Research on mercury contamination of an aqueous system in New Brunswick, Canada: a hydrologic and hydrogeochemical approach

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Mercury contamination of Canadian aquatic ecosystems has become an important issue as a number of freshwater fish species have been reported to bear mercury levels of concern to human health. Gossan Creek, a first-order stream in the Upsalquitch River watershed in northern New Brunswick carries elevated concentrations of Hg as a result of leaching from a gold-mine tailings disposal site. Hydrological and hydrogeochemical methods are being used to investigate the transport paths, speciation, and attenuation mechanisms of Hg in this groundwater-surface water flow system.

Shallow depth (1 to 2 m) piezometers have been installed in the area between the tailings pile and the head of Gossan Creek for systematic sampling of groundwater. Major anions and major cations were analyzed by Ion Chromatography and ICP-OES respectively. Oxidation, purge and trap, and CVAFS method was used to ana-

lyze Hg concentration in water. ICP-MS equipped with a dynamic reaction cell was used for trace metal analysis. Our study indicates that the tailings pile acts as a point source of mercury into the aqueous system. A contaminated groundwater plume originates from the base of the tailings pile and flows toward the headwaters of Gossan Creek. The discharge area of the plume has been delineated using chloride concentrations, a conservative solute in the groundwater. Further studies of geochemical and biogeochemical processes that occur at the shallow groundwater/soil/atmosphere interface will be focussed at this discharge zone.

The headwaters of the stream system contain high concentrations of total dissolved Hg (up to 60 μg/L) and other elements like Cu, Zn, Mn, Ni, Co, As, Al, and Fe. The mass flux variations of total dissolved mercury (0.45μm; HgT) along the stream system have been calculated based on stream discharge measurements and HgT concentrations in water samples. More than 99% of the mass flux of the HgT is attenuated in the first 3 to 4 km from the source. Delineation of the Hg sinks and the attenuation mechanisms will be the focus of the future research.