Isotope and chemical hydrogeology of the Avon River drainage basin, Nova Scotia

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Recent dry summers in Nova Scotia have underlined the increasing importance of clean, available surface water and groundwater. Such resources cannot be properly managed without a clear and detailed understanding of the terrestrial water cycle including geological and anthropogenic effects. This study investigates the applicability of isotopic analyses in conjunction with standard water chemistry to gain insight into the water cycle in a single catchment basin. Samples of lake, stream, and well water were taken along the south branch of the Avon River during the summer of 1998 with some follow-up sampling in 1999.

Beginning at Card Lake in the south, the Avon River flows through a chain of lakes in the tree covered granite highlands of the South Mountain Batholith following the number 14 highway. It then drops down to the fairly flat farmlands overlying sedimentary rocks of the Carboniferous Windsor and Horton groups, where its southwest branch joins it before flowing into the Minas Basin at Windsor, Nova Scotia. It was expected that the groundwater chemistry would reflect the change in geology between the granite highlands, and the down stream lowlands containing limestone and gypsum. Instead, the groundwater samples are clearly divided based on their stage in the water cycle. The surface waters are acidic (pH 3.9-5.9), with extremely low TDS (10-20 ppm). The surface waters have a clear sea salt signature. The groundwater is dominated by calcium carbonate chemistry. The pH values are mostly neutral to slightly basic (5.2-8.0). The groundwater also exhibits appreciably higher

concentrations of dissolved salts (40-740 ppm).

These data, combined with trends in the isotopic data, suggest a hydrologic system that is rapidly flushed. The surface waters are essentially rainwater, while the groundwater rarely reaches equilibrium with the bedrock or the till through which it flows. The oxygen isotopes demonstrate that groundwater in the source area, (δO^{18} –7.5 to –8.5‰) is derived dominantly from seasonal rainfall recharge. The oxygen isotopic composition of the groundwater becomes systematically more depleted in the downstream direction ($\delta O^{18} \approx$ -10‰). This suggests increasing inputs downstream of meltwater drainage from the winter season, when precipitation is primarily in the form of snow, which is isotopically depleted compared to rainfall. The strontium isotopes suggest interaction with granite in the source area, which is subsequently overprinted by interaction with sedimentary rocks.