

Clim. Past Discuss., referee comment RC2  
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## Comment on cp-2021-132

Anonymous Referee #2

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Referee comment on "Was there a glacial outburst flood in the Torngat Mountains during Marine Isotope Stage 3?" by Tamara Pico et al., Clim. Past Discuss.,  
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**Manuscript Number:** cp-2021-132

**Manuscript Type:** Research Article

**Title:** Was there a glacial outburst flood in the Torngat Mountains during Marine Isotope Stage 3?

**Authors:** Tamara Pico, Jane Willenbring, April S. Dalton and Sidney Hemming

### Comments to Authors:

Pico et al's manuscript provides evidence of an outburst flood from Glacial Lake Koroc in the Torngat Mountain of northern Quebec and Labrador, Canada. Using two  $^{10}\text{Be}$  cosmogenic exposure ages they suggest this outburst occurred during MIS 3 and the flood volume could have contributed to surface ocean freshening and measurable meltwater signal in  $\delta^{18}\text{O}$  records. The manuscript is, for the most part, clearly written, and is well supported by figures. However, I have a number of concerns that need to be addressed before this manuscript is ready for publication.

1). The authors constrain the age of Glacial Lake Koroc using two  $^{10}\text{Be}$  cosmogenic exposure ages. My main concern is the small sample size and the possibility of inheritance in these samples. The presence of a cold-based ice sheet covering the study area is highlighted in the text (lines 293-296). It, therefore, seems equally plausible that the high elevation shorelines dated in this study could be one of the earliest stages of a post-LGM lake in the region and samples simply appear older due to inherited  $^{10}\text{Be}$  concentrations. The authors explore the possibility of erosion and burial of the sample site but no mention of inheritance in the samples is made.

2). More detail is needed regarding the geomorphic/sedimentological evidence for pre-LGM Glacial Lake Koroc. No details regarding the mechanism of failure and evidence for a spillway that drained the lake are discussed, despite 'outburst flood' being in the title. During LGM ice recession, multiple glacial lakes occupied the Torngat Mountains. Could this not have been the case for pre-LGM and if so, what is the likelihood that this lake

didn't drain into another lower elevation lake nearby? Is it likely that the whole lake drained during the outburst event? Without the elevation of the spillway, this cannot be assessed.

3). The main conclusion drawn in this study is the contribution an outburst flood from this lake could have had to surface ocean freshening and possible implications this may have had for Heinrich events.

'A freshwater volume of  $1.14 \times 10^{12} \text{ m}^3$ , associated with the glacial lake outburst described in this

study could contribute to the large  $\delta^{18}\text{O}$  recorded for MIS 3 Heinrich events (minimum volume

required =  $1.4 \times 10^{13}$  -  $2.3 \times 10^{14} \text{ m}^3$ ; Hemming, 2004).'

The minimum volume stated is from Hemming, 2004 is 'a value assuming a volume the area of the Heinrich layers, and the thickness of the mixed layer is mixed one time with enough ice and water to make the  $\delta^{18}\text{O}$  excursion'. However, my understanding of the paper is that 0.6 -1.9 Sv of water over 1 yr to 500 yrs is needed to explain the observed  $\delta^{18}\text{O}$  excursion. The estimate presented in this manuscript is  $0.004 \times 10^6$  over 3 days. This seems to be significantly less water than is needed to contribute to the  $\delta^{18}\text{O}$  excursion observed during a ~500 yrs of a typical Heinrich Event.

#### **Line edits:**

Line 24: Provide a value for the magnitude of freshwater flux in the abstract. Consider also adding the lake name to the abstract

Line 27: Present freshwater flood volume in  $\text{km}^3$  rather than  $\text{m}^3$

Line 123: Delete space

Figure 3: Please add the drainage route to panel B. It would also be useful to add the location of mapped shorelines to this figure

Line 206: Evidence for outlet needs to be clearly stated

Line 232/233: More information is needed regarding the duration of ice cover during the LGM. The uncertainty surrounding the 20 kyr ice cover is very briefly mentioned and needs to be more clearly stated

Line 232: Add space 'concentration( Gosse and Phillips, 2001)'

Line 235: Add space 'calculation(Jones et al., 2019)'

Line 230: Add a brief statement to highlight that this is a minimum age

Line 234: You describe the impact of GIA on your ages however no age GIA correct age is available to the reader. Consider adding these ages to the text and Table S2.

Line 206: 'The shoreline is an erosional feature, and there is a small inlet channel at this elevation with rounded imbricated cobbles, suggestive of outburst flooding.' Imbricated sediment can be produced by outburst events. However, is these are within a small inlet channel how do they suggest outburst flooding?

Line 263: Should glacial not be capitalized in 'Pre-LGM glacial Lake Koroc'?

Supplementary Material Line 18: Table S2 seems to be identical to the table above