

## ***Interactive comment on “Pleistocene glacial history of the New Zealand subantarctic islands” by Eleanor Rainsley et al.***

**Eleanor Rainsley et al.**

e.b.fogwill@keele.ac.uk

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We thank Reviewer 2 for their detailed and complimentary review, which highlights the value of our study to Quaternary science. We address their suggestions and queries below.

"1. Structure and content of the methods and results chapter"

The reviewer makes some helpful and sensible suggestions for improving the clarity and readability of this complex multidisciplinary paper, which we will act on in our revised manuscript.

"2. Basal peat ages (p. 12, line 15ff)"

C1

Our constraint for the onset of peat growth, modelled in OxCal, is included as a bar in Figure 9. We will also provide a Kernel Density (KDE) distribution plot summarising the ages on the same figure (Bronk Ramsey, 2017).

"3. Perseverance Harbour moraine In Figure 5, the authors show multibeam data that potentially indicate the presence of moraine ridge on the floor of the inlet. The question would then be if the ridge at Shoal Point is also of glacial origin. Looking at Google Earth, Shoal Point is a limited, but very straight structure, which I rather attribute as a 'hardrock' feature. Are there any indications that the Shoal Point has any glacial deposit on land? See also comment for Fig. S9."

This is an important point to clarify. Unfortunately the large amount of peat covering the island prevented us from confirming the presence of glacial deposits. However, the mirror image features on either side of Perseverance Harbour (including the extension of these features up the valley side) argues strongly these are glacial in origin.

"4. Synthesis figure What I miss in this paper is a figure that synthesizes the (many!) results of this study. Figure 9 currently only shows two gray bars (!) representing a tiny amount of the generated results! Why not compiling your data including all the dates from the onset of the peat formation, the modeled glacial length, and so on. Maybe extend the time axis further back in time (evt. with axis breaks). That would greatly increase the impact of the paper."

Thanks to the reviewer for some suggestions of how to improve this figure and incorporate more of our results into it. We shall take these on board in our revised manuscript, and include the Kernel Distribution (KDE) of the  $^{14}\text{C}$  ages, the IRSL ages (with a break in the time scale), as well as our modelled glacier lengths. Set against the SST (subtropical front) record from Bard & Rickaby 2009, this will substantially improve the communication of our study's key results. We thank the reviewer for their excellent suggestion.

"Minor remarks: Abstract: The maximum ice extent around 68 ka is not mentioned in

C2

the abstract."

We have tried to simplify the wide-ranging findings of this multidisciplinary paper as much as possible within the abstract, but will add that our modelling, combined with field evidence, suggests a possible larger (than LGM, but smaller than the 384 ka maximum) glaciation at 68 ka.

"p. 6, line 18: Explain why the top part of the LLS Cirque core was not sampled between 64-104: Lost? No recovery?"

The focus of this study was the timing and impact of deglaciation. As such we did not undertake work on the Holocene part of the sequence. We will make this explicit in the revised text.

"p.6, line 24: Mention here that the Enderby Formation was sampled at Site 1."

The Enderby Formation is located on the north coast of Enderby Island, as shown on Figure 1, distinct from Core Site 1 to the south of the island. We will clarify this in our revised manuscript.

"p. 9, line 2: Introduce the acronym NIWA"

NIWA is the National Institute of Water and Atmospheric Research, a Crown Research Institute of New Zealand. We will define this in our revised manuscript.

"p.12, line 3: This should be Fig. S7D (and not S3D)"

We thank the reviewer for spotting this.

"p. 12, line 27 the age inversion is further UP (not down) the core"

This is correct, thanks to Reviewer 2 for the correction.

"p. 14, line 1: The subset of 25 simulations is shown in Fig. S10!"

This will be corrected.

C3

"p. 14, line 22: Port Ross is not labeled on the map in Fig 1."

Our thanks to the reviewer for spotting this. We will rectify this in the revised manuscript.

"p. 19, line 6: Here, the authors talk about the loss of catchment. Can this loss of catchment be quantified in order to judge if that is an important factor for the more recent glacials. For me it is hard to believe that this substantially modified the growth of the glaciers in the recent past."

The past erosion of basaltic rocky shorelines such as those found in the Auckland Islands is hard to quantify, further complicated by the oscillating global and regional sea levels over the past ~400 kyr covered by this study. Quantifying the possible effects of this erosion, as well as other potential contributors to the extensive MIS10 ice cap is beyond the bounds of our work here, but could form the basis for an interesting future investigation.

"p. 25, line 2: Space before reference"

This will be corrected.

"Figure 1: Site 20 is not mentioned in the manuscript"

A number of the sediment core sites are not discussed explicitly within the text of the manuscript, as they provided no data to the study beyond their basal peat dates. All such sites, including Site 20, are included in Table 1 and their location shown in Figure 1.

"Figure 3: Maybe add on the side the extent of Fig. S7D for reference. Figure needs a higher resolution. Erosional contacts are very hard to see."

We apologise for the low resolution of this figure in the discussion paper, which is an artefact of the submission guidelines that ask for figures to be included within the manuscript file. When uploaded separately for publication, the figures will be of their original high resolution, and much easier to view.

C4

"Figure 4: Short explain how the two sections were correlated."

The sequence has multiple prominent lithostratigraphic layers which extend from one section to the other. It was from one of these that we correlated the two sections. We will make this explicit in the revised version of the manuscript.

"Figure 9: Label in the figure should most likely be NZ eLGM (instead of NZ gLGM) In the figure caption: Space before reference (twice)."

To clarify, on this figure we have highlighted the global Last Glacial Maximum as defined by its timings in New Zealand, as we consider this the most relevant timeframe when considering the New Zealand subantarctic LGM extent.

"Figure S7C: Please explain what you want to highlight with the dashed red line/box and the red star."

We thank the reviewer for picking up on this omission – the red star highlights the north coast of Enderby Island (the site of the Enderby till type site), visible in the background of the photo. The red box shows the sampling location for the Pillar Rock sediment sequence. The dashed red line shows the boundary between the Pillar Rock glacial till (correlated with the upper till from the Enderby formation) and the overlying sediment sequence. We will include this information in the figure caption in the revised manuscript.

"Figure S9: In the hydrographic chart in Fig. S9A the position and the shape of the proposed moraine ridge in Norman Inlet is clear, but are there any signs of a moraine ridge visible on land in Fig. S9B? If so, then please mark the geomorphological features attributed to a glacial deposit in the photograph. Please give reference of the hydrographic chart."

We thank the reviewer for spotting this and will add to the figure.

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