## Geochemistry and mineralogy of tailings at the Cochrane Hill gold district, Nova Scotia

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Since the first Nova Scotian gold rush in the early 1860s, gold mining and milling processes have generated tailings piles containing mercury, arsenic, cyanide, and other potentially toxic elements. Most of the gold deposits occur in the Cambro-Ordovician Meguma Group of southern Nova Scotia, and mining has been carried out at more than 60 formal gold districts for a total production of 47 of gold. The Cochrane Hill gold deposit is located in Guysborough County, approximately 15 km north of Sherbrooke. The host rocks consist of amphibolite-facies quartzite and slate, and most of the gold is associated with quartz veins that intrude slate rich in arsenopyrite: Mining and milling of gold ore at Cochrane Hill took place from 1877 to 1928, and again from 1981 to 1988, resulting in two separate tailings piles. During the first period of operation, stamp milling and mercury amalgamation were used to extract gold from the ore, and the tailings were slurried into a local drainage. In the 1980s, ball milling and cyanidation were used to process the ore, and the tailings were deposited into an on-site impoundment.

The main objectives of this study are to: (1) characterize the mineralogy and metal concentrations in the two tailings piles; (2) assess the relative reactivity of metals and metalloids in the amalgamation versus cyanidation tailings; and (3) examine the downstream impacts of drainage from the tailings piles. Forty five samples of tailings were collected from 16 different sites at Cochrane Hill in September, 2003, and water samples were collected at 12 locations within and downstream of the tailings in November, 2003. Efflorescent salts were also collected from the surface of the cyanidation tailings, and stream sediments were collected to determine the distance that tailings have been transported downsteam. X-ray diffraction, scanning electron microscopy, and electron microprobe analyses have been completed on select tailings samples. The primary mineralogy of the tailings includes muscovite, biotite, staurolite, quartz, anorthite, and actinolite/tremolite. Geochemical results show that the amalgamation tailings contain significantly higher Hg concentrations (21–63 000 ppb) than the cyanidation tailings (<5–25 ppb). Both tailings piles also contain high concentrations of As (280–41 000 ppm), which occurs naturally in the ore. As a result, windblown tailings and runoff from the tailings disposal areas may have a significant adverse effect on the surrounding environment. Future work will include additional electron microprobe analyses and analyses of the water chemistry data using computer models.