

The Cryosphere Discuss., referee comment RC3  
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## Comment on tc-2022-12

Anonymous Referee #3

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Referee comment on "Molecular biomarkers in Batagay megaslump permafrost deposits reveal clear differences in organic matter preservation between glacial and interglacial periods" by Loeka L. Jongejans et al., The Cryosphere Discuss.,  
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This manuscript provides detailed lipid biomarker analyses of exposed permafrost (including ancient deposits) from the recently exposed Batagay Megaslump, East Siberia. I generally found the paper to be a good read and the analyses were appropriate for the sample type, of which the deposit is quite novel and covers an impressive time window (up to 650 ka yr). A number of existing/in review studies have worked on this exposure, so it is good to see one which focuses on organic geochemistry/biomarkers.

To improve the manuscript further the palaeoclimate discussion section would benefit from some revisions by placing each time period more clearly in place with the known climate and environmental conditions at the time (palaeoclimate). Placing the results within a critical framework explaining where these results agree with (or disagree with) existing findings in each time period a little bit more clearly would be helpful and enable the interpretation of any further palaeoclimate interpretations of significance. A table might help here and a little bit of wider reading.

I was also wondering if the group had any compound-specific stable isotope analyses, for example on long chain alkanes or fatty acids to identify any differences between interglacial vegetation and its source/productivity? If they do, then these data should be included. The discussion would also benefit from a synthesis plot plotting regional data from other palaeobotanical proxies from the site (e.g. Ashastina et al., 2018; Opel et al., 2019) and more widely regionally. This will also assist with improving the palaeoclimate discussion section and show to readers more directly the similarities.

Finally, I note that the current title is quite descriptive in nature. An alternative approach is to revise the title to make it more impactful and focus on the main finding or outcome from the paper. More interrogation of the palaeoclimate discussion section will help here, but an example could be (from the abstract) to devise a title that focus on terrestrial character of the glacial periods, or the high microbial activity in the interglacial. The

potential lability of the Holocene deposit (and its vulnerability) could also be an option as here it is possible to make comparisons with older deposits so effectively.

## Detailed comments

31. Do you think that the most recent Holocene deposited permafrost is most vulnerable to warming, leading to OM degradation?

36-37. Sentences with the same reference (Strauss et al., 2021) could benefit from merging or rephrasing to improve readability.

74. Perhaps change 'herbs occur' to 'herbs are present'?

96. Change 'the Spring Expedition' to 'a spring expedition'

115-116. What instrument/technique is used for medium pressure liquid chromatography? I think you should include this.

118. "biogeochemical and alkane parameters" Alkane parameters are 'biogeochemical' so rephrase?

Table 1. References to the sources of these indexes could also be included in the table in brackets to enable easy source identification.

157- 158. Should it read "Here, we found...?"

Figure 2. You display a number of indices. You could also consider calculating and displaying TARFA (Meyers et al., 1993) and CPI for fatty acids (Matsuda and Koyama, 1977).

188. Please double check you are happy with use of the term 'lenses'.

201. Is the comma (,) necessary after 'Above'?

202 & 214. 'medium high' – how about moderately high?

Discussion first paragraph (223-229) – Make clear the differences are seen over contrasting climate periods (glacial-interglacial periods), showing how land-cover varied over different climate regimes.

233. 'to some extent' a bit vague. Can you explain to what extent or specify?

240. Write 'more terrestrial and less aquatic' to correspond with preceding order of high ACL and low Paq.

248. Do we know which microbes were present if abundance and what is their function? Check with Courtin et al, (in review).

249. Pollen findings – could these unpublished findings/companion papers data be introduced here in a summary synthesis plot (most impactful findings) to help with the biomarker comparison?

Discussion of the time periods would be helped by a table showing time period, deposit, references and interpretation to make this section clearer and easier to follow.

281. Suggest replace 'stronger OM' with greater or 'higher OM'.

309. I think the role of diagenesis/preservation in the Holocene deposits could be introduced here.

321. I suggest to change 'stated' to suggested and 'are' to 'could be'.

365 onwards. Given the relatively wet conditions interpreted are you suggesting that the Holocene was a unique interglacial then, geographically at this position, compared with previous interglacial periods?