'The collapse of the Laurentide-Cordilleran ice saddle and early opening of the Mackenzie Valley, Northwest Territories, Canada, constrained by 10Be exposure dating' by Stoker et al.

The authors have provided a robust response to the issues raised by the reviewers, and they have implemented relevant edits in the revised version of the manuscript. This is a rigorous and well written piece of work, and I am delighted to confirm that my decision is: 'publish subject to minor revisions (review by the editor)'. A few points require clarification, and these are detailed below (line numbers relate to the track-change version of the article).

Pippa Whitehouse (Editor)

Main comment: the method used to calculate the GIA correction requires clearer justification. Your argument that using the new TCN ages would over-estimate the influence of GIA (mentioned in the author response document) is robust, but it is not clear to me that identifying "when a site became ice-free according to the model of Lambeck et al. (2017)" (line 185, revised manuscript) is a more accurate approach, given the widely differing rebound curves predicted by the three GIA models you consider (Figure S1). Differences between site-specific GIA model predictions of elevation change since deglaciation are typically >100m, translating into GIA corrections that can amount to several kyrs (Table S1).

Thank you for this comment, it highlights a lack of clarity in our description of the method used for the sensitivity analysis. When calculating the exposure ages for the sensitivity analysis we use the ExPage calculator. This provides a simple tool to quickly compare the GIA rebound curves and the influence of GIA model choice on exposure age calculation. This calculator uses the timing of ice-free conditions for each model when calculating the GIA corrections (i.e. when applying a GIA correction using the Lambeck et al. 2017 model it takes the timing of ice-free conditions from this model and calculates the influence of the rebound following the beginning of ice-free conditions, and when using the GIA rebound of the Gowan et al (2020) model it takes the timing of ice-free conditions from the Gowan reconstruction). The elevation is then calculated for 500 year timesteps (interpolated in the two models with longer timesteps) and calculates the influence of the GIA rebound for each timestep. This allowed us to identify the Lambeck et al. (2017) model as the most appropriate for our use and to compare how different the influence is from different models. Arguably, this is a more sophisticated and 'accurate' approach than our method which simply takes an averaged change in elevation. However, the exposure age calculations of the ExPage calculator uses an older (slightly outdated) value of the geomagnetic field compared to the CRONUS calculator. The use of this 'old' geomagnetic value leads to the systematic overestimation of exposure ages by about 500 years. Therefore, we opt to use the CRONUS calculator for our exposure age calculation and to apply our simplified method of GIA correction. We believe this is valid as our GIA correction does not differ significantly from that of the ExPage calculator (our GIA correction [Table 1] is typically within 100 years of the GIA correction within the ExPage calculator [Table S1], which is a smaller difference than the ~500 year age overestimation). The main difference in our calculated ages vs the calculated ages of the ExPage calculator is a result of this different value for the geomagnetic field. A further sentence has been added in to the text to better describe the methodology of the sensitivity analysis.

Your arguments for adopting the Lambeck et al. (2017) model are robust, and I am not requesting that you alter the approach you have used to calculate the GIA correction, but given the lack of

independent estimates on postglacial rebound in the region, the statement that the effect of GIA is "reasonably well constrained" (line 166, revised manuscript) is not really justified…

This is a good point. We now rephrase this to 'relatively well constrained', in comparison to models of the changes in atmospheric composition following deglaciation. This sentence is intended to transition from our discussion of atmospheric circulation/composition changes to our discussion of GIA related changes, which are comparatively better understood.

…and I recommend considering the following points as you carry out final revisions to the manuscript:

- both methods of determining the GIA correction (use of GIA model output/new TCN ages) contain errors; consider quantifying this or, at least, comment on how well the assumptions in the Lambeck et al. (2017) model agree with the new chronology presented here

The Lambeck et al. (2017) ice sheet reconstruction is based on the assumptions that there was (1) rapid ice retreat during the Bølling–Allerød period and (2) that the Ice-Free Corridor did not open before 13 ka. Both of these constraints are in line with our new chronology. We have now included a sentence to highlight this point, which hopefully helps to demonstrate that the model of Lambeck et al. (2017) is appropriate for what we use it for. We believe that we now are as transparent as possible in our methodology. We have taken steps to provide detailed discussion and justification for all our calculation and correction procedures for our exposure ages. Unfortunately, we are unable to quantify the uncertainties in the corrections we apply beyond what we already do. At the same time, we are not aware of any other study using cosmogenic exposure dating doing that.

- lines 178-180: briefly quantify the differences described here

Done.

- lines 186-187: references to 'sea level data' and 'average ΔRSL' are confusing; review the description of the methods used to calculate the GIA correction

We have amended this text to increase the clarity of the method.

- table S1: what does the column labelled 'standard' represent (include units)?

In Table S1, the standard column refers to exposure ages calculated using the 'standard' calculation approach of the ExPage calculator which applies no corrections (snow cover, GIA, etc) to the exposure ages. We have now amended this to describe what 'standard' involves.

Minor comments

lines 44-46: the logic here is awkward, be more explicit that it is no longer assumed that an ice free corridor persisted between the CIS and LIS throughout the last glaciation

Done.

line 118/119 and 437/438: text is repeated [only an issue in the track change version]

This should now be fixed.

line 143-144: mention that the impacts of different methodological choices are quantified in the results section (i.e. not just in the supplementary material) and reasons for preferring not to use the Arctic production rate are discussed in section 4.1.2

Done.

lines 213-215: text repeats that of lines 197-199

We have deleted the second instance of this sentence.

line 338: “The alternate…” – does this refer to calculations using the Arctic production rates?

This is correct, we have now included this in the text.

line 476: Makenzie -> Mackenzie

Done.

line 499: insulation -> insolation

Done.

line 502: the wording is a little strong and I suggest editing “…mean that we can quantify…” to something like “…allows us to estimate…”. Also, review use of the term ‘observed’ on line 506

Done.

line 264/505/fig. 5 caption: do you use 14 or 15 simulations?

Good spot. We have double-checked the simulations in Fig. 5 and in the original data table used to calculate the sea level rise contribution and we use 15 simulations. We have double-checked this is consistent throughout the manuscript.

lines 519-520: do these ages relate to the time at which the meltwater channels were originally incised, or the period when they contained meltwater?

These ages relate to the two ice margins which bracket the location of the meltwater channels. These channels were likely incised over a period of 10s to first 100s of years and since then have not carried any meltwater, so the time of incision and period they contained meltwater is the same event.