



Reducing Risks from Metals: Environmental Impacts of Historical Gold Mines

The environmental effects of early gold production in Canada were unregulated. Many abandoned mine sites are now contaminated with metals and other potentially hazardous substances because of poorly controlled waste disposal. Recent studies in Nova Scotia by Natural Resources Canada (NRCan) and its partners are helping to characterize the environmental and human health hazards associated with these historical mine wastes.



Researchers sample gold mine tailings along a community pathway in Caribou Gold Mines, Nova Scotia.

The project partners include the Nova Scotia Department of Natural Resources, Environment Canada, Fisheries and Oceans Canada, and five universities (Queen's University, University of Ottawa, Royal Military College of Canada, Dalhousie University, and the University of Saskatchewan).

Research results are being used to assess the risks associated with these contaminated sites and to make informed land-management decisions. The studies will improve our understanding of the naturally occurring background levels, chemical forms, mobility, and biological uptake of arsenic and mercury at historical gold mines throughout mainland Nova Scotia.

Source of the contaminants

Across Canada, most of the gold mined from 1861 to the mid-1940s was recovered using stamp milling and mercury amalgamation. During this process, the ore was crushed to the size of sand or silt, then free gold particles were recovered by dissolving them in liquid mercury, which was later boiled off to refine the gold. The remaining crushed material, called tailings, was often deposited directly into local rivers, swamps, lakes and oceans. In general, up to 10-25% of the mercury used for amalgamation was lost to tailings. Because arsenic occurs naturally in the gold ore and surrounding bedrock, it can usually be found in high concentrations in mine tailings.

Historical production records show that more than 3 000 000 tonnes of tailings were generated at the various gold districts in Nova Scotia between the 1860s and 1940s. Most mine sites have one or more deposits of tailings, which generally contain elevated concentrations of arsenic and mercury. Since the mines closed, ongoing residential development, industrial construction, and recreational activities on these sites (e.g. ATV, dirt bike, and 4X4 racing) have increased the potential for human exposure to these mine wastes. In some cases, containment or isolation of these tailings from human use may be required.



Arsenopyrite (FeAsS) is an arsenic-bearing mineral commonly found in the bedrock and quartz veins associated with gold deposits in Nova Scotia.

Key Findings

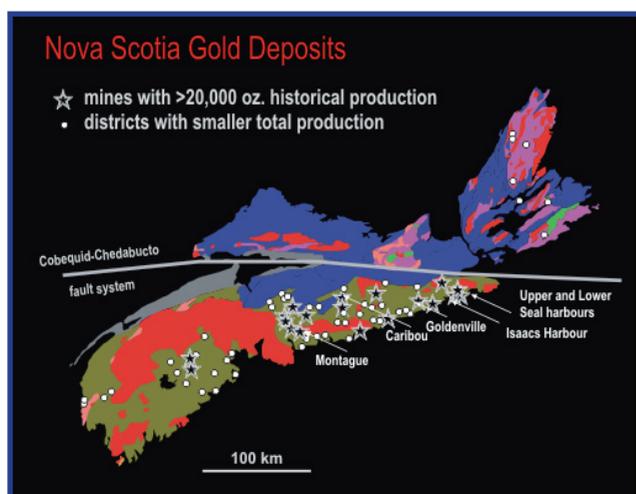
1. Most abandoned gold mine sites in Nova Scotia contain large amounts of tailings. In some areas the tailings have been transported significant distances (>2 km) offsite by local streams and rivers.
2. Tailings and stream sediments near these mine sites contain average concentrations of arsenic and mercury that are about 340 and 140 times background levels in soils, respectively.
3. Dissolved arsenic concentrations in stream waters that drain through tailings are well above guidelines for drinking water quality and the protection of aquatic life.
4. Both mercury and arsenic have accumulated in fish and shellfish in some tailings areas, which may pose a risk to human health.

Making a Difference

In response to the results of key findings of this study (see side bar), the Province of Nova Scotia established the Historic Gold Mines Advisory Committee (HGMAC) in April 2005. This Committee has representatives from five provincial and five federal departments, including NRCan. The mandate of the HGMAC is to evaluate the potential ecological and human health risks associated with gold mines throughout Nova Scotia, and to develop recommendations for future management of these tailings sites. To date, the Committee has issued two press releases warning Nova Scotians of potential health hazards at these mines. Health warning signs have been posted at the Montague and Goldenville districts to limit the use of these sites by off-road vehicle enthusiasts and local residents. Fisheries and Oceans Canada has also issued a precautionary bivalve shellfish closure for Seal Harbour and Isaacs Harbour on the eastern shore of Nova Scotia in response to recent data showing high arsenic levels in clams and marine sediments near former gold mine sites.

The Earth Sciences Sector (ESS) of Natural Resources Canada is continuing to research and assess gold mine tailings, and is working with members of the HGMAC to provide scientific information for sound management decisions. These studies form part of the ESS Environment and Health Program, which is generating new earth science knowledge to help protect the environment and human health.

Courtesy of Nova Scotia Department of Natural Resources



Over time, more than 1 000 000 ounces of gold were extracted from the deposits. This simplified bedrock geology map reveals the relationship of gold with metasedimentary rocks (tan colour) of southern Nova Scotia.

For additional information, visit these websites

Environment and Health Program - ess.nrcan.gc.ca/eh-esh/index_e.php
Reducing Risks From Metals Project - ess.nrcan.gc.ca/eh-esh/proj1_e.php

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