Outlook for Canadian Mine Production, Mine Life and Ore Reserves

Donald Cranstone

The author recently retired from the Minerals and Metals Sector, Natural Resources Canada.
Telephone: Robert Clark at (613) 996-3286
E-mail: rclark@nrcan.gc.ca

INTRODUCTION

The purpose of this chapter is to provide the reader with an understanding of the outlook for mining in each of Canada's 13 provinces and territories over the medium term to 2026.

The mineral commodities covered are metals, the industrial minerals, construction materials and coal. The emphasis is on metal mining. Based on the best information the author was able to obtain in 2002, estimates have been made of the expected lives of Canada's metal mines, either individually or in groups, such as all mines at Sudbury, Ontario, or all the gold mines in Quebec.

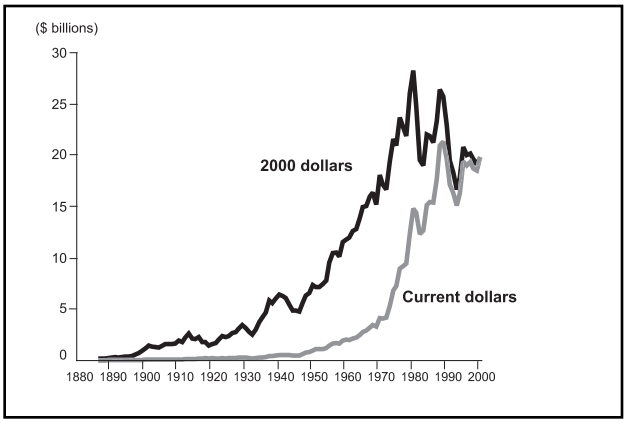
When looking at predicted mine lives, one should keep in mind that the prices of the metals produced in Canada, notably the prices of copper, lead and zinc, were exceptionally low in 2002 and continue to be low. Such low prices might result in the unexpected closure of mines, either temporarily or, in the case of mines already near the end of their lives such as the Con mine in the Northwest Territories and the Lupin mine in Nunavut, both of which closed in 2003 after this chapter was written, closure could be permanent.

CANADA'S MINERAL PRODUCTION HISTORY

Canada's non-petroleum mineral production has increased over the more than 115 years for which production statistics are available. Figure 1 shows the value of Canada's non-petroleum mineral output from 1886 to 2000. In inflation-adjusted year 2000 dollars, the production peak in the 1970s, and the decline in production value since then, probably reflect exceptionally high metal prices in the 1970s followed by generally declining metal prices rather than lower physical production of minerals.

In Figure 2, the graph at the top depicts Canada's annual metal production from 1886 to 2000 converted to 2001 dollars to compensate for inflation. The graph at the bottom depicts Canada's annual metal production tonnages all valued at metal prices of mid-2002. The graph demonstrates that Canada's aggregate metal production has not declined significantly over the past 30 years.

Figure 1
Value of Canada's Non-Petroleum Mineral Production, 1886-2000

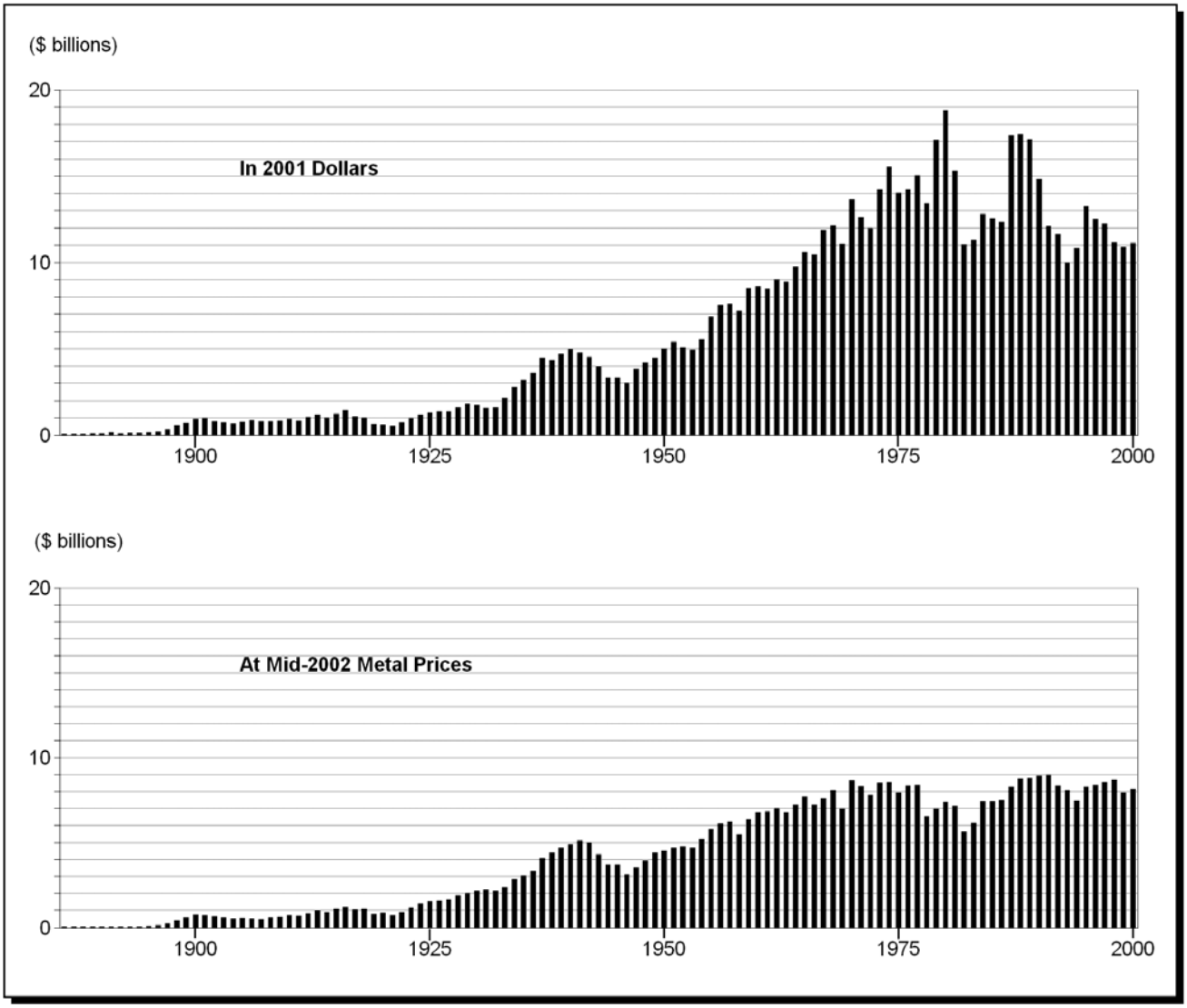


Source: Natural Resources Canada.

CANADA'S POSITION IN MINERAL EXPLORATION

For 22 years, Canada has been one of the world's top two mineral exploration targets (Figure 3). Since 1992, Canada has been second after Australia as a recipient of exploration expenditures. With Australia's mineral production in 1998 being 27% higher than that of Canada, it is not surprising that Australia has been ahead of Canada in terms of mineral exploration expenditures. However, indications are that exploration expenditures in Canada exceeded those in Australia again in 2002, likely as a result of the Canadian exploration tax credit for flow-through share investors.

Figure 2
Value of Canadian Metallic Mineral Production, 1886-2000



Source: Natural Resources Canada.

It may be that the exploration efforts in China and in Russia, both of them countries that are more important mineral producers than Canada, exceed those in Canada. However, comprehensive exploration expenditure statistics are not available for either of those countries.

Provided that the necessary exploration expenditures are made, a substantial number of metal orebodies should be discovered in Canada and developed for production over the next 25 years. However, there is no certainty that discoveries will be made in all provinces and territories.

MINERAL PRODUCTION BY PROVINCE AND TERRITORY, NOW AND IN THE FUTURE

Figures 4 to 16 depict, for each province and territory, expected future mineral production from current mines and from mines being developed, but not for mines that may be developed from deposits for which a firm production decision had not been made by the end of 2002. There will be additional discoveries and additional new mines in most provinces and territories. These are not shown in Figures 4 to 16.

Figure 3
Top Three Country Destinations of Mineral Exploration Capital from World-Wide Sources, 1980-2001

	RANK		
	1	2	3
2001	Australia	**Canada**	United States
2000	Australia	**Canada**	United States
1999	Australia	**Canada**	United States
1998	Australia	**Canada**	United States
1997	Australia	**Canada**	United States
1996	Australia	**Canada**	United States
1995	Australia	**Canada**	United States
1994	Australia	**Canada**	United States
1993	Australia	**Canada**	United States
1992	Australia	**Canada**	United States
1991	**Canada**	Australia	United States
1990	**Canada**	Australia	United States
1989	**Canada**	Australia	United States
1988	**Canada**	Australia	United States
1987	**Canada**	Australia	United States
1986	**Canada**	Australia	United States
1985	**Canada**	Australia	United States
1984	**Canada**	Australia	United States
1983	**Canada**	Australia	United States
1982	**Canada**	Australia	United States
1981	**Canada**	Australia	United States
1980	Australia	**Canada**	United States

Source: Natural Resources Canada.

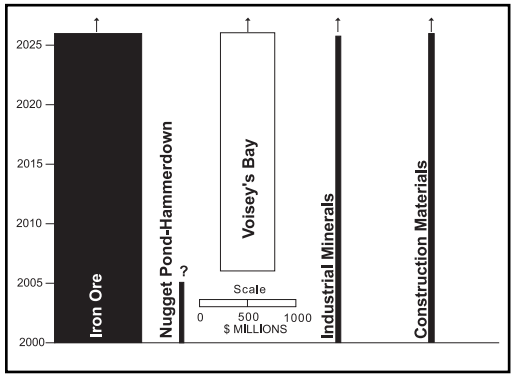
For each metal mine or group of metal mines, the width of each bar is based on expected production values at March 2001 metal prices. For industrial minerals, construction materials and coal, bar widths are based on provincial/territorial production values in 1999.

The bars for some mines have both black and white portions. The black portion represents production based on 2002 ore reserves. The white portion represents either additional known resources expected to be upgraded to reserves in the future or, in a few cases (Raglan, Niobec, Kidd Creek, Hudson Bay Mining and Smelting Co., Limited [HBMS], Eskay Creek and Highland Valley Copper), the white portion of the bars reflects either company statements concerning future potential ore or the author's expectations that levels of ore reserves that have been maintained over the years will continue to be maintained.

Newfoundland and Labrador

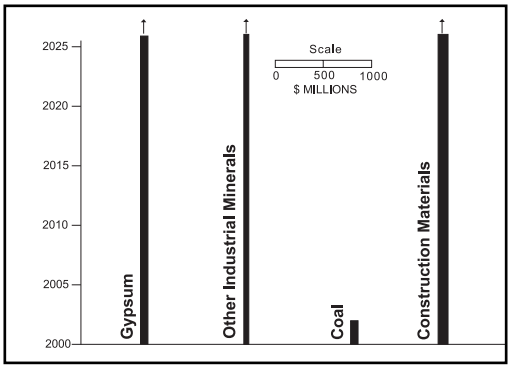
In the province of Newfoundland and Labrador, production from the Voisey's Bay deposit is expected to commence in 2006 and will result in a substantial increase in the value of the province's mineral production. There is a good possibility that production of iron ore will also increase. Production capacity for iron ore was recently increased by 25% at one operation and by a smaller percentage at the other.

Figure 4
Newfoundland and Labrador
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Figure 5
Nova Scotia
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Nova Scotia

Metals are not produced in Nova Scotia.

Prince Edward Island

Metals are not produced in Prince Edward Island.

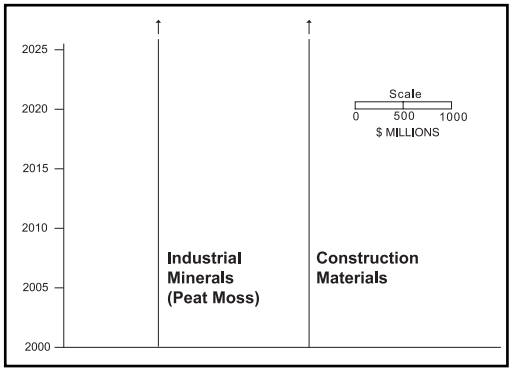
New Brunswick

In New Brunswick, ore reserves at the Brunswick No. 12 mine will be depleted by 2010 with production expected to decline after 2007. The mine might close as early as 2008. The Noranda Inc. Halfmile Lake deposit, not yet developed for production, will not be viable at foreseeable zinc prices, so it is not portrayed in Figure 7. Several tens of millions of tonnes of mineralized material are known to exist at the Caribou mine. There have been several attempts to mine this deposit, but they have not succeeded because of extremely poor metallurgical recoveries. The current owner of the mine has stated that metallurgical recoveries can be improved but that higher zinc prices will be required. Such prices would have to be much higher than 2002 zinc prices. The carrying value of the mine has recently been written down from $53.4 million to zero. It is highly unlikely that zinc prices higher than those that have prevailed in recent years will be available in the future except possibly for short periods. Therefore, any future production from the Caribou mine is likely to be sporadic at best.

Quebec

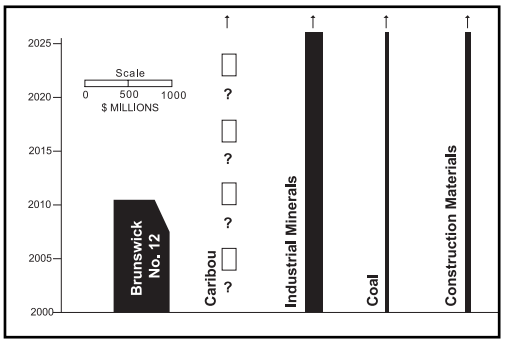
In Quebec, production of iron ore, nickel, ilmenite, niobium, industrial minerals other than asbestos, and construction materials is likely to continue at current or higher levels for at least the next 25 years.

Figure 6
Prince Edward Island
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Figure 7
New Brunswick
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

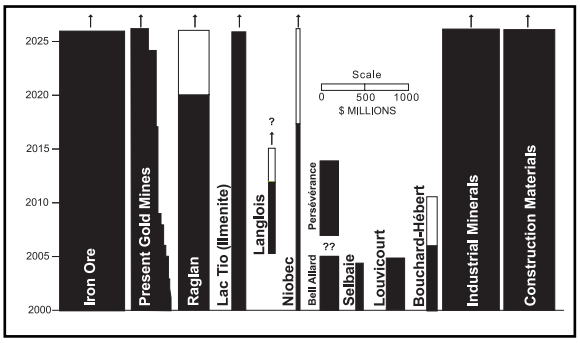
The Louvicourt and Selbaie mines, and possibly the Bouchard-Hébert mine, are expected to close in about 2004 or 2005.

The Bell Allard mine at Matagami will run out of ore at the end of 2004. Owing to the low zinc price and to the financial situation of Noranda Inc., production from the Perseverence deposit will be delayed, perhaps until about 2006. Noranda is of the opinion that there is still considerable potential for additional discoveries in the Matagami area.

Current reserves and measured and indicated resources at the Raglan operation are adequate to support production there until 2020. New deposits continue to be discovered; therefore, production is likely to continue for longer than 25 years.

The Langlois mine will eventually re-open. Once it does, it is expected to produce for seven years. If metal prices are adequate it might produce for longer. Production at Langlois is arbitrarily shown in Figure 8 as beginning in 2005.

Figure 8
Quebec
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Ontario

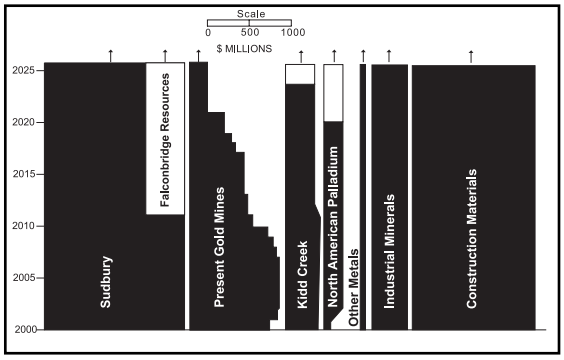
In Ontario, Inco Limited's current reserves at Sudbury are adequate to support production there well beyond 2026. Although Falconbridge Limited's current proven and probable reserves are adequate for only about nine years, the Onaping deep deposit, discovered in 1996, and the Nickel Rim South deposit, discovered in 2001, together should support Falconbridge's current production level at Sudbury for approximately another 18 years. Although both deposits are exceptionally high grade (for Sudbury), they are not yet included in proven and probable reserves.

For the Kidd Creek mine, the Falconbridge 2001 Annual Report states that current reserves and resources will support production until 2024 and that the orebody is open below the currently planned bottom mining depth of 10 000 feet, so production seems likely to continue beyond 2024.

Current proven and probable reserves and resources, and measured and indicated resources, of North American Palladium Ltd. are adequate to support production for 29 years, although low palladium prices may have a negative effect on the life of the mine.

As a production decision has not yet been made, Figure 9 does not include Falconbridge's proposed Montcalm nickel mine, which should be capable of producing some $160 million of nickel annually over a seven-year period.

Figure 9
Ontario
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Manitoba

In Manitoba, current ore reserves and resources for the Thompson Nickel Belt can support current production levels there until 2022 or 2023. Both the Thompson and Birchtree orebodies are open at depth (although the depth potential at the Thompson mine appears limited) and there are other known ore deposits in the area that are not yet included in ore reserves, so it seems likely that Thompson Nickel Belt production will continue beyond 2026.

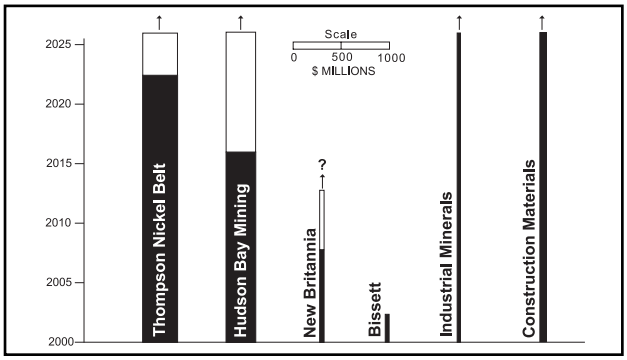
Hudson Bay Mining and Smelting Co., Limited (HBMS) has current ore reserves and resources that will be sufficient to produce until 2016. Production seems likely to continue well beyond 2016 for the following reasons:

- The large new 777 orebody is open at depth and laterally.
- HBMS has operated a total of 29 mines in the Flin Flon-Snow Lake area to date.
- The company has discovered three more orebodies per decade since 1940, including three in the 1990s.

- Anglo American plc's Spectrem airborne geophysical system has been flown over the area and yielded two new orebodies and many new anomalies that have not yet been drilled.

- It would be surprising if additional orebodies are not discovered.

Figure 10
Manitoba
Expected Mineral Production, 2000-2026



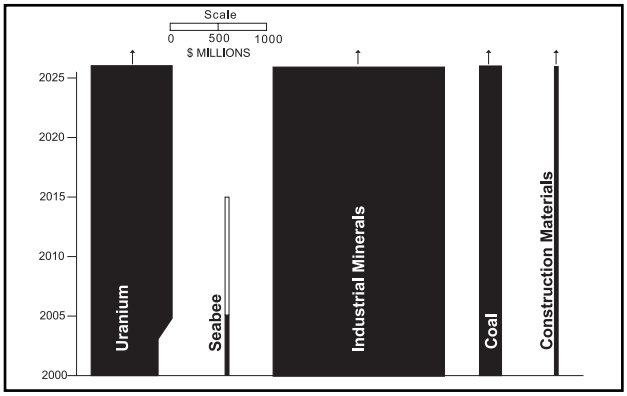
Source: Natural Resources Canada.

Saskatchewan

In Saskatchewan, uranium is the principal metal produced. Current ore reserves and resources are adequate to support current or higher production beyond 2026.

HBMS's Konuto Lake mine, located in Saskatchewan, and the Saskatchewan portion of the Callinan mine have been included in the Manitoba graph (Figure 10) because data are not available that permit the separation of those mines from the company's total production and reserves information.

Figure 11
Saskatchewan
Expected Mineral Production, 2000-2026

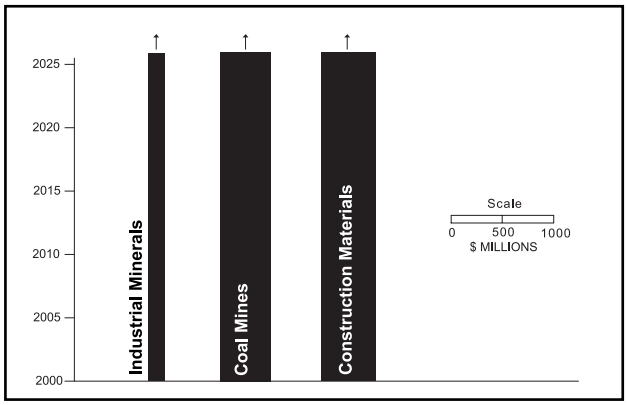


Source: Natural Resources Canada.

Alberta

Metals are not produced in Alberta.

Figure 12
Alberta
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

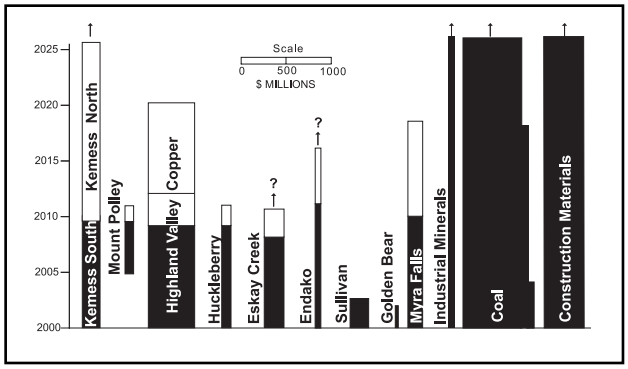
British Columbia

In British Columbia, the Kemess, Mount Polley, Highland Valley Copper, Huckleberry and Endako mines, which yield 70% of the metal production value of this province, are all low-grade porphyry-type deposits. Because many much-higher-grade and mostly much larger porphyry-type deposits in South America and elsewhere have commenced or increased production in recent years, copper and molybdenum prices have declined to the point where Canadian porphyry-type deposits have difficulty competing. Therefore, there is little interest in exploring for porphyry-type deposits in British Columbia at present. Non-porphyry deposits will have to be discovered soon if the province is to remain a significant producer of metals. This will require increased mineral exploration expenditures.

In the preparation of Figure 13, the assumption has been made that when the Kemess South orebody is mined out in about 2010, ore will come from the Kemess North deposit.

At the Highland Valley Copper mine, current ore reserves should last until 2009. Two unmined sections of the pit could be mined if market conditions for copper are appropriate. The smaller of these would extend production for three years. The larger of these would add an additional nine years to the life of the mine but would require an investment of $250 million, an investment that will depend on a favourable copper price outlook.

Figure 13
British Columbia
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Yukon

Placer gold mining is the Yukon's only remaining metal mining industry. As there has been placer mining in the Yukon continuously for 118 years, in the preparation of Figure 14 the assumption has been made that placer mining will continue for at least another 24 years, despite the new requirements.

Northwest Territories

In the preparation of Figure 15, expected production from the Ekati, Diavik and Snap Lake diamond mining operations has been estimated (Snap Lake is not yet in production but production is definitely planned), including potential production from additional deposits at Ekati that are not in the current mining plan.

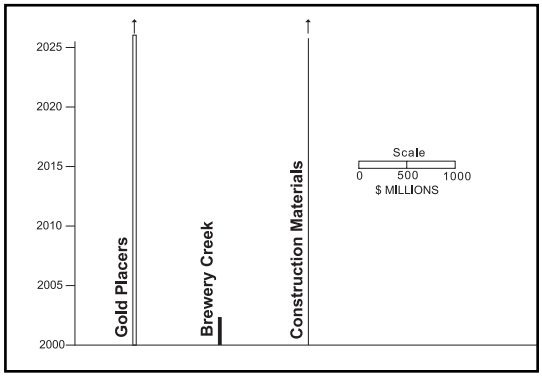
Miramar Mining Corporation plans to operate the Con mine until late 2003, but will continue to operate the Giant mine and the Con mill until the end of 2004 and hopes that production will continue beyond that. Substantial unmined resources remain in the Con mine but, because of low gold prices in 2001 and 2002, it does not appear that the required development has been done to permit mining of these resources now that the gold price has improved.

Nunavut

In Nunavut, the Lupin mine closed in August 2003, following the closures of Nanisivik and Polaris in 2002, and metal is no longer mined in the territory.

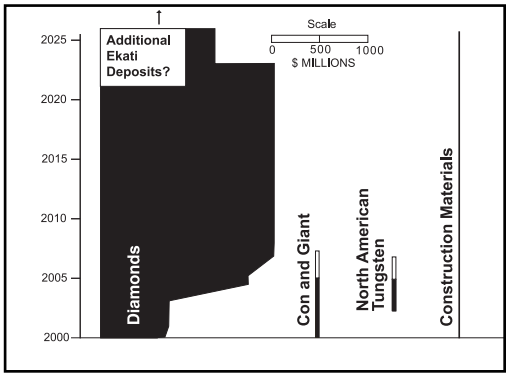
Feasibility studies are in progress for the Hope Bay and Meadowbank gold projects, where exploration continues. These two projects are not shown in Figure 16 because production decisions have not yet been made.

Figure 14
Yukon
Expected Mineral Production, 2000-2026



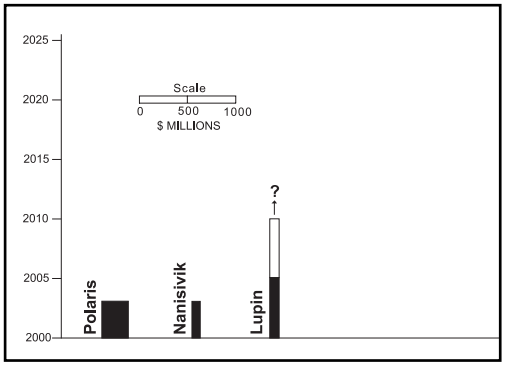
Source: Natural Resources Canada.

Figure 15
Northwest Territories
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Figure 16
Nunavut
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

HISTORICAL CANADIAN PRODUCTION AND RESERVES FOR VARIOUS MINERAL COMMODITIES

Nickel

Canada's nickel reserves have generally declined since 1981 because, at more than 40 times annual production, they were too expensive to maintain. Production from a mine at Voisey's Bay and recently increased production from the Raglan Nickel Belt should increase Canada's nickel production to the record levels of the early 1970s. Such production levels will be sustainable for at least the next 25 years.

Copper

Canada's copper reserves and copper production are both declining. This is because British Columbia's porphyry copper orebodies are being depleted, as are the volcanogenic copper-bearing orebodies being mined in Quebec and in New Brunswick. Copper that is expected to be produced from the Voisey's Bay and Kidd Creek mines and from mines at Sudbury and in the Flin Flon area should maintain Canada's copper production at more than half the current level for more than 25 years. New copper discoveries and new mines will be needed to maintain current copper ore reserves and production levels.

Zinc

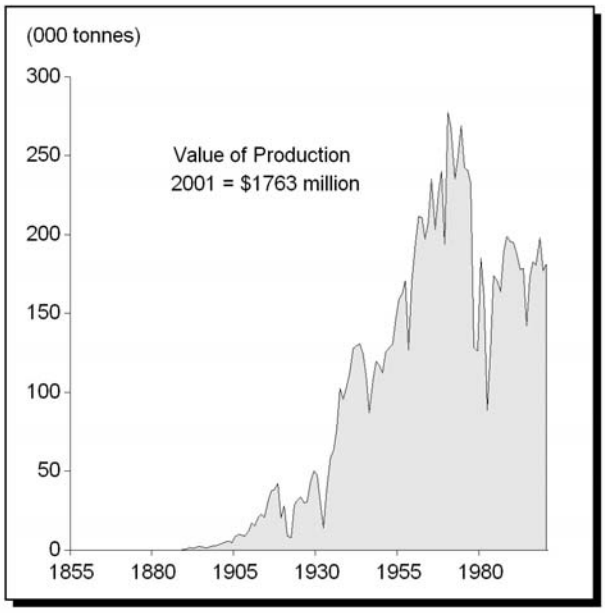
Canada's zinc reserves have been declining since the early 1980s when ore reserves began to decline at some of Canada's largest zinc mines where ore reserves could no longer be maintained once the ore limits had been defined. Without new zinc discoveries and the development of new zinc mines, Canada's zinc reserves and zinc production will continue to decline dramatically.

For the next 25 or more years, the Kidd Creek mine, together with the mines of HBMS, can be expected to yield some 200 000 t of zinc annually, about 20% of Canada's current zinc production. New discoveries will be needed to produce much more than this.

Lead

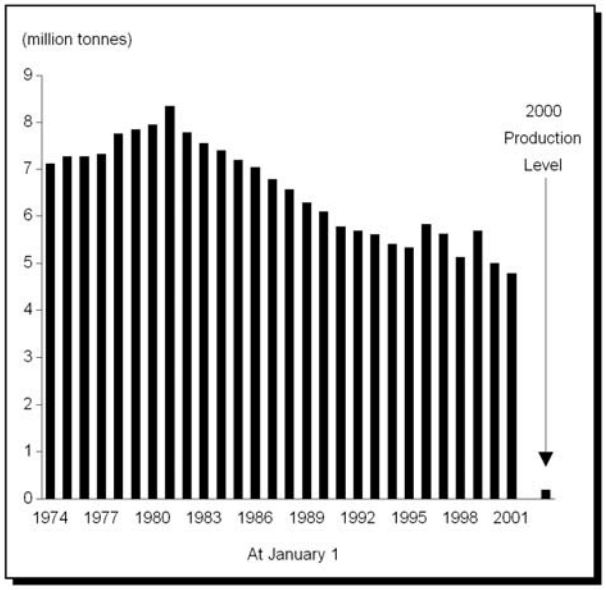
Canada's reserves of lead in ore and its lead production continue to decline. The Brunswick No. 12 mine will be mined out in another three to five years. When that mine closes, Canada's lead reserves and lead production will both be zero unless new discoveries are made. As the value of Canada's lead production was only $108 million in 2000, cessation of lead production will not have much of an impact on the total value of Canada's mineral output.

Figure 17
Nickel Production, 1889-2000



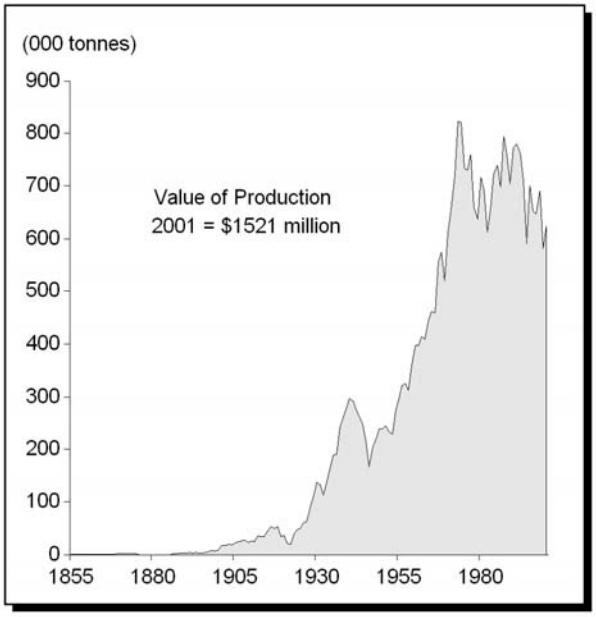
Source: Natural Resources Canada.

Figure 18
Nickel Contained in Mineable Ore, 1974-2001



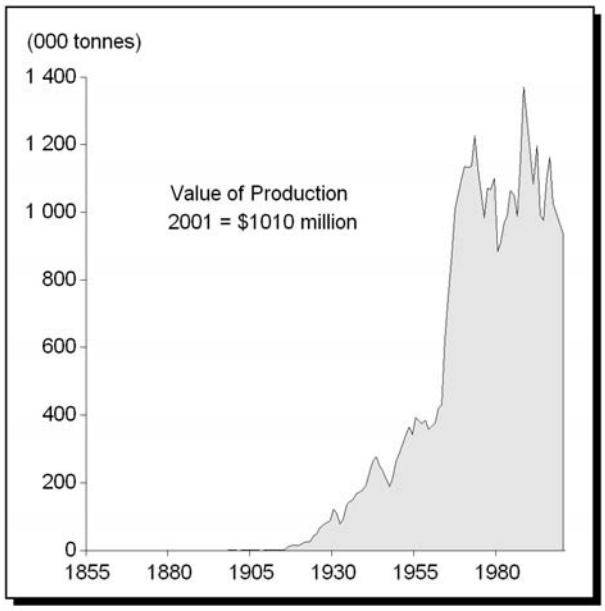
Source: Natural Resources Canada.

Figure 19
Copper Production, 1848-2000



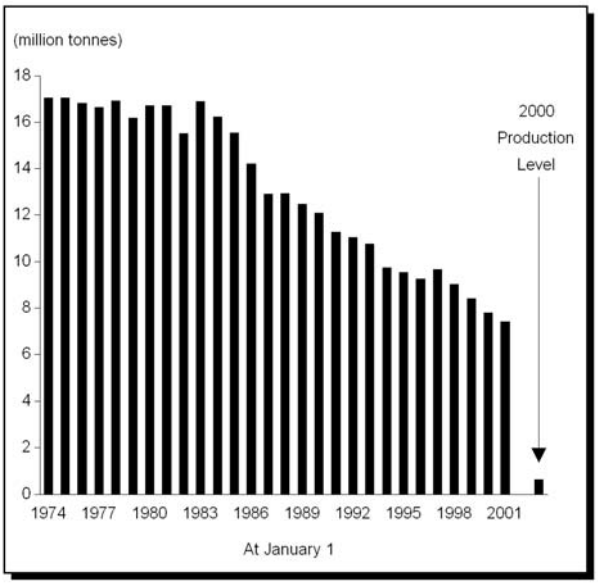
Source: Natural Resources Canada.

Figure 21
Zinc Production, 1898-2000



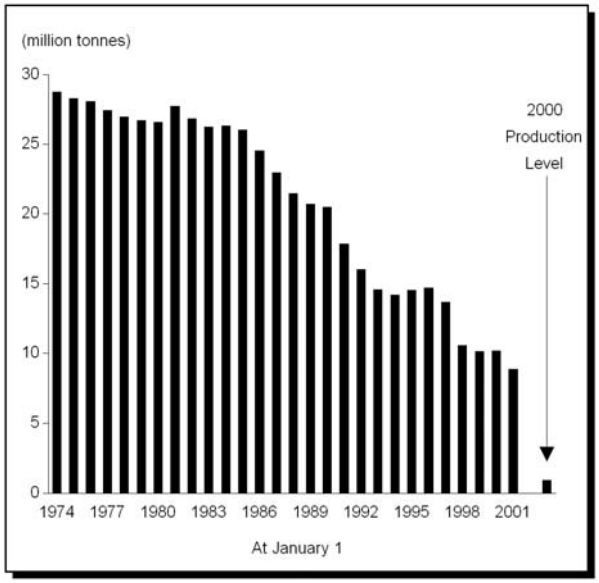
Source: Natural Resources Canada.

Figure 20
Copper Contained in Mineable Ore, 1974-2001



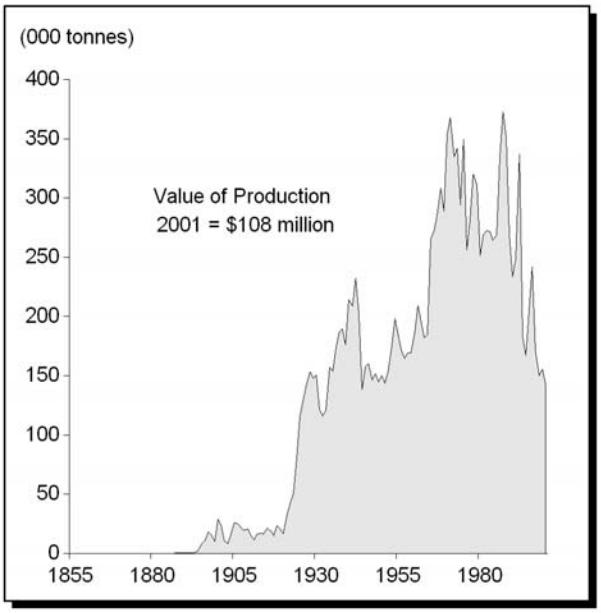
Source: Natural Resources Canada.

Figure 22
Zinc Contained in Mineable Ore, 1974-2001



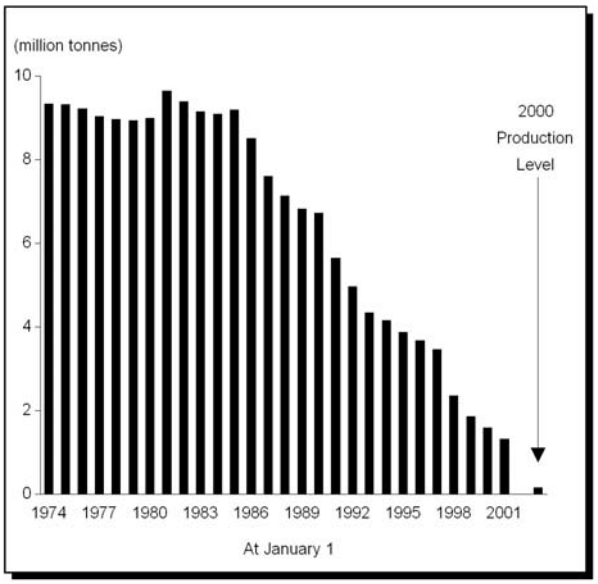
Source: Natural Resources Canada.

Figure 23
Lead Production, 1887-2000



Source: Natural Resources Canada.

Figure 24
Lead Contained in Mineable Ore, 1974-2001



Source: Natural Resources Canada.

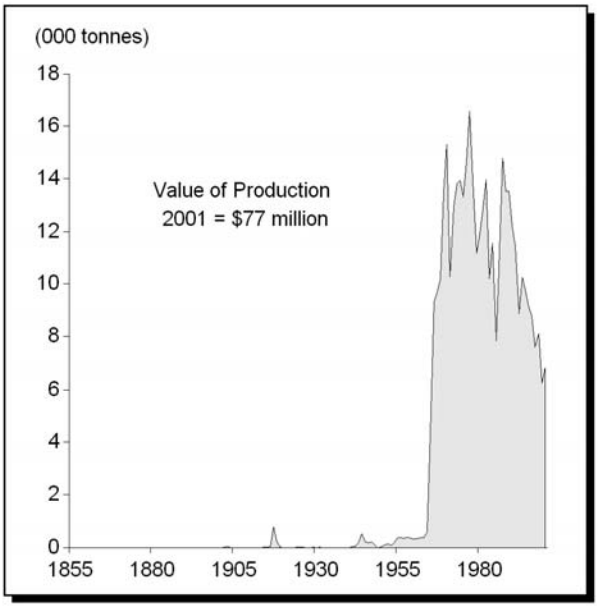
Molybdenum

The Endako, Highland Valley Copper and Huckleberry mines are Canada's only remaining molybdenum producers. All three mines have limited life expectancies. The life of the Endako mine could be extended provided molybdenum prices were adequate. As the value of Canada's molybdenum production was only $77 million in 2000, as is the case with lead, cessation of molybdenum production will not have much of an impact on the value of Canada's mineral output.

Silver

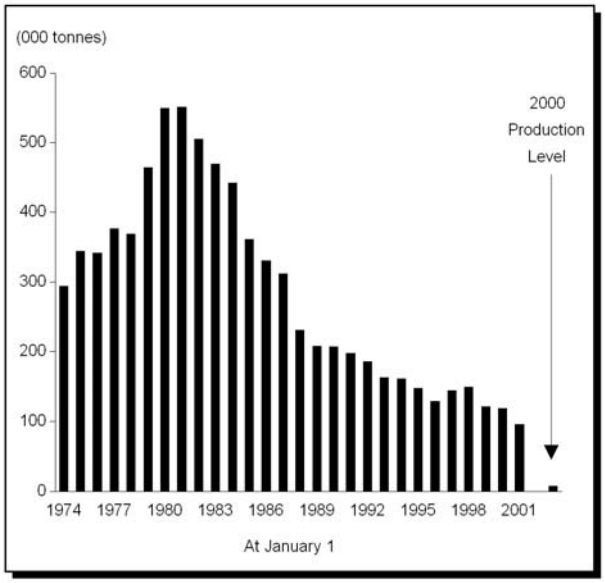
At present, Canada's silver production is entirely a by-product of base-metal and gold mining. The Eskay Creek gold-silver mine accounted for 41% of Canada's silver production in 2001. Canada's silver reserves have been mostly declining since the early 1980s when base-metal reserves began to decline. Silver reserves and silver production will continue to decline if base-metal reserves decline and the Eskay Creek mine comes to an end, unless significant new discoveries can be made.

Figure 25
Molybdenum Production, 1902-2000



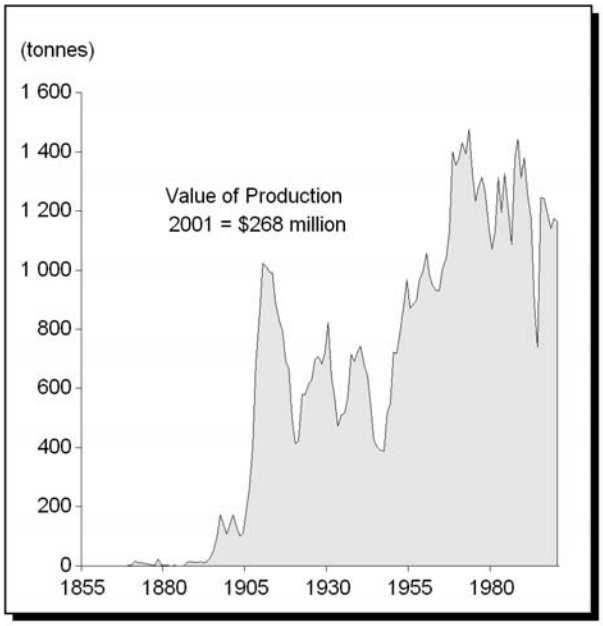
Source: Natural Resources Canada.

Figure 26
Molybdenum Contained in Mineable Ore, 1974-2001



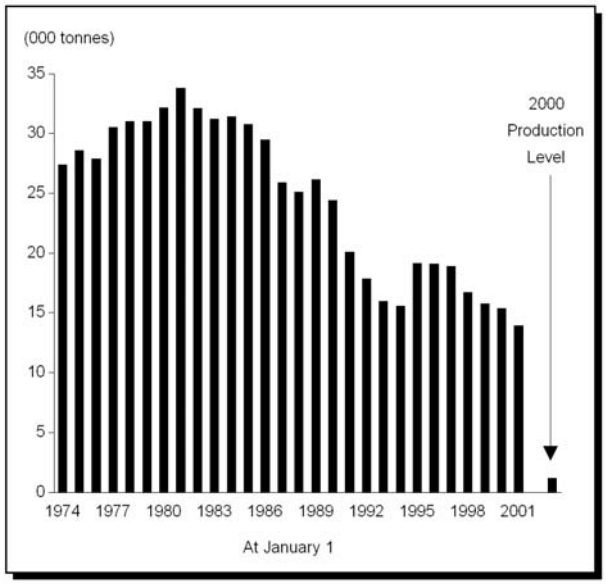
Source: Natural Resources Canada.

Figure 27
Silver Production, 1869-2000



Source: Natural Resources Canada.

Figure 28
Silver Contained in Mineable Ore, 1974-2001



Source: Natural Resources Canada.

Gold

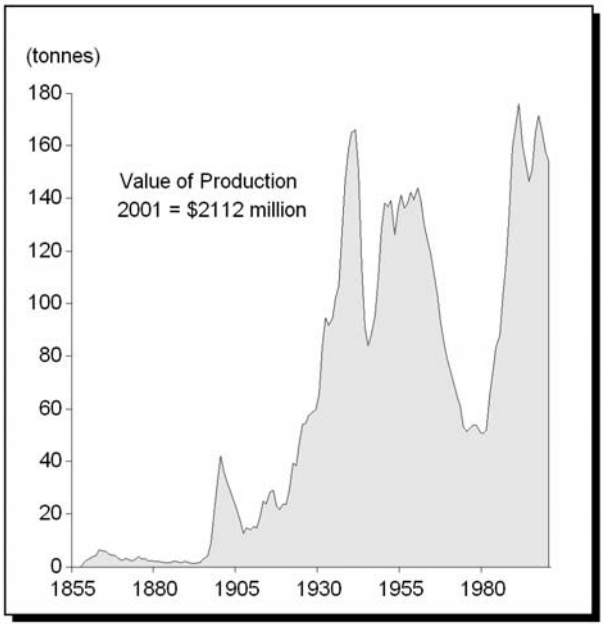
Canada's gold production is currently at close to record-high levels. When the gold price increased rapidly at the end of the 1970s, both reserves of gold in ore and gold production increased rapidly. Reserves have declined somewhat as gold prices have declined. The future of gold mining in Canada depends on higher gold prices, new discoveries, and the development of new gold mines. Gold prices generally rose throughout 2002 and 2003, resulting in increased exploration for gold.

Uranium

In 2001, Canada's uranium production totaled 12 992 t (preliminary), an all-time record production. Uranium production for 2001 is not shown in Figure 31 because the available total is only a preliminary estimate. If demand should exist, Canada's uranium output could increase from current levels and be maintained at higher levels for many years.

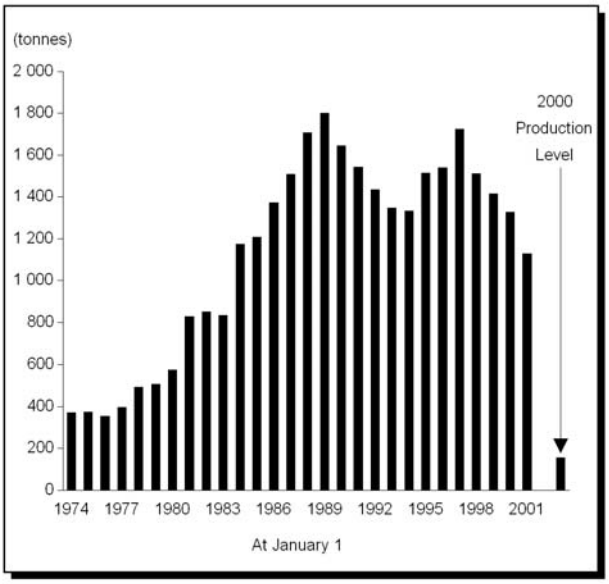
Canada's uranium resources are compiled and graphed, not uranium reserves, because the world's nuclear power producers want to know how much uranium will be available at prices they could afford to pay if they had to, rather than how much is available at current prices. Canada's uranium resources are high at present.

Figure 29
Gold Production, 1858-2000



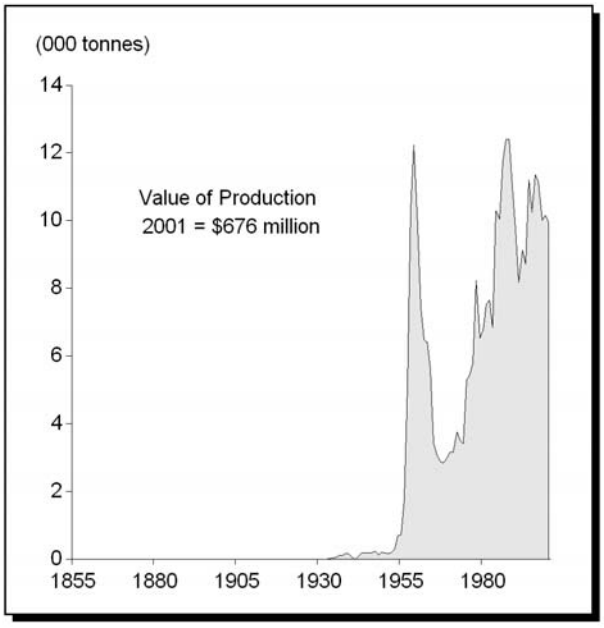
Source: Natural Resources Canada.

Figure 30
Gold Contained in Mineable Ore, 1974-2001



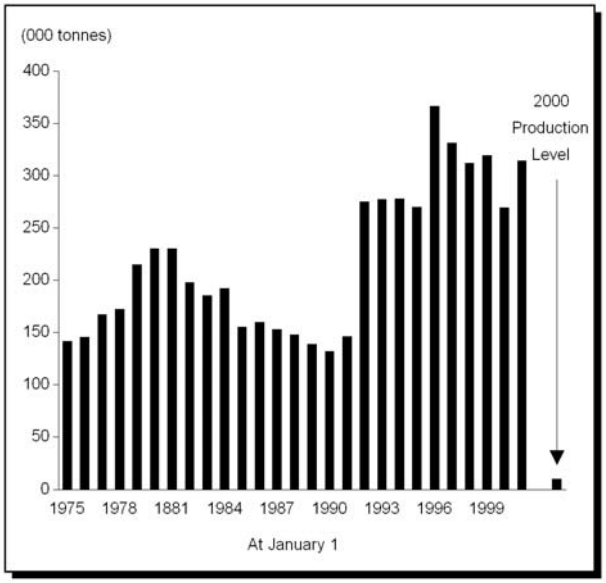
Source: Natural Resources Canada.

Figure 31
Uranium Production, 1933-2000



Source: Natural Resources Canada.

Figure 32
Measured and Indicated Uranium Resources



Source: Natural Resources Canada.
Notes: Resources recoverable at prices up to $100/kg of uranium. Prices are not adjusted for inflation. Prices used for 1975-83 varied from year to year.

Platinum Group Metals

Recently increased production from the Raglan Nickel Belt and from the North American Palladium mine will yield record production of platinum group metals. Such production can be sustained for 25 years or longer, although output from the North American Palladium operation could be affected by periods of low palladium prices.

Canada's reserves of platinum group metals are not compiled.

Cobalt

Production of cobalt from the new Voisey's Bay mine, together with recently increased production from the Raglan Nickel Belt, will yield record levels of Canadian cobalt production that can be sustained for longer than 25 years. Canada's reserves of cobalt are not compiled.

Iron Ore

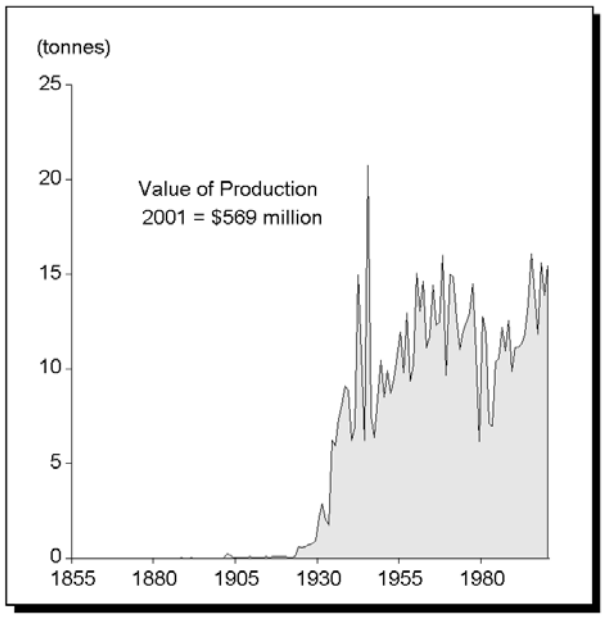
The peak in Canadian iron ore production over the period from the 1960s to early 1980s included production from the former Wabana mine in Newfoundland (where resources still exist but of material that no longer meets current grade and phosphorous content requirements) and from a number of other smaller mines in Quebec, Ontario and British Columbia at which ore reserves have been mined out.

Canada's current iron ore production is now entirely from the Labrador Trough (from two large mines in Labrador and one in Quebec). Iron ore reserves, resources and available production capacity are adequate to support higher than current production for many years to come.

Coal, Potash, Salt, Asbestos, Gypsum and Peat Moss

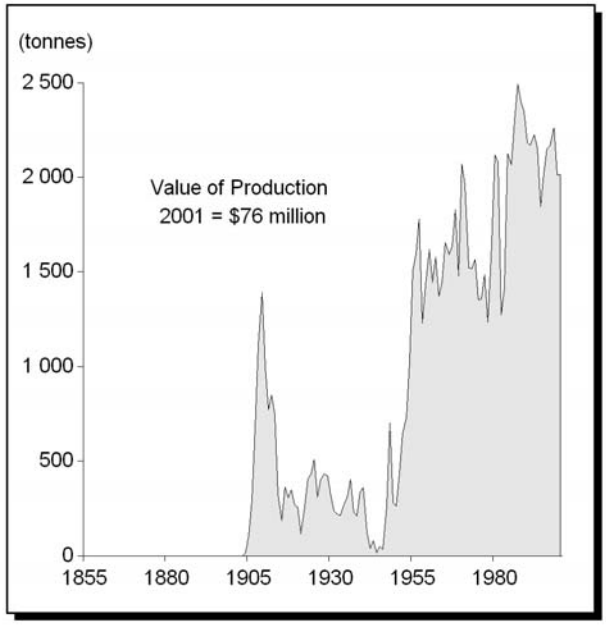
Figures 36 to 41 depict historical Canadian production of coal, potash, salt, asbestos, gypsum and peat moss. With the exception of asbestos, production of these mineral commodities has been increasing over the past several decades and is at or close to record production levels. Canada's undeveloped resources of all these mineral commodities is adequate to support much higher production levels. The sharp decline in Canadian asbestos production is related more to restrictions on the use of asbestos and the resultant declining markets. Canada has known, undeveloped asbestos deposits of grades comparable to those that have been mined and could produce more asbestos if market demand existed.

Figure 33
Platinum Group Metals Production, 1887-2000



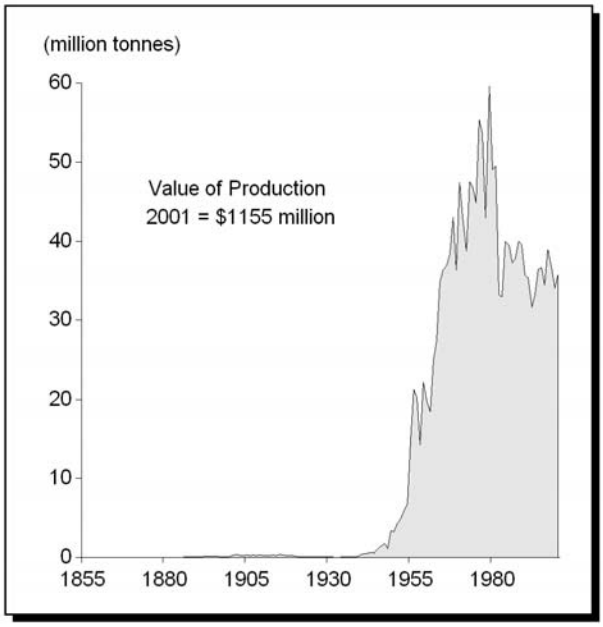
Source: Natural Resources Canada.

Figure 34
Cobalt Production, 1904-2000



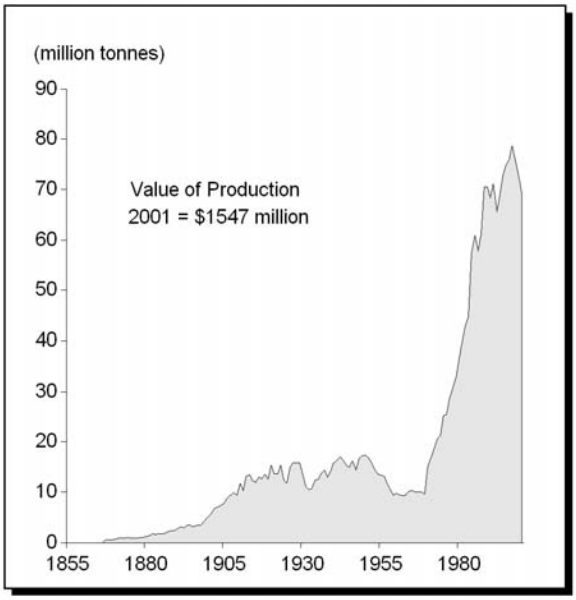
Source: Natural Resources Canada.

Figure 35
Iron Ore Production, 1886-2000



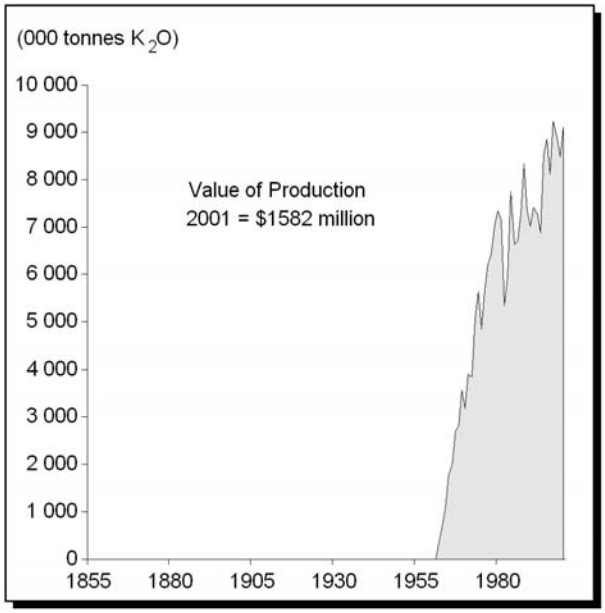
Source: Natural Resources Canada.
Note: Does not include about 50 Mt mined in Newfoundland between 1893 and 1949 before Newfoundland joined Canada.

Figure 36
Coal Production, 1867-2000



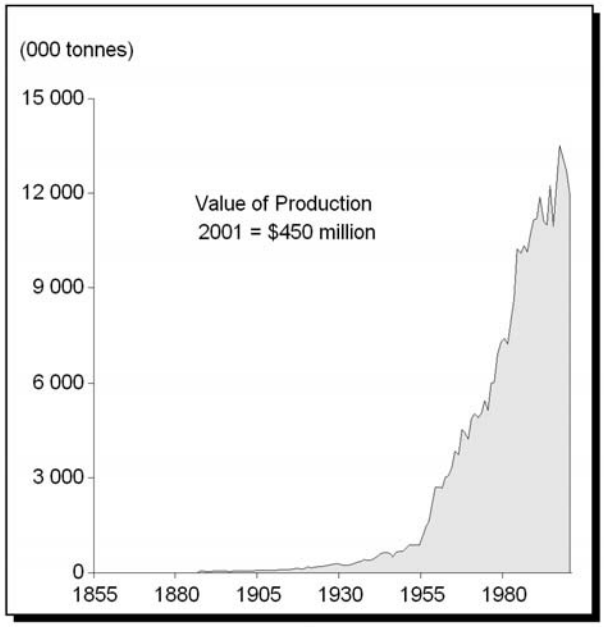
Source: Natural Resources Canada.
Note: Canada produced a cumulative total of 2.6 Mt of coal from 1785 to 1866.

Figure 37
Potash Production, 1858-2000



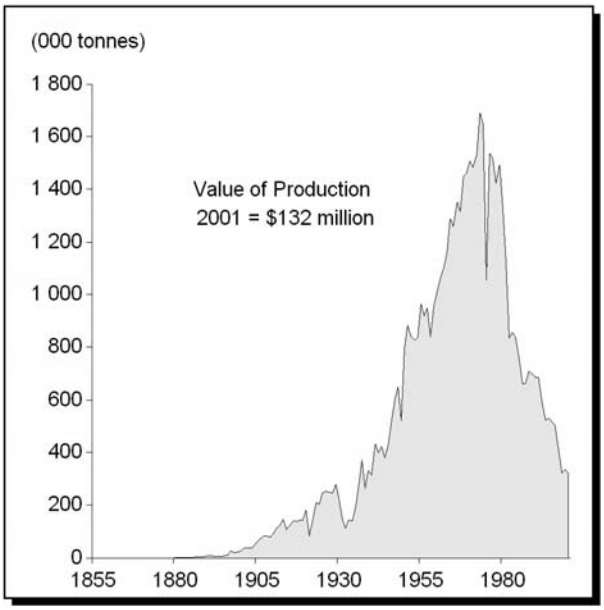
Source: Natural Resources Canada.
Note: The graph does not show the minor production from one mine in 1958 and 1959.

Figure 38
Salt Production, 1886-2000



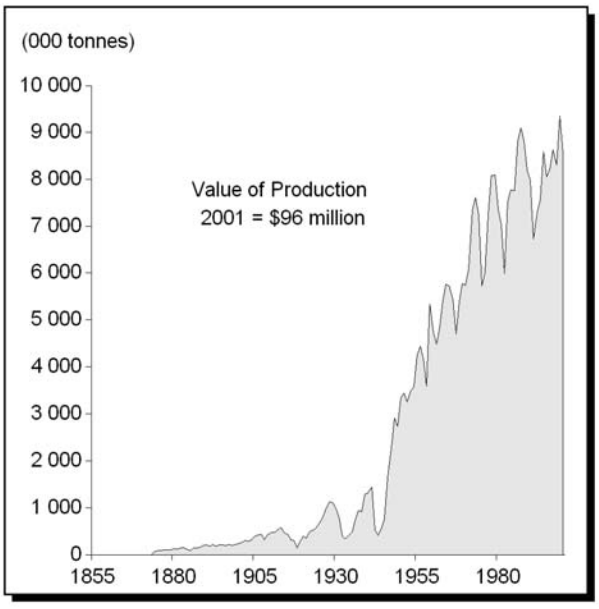
Source: Natural Resources Canada.

Figure 39
Asbestos Production, 1880-2000



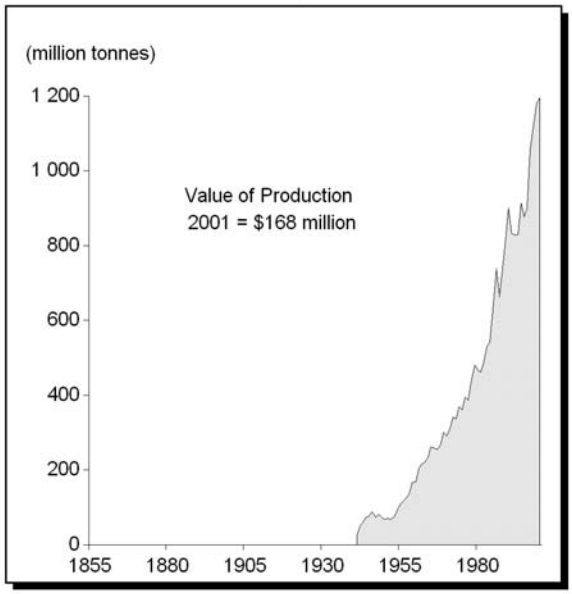
Source: Natural Resources Canada.

Figure 40
Gypsum Production, 1874-2000



Source: Natural Resources Canada.

Figure 41
Peat Moss Production, 1941-2000



Source: Natural Resources Canada.
Note: This graph does not include a cumulative total of about 40 000 t of peat fuel produced between 1900 and 1955.

SUMMARY, DISCUSSION AND CONCLUSIONS

In most of Canada's provinces and territories, provided mineral commodity prices are not too low over prolonged periods, the outlook for continuation of the mining industry over the next 25 years is reasonably good. But a continuous supply of new discoveries and new mines will be needed during those 25 years and beyond to sustain the mining industry.

Mineral commodity prices are set on world markets. Canada has little influence on, or control of, those prices, so there is little that can be done to avert temporary or permanent mine closures that result from periods of low prices.

Major problem areas for metal mining in the near future appear to be the Bathurst region of New Brunswick, the Abitibi region of Quebec, British Columbia metal mining in general (especially the porphyry-type deposits of copper, molybdenum and gold in the province), the Yukon, and Nunavut.

In New Brunswick, a total of 42 massive sulphide deposits have been discovered in the Bathurst region over the past 50 years. Massive sulphide discoveries continue to be made; the latest, the Mount Fronsac deposit discovered in 2001 (1.2 Mt averaging 7.65% zinc, 2.18% lead, 0.14%

copper, 40.3 g/t silver and 0.40 g/t gold) is too small to be viable. There is still hope for additional ore discoveries in the Bathurst region, so it is important that exploration continue there.

In Quebec's Abitibi region, without new ore discoveries, mining will soon begin to decline. However, over the past 15 years, a dozen mineable orebodies have been discovered there. It seems reasonable to expect that new orebodies will continue to be discovered. Higher levels of exploration will be required to ensure that a sufficient number of discoveries are made to maintain the Abitibi region's mining industry.

Several proposed new mines and mine re-openings in the Abitibi region, which are not shown in Figure 18 because future production from them does not seem certain, may yet help to maintain production from the region. These include Casa Berardi (gold), Copper Rand (copper-gold), East Amphi (gold), Corner Bay (copper), and a possible resumption of production at the former Kiena gold mine.

In British Columbia, most of the low-grade porphyry-type deposits being mined in the province have difficulty competing with higher-grade orebodies elsewhere in the world. The discovery of other higher-grade metal deposit types in British Columbia is essential.

In the Yukon, mining of placer gold is now the only remaining metal mining activity. Without adequate exploration, metal mining in the Yukon will eventually come to an end. In Nunavut, closure in 2002 of the Polaris and Nanisivik mines and the closure in 2003 of the Lupin gold mine left Nunavut with no mines. Several promising gold deposits have been discovered in Nunavut in recent years. Hopefully, some of these will be developed for production, with the Hope Bay project most likely to produce soon. Increased exploration will be needed to ensure the future of metal mining in Nunavut.

Except for the possible effects of current low metal prices, the future of the mining industry in Canada's other provinces and territories appears reasonably secure over at least the next 25 years. As always, mines will continue to have their ore reserves depleted and will close as those reserves are depleted. To have a mining industry that continues after 25 years will require a continuing flow of new mineral discoveries and the development of new mines. To make these new mineral discoveries, mineral exploration expenditures at historical or higher levels will be required.

From 1997 to 2001, exploration expenditures in Canada were significantly lower than the inflation-adjusted average expenditures of the previous 30 years. While there has been a modest recovery in 2002 and 2003, exploration levels are still low relative to the long-term historical expenditures.

Discovering orebodies in Canada is becoming increasingly more expensive (in inflation-adjusted terms). Therefore, exploration expenditures in Canada (as well as in most other countries where discovery costs are also getting higher) need to be higher, not lower, than long-term historical expenditures. Both in inflation-adjusted dollar terms and as a percentage of Canada's mineral production value, exploration expenditures have been declining. There are several reasons for the recent decline in exploration expenditures in Canada:

- The many large, highly attractive mineral deposit discoveries made elsewhere in the world in recent years have diverted exploration funds from Canada.
- With most metal prices low, most metal-producing companies have had to cut back on exploration.
- With metal prices low, it has been difficult for junior exploration companies to raise the exploration funding they need.
- Mining company mergers and takeovers have removed exploration participants. The newly formed companies are invariably spending less on exploration than the previously separate companies were.

Another factor that must be taken into account in determining the levels of exploration expenditures needed to sustain the Canadian mining industry is that when metal prices are low, only the very best of the deposits discovered will be economically viable. This means that higher-than-normal levels of exploration will be needed to ensure that we find the orebodies needed to maintain Canada's ore reserves and current production levels of metals.

In only a few years, without new discoveries and the development of new mines, Canada's production of copper, zinc, lead, molybdenum and silver will decline sharply. The production of lead and molybdenum may even cease completely. Declining production of copper, zinc and lead concentrates will leave existing copper smelters in Quebec and Ontario, a lead smelter in New Brunswick, a copper refinery in Montréal, and zinc refineries in Quebec and Ontario partially or completely dependent on imported metal concentrates. Under such conditions, more of these facilities are likely to follow the Gaspé copper smelter in closing their operations.

Notes: Information in this review was current as of May 2003. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/2002cmy_e.htm.

NOTE TO READERS