Sources and Transformations of Nitrate in a Colorado Mountain Watershed

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Abstract. Although nitrate removal is a common phenomenon in a wide variety of environments, the underlying processes involved are often not well understood. According to the hypothesis of this study, denitrification plays a significant role in nitrate removal in the Turkey Creek Basin of Colorado. More specifically, reactions taking place within the hyporheic zone may be of particular importance.

In order to test the hypothesis, two different approaches were used. The first approach involved collecting surface-water samples on a regular basis in order to investigate seasonal trends in the basin. The second approach involved the analysis of stable isotopes of nitrogen in nitrate (denoted as $\delta^{15}N\text{-}NO_3^-$ values). Stable isotope signatures were obtained through the use of a denitrifying technique coupled to analysis on an isotope-ratio mass spectrometer.

During the spring of 2007, large amounts of snowmelt resulted high discharge in streams as well as notable changes in water chemistry. While parameters such as conductivity, alkalinity and chloride concentrations all decreased during spring runoff, nitrate levels rose dramatically during the months of March, April and May. Although several mechanisms may be responsible for nitrate breakthrough at this time, a diminished extent of hyporheic exchange is likely to be involved.

In order to investigate the specific role of denitrification in the basin, stable isotopes of nitrogen in nitrate were measured. Average differences in $\delta^{15}N\text{-}NO_3^-$ values throughout basin indicated that surface waters were generally more isotopically enriched than ground waters, in accordance with the hypothesis that denitrification is occurring in the hyporheic zone. For instance, while the average ground-water value for 41 wells was $9.9 \pm 3.1‰$, the average value for stream-water samples was $14.8 \pm 1.5‰$ (N=28). On the other hand, due to low enrichment factors determined from stream samples, stable isotope values cannot be used in order to prove that denitrification is occurring.