# Review Report

**Magee et al., Quantifying Dyke-Induced Graben and Dyke Structure Using 3D Seismic Reflection Data and the Role of Interpretation Bias, TEKTONIKA, 2023.**

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# 1st Round of Revisions

## Decision Letter

Dear authors,

Thank you for submitting your research to Tektonika. Regarding your submission, firstly I would like to apologize for late response. As you can follow the two reviewers' responses, the suggestion is that you perform moderate review of the manuscript. Please take into account the reviewers' comments and their commented pdf in order to send us back your revised manuscript.

I would like to stress out some observations from the reviewers and myself. First it seems that you can shorten a bit the submission, one reviewer suggested that there were two different stories in the same paper (related, but not necessarily needed to be told together). I ask you to reflect on this. The second issue, pointed out by the other reviewer, is that the present manuscript presents several similarities with a previous work published by the authors (Magee and Jackson, 2020). Maybe it would be worth to use less figures from the previous published paper and then at the same time you reduce your manuscript.

Finally, the submission is very intriguing since the mechanism of dyke intrusion is still a controversy in terms of the role and interaction of tectonic and hydraulic forces during emplacement and the interpretation of these faults.

Looking forward to receive the revised submission.

Best regards

Renata Schmitt

## Comments by Reviewer 1

**NATASHA STANTON**

**Completed 2 February 2023**

The authors present a manuscript on “Quantifying dyke-induced graben and dyke structure using 3D seismic reflection data“.

The subject is interesting and relevant to the scientific community. The analyses are coherently conducted and the Discussion is attractive. However, I raise some points that are not entirely satisfactory: 1) the methods and result figures are not very clear, displaying an excess of information that is somehow confusing and precludes the complete understanding of the results. 2) the present manuscript presents several similarities with a previous work published by the authors (Magee and Jackson, 2020). The same subject, study area and (some of the) figures, similar results and the same topic of Discussion have been presented in that previous paper. Although the authors justify the relevance of the quantification aspect of their study, these similarities bring to doubt if the submitted manuscript constitute a relevant and original article.

I present some comments below and detailed suggestions at an attached pdf, with the aim of improving the clarity of the manuscript.

Detail comments

In the Methods section, the authors present a detailed methodology for the analysis of dykes from seismic data. However, there is a lack of contextualization (pages 11-12); It is necessary to explain the meaning of each parameter measured/calculated, since not all readers are familiar with the subject. For instance, I could not understand what is the importance of parameter GL and how it is measured, how can you predict the current (DDn) and syn-emplacement (DD0) top-dyke depths and why you don’t treat them as equals. I recommend that these are better explained, including their geological meaning.

Why do you use Line length and diagonal Line length? Explain.

I find some figures (ex: 4, 6, 8) extremely dense to understand due to the excess of information. It takes a large amount of time to grasp its meaning and all its elements. I strongly suggest to split these figures, increase their size and clarify the graphical presentation.

Please see some detailed comments on the attached pdf

## Comments by Reviewer 2

JUAN ALCADE

Completed 19 March 2023

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:

This article evaluates the use of different methods to estimate the relationship between dykes and their corresponding dyke-induced faults, as well as explores the variance in interpretations done by different individuals. The paper uses a nice 3D reflection seismic dataset to study a set of dykes in NW Australia. I found the manuscript very informative in terms of understanding the effects of dyke intrusion in the overburden, a topic that is out of my field of expertise but that I found very intriguing. I believe that the paper is slightly long, but it is well written and detailed. It is almost as if there were two papers in one, this is something that the authors may want to explore... I have a few moderate comments about some issues but in general the paper would be suitable for publication after they have been addressed by the authors.

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

☐ No changes required ☒ Rewriting

☐ Reorganising

☐ More data/figures

☒ Condensing
☐ Reinterpretation ☐ Other

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

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

The paper can get too long for the reader, perhaps some parts could be summarised, or even some figures could be merged (e.g. 10 & 11).

A2) Summary of main merits and main points of improvement

A2.1) Reviewer's comments

The article is highly informative. Coming from a different field of expertise, I was able to follow the reasoning throughout the entire manuscript, and the authors interpretations are solidly supported. The input data quality is outstanding, and the authors have clearly done a tremendous effort acquiring and processing the data. I liked the inference of

The article is quite long, almost as if there were two different stories (related, but not necessarily needed to be told together). The quality of some of the figures, especially the ones showing the statistical analyses, could be improved. I understand it is difficult to plot many different datasets together (e.g. Fig 9a&b), but perhaps the authors should prioritise to make the figures clearer.

Section B: Detailed evaluation of manuscript

B1) Title and abstract

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]

B1.1) Reviewer's comments

There is no mention to the interpretational uncertainty analysis in the title

B2) Introduction

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]

B3) Data and methods

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]

B4) Results

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]

B5) Discussion and conclusions

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]

B6) Figures, tables and citations

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

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

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

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

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

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

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

Please, check our [Figure guidelines]

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

Figures with maps have sufficient location information (in the map or caption) — [YES] Cross-sections have clear labels for scale and coordinates at ends and within-section kinks — [YES]

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

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

Section C: Additional comments C1) Minor/line-numbered comments

Section D: Feedback to improve Tektonika's review process

This form is TOO LONG, especially if the article is already in good shape. There are too many questions to answer, and after reviewing a lengthy manuscript, the thought of facing another 13-page document is daunting. Furthermore, some comments are general and pertain to different parts of the manuscript simultaneously, so breaking down all sections is unnecessary. While I appreciate the effort to provide a more informative reviewing system, in a time when finding reviewers is increasingly difficult, adding more paperwork for reviewers may make them less likely to accept the job.

Should a comment about a figure included in the introduction be placed in the "Introduction" section or the "Figures" section?

## Authors' Reply to Editor

Completed 8 June 2023

1) First it seems that you can shorten a bit the submission, one reviewer suggested that there were two different stories in the same paper (related, but not necessarily needed to be told together). I ask you to reflect on this.

We have carefully considered separating the dyke-induced fault kinematics and interpretation bias stories, but have decided against taking this route because each theme reinforces the other; i.e. if we separated them, that which was published first would be weaker than it could be, whereas the would be highly repetitive.

Regarding the length of the manuscript, we have had a detailed look at all sections and, where possible, have streamlined the text; this is particularly the case for the results section where we have also removed several figures (Figs 8A, part of 8E, 9C, 10C-D, and 11C from original version). However, we are reticent to further shorten the Data and Methods section of manuscript because due to the readership breadth of Tektonika, we feel it important to explain and justify all aspects of the data and methods needed for the reader to understand our approach. Additionally, due to the issue of interpretation uncertainty from seismic reflection datasets (e.g., Bond et al., 2015), we felt that for the study to be replicable, and to have confidence in the interpretations drawn (Ireland et al., 2023), we needed a handle on the magnitude of this uncertainty. By considering the uncertainty, we are able to deduce a model of dyke emplacement that is independent of the interpreter extracting the data and thus more likely representative of physical processes.

2) The second issue, pointed out by the other reviewer, is that the present manuscript presents several similarities with a previous work published by the authors (Magee and Jackson, 2020). Maybe it would be worth to use less figures from the previous published paper and then at the same time you reduce your manuscript.

It is true there is much overlap between our work here and Magee & Jackson (2020). Magee & Jackson (2020) present the first high-resolution quantitative analysis of the 3D structure of natural dyke-induced faults, focusing on a fault-pair and their underlying dyke. The data presented in Magee & Jackson (2020) suggests that the surface expression of dyke-induced faults cannot be used as a proxy for dyke width or upper tip depth: this questions previous research that assume dyke-induced graben width and cumulative extension provides some insight into dyke width and depth. As Magee & Jackson (2020) only looked a one dyke-fault pair, the hypotheses they derived required testing, with one way to accomplish this being additional analysis of other

dyke-induced faults in the area. In designing these tests (the culmination of this manuscript), we also realised the need to account for various interpretation biases as, for example, the measurements of fault throw were, in places, close to the spatial resolution of the data such that i.e. interpretation biases and human error may undermine the hypothesis.. We thus consider our work here to be a relevant progression of the Magee & Jackson (2020) study, and is original in its treatment of interpretation bias in the examination of dyke-induced faulting. Furthermore, although we use data and some parts of the Magee & Jackson (2020) figures, we do not think these can be removed as they provide an important link to data provided in their study and thus underpin the hypothesis test presented here. To help show the link to, and expansion of, Magee and Jackson (2020) we relate our findings more explicitly to this work and highlight the importance of this new study in the introduction to the paper.

## Authors' Reply to Reviewer 1

3) The methods and result figures are not very clear, displaying an excess of information that is somehow confusing and precludes the complete understanding of the results.

We agree that there is a lot of information to extract from these sections, and we have worked to clarify confusing text and figures (e.g., see responses to specific reviewer comments) and reduce the length of the results (see response to Comment 1). However, as highlighted in Comment 1, we chose not to shorten the methodology, given it will be highly likely many readers with a structural and/or igneous geology background will be unfamiliar with the geophysical tools and analytical methods we use.

4) The present manuscript presents several similarities with a previous work published by the authors (Magee and Jackson, 2020). The same subject, study area and (some of the) figures, similar results and the same topic of Discussion have been presented in that previous paper. Although the authors justify the relevance of the quantification aspect of their study, these similarities bring to doubt if the submitted manuscript constitute a relevant and original article.

Please see response to Comment 2.

5) In the Methods section, the authors present a detailed methodology for the analysis of dykes from seismic data. However, there is a lack of contextualization (pages 11-12); It is necessary to explain the meaning of each parameter measured/calculated, since not all readers are familiar with the subject. For instance, I could not understand what is the importance of parameter GL and how it is measured, how can you predict the current (DDn) and syn-emplacement (DD0) top-dyke depths and why you don't treat them as equals. I recommend that these are better explained, including their geological meaning.

We have rephrased the GL description, and added a summary sentence to explain why these measurements were obtained: "Along each transect, we also use fault cut-off coordinates to calculate (Fig. 4A): (1) the horizontal graben width (GW) and half-width (GHW) between footwall cut-offs; (2) the line length distance (GL) between footwall cut-offs, which unlike GW or GHW accounts for differences in cut-off elevation; (3) the horizontal graben width (gw) between hanging wall cut-offs; (4) the line length distance (gl) between the hanging wall cut-offs; and (5) the diagonal line length (GDIA) between one hanging wall cut-off and the opposing footwall cut-off

(see also Rivas-Dorado et al. 2021). These graben width and line length measurements are required to calculate the graben area on each transect (Rivas-Dorado et al. 2021)." (L253)

For the DD0 and DDn, we have clarified: "We apply two methods to predict the current (DDn; i.e. the predicted depth of the dyke below the current seabed) and syn-emplacement (DD0; i.e. the predicted depth of the dyke below horizon HK, the seabed concurrent to dyke intrusion) top-dyke depths from calculated graben width properties (Fig. 4)." (L269)

In their marked-up manuscript, the reviewer comments on improving the representation of these measurements in Fig. 4A, which we have achieved by accentuating the elevation differences between cut-offs.

6) Why do you use Line length and diagonal Line length? Explain.

For clarity we have added: "The area of loss method specifically calculates the area between the four fault cut-offs on each transect, which form the vertices of an irregular quadrilateral shape, using the defined line length measurements GL, gl, and GDIA (Figs 4A, C) (Rivas-Dorado et al. 2021). From the area of this irregular quadrilateral shape, a rectangle of the same area is created (Rivas-Dorado et al. 2021)." (L283)

7) I find some figures (ex: 4, 6, 8) extremely dense to understand due to the excess of information. It takes a large amount of time to grasp its meaning and all its elements. I strongly suggest to split these figures, increase their size and clarify the graphical presentation.

We have carefully assessed all figures, balancing their clarity and the lengthening of the paper caused by splitting them (noting Reviewer 2 recommended joining figures). We have split the original figure 6 (now 6 and 7), removed part of figure 8 (now 9), and combined figures 10 and 11, whilst also removing four graphs from these plots. We have also increased the size of most figures associated with the results and added annotations to some plots where useful (e.g. Fig. 9A).

Comments from marked-up manuscript

8) Line 94: this idea is not well sustained by the arguments. The concept seems difficult to endorse, specially if based on just two case studies, which are on the same region and by the same authors.

We agree that more work, ideally by other people in different geographical areas, is required to test this hypothesis, but think it still pertinent to raise this point here in the hope of inspiring further, related research. We have rephrased the text slightly to address this comment: “However, it seems that building confidence in estimating dyke parameters from related ground deformation requires knowledge of how fault properties, particularly dip, change with depth.” (L102)

9) Line 142: what is this? Explain

Rephrased to “The dyke-induced faults offset siliciclastic Triassic-to-Jurassic strata, and terminate upwards at the Base Cretaceous unconformity, which is inferred to mark the free surface at the time of faulting and dyking (i.e. the seabed; e.g., Figs 3A and B) (Magee & Jackson, 2020a, Magee & Jackson, 2020b)” (L163)

10) Line 192: The "meaning" proposed by the authors is based on an inference and should be stated as a possibility instead of an affirmative. This is a constant problem along the manuscript

We broadly agree with Reviewer 1 that the subsurface structure of dyke-induced faults and their extent are an inference. Here, however, we can map the dyke-induced faults and see they extend to the dyke tip (or at least very close to it). We have checked through the text and rephrased it to highlight this inference where relationships are uncertain, noting there are times where we are more certain of our interpretation and can thus be affirmative. In the specific example raised here by the reviewer, we replace ‘meaning’ with ‘and’.

11) Line 216: why? explain and justify better this assumption [refers to assuming slip vector is dip-parallel]

We have added, “There is no evidence within the seismic reflection data to support or challenge the assumption that the dyke-induced fault slip vectors were dip-parallel, but this is broadly consistent with observations of tensile opening and slip vectors of active dyke-induced faults observed elsewhere (e.g. Tibaldi et al. 2022).” (L248)

12) Line 239: confusing description. Improve

Expanded and clarified to read: "We also use an area of loss method, which relates the cross-sectional area of a graben on a given transect to the top-dyke depth (Rivas-Dorado et al. 2021). The area of loss method specifically calculates the area between the four fault cut-offs on each transect, which form the vertices of an irregular quadrilateral shape, using the defined line length measurements GL, gl, and GDIA (Figs 4A, C) (Rivas-Dorado et al. 2021). From the area of this irregular quadrilateral shape, a rectangle of the same area is created (Rivas-Dorado et al. 2021)." (L281)

13) Line 269: I suggest to improve the arguments here. This result implies an homogeneity of dyke geometries that seems unlikely in nature.

We think there is some confusion here. We did not mean that all dykes and dyke-induced faults everywhere occur at 3-4 km depths; we are only referring to those in our study area. We have clarified the text to read: "However, we note that all dykes and dyke-induced faults in the study area occur at similar depths (~3–4 km) under a similar overburden thickness, so we suggest compaction, and compaction-related modification of the primary geometries, can be considered to have been constant across the study area (Magee and Jackson 2020a; Magee and Jackson 2020b)." (L320)

14) Table 1: you need to indicate the units for all parameters and the meaning of the abbreviations (Fcrit, for example)

All units are shown; numbers without are dimensionless. Abbreviations are defined in text.

15) Line 325: Show this clearly in figure 3C

It is actually clearer in Fig. 6A, so we have cite that figure here.

16) Figure 6: This figure carries too much information, not clearly displayed. I suggest to enlarge and split it and clarify each element. Use arrows or other symbol and indicate the relevant variations and/or results. At present is very difficult to understand and see the relevance.

We agree and have split this figure, enlarging each portion (Figs 6 and 7).

17) Line 456: what values are insignificant? report the values here and let the reader decide.

The values we refer to are those in Table 2, where F is either greater or less than Fcrit. We have clarified this in the text, although we consider adding all the values would make the sentence unclear: “We also show that variance between top-dyke depth predictions for Dyke E in the Chandon 3D survey is insignificant (F<Fcrit), but for the Glencoe 3D survey most predictions are significantly different from each other (F>Fcrit), except where we us the area of loss method (Table 2).” (L587)

18) Line 473: meaning?

These are results and we prefer to avoid interpreting them here as doing so may bias the reader’s independent assessment of our work.

19) Line 507: Very confusing paragraph. Rewrite and clarify please.

We had accidentally pasted the Figure 11 caption into the text here. It has now been removed.

20) Line 519: displacement of what? which hint? Explain your interpretations

This text has been removed, along with the accompanying figure, as we did not return to it in the Discussion.

21) Line 726: by who? citation needed.

We prefer not to include citations in conclusions.

22) Line 733: which previous findings? From the same authors? It is tendencious to use your previous work to sustain your new work, considering that this technique is still new. I would recommend caution in your conclusions.

We understand the reviewers comment here, and indeed this was one of the reasons for this study – more people, independent of Magee and Jackson, were bought in to interpret and interrogate the data.

23) Line 733: do you mean "isolated fault segments"? Be specific please.

Corrected.

## Authors' Reply to Reviewer 2

24) The paper can get too long for the reader, perhaps some parts could be summarised, or even some figures could be merged (e.g. 10 & 11).

Please see responses to Comments 1, 3, and 7.

25) The quality of some of the figures, especially the ones showing the statistical analyses, could be improved. I understand it is difficult to plot many different datasets together (e.g. Fig 9a&b), but perhaps the authors should prioritise to make the figures clearer.

We have enlarged plots and simplified them where possible.

26) There is no mention to the interpretational uncertainty analysis in the title

We have rephrased this to: "Quantifying dyke-induced graben and dyke structure using 3D seismic reflection data and the role of interpretation bias" (L1)

27) Line 25: This sentence is difficult to follow

Rephrased to, "We also find that prediction of dyke upper tip depths using graben width and area of loss methods are sensitive to fault dip variations and interpretation biases, but often still produce similar results to measured dyke depths." (L27)

28) Figure 1: This [dyke-induced fault trace] is too thin, difficult to be seen on top of the seismic. Variance colour bar - The reddish colour gradient is imperceptible. Is this for the time slice or the cube is also showing the Variance attribute?

We have thickened the relevant lines. The Variance colour bar is white-black, not reddish. We think the reviewer refers to the 'brown' of the Top Mungaroo Formation. There is little gradation to this colour bar here as it is set to capture depth variations across a much larger area. As the depth variation of the surface here is not key, at least in this figure, and including it would add extra information to an already busy figure, we bear in mind the reviewers comments on other figures and have thus decided to leave Fig. 1 as is. However, we agree that what the colour bars correspond to are not clear, so we have added labels to describe what figure

elements they refer to (i.e. the west fault surface, east fault surface, and horizontal slice).

29) Line 72: "indicates that"?

Corrected

30) Line 134: What was the purpose of these boreholes? Just out of curiosity

They were collected during hydrocarbon exploration.

31) Figure 3: A+B - The amplitudes (not just the polarity) are significantly different. C - The dashed red on top of orange is difficult to see

We agree that there is an amplitude difference, which we have conveyed in the inset sketches. We have increased the transparency of the interpreted horizon, which makes the red clearer, and increased the line thickness.

32) Line 163: This could be summarised? "Note that the two surveys present opposite polarity". It's also mentioned in the caption.

We have removed “whereby a downward increase in acoustic impedance corresponds to a peak (white) reflection and a downward decrease in acoustic impedance is marked by a trough (black) reflection” but feel the rest of the paragraph provides important context for readers without much experience with seismic reflection data.

33) Also, why didn't you just reverse the polarity of one of the two surveys?

Reflection polarity has no impact on the presented work.

34) Line 172: Again, unless I'm missing something you are just describing the vertical resolution. I think this is a well-known feature, there is no need to spend a paragraph describing it... Also, you should use explicitly the term "vertical resolution", which is more common than "limit of separability" etc (even if they are synonyms).

Please see our response to Comment 1 regarding not shortening some sections of the text; i.e. we prefer the use of limits of separability and visibility because their meaning is clearer. The problem with using vertical resolution is that although we can see features below the vertical resolution of seismic reflection data, they are tuned; i.e. their top and base are not defined by a discrete reflections. Compared to most other data where resolution is used to define the absolute limit of certainty, this is not the case for seismic reflection data.

35) Line 189: There are more? Some 15 I've counted?

There are, but '11' corresponds to the horizons originally mapped by Magee & Jackson (2020), and we extended here. We do map extra horizons and note, "we thus also map several horizons below HA (i.e. HAZ–HAW; Fig. 3A)" (L208) and "In the Glencoe volume we also map an extra horizon, HA-B, between HA and HB (Fig. 3B)" (L216)

36) Line 203: Why did you choose these spacings? Why are they different for the different interpreters? Perhaps you should add a statement explaining why this is not significant for the results

We have added, "; these values were selected to provide a high-resolution dataset in a suitable timeframe, with the 100 m and 125 m spacings used to check whether line selection influenced results." (L234)

37) Line 216: I don't see the point of citing this article here

We cite this article because Magee & Jackson 2020b discussed the assumption that slip was dip-parallel. See also response to Comment 11.

38) Line 258: Add the number in each case – re time-depth numbers. Why did you project the curves so deep (>8km, when you have data down to 3.5!)?

There are too many time-depth data to quote here, but they are provided in the supplementary data for assessment. We projected the data because the boreholes do not penetrate to the depths of the dyke (or deeper); this projection thus allows us to provide some estimate of dyke depth, etc… in metres even without velocity data.

39) Figure 5: Can you add an estimate of the scale in the caption? Same for Fig. 3

We do not think these are required in the caption given scales are already provided in the Figures.

40) Line 305: authors (same as before)

Corrected here and throughout.

41) Figure 6: Colour bar. Add labels (A, B, C etc) as in Fig. 7. The dotted and dashed red lines are hard to distinguish

Due to space constraints and to avoid cluttering the figure, we decided not to add the colour bar, and to instead refer to where the colour bar can be found in the caption (i.e. Fig. 3C). Labels have been added, and we have changed the line weight, colour, and dash style to make them easier to distinguish.

42) Table 1: The numbers are misaligned (horizontally?)

This misalignment is because 2 columns compare results from 2 interpreters, and the other compares results from three interpreters. The way the cells are merged and where their centres are is thus different.

43) Figure 7: Why some panels have a blue background? Not distinguishable – mean and st. dev. D - Use a global legend

Some of the data are white as we present different horizons as a greyscale. The light-blue means those white data points can still be distinguished on a white background. There is not much else we can do to differentiate the mean and st dev. We are not sure what a ‘global legend’ refers to. Note Fig 7 is now Fig 8.

44) Figure 8: Perhaps use the same colours per interpreter

We do.

45) Table 2: Add a column with the calculation of the F-test

We are unsure what the reviewer refers to here as the last two columns show the F-test information.

46) Figure 9: Why are you using negative values for the depth? Shouldn't a negative depth be the height? D - The statistical analysis is not very convincing. You could try removing the outliers (e.g. 2 or 3 SD) and perhaps the correlation will be higher. Also, there seems to be a remarkable change in the slope at c. 3.7km depth (clear in Trig 45, Area of loss and slightly less clear in Tig 60. What could be reason?

We use negative values as these are how depth values are output in Petrel. Whilst removing outlier data may improve the statistical fit, these outliers are still data points that need to be accounted for. We prefer to try and fit all data, rather than remove data to acquire a desirable fit. There is a gap at ~3.7 km where no horizons could be consistently mapped across the faults. We suspect that the apparent change in slope the reviewer describes is due to the absence of data and a decrease in the data resolution/quality with depth.

47) Line 484: What does this mean?

These are results and we prefer to avoid interpreting them here as doing so may bias the reader's independent assessment of our work.

48) Fig 10: A- caption add "in the Chandon (top) and Glencoe (bottom)"

We have added: "across the Chandon (top) and Glencoe (bottom) 3D surveys" (L704). Note this is now Fig. 11.

49) Fig. 11 C r2line - This is not necessary. You could draw the line at any direction with the same R^2

Figure panel removed.

50) Section 5.1: references to Fig 5i, ii, iii - ?

These have been changed to refer to 5B, C, and D.

51) Line 571: Perhaps "equal" is not the most appropriate description. Perhaps it would be better calling the two sets "similar" or "comparable"? They are not equal, they just share some statistics (e.g. see Alberto Cairo's "Datasaurus" - https://twitter.com/nespinozap/status/1400405556033114112?s=20 )

This is an important comment and we thank the reviewer for highlighting this subtle distinction. We have changed ‘equal’ for ‘similar’, here and throughout.

52) Line 577: conceptual not mental

Corrected

53) Line 581: I'd add Andrews et al. 2019 here too

Added.

54) Line 596: Cool, so does this have an implication for the results presented in Magee and Jackson (2020b)?

An interesting point, and one we have developed by adding: “Such an increase in error would not significantly affect the displacement (and heave) patterns mapped by Magee and Jackson (2020b), implying their inferences on fault growth and the utility of surface heave as a proxy for dyke thickness remain valid interpretations. However, we note that accounting for ±10% errors will reduce the potential discrepancy between their top-dyke depths measured from the data and estimated from graben width (Magee and Jackson 2020b).” (L869)

55) Line 604: dips - 5.2 (?) You should add the 41º case (or at least mention it), since it's the mean dip calculated in Fig. 11

We used 45 degrees as it was a value previous studies have insinuated as an approximate dip of faults in the area. It was not until our detailed analysis, where we

had the required data to statistically test this, that showed 41 degrees as the average. As such, all analyses were conducted before we knew the average fault dip.

56) Line 620: What does this mean? A planetary surface

Altered to read: “However, we note that without 3D imaging of dyke-induced fault planes, we cannot ascertain whether the average of fault dips measured at a single surface or horizon, or an assumed fault dip (e.g., 60° or 45°), are representative of its dip variations with depth” (L883)

57) Line 622: They would result in overestimation at shallow (i.e. higher angles) but underestimation at higher angles?

The use of ‘higher’ twice in this comment adds some confusion, but yes, if estimates are made using a constant dip, predictions will underestimate top dyke depths if the faults dip steeper than assumed (and vice versa).

58) Line 713: Ok, I believe this is an important outcome, and should be expanded (it took me a few re-reads to understand it, so perhaps it could be made clearer)

We would not necessarily call this an outcome; it is simply one potential limitation of our study that would be difficult to test. Hopefully this addition clarifies the text: “Alternatively, displacement may preferentially accrue on faults away from their nucleation site if post-emplacement dyke thickening instigated slip (Magee and Jackson 2020b); in this scenario, displacement maxima may develop along faults away from their nucleation sites, meaning displacement distribution cannot be used to reconstruct dyke-induced fault kinematics.” (L1001)

59) References Magee & Jackson 2020a, b

Corrected.

## 2nd Round of Revisions

After receiving the authors responses, the Executive editor decided to contact only Reviewer 2, since Reviewer 1 finalized their review emphasizing that the were not an expert on structural geology and therefore, they would not like to be involved in reviewing the revised version of the manuscript. In addition, all their initial suggestions were incorporated by the authors.

Reviewer 2 was positive about the revised manuscript and approved its published in its revised form.

## Acceptance Letter

Dear authors,

Thank you for providing a detailed revised manuscript and addressing to all comments from the two reviewers. As an editor, I am satisfied with the arguments and response, as well as the two reviewers. Therefore, there was not necessary a second round of revision and I decide to accept the manuscript on this new version.

Soon, you will receive information to proceed with the publication on Tektonika.

Regards

Renata Schmitt