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MINNESOTA GEOLOGICAL SURVEY
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GOLD
in
Minnesota

by
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**Gold in quartz vein at unknown location.
(From collection of Department of Geology
and Geophysics, University of Minnesota.)
Photograph is approximately actual size.**

MINNESOTA GEOLOGICAL SURVEY
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Is There Gold in Minnesota?

The recent discovery of gold at Hemlo, Ontario, has prompted several exploration efforts for gold in Minnesota. Hemlo, which is located about 200 miles east of the northeastern tip of Minnesota, on the North Shore of Lake Superior, has a similar geologic setting to that of northern Minnesota, which makes our state a promising target. A large gold deposit has yet to be discovered in Minnesota, but there have been reports of several minor finds.

Gold has been found in small amounts in Minnesota since 1865. In that year a gold rush to Vermilion Lake was started by the finding and report of gold and silver. Prospect shafts were quickly sunk, but by 1867 it was clear that the ore was too lean, and the area was abandoned. The prospects were mainly on small quartz veins, which contained the minerals pyrite, ankerite, chalcopyrite, smaller amounts of rutile and tourmaline, and sparse gold. The wall rocks include several types of greenstone and dacitic porphyry.

A little gold has been produced from the Little American mine on Little American Island near the south shore of Rainy Lake, about 10 miles east of International Falls. Gold was discovered on the island in 1893, and the mine yielded \$5,535.33¹ of bullion in 1894. The stamp mill that was built to process the ore crushed about 500 tons of rock and operated for 52 days. The ore assayed at about \$12.50 per ton. Within a year the ore played out and the mine was abandoned. The gold was extracted from a quartz vein about 10 feet wide in sheared chloritic and biotitic schist. In addition to gold, the vein contained ankerite and pyrite, as well as minor chalcopyrite and tourmaline. The Lyle mine, located on the small island north of Dryweed Island, operated for a short time during the same period, but the gold content in quartz-siderite veins was extremely low. Numerous prospects were dug in other nearby islands and on the mainland in an effort to trace the gold, but values were apparently too low for production.

Gold that has weathered out of its original setting in bedrock is commonly transported by water. Such placer deposits have been found at the bottom of the sand and gravel bed of the Zumbro River between

Rochester and Mazeppa, Minnesota, but only in small amounts. The source rock from which the gold was weathered is unknown. The gold could not have come from the underlying limestone bedrock.

Gold has also been found in small amounts in the unconsolidated glacial deposits in Minnesota. When large glaciers once overran Minnesota the ice apparently passed over gold-bearing bedrock and transported some of the gold along with the rock debris entrapped within the basal part of the glacier. This gold is typically small, sparsely scattered flakes. Such large amounts of drift would have to be washed, or processed, in order to recover even small amounts of gold, that the operation would be marginal at best, economically speaking. Careful study of the occurrence of gold in the glacial drift, however, may help prospectors discover the bedrock source for gold.

What is Gold?

Gold is an element and a heavy, rare metal with a density of 19.32. It is relatively chemically inert, which means it does not readily combine with other elements to form compounds. Gold does, however, combine with most of the metals to form alloys. Gold is dispersed in most common rocks, in seawater, and in the lithosphere. The estimated average content in crustal rocks and ocean water is 0.004 parts per million (ppm), in meteorites 0.7 ppm, and in the earth as a whole 0.25 ppm. About 10 billion tons of gold are estimated to be held in suspension in the oceans of the world, but the practicality and expense of actually obtaining this gold makes its recovery unlikely. Gold is so rare that only an estimated 88,000 tons have been taken from the earth during all of recorded history. This amount of gold can be visualized as a cube with sides 54 feet in length.

Where is Gold Found?

Most gold deposits range in age from Precambrian to late Tertiary (more than 600 million years to less than 10 million years). Significant deposits have been found in greenstone belts in Archean (>2,500 million years) cratons like the Canadian Shield. Gold is also associated with certain Precambrian iron-formations in southern Africa and in Australia. In one unusual setting, small quantities of ore-grade precipitates are forming now in waters heated by vol-

¹Winchell and Grant (1895) list shipments that total \$5,535.33; their report is reprinted in Volume IV of the Final Report, The Geology of Minnesota (Winchell and Grant, 1899) with minor alterations, in which the list of shipments totals \$4,635.33. The discrepancy is in the shipment for August 20, 1894, which lists \$1,958.85 in the 1895 report (p. 79), and \$1,058.85 in the 1899 report (p. 206).

canic activity in New Zealand. There a mixture of amorphous sulfides and opaline silica contains as much as 2.7 ounces of gold per ton. Most primary gold deposits are found where igneous activity has occurred, especially in intrusions of intermediate to silicic composition.

Most of the world's gold comes from Witwatersrand, Republic of South Africa, where the gold occurs as sedimentary particles in rocks of Precambrian age that originally had been laid down as gravelly river deposits. Mining at Witwatersrand is done more than 2 miles beneath the earth's surface. In North America the greatest gold belt lies within the Precambrian Canadian Shield, some of which extends into northern Minnesota. Most Canadian gold deposits are found in sequences of metamorphosed and deformed volcanic rocks (greenstone). Many deposits are networks of gold-bearing quartz-pyrite veins that occupy fault zones and other fractures in the volcanic rocks; others are gold-bearing, layer-like bodies of sulfides, tourmaline, barite, and other minerals that may have been hot-spring deposits on the Precambrian sea floor. The recently discovered deposit at Hemlo, Ontario, is in Archean rocks which are about 2.7 billion years old. The main ore zone is composed of a diverse group of stratabound, pyrite-poor, siliceous and locally barite-rich metasediments, within which the gold occurs as finely disseminated native gold on molybdenite grains in siliceous mica schist.

How is Gold Found?

Gold is still mostly discovered by prospectors examining rocks in the field. An important new technique, however, is geochemical prospecting, because modern laboratories can determine very low, but anomalous values. For example, a gold value of only 25 parts per billion (ppb) from the uppermost, humus-rich soil horizon would be about 5 times the background level—the value to be expected for most places—and can reflect the presence of gold in the underlying bedrock. In addition to collecting soil samples, prospectors also can collect certain plants for analysis. Some species of spruce and horsetails accumulate minute amounts of gold during growth if gold-bearing rock lies below them. Another indicator of the presence of gold is exceptional concentrations of the bacterium *Bacillus cereus*, which have been found in greater numbers in soils over or near gold deposits in parts of Colorado, California, and Nevada.

How Does Gold Differ from Fool's Gold?

Gold can be distinguished from its look-alike minerals because it is so soft. If a sample can be crushed or easily scratched with a knife tip, it may be gold. The other metallic yellow minerals, notably pyrite and chalcopyrite, are much harder. Yellow flakes of altered mica are often mistaken for gold because they also are soft. Gold has a higher specific gravity than these other minerals, and unlike them, it does not dissolve in nitric acid.

Where Can One Obtain More Information?

Geologists at the Minnesota Geological Survey are always happy to look at rock samples. The samples can be brought in during University working hours, or they can be mailed. If you would like us to return the sample, please enclose return postage. Questions about possible gold potential in relation to the geology of specific areas can be directed to the Survey by mail or telephone (612) 373-3372.

How is Gold Exploration Regulated in Minnesota?

State laws and regulations regarding sampling, exploration drilling, leasing, and lands available for prospecting in Minnesota should be discussed with the Minnesota Department of Natural Resources, Minerals Division, 3rd Floor Centennial Office Building, 658 Cedar Street, St. Paul, Minnesota 55155. Telephone: (612) 296-4807. The Minerals Division also has an office at 1525 3rd Avenue East, Hibbing, MN 55746. Telephone (218) 262-6767.



Stamp mill on the mainland at Rainy Lake City, about 1 mile east of the Little American mine (from Winchell and Grant, 1895).

Useful References

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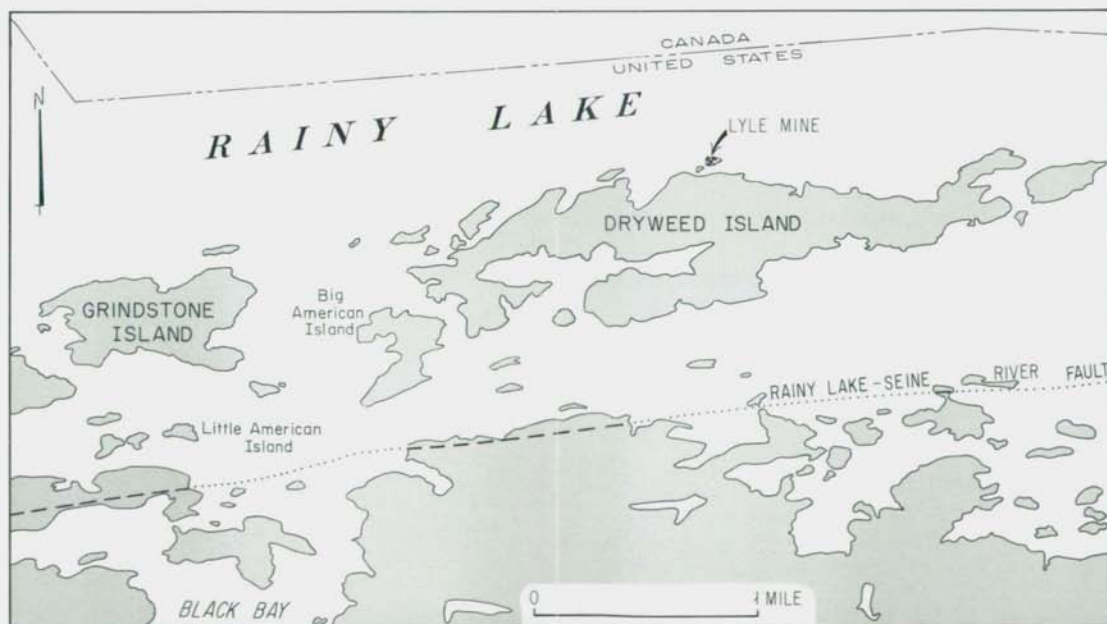
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Map of Rainy Lake area where some gold was mined prior to 1900.