**Reviewer #2**

**We are very grateful to you for the detailed comments and very useful suggestions. The manuscript has been modified based on these comments/suggestions. Below, we give a point-by-point response to the comments and suggestions, in the order of (1) comments from Referees, (2) author's response.**
**Comments are in black, and the responses are in blue.**

**(1) comments from Referees**

This is an extremely simple brief communication whose purpose is to show that the grove mountains blue ice area would be a good place to do ice coring for palaeoclimate. The novelty in the paper consists of two (similar) dates obtained using 81Kr dating, which show that ice 140000 years old is present at the surface. The authors comment that the isotopic and chemical data suggest that the ice originated somewhere relatively local and not high on the East Antarctic plateau.

There is not really much to comment on. The date is hard-won, as this is a dating method that requires a lot of effort and a lot of ice. The finding is novel if a bit limited - it would of course have been much more interesting if the authors had been able to say anything about ice at depth, or to demonstrate that the greenhouse gas content of the ice was compatible with the ages they found. However, it is what it is. This seems like a result and proposal that is worth publicising, and the science in the paper is correct. I therefore recommend publication with very limited revision.

**(1) author's response**

We thank you for your time in reading our manuscript and the very constructive comments. We totally agree with you that the greenhouse gas data would be more helpful in terms of assessing the values of Grove Mountain BIA as paleoclimate archives. In addition, a deeper ice core will provide more information about the stratigraphy, which could be constrained by gas measurements as well. Unfortunately, these surface ice samples were not analyzed for the greenhouse gas content. In the revised manuscript, we included a discussion on the possible ice core drilling sites in Grove Mountains. In the future work of the blue ice core, we will include the greenhouse gas analysis. Thank you very much for the suggestions.

**(2) comments from Referees**

Minor comments:

Line 25: Princess Elizabeth rather than Elizabeth princess (it's right elsewhere in the paper)

**(2) author's response**
Corrected, thanks.

**(3) comments from Referees**

Line 53 “potential” rather than “potentials”

**(3) author's response**

Corrected.

**(4) comments from Referees**

Table 1. For Allan Hills it might be nice to add a more recent paper such as Yan 2023 (Yan, Y., Kurbatov, A. V., Mayewski, P. A., Shackleton, S., and Higgins, J. A.: Early Pleistocene East Antarctic temperature in phase with local insolation, Nature Geoscience, 16, 50-55, doi: 10.1038/s41561-022-01095-x, 2023)

**(4) author's response**

Thank you for the suggestion. However, the Yan et al (2023) paper deals with existing data first reported in earlier publications. The Yan et al (2019), cited in the first draft, is the first paper that reports the existence of old ice (>2 Ma) in the Allan Hills BIAs.

**(5) comments from Referees**

On page 5 (around line 108), the reader would appreciate more information about why 85Kr indicates contamination. I suppose giving its short half life would explain this.

**(5) author's response**

We follow the reviewer’s suggestion and added the following sentence to make it clearer. Now it reads (subsection 2.2),

“*The anthropogenic $^{85}Kr$ isotope is analyzed since it has a half-life of 10.7 years, making it a good indicator of cross-sample contamination from the modern reference sample.*”

**(6) comments from Referees**

Line 161. If possible it would be nice to see a small table with the water isotope data for Grove Mts, for nearby sites from the paper by Ma et al, and for inland sites (Dome A, Vostok, Dome Fuji), along with their elevations. This would help to make the point that the ice must have a local rather than plateau origin.

**(6) author's response**

Agree and thank you for this helpful comment. For the Brief Communication in The Cryosphere, the total number of tables and figures should be no more than three. In the main manuscript, we have two tables and one figure; thus, we included this table in the supplementary materials (Table S1).

Table S1 Stable isotopes of water in the snow and ice from different sites in Antarctica

| Sites | $\delta^{18}O(H_2O)$ /‰ | $\delta^{2}H$ ($H_2O$)/‰ | Elevation/m | References |
|---|---|---|---|---|
| Blue ice in Grove Mountains | -40.3 | -321.2 | ~2000 | This study |
| Surface snow near Grove Mountains [a)] | -37.0±1.6 | -289±14.8 | 2556 | (Ma et al., 2020a) |
| Dome A | -58.5±2.3 | -449.4±17.0 | 4089 | (Ma et al., 2020b) |
| Dome A | -58.4 | -450 | 4093 | (Xiao et al., 2008) |
| Dome C | -50.1 | -390 | 3240 | (Stenni et al., 2001) |
| Vostok | -56.4 | -440 | 3490 | (Ekaykin et al., 2004) |
| Dome Fuji | -54.9 | -425 | 3810 | (Watanabe et al., 2003) |
| Dome B | -55.2 | -430 | 3650 | (Masson et al., 2000) |

[a)] Surface snow samples were collected on the Chinese inland Antarctic expedition traverse route from Zhongshan to Dome A (Figure 1a), about 65 km from the Grove Mountains.

## References


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**End of responses to Reviewer #2.**