

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

**Anonymous Referee #3**

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General comments Barrett et al. propose that arid systems such as the Antarctic dry environment provide a useful extreme situation for understanding the influence of water on ecosystem development. The presence of liquid water in these environments is one of the primary organizers of physical and chemical functions present in the soils and sediments of Antarctic terrestrial and aquatic systems.

The objective of the paper was to provide an assessment of the spatial and temporal variability in soil biogeochemical and physical properties in terrestrial and aquatic transition zones. Implicit in this assessment is the test of the hypothesis that lake margins

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and stream margins have different biogeochemical functions that vary in space and time. This hypothesis is used as a design for a replicated observational analysis of what the authors refer to as landscape type.

The paper provides evidence that the evaporative water flux exerts a strong influence on the geochemical cycles across the hydrologic gradient, while biological cycles are more important in biogeochemical properties in saturated sediments. The physical organization of the soils and sediments is the primary influence on ecosystem functions with biological properties overlying these physical factors.

This paper provides an extensive amount of data in support of the conclusions and establishes a geochemical template for the patterns of nutrient concentrations across the terrestrial and aquatic margins of lake and stream ecosystems in the Antarctic dry valleys. The authors also support the implicit hypothesis that the lake and stream systems have different nutrient concentrations and biogeochemical functions.

Specific comments The study has an adequate design that provides a credible basis for the conclusions drawn from the measurements. This paper meets the stated objectives of the authors, and provides a good foundation for future testing of mechanisms related to nutrient cycling and soil development along the lake and stream margins.

I would like to suggest that the authors reconsider the focus on hydropedology in the study. Hydropedology provides a template to understand the relationship between the presence and movement of water in relation to soil development. The strength of this approach is to combine measurements of soil water with soil attributes. The authors provide an adequate amount of information on soil water, but there is little pedological information. The response factors measured in the study may be responding to physical soil factors such as texture or mineralogy, but there is no data provided on these conditions. The soils are described by their position relative to the water body margin, but the authors do not provide any information on the soil types associated with these landscape positions

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There are several areas where future research of this type could address these information gaps and improve the evaluation of the hydrogeological relationships in the Antarctic environment. Soil descriptions and soil geomorphic relationships could provide a means to stratify the transects into discrete units. Further, with good soil and landscape descriptions, the nutrient information could be applied to models of landscape development in the local area and provide a model for similar environments. A model of landscape evolution could meet the authors' objective of using the extreme arid system as an example of hydrogeological influence on ecosystem function.

Another observation I had was in regard to the hydrologic measurements. The sites were established next to water margins with standing water. Was there free water in the soils that were sampled along the transect, or were the samples taken exclusively from zones that were only tension saturated. The figure that includes the gravimetric water content indicates that the soils were not saturated.

I realize that a revision of the paper to include this information may not be possible. Therefore, I would only request that the authors' consider obtaining any soil morphological information from similar areas if it is available. This type of information could provide a means to design future studies that include pedology as a component of the design.

Technical corrections None noted.

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