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Using Multiple Tracer Approaches to Investigate the Influence of Stream-Groundwater Exchange on Biogeochemical Cycling in the McMurdo Dry Valleys, Antarctica

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Streams in the McMurdo Dry Valleys of Antarctica are connected to extensive hyporheic zones through which stream water exchanges during the 10-12 week flow season. We have used a variety of study designs and techniques to determine how hyporheic exchange influences biogeochemical cycling in these glacial meltwater streams. Synoptic sampling campaigns and subsequent simulation of major ion concentration changes downstream have provided evidence that hyporheic exchange is responsible for the very high chemical weathering rates we observe in these streams. Data from stream tracer experiments, including nutrient additions, and subsequent transport modeling have indicated that nitrogen and phosphorous uptake occur both in the channel and within the hyporheic zone, under enriched nutrient conditions. Furthermore, these experiments indicate incomplete denitrification in the algal mats that cover these streambeds. Long timescale (i.e. on the order of weeks) hyporheic exchange has been observed using stable isotopes as a natural tracer of exchange and mixing of surface and hyporheic waters. We have also recently made use of high temporal frequency electrical conductivity measurements from glacier sources to stream outflows to determine the intensity of hyporheic exchange in theses streams continuously. Our findings from these different approaches indicate that Dry Valley streams are intimately linked with their hyporheic zones, which are hot spots for biogeochemical cycling within this desert landscape.