Identifying sources of nitrate in the Bow River (Alberta, Canada) using B, N and O isotope ratios

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The widespread use of nitrogen (N)-based organic and inorganic fertilizers as well as wastewater effluents have caused nitrate loading of surface and groundwater systems in many regions. NO_3 source identification is an important step in preventing pollution or remediation of aquatic systems with N-containing compounds. Stable isotope tracer techniques have been used for identification of nitrate sources in previous riverine studies in Alberta by measuring $\delta^{15}N$ and $\delta^{18}O$ values of NO_3. However, due to NO_3 lost during denitrification and overlap in $\delta^{15}N$ and $\delta^{18}O$ values of some nitrate sources, unique source identification is sometimes challenging. Therefore, we evaluate the use of boron as a co-tracer by characterizing the concentrations and $\delta^{11}B$ values of major nutrient sources such as synthetic fertilizers, wastewater treatment plant effluents, and manure in the Bow River basin. Increasing NO_3 concentrations in the Bow River with distance from the headwaters at Lake Louise as well as increasing $\delta^{15}N$ and decreasing $\delta^{18}O$ values suggest that this trend is in part caused by wastewater treatment plant (WWTP) effluents delivering nitrate to the river. Boron concentrations were measured in cow manure (1.1 µg/g), WWTP effluents (up to 17 ppb), and in Bow River water (1-8 ppb). Emerging $\delta^{11}B$ values are used to determine the efficacy of boron as a co-tracer for identifying the major sources of nitrate in the Bow River basin.