

The Cryosphere Discuss., referee comment RC1
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Comment on tc-2021-95

Anonymous Referee #1

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-RC1>, 2021

This manuscript reports on the Holocene history of the Ryder Glacier and its floating ice tongue that drain into the Sherard Osborn Fjord in north Greenland. Ryder Glacier's floating ice tongue is one of the last of these features which are remnants of a much colder climate period and have persisted despite modern Arctic warming. The past behavior of outlet glaciers buttressed with ice tongues is of interest for predicting the future rate of mass loss and contributions to

sea-level rise. This study uses radiocarbon dated sediment cores (lithofacies, grain size analysis, XRF, MS data) along a transect of the fjord, combined with fjord bathymetry, bedrock geology, subbottom profiles and the glacier limits and glacial stages mapped on land in previous work to reconstruct the dynamics of the Ryder Glacier from the early Holocene to present. The dynamic history encompasses retreat of grounded ice from the fjord mouth with retention of an ice tongue, followed by middle Holocene retreat well inland (ie. 60 km inland) of the modern grounding zone, Neoglacial readvance of the glacier together with an ice tongue and finally expansion of the ice tongue to the outer sill at the fjord mouth in the latest Holocene.

This is a very carefully and thoughtfully written manuscript. The data are of high quality and are well presented. The figures are very professional and effective, and the writing is very clear and concise. It was a pleasure to read the manuscript and I have very little to say to contribute as a critique. The comments I have are presented from beginning to end by line number.

Lines 85 to 90. Can you just say how long the fjord is and how long the ice tongue is? These details can be stated more clearly

Line 88. Instead of sills 'dissecting' perhaps say 'crossing'. I don't think dissecting is quite right.

Line 89. Define what you mean by 'overdeepened'.

Line 141. Delete 'that extent'

Line 150. Replace 'exerting' with another word...'exhibiting'?

Line 162. Delete 'a'

Line 167. Replace 'highly lithified' with 'compacted' or 'consolidated'. It has not been formed into rock so is not lithified.

Line 214. Delete 'the'

Line 221. Is the piston core just the 'reference core'? I don't know why it is called 'undistorted'. That seems unlikely actually, and the word is not needed.

Line 229 under radiocarbon dating. I suggest you use *Cassidulina neoteretis* throughout and cite Cage et al., 2021 <https://doi.org/10.5194/jm-40-37-2021> which is a paper that clearly shows how to identify *C. neoteretis* and *C. teretis*.

Line 230. What benthic foram species were included in the mixed benthics. These appear to be older than the single species dates on *C. neoteretis*. It is important to present the species dated. If Miliolid species were included in the dated material (e.g. *Triloculina* or *Quinqueloculina*) this can explain the too old results. Hopefully the specific contents of the mixed benthic dates was recorded and can be reported here. It is useful information to guide future chronological studies.

Line 260. *Neoteretis*

Line 266. Delete double s in cores.

Line 271. Is it diamict or diamicton. I think diamicton is correct.

Line 280. Is deformation beneath grounded ice the only way to get deformation? Can this deformation be due to coring or slumping? I am not contesting that the unit is subglacial in origin.

Line 326. Suggest you delete 'Across Sherard Osborn Fjord' and just begin the sentence with LU4. Or you could say 'Throughout Sherard....'

Line 430. Delete one l in Fulford.

Line 480. Not clear what 'become cut-off from the main fjord' means. Does it mean the ice retreated onshore?

Line 493. I think this part about how far the ice may have retreated inland is really great and interesting! It is so helpful to be able to define a minimum ice margin.

Lines 515, 525, 565 suggest you refer to Detlef et al., in review which provides important sea ice reconstructions and marine conditions for Petermann Fjord over the same time period. See <https://doi.org/10.5194/tc-2021-25>