

Interactive comment on “A Race for Ice Discharge between Ice Streams on Glaciated Continental Shelves” by Etienne Brouard and Patrick Lajeunesse

Anonymous Referee #1

Received and published: 18 October 2018

The authors provide a nice manuscript that describes a case study for the evolution of ice stream flow along the northeastern Laurentide Ice Sheet margin. The inference of ice stream piracy is based on the authors' interpretation of shelf bathymetry – chiefly how a prominent marginal (coast parallel) trough extends to a neighboring fjord. This sets up a topographic pattern such that two major fjords (the primary fjord plus the neighboring fjord) feed into a single cross-shelf trough that lies outboard of the primary fjord. The cross-shelf trough fronting the neighboring fjord is much shallower than the cross-shelf trough of the primary fjord. Thus the formation of the shallower cross-shelf trough is interpreted to be relict from prior to the ice piracy.

C1

For the most part the manuscript clearly explains the authors' interpretation, although in my opinion it should be couched more as such – an interpretation – and not quite as factual as the authors tend to make it seem. The paper is well illustrated. The writing is mostly good; I provide some comments that would help clean it up a little. The manuscript is also fairly brief. I do not think that this is any sort of serious flaw – the contribution comes across as a note, or a case study, and I think that is fine. However, I found the manuscript to be lacking in its description of the glacial history of the study region and in covering the published literature on the evolution of fjords, which seems relevant to this topic (even though these are offshore troughs). I would suggest that the authors consider adding some text to their manuscript on these two topics (glacial history and fjord evolution).

I have one additional comment of note regarding the authors' main interpretation of ice piracy and flow switching. It strikes me that the authors' present one interpretation, and perhaps a very reasonable one given the likely nature of troughs to propagate in the headward direction over repeated glaciations. That said, can one really rule out an alternative? One alternative being that the topographic situation has always been the same as it is today – that the Hecla and Griper marginal trough funneled ice into the Scott system from day 1, and that only during the most extensive glaciations did Sam Ford ice spill onto the shelf fronting the entrance to Sam Ford Fiord. This led to a less developed (shallower) cross shelf trough and lack of a trough mouth fan. I think unless one drilled the Sam Ford Trough and found ancient tills, but not recent tills, one couldn't rule out this alternative scenario. For this reason, I really encourage the authors to use looser terms, couching their piracy mechanism as an “interpretation” or “inference”...

Line by line comments:

Title. I wonder if a title that more closely describes the inferences made in the paper (e.g., using words such as “evolution of shelf troughs,” or “ice piracy and flow switching”) would better advertise this nice case study.

C2

Line 13. Similar to what?

Overall abstract. Use of “marginal trough.” I did not know what this was until it was defined later in the paper. Reading the abstract again made more sense after I learned the terminology. Given the broad audience of this journal, I wonder if the term can be defined – or a more descriptive term could be used – in the abstract?

Line 16. Suggest “Ice-flow switching was first invoked. . .” instead of “Ice-flow switching has first been invoked. . .”

Line 19. Can do without the word “then”

Line 25/26. I do not think that because a variety of driving mechanisms for flow switching have been described in the literature, that this means that the problem is poorly understood. All of the mechanisms might be valid in their various contexts. I also suggest that the sentence starting with “This wide range . . .” should be removed.

Paragraph beginning on Line 35. Are the terms “Scott Trough” and “Sam Ford Trough” formally defined – do they appear on topographic/bathymetric charts? If not, and are defined here, authors should point out that they are “informally” called. . .

The spelling of the word “fjord.” It is fine to use the Scandinavian spelling when referring to fjords generally, but when referring specifically to the particular fjords on Baffin, they are proper place spelled “Fiord.”

Line 38. It would be more correct to write that the MSGs and a till unit that extend onto the TMF “have been interpreted” to indicate that the LIS reached the shelf break during the LGM (B and L, 2017). The evidence points to LGM ice cover, but it has not been confirmed with coring and dated sediments, for example?

Line 40. Sam Ford Fiord (not Fjord)

Line 42. Replace “Last glacial episode” with “LGM”

Line 42. Is it really possible that a glacier lobe on the continental shelf could have been

C3

cold based? Would the bed have been below sea level or above? If below, I think cold-based is out of the question?

Line 42. Should write more literally. “. . .slow-flowing or cold-based ice” (not “slow flow. . . ice”)

Line 43. “ice-flow” does not need a hyphen in this case.

Line 44. Look up use of “that” versus “which.” Here and several instances throughout the manuscript the two are improperly used.

Line 45. This is a long and awkward – not entirely grammatically correct – sentence. I think there is a word or some words missing immediately in front of “bathymetric data are here used. . .” I found the info in the first half of the sentence to be too highly detailed about the methods to be appropriate for this paragraph.

Rather than “. . . used to analyze an ice stream switching. . .” I would suggest that what the authors are really doing is “hypothesizing” ice stream flow switching.

Line 54. “realized” awkward verb to use.

Line 58. “. . . was used to analyze Sam Ford Trough. . .” “data were”

Line 74. “. . .up to the middle of. . .” I can’t make sense of this, what does “up to” mean, starting from the shelf break or the continent?

Line 75. Fiord (search and replace throughout manuscript, I won’t comment again on these misspellings)

Line 77. 12 km long (not large)

Line 90-97. Starting with the sentence “If the tributary. . .” I become lost about the points being made. I think these sentences could be re-written. I also think that studies of fjord evolution, by headward erosion, should be discussed in this section.

Line 103. Here an anomalous high number of refs are used supporting the point.

C4

Line 140. “flow” switching

Line 141. “Evidence” feels too strong for me. It is an interpretation. There are alternatives.

Line 159. The description of the “feedback” reminds me of the Kessler et al. (2008) paper on Baffin fiord evolution, which seems to be a quite relevant reference that doesn’t appear in this manuscript.

Line 163. “an” ice sheet

Line 166. “in” both

Line 170. The discussion here seems to imply that ice piracy can take place within a single glacial cycle. I think it occurs over longer timescales? So I might argue that “surge” and “readvance” are not relevant here.

Line 170. I think a new paragraph could be started at “Although. . .”

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2018-196>, 2018.