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Biogeosciences Discussions

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.

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Dear Referee #2,

We thank you for your valuable and very helpful comments on our manuscript! We appreciate that they supported us substantially with further improving it. Please find our answers to your remarks below, we also added the respective line numbers of the updated manuscript to improve the traceability:

General: You might want to consider to call oPOM oPOMl (l for large), this would be more consistent when you also have oPOMs as individual fraction.

We agree that your suggestion could imply some consistency in the naming. We discussed this and decided to keep our naming as the use of oPOMl and oPOMs could imply the existence of at least one more oPOM fraction between oPOMl and oPOMs and could therefore cause confusion. Furthermore, there are numerous publications that use the same terminology and we would like to maintain comparability for the reader.

l.16: "the permafrost region" appears too unspecific. Is it the Northern Circumpolar Permafrost region or do you include the high mountain ranges here?

We agree that this term is relatively broad. In l. 18 we mentioned the Arctic and according to your suggestion we additionally added "Northern circumpolar" to avoid further misunderstandings (l. 19).

l.74: Why Ping et al. at the end?

We placed Ping et al. 2015 here (l. 79), as we think this paper provides a great overview on the facts that we stated before.

l.94-97: Please be more specific about the sapling locations, or the selection of these 4 cores. Why those, any criteria to ensure that they are representative for the most likely very heterogeneous area? Can't really find information on that in the cited literature. Also, please mention the soil types. In Zubrzycki et al.2013, different soil types are mentioned. Was it all cryoturbated soils?

You are right that this is a very important point in our study. We further specified the sampling area (l. 104), and referred here directly to the Holocene river terrace and also added another reference with more details on the sampling area (l. 108). We also added information on the soils (l. 93-95).

l.102: Which selected layers, how many samples were fractionated? l.102: Table 1 is missing, but would be extremely important, also to judge about some interpretations of the authors.

We thank you very much for this crucial hint. 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 as the depth layers etc. is now given in table S1. We also added the number of the selected layers we fractionated (l. 113).

l.117: During the washing... → How did you separate MAOM and oPOMs? Another density step? This is not clear.

As this step is very fundamental for our study we are thankful for your remark. To better clarify the procedure, we added more detailed information (l. 128/129). We followed a standard density fractionation approach, where we separated the POM fractions (including oPOMs) from the MAOM by density fractionation, which we describe in l. 116-129. The oPOMs was not separated from the MAOM, but from the oPOM fraction as described in l. 128/129.

l.126: Projected to 1m: How was this done exactly, and why is there no information about the depth distribution of fractions if the authors state that different depths were analysed? This is a bit confusing.

The stocks for the respective sampled and analyzed soil depths were taken as a bulk and projected to one cubic meter. As common practice, we report the stocks based on the sampled and analyzed material. The depth distribution and all according information can be found in table S1.

l.164: find correlations with what?

We rephrased this sentence (l. 173) to better clarify the statement.

l.188: give ranges for the silt and sand-sized MAOM as well, otherwise the sentence reads incomplete.

Thank you, we totally agree and added the missing information (l. 200/201).

l.217: This is something that is not clear to me: How do you explain this trend? Usually

it should be the other way around. Why is d13C more negative when C/N ratios are decreasing?

You are pointing to a very interesting aspect of our work that nicely demonstrates the specificity of the studied soil systems. We discuss this in more detail in the discussion section 4.3 (l. 338-356). We rewrote this section to better emphasize the differences in the 13C abundance for different SOM fractions.

Results in general: I was missing a depth distribution of the fractions, all results are depth independent and it is unclear, how homogeneous the profiles were.

You are right that the depth distribution of fractions is an important fact. We are now providing all according information in table S1.

l.268: It is not clear to me, if really cryoturbation caused the depth distribution of POM, but again this can only be judged if some depth information is included. Especially in river terraces, it could also be successive growth of the soil profile via sedimentation, and potentially even growth of organic layers.

You are right, in areas that are flooded regularly a burial of organic matter can be expected. This was the reason we avoided such areas and did not take samples from the floodplain. We only sampled the terrace that is only very rarely flooded, which is thought not to lead to the burial of pockets of organic matter as the ones discovered. Related information on the depth distribution is given in table S1.

l.286: Title sounds like POM fractions do also dominate N stocks, which doesn't seem to be the case (table 1). Maybe consider to rephrase.

In the studied soils, the particulate OM represents an important N storage pool. While the C stock is dominated by the large POM fractions, the N stock is dominated by the fPOM and the oPOMs fraction – especially the fPOM fraction plays a crucial role for both stocks. We discuss this in l. 302-306.

l.293: "release vasts amount of N" → This is a contradiction to what has been said

before and also the title (not much N in POM fractions)

We found relatively high amounts of N in fPOM, oPOMs and clay-sized MAOM, therefore, we assume an increased release of this N under ongoing warming. With the title we want to indicate that the POM fractions are more important for the C stock than for the N stock, not that the POM fractions are negligible.

l.313: Where does this information come from that fibres act as hot spots for microbial decay?

Thank you for this hint, we added a source for this information (l. 329) and rewrote parts of the respective section. The fibrous OM particles represent relatively undecomposed plant residues, as we were able to demonstrate using NMR spectroscopy. Thus, these particles represent detrital material that most likely provides highly bioavailable OM sources for microbial activity. This hot spot effect of the detritusphere for microbial activity is well known and was addressed in numerous other studies (e.g. Beare et al. 1995, Poll et al. 2006, 2008, Sanaullah et al. 2016).

l.356: Where is this comparison per single soil layers?

Thank you for this hint, we added the respective information (l. 382).

Fig.4: X-axis: Why did you put the x-axis on top of the graph and show only 10 and 100? Is there any reason for that. Readability would improve when numbers are at the bottom and more continuous.

Thank you for this remark, we reworked all of our figures and changed fig. 4 according to your suggestion.

Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2020-52/bg-2020-52-AC2-supplement.pdf

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