and added it in the revised version of our manuscript.

B3.2) Author's responses

[Free form box]

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** — YES

The *Results* findings are presented **clearly and succinctly** — YES

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

The *Results* directly **relate to the study objectives** — YES

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.* — YES

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

Comments:

Perhaps section three can be divided into a ‘methods’ and ‘results part. Now they are stuck together and the results get a bit lost.
We understand this and have revised the previous section three. In the revised version of this manuscript, we have added a new section 2 where we state the research strategy, the new section 3 details the geological setting and the orogenic architecture of the two natural laboratories (these are observations from the literature review together with our own analysis) and the new section 5 shows first the input data and modelling setup and then the numerical modelling results. We believe that now the methods are clearly separated from the results part. As asked by reviewer 1, the particularities and strengths of our study-cases are now also included in the new section 4.

B4.2) Author’s responses

[Free form box]

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 — YES

The *Discussion* section properly identifies all **speculative statements** — YES

The *Discussion* section presents the **implications of the study** persuasively — YES

The *Discussion* section **highlights novel contributions** appropriately — YES

The *Discussion* section **addresses the limitations** of the study appropriately — YES

The *Discussion* section is **organised effectively** — YES

The *Conclusions* are **consistent** with and **summarise** the rest of the manuscript — YES

The *Conclusions* are **supported by the data** in *Results* and **follow logically** from the *Discussion* — YES

The *Conclusions* are **clear and concise** — YES

Comments:

[Free form box]

B5.2) Author's responses

[Free form box]

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.…) — NO
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] — n.a.

Citations throughout are relevant, suitable, and comprehensive — YES

Comments:

In figure 2 and 3 the font size of the legend could be a but larger.
This has been done in the revised version of the figures.

In figure 4 the axis-numbers are quite small and could be larger.
The former figures 4 has now been splitted in Figures 4 and 5 giving more space to enlarge the figures and thus the axis-numbers are now bigger.

In figure 2 and 3 the labels on the maps are sometimes covering structural features, which means that it is not so well readable. Also the font size of the labels in figure 3a are quite small.

We have revised the labels on the maps of Figures 2 and 3 and made sure that they are now readable in the revised version figures. Also, we have increased the font size of the labels in Figure 3a.

B6.2) Author's responses

[Free form box]

Section C: Additional comments

C1) Minor/line-numbered comments

C1.1) Reviewer's comments

I have added these comments in the annotated .pdf.

C1.2) Author's responses

[Free form box]

C2) Other remarks

C2.1) Reviewer's comments

I would like to congratulate the authors with their work. I very much enjoyed reading their manuscript and I think the insights we got from this study on the reactivation of passive margins will help us to better identify them in the field and understand the dynamics behind their evolution. I look forward to the published version of this manuscript.

Dr. Anouk Beniest
Assistant Professor
Vrije Universiteit Amsterdam

Thanks, we appreciate this very much. We believe that the edits carried out after this round of review provides a better manuscript suitable for Tektonika.

C2.2) Author's responses

Author's responses are provided in red below of each reviewer comment for facilitating the revision process. I found very difficult to response to a substantial number of comments in a section in two pages later as it is impossible to make the link to the comments made by the reviewer.

3/

2nd Round Decision Letter Followed by AE Comments and 2 Reviews:
Sent: 17th January

Thank you for your resubmission of your article "Inverted magma-rich vs magma-poor rifted margins: Implications for early orogenic systems" to Tektonika. We have now received two reviews for the submitted manuscript and have reviewed these along with your submission. Based on our reading of the reviews and the paper itself, we have reached a decision regarding your article.

Our decision is: Revisions Required

As you will see, the reviews are quite split in terms of their suggestions and general recommendations. To be clear, we do not agree with the main premise of Reviewer 1's review, i.e., that the paper should be fundamentally different than what it is. However, we send it to you along with Reviewer 2's review, as both of these have useful thoughts in their 'detailed comments', which we encourage you to pay particular attention to as these will improve the readability of your paper.

We also ask that you look again at your figures and their accessibility as this is an important aspect of Tektonika's ethos. You can check our figure guidelines for authors here: https://tektonika.online/index.php/home/figure_guidelines

We do not anticipate the need to send your paper for further review, and this round of revision should instead focus on making the existing points clearer. We look forward to receiving a revised manuscript from you within 4 weeks, including a response to the points raised, changes to the revised manuscript highlighted and a clean copy of the manuscript.

Thank you for giving us the opportunity to consider your work.

Yours sincerely,

Adam Forte, PhD, Associate Editor - Tektonika
Janine Kavanagh, PhD, Executive Editor – Tektonika

Reviewer 1 Comments:

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:

Please use this space to describe, in your own words, the core subject of the submission and your overall assessment of its suitability for publication.

- The resubmitted manuscript has been modified, and the topic addressed is very interesting and relevant. As such, I believe that there is great potential in this work. However, I am afraid I have to be harsh and point out that most of the issues I found the first manuscript are still prevalent in the resubmitted version. As such, the paper needs to be revised. Please find the details below, I hope that the authors will find my feedback helpful. Kind regards, Frank Zwaan

General comments:

- Firstly, the topic is a great one, and the question why no (or only little) magma-rich margins are preserved in origins is an excellent research question. Here, numerical models can surely bring new insights and I think that the authors are onto something.

- However, the study really seems to be split in two parts that do not work together: there is first a presentation of two (partially inverted) margins that are rather specific in tectonic setting and thus difficult to accept as two good examples of magma-rich/poor end-members, followed by two numerical models that are not convincingly linked to these margins:
- The first example is magma-rich passive margin boarding a fully-developed ocean, that was slightly inverted by what seems to be a transform or strike-slip fault, and may in fact be some kind of flower structure (?). This inversion seems to have created a reverse fault above the SDRs.
- The second example is a more strongly inverted magma-poor hyperextended rift basin. Importantly, this setting contains a pre-rift evaporite layer that the authors mention as having been active during subsequent basin inversion (where the closing of the basin was more or less parallel to the basin).

- How are these both examples clear end-members? They are very different from each other in terms of the inversion mechanism, and the presence of pre-rift salt in one of them. Furthermore, various researchers have shown the variability in rifted margin architecture, why should these two specific examples be taken as end member cases? Only the fact that they register (some) inversion does not suffice here.
- Then, numerical models are run, which involve the full-scale subduction of a mature oceanic basin, up to early continental collision. These models clearly represent very different tectonic settings from the natural examples that are described in much detail earlier on. In fact, these natural examples are really not touched on again in the discussion, although the authors do mention that they use them (start of section 6). Note that in section 2, the authors describe that they use the natural cases to constrain their models, but it is not really clear how this is done (too few details on model set-up).
- The authors do claim (section 5.1) that the models contain the main rheological contrast found in the natural examples (and in the abstract it is stated that this is intentional), but as far as I can tell, the depth of the rheological contrast may simply be coincidence and not representative of end-member cases. The rheological profile shown in Figs. 4 and 5 is taken at a specific place, and could easily be different more towards the continent (or away). Also, it is well-known that many factors affect the rheology of the lithosphere (including the presence of salt), and it is really not clear how representative the set-up shown in this paper is (also since insufficient details are provided to assess this, and as I pointed out in my previous review, more models to explore the parameter space a bit more would help to mitigate this significant weakness in the modelling results). As it is, the two models really only provide a first attempt at studying the topic (as is very clear from the discussion in section 6.2), and the outcomes, although really interesting, should not be presented as conclusive (which needs to be changed in the manuscript text and conclusions).

- Overall, I believe that the inclusion of the natural examples, although interesting, significantly hampers the story the authors aim to tell, as the models do simply not represent the tectonic settings of the natural examples. I think it would be much better to present a much more generalized introduction providing the end-member settings from Fig. 1, and motivate the modelling effort based on that. The natural examples could perhaps come back in the discussion to show how inversion of a margin may work, even if the tectonic setting is somewhat different in these cases. As it is, the natural examples just take a lot of space and distract from what I think should be the main focus of the

manuscript: what do the models tell us about the development of orogens from magmarich vs. magma-poor margins, and how can we recognize (traces of) magma-rich margins in orogens? As it is, introducing the natural examples feels as the inspiration for the two numerical models in the manuscript feels very forced (even if they may have been the original inspiration for this study).

- Removing the detailed description of the natural examples would also remove the ambiguity in what the geological setting is representing (see comments on the structure of the paper below).
- Note also, that the introduction mentions cases like the Pyrenees and Alps in some detail, the latter being a rather complex system with continental ribbons (Briançonnais) that is not that well represented in the models. Again, I feel it would be better to introduce the issue in general terms, and focus the text on what the main message is. This will also help to streamline the manuscript, as the authors state in their reply they aim at a short paper (this however does not mean that crucial information regarding model set-up can be left out).

- Structure of the paper:
- The paper seems to not follow a clear structure. The authors have added a section “Research strategy”, but it is not very clear if this is meant to be a proper methods section, or simply the last part of the introduction where the general methodology is described. In any case, very few practical details are included here.
- Then, the authors present the geological setting, and it is not really clear if there is new information here as a description of the methodology is lacking. As far as I can tell, they simply reuse published knowledge here.
- Section 4 as a separate section feels a bit off, should this not be part of section 3?
- Only at the start of section 5 is there a clear mention of methodology, but as with section 2, this is very short. There is some supplement, but also this is insufficient (for instance, what are the thicknesses of the continental crust in these models? Why are the specific geometries chosen, why the specific velocities, are surface processes involved etc. Such basic details need to be included).
- There are some very short results and discussion, where the main message is that magma-rich margins tend to subduct, and syn-rift units will likely be removed.

- A question: what happens if two magma-rich margins collide? Will the SDRs from both margins subduct? Or will one thrust over the other? This could be an interesting additional model to include.

- Overall, what I think could be the solution to this model is a restructuring and the removal of the focus on the natural examples. There should be a proper methods section after the introduction that describes in sufficient detail what has been done, and I think the paper should have a focus on numerical models (where I believe there should be more model results than presently included, for the reasons outlined above: the two models are interesting but may simply not be representative). The natural examples could perhaps be introduced in the discussion section, but in such a way that they do not distract from the main message as they do in the current manuscript.

- Finally, there remains numerous grammatical issues in the text, that in various cases hamper a proper reading of the text. In fact, I feel that the reader needs to do a lot of work to follow the text, partially to the issues listed above (but also due to complex wording or sometimes imprecise or seemingly inconsistent statements), where the authors should strive to make the text as accessible as possible. I have noted a couple of suggestions for improvements below, please make sure to double-check the text for future submission.

Detailed comments:

- Title:
- why not go all-in, something like: “Recognizing magma-rich rifted margins in orogenic systems”?
- I feel that may cover the message in a clearer way
- NB: I would remove the capitalization, that way it reads easier.

- Abstract:
- Line 20-22: unclear sentence, as it seems to state that the presence of mountain belts depends on the type of margin, which is clearly not the case. Please rephrase.
- Line 25: perhaps add a comma after “systems”
- Line 33-34: “subduction zone” is meant? This issue occurs more often in the text
    - Note that the use of “subduction” feels often a bit off, especially in the case of the Demerara Plateau, where really only a bit of underthrusting occurs.

Subduction, to me, is something on a different level, and strongly related to an oceanic domain.

- I have a similar issue with the use of the term “orogeny”, which is a largescale process, whereas the Demerera Plateau seems to have only undergone some minor inversion or contraction, clearly no real orogeny.
- NB: I would use “orogeny” for the collisional phase at the end of (oceanic) subduction.
- Line 35-36: use “with the décollement level”
- Line 39-40: reconsider use of “subduction”
- Line 44: presence or absence
- Line 46: this sentence does not work, please rephrase to something like: “We believe that our results may strongly contribute to recognizing the so far elusive presence of magmarich rifted margins within present-day orogenic systems.”

- Introduction (section 1):
- The introduction should I think be merged with section 2 (see general comments). Furthermore, there remains the issue of the two questions that comfuse the reader. In lines 55-57, the main question seems to be presented, which I think should be the main research question. The second question presented in lines 91-93 is a bit confusing and imprecise compared to lines 55-57. From the way it is phrased, it also it seems to apply that only collision of magma-rich margins should lead to the formation of orogens.
- NB: it also states that a point of interest is how “more mature” orogenies form, but this is explicitly not the focus of the paper as the authors have stated elsewhere (either in the manuscript, or in the replies).
- The introduction also has some internal inconsistence, as it starts off at line 59 with magma-poor margins, describing quite some details of the Pyrenees and Alps. Then it goes on to describe magma-rich systems (from line 79 on), only to revert to typical structures of magma-poor margins (from line 87 on). This structure feels off; it would be more logical to already describe these typical structures when magma-poor margins are introduced earlier on.

- Line 52-53: Sentence is off, something like this would be better: “Passive margins are are found around the globe and can be classified as magma-poor, magma-rich or transform margins”
- NB: why mention transform margins separately? Are they not either magmapoor or magma-rich margins as well? Creating a third category distracts from the main juxtaposition presented in this paper.

- Line 56: it should be “while its magma-poor counterpart”
- Well-recognized is a bit off, well-represented is better here
- Line 59: perhaps “mostly by industry player” or so
- Line 61: “domains, and this to better”
- Line 74: use “despite this different divergence maturity”
- Line 87: use “its distal magma poor margin end-member”
- NB: why use distal? That is only a part of the margin. The margin itself is surely a hyperextended margin?

- Research strategy (section 2):
- See general comments on this section; it is not clear if these are the methods, or the second part of the introduction.
- Section 2 seems somewhat repetitive in places (repeating what is done a couple of times, and also repeating the aim of the study that is already mentioned twice in the introduction).

- Line 101: use “thermo-mechanical models/modelling” (more than one model is presented)
- Line 102: I would avoid “early orogenis” here (see previous comments). Why not simply use “inversion” (as is also used in the title), and stick to that term throughout the text?
- Line 108: see previous comment on the use of “distal” to characterize a whole margin.
- Line 118: does the position of the décollement evolve? It seems rather stable? Consider rephrasing.
- Line 119: the second point feels a bit off, what is shown is how certain units are preserved, not specifically the sedimentary record of the orogenic wedge (i.e. the syncollision units, as seems to be implied here). Please rephrase.

- Geological setting (section 3):
- See general comments on geological setting. As this is a modelling paper, the geological setting should represent the details on which the models are based. As pointed out above, this is not really the case, so I would strongly suggest removing this part (along with part 4) to avoid confusion.

- Line 125: this seems to suggest that this section contains results. As such, the methodology needs to be described first (see general comments on paper structure).

- Line 130 the plateau is “bounded by a Jurassic magma-rich rift segment to its west”
- Add a figure reference to the sentence?
- Line 136: use “with respect to”
- Line 144: “Orogenic architecture” really feels out of place here, why not simply use “structural architecture” or so?
- Line 147: what are syn-kinematic deposits? Since there are multiple phases, it needs to be clear whether these are syn-rift or syn-inversion/contraction
- Line 154-155 is off and needs to be rephrased, something like: “We interpret this structure as the bottom bound of thin-skinned compressional deformation that creates place for the early accretionary prism, which only consists of post-rift sediments”
- Line 157: use “footwall” instead of “lower plate”
- Line 159: use “overlying” instead of “above” (the latter may seem to refer to some earlier mention in the text, causing confusion)
- Line 176-177: “leading to the inversion of the hyper-extended rift to form the present-day BCB”.
- NB: perhaps consider spelling out Basque-Cantabrian Belt, instead of using BCB. It may be clearer to the reader.
- Line 179: use “mature continent-continent collision”
- Line 181-183 (and Line 201-203): the presence of pre-rift salt as an efficient décollement is a strong argument to not use this natural example as an end-member for magma-poor systems, in contrast to the claim in Line 185-186 (see general comments).
- In the case of an inverted magma-poor system with syn- or post-rift salt, I then should expect a décollement in the syn or post-rift, rather than in the pre-rift units?

- Particularities (section 4):
- This seems like a summary of section 4, and not like something that should really be a new chapter. I strongly suggest making this section 3.3 instead.

- Line 213: this is a shift to strike-slip tectonics (see general comments on the issue with that).
- Line 218: delete “former”
- Line 219: this seems off: should we expect proper subduction happening in a strike-slip system?

- Line 219-220: I am not sure what this has to do with the system at hand: is there extensive syn-inversion volcanism? Delete this sentence?
- Section 4.2: if the less-inverted system is preserved farther to the west, why not take that as a counterpart of the Demerara Plateau? That would allow a better comparison of more similarly mature rifts that have undergone limited inversion (the BCB has seen quite a lot more inversion after all).

- Models and discussion (sections 5 and 6):
- See general comments

- It may be worthwhile to label the models (1 and 2, A and B, MR and MP). This may make the model descriptions easily recognizable to the reader. If more models are to be included, this can be a great help.

- Line 262-263 and Line 276-277: see general comments on why having the rheological weakness from the natural examples copied in the models is an issue (the natural examples may not be good end-member cases, and various parameters can affect the rheology of the lithosphere).

- The model results in general are quite interesting, but I am not sure how representative they are given that there are only two models, based on natural examples that may not be proper end-member cases.

- There is very little citation of literature in the discussion. In fact, there is almost none. Please add ample literature to put these findings into context. (there are plenty relevant references in the introduction it seems).

- Line 290-291: use “After 20 Myr of shortening, the oceanic crust is largely subducted below the thick continental crust upper plate”
- Note that it should be Myr instead of Ma throughout the text, when describing the models: Ma indicated million years ago and is used for describing the age of geological units, Myr indicates simply a million years and should be used for describing the stages in models.

- Line 298: use “for the reactivated magma-poor rifted margin end member”

- Line 318: use “giving way to”

- Line 323: Perhaps a more general comment: it would be better to tune down these claims and state that the models show how both types of margins **may** react, given the lack of other models done in this study. This goes for the whole manuscript → it would be good
  to approach these two models as an early attempt to investigate this topic (which indeed becomes very clear when reading section 6.2), and not make such hard claims here.

- Line 342: use something like: "Therefore, it remains unclear why magma-rich rifted margins have not been found within Meso-Cenozoic orogens while its magma-poor endmember is well represented."

- Line 347: use "post-rift sediments are preserved" (sampled does not fit here)

- Line 381: use "low sedimentation rates" or "a low sedimentation rate"

- Line 378-379: please rephrase the end of the sentence, and mind word order, it is unclear what is meant.

- Line 392-394: this would be the ideal location to introduce the two natural examples in a short fashion, and point out the key points we can learn from them. That way, the unnecessary early focus on these natural examples is alleviated, but they can still be of use (see general comments).

- Line 398-400: This is a circular argument: of course the locations of the décollements are similar in the models and the natural cases, as the model décollement levels are explicitly chosen to reflect the natural examples. In no way is this proof that these structures would also evolve in a fully oceanic setting. See also general comments on why additional models to explore the parameter space are needed.

- Line 407-409: Suddenly, the authors add another aim of the modelling work that is rather different from the original aim specified in the introduction and at the start of section two. Please don't do this in order to keep the text consistent…

-

- Conclusions (section 7):

- In the light of the above comments, point one is not tenable: it is ok to say that the location of the detachment may control what units are downthrusted/subducted, but from the study it is not that clear if that is really linked to having a magma-poor or magma-rich system.
- Could not simply the weight of the volcanics prevent them from being incorporated into orogens?

- Line 440: Use “why magma-rich rifted margins may not be easily recognizable” here.

- Supplement:
- More details are needed in the methods, colleagues should be able to reproduce the models is they wish to (see general comments).

- Line 464: what domain?
- Line 465: what is the finest grid resolution, and where is it exactly located?

- Acknowledgements:
- I believe it would be appropriate to include the reviewers and editor for the many hours spent on going through the manuscript.

- Figure 1:
- (a) Transform margins have almost the same color as magma-poor margins. Please use another color, or perhaps remove them altogether (are transform margins relevant in the framework of this study, where the models only study orthogonal compression?). And it may be a nice touch to add a marker to indicate where remains of magma-rich margins are found in orogens to highlight how rare they are.
- (b)/(c) as magma-rich margins are generally presented first in this study I believe, I suggest swapping the sections so that the magma-rich margin comes first.

- Figure 2:
- Map: the green is barely visible on the map, consider using another color, e.g. yellow (or use another color scale for the bathymetry.
- Section:

- the red on green is very poorly visible, please use another color (black would work well)
- Syn-kinematic should be syn-rift
- The location of the section is a bit curious: it is parallel and very close to the western limit of the plateau. Is this not an issue? → see comments on the use of this natural example as an end-member case.

- Figure 3:
- Please indicate the salt that forms the décollement.
- Panel (c) and (d): why include these lines without providing the interpretation? As it is, they are not that useful. Just referring to Lescoutre et al. (2021) is not that helpful, please simply provide the interpretations here. Otherwise the seismics should probably be removed. In fact, I believe that only panels (a) and (e) would suffice.

- Figures 4 and 5:
- The strength profile vertical scale is not in accordance with the sections, an indication of the scale on panels (a) would be useful.
- Please specify in the caption what MRC means (see general comments on the strength profiles)
- Now I am looking closer at the figures: there seems to be a mountain range forming in the continental lithosphere of the downgoing plate, away from the subduction zone. This is a boundary effect I assume? This should probably be mentioned in the text as it takes up strain.
- New strain images are included, I believe these were requested by the other reviewer? I am not sure how much extra information they bring as is, but it could be nice to add the same zoom-ins as done of the left-hand result column, to show the active faults as also indicated in the present zoom-ins
- In Fig. 4: I noticed that the MCR is drawn where the lithosphere is in fact relatively strong.
  I believe it should be just a little bit higher to make sense.
- In Fig. 4: note that there are no volcanics in this model, so these should be removed from the legend.

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:

See above

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:

See above

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:

See above

Reviewer 2 Comments:

Recommendation: Accept Submission

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:
Please use this space to describe, in your own words, the core subject of the submission and your overall assessment of its suitability for publication.

The authors have studied the mechanical behaviour of reactivated magma-rich and magma-poor rifted margins during orogenesis. Their case study regions are the Demerara Plateau and the Basque-Cantabrian Belt. They found that for magma-rich margins the SDR (which consist of volcanic material) subduct during orogenesis and only post-rift sediments are accreted to the accretionary wedge. For magma-poor margins both syn-rift and post-rift sediments are expected to be preserved in the accretionary wedge.
I think the modelling methods used are very suitable for this study and the results are presented in a clear and coherent way. I would therefore highly recommend publishing this paper.

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:

The only recommendation I have is to separate chapter 5.1 and 5.2 in to chapters '5. Numerical modelling setup' and chapter '6. Numerical modelling results'. I think the results deserve a separate chapter because it is quite a significant body of text.

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:

I think the provided information is sufficient.

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:

N.A.

A1.2) Author(s) Responses:

A2) Summary of main merits and main points of improvement

A2.1) Reviewer's comments

Please describe below in a few sentences (100 to 300 words) the main merits of the submission and suggestions for improvements.

The main merits I have found are...

This is insight in the mechanism of how magma-poor and magma-rich margins accrete during collision, is extremely useful for scientists that study past break-up events in regions that are only preserved in accretionary wedges.

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

N.A.

A2.2) Author's responses:

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** — [YES]

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** — [YES]

The *Abstract* clearly describes the **importance/impact of the study** — [YES]

The *Abstract* clearly states the **conclusions of the study** — [YES]

The *Abstract* is **clear** and **well structured** — [YES]

Comments:

Great abstract!

B1.2) Author's responses

[Free form box]

B2) Introduction

B2.1) Reviewer's comments

*These statements are a **guide** to what good* Introductions *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 *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) — [YES]

The *Introduction* contains **relevant, suitable citations** — [YES]

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

Comments:

No further comments.

B2.2) Author's responses

[Free form box]

B3) Data and methods

B3.1) Reviewer's comments

*These statements are a **guide** to what good* Method *sections include and good practices for* Dataset *accessibility. 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 *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:

Yes, I am happy with the addition of the numerical setup chapter. I think the detailed description of the model in the appendix makes sense, but it's good that you now have information of the modelling approach in the main text.

The only comment I had (also mentioned above) is to separate the results from the methods in two different chapters '5. Numerical modelling setup' and '6. Numerical model results', because it's quite a lot of text in your current chapter 5.2. I think this deserves its own chapter.

For the rest I think it's very clear and well-written!

B3.2) Author's responses

[Free form box]

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** — [YES]

The *Results* findings are presented **clearly and succinctly** — [YES]

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

The *Results* directly **relate to the study objectives** — [YES]

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.* — [YES]

The *Results* section is **organised effectively** — [YES]

Comments:

See above on separating method section and results.

In general I think the results are really well-described.

B4.2) Author's responses

[Free form box]

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 — [YES]

The *Discussion* section properly identifies all **speculative statements** — [YES]

The *Discussion* section presents the **implications of the study** persuasively — [YES]

The *Discussion* section **highlights novel contributions** appropriately — [YES]

The *Discussion* section **addresses the limitations** of the study appropriately — [YES]

The *Discussion* section is **organised effectively** — [YES]

The *Conclusions* are **consistent** with and **summarise** the rest of the manuscript — [YES]

The *Conclusions* are **supported by the data** in *Results* and **follow logically** from the *Discussion* — [YES]

The *Conclusions* are **clear and concise** — [YES]

Comments:

I like the addition of the discussion of the model limitations and applicability. It makes your paper stronger.

B5.2) Author's responses

[Free form box]

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 — [NO]

All georeferenced elements are provided in common format (.shp, .geotiff, .kml) [in an open-access repository] — [YES]

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

Comments:

The figures are very clear and readable and contribute to the general understanding of the paper.

Some small improvements to make:
Figure 2: add horizontal distance-scale and orientation (NW-SE) to the seismic profile and interpretation. Add letters b and c to the seismic profile and the interpretation. Add a North-arrow to figure a.

Figure 3: for b, c, d and e add a label to the x-axis of the profile (Distance (km))

B6.2) Author's responses

Section C: Additional comments

C1) Minor/line-numbered comments

C1.1) Reviewer's comments

[Free form box]

C1.2) Author's responses

[Free form box]

C2) Other remarks

C2.1) Reviewer's comments

I still think this is a very nice paper and this study deserves to be published soon. Well done!

With kind regards,
Anouk Beniest

C2.2) Author's responses

[Free form box]

4/

Author Response to Reviewer 1 Comments:

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:

Please use this space to describe, in your own words, the core subject of the submission and your overall assessment of its suitability for publication.

- The resubmitted manuscript has been modified, and the topic addressed is very interesting and relevant. As such, I believe that there is great potential in this work. However, I am afraid I have to be harsh and point out that most of the issues I found the first manuscript are still prevalent in the resubmitted version. As such, the paper needs to be revised. Please find the details below, I hope that the authors will find my feedback helpful. Kind regards, Frank Zwaan

General comments:

- Firstly, the topic is a great one, and the question why no (or only little) magma-rich margins are preserved in origins is an excellent research question. Here, numerical models can surely bring new insights and I think that the authors are onto something.

- However, the study really seems to be split in two parts that do not work together: there is first a presentation of two (partially inverted) margins that are rather specific in tectonic setting and thus difficult to accept as two good examples of magma-rich/poor end-members, followed by two numerical models that are not convincingly linked to these margins:
- The first example is magma-rich passive margin boarding a fully-developed ocean, that was slightly inverted by what seems to be a transform or strike-slip fault, and may in fact be some kind of flower structure (?). This inversion seems to have created a reverse fault above the SDRs.
- The second example is a more strongly inverted magma-poor hyperextended rift basin. Importantly, this setting contains a pre-rift evaporite layer that the authors mention as having been active during subsequent basin inversion (where the closing of the basin was more or less parallel to the basin).
- How are these both examples clear end-members? They are very different from each other in terms of the inversion mechanism, and the presence of pre-rift salt in one of them. Furthermore, various researchers have shown the variability in rifted margin architecture, why should these two specific examples be taken as end member cases? Only the fact that they register (some) inversion does not suffice here.
- Then, numerical models are run, which involve the full-scale subduction of a mature oceanic basin, up to early continental collision. These models clearly represent very different tectonic settings from the natural examples that are described in much detail earlier on. In fact, these natural examples are really not touched on again in the

discussion, although the authors do mention that they use them (start of section 6). Note that in section 2, the authors describe that they use the natural cases to constrain their models, but it is not really clear how this is done (too few details on model set-up).

- The authors do claim (section 5.1) that the models contain the main rheological contrast found in the natural examples (and in the abstract it is stated that this is intentional), but as far as I can tell, the depth of the rheological contrast may simply be coincidence and not representative of end-member cases. The rheological profile shown in Figs. 4 and 5 is taken at a specific place, and could easily be different more towards the continent (or away). Also, it is well-known that many factors affect the rheology of the lithosphere (including the presence of salt), and it is really not clear how representative the set-up shown in this paper is (also since insufficient details are provided to assess this, and as I pointed out in my previous review, more models to explore the parameter space a bit more would help to mitigate this significant weakness in the modelling results). As it is, the two models really only provide a first attempt at studying the topic (as is very clear from the discussion in section 6.2), and the outcomes, although really interesting, should not be presented as conclusive (which needs to be changed in the manuscript text and conclusions).

- Overall, I believe that the inclusion of the natural examples, although interesting, significantly hampers the story the authors aim to tell, as the models do simply not represent the tectonic settings of the natural examples. I think it would be much better to present a much more generalized introduction providing the end-member settings from Fig. 1, and motivate the modelling effort based on that. The natural examples could perhaps come back in the discussion to show how inversion of a margin may work, even if the tectonic setting is somewhat different in these cases. As it is, the natural examples just take a lot of space and distract from what I think should be the main focus of the manuscript: what do the models tell us about the development of orogens from magma- rich vs. magma-poor margins, and how can we recognize (traces of) magma-rich margins in orogens? As it is, introducing the natural examples feels as the inspiration for the two numerical models in the manuscript feels very forced (even if they may have been the original inspiration for this study).
- Removing the detailed description of the natural examples would also remove the ambiguity in what the geological setting is representing (see comments on the structure of the paper below).
- Note also, that the introduction mentions cases like the Pyrenees and Alps in some detail, the latter being a rather complex system with continental ribbons (Briançonnais) that is not that well represented in the models. Again, I feel it would be better to introduce the issue in general terms, and focus the text on what the main message is. This will also help to streamline the manuscript, as the authors state in their reply they aim at a short paper (this however does not mean that crucial information regarding model set-up can be left out).

- Structure of the paper:
- The paper seems to not follow a clear structure. The authors have added a section “Research strategy”, but it is not very clear if this is meant to be a proper methods section, or simply the last part of the introduction where the general methodology is described. In any case, very few practical details are included here.

- Then, the authors present the geological setting, and it is not really clear if there is new information here as a description of the methodology is lacking. As far as I can tell, they simply reuse published knowledge here.
- Section 4 as a separate section feels a bit off, should this not be part of section 3?
- Only at the start of section 5 is there a clear mention of methodology, but as with section 2, this is very short. There is some supplement, but also this is insufficient (for instance, what are the thicknesses of the continental crust in these models? Why are the specific geometries chosen, why the specific velocities, are surface processes involved etc. Such basic details need to be included).
- There are some very short results and discussion, where the main message is that magma-rich margins tend to subduct, and syn-rift units will likely be removed.
- A question: what happens if two magma-rich margins collide? Will the SDRs from both margins subduct? Or will one thrust over the other? This could be an interesting additional model to include.

- Overall, what I think could be the solution to this model is a restructuring and the removal of the focus on the natural examples. There should be a proper methods section after the introduction that describes in sufficient detail what has been done, and I think the paper should have a focus on numerical models (where I believe there should be more model results than presently included, for the reasons outlined above: the two models are interesting but may simply not be representative). The natural examples could perhaps be introduced in the discussion section, but in such a way that they do not distract from the main message as they do in the current manuscript.

- Finally, there remains numerous grammatical issues in the text, that in various cases hamper a proper reading of the text. In fact, I feel that the reader needs to do a lot of work to follow the text, partially to the issues listed above (but also due to complex wording or sometimes imprecise or seemingly inconsistent statements), where the authors should strive to make the text as accessible as possible. I have noted a couple of suggestions for improvements below, please make sure to double-check the text for future submission.

Detailed comments:

- Title:
- why not go all-in, something like: “Recognizing magma-rich rifted margins in orogenic systems”?
- I feel that may cover the message in a clearer way
- NB: I would remove the capitalization, that way it reads easier.

We believe that the current title describes best the work presented in this manuscript. The primarily aim of our work is not to recognize magma-rich rifted margins in orogenic systems, instead, the lack of their recognition is what led to our research question (i.e. why magma-rich rifted margins are not preserved in orogenic systems). Our first objective is to understand how magma-rich margins reactivate in comparison with its end-member magma-poor rifted margins and their implications for early orogenic systems. By better understanding this in addition of future work, the recognition of magma-rich rifted margins within orogens may be achieved. We believe that the capitalization highlights the title.

- Abstract:
- Line 20-22: unclear sentence, as it seems to state that the presence of mountain belts depends on the type of margin, which is clearly not the case. Please rephrase.

This sentence has been clarified as: “Mountain belts are often the result of former inverted rifts or rifted margins. The margins can be either magma-rich or magma-poor depending on the magmatic budget involved during the rifting process”.

- Line 25: perhaps add a comma after “systems” Thanks, this has been added.

- Line 33-34: “subduction zone” is meant? This issue occurs more often in the text
- Note that the use of “subduction” feels often a bit off, especially in the case of the Demerara Plateau, where really only a bit of underthrusting occurs. Subduction, to me, is something on a different level, and strongly related to an oceanic domain.

Frozen incipient subduction refers to the early stage of subduction which is characterized by; (i) a boundary between an upper plate and lower plate and (ii) the latter starting to subduct below the former. This is what is observed in the Demerara Plateau. A mature subduction would involve an oceanic domain (more or less wide) however that is why we refer to an incipient frozen subduction indicating that only the early stage of subduction occurred and stopped.

- I have a similar issue with the use of the term “orogeny”, which is a large- scale process, whereas the Demerera Plateau seems to have only undergone some minor inversion or contraction, clearly no real orogeny. Orogenesis, consisting of the formation of orogens more or less mature, is characterized by contractional tectonics. Early orogenesis results from the inversion of distal rifted margins which is the case of the Demerara Plateau and the BCB examples. Therefore, we agree, the Demerara Plateau is not a late orogenesis study-case.
- NB: I would use “orogeny” for the collisional phase at the end of (oceanic) subduction.

Thanks, but we prefer to use the terminology published by Gómez-Romeu et al 2019 where they define early orogenesis (inversion of distal rifted margins) and late orogenesis consisting of the shortening of proximal rifted margins leading to crustal thickening.

- Line 35-36: use “with the décollement level” This has been added.

- Line 39-40: reconsider use of “subduction”

See comments above. Subduction dynamics does not only involve a wide oceanic domain. Its early stage consists of inversion of distal rifted margins if there is an absence of an oceanic domain. This is the case of the Demerara Plateau.

- Line 44: presence or absence Thanks, this has been added.

- Line 46: this sentence does not work, please rephrase to something like: “We believe that our results may strongly contribute to recognizing the so far elusive presence of magma- rich rifted margins within present-day orogenic systems.”

This has been rephrased as: “We believe that our results may strongly contribute to recognize, the so far little presence of, magma-rich rifted margins within present-day orogenic systems.”

- Introduction (section 1):
- The introduction should I think be merged with section 2 (see general comments).

We disagree. The introduction should not be merged with the research strategy. We believe that they are two stand-alone sections that should be kept separated for simplicity reading purposes.

Furthermore, there remains the issue of the two questions that comfuse the reader. In lines 55-57, the main question seems to be presented, which I think should be the main research question. The second question presented in lines 91-93 is a bit confusing and imprecise compared to lines 55-57.

The question in lines 55-58 is the motivation of this work. Question in lines 91-93 is the research question. We cannot answer the question in lines 55-58 until we answer first the question in lines 91-93. We agree that the question in lines 55-58 is a very interesting question to explore however some previous work should be carried out first to be able to answer it.

- From the way it is phrased, it also it seems to apply that only collision of magma-rich margins should lead to the formation of orogens.

In lines 55-58, beginning of the introduction, this is clearly not the case. In lines 91-93 we only refer to magma-rich rifted margins, but this does not imply that orogens result only from their inversion.

- NB: it also states that a point of interest is how “more mature” orogenies form, but this is explicitly not the focus of the paper as the authors have stated elsewhere (either in the manuscript, or in the replies).

We are showing the magnitude of the scientific problem and starting by using the word subduction as it already exists some published work about it which is referenced accordingly. However, we then say that prior to understand mature subduction dynamics, it is necessary first to understand rifted margins reactivation (i.e. immature subduction) as this occurs before a mature subduction.

- The introduction also has some internal inconsistence, as it starts off at line 59 with magma-poor margins, describing quite some details of the Pyrenees and Alps. Then it goes on to describe magma-rich systems (from line 79 on), only to revert to typical structures of magma-poor margins (from line 87 on). This structure feels off; it would be more logical to already describe these typical structures when magma-poor margins are introduced earlier on.

The way it is done is in purpose to point out to the reader the difference of architecture between magma-rich and magma-poor rifted margins as well as to introduce Figure 1.

- Line 52-53: Sentence is off, something like this would be better: “Passive margins are are found around the globe and can be classified as magma-poor, magma-rich or transform margins”

  It has been edited.
- NB: why mention transform margins separately? Are they not either magma- poor or magma-rich margins as well? Creating a third category distracts from the main juxtaposition presented in this paper.

  Transform margins are not rifted margins as they are formed by transform tectonics which distinguish from rifting (extensional movement not transform) tectonics. Indeed, transform margins can be magma-rich or magma-poor but we not want to go into that detail.

- Line 56: it should be “while its magma-poor counterpart” End-member is also widely used.
- Well-recognized is a bit off, well-represented is better here

  Well-recognized means that have been discovered and this is what we mean. We believe that well-represented is misleading here. It sounds off to say rifted margins are well-represented within orogens. They are not representation of orogens. Rifted margins are often the pre-orogenic template therefore we believe that well-recognized is best.

- Line 59: perhaps “mostly by industry player” or so We believe that only industry is clear.

- Line 61: “domains, and this to better” It has been added.

- Line 74: use “despite this different divergence maturity” It has been modified.

- Line 87: use “its distal magma poor margin end-member” It has been modified.
- NB: why use distal? That is only a part of the margin. The margin itself is surely a hyperextended margin?

  The difference between a magma-rich and magma-poor proximal domain is very little or none. We refer to the distal part of the margin as the difference of architecture/composition is higher.

- Research strategy (section 2):
- See general comments on this section; it is not clear if these are the methods, or the second part of the introduction.

  It is a transition between the introduction and the methods to clarify the purpose and the strategy of this work.

- Section 2 seems somewhat repetitive in places (repeating what is done a couple of times, and also repeating the aim of the study that is already mentioned twice in the introduction).

The aim of the study is also mentioned once in the introduction (last paragraph). Indeed we remind the reader the aim of the paper in section 2 to allows us to explain how we do so (i.e. the work strategy).

- Line 101: use “thermo-mechanical models/modelling” (more than one model is presented)

It has been modified as “thermos-mechanical modelling approach”. We believe is best.

- Line 102: I would avoid “early orogenis” here (see previous comments). Why not simply use “inversion” (as is also used in the title), and stick to that term throughout the text?

Please see comments above. We use the terminology defined by Gomez-Romeu et al 2019. Note that early orogenesis means inversion of distal rifted margins. Early orogenesis is shorter and thus we believe that it facilitates the reading.

- Line 108: see previous comment on the use of “distal” to characterize a whole margin.

Please see comments above. The major difference is in the distal part of the margin. Also in this sentence is key to mention what part of the margin is preserved in the BCB as this tells a lot about the orogenic processes.

- Line 118: does the position of the décollement evolve? It seems rather stable? Consider rephrasing.

It does. This is described in detail in section 5.2 and well-illustrated by Figures 4 and 5.

- Line 119: the second point feels a bit off, what is shown is how certain units are preserved, not specifically the sedimentary record of the orogenic wedge (i.e. the syn-collision units, as seems to be implied here). Please rephrase. It has been modified.

- Geological setting (section 3):
- See general comments on geological setting. As this is a modelling paper, the geological setting should represent the details on which the models are based. As pointed out above, this is not really the case, so I would strongly suggest removing this part (along with part 4) to avoid confusion.

Following the editors comments, we are only addressing the detailed comments. This is a modelling paper that uses observations from two study-cases. We believe that having the geological setting of both areas is key and necessary.

- Line 125: this seems to suggest that this section contains results. As such, the methodology needs to be described first (see general comments on paper structure).

That’s why section 2 is important and needed (i.e. research strategy), where we first explain our approach.

- Line 130 the plateau is “bounded by a Jurassic magma-rich rift segment to its west”
- Add a figure reference to the sentence?

This has been added.

- Line 136: use “with respect to” This has been modified.

- Line 144: “Orogenic architecture” really feels out of place here, why not simply use “structural architecture” or so?

  We describe the orogenic architecture not the preserved extensional structures. Therefore, we feel that orogenic architecture is a better title.

- Line 147: what are syn-kinematic deposits? Since there are multiple phases, it needs to be clear whether these are syn-rift or syn-inversion/contraction

  The sentence is followed by “consisting of SDRs”.

- Line 154-155 is off and needs to be rephrased, something like: “We interpret this structure as the bottom bound of thin-skinned compressional deformation that creates place for the early accretionary prism, which only consists of post-rift sediments” This sentence has been rephrased.

- Line 157: use “footwall” instead of “lower plate”

  To be consistent with the text in the figures, we prefer to keep the term lower plate as we also define the upper plate.

- Line 159: use “overlying” instead of “above” (the latter may seem to refer to some earlier mention in the text, causing confusion) Thanks, this has been edited.

- Line 176-177: “leading to the inversion of the hyper-extended rift to form the present-day
  BCB”.

  This sentence has been edited.

- NB: perhaps consider spelling out Basque-Cantabrian Belt, instead of using BCB. It may be clearer to the reader.

  It Is given the definition of BCB just above in line 167.

- Line 179: use “mature continent-continent collision” It has been fixed.

- Line 181-183 (and Line 201-203): the presence of pre-rift salt as an efficient décollement is a strong argument to not use this natural example as an end-member for magma-poor systems, in contrast to the claim in Line 185-186 (see general comments).

- In the case of an inverted magma-poor system with syn- or post-rift salt, I then should expect a décollement in the syn or post-rift, rather than in the pre-rift units?

  Following the editors comments, we are only addressing the detailed comments.

- Particularities (section 4):

- This seems like a summary of section 4, and not like something that should really be a new chapter. I strongly suggest making this section 3.3 instead.

Section 4 highlights the particularities and strengths of our study-cases. The other reviewer and editors asked to add this section and we thought that was a good idea. We believe is best as a standalone section so that it differentiates from the geological setting. The content of it differs from the content of section 3.

- Line 213: this is a shift to strike-slip tectonics (see general comments on the issue with that).

  Following editors comments I am addressing only the detailed comments.

- Line 218: delete “former” This has been fixed.

- Line 219: this seems off: should we expect proper subduction happening in a strike-slip system?

  This is a reference of Hynes (200) and Zhou et al (2018). They showed that subduction initiation occurred at former fracture zones.

- Line 219-220: I am not sure what this has to do with the system at hand: is there extensive syn-inversion volcanism? Delete this sentence?

  We suggest that shortening in the Demerara Plateau occurred due to the reactivation of a former transform structure (see lines 217-219). This sentence is followed by a reference sentence stating that some other authors already proposed this tectonic scenario for subduction initiation.

- Section 4.2: if the less-inverted system is preserved farther to the west, why not take that as a counterpart of the Demerara Plateau? That would allow a better comparison of more similarly mature rifts that have undergone limited inversion (the BCB has seen quite a lot more inversion after all).

  We agree that the quantity of inversion between Demerara and BCB differs. However, our aim is to investigate how distal rifted margins invert during early orogenesis and thus we need two natural examples that show a reactivated rifted margin within an orogenic system. Westwards of the BCB there is the record of early subduction of an oceanic domain. This event did not reactivate the distal rifted margin and thus is impossible to address our scientific question.

  Thus, we picked two natural examples that show a present-day similar architecture (i.e. a reactivated rifted margin preserved in a more or less mature orogenic system) regardless of how much shortening underwent to reach to their present-day architecture (that is another issue out of the scope of our work). Please see the last paragraph of section 4 for more details.

- Models and discussion (sections 5 and 6): • See general comments Following editors comments, we are only addressing the detailed comments.

- It may be worthwhile to label the models (1 and 2, A and B, MR and MP). This may make the model descriptions easily recognizable to the reader. If more models are to be included, this can be a great help.
  Additional models are not included. The models are all labeled by letters.

- Line 262-263 and Line 276-277: see general comments on why having the rheological weakness from the natural examples copied in the models is an issue (the natural examples may not be good end-member cases, and various parameters can affect the rheology of the lithosphere).
  Following editors comments, we are only addressing the detailed comments.

  Focusing only on numerical models and not using observations from natural examples may be an option. However, our research approach and manuscript aims strongly differ from this. Our approach is to use geological observations from two natural laboratories to constrain the modelling experiments. The aim of these experiments is to investigate the mechanical behaviour of reactivated magma-rich and magma-poor rifted margins during early orogenesis by reproducing the first-order orogenic architecture of our natural laboratories to better understand geological processes. Based on that, we then provide insights on the recognition of magma-rich rifted margins within orogens.

- The model results in general are quite interesting, but I am not sure how representative they are given that there are only two models, based on natural examples that may not be proper end-member cases.
  Thanks! That's why section 6.2 is in the manuscript. There we argue about the applicability and limitation of our modelling results.

- There is very little citation of literature in the discussion. In fact, there is almost none. Please add ample literature to put these findings into context. (there are plenty relevant references in the introduction it seems).
  There is very little research, so far, about reactivation of magma-rich rifted margins. Especially on the identification of these margins within orogens and in particular how its distal part reactivates and ends up in orogens (please, may we be missing any reference let us know and we will added).
  Our discussion focuses on magma-rich rifted margins, not on what we already know about reactivation of magma-poor rifted margins (we agree there is a lot of literature about that).

- Line 290-291: use "After 20 Myr of shortening, the oceanic crust is largely subducted below the thick continental crust upper plate" Thanks, this has been modified.

- Note that it should be Myr instead of Ma throughout the text, when describing the models: Ma indicated million years ago and is used for describing the age of geological units, Myr indicates simply a million years and should be used for describing the stages in models. This has been fixed.

- Line 298: use “for the reactivated magma-poor rifted margin end member” It has been fixed.

- Line 318: use “giving way to”

We believe that giving way and giving place are synonymous.

- Line 323: Perhaps a more general comment: it would be better to tune down these claims and state that the models show how both types of margins **may** react, given the lack of other models done in this study. This goes for the whole manuscript → it would be good
to approach these two models as an early attempt to investigate this topic (which indeed becomes very clear when reading section 6.2), and not make such hard claims here.

This paragraph summarizes the results shown in this study. I am afraid but I do not see an issue if the results are found interesting! Since there is not a lot of literature about this topic yet, it is obvious that our work is an early-stage study about this topic. Look forward to see what will come after it!

- Line 342: use something like: “Therefore, it remains unclear why magma-rich rifted margins have not been found within Meso-Cenozoic orogens while its magma-poor end- member is well represented.” It has been fixed.

- Line 347: use “post-rift sediments are preserved” (sampled does not fit here) The word preserved twice in a sentence does not fit.

- Line 381: use “low sedimentation rates” or “a low sedimentation rate” It has been fixed.
- Line 378-379: please rephrase the end of the sentence, and mind word order, it is unclear what is meant.

It has been fixed.

- Line 392-394: this would be the ideal location to introduce the two natural examples in a short fashion, and point out the key points we can learn from them. That way, the unnecessary early focus on these natural examples is alleviated, but they can still be of use (see general comments).

Following editors comments, we are only addressing the detailed comments.

- Line 398-400: This is a circular argument: of course the locations of the décollements are similar in the models and the natural cases, as the model décollement levels are explicitly chosen to reflect the natural examples. In no way is this proof that these structures would also evolve in a fully oceanic setting. See also general comments on why additional models to explore the parameter space are needed.

Following editors comments, we are only addressing the detailed comments.

The decollement level in the models is a consequence of the margin architecture setup and the rheological characteristics (parameters of the viscous flow law) of the material used in the model (see supplementary material).

- Line 407-409: Suddenly, the authors add another aim of the modelling work that is rather different from the original aim specified in the introduction and at the start of section two.

  Please don't do this in order to keep the text consistent…

  It has been fixed and rephrase as: "Our modelling experiments are focused on the evolution and nature of the lower plate".

- Conclusions (section 7):
- In the light of the above comments, point one is not tenable: it is ok to say that the location of the detachment may control what units are downthrusted/subducted, but from the study it is not that clear if that is really linked to having a magma-poor or magma-rich system.
- Could not simply the weight of the volcanics prevent them from being incorporated into orogens?

  In the Demerara Plateau example, we see a decollement above the volcanics and we see the volcanics subducting.

- Line 440: Use "why magma-rich rifted margins may not be easily recognizable" here.

  We prefer to leave "are not". We show that the SDRs subduct and this is important because when looking for magma-rich rifted margins within orogens these deposits are not expected to be preserved in the orogenic wedge.

- Supplement:
- More details are needed in the methods, colleagues should be able to reproduce the models is they wish to (see general comments).

  Following editors comments, we are only addressing detailed comments.

  The code that we use to carry out the models is free-access and we provide the link to it. In addition, all the rheological input data of our models is given in detail in the supplementary material and in particular in Table 1. The margin architecture setup of our models is constrained based on the observations from our natural examples (this is detailed in section 5 of the manuscript). We believe that with this information the models can be reproduced.

- Line 464: what domain?

  Thanks, we fixed this (see new paragraph below).

- Line 465: what is the finest grid resolution, and where is it exactly located?

  Thanks, this has been fixed as: "The model setup of our experiments (Figures 4 and 5) is
  320 km deep, 960 km long and composed of 74 by 448 elements with the finest grid (3x1.5 km) located in the middle (between 300 and 660 km) up to 50 km depth."
- Acknowledgements:
- I believe it would be appropriate to include the reviewers and editor for the many hours spent on going through the manuscript.

  Of course. This will be done once the paper is accepted.

- Figure 1:
- (a) Transform margins have almost the same color as magma-poor margins. Please use another color, or perhaps remove them altogether (are transform margins relevant in the framework of this study, where the models only study orthogonal compression?).

This has now been fixed. Another color is used.

And it may be a nice touch to add a marker to indicate where remains of magma-rich margins are found in orogens to highlight how rare they are.

Since this is not discussed in the manuscript, we prefer to keep Figure 1 as it is.

- (b)/(c) as magma-rich margins are generally presented first in this study I believe, I suggest swapping the sections so that the magma-rich margin comes first. The introduction of the manuscript describes first magma-poor rifted margins, which are up to date better understood, followed by what is so far known about magma-rich rifted margins. Following this and given that Figure 1 is cited within the introduction, we prefer to first show the magma-poor rifted margin and then the magma-rich.

- Figure 2:
- Map: the green is barely visible on the map, consider using another color, e.g. yellow (or use another color scale for the bathymetry.

This has been fixed. Another colour is used.

- Section:
- the red on green is very poorly visible, please use another color (black would work well)

Black is already used for gravity-driven extensional faults. For consistency purposes with Figure 3, we use red to indicate syn-transpression faults. As you can see, thicker (major shortening) and thinner (less shortening) red lines are used.

- Syn-kinematic should be syn-rift

We use the terminology of Gomez-Romeu et al 2022 where the SDRs are described as syn-kinematic.

- The location of the section is a bit curious: it is parallel and very close to the western limit of the plateau. Is this not an issue? → see comments on the use of this natural example as an end-member case.

Following editors comments, we are only addressing the detailed comments.

- Figure 3:
- Please indicate the salt that forms the décollement.

The décollement is at the base of the salt as described in the text. For consistency purposes with Figure 2 we prefer to distinguish the same units in both figures; pre/syn rift, post-rift and syn-shortening. Including the salt layer would be a distraction on the message of the figure. See Lescoutre et al 2021, as indicated in the figure caption, for further detail on the salt layer.

- Panel (c) and (d): why include these lines without providing the interpretation? As it is, they are not that useful. Just referring to Lescoutre et al. (2021) is not that helpful, please simply provide the interpretations here. Otherwise the seismics should probably be removed. In fact, I believe that only panels (a) and (e) would suffice.

  To follow the same philosophy as in Figure 2. We first show the raw seismic data and then the interpretation below (for a detailed interpretation see Lescoutre et al 2021 nevertheless in panel (e) a simplified interpretation is provided).

- Figures 4 and 5:
- The strength profile vertical scale is not in accordance with the sections, an indication of the scale on panels (a) would be useful.

  An indication of the scale in panel (a) was already displayed in the submitted version.

- Please specify in the caption what MRC means (see general comments on the strength profiles)

  This was already specified in the caption (and it still is).

- Now I am looking closer at the figures: there seems to be a mountain range forming in the continental lithosphere of the downgoing plate, away from the subduction zone. This is a boundary effect I assume? This should probably be mentioned in the text as it takes up strain.

  Thanks, this has been considered and some text has been added in the first paragraph of section 5.2. The sentence is: “Note that at around 200 km in the x axis of the model, a high strain rate is also observed leading to crustal thickening (Figures 4c-d and 5c-d). This occurs due to inheritance characterized by the edge of the post-rift basin.”

- New strain images are included, I believe these were requested by the other reviewer? I am not sure how much extra information they bring as is, but it could be nice to add the same zoom-ins as done of the left-hand result column, to show the active faults as also indicated in the present zoom-ins. Yes, this was asked by the other reviewer.

- In Fig. 4: I noticed that the MCR is drawn where the lithosphere is in fact relatively strong. I believe it should be just a little bit higher to make sense. This has been fixed.

- In Fig. 4: note that there are no volcanics in this model, so these should be removed from the legend.

  This has been fixed.

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:

See above

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:

See above

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:
See above

Author Response to Reviewer 2 Comments:

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:

Please use this space to describe, in your own words, the core subject of the submission and your overall assessment of its suitability for publication.

The authors have studied the mechanical behaviour of reactivated magma-rich and magma-poor rifted margins during orogenesis. Their case study regions are the Demerara Plateau and the BasqueCantabrian Belt. They found that for magma-rich margins the SDR (which consist of volcanic material) subduct during orogenesis and only post-rift sediments are accreted to the accretionary wedge. For magma-poor margins both syn-rift and post-rift sediments are expected to be preserved in the accretionary wedge.
I think the modelling methods used are very suitable for this study and the results are presented in a clear and coherent way. I would therefore highly recommend publishing this paper.

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:

The only recommendation I have is to separate chapter 5.1 and 5.2 in to chapters '5. Numerical modelling setup' and chapter '6. Numerical modelling results'. I think the results deserve a separate chapter because it is quite a significant body of text.
Thanks. We have considered it, but we believe is best to keep both modelling setup and modelling results in section 5 labelled as numerical modelling experiments. Separating these two sections would imply to create another section and that would not be in line with the short-paper format we are aiming for.

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:

I think the provided information is sufficient.

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:

N.A.

A1.2) Author(s) Responses:

A2) Summary of main merits and main points of improvement

A2.1) Reviewer's comments
Please describe below in a few sentences (100 to 300 words) the main merits of the submission and suggestions for improvements.

The main merits I have found are...

This is insight in the mechanism of how magma-poor and magma-rich margins accrete during collision, is extremely useful for scientists that study past break-up events in regions that are only preserved in accretionary wedges.

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

N.A.

A2.2) Author's responses:

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** — [YES]

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** — [YES]

The *Abstract* clearly describes the **importance/impact of the study** — [YES]

The *Abstract* clearly states the **conclusions of the study** — [YES]

The *Abstract* is **clear** and **well structured** — [YES]

Comments:

Great abstract!

B1.2) Author's responses

[Free form box]

B2) Introduction

B2.1) Reviewer's comments

*These statements are a **guide** to what good* Introductions *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 *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) — [YES]

The *Introduction* contains **relevant, suitable citations** — [YES]

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

Comments:

No further comments.

B2.2) Author's responses

[Free form box]

B3) Data and methods

B3.1) Reviewer's comments

*These statements are a **guide** to what good* Method *sections include and good practices for* Dataset *accessibility. 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 *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:

Yes, I am happy with the addition of the numerical setup chapter. I think the detailed description of the model in the appendix makes sense, but it's good that you now have information of the modelling approach in the main text.
Thanks!

The only comment I had (also mentioned above) is to separate the results from the methods in two different chapters '5. Numerical modelling setup' and '6. Numerical model results', because it's quite a lot of text in your current chapter 5.2. I think this deserves its own chapter.
Thanks. We have considered it, but we believe is best to keep both modelling setup and modelling results in section 5 labelled as numerical modelling experiments. Separating these two sections would imply to create another section and that would not be in line with the short-paper format we are aiming for.

For the rest I think it's very clear and well-written!
Thanks!

B3.2) Author's responses

[Free form box]

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** — [YES]

The *Results* findings are presented **clearly and succinctly** — [YES]

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

The *Results* directly **relate to the study objectives** — [YES]

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.* — [YES]

The *Results* section is **organised effectively** — [YES]

Comments:

See above on separating method section and results.
Thanks. We have considered it but we believe is best to keep both modelling setup and modelling results in section 5 labelled as numerical modelling experiments. Separating these two sections would imply to create another section and that would not be in line with the short-paper format we are aiming for.

In general I think the results are really well-described.
Thanks!

B4.2) Author's responses

[Free form box]

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 — [YES]

The *Discussion* section properly identifies all **speculative statements** — [YES]

The *Discussion* section presents the **implications of the study** persuasively — [YES]

The *Discussion* section **highlights novel contributions** appropriately — [YES]

The *Discussion* section **addresses the limitations** of the study appropriately — [YES]

The *Discussion* section is **organised effectively** — [YES]

The *Conclusions* are **consistent** with and **summarise** the rest of the manuscript — [YES]

The *Conclusions* are **supported by the data** in *Results* and **follow logically** from the *Discussion* — [YES]

The *Conclusions* are **clear and concise** — [YES]

Comments:

I like the addition of the discussion of the model limitations and applicability. It makes your paper stronger. Thanks!

B5.2) Author's responses

[Free form box]

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 — [NO]

All georeferenced elements are provided in common format (.shp, .geotiff, .kml) [in an open-access repository] — [YES]

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

Comments:

The figures are very clear and readable and contribute to the general understanding of the paper.
Some small improvements to make:
Figure 2: add horizontal distance-scale and orientation (NW-SE) to the seismic profile and interpretation. This has been added.

Add letters b and c to the seismic profile and the interpretation. Add a North-arrow to figure a. This has been fixed.

Figure 3: for b, c, d and e add a label to the x-axis of the profile (Distance (km)) This has been fixed.

B6.2) Author's responses

Section C: Additional comments

C1) Minor/line-numbered comments

C1.1) Reviewer's comments

[Free form box]

C1.2) Author's responses

[Free form box]

C2) Other remarks

C2.1) Reviewer's comments

I still think this is a very nice paper and this study deserves to be published soon. Well done!

With kind regards,
Anouk Beniest

C2.2) Author’s responses

[Free form box]

5/

Final Decision Letter:

Sent: 9th February

Thank you for the resubmission of your article "Inverted magma-rich vs magma-poor rifted margins: Implications for early orogenic systems" to Tektonika. We have now reviewed your revised manuscript and response to the reviews.

Our decision is to: Accept Submission

Your article will now move to the production phase. However, there are some remaining minor text issues which will now need to be addressed with the editorial team, and you will be required to submit new versions of your figures as these are not currently sufficiently accessible. Our production team will be in touch with you soon.

Congratulations and thank you again for submitting your work to Tektonika.

Yours sincerely,

Janine Kavanagh, PhD, Executive Editor - Tektonika
Adam Forte, PhD, Associate Editor - Tektonika

Preliminary accessibility report:

Regarding the figure accessibility, please use a colour blindness simulator to modify your colours so they are accessible. A suggested colour-blindness simulator is: https://www.color-blindness.com/coblis-color-blindness-simulator/ however other simulators also exit. We have listed below the figures that do not reach the required accessibility for our readership and the specific issues to address. Thank you in advance for working to make your science accessible to all.

Figure 1a: not accessible - Red-Blind/Protanopia, Monochromacy/Achromatopsia
Figure 2a), b), c): not accessible - Red-Blind/Protanopia, Green-Blind/Deuteranopia, Monochromacy/Achromatopsia
Figure 3b): not accessible - Monochromacy/Achromatopsia
Figure 3e): not accessible - Monochromacy/Achromatopsia
Figure 4 and 5: not accessible - Blue-Blind/Tritanopia, Monochromacy/Achromatopsia
Figure 6: not accessible - Red-Blind/Protanopia, Monochromacy/Achromatopsia