Tracing Saline Groundwater Inputs to the Athabasca River Using Stable and Radiogenic Isotopes

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Abstract

Here we compile and compare new isotope data collected from various groundwater seep sampling campaigns conducted along the Athabasca River north of Fort McMurray with regional groundwater and river water datasets to better understand the potential sources of dissolved solutes entering the river from natural groundwater discharge. Electrical conductivity surveys conducted along the Athabasca River were used to identify areas with elevated terrain conductivity to detect areas where high salinity groundwater could be discharging to the river. Samples of pore water from the alluvial sediment in these areas were obtained using drive point piezometers installed between 1- 3m below the sediment interface. The pore water, groundwater and river water isotope data provide information about the sources of the water ($\delta^{18}O$ and $\delta^{2}H$), and solutes ($\delta^{34}S$-SO_4 and $\delta^{18}O$-SO_4, and $^{87}Sr/^{86}Sr$) and groundwater ages (^{3}H, ^{14}C). The pore water in the alluvial sediment showed variable degrees of mixing with the overlying Athabasca River water, but the geochemical and isotopic composition of these samples are consistent with discharge of Cretaceous and Devonian Formation waters. The distribution of the seep geochemistry and some of the bulk river chemistry and isotopic labeling are related to changes in geology along this stretch of the Athabasca River. The results of this investigation provide insight into the geochemical and isotopic evolution of riverine water quality, specifically the significant influence of natural groundwater sources of salinity to the Athabasca River.

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