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Comment on bg-2021-331

Anonymous Referee #1

Referee comment on "Organic matter characteristics of a rapidly eroding permafrost cliff in NE Siberia (Lena Delta, Laptev Sea region)" by Charlotte Haugk et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-331-RC1, 2022

Accept with minor revision
Summary of the paper: Organic matter characteristics of a rapidly eroding permafrost cliff in NE Siberia (Lena Delta, Laptev Sea region)
Haugk et al. studied the characteristic of organic matter (biomarkers, bulk parameters) on a permafrost erosional cliff (located at the Lena Delta, Sobo-Sise Island) that they dated and described. A good amount of samples were studied covering the whole cliff at a 0.5 m resolution which allowed the clustering of the cliff into 3 units. These units are characterized by different biomarker ratios and bulk parameters linked to the quality of the organic matter. MIS 1 and 3 deposit seems to have a stronger microbial biomass activity.
I really like this study because of the nice description and the clear clustering of the samples into these 3 units. I am missing a bit more of bulk sedimentological analysis, but it's already a lot of data for such a small scale study. I recommend very minor revisions, it would be amazing if mineral surface area could be measured but I know that takes time.
Main comments:
- This study is a very well rounded descriptive study. I am missing a bit of comparison with other permafrost coastal erosion sites such as Muostakh Island (Vonk et al., 2012. Nature); or thaw slump on the Peel Plateau in Canada (Bröder et al., 2021. Environmental Research Letter).
- I was surprised to not see any grain-size or mineral surface area data. When looking at preservation of organic matter, grain size and mineral surface area analysis can give a lot of information as organic matter preserve better when associated with the surface of minerals, in particular long chain alkanes and fatty acids are better linked to the minerals than their short-chain counterpart. So I would advice to measure mineral surface areas or grain size (usually negatively correlated to mineral surface area) for these samples and look at biomarker as loadings (ug m2, see Bao et al., 2018 Influence of Hydrodynamic Processes on the Fate of Sedimentary Organic Matter on Continental Margins).
Minor comments:
-L42-44: The last sentence is quite a stretch for this study, considering that you only look at a small eroding cliff in a small area of the Lena River Delta. I know that an introduction looks good when it ends with a global statement but this one is quite over the scope of the study.
-L45: I think that this sentence would make more sense if it was said that climate warming risk to thaw permafrost, hence arctic region underlain with permafrost might change very rapidly.
-L47: maybe define what is permafrost, we are not all working in these polar regions.

-L53-58: The end of the paragraph comes a bit out of the blue, I would move it to the study area part or after L69.
-L114: "remarkably high" could you add other retreat rate to compare with yours?
-L122: Maybe "Material" instead of "Fieldwork"
-L144: I guess you dried the samples after washing?
-L153: Why did you only select 13 samples? Just curious: was it because of low concentration?
-L160: is this a volumetric or weight ratio?
-L189: Please add more references to this statement or use a review. The use of long-chain alkanes to trace for higher terrestrial plants has first been proposed by Eglinton and Hamilton, 1967; Eglinton and Eglinton 2008 and since then used a lot. It is diminishing to only cite Schäffer et al., 2016 although a good study. Furthermore, a reference is missing for the use of shorter chain alkane to trace for bacterial biomass.
-L190: precise what you mean by "long chain range", is that changes above 25 or changes toward 25?
-L193: Why did you choose to start at C_{23}? Is it to include potential moss influence?
-L214: Similarly why not include higher chain length of FA, such as C30 and C32?
-L246: should it be 42 ug $gSed^{-1}$?
-L276: Please repeat which chain length you include in your short, mid and long chain fatty acids
-L277-278: If only the short-chain alkane concentration varies between the units, how come the HPFA differs between the units? From which compounds is the variation coming from?
-L283: You define the long chain alkane starting at nC21, whereas before you included starting nC23. Can you make the manuscript homogenous or detail why you choose to change mid-manuscript.
-L284-288: It would have been great to obtain compound-specific d13C for the fatty acids and alkane found in those samples, or even better hydrogen isotopes. Then tracking the differences between units to know more precisely how this permafrost was created (if all FA and alkanes originated from the same region …). I am aware that it is not the scope of this manuscript but maybe an idea for later?
-L296-297: iso and anteiso FA are historical biomarkers for bacterial activity but have you thought of branched and isoprenoid GDGT? They are typical for Acidobacteria in soils as well as methanogen/methanotrophic Archaea. These biomarker can add more details to the theory of increased bacterial acticily/biomass.
-L297: I totally agree, using C16 FA is tempting because of high abundance, but it has such a large range of source that its interpretation without isotopic signature is too ambiguous.
-L391-395: I feel like this paragraph is added without much reason. Of course there is a lot of unknown in coastal biogeochemical processes and more studies to be done, nothing new about that. You could take that paragraph out without changing the scope of this manuscript.
-Figure 3: in the short-chain panel you could use an logarithmic scale to better capture the variations between SOB18-01 and SOB 18-06.
Typographical corrections:
- Always add a space between number and unit except for % and ‰. At least be consistent throughout the manuscript.
- Liter is sometimes written "L" or "l". Be consistent "L" is the official SI abbreviation.
- BG guidelines indicate that instead of "µg/gTOC", "µg $gTOC^{-1}$" should be used, please correct throughout the manuscript.
- L88: C_{25} or 25 atoms of carbon instead of "C25"
- L191: C_{23} to C_{25}