Hydrol. Earth Syst. Sci. Discuss., 6, C2226–C2229, 2009
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**Hydrology and Earth System Sciences Discussions**

# *Interactive comment on* "Spatial variation in soil active-layer geochemistry across hydrologic margins in polar desert ecosystems" *by* J. E. Barrett et al.

**H. Lin (Editor)**

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Received and published: 1 October 2009

This is a well-written and interesting paper that relates observed soil physiochemical properties to soil moisture gradients in polar desert lake and stream margin environments. The authors have demonstrated the critical linkage between soil and hydrology in controlling major ions and nutrients spatial patterns. The authors have reasonably addressed the review comments, and pointed out the further research needs in answering some of the important questions raised by the reviewers. I hope the following comments would help the authors to further improve the manuscript before its final



publication.

1. It may be better to consistently call the samples the authors analyzed "soils." Apparently, the authors have used "soils and sediments" in the revision to deal with one of the review comments, but the revised manuscript remains some inconsistency in various places, with either "sediments" label or "soils" label. It causes some confusion, if not unintentionally showing the authors' uncertainty about what to call soils or sediments. For example, the subheadings of 3.1 and 3.2 still use only "sediments" while the paper tile uses "soil." The fact that Fig. 4 shows some depth functions of nitrate and Cl is the evidence of pedogenesis. Even permanently submerged soils are now recognized to have pedogenic processes so they are now called subaqueous soils or submerged soils, instead of sediments. Fig. 4 is really valuable. So I wonder whether the authors also have other soil properties reported in this paper (such as carbon, total N, soil water content, PO4, EC, pH, etc.) that could also be added to Fig. 4? Do authors have more replicates for such datasets, or only one sample per soil pit? If replicates are available, it would be good to include that by using error bars (like Figs. 2-3).

2. Although the authors have addressed the soil texture issue in their responses to review comments (especially reviewer #3) by citing a reference, it would still be desirable to mention soil texture of the samples studied in this manuscript. This could be added to Table 1 or one of the figures, or at least state soil texture in 2.1 site description section. Otherwise, the whole paper has gravimetric soil moisture content as the only physical property, and the rest are all about chemistry. In addition, it would also help data interpretation, especially regarding water content distribution in the soils and related water movement, by indicating the slope gradient of the transects sampled.

3. p. 6 in the middle of 2.2: a clarification is needed here regarding hand-held Delta T soil moisture probe, which measures volumetric soil moisture content, vs. what is stated in the following (<5% gravimetric soil water content).

4. p. 7 2.2: it is necessary to state briefly the soil processing procedures that were

followed, e.g., were soil samples air-dried first and then sieved? How soil water sample was collected and processed before over-drying? It is also necessary to provide reference for the analysis methods used.

5. p. 8 in the middle of the 1st paragraph of 3.1: "sediments were above saturation content in the 1st transect position . . ." Was there a prove for this "saturation" claim? Looking at Fig. 2, the max. gravimetric soil water content was lower than about 18%, kind of low unless the soils are really coarse-textured. Again, soil texture information would help. I also wonder whether the authors have any soil bulk density or total soil porosity data? If so, then it is easy to confirm whether soil was saturated or not.

6. p. 9, the top paragraph: it would be good to add a sentence stating why the observed patterns in Fig. 2c-j. I'm still left wondering why the 3rd sampling position in lentic environment peaks? Also, I think the authors should add "for lentic environments" before both "(Fig. 2c)" and "(Fig. 2d-j)" as the discussed spatial trend does not quite fit the lotic environment.

7. p. 9, last sentence in the 2nd paragraph: the authors should add "except PO4, carbon content, and total nitrogen" before "(Table 4)", right?

8. I would suggest that the authors strengthen a bit on the temporal variation data presentation and discussion. Besides Table 5, perhaps some graphic plots showing those significant seasonal and annual changes would be helpful. The result presented in p. 11 single paragraph is kind of weak and not very clearly related to Table 5. For example, how the 1% and 2% variance were determined? What exactly is the R2 in Table 5? The authors also stated that "Inter-annual variability was noted only for ammonium. . ." but the data in Table 5 also shows the significance of nitrate and Cl. So what may be going here?

9. Table 4: significance level for the correlation values is missing (although 4 levels are indicated in the footnote of the table). Also, if the authors claimed that some variables are not normally distributed (and thus they were long transformed), then they cannot



use Pearson correlation; instead, they should have used Spearman correlation instead.

10. Figures 2 and 3: need to indicate what error bars mean and the sample number (n value). Also, the captions should note that the data shown are for surface soils (0-10 cm) only.

Additional minor editorial comments are also listed below for the authors' consideration:

11. Should "physicochemical" be "physiochemical"?

12. p. 7 line 2 at the end: add "in each location" after "excavated"

13. p. 8 line 8 from the bottom up: typo here – 4rth should be 4th

14. p. 9 2nd line in 2nd paragraph: Shouldn't Table 2 be Fig. 2?

15. p. 9 lines 2-5 in the 2nd paragraph: not very clear to me

16. p. 9 1st line of the 3rd paragraph: spell out "DI"

17. p. 10 line 2 in the 2nd paragraph: shouldn't Table 3 be Fig. 3?

18. p. 11 line 5 under 3.2: Table 4 should be Table 5

19. p. 13 line 4: 4-5% by weight or by volume?

20. p. 14 line 4: add a reference after "within one meter of open water"

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 3725, 2009.