

Dear authors,

the manuscript "Environmental Controls on Observed Spatial Variability of Soil Pore Water Geochemistry in Small Headwater Catchments Underlain with Permafrost" presents an extensive data base on geochemical, geomorphological, petrophysical data collected at two Arctic sites. The analysis proposed by the authors permits to identify key parameters controlling solute behavior relevant for nutrient cycles as well as the correlation between different geochemical processes and vegetation, for instance. Such effort permit to identify spatial variability in the geochemical processes between the two sites under investigations but also within each site. Understanding the link between physical, hydrogeological and geochemical parameters, as well as their spatial variability is critical in frame of climate change; thus, this study is an important contribution to The Cryosphere. Its results may help further modeling efforts or the development of non-invasive techniques to conduct similar studies in other permafrost sites.

The paper was reviewed by external referees and the authors have make a significant effort to address the list of suggestions and corrections. Hence, I recommend this manuscript for publication.

Additional private note (visible to authors and reviewers only):

Dear authors,

please find below a list of minimal changes that you could consider in your manuscript before publication:

Line 22: Our research goal IS....

*Changed. Thank you.*

Line 24: from "which environmental factors were important" to "attempt to identify the key factors controlling...."

*We then attempt to establish which environmental factors were important for controlling concentrations of important pore water solutes in these systems.*

*Changed to:*

*We then attempt to identify the key factors controlling concentrations of important pore water solutes in these systems.*

Line 349 - wetter station is correct or the authors mean weather station?

*Wetter station is correct.*

Line 436 - paragraph starting in line 436 - could be linked to results presented in Figure 8? Otherwise seems like an abrupt change in the presentations of results or at least not related to the data collected

*References to Figure 8 added. Thank you.*

Maybe you could add a paragraph at the end of the discussion regarding some outlook to other methods

that need to be taken into account for further investigations (detailed geophysical surveys?) or analysis that need to be conducted to further understand the parameters controlling the variability reported in your study?

*The following text was incorporated into the end of the discussion section:*

*“We hope that the observations and trends discussed here should aid future studies in the selection of appropriate sample sites and sampling schemes. Future studies should more fully consider the role of spatial variability of the solid phases (i.e. soils, leaf litter, and underlying geology). Soil digestions (elemental composition), sequential extractions (organic character), or XRD (mineralogical character) all would have been helpful in our work. Detailed geophysical surveys would have greatly aided our interpretation and increased the significance and impact of the work. More regular sampling of soil pore waters to capture the seasonality of active layer thaw, leaf fall/litter degradation, would have also provided additional insight. For catchments with well-defined drainages, gauging stations with periodic sampling could also be very useful in interpretation.”*