Biogeosciences

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Interactive comment on "Trace elements transport in western Siberia rivers across a permafrost gradient" *by* O. S. Pokrovsky et al.

Anonymous Referee #2

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Overall, the manuscript provides the results of a detailed geochemical study on Siberian rivers located across a permafrost gradient. The concept of the study is very interesting because permafrost-affected regions are very vulnerable to climate change and will probably affect local and regional geochemistry of rivers and coastal waters. Although the dataset is interesting, there is a lack of focus in the manuscript through which the reader gets lost in all the details and has difficulties to follow the reasoning of the authors and to understand what's the actual outcome of the study. In addition, the English is overall average to poor, which does not contribute to a clear presentation of results and interpretation. Accordingly, the manuscript is not publishable in its current form but needs reworking including the clarification of some contradictions (see below for details).

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As the title suggests, the focus should be more on the permafrost gradient. The authors refer frequently to latitude patterns. If they use latitude pattern as a synonym for permafrost gradient, then I would suggest to use the latter. In the end we are interested in the effect of the permafrost gradient on the elemental chemistry and not the change in latitude of the watershed. Another general comment, the authors should be more clear why we are interested in the distribution of certain elements such as Mo, V, Ba,… Also on what basis did the authors decide to show the distribution of Mo in the manuscript while for other elements (e.g. Ti) it has been included in the supplementary information? In other words, why are certain elements considered to be more interesting/important than others and therefore merit to be in the manuscript and not in the supplementary information?

Abstract Lines 25-32 : this section needs restructuring. Three trends (categories) are suggested but in the end there are so many exceptions that it becomes very unclear what the actually trend is for each element. Maybe the authors could first subdivide the elements into two groups : (1) elements that show the same trend throughout the year and (2) elements that show seasonal differences. Then discuss the variability per season, e.g. in spring elements Fe, Al, REEs, Pb, Zr, Hf, Mn, Co, Zn and Ba show a northward increase while elements Ni, Cu , Zr, Rb show a southward decrease. Note that the authors contradict themselves, they mention that Zr both increases (line 27) and decreases (line 35) northward during spring. Line 25 : specify the meaning of TE Line 31 : Ti does already appear in category 1 (line 27). Do the authors mean that Ti does not show any distinct trend in spring and autumn? This needs to be made more clear. Line 32 : Very confusing, category 1 does already describe the metals which show a northward increase in spring (line 26) so why is this trend discussed again in this line?

Introduction The introduction lacks discussion of the elements discussed in the paper. Why are we interested in the distribution of the discussed trace elements (e.g. REE, Mo, V, Ga, Be,…)? How is their distribution in other similar regions e.g. Alaska,

Canada. What parameters control their distribution in those regions?

Line 68 : What do the authors mean by geochemical traces ?

Study site and methods line 186 : After storage, were the samples dried down before analysis on the Agilent ? Line 221: Did the authors apply any transformations to the dataset before PCA? Concentrations are a closed system as everything is calculated relative to 100% to get out of this system, which is essential for PCA, generally log transformations are applied.

Results line 234 : Can the authors explain why they chose Fe and Al as tracers. line 237 : On the other hand. . . Can the authors explain why and/or add a reference ? Line 256: I don't really see how the first factor is marked by DOC and UV28nm, both are located within the cloud of data points. The negative trend seems to be controlled by DIC on the one hand: the distribution of Ca, Sr and Mg, defined by DIC and thus ground-water feeding of rivers and water-rock interactions in the basement (line 238). The other end of the negative trend is marked by REE. The correlation/ or lack of correlation with DOC and Al, Ti, . . . could be verified with correlation plots. As a result I am not convinced that the PCA results really contribute to the interpretation of the data. Also both factors explain less than 50% of the variability in the data. It would be nice to see the fractionation of communalities. Line 268: seems an over-interpretation of the data; The focus should not be on what explains the 5% variability in the dataset but the 70% which is not discussed in the paper. line 276 : this sentence should be moved to line 234. line 278 : Is this a general statement our specific to this project? If it is specific to the project then this sentence belongs in the discussion section otherwise add a reference. line 294 : Mn seems to be rather constant for all three seasons especially compared to Zn and Pb. I don't think you can say that Mn increases northward in spring. line 329 : which elements ? lines 380-384 : What is the interest of calculating fluxes across latitudinal gradients for all elements when clearly from figs. 4-11 there are elements which are not affected by latitudinal changes ?

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Discussion Overall, references and/or a more detailed explanation are missing for made statements.

Line 428 in contradiction with line 427: If mobile element concentrations decrease northwards regardless season then this can not be due to change in chemical weathering with temperature as temperatures change with seasons. Line 434 in contradiction with line 430 and 428: if the distribution of elements is not dependant on the river size (line 428) than their distribution cannot be explained by a decrease in degree of groundwater feeding (430) as the river size impacts the impact of groundwater input (line 434). Line 472: "clearly" is not appropriate here, see previous comments Line 533: What does the latter refer to? Unclear transition in text, please clarify. Line 569: What does "re-increase" refer to? Line 574: add reference. There doesn't exist any geochemical profiles of peatlands in Siberia to have an idea of how much of these metals are stored in these bogs? If these bogs are ombrotrophic then they are only fed by atmospheric deposition. Accordingly, it would seem rather unlikely that large amounts of metals would be leached from these bogs. Line 599: add reference Line 614: Can the location of active layer not be included in the PCA? Line 620: add reference Lines 507 and 626: Does this mean that melt in Spring is minimal? Line 695: How were these factors calculated? Line 720: latitude should be replaced by permafrost gradient. Changes with latitude, is not really what is interesting. As the title indicates, changes with permafrost is what matters.

Technical corrections:

Title: Please replace "trace elements transport" by "Trace element transport".

Line 25 : three categories Line 32 : a northward increase Line 67 : rephrase Âń Transport of trace element Âż into Âń Trace element transport Âż Line 68 : Earth's surface Line 89 : colloidal form Line 92 : major and trace elements Line 93 : of these regions to climate change Line 116 : was first the assessment of TE concentrations and fluxes across significant gradients of permafrost Line 123 : major element transport Line 137

: this study aims at line 147 : and are represented line 148 : WSL, carbonate concretions and shells line 212 : trace element concentrations in rivers line 228 : major and trace element concentrations line 252 : trace element carriers line 312: TE concentration variations line 325 : pronounced than those Line 488: not allow to explain Line 511: by the TE concentration trend observed in the WSL rivers (Figs. 9-11 and Figs. S7-S8 and section 3.2). Line 702: On the other hand Line 739: On the other hand

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