How Do Hyporheic Zones Mediate Stream Solute Loads? Using Antarctic Glacial Melt Streams to Simplify the Problem.

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Abstract. The McMurdo Dry Valleys of Antarctica are one of the coldest and driest places on earth. This polar desert provides a simple hydrologic system, where seasonally intermittent streams convey glacier melt water into closed basin lakes. Streams are underlain by continuous permafrost, but during the flow season a thawed hyporheic zone (<1m) develops around the open channel. The exchange of relatively dilute glacier water with hyporheic sediments facilitates weathering processes that control stream solute loads. This study uses several end-member mixing models to simulate concentration – discharge relationships observed in 14 streams, using over 20 years of hydro chemical data. Results show that (1) streams exhibit chemostatic behavior across daily and annual timescales, indicating a temporally variable flux of solutes from the hyporheic zone; (2) the chemical budgets of longer streams are more influenced by hyporheic zone reactions than shorter streams; and (3) end-member mixing models and naturally occurring tracers allow for the passive modeling of hyporheic exchange processes. This work provides insight into how weathering contributions from hyporheic zones affect catchment ionic budgets in diverse temperate and polar catchments with dilute snow and glacial meltwater sources of streamflow.