Review of manuscript: Sedimentary insights into organic matter alteration in Arctic Alaska's saline Permafrost.

General comments

The manuscript of Seeman and co-authors present organic matter characteristic (TOC, alkane and alkane-derived proxies) in deposits along a salinity gradient including permafrost and active layers in Arctic Alaska. They target a unique type of deposit, rarely studied so this wealth of data is definitely interesting to publish. However, I would recommend presenting the proxies used in this study a bit better, especially their limitations.

Generally the discussion is hard to follow and the manuscript would benefit from a bit more organization in this part, maybe grouping the type of observation together rather than for each type of deposit? Or maybe focusing more on the effect of salinity on the observed degradation?

Specific comments

L39-40: "Therrmokarst processes are accelerating in the Alaskan tundra (Chen et al., 2021) while Nitze et al. (2017) describe a thermokarst lake drainage trend." I'm not sure I clearly understand this sentence, especially the use of "while".

L42: can you explain what is "saline permafrost"?

L45: same for "unfrozen cryotic conditions"

L58: could you give a range of expected salinities

L59: what do you mean with "differentiated"? More detailed, or with different techniques? It would be good to refer to the techniques used before in Giest et al. 2025 and expend on what will be newly applied in this study.

L62-64: I agree with the authors that CPI has been increasingly used but it has major bias, in particular in region with old rock deposit that can lower the CPI. It would be good to present the organic carbon proxies and their limitation to be clear with the readers. Similarly d13C, D14C, C:N ratios have bias that need to be presented (heterogenous source effect, post deposition transformation, …).

L77-78: is the temperature average from a meteorological station? IF so which one and how close to the study area is it?

L83-86: I'm not sure this part on vegetation in the region is needed as all the sites are mainly aquatic

L90: 22 and 50% of what is covered by thermokarst and DLB?

L154: for this part the subsamples were freeze dried?

L159: Since the samples were not acidified TOC determined with a SoliTOC can be overestimated as some carbonate already burn before 900C. This is not an issue but should be acknowledged.

L171-172: "Stable carbon isotope ratios are commonly applied as a proxy for organic matter origin and degradation in permafrost regions (e.g., Alewell et al., 2011; Strauss et al., 2015).", as in the paragraph before this technical explanation should come after the method explanation.

L170-176: Can you give the standards used for this analysis as well as the measurement error.

L180: How was the radiocarbon dating conducted, what pre-treatments were done on the samples? Were the bulk sediment samples acidified?

L185: "eluted" or "extracted"

L190: how was the medium pressure liquid chromatography performed, with which solvents?

L201-202: "transformation effect", do you mean degradation?

L211-212: another limitation of the ACL and n-alkane proxy is the heterogeneity and potential overlap of the source, see the review of Diefendorf et al., 2011

L214: There is an odd over even predominance in terrestrial vegetation. In hypersaline environment the contrary can be observed (e.g. Li et al., 2024 Salinity impacts on *n*-alkanes in lake sediments of the Badain Jaran Desert, Northwestern China: Implications for paleoclimate reconstruction; Samantaray and Sanyal 2023 Effect of salinity on the preservation of plant-derived *n*-alkyl compounds in the terrestrial-aquatic interface). This effect of salinity might be relevant for the study site.

L259-264: Since TOC varies so much between units (35 to 5%) it would be more informative to express concentration normalized by TOC (ng/gOC) so that differences between units actually reflect different alkane concentration and not just the TOC effect.

Figure 3: I don't see any red point in the figure, which incubation is referenced in the caption? It is not described in the method. I think the 14C ages should be added next to the depth to give a better idea of the period captured by the cores.

Paragraph 4.1. This paragraph has a lot of results instead of discussion and can be shortened by moving the core unit description into the results section. The interpretation of the different thaw process and organic matter input fits well in the discussion.

L397-399: There is no explanation of the claim that ACL values support a shift from grass to a more mixed vegetation in the early Holocene.

L399-403: Paq limitation is presented but just brushed aside without any reason (how is Betula shrub input influencing Paq for example?). In general this whole paragraph investigation the changes in ACL and Paq is not well described and there is no clear support in the text or in the figures.

L413-414: What is the consequence of finding brackish talik sediment in a lake that was previously described as fresh? I get the point but this is not clearly explained. Also when did East Twin Lake experiences a transition to brackish water?

L417: Is the Teshepuk lake area far from the studied sites?

L417-418: Could Paq also indicate increased input from Betula as mentioned in the paragraph before? Which would fit with the info from ACL and n-alkane ratio?

L419-423 "At this point, it needs to be stressed that in our study the ACL decreases with decreasing CPI values (r = 0.79, p < 0.001), meaning that the vegetation signal is influenced by organic matter degradation (strongest in ETL). This is a commonly observed process (e.g., Jongejans et al., 2020; Struck et al., 2018), which needs consideration when interpreting *n*-alkane proxies." This statement is coming a bit late and can be presented in the results already or at the beginning of the discussion. Why are the authors still using it if the main control on ACL is OM degradation?

L432: Can you indicate again what material has been dated for this site? The age difference could be due to the type of material.

L452-453: Would it be better to compare your lagoon with north American lagoon TOC and TN data like those in the Tuktoyaktuk area?

L466-467: Can you give some numbers? In general in part 4.2. it would help the reader to get some numbers, averages …

L469-470: Can you give a reference for " δ 13C values become lighter (less negative) with degradation"

L479-480: I don't think there is much of a difference between 6.5 and 6.9 for a CPI value. If you think this is a significant difference, can you cite similar setting where such a small difference has been interpreted.

L495: please give standard deviation and number of point when you give an average for transparency.

Technical corrections

Throughout the text: There are some space missing before references, likely dues to reference formatting (for example L75).

Throughout the text: avoid the formulation "we" and use passive sentence throughout the text

L31: "the polar north" could instead be "the poles"

L33: "which relate […] to climate change" maybe to be more precise write to "temperature change"

L37: I think what matters most here is that these plains are low elevation? Instead of "vast"?

L42: "Furthermore" is maybe not needed here as there is a new paragraph starting

L48 "coast" instead of "coastlines"

L608-609: The font differs for the last sentences