Reply to the reviewers' comments (RC2) on "Circum-Arctic Sediment PROvenance Database (CASPROD): A database of mineralogy and geochemistry for the Circum-Arctic surface sediments" by Yao et al.

This manuscript presents the first circum-Arctic surface sediment provenance database (CASPROD), which systematically integrates multi-proxy datasets including Sr-Nd isotopes, detrital zircon U-Pb ages, clay mineral assemblages, and detrital mineral compositions from 4308 sampling stations. The dataset is rich in volume and broad in spatial coverage. The study has a clear objective and holds significant scientific significance for understanding sediment source-to-sink processes in the Arctic, as well as for reconstructing past ice-sheet dynamics, palaeoceanographic circulation, and sea-ice variability. The database thus fills a critical gap caused by previously fragmented and non-standardized sediment provenance data in the Arctic region, and provides a reliable baseline for future palaeoceanographic and paleoclimate research in the Arctic region. Given the scientific importance and the quality of the compiled dataset, I strongly recommend publication after minor revisions as outlined below.

Reply:

We are grateful to the reviewer for positive assessment of our work. Your validation of the database's scientific significance, data volume, and spatial coverage is highly appreciated. We have carefully addressed each of the points raised in the detailed comments below, which we believe have significantly enhanced the quantality of the manuscript. The changes have been highlighted in blue color in the revised manuscript.

Comment 1: The current introduction focuses primarily on Sr-Nd isotopes, detrital zircon U-Pb ages, clay minerals, and detrital mineral compositions. However, in Arctic sediment provenance studies, iron oxide minerals have also been used to trace sediment sources and transport pathways, particularly for distinguishing ice-rafted debris and current-transported materials from different source regions. I suggest that the authors briefly mention other potential provenance indicators, e.g., iron oxides in the introduction. This would help to contextualize the chosen proxy system and further highlight the comprehensiveness and rationale of the approach adopted in this study.

Reply:

We agree with the reviewer's valuable suggestion. Iron oxide minerals indeed represent an important provenance tracer in Arctic sediment provenance research, particularly for tracking sea-ice drift pathways and matching ice-rafted debris (IRD) to specific circum-Arctic source regions. In fact, this constructive point was also emphasized by Prof. Dennis Darby, whose pioneering work has established iron oxides as a foundational tool in Arctic oceanography. In the Introduction in the revised manuscript, we highlight the significance of Fe-oxide minerals as critical provenance indicators alongside radiogenic isotopes, geochronology, and bulk mineralogy.

"A range of provenance tracers, such as Sr-Nd isotopes, clay mineral assemblages, detrital mineral compositions, detrital zircon U-Pb ages and Fe-oxide minerals, provide complementary constraints on sediment sources in the Arctic Ocean."

"In addition, Fe-oxide minerals have been widely utilized to constrain sediment provenance in the Arctic Ocean and to reconstruct past sea-ice conditions (e.g., Darby, 2014; Darby et al., 2015; Tripati and Darby, 2018; Cofield and Darby, 2025)."

Comment 2: Section 3.2 provides a relatively detailed interpretation of the provenance implications of the dataset. For a data paper, this section could be shortened to focus more on the spatial patterns, major trends, and key findings revealed by the database. Overly extended discussion of individual proxy interpretations may be better placed in follow-up research papers. This adjustment would better highlight the contribution of the dataset itself and align with the conventions of data journals.

Reply:

We agree with the reviewer's suggestion. To address this, we have thoroughly revised Section 3.2 (*Circum-Arctic provenance implications*) by removing overly extended discussions and interpretations. This structural tightening successfully highlights the value of the database itself as a community benchmark while leaving highly localized, detailed mechanism interpretation for follow-up research papers.

Comment 3: Figure 1: this figure includes red and blue arrows indicating ocean circulation patterns, but these are not mentioned in the figure caption. Please add a clear description of these arrows in the caption and include the relevant literature sources.

Reply:

We thank the reviewer for pointing out this omission. We have revised the figure caption for Figure 1 to include a description of the red and blue arrows representing the primary ocean circulation systems.

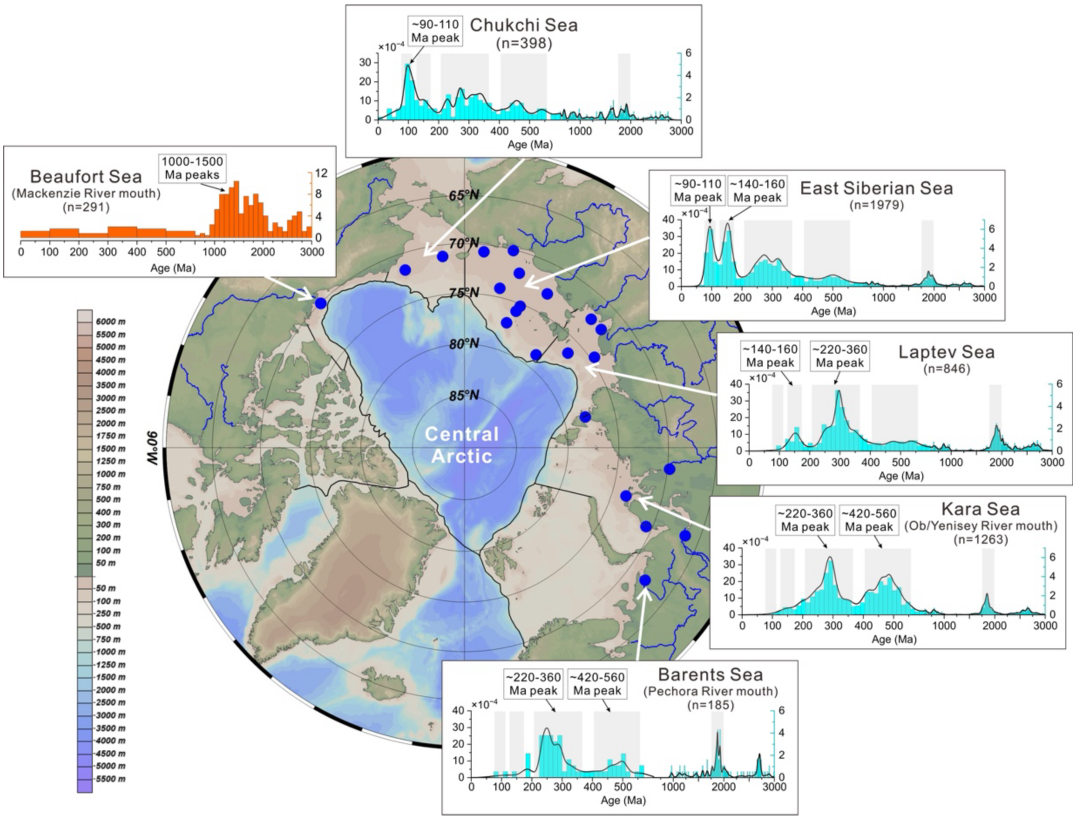
Revised Caption for Figure 1:

"Figure 1. Overview map of the Arctic Ocean illustrating regional subdivisions and circum-Arctic lithological frameworks. The study area is divided into the central Arctic Ocean and the Arctic marginal seas. The geological background is adapted from Harrison et al. (2011). Major magmatic and volcanic belts and cratons (Akinin et al., 2020) are indicated by arrows and annotated with colored boxes. BS denotes the Bering Strait. Major surface ocean circulation pathways are denoted by colored arrows, where red arrows indicate the Transpolar Drift, dark blue arrows indicate the Beaufort Gyre, and green arrows denote regional coastal currents (Timmermans and Marshall, 2020)."

Comment 4: Figure 3: In figure 3, the depth legend appears to be incorrectly labeled. Ocean bathymetry values should be negative numbers. Please correct this.

Reply:

We thank the reviewer for catching this oversight. We have corrected the depth legend in Figure 3 (See below), modifying the labels for ocean bathymetry to negative values (e.g., -50 m to -5500 m).



Chukchi Sea
(n=398)
~90-110 Ma peak
Beaufort Sea
(Mackenzie River mouth)
(n=291)
1000-1500 Ma peaks
East Siberian Sea
(n=1979)
~90-110 Ma peak
~140-160 Ma peak
Laptev Sea
(n=846)
~140-160 Ma peak
~220-360 Ma peak
Kara Sea
(Ob/Yenisey River mouth)
(n=1263)
~220-360 Ma peak
~420-560 Ma peak
Barents Sea
(Pechora River mouth)
(n=185)
~220-360 Ma peak
~420-560 Ma peak
Age (Ma)
Central Arctic
65°N
70°N
75°N
80°N
85°N
90°W

Figure 3