Review of manuscript tc-2021-162: “Deep ice as a geochemical reactor: insights from iron speciation and mineralogy of dust in the Talos Dome ice core (East Antarctica)” by Giovanni Baccolo et al.

25 August 2021

Summary

The authors present a new perspective of possible post-depositional processes that affect mineral dust records, particularly below 1000 m depth in the 1620 m long TALDICE ice core. The datasets are of high quality and obtained using Coulter counter and spectroscopic measurements such as Synchrotron radiation, X-ray fluorescence and XANES. Crucial properties of dust such as the concentration, grain-size, their elemental composition with a focus on Fe-mineralogy are discussed in depth. The study shows englacial formation of specific minerals in deep ice affecting the original scenario of dust deposition and conclude highlighting potential impacts while interpreting dust records on deep ice cores. While the originality, scientific quality and significance of the work is excellent, the manuscript falls short on language with several grammatical errors which needs language editing. I recommend this manuscript, after necessary language editing, for publication in the journal’s special issue: Oldest ice: finding and interpreting climate proxies in ice older than 700000 years.

Specific comments

I do not mention any corrections regarding language as the manuscript needs thorough language editing. Following are some specific comments.

Line 35: The authors mention the role of depth and pressure in the post-depositional processes that has not been previously addressed - however this aspect of depth and pressure altering dust records aren’t discussed in the results and discussion. I suggest to modify or delete this sentence.

Line 38: replace ine with ice.

Section 2: Though co-ordinates are provided, I suggest a location map especially with surrounding dust sources would be useful for many.

Sample Preparation: I have some queries on technical aspects of sample preparation. You mention that the preparation took place in the ISO6 clean room - were the ice sections decontaminated under the laminar flow bench or in the clean room? At what temperature did this process take place? Also, considering the 2 cm thin ice sections used in this analysis, how thin was the ice after 3 baths decontamination? do you decontaminate the ice sections using ice cold ultra-pure water bath to avoid melting the sections that are already 2 cm thin?

I understand that you analysed 191 coulter counter samples and 54 filtered samples for spectroscopy. If not, you might have to clarify it in the sample preparation section.

line 78: remove extra ”in”.

Line 93: According to this paragraph, there are 55 samples, while you mention 54 in Lines 78 and 87. Your dataset in the supplement seems to have 54 samples.

Line 144: CLPP (coarse local particle percentage).

Lines 197–201: This paper focuses on many possible reactions of Fe-minerals happening in deep ice. The authors do mention about carbonate dissolution in deepest samples backed with well-known ice core studies. However, there is also a possibility that such post-deposition processes alter dust chemistry immediately after the snow deposition as shown from the surface snow cores by Mahalinganathan and Thamban (2016) that has not been observed in the holocene / interglacials of deep ice cores. Do you think the carbon dissolution and Fe-mineral reactions which are apparent in deep sections of TALDICE may be happening constantly from the time after snow deposition (instead of happening at a deeper section, (unless it is depth-pressure based), but are missed due to lesser spatial study?

Figure 1: $ng_{dust}g_{ice}^{-1}$ of dust concentration in figure. The caption misses mentioning MIS 7.5 and 9.5 for red bands.

Figure 3: Reference is not linked.

Figure 6: Choose contrasting colors for panels c, d and e.

Table 2: SD for MIS-6 column is missing.

References

Mahalinganathan, K. and Thamban, M.: Potential genesis and implications of calcium nitrate in Antarctic snow, The Cryosphere, 10, 825–836, 2016.