

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2021-25

Anonymous Referee #2

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-RC2>, 2021

This study aims at understanding the role of sea ice on the stability of the Petermann Glacier floating ice tongue. It is based on a series of sedimentary and biogenic proxies preserved in a marine sediment core spanning the Holocene and collected 80km from the 2015 glacier grounding zone. It focuses on sea ice-glacier-ocean interactions at one of the key regions of freshwater export from the Arctic Ocean. The purpose of the work is clearly articulated, and the multi-proxy approach used is suitable. The authors make a thorough review of the oceanographic setting and signal associated with each individual proxy used, ensuring that the paper can be understood by a broad multidisciplinary readership.

The context and results of the study are presented in a clear and logical manner. However, a key component of the interpretation may need to be revisited. The authors compare their marine sediment core to other regional proxy records, including core AMD14-Kane2B (Georgiadis *et al.* 2020), located in the Kane Basin to infer the role of the northern and southern ice archs on the sea ice conditions in the Nares Strait. The interpretation of conditions in the NOW and southern ice arch are at odds with what is reported in the paper cited (see also comments below, where specific sections have been identified). In particular, the interpretation of the intervals of stability/instability of the southern ice arch is not supported by the available data. As a consequence, the interpretation that the inception of Petermann ice tongue is preceded by the transition towards a southern ice arch regime is not corroborated (for the period 3-2.2 kyrs BP) by the only data available for the southern ice arch region. This aspect of the study should therefore be toned down. For this reason, the paper requires moderate revisions (note that the system only allows me to select minor or major revisions).

General comments:

- The paper is lengthy and unnecessary repetitions between sections should be avoided (e.g., Introduction and Regional settings).
- *Neoglacial* should be capitalized

Figure 1.

- Please precise what the extent of the NOW represents (average between year-a/year-b, and season). It is not necessary to repeat the same sentence twice "*The approximate extent of the NOW is indicated with a black dashed line.*" The red box already indicates the close up.
- From the caption, one may interpret that core AMD15-Kane2b was analysed as part of this study. Should add reference to paper.

Line 107. Since this sentence is already the first of the introduction, it should be left out here. Avoiding repetition will help reduce the length of the paper.

Lines 150-152. This sentence does not read easily. Please try to reformulate.

Line 205. Should also mention HBI II-producing species. Co-production implies same species, strictly? Please clarify.

Figure 2.

- Line 166 should be Hall
- "*After 2012/2012, the differences increase due (...)*" remove "s" in "increase".

Lines 222-225. This information does not seem necessary since both sterols are not direct indicators of sea ice conditions. Could only keep the last sentence of this paragraph.

Lines 234-236. These sentences seem out of place. This information (storage of research material and subsampling) should be included in the first paragraph of the Method section.

Line 252. "*The $d^{13}C_{org}$ reproducibility of non-acid pretreated (...)*" add "of"

Line 284. "Dry bulk densities were calculated (...)" this is repetitive with Line 258. No need to repeat multiple times. If applies to all, could be included in the first paragraph of the method section.

Line 288. Could rephrase to "A multitude of environmental factors determine the abundance and species composition of benthic and planktonic foraminifer assemblages"

Line 294. Replace *light conditions* by *light availability*.

Results section

- Verify significant digits for the foraminifer fluxes.
- Why aren't the results reported against the age rather than depth (or both)? This would make it easier to follow the changes/story in the context of Holocene climate variability.
- The same structure (i.e., order) could be maintained between the Method and Result sections.

Line 317. Add "s" to "unit"; same in **Line 342** (please correct throughout)

Figure 3.

- Should include an age axis.
- Remove "s" in foraminifers results
- turquoise
- Should mention in the captions why the fluxes do not extend beyond 400 cm.
- Should include HBI concentrations normalized to TOC.

Line 441. "Sedimentary unit 3 represents" add a "s"

Lines 447-449. This sentence is not clear.

Figure 5. The title of this figure is "*Temporal changes in the environmental conditions in Petermann Fjord*". Yet, there is no indication of "environmental conditions" in this figure, with the only exception of the ice tongue length from the grounding zone. To make this figure truly distinct from the other figures presented in the results, more interpretive information could be added.

Line 600. "In years **when** only the northern (...)" replace were by when.

What about pelagic productivity?

Figure 6. Great representation of scenarios.

Lines 695-704. This section as well as the interpretation of the southern/northern ice arch conditions (e.g., Line 738), need to be revisited. The IP_{25} fluxes reported by Georgiadis *et al.* 2020 are very low around 2,200 cal yrs BP. Authors from this paper indicate that IP_{25} fluxes are at their lowest between 2.2 and 1.1 cal ka BP, which they interpret to result from an *unstable* southern ice arch in Kane Basin from 3.0 cal years BP. Little auks are present in low numbers at lake Annikitsoq and only one discrete event of local peak in bird abundance is reported from lake Qeqertaq (Davidson et al. 2018). These data do not point towards a stable spring/summer North Water polynya and return to a southern ice arch dominated regime in Nares Strait, as suggested here.

Lines 760-762. See comment above. Perhaps supported for the rapid extension at 600 cal yrs BP and double-arching, but the evidence from Kane Basin is pointing towards less stable southern ice arch from 3.0 to 1.1 cal yrs BP.