

## ***Interactive comment on “From fibrous plant residues to mineral-associated organic carbon – the fate of organic matter in Arctic permafrost soils” by Isabel Prater et al.***

**Isabel Prater et al.**

i.prater@tum.de

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Dear Referee #3,

We are very grateful for your helpful and supporting comments on our manuscript that help to further improve it. Please find our answers to your remarks below in italics, we also added the respective line numbers of the updated manuscript to improve the traceability:

L. 25: "We demonstrate that" It would be helpful in this sentence to operationally identify the fraction being discussed (that is, how was it isolated physically?) to better un-

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derstand how it is being interpreted as "bioaccessible." Can you define the term bioaccessible? Is it synonymous with the more common "bioavailable" or does it specifically refer to physical accessibility?

We agree that these terms are often used in a confusing way. When we aim at emphasizing the spatial inaccessibility of the OM, we use "bioaccessibility". When we refer to the microbial availability determined by the chemical composition of a substrate, we use "bioavailability". We made some changes in our manuscript according to our remark.

Methods: The methods indicate soil drill cores are taken but do not highlight what depths are analyzed and presented. The text states in L. 102 : "Our analyses focused on selected layers only, as shown in Table 1" but Table 1 does not include this information. One would expect that the contribution of POM vs MAOM and the state of decomposition may vary with soil depth (perhaps not in the traditional predictions) yet the paper does not describe what depths are being analyzed.

We thank you very much for this crucial hint that we were not aware of. We moved the respective table to the Supplement, but at this point (l. 113) we did not change the reference. The information on the samples like depth layers etc. is now given in table S1 and we corrected the reference accordingly.

Discussion: The discussion is quite long with extensive paragraphs that have multiple ideas, which makes it sometimes a little difficult to follow all the ideas. Consider where the discussion can be streamlined and how paragraphs could be split into smaller blocks of text.

According to your suggestion, we restructured the discussion to increase the readability of the manuscript and split the paragraph discussing stable isotopes and NMR results into two paragraphs.

Section 4.1: The section heading is perhaps not the most informative of the text, as

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permafrost processes (other than one mention to cryoturbation) are not discussed in depth here. Consider renaming the section or including more information on processes. It may also be helpful to separate the text into a paragraph on C and N stocks and another one on composition of SOM, mainly C:N ratios.

According to your suggestion we changed the heading to "Cryoturbation determines bulk soil organic matter distribution". As we do not widely discuss the C and N stocks, the aim of the manuscript is clearly on the composition of the SOM fractions, thus we would like to stick to the current paragraph.

Section 4.2: It is very interesting that the POM and MAOM fractions play such different roles in C and N storage in these soils.

We are happy that you acknowledge that this is an interesting finding in our study.

Section 4.3: Consider starting the paragraph l. 332 with summarizing results of N dynamics or  $\delta^{15}\text{N}$  and their implication as the first sentence on N fixation seems to have no context. This paragraph could also be moved after the NMR paragraph which flows better after the  $\delta^{13}\text{C}$  paragraph.

We followed your suggestion above and separated the paragraph further. We have now one paragraph (4.3) discussing  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  and we slightly rearranged this paragraph. Another paragraph (4.4) is now only focusing on the NMR discussion.

Minor edits: Introduction, paragraph starting l. 58-78 is too long with too many different ideas. Should be broken up into smaller paragraphs, one on effects of climate change on SOM, one on SOM methods, then the research objectives.

We slightly restructured the Introduction according to your suggestion.

Spell out abbreviations for symbols in the Table legends. For example, fPOM, MAOM... Also indicate whether data reported are means and standard error or means and standard deviation.

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Thank you for this remark, we added the missing information to the captions of the tables.

Table 2. Should a/o-a ratio be O-a ratio? (capital O)

This ratio relates to functional groups that consist of O/N-alkyl-C and Alkyl-C, which is normally given as "Alkyl-C to O/N-alkyl-C ratio". To make it easier to read, we defined the ratio of alkyl C to O/N alkyl C as a/o-a ratio in the method section (2.4) and we kept this wording throughout the manuscript and in the tables and figures as well.

Figure 1. May be helpful to indicate what the white and blue colors are on the image. Ice and open water? Unclear because the ocean is black.

Thank you for this important remark, we added the information according to your suggestion. The white color mainly in the western part is the unvegetated sandy sediment of the floodplain and the blue spots indicate water: larger water bodies and shallow water on the terrace. The complete caption reads now "On this aerial image of Samoylov Island, the separation between the floodplain in the west (with the white unvegetated sandy sediment) and the Holocene terrace on the eastern part (with blue-grey spots indicating shallow water and larger water bodies). Red crosses indicate the sampling sites and the identification numbers of the cores are given (Boike et al., 2012)."

l. 240: add ppm after 70-75 ppm /52-57 ppm

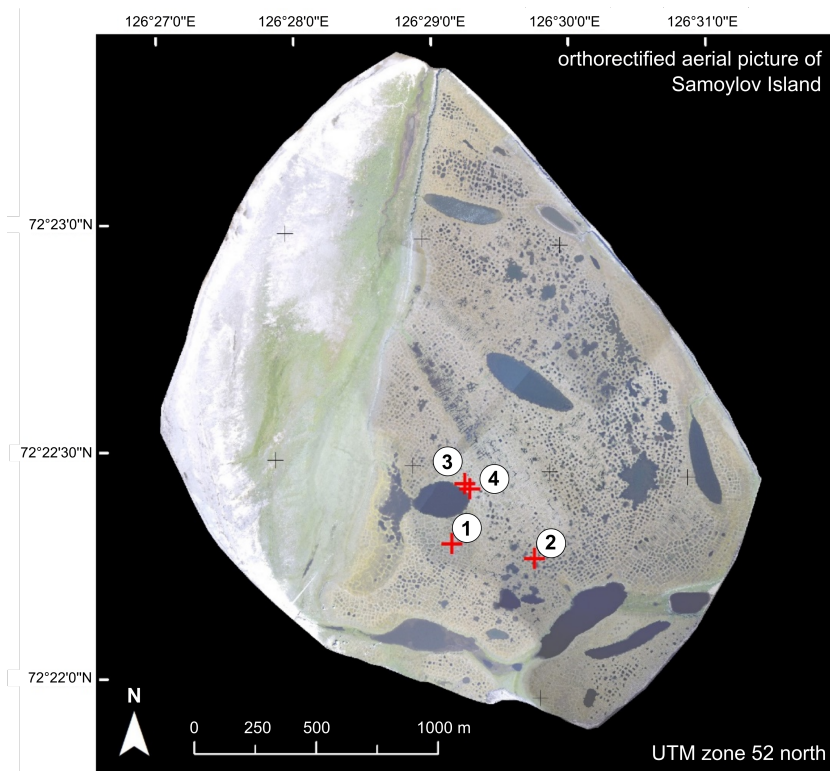
We introduce the ratio according to Bonanomi et al. (2013) in the methods section (2.4), where we clearly state the chemical shift regions that are considered for this decomposition proxy. To increase readability we use a reduced naming of the ratio which is in accordance with the "a/o-a ratio" term. Thus, we would like to be consistent in the form that we use to express NMR-derived decomposition proxies.

Please also note the supplement to this comment:

<https://www.biogeosciences-discuss.net/bg-2020-52/bg-2020-52-AC4-supplement.pdf>

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**Fig. 1.** On this aerial image of Samoylov Island, the separation between the floodplain in the west (with the white unvegetated sandy sediment) and the Holocene terrace on the eastern part (with blue-grey spot

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