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ONTARIO

GOLD

510638

MINES AND MINERALS

INFORMATION CIRCULAR NUMBER ONE

INTRODUCTION

GOLD! The word has fired our imagination like no other metal. Wars have been fought for it, and countries founded on its pursuit. For more than 8,000 years we have sought this "noble metal." In addition to its beauty, gold's appeal also lies in its indestructibility and rarity. It is estimated that all the gold mined in the last 6,000 years would amount to 100,000 tonnes, most of it mined in the present century. Due to its high density, this amount of gold would form a cube measuring almost 17 metres a side.

At the end of 1989, there were 23 operating gold mines in Ontario, producing more than 80 tonnes (2.8 million ounces) of gold per year, or about 50 per cent of the total Canadian production.

HISTORY

In August 1866, Marcus Powell discovered a Madoc-area cave whose walls contained "gold in the form of leaves and nuggets"; this was the first lode gold discovered in the Canadian Shield. Soon the area was inundated with fortune seekers, and the town of Eldorado was founded. Provincial geologists defined a gold belt in eastern Ontario which supported several mines around the turn of the century.

In 1878, gold was discovered in the Lake of the Woods area of northwestern Ontario; a total of about \$5 million of gold was produced between 1898 and 1951 from several mines.

The next major discovery took place in northeastern Ontario in 1906 near Larder Lake, as prospectors attracted by the Cobalt silver boom pushed northward, founding the mine and town of Swastika. Interest in the area was short-lived.

In 1896, provincial geologist E.M. Burwash found gold showings near Night Hawk Lake, east of present-day Timmins. However, there was little activity in this area until 1909, when several discoveries were made, including that by Harry Preston, who slipped on a rock knoll and accidentally exposed a quartz vein that led to a rich gold vein, which became the Dome Mine.

Benny Hollinger discovered a quartz vein that looked as though "someone had dripped a candle along it, but instead of wax it was gold." Hollinger staked six claims which were sold to Noah Timmins, the proprietor of a general store who had made his fortune in the Cobalt silver boom. On these claims Noah built the Hollinger Mine, and developed the townsite that was named after him. About the same time Sandy McIntyre staked a few claims adjacent to the Hollinger to the north, on which was built the McIntyre Mine. Truly, 1909 was a bonanza year for Ontario mining. Discoveries made that year in the Timmins district have so far produced 60 million ounces of gold.



In 1912, gold was discovered near Swastika by W.H. Wright, becoming the Wright-Hargreaves Mine, and by Harry Oakes, who single-handedly developed the Lake Shore Mine.

Mines sprang up, and the town of Kirkland Lake grew. The Kirkland Lake district has produced 38 million ounces of gold to date.

Gold was first discovered at Red Lake in 1897, but it remained undeveloped until rediscovered in 1924 by Gus McManus. This discovery prompted the Ontario government to send in geologist E.L. Bruce to examine the area. He noted that the area had many of the same geological characteristics as the Porcupine gold camp. The first prospectors to follow up on this lead were the Howey brothers, Lorne and Ray, who staked what became the Howey Mine. In the ensuing staking rush, the first use of air-planes to supply the growing but remote gold camp occurred, and a new service industry was born.

As was the case with many Ontario discoveries, the area around Hemlo had been picked over by generations of prospectors. Gold had originally been found nearby in 1662 by French explorers, and several short-lived mining ventures had tested local occurrences. Hemlo owes its recent spectacular development to provincial geological reports, improved gold prices and persevering explorationists. In 1980, encouraging drilling results were obtained from a group of claims adjacent to the Trans-Canada Highway and the Hemlo boom was on, resulting in three major mines.



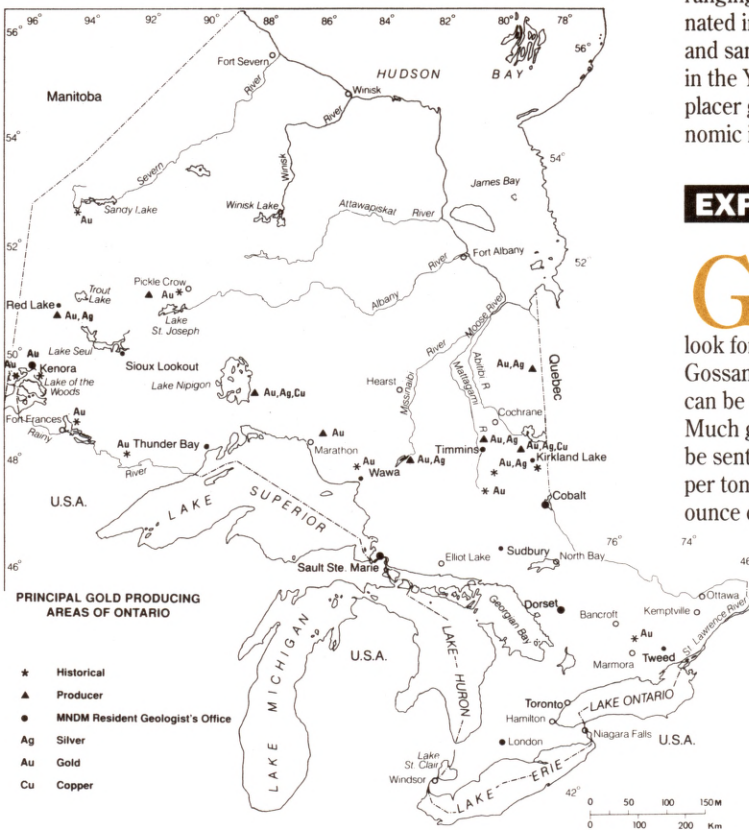
Ontario

Ministry of Northern Development and Mines



Harry Preston's "Dome" gold vein, Porcupine area.

The Timmins/Porcupine, Kirkland Lake and Red Lake gold camps are still major gold producing areas, and along with byproduct gold from base-metal mining and the Hemlo camp have made Ontario the major gold producing province in Canada.



GOLD MINERALOGY

Principal Gold Ore Mineral:

Native Gold (Au)

Properties:

Hardness 2 1/2 to 3 (harder than a finger nail, softer than a copper penny), specific gravity 19.3 (very heavy), colour characteristic gold-yellow, streak gold-yellow, lustre metallic, fracture hackly (catches at your skin), and very malleable.

Habit:

Usually found as irregular masses, flakes, scales; rarely in crystal form.

Other Gold Ore Minerals:

Sylvanite [(Au, Ag)Te₂] and Calaverite (AuTe₂).

GEOLOGY

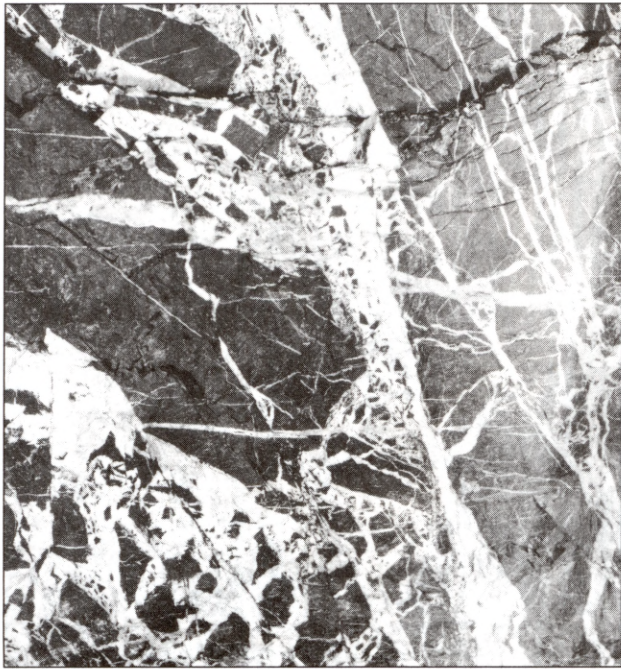
Most gold deposits in the Canadian Shield are related to belts of Archean (Early Precambrian)-age volcanic rocks. Gold deposits are usually found in mafic (dark coloured, magnesium- and iron-rich) volcanic rocks and sedimentary rocks derived from these rocks. Commonly, the deposits are closely associated with small bodies of felsic (light coloured, feldspar- and quartz-rich) plutonic rock, which intrude into the volcanic rocks. The gold is usually found in and near quartz veins and stringers, along with sulphide and/or arsenide minerals (e.g. pyrite, arsenopyrite). The veins are associated with intense deformation and alteration of the host rocks.

Loose pieces of rock or vein material separated from the bedrock, usually through glacial action, are called *float*, and further weathering or glaciation can reduce material to sizes ranging down to clay-sized particles. Gold particles which originated in the bedrock may be found among the resulting gravel and sand as *placer* gold. Although forming major sources of gold in the Yukon and other parts of the world, there are few known placer gold occurrences in Ontario – none of which are of economic importance.

EXPLORATION METHODS

Geological, geophysical, geochemical and mineral exploration records and maps are used to identify likely areas for the occurrence of gold. In these areas, prospectors look for shearing, alteration and rusty zones called *gossans*. Gossans and quartz veins or stringers in a favourable rock unit can be crushed and panned to determine if visible gold is present. Much gold is too fine to be visible, and likely rock samples must be sent to laboratories to be assayed. Ore grading 0.11 ounce gold per ton (that is, eight tonnes of ore must be milled to get one ounce of gold) is mined at the Dome Mine near Timmins.

Geochemical exploration methods, using stream or lake sediments, soils, humus or plant material can be used, and drilling is used to sample rocks beneath the surface. Sometimes the presence of elements associated with gold, such as arsenic, antimony, mercury and molybdenum can indicate the presence of gold.



Quartz-vein breccia, Lake Shore Mine, Kirkland Lake.

MINING, MILLING, REFINING

Mining methods for lode gold are similar to other metals, i.e. either open-pit or underground, depending on the depth of the ore. The ore is first crushed to one centimetre chunks before being sent to the mill, where it is ground to a fineness sufficient to release the particles of gold, usually to about the consistency of fine flour.

The milling processes used at any one mill depend on the nature of the ore. Coarse or large particles of gold can be recovered mechanically from jigs or shaking tables where the gold settles out due to its greater specific gravity. Mercury is added to the gravity-recovered product to make an amalgam. This amalgam is then heated to vapourize the mercury and recover the pure gold.

For fine gold, or gold being recovered from base-metal ore, a chemical cyanidation process is used. A cyanide solution is added to the ground ore to dissolve the gold. This solution is then treated to recover the gold using either zinc precipitation or carbon-in-pulp (CIP) methods. Although the addition of zinc dust to precipitate the gold has long been used in Ontario mines, the CIP method is generally favoured in new plants. Here, activated charcoal absorbs gold from the cyanide solution, then gold is recovered from the charcoal either by zinc precipitation or by electroplating onto steel wool.

For gold in base-metal sulphide ore, a flotation process must be used first. The ground ore is mixed with chemicals and water. The gold and other metal-sulphides are separated from the "waste" mineral particles in flotation cells and then passed through filters to remove the water. The resulting sulphide-gold concentrate is roasted, and the cyanide treatment used to recover the gold.

Heap leaching is a method of recovering gold that is gaining popularity. This method is especially useful in recovering gold from low-grade ore or tailings from older mines; these tailings frequently contain gold left from older, less efficient recovery methods. The material to be leached is loaded onto huge polyethylene liners, frequently over 10 hectares (25 acres) in size. Sprinkler systems soak this "heap" with a weak cyanide solution, and the

solution containing dissolved gold is recovered from the bottom.

Refining upgrades the precipitated or amalgamated gold from the milling process by heating it with a flux so that a chemical reaction occurs; the flux combines with the impurities to form slag, and the molten gold sinks to the bottom where it can be drawn off and poured to make impure or *doré* gold bullion bars. In the CIP process, the gold-plated steel wool is melted and the gold and steel separated to obtain the *doré* bullion. Further refining is done to make gold of up to 99.999 per cent purity.

When gold is recovered as a byproduct of base-metal mining, it is recovered from the sludge left from electrolytic refining of other metals, and refined as above.

ONTARIO PRODUCTION

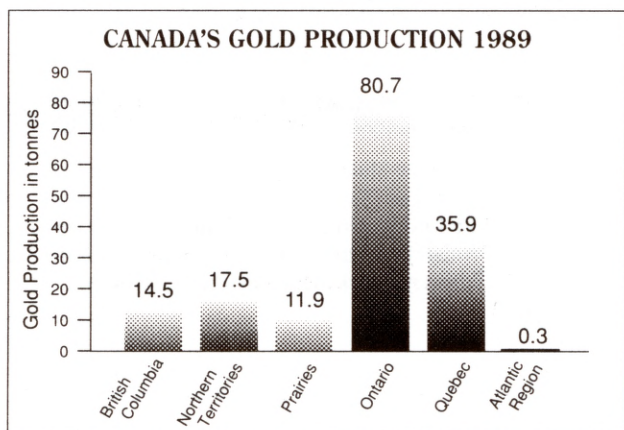
Canada is one of the leading producers of gold worldwide, ranking fifth after the Republic of South Africa, U.S.S.R., the United States, and Australia.

*1989 Ontario Production:

Volume: 80,707 kg Value: \$1,170,487,000

*1989 Canada Production:

Volume: 158,440 kg Value: \$ 2,297,747,000



*Preliminary statistics from: Information and Statistics Section, Ministry of Northern Development and Mines, with additional information from Energy, Mines and Resources Canada.

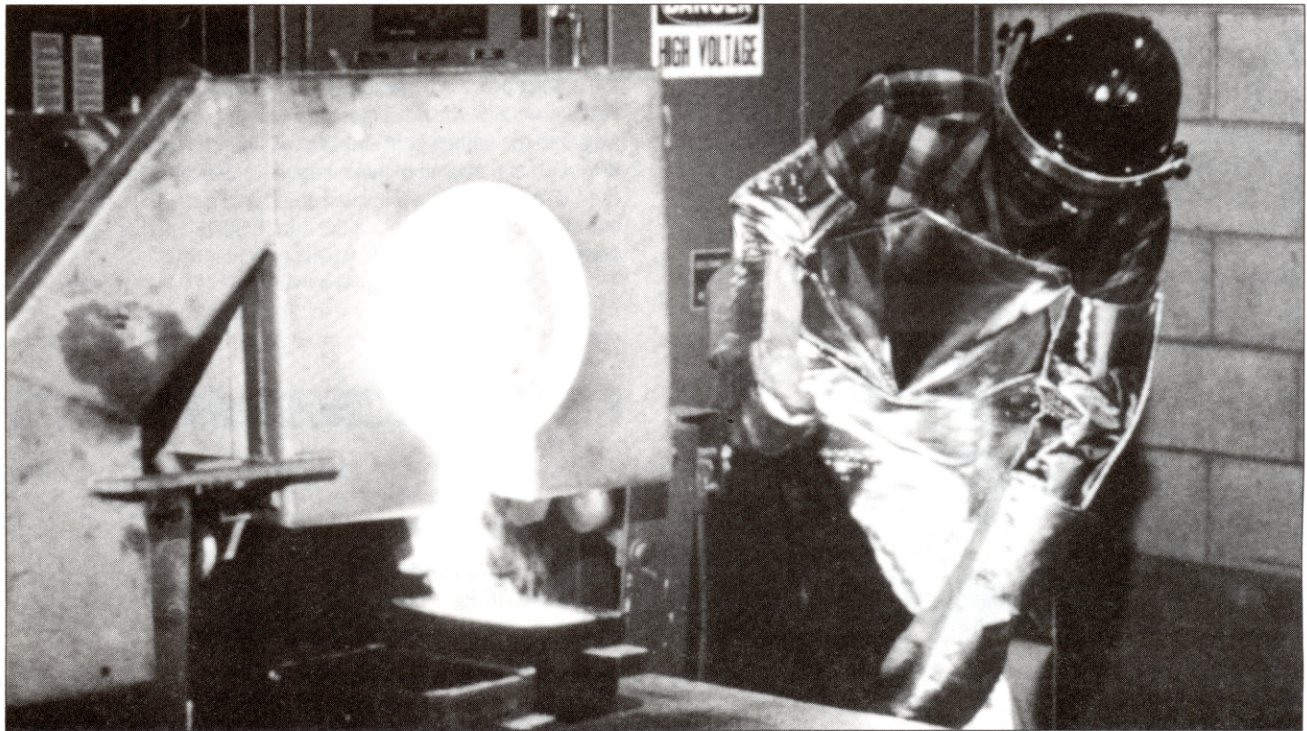
USES

The world demand for gold is still mainly for jewellery and coinage. The largest use of Canadian gold is in bullion coins, such as the Canadian Maple Leaf, which is the largest selling bullion coin in the world.

Gold has an increasing number of industrial and medical uses.

One gram of gold can be drawn into a wire almost three kilometres long; many micro-circuits in computers and aircraft contain gold wire which is only half the thickness of a human hair.

Gold can be beaten into leaves which are 0.0001 mm (about five millionths of an inch) thick or 10,000 leaves to a millimetre. When gold is thin enough, light can pass through, reflecting glare and heat, and transmitting mostly green light (i.e. the windows look pale green from inside). The windows in the Royal Bank Plaza in Toronto contain 77,000 grams of 24-carat gold, reflecting the hot infrared rays of the sun to reduce air-conditioning costs in summer, and reflecting the heat inside the building in winter. Gold and gold/silver alloy coating on windows can also be heated electrically for de-icing and demisting aircraft.



Pouring gold at the Golden Giant Mine, Hemlo Gold Mines Inc., Hemlo

PUBLICATIONS

Publications of the Ministry of Northern Development and Mines, Mines and Minerals Division, are available from the **Public Information Centre, Ministry of Natural Resources / Ministry of Northern Development and Mines, Room 1640, Whitney Block, Queen's Park, Toronto, Ontario M7A 1W3.**

On Gold

Gold, 1981, by T.P. Mohide, Mineral Policy Background Paper 12. Price \$30.

Gold Deposits, 1977, by J.B. Gordon, Mineral Deposit Maps P.1226 - P.1229, scale 1:1 013 760. Price \$0.50 each plus tax.

Gold Deposits of Ontario, Part 1, Northern Ontario, 1971, by S.A. Ferguson et al., Mineral Resources Circular 13. Price \$4.

Gold Deposits of Ontario, Part 2, Southern Ontario, 1979, by J.B. Gordon et al., Mineral Deposits Circular 18. Price \$5.

Gold Deposits of the Atikokan Area, 1982, by S.J. Wilkinson, Mineral Deposits Circular 24. Price \$4.

Ontario Occurrences of Float, Placer Gold, and Other Heavy Minerals, 1978, by S.A. Ferguson and E.B. Freeman, Mineral Deposits Circular 17. Price \$5.

The Geology of Gold in Ontario, 1983, edited by A.C. Colvine, Miscellaneous Paper 110. Price \$5.

Archean Lode Gold Deposits, 1988, by A.C. Colvine et al., Miscellaneous Paper 139. Price \$5.

Of General Interest

Harvest from the Rock: A History of Mining in Ontario, 1986, by Philip Smith, Macmillan of Canada with the co-operation of the Ministry of Northern Development and Mines. Price \$32.95.

Publications available free from the **Publication Distribution Office, Mineral Policy Sector, Energy, Mines and Resources Canada, 580 Booth St., Ottawa, Ontario K1A 0E4** include:

Gold in Canada (brochure), a reprinted chapter from the Canadian Minerals Yearbook (specify the chapter on **Gold**), and Map 900A *Principal Mineral Areas of Canada*.

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For further information contact the Geoscience Information Office, Ontario Geological Survey, Room 812c - 77 Grenville St., Toronto, Ontario M7A 1W4, telephone (416) 965-0190.

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