The Cryosphere Discussions

The Cryosphere Discuss., referee comment RC2
https://doi.org/10.5194/tc-2021-95-RC2, 2021
© Author(s) 2021. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on tc-2021-95

Anonymous Referee #2

Referee comment on "The Holocene dynamics of Ryder Glacier and ice tongue in north Greenland" by Matt O'Regan et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-95-RC2, 2021

The manuscript comprises new and interesting information about the Holocene deglaciation history of the Ryder Glacier in North Greenland. A number of marine sediment cores from a transect through the Sherald Osborn Fjord has been analyzed using XRF, CT, bulk density and MS and the chronology has been constrained using 48 ^{14}C dates. Overall the manuscript is well-written and the scientific outcome is definitely suitable for publication in Cryosphere after minor revision.

I have a few general comments that could be addresses besides some more technical comments that are easy to implement.

General comments:

0) It doesn’t really make sense to use uncalibrated 14C ages in the Geological Setting. I suggest that the existing radiocarbon dates from Kelly and Bennike (1992) should be re-calibrated using Marine20 and the same deltaR as the new marine cores.

1) The result section is a mixture of descriptions and interpretations. Example line: 287-288, 299-300, 308-309, 317, 324, 336-338. I suggest to clearly divide the result section into two separate sub-sections: description followed by interpretation. This will allow the ready to assess the data and follow the logic in the interpretations.

2) Figure 5 offers a great summary of the most important data. It would be really nice to compliment the figure with the CT scans from the suppl. material or the high-resolution picture from the XRF scanner. It is really a pity that the CT scans are hidden in the suppl. material.

3) The way the age of the individual units has been constrained differ from most studies as it uses the min. and max. ages from each unit to define the age range. However, as the radiocarbon dates are not always placed optimally at the boundaries between units this makes it difficult to compare the age ranges of the units between the different cores. I suggest that an age-depth model for each sediment core is produced. This would make it possible to determine the age at the boundaries (with an uncertainty) and also allow for a figure to be made where the proxy data (from figure 5) is plotted on an age scale. This is standard procedure and it would make a great supplement to the discussion section 5.2-5.4.

4) It is clear that the most challenging unit to interpret is the diamictic unit 3. The unit differs from most other units which are laminated. It only resembles unit 6 the lowermost unit which is interpreted as subglacial till. However, the authors prefer an alternative explanation where unit 3 represents massive IRD deposition during a period where the ice front is most retracted. They also discuss other possibilities but find them less likely. I am not completely convinced but agree that it is difficult the interpretation of unit 3 is not straight forward. I wonder if unit 4 instead could represent the period where RG is most retracted and that unit 3 represents the phase where it begins to readvance sending icebergs (IRD) into Sherard Osborn Fjord again. If correct, the onset of readvance is c. 6 cal ka BP which coincides with the general cooling trend in the Agassiz ice core record.

Technical comments:

Line 20: Change to Greenland Ice Sheet

Figure 1: Add Gl. for glacier after Humboldt, Petermann etc. Also add Ice Sheet after Greenland.

Line 43: Change to Greenland Ice Sheet

Line 61: Change to Last Glacial Maximum

Line 66: Change to Möller

Line 75: Add glaciers after Petermann

Line 75: Change to Nioghalvfjerdsfjord Glacier

Line 110: Change to north Greenland

Line 118: 9390+-90 date is not in table 1

Table 1: Combine with Table and calibrate the old ages with Marine20.

Line 127: Delete cal a BP after >9.5

Line 129: Mark the ice-dammed lake on the map.

Line 131: Are the dated shells reworked into the moraine?

Line 136: Change to Ryder Glacier

Table 2: Could be moved to suppl. material.

Figure 4: Is not showing much and could be moved to suppl. material.

Line 167-168: Change lithified to compacted.

Table 3: 13C is missing for sample 26.

Line 268: Delete glacial after Holocene

Line 271: Change through to and

Figure 5:

On 10-GC the 2450 date seems to be within unit 3 but it is marked as unit 2 in figure 8?

On 7-PC the date 7090 seems to be an outlier but it is not marked with red. Also, what is the square next to 7090 representing?

Why is the last date in core 8-PC/GC an outlier?

Figure 8: I don't understand why the 14C dates in this plot have a normal distribution? Also see general comment 3.

Table 4: Not important and can be omitted if the age depth models as suggested in general comment 3 will be made.

Line 393: Change to Northern Hemisphere

Figure 9: Really nice illustration – are the radiocarbon ages from Ellesmere re-calibrated?

Line 419: Change to Möller

Line 423: Add cal ka BP after 12.5

Line 430: Delete one l in Fullford

Line 435: Change to GrIS

Figure 10. Again, a really great illustration. Could you add the locations of the Warming Land and Kap Fulford Stades on the figure?

Line 466: It is stated that …LU3 range from 6.3 to 3.9 cal ka BP. However, the upper part of unit 3 in 10-GC is 2450 14C a BP. Why is this date omitted in the summary?

Line 508-510: Temperatures were not 2.5-4ºC warmer until 6.2-6 ka. They were still high but the peak warmth occurred in the beginning of the Early Holocene and was insolation driven.

Line 517: Zekollari models suggest that at least part of the Hans Tausen ice cap survived the HTM.

Line 520: Change to: Middle Holocene

Line 521: Change to: GrIS

Figure 11: Again, a great illustration. Maybe consider changing the white color of the modern ice limit to red. It would also be great to get the Kap Fuldford and Warming Land moraines on the maps.

Line 540: or 2450 14C a BP? See comment Line 466.

Line 564: Change to Funder et al., 2011

Line 585: north Greenland

Line 600: Søndergaard et al (2020) have published a paper in Climate of the Past on the deglaciation on Inglefield Land, Smith Sound and nares Strait that would fit into the discussion.

Line 601: Can the differences in fjord physiography play a role in the different timing of retreat between Petermann and Ryder glaciers? Sherard Osborn Fjord is deeper and potentially more susceptible to dynamic ice retreat compared to the shallower Petermann fjord.

Line 650: Change to: Late Holocene