Supplementary materials related to the manuscript:

**The collapse of the Laurentide-Cordilleran ice saddle and early opening of the Mackenzie Valley, Northwest Territories, constrained by 10Be exposure dating**

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Map

Description automatically generated Figure S1. A comparison of the elevation change over time for each site according to the three main models of GIA for North America. The ‘Norman Range and Mackenzie Valley’ sites, and the ‘Cap Mountain, Cap Mountain lower, and the Smith Ridge’ sites were grouped together as they were all located on a single pixel within the GIA models and so display the same GIA history. All figures were plotted within Octave v.6.4.0 using the Expage-201912 calculator. ICE6G - Peltier et al., 2015; ANU2017 - Lambeck et al., 2017; Gowan2021 - Gowan et al., 2021.

References:

Gowan, E.J., Zhang, X., Khosravi, S., Rovere, A., Stocchi, P., Hughes, A.L., Gyllencreutz, R., Mangerud, J., Svendsen, J.I. and Lohmann, G., 2021. A new global ice sheet reconstruction for the past 80 000 years. *Nature communications*, *12*(1), pp.1-9

Lambeck, K., Purcell, A. and Zhao, S., 2017. The North American Late Wisconsin ice sheet and mantle viscosity from glacial rebound analyses. *Quaternary Science Reviews*, *158*, pp.172-210

Peltier, W.R., Argus, D.F. and Drummond, R., 2015. Space geodesy constrains ice age terminal deglaciation: The global ICE‐6G\_C (VM5a) model. *Journal of Geophysical Research: Solid Earth*, *120*(1), pp.450-487

Calendar

Description automatically generated Figure S2. Photographs of the sampled boulders. (A) NWT-MM-01 in red dashed circle with a person pointing to it, perched on the sandstone bedrock. (B) Close-up of NWT-MM-01 (the longer axis of the notebook is 184 mm). (C) Samples NWT-MM-02 (in the front, notebook for scale) and -03 (in the background, chisel for scale, ~30cm). (D) Close-up of NWT-MM-02. (E) Close-up of NWT-MM-03. (F) Sample NWT-MM-04. (G) Sample NWT-MM-05 with a chisel on top of it. (H) Sample NWT-MM-06; chisel for scale. (I) Sample NWT-MM-07 (large pinkish boulder in the centre). (J) Sample NWT-MM-08. (K) Sample NWT-MM-09 resting on the limestone bedrock. (L) Sample NWT-MM-10 on the limestone bedrock. (M) Samples NWT-MM-11 (in the front) and -12 (in the background). (N) Sample NWT-MM-12. (O) Sample NWT-MM-13. (P) Sample NWT MM-14. (Q) Sample NWT-18-07. (R) Sample NWT-18-09. (S) Sample NWT-18-10. (T) Sample NWT-18-11. (U) Sample NWT-18-12. (V) Sample NWT-18-15. (T) Sample NWT-18-16. (X) Sample NWT-18-17. (Y) Sample NWT-18-18. (Z) Sample NWT-18-19. (AA) Sample NWT-18-20. (AB) Sample NWT-18-21. (AC) Sample NWT-18-22.

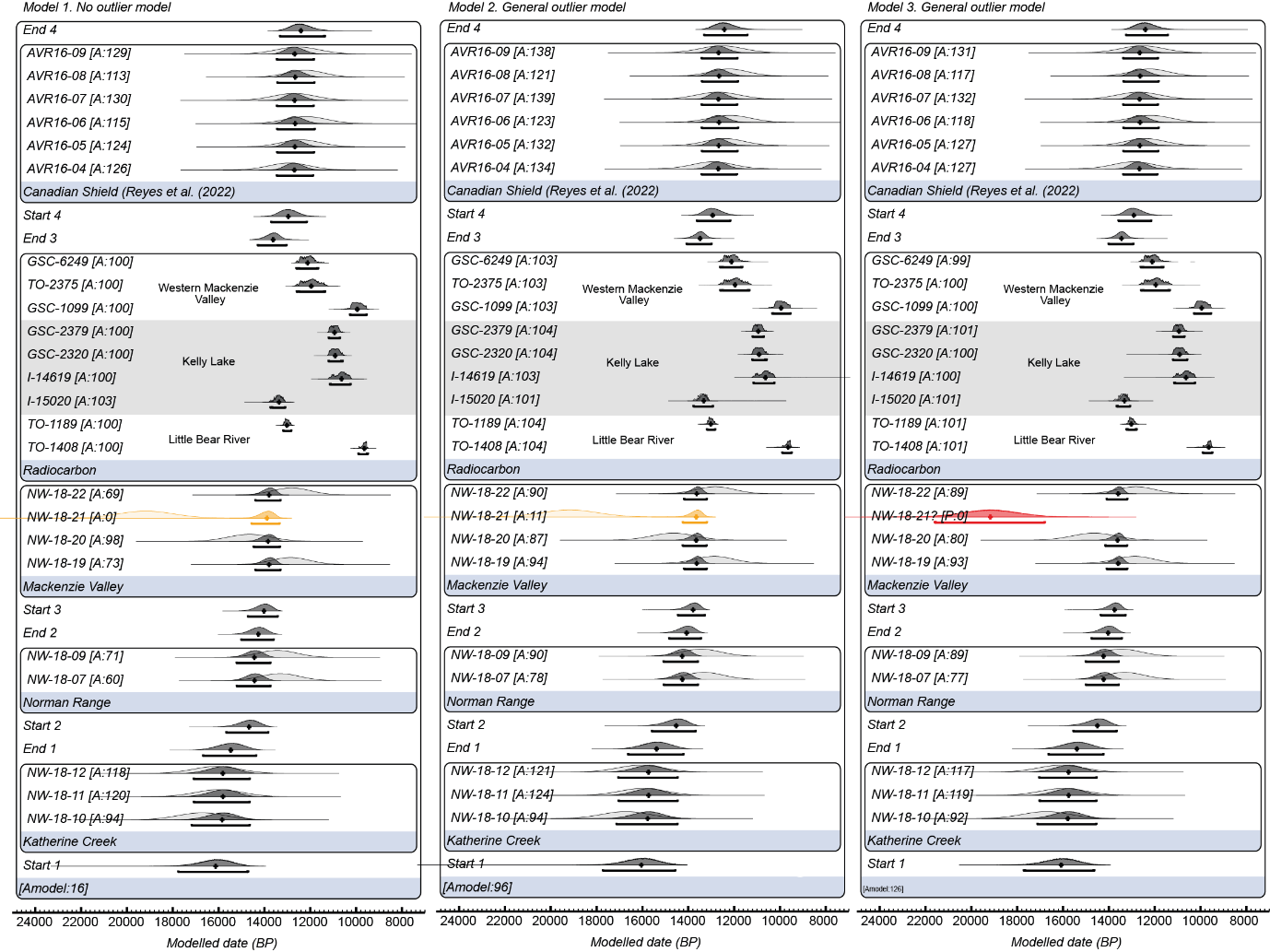


Figure S3. Outputs from Oxcal sequence models from northern study sites (Katherine Creek, Norman Range and the Mackenzie Valley) (Bronk Ramsey, 2017). Model 1 was run with no outlier model. Model 2 was run using a General outlier model. Model 3 was run using a General outlier model, excluding TCN dates with <60% agreement indices in model 1. Modelled dates are reported at 2 σ uncertainty. Exposure ages were calculated using the ‘primary’ production rate dataset (Borchers et al., 2015).

Graphical user interface

Description automatically generated with medium confidence

Figure S4. Outputs from Oxcal sequence models from southern study sites (Cap Mountain summit and Lower Franklin Mountains) (Bronk Ramsey, 2017). Model 1 was run with no outlier model. Model 2 was run using a General outlier model. Model 3 was run using a General outlier model, excluding TCN dates with <60% agreement indices in model 1. Modelled dates are reported at 2 σ uncertainty. Exposure ages were calculated using the ‘primary’ production rate dataset (Borchers et al., 2015).



Figure S5. Outputs from Oxcal sequence models 13, 14 and 15, from northern study sites (Katherine Creek, Norman Range and the Mackenzie Valley) (Bronk Ramsey, 2017). Model 13 was run with no outlier model. Model 14 was run using a General outlier model. Model 15 was run using a General outlier model, excluding TCN dates with <60% agreement indices in model 1. Modelled dates are reported at 2 σ uncertainty. Exposure ages were calculated using the Arctic production rate (Young et al., 2013) and Lal/Stone scaling method.



Figure S6. Outputs from Oxcal sequence models 16, 17 and 18, from southern study sites (Cap Mountain summit and Lower Franklin Mountains) (Bronk Ramsey, 2017). Model 16 was run with no outlier model. Model 17 was run using a General outlier model. Model 18 was run using a General outlier model, excluding TCN dates with <60% agreement indices in model 1. Modelled dates are reported at 2 σ uncertainty. Exposure ages were calculated using the Arctic production rate (Young et al., 2013) and Lal/Stone scaling method.

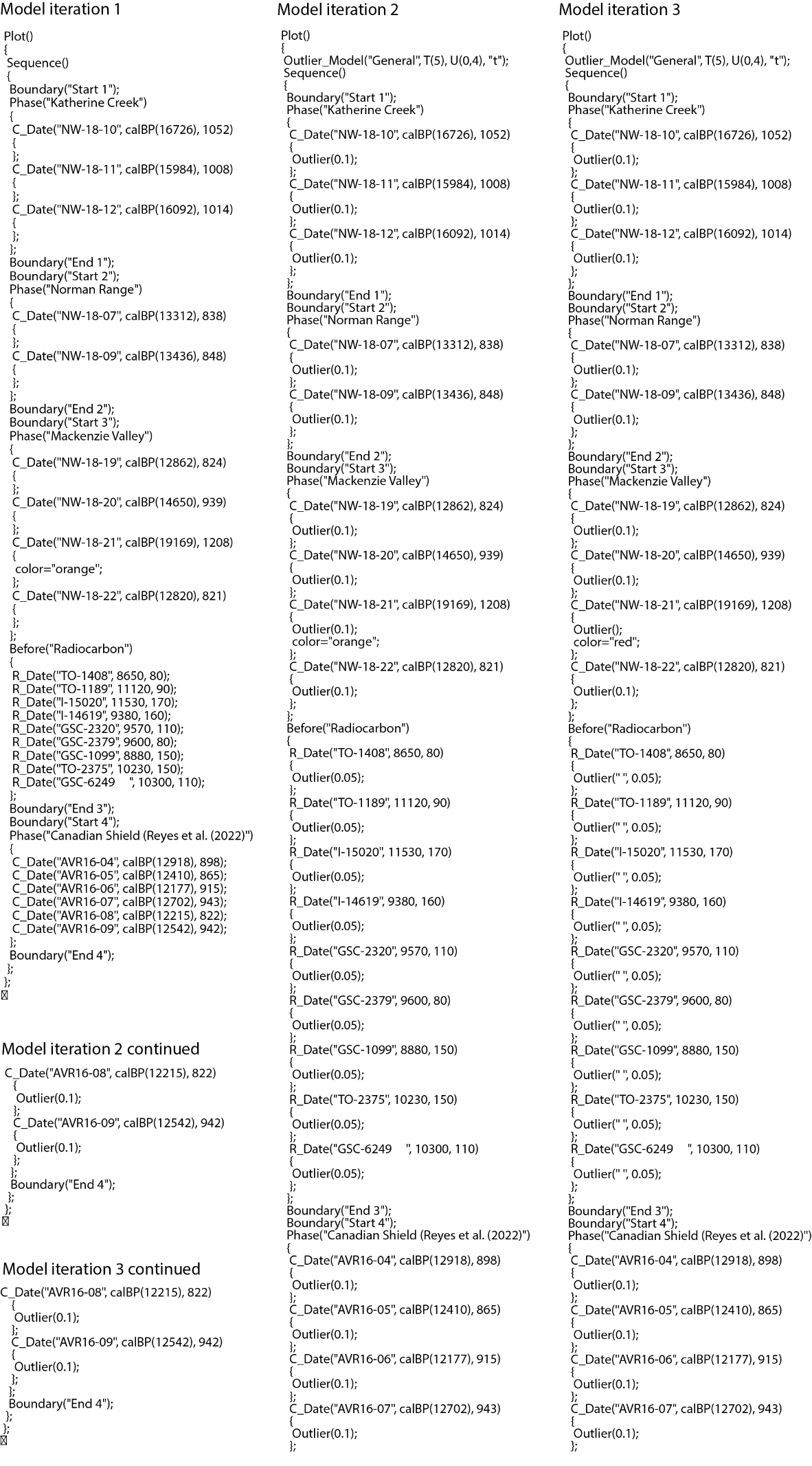


Figure S7. Inputs from Oxcal sequence models from northern study sites (Katherine Creek, Norman Range and the Mackenzie Valley) (Bronk Ramsey, 2017)

Shape

Description automatically generated with medium confidence

Figure S8. Inputs from Oxcal sequence models from southern study sites (Cap Mountain summit and Lower Franklin Mountains) (Bronk Ramsey, 2017)

Figure S9. Scatter plot of boulder height and exposure age for the northern sites (Katherine Creek, Norman Range, Mackenzie Valley). Note the lack of relationship between boulder height and exposure age, suggesting that the influence of snow cover or any surface till layer was minor.

Figure S10. Scatter plot of boulder height and exposure age for the southern sites (Cap Mountain, lower Franklin Mountains). Note the lack of relationship between boulder height and exposure age, suggesting that the influence of snow cover or any surface till layer was minor.