Answers to reviewer #3

Thank you very much for recognizing the importance of our study and for the time and effort you have put into reviewing and improving our work. We would also like to thank you for the constructive comments, which we have addressed individually below.

1. There is a very clear and detailed introduction providing background context for the study. I think it would be useful to include on fig 1 other cores in Petermann Fjord that have been used in the Reilly et al (2019) paper to assess the development of the ice tongue.

   Thank you for this comment. We have added the additional cores discussed in Reilly et al. (2019) to Figure 1 of this manuscript.

2. Methods provide a detailed rationale for the proxies used – very clearly outlined and justified. The datasets are then very clearly described in the results section. There are numerous well developed figures used to illustrate the data. One aspect that it would be useful to consider adding is a plot showing the development of the age model – even though this may have been published elsewhere, I think it would be useful context here.

   Thank you for this suggestion. We describe the development of the age model in quite some detail. Thus, we do not think a figure is necessary (as there are already quite a few figures in the manuscript). In this case, the reader is referred to Reilly et al. (2019) for a more detailed insight to the age model.

3. The data are plotted against depth in many of the figures (3, 4 and 5) – this is fine for the initial results description, but I think it would be clearer if the data were then plotted against age to help in the discussion section. Fig 5 shows an age axis, but it is not always easy to follow.

   Thank you for this comment. We have switched around the position of the age axis and depth axis in Figure 5 to make it easier to interpret the data against age.

Discussion

4. I found Section 5.1 confusing in places - it seems to assume an interpretation that is more clearly presented in section 5.2 – and often based on the earlier Reilly et al. 2019 paper. For example in lines 463 – 464: 'Following the break-up of the deglacial Petermann ice tongue at ~6,900 cal yrs BP (unit 2/unit 1C boundary)' ok, this does seem sensible, but would be good to be clear what the evidence is for the break-up of the ice tongue based on the data presented here (based on IRD input, disappearance of laminations, increase in marine productivity?).

   Thank you for this comment. The ice tongue dynamics are published in Reilly et al. (2019) based on sedimentary proxies from multiple cores inside the fjord. While our data support the timing of ice tongue changes, the aim of this study is not to determine ice tongue dynamics, which is why we rely on the timing published in Reilly et al. (2019) for this. Thus, we take the timing of ice tongue break-up/re-establishment as given. However, we discuss our data in light of ice tongue dynamics and how it supports the interpretations made in Reilly et al. (2019).

5. Development of the ice tongue (Lines 468 – 490) - It is not clear what the evidence is for the development of the ice tongue again from 2,100 cal BP (transition from unit 1C to 1B). Again, this is partly based on Reilly et al 2019 and supported by data presented in this paper, but this discussion comes in a later section. The decrease in marine productivity from 600 cal BP seems clear support for the development of the ice tongue…

   Thank you for this comment, see answers to comments 6 and 7.

6. I wonder if section 5.1 is actually needed as a separate section? I think it would actually be clearer if this section was removed and key parts subsumed with the rest of the discussion section. This would likely save on repetition and make the paper easier to follow.

   Thank you for these comments. We have combined section 5.1 and 5.2 to avoid repetition and to bundle our interpretations of with previous studies (e.g. Reilly et al. 2019) more clearly.

7. Section 5.2 presents the interpretation of the dataset very clearly and would actually be better coming before section 5.1 (or as suggested above remove section 5.1). Perhaps be clearer what the evidence is for initiation of ice tongue development from 2100 cal BP – based on Reilly et al and other cores closer to the grounding line (ie up-fjord)?

   Thank you for these comments. We have added additional information regarding the evidence presented in Reilly et al. (2019) for the inception of the ice tongue at 2,100-2,200 cal yrs BP ('*This interval precedes the late Holocene inception of a small ice tongue in Petermann Fjord at 2,200-2,100 cal yrs BP, inferred from Ti/Ca ratios and the stacked >2 mm clast index from four cores in Petermann Fjord (Reilly et al., 2019).*').

8. The discussion sections are very detailed, and from what I can tell they seem to be well supported by the datasets presented here. I think there is probably scope for reducing the length of the discussion (avoiding repetition). I think having the key datasets presented together plotted against age rather than depth would also help the reader. Fig 7 presents some of the data form the paper plotted against age, alongside a range of other datasets – this is a really useful to visualise the various datasets, but having more of the primary data presented in this paper plotted against the age model would be helpful.

   Thank you for this comment. In accordance with combining section 5.1 and 5.2 and comments by reviewer #2 we have carefully screened the discussion for repetition to reduce the length of the manuscript. As mentioned above we have changed the position of the age and depth axis in Fig. 5 to make visual comparison of the data against age easier for the reader. However, we kept the depth axis in Fig.5 as the age model for core OD15-03TC-41GC-03PC does not cover the entire depth range analysed as part of this study.