

## **Reviewer 2**

### **General Comments:**

There are a couple of areas within the manuscript where I felt lost and needed to read Rowell et al, 2022, for context. These areas are discussed in the Specific Comments below. If these areas are addressed, it will make the manuscript much more accessible to readers unfamiliar with Rowell et al, 2022, and help the manuscript achieve a “stand-alone” status.

With minor revisions, this paper will be an important contribution to the *Ice core science at the three poles* special issue.

*Thank you for your careful consideration of this manuscript and for your helpful suggestions. We agree that more information is required in the introduction and methods to ensure that the text can be considered a standalone paper without the need to refer to Rowell 2022. We have made additions to the introduction to provide more context, particularly with regard to the choice of Sherman Island as a drill site, and the use of the RAID, as you suggest in “specific comments”. We have added some of the information that is in Rowell 2022 to the methods, specifically regarding how the ice was sampled and what makes RAID sample different from “normal” ice core samples (as also requested by another reviewer).*

### **Specific Comments:**

35: Without the context from Rowell et al, 2022, it is not clear why WACSWAIN would choose to drill at Sherman Island to investigate the WAIS during the LIG if there is high risk of no LIG ice at the site. A sentence (or two) further explaining why Sherman Island was chosen as the site to investigate the LIG will help the reader understand the scientific context for drilling at Sherman Island.

*Thank you for pointing this out. We have expanded on the introduction between lines ~35-55 and added more information about why Sherman Island was chosen. Specifically, we have explained that if LIG ice was present at Sherman Island it would provide an additional constraint into LIG WAIS stability to other cores from around the WAIS (Skytrain, soon to be Hercules Dome), providing an additional point for better spatial understanding of this time period.*

35: Without context from Rowell et al., 2022, it is not clear why the RAID was chosen for the drilling. All that is needed here is some of the context that is contained in Rowell et al., 2022, such as ...high risk of not finding LIG ice at Sherman Island... the RAID was used, as opposed to a conventional ice core drill, to obtain a lower resolution water isotope record from the site which would indicate the ice age at the bedrock and give a first indication of the climate signal at Sherman Island... the RAID will save on logistics... etc..

*Yes this is useful information to include here as well as in the Rowell 22 paper, to save the reader having to look elsewhere. We have added more information about why the*

*RAID was used on Sherman island. Specifically, that it was used because of the risk presented by Sherman island (of not containing LIG ice) so that in the event of not obtaining LIG ice, a full scale drill campaign would not have been carried out, but we would still have a long and useful record from a new and interesting location in the WAIS. We explain that the RAID is much quicker than traditional drilling methods so this is essentially a compromise for a higher-risk site.*

40: The first sentence in the last paragraph talks about the “last few centuries” whereas the previous paragraph focuses on the LIG. I believe I understand your overall point – a reliable age scale is needed for the core – but the last paragraph could use some rewording to make it fit better within the context of all of the previous text up to that point. *Thank you for your input on this. The aims of the WACSWAIN project and background for drilling at the site necessitate that we discuss at least briefly the LIG and why Sherman was chosen (which we have now expanded upon since the original submission). But you are right to also point out the abruptness of the change in focus from the LIG to the last few centuries. We have added some more text to link the overarching project aims with what we actually aim to achieve with this paper.*

60: It would be good to include a reference regarding “sulfur (S) isotope analysis to differentiate between background and volcanic samples”.  
*A reference to Patris et al 2000 has been added.*

#### **Technical Corrections:**

30: The word “in” is not needed in the sentence that reads, “the Abbott Ice Shelf in between continental Antarctica and Thurston Island”.  
*The word “in” has been removed*

45: The acronym for RAID is defined earlier in the text (at 30). Instead of “Sherman Island Rapid Access Isotope Drill (RAID) field campaign”, it can simply say “Sherman Island RAID field campaign”.  
*This has been corrected.*

55: The title of this section is “SI:RAID age scale development”. It will help the reader if “SI:RAID” is defined somewhere. The first sentence of this section could be changed from “The Sherman Island RAID age scale” to “The Sherman Island RAID (SI:RAID) age scale” to give a reader a clear understanding of what is meant by “SI:RAID”.  
*Thank you, yes this change has been added to (1) address your comment and (2) distinguish the SI:RAID from the SI:Core (the 20 m firn core) which is defined in the subsequent sentence in the text. The title of this section has been re-named to simply “Age scale development” to avoid confusion.*

65: Up to this point in the text, Sherman Island has not been assigned the acronym “SI”. So, in the second sentence, it is clearer if “20 m long SI ice core (SI:Core)” is changed to “20 m long Sherman Island ice core (SI:Core)”.  
*Yes this is a helpful comment and your suggested change has been made.*

70: In some places throughout the text “sea salt” is used and in other places “sea-salt” is used.

*Occurrences of “sea-salt” have been changed to “sea salt”.*

105: In the first sentence, include the word “Island” after “Sherman”.

*Thank you! This is corrected.*

110: It seems like the first paragraph (both sentences) “It became clear during....dating of the deeper samples” should be in the previous section, and section 3.03 should begin with the sentence/paragraph “The records of chemical species were closely...”.

*You are right that the sentence does make more sense at the end of the previous paragraph. We had placed it as the start of the “volcanic horizon identification” section to justify using the flank age model as the age scale to use for searching for volcanic horizons. This meaning still stands at the end of the previous section. The phrase “described below” has been added to the end of the sentence.*

110: Suggest rewording the second sentence to: “We use the flank-flow depth/age model to guide us in dating the deeper samples.”

*Thank you, this is a clearer sentence and your suggestion has been taken.*

130: The authors are asked to double-check their stated values in the text for  $R_m$  and  $R_t$ . I think the values stated in the text are mismatched. I believe  $R_m$  should be 0.038 and not 1.78, and  $R_t$  should be 1.78 and not 0.038.

*Yes you are correct and this is an error.  $R_m$  and  $R_t$  have been swapped in the sentence to match with the correct values.*

170: Incorrect use of “an”. Should read “we use a depth/age model”.

*Corrected*

175: Should be either “Under these assumptions...” or “Under this assumption”.

*Corrected to “these assumptions”*

200: Delete the first occurrence of the word “were” in the following sentence “Peaks present in some species in RAID data were which were not identified in the Core”. Sentence should read, “Peaks present in some species in RAID data which were not identified in the Core”

*We have corrected the sentence as per your suggestion and added “the” - “Peaks present in some species in **the RAID data**...”*

210: It looks like the word “Table” is missing in “...added to the average uncertainty at the two adjacent ties (2)”. Should it read “...added to the average uncertainty at the two adjacent ties (Table 2)”.

*Corrected*

225: Suggest rewording sentence to “The model was used to estimate the age of the ice towards the bed at the RAID drilling site; however, in the lowest 13 meters, model

outputs are meaningless.”

*Corrected*

265: Previously in the text it is written as “S isotope” rather than “S-isotope”.

*Corrected all occurrences to “S isotope”*

300: “IC” is defined anywhere in the text. Could use “chemistry data” to be consistent with Section 2 of the manuscript.

*Corrected to “chemistry data”*

300: Most previous places in the text it is written as “S isotope” rather than “S-isotope”.

*Corrected all occurrences to “S isotope”*

305: “SI” isn’t defined anywhere else in text. Suggest rewriting sentence to “The records contained in the existing Sherman Island data”

*Corrected to say “Sherman Island”*

310: “SI” isn’t defined anywhere else in text. Suggest rewriting sentence to “The Sherman Island ice core was drilled by DT.”

*Corrected both occurrences in the contributions to say “Sherman Island firn core” to make it very clear that this is referring to a separate core, not the RAID borehole and chippings.*

325: The Basen et al., 2012, reference is to a discussion paper. Is there a corresponding final paper to reference? If not, a reference to a published, non-discussion paper should be used in lieu of this one.

*This reference has been updated from the pre-print discussion to the final paper.*

340: The stated reference is to a pre-print. Printed manuscript reference is: Crick, L., Burke, A., Hutchison, W., Kohno, M., Moore, K. A., Savarino, J., Doyle, E. A., Mahony, S., Kipfstuhl, S., Rae, J. W. B., Steele, R. C. J., Sparks, R. S. J., and Wolff, E. W.: New insights into the ~ 74 ka Toba eruption from sulfur isotopes of polar ice cores, *Climate of the Past*, 17, 2119–2137, <https://doi.org/10.5194/cp-17-2119-2021>, 2021.

*Reference updated*