

Earth Syst. Sci. Data Discuss., referee comment RC2
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Comment on **essd-2022-240**

Anonymous Referee #2

Referee comment on "Quantifying exchangeable base cations in permafrost: a reserve of nutrients about to thaw" by Elisabeth Mauclet et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2022-240-RC2>, 2022

The authors quantified the variability with depth of soil exchange complex properties (constituents, cation exchange capacity and base saturation), and the stocks in exchangeable cations in permafrost. The authors found that the CEC density, base saturation, and the average total stock in exchangeable base cations increased with depth. Overall, this dataset is valuable, and the paper is well written. I enjoyed reading this paper.

However, my main concern is that although the authors highlighted the importance of the potential reservoir of newly thawed nutrients to promote plant productivity, the permafrost thaw upon warming also increase the potential of the losses of these base cations through leaching. Thus, I think the authors should also highlight this point. Besides, I have some comments though I believe the authors should address in more detail in the results and discussion to make it clear. Please see the following detailed comments.

L21 Please have a brief explanation for the base saturation here.

L34–35 This sentence seems redundant in this paragraph. The authors may think about moving it to the place when talking about the transient layer in the section of results and discussion (L327).

L37–39 I think this sentence can be removed to the section of "Results and discussion" to support the results of increase in SOC content at depth (up to 30% OC; L199–200).

L37 Soil acidity sometimes is also one of the mechanisms that leads to high SOM

accumulation although low temperature and O₂ limitation are the main factors.

L48–50 This sentence influences the overall flow of this paragraph. Suggest removing it.

L115 Do you have any data or evidence to show there is no difference in pH by using 1:5 proportion vs. 1:15 proportion?

L148 Could you please provide the details on alkaline fusion method?

L155 Please explain the differences in measuring Ca and K in soil by using the non-destructive portable X-ray fluorescence device vs. ICP-OES. Which data did you report in the results?

Fig. 2 I was confused about the total number of the points in this figure. Total seven soil cores were sampled. But why were there more than seven points in this figure?

L214–215 It is unclear here. How can the difference in patterns of SOC distribution between the “organic-thick” and “organic-thin” permafrost soil profiles suggest a potential loss in C with permafrost degradation? Do you mean the organic-thin permafrost soil profiles have a more potential loss in C with permafrost degradation?

L283: Please explain why accumulation of Fe-oxides can increase potential CEC.

L315 Please consider change the subtitle as the following paragraphs did not mainly talk about the influence of total reserve in bases on the base saturation.

L316 Please explain base saturation here to help remind the readers.

L320–330 I was confused about the discussion on the overall increase in BS with depth. The authors first referred to another study showing larger concentration of exchangeable K and Ca within permafrost than active layer soils. However, I don't think these results are consistent as the author used the BS in this study to compare with the exchangeable K and Ca in another study. Later, the authors stated that the rare thaw events have likely favored the leaching of the soil base cations of this layer. However, the thaw is less frequent (as mentioned), and then what the mechanism for the leaching was in this transient layers.

L340–341 Based on the above statement, it seems that the data only supported Al^{3+} and H^{+} in more acidic soil surface, but not the Ca^{2+} , Mg^{2+} , and K^{+} in more acidic soil surface unless the authors can show these data.

L342–344 Please explain this mechanism. Does the presence of exchangeable acid cations refer to Al^{3+} as KCl could extract more Al^{3+} from soil particles than water that caused the lower values of pH_{KCl} than $\text{pH}_{\text{H}_2\text{O}}$?

L347 Again, it is worthy to mention here what the total reserve in base to help remind the readers, especially when reading a long paper.

L376–378 It seems that the difference in distribution of base cation stocks between the organic-thick vs. organic-thin permafrost soils was due to the thickness of the organic layer. Is this right? Or what's the explanation or implication for this difference?

L382–384 Although the permafrost thaw upon warming provides newly thawed pool of nutrient base cations, it also increases their potential of the losses via leaching.

L410–411 I don't think there was enough evidence to support the argument that K is a plant limiting nutrient due to its higher stock in the organic surface horizons than in mineral soil horizons.

L417 How about the potential of loss for the exchangeable base cations upon permafrost thaw?