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Earth System Science Data Discussions

Interactive comment on "Mineral element stocks in the Yedoma domain: a first assessment in ice-rich permafrost regions" *by* Arthur Monhonval et al.

Anonymous Referee #1

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The manuscript is devoted to estimation of concentrations and stocks of some major and trace elements in mineral soils of the yedoma regions. The novelty of this work is not clear, the methodology of sampling, analysis and upscaling is not presented and there are a number of issues that have to be clarified before further evaluation of this manuscript becomes possible.

Major issues It is unclear, over which depth the stocks and concentrations are evaluated. The stocks are proportional to the volume so this should be clearly specified. Note that for soil C, the lateral pools are usually estimated as 0-30 cm, 0-100 cm and 0-300 cm. Here, similar distinction is needed.

The nature of mineral deposits is not discussed and unclear from the abstract - are these clays sands, shales?

The working hypothesis is missing. Why one would expect that sediments of yedoma be different from average world soils or sedimentary rocks (silts, shales)? Or from the world average alluvial or aeolian sediments? Might be so with some nutrients (N, P) but certainly not for conservative major and trace elements. . .A brief look at Table 4 demonstrates that the yedoma sediments are between world average soils (Bowen, 1979 Environmental chemistry of the elements) and shales/earth crust. Considering Q1-Q3 range of obtained values, the interest of conducting the whole work is unclear. In this regard, one could also estimate the storage of Ca, P, C in frozen sedimentary rocks of eastern Siberia, where the permafrost is 500 m deep. This permafrost may thaw in the future thus rising environmental concern.

The representativeness of samples is poor: only one site in Siberia and one site in Alaska are from the coast. In all samples, (past) marine sediments may influence the chemical composition

The use of BHVO-2 as certified material might not be suitable given some amount of OC. Instead/in addition, some LKSD or standard soil reference material is needed.

Section 3.2. Please provide the results of pXRF measurements using Niton X13tGoldd of BHVO-2, LKSD, and other soil certified materials whose mineral and organic composition roughly matches those of studied yedoma samples.

Table 2. The disagreement of Al, Fe, Ca, K and Sr strongly exceed any uncertainties. The reliability of pXRF measurements is in question.

The reasons of presenting correlations in Fig. 5 are unclear. Ca exhibits the highest correlation between two methods yet it is strongly (by a factor of 3.9) underestimated by pXRF (Table 2).

Specific comments L51-52 "associated to minerals" is unclear term. Does it imply stored in mineral (not peat) soils? Adsorbed onto /incorporated into mineral (such as Fe hydroxides or clays)?

L123-130 and Fig.3: The vertical scale is missing / unclear Table 1: Total deposits depth and sampled depth are missing.

L 153: One cannot use term 'soils' without providing soil sampling depth and soil classification. Were the samples subjected to < 2 mm sieving?

L234 elements in ice wedges. It is true that their concentration is negligible compared to that in quartz and clays. However, the lability (rate of release from reservoir to the hydrological network) of Ca, K, Fe from the ice is million (or billion?) times faster than that of refractory minerals. One cannot neglect ice wedges in this context of elementary transport from permafrost to rivers and soils within the thawing scenario

L258-259 please provide the depth of these deposits, otherwise the surface area estimation is irrelevant

Table 3: Slope of dependences should be provided

L290 This is relative uncertainty. Correctness of analysis is not discussed. Add slopes or 1:1 line to Fig. 5

L317-318: Table 3 does not allow to obtain reliable element concentrations; a linear equation with slope and intercept should be presented.

L375-377: Depth of sediments is absolutely needed, otherwise the vulnerability cannot be assessed.

L420-242: What about other highly labile elements such as Li, B, Mg, Na, K, Sr, Ba?

L428. Ca solubility is improper term (unless Ca is considered as native metal). One can speak about CaCO3, CaSO4 solubility. Otherwise use the term "mobility" or "lability" Section 5.3.1 is too general and irrelevant to the main findings of this study. Instead, based on mineral composition of studied yedoma soils, one can attempt to estimate the capacity of soil to capture organic matter. One can also explore element : C ratio to reveal which elements are most important for OC storage (unlikely that it would be

Si, Mn, Sr. . .).

L435: These are not elements that interact with OC but minerals. More specifically, surface sites of minerals (>AlOH2+, >FeOH2+, >CaOH2+) can adsorb negatively charged organic ligands.

L459-460: The primary nutrients in this context are N and P

L480: depth is needed

L485-486: vertical distribution is not shown in the paper; why it is presented in the Conclusions?

L490-493 Compared to fully instantaneous mobility of elements from ice wedges, the amount of elements that can be released from minerals such quartz or clays might be negligible at the time scale of decades.

The term 'stock' is highly confusing: in Fig B1 it is in Gt, but in Table D1 it is in kg/m3. These are totally different units.

Fig. B1: L510+513 contradict to L515-516

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