

## ***Interactive comment on “Glacial sedimentation, fluxes and erosion rates associated with ice retreat in Petermann Fjord and Nares Strait, NW Greenland” by Kelly A. Hogan et al.***

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Review: Anonymous Referee #2

The manuscript of Hogan et al. present new knowledge from the Petermann Fjord, and is based on seismic profiles. The study gives important information from a fjord environment that rarely are surveyed due to ice conditions and its remote location. The paper is suitable for publishing in the journal, but only after a moderate to major revision. The main comment to the paper is that it must be better structured and that the discussion has also to implement a depositional history of the fjord system.

C1

Comments: 1) Chapter 1. Introduction: The paper should better explain why this study is of regional interest. As it is in the present paper the focus is quite local (Greenland). Why should we read this paper?

We have replaced the first paragraph of the Introduction to broaden the relevance of this paper and also adjusted the objectives to have a less regional focus.

2) Chapter 1. Introduction: In the listing of the objectives a more overall objective should also be included, e.g. compare erosion rates in this fjord environment with fjords elsewhere, global outlook, regional considerations. The objectives as they are now is quite “local”.

We have now modified the objectives to be more regionally significant, see objective (4). They now read: “The objectives are: (1) to map glacial marine sediment units, interpret their seismic stratigraphy, and calculate their volumes; (2) to derive deglacial sediment fluxes and erosion rates; (3) to compare our results with other high-latitude fjord settings (Northern and Southern hemisphere) considering regional variations; and (4) to provide geological boundary conditions for numerical glacier modelling exercises.”

3) Some more references to Figures 1 and 2 should be included in Chapter 1

We have now referred to these figures in Chapter 1.

4) In the heading of Chapter 2 delete “(geology, physiography, oceanography)”

This has been done.

5) Chapter 3 should be renamed to “Data and Methods” as you also describe the data used in the study

This has been done.

6) Chapter 3 does not include information about the cores you have used in the study. Information about these cores (and which now partly are in Supplementary Material) should be mentioned.

C2

We appreciate this comment and we have now incorporated the seismo-acoustic/lithofacies correlation in Section 3.2. We have also added the figure (now Fig. 6) and table describing the cores to the main text.

7) All information provided in Supplementary Material should instead be implemented in the main text as I think the information in Supplementary Material is essential for the paper.

As described above, we have now added the core correlation material to the main text. We have chosen not to add the Supp. Fig. 2 (glacial catchment areas for erosion estimates) to the main text because the discussion around glacial erosion rates and how to define glacial catchment areas remains integrated in the results and discussion section (sections 4.5, 5.3) and, therefore, we elect to leave this as a supplementary figure.

8) The methods used in the papers (how to calculate drainage area, erosion rates etc) are as I read it spread a bit around in the paper. Please structure the paper in such a way that all your methods are included in Chapter 3.

We have now restructured the Methods section to include descriptions of how we calculate glacial sediment volumes, fluxes and erosion rates (section 3.4).

9) The Result chapter should be restructured. As it is now it is some repetition of the text. I suggest that you in 4.1 included information (text and figures) from the Supplementary Material in defining your facies. Furthermore, I suggest that Chapters 4.2 and 4.3 are merged to get a better overall view of the study area. You do not need to repeat the definition of the facies in chapters 4.2 and 4.3 (or what these facies are composed of) since you have already defined this in Chapter 4.1.

We have followed these suggestions and modified the Results chapter. 4.2 and 4.3 have been merged and unnecessary repetition of the acoustic facies has been removed. We have also incorporated the core lithofacies in to section 4.1.

C3

10) Why do the manuscript have an own chapter on GZWs (Chapter 4.4). This chapter could also be merged into the merged 4.2-4.3 chapter. I also find that there is some repetition of text in this chapter (Chapter 4.4) from previous part of the text.

There is a separate section on GZWs because these landforms represent a discrete sedimentary deposit that has a different origin (subglacial deposition) than the adjoining sediments but must be accounted for when calculating glacial sediment fluxes and erosion rates. In addition, the GZWs have distinct significance for the interpretation of the glacial history and sedimentation processes that have produced (part of) the infill. Thus, we prefer to highlight them in a separate sub-section (4.3) but we have added a sentence at the start of this section to outline why these deposits are treated separately from the rest of the unlithified fill.

11) Chapter 5 is also a result and should be part of Chapter 4. I do not think it is necessary to subdivide the sediment volume chapter into sub-chapters.

We have now combined Chapter 5 with Chapter 4 with a new sub-section 4.5 being: "Unlithified sediment volumes". We have renumbered the following sections accordingly.

12) Chapter 6.1 is partly a review (e.g. lines 355-370) and partly a result/discussion text about how to calculate volumes (lines 383 - 400). Thus, part of the Chapter 6.1 text should be included in the result chapter and the entire Chapter 6.1 should instead include a text about the development of the fjord system; telling the reader what have happened in the fjord during LGM and the last deglaciation (based on your data)

Following comment #11 Chapter 6 has become Chapter 5. We have now added a section describing the evolution of the infill as section 5.1 and we have moved the text describing how to calculate volumes to the methods chapter (section 3.4).

13) Chapter 6.2 also includes methods (e.g. calculation of erosion rates in lines 435-450) which should be included in Chapter 3 and results (the erosion rates itself, e.g.

C4

lines 450-470) which should be in the result chapter. Chapter 6.2 should focus on comparison with other fjord systems (regarding erosion rates, volumes etc).

We have followed this advice and moved text describing methods to the methods chapter and created a new results chapter (4.5) to present the calculated fluxes and erosion rates.

14) Some more references to fjord papers from UK, Norway and Svalbard should be implemented. The last few years numerous papers have been published, and which are relevant for the present manuscript.

We have added the following more recent references from UK, Norwegian, and Svalbard fjords to the manuscript in Sections 3.2, 3.4, 5.2:

Bellwald, B., Hjelstuen, B.O., Sejrup, H.P., and Hafliðason, H.: Postglacial mass movements and depositional environments in a high-latitude fjord system – Hardangerfjorden, Western Norway, *Marine Geology*, 379, 157-175, 2016.

Callard, S.L., Ó Cofaigh, C., Benetti, S., Chiverrell, R. C., Van Landeghem, K. J. J., Saher, M. H., Gales, J. A., Small, D., Clark, C. D., Livingstone, S. J., Fabel, D., and Moreton, S.G.: Extent and retreat history of the Barra Fan Ice Stream offshore western Scotland and northern Ireland during the last glaciation, *Quaternary Science Reviews*, 201, 280-302, 2018.

Nielsen, T. and Rasmussen, T. L.: Reconstruction of ice sheet retreat after the Last Glacial maximum in Storfjorden, southern Svalbard. *Marine Geology* 402, 228-243, 2018.

Stoker, M. S., Bradwell, T., Howe, J. A., Wilkinson, I. P., and McIntyre, K., Lateglacial ice-cap dynamics in NW Scotland: evidence from the fjords of the Summer Isles region, *Quaternary Science Reviews*, 28, 3161-3184, 2009.

A revised version of the manuscript with edits made in MS Word Track Changes is attached as a supplementary zip file.

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Please also note the supplement to this comment:

<https://www.the-cryosphere-discuss.net/tc-2019-171/tc-2019-171-AC2-supplement.zip>

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-171>, 2019.

C6