

Answer to reviewer comment 3

It's of great significance to compile the radiogenic isotope compositions data of Sr and Nd at the "three poles" for researchers to further understand and trace dust transportation. In this respect, the database is necessary and meet the demand of many readers.

We appreciate that the reviewer 3 finds our work interesting. We agreed with the reviewer's comments for improvement. We hope that this version addresses the suggestions and comments of the reviewer 3 to improve the smooth flow of the text.

The following are some comments to improve this manuscript:

Main comments:

I suggest to add a paragraph before Line 55 to explain why  $^{87}\text{Sr}/^{86}\text{Sr}$  and  $^{143}\text{Nd}/^{144}\text{Nd}$  were chosen to trace dust sources. That means the tracing principle of radiogenic isotope compositions of Sr and Nd should be introduced here. There were a mass of Sr-Nd data measured in the "three poles" in different medium (e.g. rock, clay, sediments, dust...), why only data from sand, sediment, loess, Aeolian deposits and snow/ice were compiled here? Were they all connect to Aeolian dust and easy to trace the sources? Is this manuscript only focus on "Cryospheric science"? There should be some words to explain these choice.

Reply: We explained why  $^{87}\text{Sr}/^{86}\text{Sr}$  and  $^{143}\text{Nd}/^{144}\text{Nd}$  ratios were chose to trace the dust sources in lines 50-56. We added Sr-Nd data from rock, sediments, dust and others from the Third Pole in revised manuscript. Of course, we concerned the dust in snow/ice, therefore, we gave the examples about dust tracing in snow or ice in the three poles.

Some conclusions in the manuscript needs more robust evidence: L. 362-364: “As shown in Fig. 6, the lowest  $\epsilon$  Nd values were observed along the ice-free periphery of the GrIS and SV; therefore, these ice-free regions are potential dust sources for natural dust in the Arctic Ocean.” Do same/similar values of dust mean the same sources? It’s better for the authors to give some robust evidence from modern or ancient atmosphere circulation pattern to explain the transport pathway.

Reply: Thanks for your suggestion, we agreed with you. In general, the same or close Sr-Nd values indicate the similar or same sources, but it need consider the other factors. As the reviewer of Cécile Blanchet’s suggestion, we reorganized the manuscript structure for describing the data. The scientific aspects were simplified, because the much scientific interpretations may be outside the scope of data article. Therefore, we tried to introduce the data characteristics and present the some cases in revised manuscript.

As the author mentioned in L.212-219, there exist “grain size effect” and “acid leaching method effect” that influence the Sr isotopic composition data, maybe there is also “altitude effect” on the glaciers, then the questions arise : How to avoid above “effects” when compare different data obtained from different grain sizes, different leaching methods or different altitudes?

Reply: The previous studies had demonstrated that the “grain size effect” and “acid leaching method can significantly influence the Sr isotopic ratios. In general, we should choose the similar or same grain size and acid leaching method when compared these data. The Sr isotopic ratios were controlled by the mineral components in solid state,

which is different with the nonmetallic isotopes as the oxygen or hydrogen isotopes in liquid state. As your question, in fact, the “grain size effect” is similar with the phenomenon of “altitude effect”. For example, the much finer dust particle will transport and deposit into the higher altitude region, while the coarse dust particle will transport and deposit into the lower altitude region. Because the “grain size effect” was widely used in geochemical field, therefore, we do not change it in revised manuscript. However, we discussed this effect (the different grain size and acid leaching method) in part 3.1 in revised manuscript. The Sr-Nd data of grain size and measurement methods were also added in dataset.

I recommend to reorganize table.2,3,4 with two comparison columns of “sink” and “source” radiogenic isotope compositions data of Sr and Nd. That needs more data from potential source areas to be collected in the database.

Reply: Thanks your suggestions, Sr-Nd data were marked the possible “sink” and “source” in the dataset. However, it is note that the possible “sink” and “source” may be changed because of the different depositional environments. The much more data was added in revised dataset, and we try to reorganize tables. 2, 3, 4 based on the updated data.

Minor comments:

L.99: “and much is still known about the cycle in the SH”<sup>1</sup>/<sub>4</sub>□the “known” should be “unknown”?

Reply: Thanks, we corrected it.

L.161-162: “with the unit of at revolutions per minute (rpm)”, a word was missed here.

Reply: The sentence was reorganized and deleted in revised manuscript.

L.194 and L.197:  $^{144}\text{Nd}/^{146}\text{Nd}$  should be “ $^{143}\text{Nd}/^{144}\text{Nd}$ ”?

Reply: Sorry, we corrected them in revised manuscript.

L.244-245: “with  $\epsilon_{\text{Nd}}(0)$  values from 0.712349 to 0.73211 and  $^{87}\text{Sr}/^{86}\text{Sr}$  values from -15.7 244 to -7.0”? The position of “ $\epsilon_{\text{Nd}}(0)$ ” and “ $^{87}\text{Sr}/^{86}\text{Sr}$ ” should be reversed.

Reply: Thanks for your reminder, we corrected them in revised manuscript.

Fig. 6: “CAA” at X axis should be “MCAA”.

Reply: This has been fixed.

Table 3: “CAA” in the second column should be “MCAA”

Reply: Done, MCAA is not right, we kept the CAA in revised manuscript.

Fig. 6: What are the red and green rectangles mean?

Reply: The red and green rectangles mean the average values, we further added the referred explanations in lines 300-304.

L. 279-280: “Sand samples from PSAs (East Asian and Saharan deserts) are also collected.” I could not find any data from Saharan deserts either in the manuscript nor the database.

Reply: Thanks. These data had been included in previous datasets (Blanchet et al., 2019; Robinson et al., 2021), we focused on the Sr-Nd data from the three poles, therefore, these data from Saharan deserts did not include in this dataset.

Fig.7: “Surface snow or snowpit samples are represented by purple solid circles, ice core samples represent blue rectangles and samples represent red solid circles”. Where is blue rectangles? What samples represent red solid circles?

Reply: Sorry, the information of these symbols are wrong, we rephrased this sentence in revised Fig. 7.

Fig.7: “The dust transport paths are marked with yellow arrows.” Do the dust transport paths here connect to the dust “sinks” of the Antarctic ice sheet?

Reply: Yes. These arrows indicated the possible dust “sinks”. Because the dust sources are relative complicated for the entire Antarctic ice sheet. The much detail transport information cannot be described in here because of its complicated routines and different media, we added the relevant references for further explaining the routines (Gaiero, 2007, doi:10.1029/2007GL030520, 2007; Shao et al., 2010, doi:10.1016/j.aeolia.2011.02.001; Gili et al., 2022, <https://doi.org/10.1038/s43247-022-00464-z>). We try to mark the possible source or sink in this dataset. And we explained this phenomenon with Fig. 7, which it clearly showed the dust transport paths based on Sr-Nd data.

Fig. 8: What did the letter “A, B, C, D” mean? Do they refer to the four regions described in L. 429-438?

Reply: Yes, “A, B, C, D” mean four distinctly different Sr-Nd regions, we updated and deleted it.