

The Cryosphere Discuss., referee comment RC3
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Comment on tc-2021-25

Anonymous Referee #3

Referee comment on "Holocene sea-ice dynamics in Petermann Fjord in relation to ice tongue stability and Nares Strait ice arch formation" by Henrieka Detlef et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-25-RC3>, 2021

This study brings together a large amount of data from a range of proxies to investigate the dynamics of the Petermann Glacier through the Holocene – in particular the dynamics of the ice tongue. It then sets this in the wider context of other studies in the region. The paper is generally very well written and structured, though I found the discussion sections rather long with quite a bit of repetition. This may be due to the authors trying to bring together such a wide range of data. I think it might be helpful, perhaps, to concentrate on the key aspects of interest.

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. There is considerable reference to the findings from this earlier paper, so it would be helpful to see exactly where the additional cores are from. This is particularly relevant as this earlier paper is used to help support the timing of ice tongue development.

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.

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.

Discussion

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?).

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...

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.

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)?

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 from 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.

This is clearly a very important contribution to our understanding of the dynamics of Petermann Glacier, and summarising an impressive amount of data. It is clearly worthy of publications after some minor amendments.