

Key:

Community & referee comment

Author response

Dear Authors,

Thank you for sharing this very interesting preprint. I enjoyed reading your work and found the dust analysis in blue ice and its implications insightful. I would like to offer a few constructive comments and questions for your consideration.

1. Size Distribution (Aeolian Dust vs. Basal Debris) & Basal Contamination:

Regarding the discussion on size distribution changes linked to basal contamination, it might be worth considering the englacial formation of large particles. For instance, visible solid inclusions found in the EDC basal clean ice are known to form englacially and are distinct from primary basal debris (Tison et al. 2015, DOI: <https://doi.org/10.5194/tc-9-1633-2015>). In addition, dust aggregation might be able to affect the size distribution as discussed in the publication by Lambert et al. (2008, DOI: <https://doi.org/10.1038/nature06763>). While chemical alteration (line 481) and dust aggregation (line 528) are discussed later in the manuscript, explicitly addressing the potential contribution of such englacial particle growth when linking size distribution shifts to basal contamination could further strengthen this section.

Thank you for this comment. We agree that the englacial formation of large particles may be relevant in this section especially in discussion of the prevalence of coarse particles where basal contamination is not expected. However, from SEM analysis of particle morphologies especially in deepest and coarsest samples (228_3), we did not observe the presence of aggregates. We will include a figure showing this imagery in the manuscript and will investigate the size distributions further to explore this possibility in the revision.

2. Clarification on Co-varying Parameters in Shallow Sections

It seems worth considering how the multiple parameters should be interpreted collectively. The long-term snapshots, which bias toward interglacial periods, show clearly low dust mass concentrations in the shallower sections (above 155 m depth, Figure 3) without significant basal contamination. However, these same samples still preserve distinctive variations in both dust size distribution (Figure 4, line 290) and $\delta^{18}\text{O}$ water isotope (Supplementary Figure 1). If these layers had been significantly altered by either glacial low-accumulation or physical mixing, one might physically expect these distinct variations in size distribution and water isotopes to have been smoothed out alongside the mass concentration. Could you perhaps elaborate further on the mechanism that allows the distinct isotope and size distribution signals to survive while maintaining a consistently low mass concentration?

Thank you for raising this important question. Notably, there are no clear relationships between dust mass concentration and water isotope values (Fig. S1). We observe that in both the $\delta^{18}\text{O}$ and dust size distribution records there remains an interglacial bias after stringent comparisons

with 1903 and established glacial-interglacial parameters. It is challenging to distinguish a sample as glacial or interglacial in nature hence the need for a screening process based on multiple physical properties of dust. We will include a more detailed outline of this screening process to provide more clarity on this topic in the revised manuscript.

Minor Comments:

The SEM images are a valuable addition to the manuscript. However, adding a clearly visible scale bar to each image would help readers more accurately assess particle size and morphology.

A larger and more visible scale bar will be added to each image.

The authors may already be aware of this, but a very recent publication on microstructural analysis by Stoll et al. (2026, DOI: <https://doi.org/10.1029/2026JB033890>) provides relevant insights into ice deformation and might be a helpful resource to enrich your discussion on these deeper or disturbed sections.

Yes, we will cite Stoll et al., 2026 and update lines 595 - 600 with the relevant information.

Thank you again for this stimulating paper, and I look forward to your response.

Thank you for your constructive input.

Best regards,

Geunwoo Lee