Author answers to reviewers comments on "Reconstruction of Holocene oceanographic conditions in the Northeastern Baffin Bay" by Katrine Elnegaard Hansen et al.

Anonymous Referee #2

We are very grateful to the anonymous referee #2 for his/her effort and time to review our manuscript and for his/her highly beneficial comments and suggestions.

The manuscript provides important new information on Holocene ocean circulation changes in eastern Baffin Bay, in an area where until now relevant knowledge has been very limited. Thus, this is a significant contribution, fitting well within the scope of CP. A few minor linguistic corrections are recommended, e.g. singular it/he/she = verb +s, plural they = without adding s to verb.

Thank you for making us aware of these mistakes. We have corrected the grammar where it was needed (lines 22, 77, 280, 375, 404, 502, 512, 548, 655).

The work is based on the analysis of the benthic foraminiferal fauna of a 7.5 m long sediment core in combination with sedimentological information and multi-element data obtained from XRF scanning. Both the laboratory methods and data quality are of high standard, whereas the age model is based on > 10 AMS C14 data levels well covering the entire core.

Both title and Abstract clearly and concise refer to the contents of the manuscript. Only doubt here, is whether the core site should be described as being situated in 'Northeastern' Baffin Bay, or this 'Northeastern' should be better replaced by just 'Eastern' (Baffin Bay).

We had chosen the term Northeastern because previous publications on the same record had done so (Caron et al 2018, 2019), but you are correct that location is not really north. We have changed northeastern to eastern where applicable, see lines: 1 (title), 59, 68, 112, 155, 613.

As for the 'Introduction' I may suggest generally some shortening and re-structuring. This includes to move the section line 55 - 68 to the Regional Setting section, where some (double) information thus could be removed.

Done.

Moreover, at the end of the 'Introduction, line 149 - 154, would fit better early in 'Regional Setting', i.e. following in line 95.

Thank you for your suggestions. We agree that the Upernavik Isstrøm should in fact be introduced earlier in the 'Regional settings' section, thus we have moved that section to the suggested place, see lines 80-85.

More generally, some older references (oceanography/hydrography) could be omitted and/or replaced by more recent, f.ex.: *) Bi et al. 2019, Baffin Bay sea inflow and outflow..., The Cryosphere 13, 1025-1042; *) Castro de la Guardia et al. 2015. Potential positive feedback between Greenland Ice Sheet melt and Baffin Bay heat content on the west Greenland shelf. Geophys. Res. Lett. 42, 12; *) Munchow et al. 2015 Baffin Island and west Greenland Current Systems in northern Baffin Bay, Progr. in Oceanography.

We have added the suggested references to the manuscript. See lines 78+100+111 (Münchow et al., 2015), 121 (Castro de la Guardia et al., 2015), 88+149 (Bi et al., 2019).

Discussion: Within the context of the Ca/Ti and Ca/Sr interpretation, mid Holocene (line 595 - 608) another Ca source could be Uumannaq fjord area, where the Marmorilik Formation includes thick strata of dolomite marble and calcite marble (Garde, 1979, Precambrian Research 8, 3-4, p.183-199). This possible source is found not far to the south, i.e. drifting with the WGC, icebergs from Uumannaq Fjord may (also) have contributed.

Rink Isbræ from the Uumannaq fjord area may indeed have contributed with additional Ca-rich IRD as you mentioned. It has now been added to the discussion (Lines 619-621).

With regard to the Mid- and Late Holocene, a short reference should be made to the later HTM stage, where f.ex. in Ameralik, near Nuuk, evidence was found for (still) strong melting until 3.2 ka (see Møller et al. 2006 Late Holocene environmental and climatic changes in Ameralik Fjord, Southwest Greenland – evidence form the sedimentary record. The Holocene 16, (5), 685-695). Same applies to Disko Bugt. Within this context, important to note is significant cooling and freshening recorded (until c. 4.0 ka) in Newfoundland cores (e.g. Solignac, Sheldon), which must be related to Baffin Bay (melting, NAO-ocean control) conditions.

Thank you for your suggestions on these papers. We have added additional information based on your suggested reference: Møller et al., 2006: Line 637-641. Though, the freshening and cooling in the Labrador Sea/Newfoundland (Solignac et al., 2011 and Sheldon et al., 2016) has already been discussed in the 'Mid Holocene' section (lines: 576-583 + 590-593).

Furthermore, the North Water Polynya was correctly mentioned in the Introduction; which function/contribution to corrosive bottom waters could this have had after it had formed?

As you point out, we discuss in the introduction that the North Water Polynya may play an important role in the formation of Baffin Bay Deep Water, but this is as mentioned not fully resolved for the present day. Thus, we have not been able to make any direct connection to NOW activity and periods of increased Baffin Bay Deep Water formation/advection to the study site.

And finally: Great support for your conclusions you can find in Saini et al. 2020. Holocene variability in sea ice and primary productivity in the northeastern Baffin Bay, Arktos doi:10.1007/s41063-020-00075-y ! Herewith I may (thus) strongly support publication of this manuscript, https://doi.org/10.5194/cp-2019-152, 2020.

Thank you for suggesting this paper. It has now been referenced in association with the peak in benthic sea-ice species recorded at 6.7 ka BP, where the biomarker record in Sanei et al., 2020 record a significant increase in the HBI III biomarker. See lines 601-604.

Notes:

Additional information was added based on the newly published paper 'Local and regional controls on Holocene sea ice dynamics and oceanography in Nares Strait, Northwest Greenland' by Georgiadis et al., (2020), Marine Geology, https://doi.org/10.1016/j.margeo.2020.106115. See lines 494-497 + 552-553. Core site AMD14-Kane2b described in this paper was added to Figure 8.