

***Interactive comment on* “Organic carbon characteristics in yedoma and thermokarst deposits on Baldwin Peninsula, West-Alaska” by Loeka L. Jongejans et al.**

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Authors reply by Loeka Jongejans, on behalf of all authors (loeka.jongejans@awi.de)

We thank this referee for the positive feedback on our manuscript and their constructive comments. We will revise our manuscript according to your suggestions. Below, we will address and reply to all the suggestions and questions that were raised.

Referee Comment (RC): This manuscript is a characterization of different deposit types in a permafrost landscape in Western Alaska. The study is very sound and provides the necessary level of detail to be useful to the research community. The results from

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this study are a good addition to existing datasets and the authors do a nice job putting the results from Baldwin Peninsula in a larger context within the permafrost zone.

Authors Reply (AR): We thank the referee for their positive feedback and for acknowledging the importance of our study.

RC: A simple but crucial fix would be to use meaningful abbreviations for the different deposits throughout the manuscript (in all figures, tables, and text). I am sure the current naming system means something to the authors but it is very disruptive and confusing to have to read BAL16-B2 and BAL16-UPL1-L1 for two different types of deposits. It should be possible to understand tables and figures without having to read the part about what the different labels mean. The flow of the manuscript would be much better with a simpler naming system.

AR: We thank the referee for their suggestion. We decided to keep the names of the study sites, as these are the names given to the samples during the field work and laboratory analyses and it would complicate data management and overview when we would rename the samples. Following the suggestion of the reviewers, we explain the naming system by adding Table 1 (see Fig. 1 on last page) with the study sites with corresponding names in chapter 2.3. We think that a consistent and defined naming system improves the reading flow as then a stratigraphical orientation is clear by reading the sample/site name.

RC: Section 3.1.4 Statistical significance: The statistics are too simplistic. I have to assume (you are not mentioning it or showing it) that your data are not normally distributed and that you therefore choose a non-parametric test, correct? The description of data distribution and statistical procedure is insufficient. Also, it is not appropriate to do pairwise comparisons when there are more than two groups without at least correcting for multiple testing. The minimum would be to perform a Kruskal-Wallis test and if significant to add a pairwise Wilcoxon-test, which would calculate pairwise comparisons between groups (you would have to include a correction for multiple testing). But,

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I think even that approach is too simplistic. You have multiple depths at different sites and so it does not make sense to compare one site with the other when you are not comparing the same thing. You could consider binning your data to different depths or different ages per site and then perform statistical analyses, preferably an ANOVA or something. The statistical results are not the core of your manuscript and that is fine, it still needs to be accurate.

AR: Thank you for the suggestion. We will improve our explanation on the applied statistics in the text and the supplement. We now also performed a normality test. However, non-parametric tests also work for normally distributed data. We see some conflicts with the aim of our study concerning the binning of our data. Our goal is to compare the different parameters between the different landscape units in order to see the range and variation of the data per landscape unit. Therefore, we do not bin the data to different depths but take the landscape unit as a whole. We will add the results of the Kruskal-Wallis tests to the supplementary information.

RC: C/N already says it is a ratio and you do not need to add ratio afterwards

AR: We will change this throughout the manuscript. Thank you for the suggestion.

RC: The photographs in the Supplementary material are useful

AR: Thank you

RC: Table 1: I don't understand what Mean cal ages and rounded 14C ages are and why only a few samples had a +/- . You need to explain what +/- is

AR: The Mean cal ages (will be changed to Calibrated ages in the revised manuscript) are the mean values of the age range that were derived from the 14C calibration software (using CALIB 7.1 and IntCal13 calibration curve). The calibrated ages are shown including one standard deviation (σ) uncertainty (\pm). The calibration is not possible for samples with infinite ages (>50,000 years) and therefore, no uncertainty is given for these samples. We will clarify this in the revised version of our manuscript.

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RC: Why are you showing 14C Ages again in Fig. 3? Isn't it the same as in Figure 2? It seems redundant but maybe there is a reason for it and an explanation is needed

AR: The reviewer is right; the 14C Ages in Fig. 3 are indeed the same as in Fig. 2, which we will clarify in the figure caption. We chose to show the ages again in Fig. 3 as the timeline inferred from them support the discussion on the biomarkers present in the sediments.

RC: Fig. 2 and 3, it would be better to show dots for all the other variables as well and not just for the age column. You are only measuring a few data points along the profile and it gives a slightly wrong impression if you show lines as you are not continuously measuring

AR: We thank the reviewer for their comment and will revise the graphs accordingly.

RC: Fig. 3, why did you not measure biomarkers in the lake sediment? In the method section you say that you only measured it in those two but you don't say why

AR: The initial focus of the project was on the terrestrial deposits and therefore the biomarker analysis is too. We later decided to also include lacustrine sediments to cover all three main landscape units of the Baldwin Peninsula. However, only general biogeochemical properties were analyzed for this landscape type.

RC: When describing results along a depth gradient I think it is much better to go from the surface downwards and not the other way around. All soils have a surface but they go to a different depths and that just makes it confusing

AR: We agree with the reviewer that soils are generally formed from the surface downwards and that age increases with depth. However, the permafrost deposits in this study, and the yedoma in particular, have built up with time. Therefore, we decided to follow the geological timeframe, also considering that the time of deposition has a big influence on the studied sediments.

RC: Section 3.1.3, add that the data to this section are shown in Figure 2 (bottom

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panels)

AR: We will add this reference as suggested.

RC: Table S2, here you introduce new acronyms for Yedoma when previously you have used this awkward BAL16-B2 naming, I very strongly suggest that you use informative labels in all figures, tables, and throughout the text

AR: We will change the names in Table S2 and S3 to match the names used throughout the manuscript.

RC: Figure 4: can probably be moved to the Supplementary Material. Is the number n-C29 or n-C31 that is indicated in the x-axis the dominant chain? I find this figure confusing.

AR: The figure will be moved to the Supplements as suggested. The number below the x-axis is indeed the dominant chain per sample, which we will clarify in the revised manuscript.

RC: The grain size distribution figures in the supplementary material require more explanation in the revised manuscript. Should S7 be for BAL16-B4 and not B2? You show BAL16-B2 in S6. What is B2.1 through B2.42 in S6 and B4.1 through B4.31 in S7? You need to write out what f., m., c., v.c. means.

AR: The first graph in the section Grain size distribution (previously S7, S8 in the revised version) shows the grain size distribution of the yedoma exposure, the second graph (previously S8, now S9) the drained thermokarst lake basin. Numbers B2.1 through B2.42 stand for the subsamples of the exposure. In the revised manuscript, we indicated the depths instead. The same changes will be made for the drained thermokarst lake basin graph. The letters f., m., etc. refer to different grain size classes, which we will explain in the revised manuscript as suggested.

RC: Table S2, S3, and S4, what is “outcome of Mann-Whitney-Wilcoxon test”? P-values? Which software did you use? Please also use a consistent number of digits

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after the comma. I would refrain from adding stars to non-significant outcomes as that is usually used to indicate significance. The table would be so much easier to read if you had less numbers per cell, why not just indicate p-values as <0.05, <0.01, and <0.001 or something like that.

AR: We calculated the Kruskal-Wallis-Test and Mann-Whitney-Wilcoxon using R (version 3.4.3) (`kruskal.test` and `wilcox.test`, respectively). To improve clarity, we will change the notation of the p-values in Table 2, 3 and 4 as suggested (<0.05, <0.01 and <0.001).

RC: Figure 6 could be moved to Supplementary Materials

AR: As suggested, we will move Figure 6 to the Supplements and will add the references to the text.

RC: Discussion: the discussion is very hard to read because it often is a listing of results followed by another listing of results from other publications. Some re-organization and focus on the important results would help the story line.

AR: Thank you for the comment. We will restructure the discussion as suggested and shift the focus to comparing our data to those of other studies.

RC: I think it is useful that you compare the results from Baldwin Peninsula with previous studies, I am hesitant to believe the statistical results at this point because of my previous comments in regard to statistics

AR: In order to identify the differences or similarities between the landscape units between this and other studies in Alaska. We performed pairwise comparisons (Mann-Whitney-Wilcoxon test) and used these results in the discussion.

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Table 1: Overview of study sites of yedoma exposure, drained thermokarst lake basin (DTLB) exposure and thermokarst lake sediments including coordinates and number of samples. BAL: Baldwin Peninsula, 16: year of expedition, 2016, B: bluff sampling, UPL: upland sampling, L: lake sampling.

| Study site ID | Landscape unit | Coordinates | Samples, n |
|---------------|----------------------------|------------------------|------------|
| BAL16-B2 | Yedoma exposure | 66.73262°N, 62.49450°W | 18 |
| BAL16-B4 | DTLB exposure | 66.73644°N, 62.50208°W | 31 |
| BAL16-UPL1-L1 | Thermokarst lake sediments | 66.74220°N, 62.41310°W | 9 |

Fig. 1.

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