

Interactive comment on “Origin, burial and preservation of late Pleistocene-age glacier ice in Arctic permafrost (Bylot Island, NU, Canada)” by Stephanie Coulombe et al.

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Comments by the two referees were very enlightening and their suggestions useful; we are grateful for their input. His/her careful reading of the manuscript and his/her good knowledge of the subject-matter allowed providing relevant suggestions and additions to the manuscript. We treat each point raised in detail and with great interest.

Note that the line numbers given in this response refer to the revised version of the manuscript in track changes mode.

Referee #1

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General comments

Comment 1: Referee #1: P1L23 - The statement on “most of the arctic landscapes...” does not hold when you consider the vast landmass of Beringia. Authors: We agree and modified for: “As most of the glaciated arctic landscapes [...]”.

Comment 2: Referee #1: P2L1-2- Please check the references. Apparently, some references are mixed up (i.e. for Antarctica). Authors: Modification made. Problem with the reference manager.

Comment 3: Referee #1: P2L25-27 - The structure of the sentences can be improved (avoid the parenthesis). Authors: Modification made.

Comment 4: Referee #1: P3L11 - How far away is Pond Inlet? Can you mark it in Figure 1? Authors: We agree and location point has been added to the map (figure 1). In the Regional Setting section (p. 3, line 13), we also added that the study site is located “... at about 80 km north-west of the community of Mittimatalik (Pond Inlet)”.

Comment 5: Referee #1: P4L17-18: Except for the massive ice samples I assume. Authors: Part of the massive ice samples were also melted.

Comment 6: Referee #1: P6L4 - Does VWC stand for volumetric water content? Please clarify. Authors: We modified for “With a volumetric ice content...”.

Comment 7: Referee #1: P6L10 - Should read mm for long axes. Authors: Modification made.

Comment 8: Referee #1: P6L27-31: For a better overview, I suggest to add a table to the manuscript providing the basic statistics for $\delta^{18}\text{O}$, δD , d-excess (max, mean, min, sd), slope, intercept, number of samples for each type of ice/water. Authors: The data is provided on NordicanaD and we prefer to keep it as it stands.

Comment 9: Referee #1: P8L20: The slope of the C93 ice is below the GMWL, too. Are there any information on past (ice cores?) and modern slopes (LMWL of IAEA

stations?) available for your study region? Authors: The closest station of the of IAEA network is Pond Inlet and it only has data for two years, from January 1990 and December 1992. In section 5.2 of the Discussion, the amount weighted mean $\delta^{18}\text{O}$ for these two years is provided. These data are also plotted in figure 8b. We also added data and slope for Resolute Bay ($n=59$; 5 years) as the Pond Inlet has a rather small of data ($n=20$, 2 years), which prevents the calculation of reliable slope (LMWL). In Section 5.1 (Discussion), we compare our data to those obtained from cores sampled on the Barnes and Penny Ice Caps (p.8, lines 23-32).

Comment 10: Referee #1: P8L25: Provide $\delta^{18}\text{O}$ numbers for Barnes ice cap for comparison. In the cited paper no d-excess values of Barnes ice cap are given, so it's not possible to compare your values. Authors: The D-excess values of Barnes Ice Cap were provided by C. Zdanowicz and recently published in Lacelle et al., 2018 (Scientific Reports). We added citation to "Lacelle et al. 2018" to clarify this part.

Comment 11: Referee #1: P9L2-7: Can you provide estimations on the elevation difference for the ice source compared to today with respect to the 3.5 to 4.5‰ in $\delta^{18}\text{O}$? Is there any indication of the age (i.e. more detailed than Late Pleistocene) of the studied buried glacier ice? Given the climate instability known from Greenland ice cores also abrupt climate changes may explain the additional 3.5 to 4.5‰ in $\delta^{18}\text{O}$. Authors: The estimation on the elevation of the ice source were recently published in Lacelle et al., 2018 (Scientific Reports). There is no other indication of the age of the studied buried glacier ice. A fragment of poorly decomposed peat sampled in the overlying sediments was radiocarbon dated (p.9, 28-29). This surficial cover of mud and sand has been affected by cryoturbations as is indicated by the incorporation of this organic material. As regards to abrupt climate changes, we show a statistical argument for/against this in Lacelle et al., 2018 when we looked at variations in $\delta^{18}\text{O}$ for GISP2, Penny and Barnes Ice Caps. It is unlikely that we would have randomly sampled one of these short-lived $\delta^{18}\text{O}$ excursions.

Comment 12: Referee #1: P14L21: Provide an URL for this dataset. Currently it isn't

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possible to find it. Authors: The dataset was being reviewed, but it is now available on NordicanaD with the DOI provided.

Comment 13: Referee #1: Figure 1 - It would be good to add an additional map (or enlarge the second provided map) of the entire Bylot Island to show the study site in the regional context of Bylot Island and the other sites mentioned the regional setting section (Lancaster Sound, Navy Board Inlet, Eclipse Sound). Authors: We agree. A general map of Bylot Island has been added to Figure 1.

Comment 14: Referee #1: Figure 2 - What does the red star represent? Please clarify the meaning of the red dots in the left part (isotope and hydrochemistry samples?) and mark the position of the radiocarbon sample. Authors: We agree. In the caption of figure 2, we added "The red star indicates the sampling location of the organic material and the red dots shows the sampling points for stable O-H isotope and hydrochemistry".

Comment 15: Referee #1: Figure 8a - It would be good to add d-excess to the figure (maybe replace δD by d- excess). Add the title for the upper x axis. $\delta^{18}O$ needs superscript. Authors: We agree, the figure 8a has been modified as suggested. We added the title for the upper axis and we replaced δD by the D-excess.

Please also note the supplement to this comment:

<https://www.the-cryosphere-discuss.net/tc-2018-114/tc-2018-114-AC1-supplement.pdf>

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2018-114>, 2018.

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