

Anonymous Referee #1

In this study, the authors present a comprehensive comparative analysis of 66 lakes across Central Yakutia and the Verkhoyansk–Oymyakon mountain plateau to investigate how geomorphological setting, hydrochemistry, and sedimentary DNA (sedDNA)-derived macrophyte diversity reflect lake development stages and environmental drivers. The study distinguishes low-mineralised glacial mountain lakes from highly variable thermokarst lakes in the Central Yakutian lowlands and demonstrates that lake developmental stage is a key factor controlling hydrochemical characteristics such as DOC concentration, pH, isotopic composition, and ionic facies. The authors further show that newly formed thermokarst lakes influenced by permafrost meltwater exhibit depleted isotopic signals and high DOC, while older *alaas* lakes display increased salinity and enriched isotopic compositions due to evaporation processes. SedDNA results reveal clear macrophyte community differentiation among lake types, with freshwater taxa serving as indicators of specific hydrological and chemical conditions. Overall, the study provides valuable insights into the functioning and vulnerability of permafrost-affected freshwater systems under ongoing climatic and land-use change. This study is very well structured, and its content is highly relevant to the scientific advancement of this field. I thoroughly enjoyed reading it. I only have a few minor comments/suggestions.

Reply: Thank you for the thorough revision and thoughtful comments. Please find attached our answers to each of your comments below.

[Referees' comments in bold and our reply in blue with *new text in the manuscript in Italic*]

Line 108 to 109. I suggest modifying this sentence as follows: “Inorganic and organic hydrochemistry (e.g., concentrations of major and minor ions and dissolved organic carbon (DOC)) can reflect natural or anthropogenic processes in lakes such as land cover and human practices (Hu et al., 2020; Du et al., 2023).”

Reply: Thank you for your comment. We implemented your suggestion.

Line 108 to 109. Focusing on DOC is appropriate for these lakes, but the authors should clarify why POC was not included.

Reply: We did not sample for POC as we undertook the filtering for DOC using syringes with the filters attached and did not use a filter-type apparatus for filtering to be able to get at the same time DOC in the filtrate and POC on the filters. To add clean sterile filtering for POC and the appropriate frozen storage for the fragile POC samples would also not have been possible for this type of fieldwork, for example in the remote mountain regions as we could not freeze samples.

Line 173 I suggest including additional lake characteristics in Table A1, such as area, length, width, mean depth, maximum depth, lake shape.

Reply: Thank you for your suggestion, we added the variables in Table A1.

Line 186 “The water samples were collected from the upper water layer at a sampling depth of 0.5 m into 2 L sample containers”. Could the authors clarify why, for the deeper lakes, samples were not also taken from the middle or bottom layers to capture potential vertical variability in hydrochemistry?

Reply: We thank the reviewer for this comment. In addition to the surface samples collected at 0.5 m depth, vertical sampling was conducted in the deeper lakes to assess the variability throughout the water column. However, the objective of the present study was to compare hydrochemical characteristics based on surface-water samples across all study lakes. Therefore, only the upper-layer data are included and discussed in this manuscript. Analyses of the vertical hydrochemical variability in deeper lakes are beyond the scope of the current study and will be analysed separately.

Line 215-216. I believe the isotope notation in this sentence is incorrect. Please replace it with: The compositions of hydrogen and oxygen isotopes are represented using the δ notation of δD and $\delta^{18}O$ in per mille (‰) versus”.

Reply: Thank you for your comment. We corrected the sentence accordingly.

Line 286 Legend of Figure 2: I believe the lake numbers should be corrected. “In panels (A, D), two examples of new thermokarst lakes are EN21448 and EN21418 (purple outlines).”

Reply: Thank you for your comment. We have corrected it in the figure caption text of Figure 2.

Line 1187, Table A3: Could the authors clarify why P and PO₄ values are not reported for Mountain lakes and Deep Mountain lakes?

Reply: Thank you for the comment. All elements were analysed for all lakes, but for several mountain lakes and elements, including P and PO₄, the values were below the detection limit. We indicated the detection limit of specific elements in Table A3