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Author: Robert G. Marvinney and Henry N. Berry IV
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Legacy Mines in Maine

Robert G. Marvinney, Maine State Geologist
Henry N. Berry IV, Maine Geological Survey

1. Introduction

Mainers have been excavating natural mineral resources from the earth since colonial times. Many farms had quarries of granite and lime for local use. Metal mines are less common, though numerous metallic mineral deposits are known throughout the State. This report is being prepared as revisions to Maine's metallic mining rules are being considered by the Maine Legislature, so this paper focuses on historical metallic mine sites. Extraction of other earth materials such as slate, crushed stone, dimension stone, lime, gemstones, sand and gravel aggregate, clay, and topsoil are governed by other laws and rules.

Mining and quarrying have always been allowed under Maine law, although the rules, restrictions, standards, and conditions under which mining could occur have changed through the years. As a consequence, operations that took place in different times in Maine history have left a varied legacy of past land use. In 1991, the most recent set of comprehensive rules were adopted for land and water quality standards at a mine site during exploration, mining, closure, and post-closure. Mining-related activities before that time are referred to as legacy mines, and have been remediated after the fact to different extents and in various ways under the oversight of the Maine Department of Environmental Protection (DEP) or U.S. Environmental Protection Agency (EPA).

This report gives an overview of the two better known legacy mine sites, the Callahan Mine and the Kerramerican Mine. Both mines were located on the Blue Hill peninsula of mid-coast Maine. They were active in the late 1960's to mid-1970's before the Federal Clean Water Act or the creation of the Maine DEP, and long before the 1991 joint mining rules of the DEP and Land Use Regulation Commission.
2. Current Metallic Mining Activity

While there are numerous metallic mineral deposits known throughout the State, and there has been sporadic exploration activity in the past few years to further evaluate some areas of known deposits, there are no metallic mineral mines in operation in Maine today.

3. Callahan Mine

A. Mineral Extraction History

The sulfide mineral deposit at the Callahan mine site was discovered in the 1880s. The deposit is located in the town of Brooksville, on the Cape Rosier peninsula, near the village of Harborside. The Harborside Copper Mine, as it was called originally, was first mined in the 1880's through underground shafts, then intermittently for several decades through 1917, producing less than 10,000 tons of ore. The deposit and environs were the subject of sporadic exploration from 1940 to the early 1960s. The Penobscot Mining Corporation leased the property in the mid-1950's and delineated a sulfide ore body, referring to the mine as the Penobscot mine. In 1965, Callahan Mining Corporation acquired the mine, and began development. They obtained permission from the State to install a dam at Goose Falls and
temporarily dewater Goose Pond, a tidal inlet. In 1968, Goose Pond was drained, a 500-ton per day concentrating mill was completed, and the deposit was put into production. The mine operated through 1972 when the economically recoverable ore was depleted. A total of 800,000 tons of ore grading 5.5% zinc, 1.3% copper, 0.5% lead, and 0.5 ounces per ton silver was processed through the mill.

Prior to closing of the Callahan mine in 1972, a group was established to oversee the reclamation of the mine area. The Goose Pond Reclamation Society consisted of four residents of Brooksville, two State representatives, and one mining company representative. Goose Pond was allowed to refill with tidewater, flooding the open-pit mine. From 1974 to 1979, the site was used for salmon and oyster aquaculture.

B. Geology

The mineral deposits at Harborside occur within a complex section of ancient volcanic and minor sedimentary rocks that have been altered and mineralized by hydrothermal fluids. The volcanic rocks, part of the Castine Volcanics, have been dated at 503 (± 4) million years old. The mineralization probably occurred at the same time the rocks formed, or soon thereafter when the volcanic system was still active. The general geologic structure beneath the surface today is steeply tilted layers whose upper edge has been eroded to just below the ground surface.
Places in the geologic system where the concentration of massive sulfide reaches economic values are in scattered bodies a few meters in thickness, as highlighted in red in the diagram to the right.

C. Remaining Environmental Concerns

*Ore processing area.* This area, which included a storage area for ore and the ore processing facilities, was unlined. Soils now contain high metal concentrations. The area was also contaminated by various petroleum products and PCBs that were used at the industrial work site. The rock in this area has some acid generating potential.

*Waste rock piles.* These are unlined and uncapped. Generally they have low acid-generating capacity due to the natural composition of the rock. About 5 million tons of waste rock were removed to access the ore.

*Tailings impoundment.* The retaining dam was constructed in 20 feet lifts of coarse waste rock lined with plastic sheeting, as recommended at the time by the U.S. Army Corps of Engineers. There was no bottom liner. Seeps have high concentrations of dissolved metals. Surface soils have high metal concentrations. Sediment in the adjacent areas of Goose Pond has high metal levels.

D. Remediation Efforts

After closure, in 1973 the mine owners attempted to reseed the waste rock piles and tailings impoundment, with limited success. Topsoil had not been stockpiled prior to putting the tailings in place. In 1987, four underground storage tanks in the ore processing area were removed. In the mid- to late-1990s, the DEP conducted various inspections to assess hazards.

In 2002, the U.S. EPA added the Callahan mine to the National Priorities List (so-called Superfund sites), making it eligible for federal clean-up funds.

By cooperative agreement in 2005, the State of Maine took the lead on the project, managed by the Maine Department of Transportation, with oversight by Maine DEP and US EPA. Site investigation studies and remediation feasibility studies were completed in 2009, and after public comment a multiphase cleanup plan was approved by EPA. By 2013, mine waste had been removed from the residential use area, and PCB cleanup from the mine operations area was completed. As of March, 2015, the remaining major cleanup activities involve the consolidation of contaminated rock and soil into the Tailings Impoundment, excavation and consolidation of sediment in the former mine pit, and the design and construction of the tailings impoundment cover system and horizontal drains for water management. These are ongoing and will continue through 2016.
4. Kerramerican Mine

A. Mineral Extraction History

The Kerramerican mine, also known as the Black Hawk mine or the Blue Hill mine, is located in the town of Blue Hill on the southeastern shore of Second Pond. Copper mineralization was discovered in 1876 on the north shore of Second Pond. The Blue Hill area has been the site of small mining operations since the late 1800s, most notably the Douglass mine which produced 2-3 million pounds of copper from 1880 to 1884. Mine facilities from that time included a smelter. There were brief periods of production in the early 1900s.

Exploration interest was renewed in the 1960s, with reserves indicating a small but high-grade zinc and copper deposit at Second Pond. After further site exploration, Black Hawk Mining Company completed a shaft to 698 feet and underground development at levels of 380, 480, and 580 feet from 1964 to 1967. Kerramerican assumed development of the property. The Kerramerican mine was permitted by the Maine Mining Commission and the Environmental Improvement Commission and underground mining began in 1972. The mine produced about a million tons of ore grading 7% zinc and 1% copper. Facilities included the underground mine, concentrating mill, and tailings impoundment, together covering about 80 acres. Due to underground operations and the continuous nature of the ore bodies, much less waste was generated at this mine than at the Callahan mine, and much of it was used to build roads and impoundments. The mine ceased production in 1977. It was officially closed in 1981.

B. Geology

The ore occurs in three main zones within a sequence of metamorphosed sedimentary rock of the Ellsworth Formation. Although its thickness varies from less than an inch to over 20 feet, the ore is fairly continuous and in a simpler structure than the Callahan ore. The cross-section shown here is looking at the structure head-on; from the side it would show that the ore zones are tilted down moderately toward southeast, parallel to the sedimentary layers. The mining followed the tilted ore, which is why different levels were developed.

The composition of minerals in the sulfide ore varies along the ore body, so that some places it is primarily a zinc ore, and other places a copper-zinc ore, with other natural variations. This implies that the ore was deposited around vents on the sea floor where hot fluids with dissolved metals were discharged onto the sediment. Later geologic processes, including burial and granite intrusion, turned the sediment to rock and recrystallized the mineral deposits between 400 and 500 million years ago.
C. Environmental Concerns

*Tailings impoundments.* Unlined, inadequate damming. High metal concentrations and potential for acid drainage. Inadequately stabilized. Below water table year-round, the tailings were not a major source of dissolved metals.

*Plant site.* No lining, inadequate capping. This area has relatively strong acid mine drainage due, in part, to the use of waste rock materials throughout the site, including redistribution of rock from earlier mining operations.

*Access road.* Portions were constructed with waste rock and are sources of acid mine drainage.

*Surface waters.* In the vicinity of the plant site and tailings impoundment, the surface waters (Second Pond and Carleton Stream) have high concentrations of zinc and other metals.

D. Remediation Efforts

After the mine ceased production in 1977, mine buildings remained in place until they were removed in the early 1980s. At this time, Kerramerican regraded the plant site, covered tailings ponds with 12 inches of fill material, and constructed vegetative cover.
covers over most of the plant site and tailings impoundments. In 1981, all exposed mine tailings were covered.

In the early 1990s, the Maine DEP conducted post-mine closure biophysical studies of the Carleton Stream system, identifying water quality impacts from the mine facilities.

From 2000 to 2002, with oversight by the DEP, contractors to Kerramerican conducted environmental investigations, geochemical evaluations, remedial investigations, human health assessments, and ecological risk assessments. The primary issues identified were elevated concentrations of metals in surface water, sediment, groundwater, and soils.

In 2007-2008, the vegetative cover on the tailings impoundment was restored, the access road material was removed, and a low-permeability cover (clay and geosynthetic cover system) was constructed over the plant site. Drainage improvements diverted runoff from passing through the impoundment, and several acres of new wetlands were constructed.

The project site currently receives periodic review by the DEP.

**Remediation.** Low-permeability cover being installed at the Kerramerican mine plant site, fall 2007.
5. References


Beck, Fredrick M., 2015, personal communication. (Mr. Beck is a Maine geologist, formerly with Callahan Mining Corp.)


