

Review Report

**Fernandez et al., How Fast Can Minibasins Translate Down a Slope?
Observations from 2D Numerical Models, TEKTONIKA, 2023.**

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1st Round of Revisions

Decision Letter

Dear Naiara Fernandez, Oliver Duffy, Christopher Jackson, Boris Kaus, Tim Dooley, Michael Hudec:

We have reached a decision regarding your submission to *tektonika*, "How fast can minibasins translate down a slope? Observations from 2D numerical models". Three expert reviewers were solicited and the manuscript was handled by two of our Associate Editors, one of whom is in a shadowing role. All readers, including myself, found the manuscript well-written and -illustrated, presenting robust and interesting ideas. We do recommend some revisions before publication. For information on these, please see the Associate Editor decision letter can be found below, with which I fully agree with. The reviews can also be found at the end of this e-mail and within our online system.

Thank you for submitting your work to and supporting *Tektonika* - your manuscript will be a great addition! Do let me know if you have any questions.

Kind regards,
Craig Magee

---- AE Decision Letter----

Dear Authors,

Thank you very much for your submission of the manuscript "How fast can minibasins translate down a slope? Observations from 2D numerical models". We have now received 3 reviews of your manuscript which are included below and/or attached.

All reviewers have found the manuscript very well written and nicely illustrated, and of great scientific relevance, which we fully agree. There are, however, a few suggestions and potential improvements on the organization and figure presentations from all reviewers.

Reviewer 3 suggests a clear separation of the method description from the results. We also think this can help with the flow of the manuscript. An easy fix would be, for example, to add a section like “Modelling Approach/Setup” somewhere around line 209. Perhaps also including something like “Analytical Solution” in the title of the previous section.

We also think it would be beneficial to have a dedicated section describing “Model Limitations” (and maybe future work) as typical for modelling papers (and suggested by Reviewer 3). We recognized that some of this (3D vs 2D) is already partially addressed in section 6, but we think that having it separately and expanded would improve the discussion of the paper.

We also agree with Reviewer 3’s comment that, if possible, a comparison with a few specific minibasin cases where there is good constrain on minibasin thickness, geometry and/or translation rates/magnitude would significantly strength this already impactful work. Ideally adding a figure with 1-2 examples and a direct comparison with your model results.

As Reviewer 2, I also believe Fig. 11 shows very interesting features that are not easily seen. We think adding a zoom on the three minibasins and their interactions would really help.

We would also encourage the authors to clarify upfront in the “Abstract” why “thicker minibasins translate slower than thinner minibasins”. Maybe it can also be made clearer or more direct in the ‘Summary’: Is it the thinner underlying salt or increasing base-salt drag or both?

We therefore recommend the authors to revise the manuscript addressing all the comments before we can accept the manuscript for publication.

We look forward to receiving your revised manuscript. If you have any questions, or need additional time to complete your revisions, please do not hesitate to contact us: leonardo.m.pichel@uib.no and/or Claudio.mora@usb.br

Leonardo M. Pichel and Claudio Mora
Associate Editors

Comments by Reviewer 1 (Dan Tamas)

Dear Authors,

Please find my review of your manuscript 'How fast can minibasins translate down a slope? Observations from 2D numerical models'. The study is on a topic of high relevance to the community and a good fit for the journal, especially now, with a renewed interest in salt tectonics.

I found the paper to be exceptionally well written and the study to be well designed, using 2D numerical modelling study consisting of three simulation series. The authors have gone through a detailed analysis of the numerical modelling results in order to assess what controls the translation velocity of the salt layer and of the overlying sedimentary cover (and minibasins).

I am listing here all of my comments and suggestions regarding this manuscript.

(1) The introduction is well written and brings the reader into perspective regarding salt minibasins. One suggestion is to add examples of areas with known salt minibasins as examples for the mentioned geodynamic settings in which they are found.

(2) In the text there is a citation to Turcotte and Schubert, 2001 and in Appendix A and references it appears as 2002. Please check and fix where needed.

(3) Lines 197-201. I would consider cutting these two sentences (For the same slope... ... at 1.58 cm/year.), as the figure is well designed and tells this by itself.

(4) Summary – I would suggest changing the name of this chapter to Summary and conclusions.

I fully support the manuscript for publication, I believe the manuscript can benefit from minor edits/corrections.

Recommendation: Accept Submission

Comments by Reviewer 2 (Conor O'Sullivan)

Dear editors,

I appreciate the invitation to review this manuscript entitled 'How fast can minibasins translate down a slope? Observations from 2D numerical models' by Fernandez et al. for the new Tektonika journal. To my understanding, the authors have run a series of numerical models to better understand how minibasins translate down a slope, testing different parameters including minibasin thickness, density and shape. They then investigate the interaction between multiple minibasins translating down a slope. The results are well illustrated with a variety of engaging figures.

The methodology and arguments are well formed and transmitted to the reader and cover a very relevant topic that will be valuable to both academia and industry working on salt-influenced basins on passive margins around the globe and I admit to being surprised similar work had not previously been carried out, given the economic importance of minibasins in hydrocarbon exploration among other industries. The results of the study are laid out in an intuitive manner, highlighting the influence of different factors including minibasin thickness, width and buoyancy relative to the encasing layer of salt. The implications of the work for practical use is then explored. I have made some specific comments below to help improve an already excellent manuscript, which mostly address presentation and structure.

Therefore, I recommend the manuscript be accepted pending the revisions I outline below. The manuscript is a great piece of fundamental modelling work which provides numerical backing and relative weighting of the different factors influencing how minibasins move on a slope which, while I feel many people working in this space may have already assumed, will nevertheless be a valuable addition to the literature and a key reference for those working in this space. If the authors wish to discuss any of my suggestions or comments in more detail I have provided my contact details below. I thoroughly enjoyed reading their manuscript and wish them the best of luck with resubmission.

Best wishes,

Conor O'Sullivan (cmnosullivan@gmail.com)

Specific comments:

68-69: This feels a bit informal. I would reword it so it flows better with the text around it.

Introduction: the introduction is very long. I wonder if it would be better to break it up into a three paragraph intro (i.e. introduce the problem, the state of understanding, what we do in this study) and then have a second section where you can present the current understanding of how minibasins move (similar to a geological setting, but for our understanding of minibasin velocity and growth).

237: Good explanation of how to get around the boundary effects in your model!

282-283: Are these realistic proportions for minibasins in salt-rich basins? For most other parameters suitable references have been provided. If available, I would continue to back-up the input parameters with suitable observations from natural examples.

289-290: Those are some speedy minibasins!

296-298: While it is great that these results are available in the appendices, I would describe the shapes you see in Fig. S2 here in the text for readers who might not make it over to the appendices, just in case!

314-315: This is a cool observation!

321-326: I would suggest taking the idea a little further here and suggest to the reader why thicker minibasins are slower. Is it because they are interacting with the slower salt that is found towards the base-salt contact, or another reason?

389-401: Nice overview of the issue with adding a water load to the model to simulate a marine slope.

398: Clarify which graph or figure you are referring to here.

555-557: A cool observation that will be important in industry particularly for petroleum systems modelling.

Figure 8: This is a very nice overview figure of the different velocity profiles discussed, and showcases the influence of the base-of-salt on the velocity nicely.

Figure 10b: Is there a reason that the velocity is presented here as normalised, while in Fig.7 just the velocity is used for the Y-axis? If the reader is looking to make a quick visual comparison of the these two graphs to get a feel for the relative impact of thickness vs aspect ratio, this is a little misleading as the graph with the normalised axis for aspect ratio shows a big change in the curve of the lines relative to those in the thickness graphs.

Figure 11: This is a very important figure for the manuscript but I find it a little hard to see the detail, particularly the interaction between individual sub-basins. I would suggest either zooming in on the area where the minibasins are, to remove the dead space either side of them, or to vertically exaggerate the figure to better show how the minibasins are behaving.

Figure 13: This is a very nice summary figure. Two minor points:

In panel C) the black arrows and welding symbols are a little hard to distinguish on the brown background. I would consider either lightening the brown colour used for the minibasins, or changing the symbols to white to help the reader.

Panels A) and B) are both in boxes while panel C) is not. I would put panel C) in a box for visual consistency.

Recommendation: Revisions Required

Comments by Reviewer 3 (Attila Balazs)

The manuscript by Fernandez et al. studies salt related motions on a continental passive margin by conducting a series of 2D numerical simulations. The topic is interesting and inferences in this field are worth to be published in Tektonika. The manuscript is well written, the simulations are clearly written, and the physics and numerical implementation used in this contribution is correct. There is some room for improvements, I hope my comments in the uploaded file will help to better clarify the manuscript.

Recommendation: Revisions Required

Response to Reviewers

Dear Editors,

First of all, we would like to apologize for the delay in responding, but personal issues during first half of the year meant I was not able to address the reviewers' comments as quickly as I would have like. With that said, I want to thank the reviewers and associate editors for their comments on the manuscript, and the editor for the handling of the manuscript. We have revised the manuscript according to the suggestions that were provided by the associate editors and reviewers, which were very helpful for improving the original manuscript.

To address the main comments, as summarized by the associated editors, we have clearly titled the sections describing the methods used as: "Analytical Solution of Salt Flowing down a Slope" and "Numerical Modelling Approach". We have also re-structured the Discussion section into three sub-sections: 1) limitation of the modelling approach, 2) comparison to natural examples, and 3) implications of the observations. We have also added a zoomed figure to Figure 11 (and to Figure S6, so that the geometry of deformed roof can be better appreciated). In addition, the abstract and summary sections have been modified following the suggestion that we should explicitly state the findings about minibasin velocities. Additional minor comments by the reviewers have also been addressed in the revised version of the manuscript. All changes have been tracked and are visible in the .doc file provided with the resubmission.

We hope that the revised manuscript can be reconsidered for publication in Tektonika.

Sincerely,

Naiara Fernandez, on behalf of the co-authors.

Decision letter

Dear Naiara Fernandez, Oliver Duffy, Christopher Jackson, Boris Kaus, Tim Dooley, Michael Hudec:

Many thanks for the submission of the revised manuscript, which reads very well and addresses all our requests. We are happy to accept the manuscript and move onto the production stage, but first wanted ask:

1) Would you like to add a sentence justifying the use of a numerical code that considers salt to be incompressible? One of our AE's spotted this and questioned how applicable it was if the salt had porosity (e.g. during deposition and early burial).

2) Could you ensure all relevant references have DOI's? I see the majority do but there are some that don't and I suspect have one available. I appreciate this is usually left to the journals production staff to arrange, but as we are all academic volunteers, and due to the rather large and unexpected influx of papers that are coming to production (a good thing!), it would help us immeasurably if you could do this.

If you can ensure all other manuscript requirements are met as well, which they look like they are to me, then that can speed things up.

Many thanks and congratulations again on an excellent manuscript. It's a pleasure to have it in Tektonika.

Kind regards,

Craig Magee

Response to Editors

Hi,

I have uploaded a new version of the final text with all the DOIs and minor tweaks (Fernandez_et_al_Minibasin_Translation_R1_Text_Modified_with_DOIS.docx). I also substituted the file with the Figures, with other minor tweaks in the captions.

I have given it some thought to the comment about the applicability of the approach during salt deposition (for salt with porosity). It is a fair point, that can be considered to pertain to the broader topic of salt rheology and the big uncertainties around it (which are discussed very briefly throughout the paper). To be rigorous about the specific case of salt rheology during burial, would require adding additional text and references to the paper, which in my opinion can complicate the paper a bit.

I have leave the text as it was, without mentioning the case of salt burial specifically, but I am happy to discuss further with the editors, if they consider it a requirement.

Thanks!

Naiara

Naiara Fernandez, Oliver Duffy, Christopher Jackson, Boris Kaus, Tim Dooley, Michael Hudec:

We have reached a decision regarding your submission to *tektonika*, "How fast can minibasins translate down a slope? Observations from 2D numerical models".

Our decision is to: Accept Submission

Acceptance letter

Naiara Fernandez, Oliver Duffy, Christopher Jackson, Boris Kaus, Tim Dooley, Michael Hudec:

We have reached a decision regarding your submission to *tektonika*, "How fast can minibasins translate down a slope? Observations from 2D numerical models".

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