Dispersion of neutralized mine tailings from the Stirling Zn-Pb-Cu Mine Site, Nova Scotia

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The Stirling Zn-Pb-Cu base metal mine (located at Stirling, Richmond County, Nova Scotia) was active between 1935 to 1938, and 1952 to 1956, when one million tons of ore was produced grading 6.7% Zn, 1.6% Pb, and 0.8% Cu. Recovery was only about 65% efficient in the 1930s and the tailings were dumped directly into Copper Brook, whereas in the 1950s processing was about 70% efficient, and the waste was contained in a tailings pond.

Forty-five samples of tailings and stream sediments were analyzed by AAS for Fe, Mn, Zn, Pb, Cu, Ag, Ni, and Co, and sixteen selected samples were analyzed by ICP-INA for 46 elements. Results show close similarities in metal concentrations between the tailings and downstream sediments, although there is greater variability in the downstream sediments. Mean metal enrichment in the downstream sediments over the upstream sediments is by factors of approximately 70x for each of Zn, Pb, and Cu, As 38x, Ag 42x, Au 20x, Ca 7x, Mg 16x, Mn 10x, and Fe 3.3x.

Six water samples from upstream, downstream, and mine site locations were analyzed for 66 elements using ICP-MS. Results show that the tailings pond water is strongly enriched in Ca, Mg, Fe, Mn, Zn and Cu, and slightly enriched in As, Sb, Se, Co and Ni; however, the downstream water is only slightly enriched in Mn, Zn, As, Sb and Se.

The main mechanism resulting in the dispersion of the tailings into Copper Brook is by physical erosion and transport, involving both wind and overflow during flooding. Transport of metals in solution is less important due to i) neutralization of acid mine drainage by carbonates associated with the sulphides, and ii) dilution of the effluent from the tailings pond.

Probably the most serious environmental problem involves the widespread dispersion of the tailings both downstream and into Framboise Inlet at the mouth of Copper Brook. Site remediation and amelioration are possible, but will require capping of the tailings pond to stop ongoing erosion and minimize percolation through the tailings. The dispersion into Framboise Inlet could be reduced by locally elevating the base level of Copper Brook at the Framboise-Stirling road culvert (4 km downstream from the mine site and 0.5 km above the inlet).