Speciation and Movement of Arsenic in the Soils of Sudbury, Ontario

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The deposition of arsenic on the Sudbury, ON landscape is largely the result of smelting processes that have occurred over the last century. Since the early 1970's, SO_2 emissions have been reduced through the SO_2 Abatement Program. With the reduction of SO_2 there has been a corresponding reduction in atmospherically deposited metals. Studies carried out on soil and vegetation have shown that the concentration of metals, such as arsenic, have also decreased with time. Similarly, it has been reported that As concentrations decrease with increasing distance from Sudbury's smelters. The high concentration of metals in the Sudbury area seem to mimic the movement of the "plume" emanating from Sudbury's main smelter complexes. That is, higher metal levels occur closer to the smelters and decrease in a NE trending fashion, away from the Sudbury area.

These smelters are believed to be the major sources of elevated As levels in the terrestrial and aquatic environments of the Sudbury area. Arsenic is of particular concern in the terrestrial environment due to the possible bioaccumulation up the food chain. Low pH and low redox potentials, on saturation, favour the solubilization of arsenate (As V), while at higher pH and redox potentials, arsenite (As III) dominates.

Unlike other metals, the inorganic form of arsenic (As III) is more toxic than the organic form (As V). In the reduced form, As can be easily transported by groundwater and, readily adsorbed onto organic matter and clay particles in the soil.

Organic matter has a high affinity for metals, being held by ionic bonds. This makes it potentially available to plants and other organisms in the soils as it can become concentrated in the root growing zone of the soil. When organic matter is broken down, arsenate coprecipitates with iron oxyhydroxides, and is released into solution as these compounds are solubilized, making it readily available for plant uptake. Arsenic is not easily broken down within a plant and tends to act as a proxy for PO_4 thereby increasing the possible concentration of arsenic within plants. Over time, the levels of As can become toxic to both the plant and any higher level organisms feeding on them.

This project will focus on the distribution of arsenic in pedons laying over a uniform parent material and will be examined along a number of transects moving outward from the regional smelters.