

# Foreword

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**T**he Minerals and Metals Sector is the focus of federal expertise for mineral and metal commodity information. Within the Sector, the Mineral and Metal Policy Branch acts as the federal government's main source of in-depth knowledge, intelligence and expertise on mineral and metal commodity markets. One of its tasks is to forecast metal and mineral demand, supply and price.

Within the Branch, the Nonferrous Division is responsible for the major base metals, the precious metals, certain associated minor by-products, and the secondary materials such as scrap.

The commodity specialists of the Nonferrous Division maintain close contacts with industry on a wide range of topics and issues. This year-end publication represents a more formal means to disseminate metal market developments through the first three quarters of the year and provides forecasts to the year 2005. We would appreciate your feedback and encourage you to contact the commodity specialists directly with your comments by telephone, facsimile or electronic mail (numbers and e-mail addresses are provided at the beginning of each chapter). You can also provide feedback to the coordinator of this publication, Patrick Chevalier, at tel. (613) 992-4401, fax (613) 943-8450, or e-mail [pcheval@nrcan.gc.ca](mailto:pcheval@nrcan.gc.ca).

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## NOTE TO READER

This Outlook has been prepared based on information available to Natural Resources Canada (NRCan) at the time of writing. The authors and NRCan make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

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# Introduction

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**T**his outlook for the major nonferrous metals was prepared by staff of the Nonferrous Division in early December 1998 and reflects the market conditions and expectations at that time.

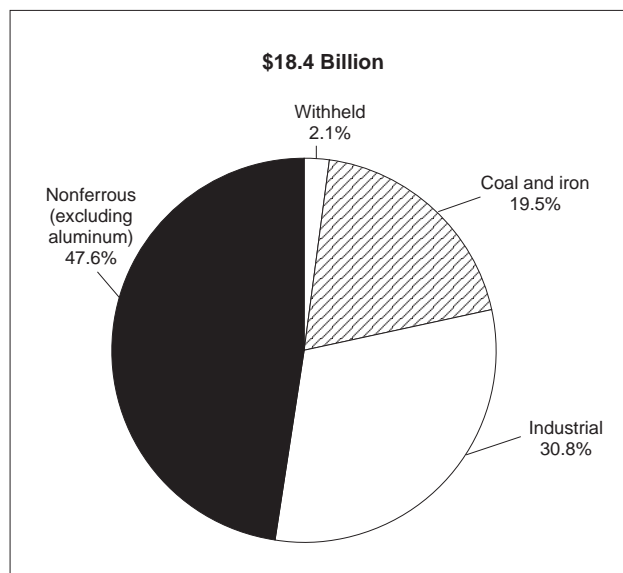
Canada's overall Gross Domestic Product (GDP) increased by 3.9% in 1997, up strongly from the 1.6% growth registered in 1996. The mineral industry accounted for 3.8%, or \$26.2 billion, of Canadian GDP, up by 4.1% from the previous year.

Mineral exports continued to perform well although, in the later stages of 1997, falling prices for most minerals and metals had a negative effect on Canadian producers and the value of their exports. Nevertheless, exports of minerals and mineral products increased 5.4% to \$72.8 billion, resulting in a trade surplus for

these products of \$7.4 billion. With a significant amount of Canadian nonferrous metals exports destined for the United States, the continued strong growth in U.S. markets has translated into strong demand for Canadian nonferrous metals and their products. One concern for the export sector is the continued weak economic situation in Japan and South-east Asia where weak markets and sinking currencies are hindering Canada's exports (especially for exports of raw materials such as lumber and aluminum).

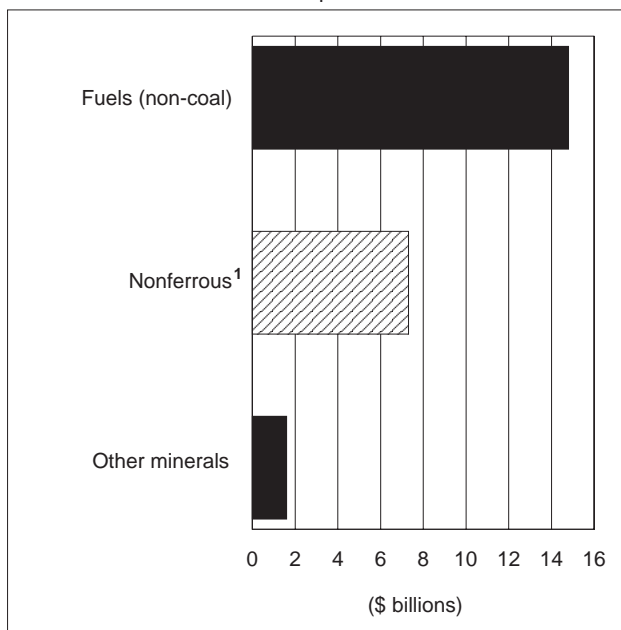
In the first six months of 1998, GDP grew by an annualized 3.0%. Slower growth in the United States and the effects of the weakness in Asian markets are expected to have a dampening effect on Canadian exports and cause growth to moderate during the latter part of 1998 and into 1999. Despite these moderating effects, Canada's economy is expected to finish the year with an average growth of just under 3.0%. Government fiscal policies aimed at reducing deficits

**Figure 1**  
1997 Canadian Mine Production



Source: Natural Resources Canada.

**Figure 2**  
1997 Net Export Earnings  
Mineral Commodities = \$21.1 Billion



Source: Natural Resources Canada.

<sup>1</sup> Includes aluminum.

and debt, and monetary policies aimed at keeping inflation under control, have contributed to this environment and provide a sound basis for continued strong growth in Canada.

The mining industry remains a vital contributor to the Canadian economy. In 1997, the mining and mineral processing industries directly employed some 368 000 Canadians. Of these, 64 400 were employed in mining, 59 100 in smelting and refining, and nearly 245 000 in the manufacture of mineral and metal products.

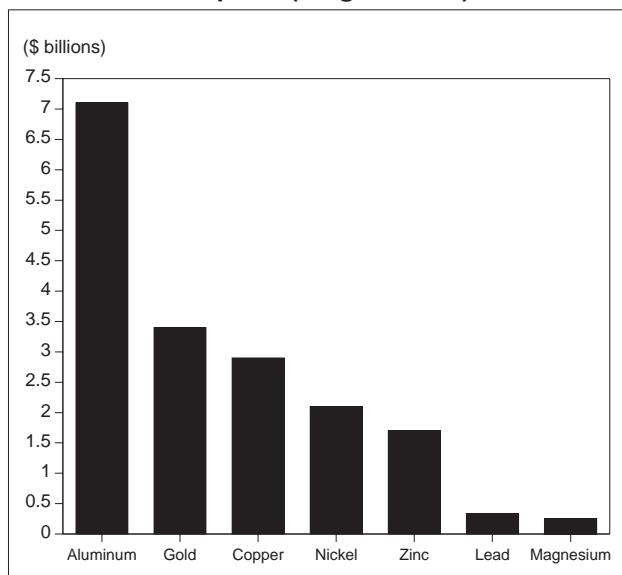
Nonferrous metals are the second most important sector in terms of value of Canadian mineral production after non-coal fuels (crude oil, natural gas and uranium). With a total value of \$8.8 billion in 1997, nonferrous metals (excluding aluminum, which is not mined in Canada) accounted for 51% of the value of non-fuel mineral production. When aluminum production is added, the value of Canada's nonferrous metal production increases to an estimated \$13.9 billion.

In 1997, nonferrous metals generated a net trade surplus equivalent to about 50% of that for mineral fuels (excluding coal). Canada's overall merchandise export surplus was due in large part to the net surplus generated by the Canadian mining industry. Non-coal fuel minerals generated a net surplus of \$14.8 billion. Nonferrous metals (including scrap), with exports of \$20.7 billion and imports of \$13.4 billion, generated a net Canadian trade surplus of \$7.3 billion. Other mineral products generated a combined net trade surplus of \$1.6 billion.

Nonferrous and precious metals (aluminum, copper, gold, nickel and zinc) are reviewed in the following pages. Trade tables covering the period 1996-98 follow these commodity reviews.

We would appreciate your feedback, and encourage you to contact the commodity specialists directly with your comments by telephone, facsimile or electronic mail.

**Figure 3**  
**1997 Value of Exports (Stages I to IV)**



Source: Natural Resources Canada.

# Aluminum

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1997 metal production: \$5.2 billion<sup>e</sup>  
 World rank: Third  
 Exports (unwrought): \$7.1 billion  
 Installed capacity: 2.320 Mt/y

| Canada       | 1997  | 1998 <sup>e</sup> | 1999 <sup>f</sup> |
|--------------|-------|-------------------|-------------------|
| (000 tonnes) |       |                   |                   |
| Production   | 2 327 | 2 360             | 2 360             |
| Consumption  | 642   | 700               | 720               |

<sup>e</sup> Estimated; <sup>f</sup> Forecast.

**A**luminum, in both its pure and alloyed form, is used to make a wide variety of products for the consumer and capital goods markets. Aluminum's largest markets are transportation (29%), packaging (23%), building and construction (19%), electrical (8%), machinery and equipment (8%), and consumer goods (6%). North America is the largest consuming region in the world, accounting for 33% of total Western World demand. Europe accounts for another 30% and Asia accounts for 27%.

## ANNUAL AVERAGE SETTLEMENT PRICES, LONDON METAL EXCHANGE

| 1994     | 1995  | 1996  | 1997  | 1998 <sup>e</sup> |
|----------|-------|-------|-------|-------------------|
| (US\$/t) |       |       |       |                   |
| 1 477    | 1 806 | 1 506 | 1 599 | 1 360             |

<sup>e</sup> Estimated.

## CANADIAN OVERVIEW

- In March, Alcan started construction of a new \$2.2 billion smelter at Alma, Quebec, to replace the Isle-Maligne smelter. When completed, the smelter will have an annual capacity of 375 000 t of primary aluminum produced with 620 MW of hydro-electric power. The Alma smelter is expected to start producing metal in the fall of 2000.
- In November, Alcan announced that it had signed a 10-year aluminum supply agreement with U.S.-based auto-maker General Motors for the integrated use of aluminum in automobile components and structures, including the development of more fuel-efficient vehicles.
- U.S. aluminum producer Alcoa returned to Canada in 1998 with its acquisition of Alumax. Alcoa now owns the 230 000-t/y Lauralco smelter and a 25% interest in the 372 000-t/y Aluminerie de Bécancour smelter.
- In February, Reynolds announced that it had completed the sale of its Canadian aluminum extrusion plants in Richmond Hill, Ontario, and Sainte-Thérèse, Quebec, to Tredegar Industries. The plants manufacture aluminum products used primarily in the construction, transportation, electrical, machinery and equipment, consumer durables, and climbing equipment markets.

## WORLD OVERVIEW

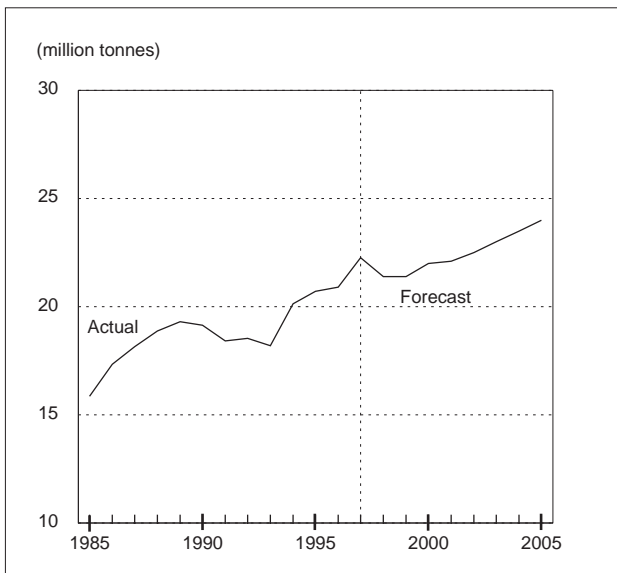
- In May, Billiton Plc, Mitsubishi Corporation and the Industrial Development Corporation of South Africa Ltd. announced the go-ahead of the 250 000-t/y Mozal smelter project near Maputo, Mozambique. The US\$1.3 billion smelter is expected to be commissioned in early 2001.
- In March, Alcoa announced that it was acquiring Alumax. The deal was finalized in July. In November, Alcoa reduced primary aluminum production at Eastalco Works in Frederick, Maryland, by 30 000 t/y. Alcoa is the world's largest producer of aluminum and alumina with 250 operating locations in 30 countries.

- Norsk Hydro of Norway announced that it had entered into a project agreement with the Government of Trinidad and Tobago to work towards the construction of a 474 000-t/y smelter in Trinidad and Tobago. The US\$1.5 billion project is expected to be built in two stages on Trinidad's west coast at Point Lisas. The first phase is planned for 2002 and will have a production capacity of 237 000 t/y, while the second phase is to be built at a later date.
- Nordurál's new 60 000-t/y smelter in Grundartangi, Iceland, began producing aluminum in June.

## CONSUMPTION OUTLOOK

Total world consumption of primary aluminum is expected to be an estimated 21.4 Mt in 1998, which is less than 1% higher than the 22.2 Mt recorded in 1997. Western World demand is also expected to increase by less than 1% to 18.7 Mt in 1998. In 1999, demand for primary aluminum is forecast to be 0.5% higher in the United States, 0.8% lower in Europe and 3.5% lower in Japan. Total world demand for aluminum is expected to stay about the same as in 1998. In the longer term, annual growth of 2-3% is forecast for the early part of the next decade. The transportation and packaging (in particular, beverage can) markets are expected to lead the increase in demand for aluminum to the year 2005. Canadian consumption in 1998 is expected to remain strong at about 700 000 t.

**Figure 1**  
World Aluminum Consumption, 1985-2005



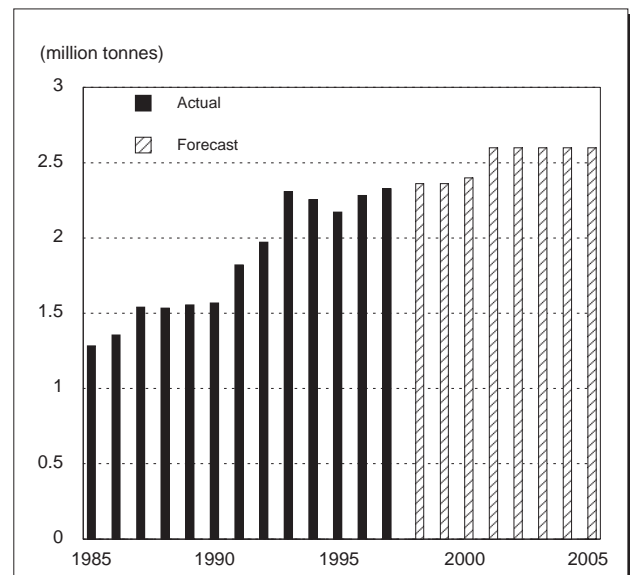
Source: Natural Resources Canada.

## CANADIAN AND WORLD PRODUCTION OUTLOOK

Canada is forecast to produce about 2.360 Mt of primary aluminum in 1998. Canada produced 2.327 Mt in 1997 valued at an estimated \$5.2 billion, ranking it third after the United States and Russia. Canadian aluminum production capacity increased substantially during the latter half of the 1980s. Its production capacity is forecast to increase to over 2.6 Mt in 2000 with the completion of Alcan's Alma smelter. Other smelter expansion projects in Quebec (at Alouette, A.B.I. and Lauralco) are dependent on the negotiation of new long-term power supply contracts with Hydro-Québec. Other companies, including U.S.-based Alcoa, are exploring the possibility of new greenfield expansions in British Columbia.

World production of aluminum is expected to increase to 22.0 Mt in 1998 from 21.8 Mt in 1997. Western World production will increase to 16.3 Mt, up from 16.2 Mt in 1997. Aluminum production in 1999 is expected to be about 3.4 Mt in the United States, 3.8 Mt in Western Europe, and 2.9 Mt in Russia.

**Figure 2**  
Canadian Primary Aluminum Production, 1985-2005



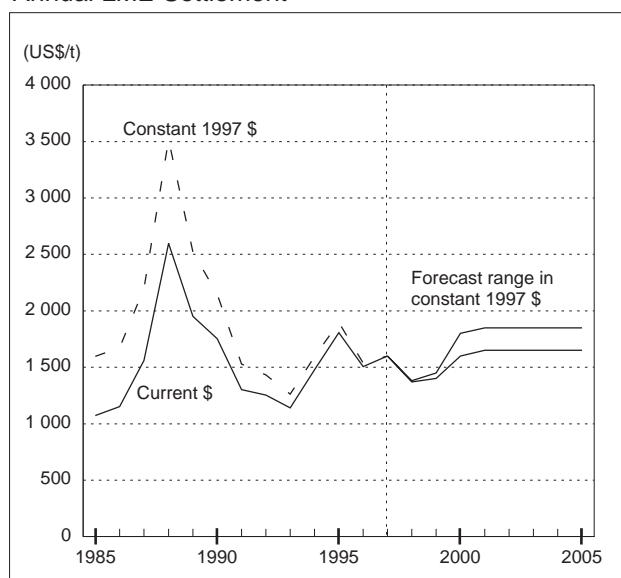
Source: Natural Resources Canada.

## PRICE OUTLOOK

Cash settlement London Metal Exchange (LME) prices started the year at or below US\$1500/t (68¢/lb) and continued in a steady decline to a low of \$1261/t in July, rising to \$1395/t in August, only to resume

the overall yearly downward trend in the fourth quarter for a year-to-date average of \$1365/t (62¢/lb) by the end of November. LME inventories, which began the year at about 624 000 t, maintained a steady decline through to May, followed by a slight increase that in turn was followed by another steady decline to reach 452 000 t in September. Stocks continued to rise throughout the third quarter to peak at about 565 000 t by the end of November. Prices are expected to remain at or below the \$1300/t range for the remainder of 1998. For 1999, prices are forecast to average between US\$1350 and \$1400/t. In the longer term, prices are expected to average between US\$1650 and \$1850/t (75¢ and 85¢/lb) in constant 1997 dollars.

**Figure 3**  
**Aluminum Prices, 1985-2005**  
 Annual LME Settlement



Source: Natural Resources Canada.





# Copper

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1997 production: \$2.1 billion  
 World rank: Fourth  
 Exports (concentrate and unwrought): \$1.77 billion

| Canada                    | 1997         | 1998 <sup>e</sup> | 1999 <sup>f</sup> |
|---------------------------|--------------|-------------------|-------------------|
|                           | (000 tonnes) |                   |                   |
| Copper mine production    | 658          | 700               | 700               |
| Refined copper production | 560          | 566               | 598               |
| Refined consumption       | 225          | 243               | 250               |

<sup>e</sup> Estimated; <sup>f</sup> Forecast.

Copper's properties, particularly its high electrical and thermal conductivity, good tensile strength, elevated melting point, non-magnetic properties, and resistance to corrosion, make it and its alloys very attractive for electrical transmission, water tubing, castings and heat exchangers. Copper is the most efficient conductor of electrical power, signals and heat of all the industrial metals. In Canada, more than half of the refined copper consumed annually is used for electrical applications, mostly as wire.

## ANNUAL AVERAGE SETTLEMENT PRICES, LONDON METAL EXCHANGE

| 1994     | 1995  | 1996  | 1997  | 1998 <sup>e</sup> |
|----------|-------|-------|-------|-------------------|
| (US\$/t) |       |       |       |                   |
| 2 307    | 2 930 | 2 294 | 2 276 | 1 660             |

<sup>e</sup> Estimated.

## CANADIAN OVERVIEW

- Canadian mine production of copper increased in 1998 due to the start-up of several new mines in 1997 and 1998, including the Huckleberry, Mount Polley and Kemess mines in British Columbia and the Raglan mine in Quebec.
- In October 1998, Royal Oak Mines Inc. announced that its Kemess gold-copper mine in north-central British Columbia had reached commercial production. Royal Oak began construction of the Kemess facilities in July 1996 and started limited production in the concentrator on May 19, 1998. The Kemess mine is expected to produce an average of approximately 7800 kg/y of gold and 27 000 t/y of copper over a mine life of approximately 16 years.
- Boliden Westmin Limited announced that it would suspend operations at its Gibraltar mine in December 1998. Boliden acquired the operation in early 1998 when it completed the takeover of Westmin Resources Limited. The company stated that its decision to close the mine was based on low ore grades and low copper prices.
- Boliden announced in November 1998 that it would temporarily suspend production at its Myra Falls operation in mid-December in order to address challenging ground conditions in the Battle Zone of the mine. The company expects that full production will resume by April 1, 1999.
- HBMS is proceeding with the development of its Konuto Lake deposit, located 20 km west of Flin Flon, Manitoba. The project, which is expected to begin commercial operations in the first quarter of 1999, will produce about 10 000 t/y of copper in concentrate plus zinc. The mine is expected to operate for approximately six years. HBMS is also proceeding with a feasibility study on its Triple Seven deposit, which is adjacent to the company's Callinan mine in Flin Flon. The deposit contains a preliminary reserve estimate of 13.4 Mt grading 5.8% zinc and 3.3% copper, plus gold and silver.

## WORLD OVERVIEW

- In 1998, world mine production of copper is forecast to increase to 12.0 Mt from about 11.5 Mt in 1997. World production of refined copper is expected to increase to 13.8 Mt in 1998 from less than 13.6 Mt in 1997, while world refined copper consumption is expected to increase to almost 13.4 Mt from 13.1 Mt in 1997.
- As a result of the economic downturn in Southeast Asia and rising copper output, copper prices weakened in the second half of 1997 and remained depressed throughout 1998. The average copper price on the London Metal Exchange (LME) in 1998 to mid-December was US\$1664/t (75.5¢/lb). The average LME copper price in 1997 was US\$2276/t (103.2¢/lb).
- At the time of writing, it was expected that smelting and refining charges for 1999 contracts would be set in the range of US\$65-\$70/dry metric tonne (dmt) and 6.5¢-7.0¢/lb. Contract prices for the first half of 1998 were set at roughly US\$100/dmt and 10¢/lb, declining to US\$85/dmt and 8.5¢/lb in the second half of the year.

## MARKET OUTLOOK

Copper consumption growth in Europe and the United States, which was very strong during 1998, is expected to slow somewhat during 1999. Although consumption in China is expected to experience relatively strong growth in 1999, demand throughout much of the rest of Southeast Asia will remain depressed. This region experienced a significant decline in copper consumption in 1998.

Without significant further cutbacks of copper output, it is expected that there will be a world copper supply surplus of between 250 000 and 350 000 t in 1999.

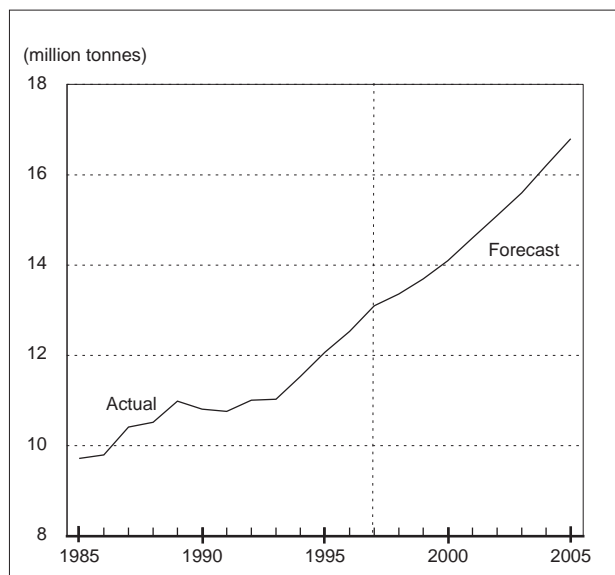
For the period 2000-2005, copper consumption is expected to grow at an annual average rate of about 3.5%. The largest increases in copper consumption will occur in the construction, transportation, and electrical and electronics industries. China and India are expected to account for a significant portion of this growth.

A number of promising new markets for copper could provide significant growth opportunities. These include certain roofing applications, fire suppression systems, natural gas systems, solar power generation, data communications, and the storage of spent nuclear fuel.

While aluminum has largely replaced copper in original-equipment automotive radiators, new fabrication techniques such as no-flux brazing could allow

copper to regain a significant share of this important market. In addition, the expected increase in the number of electrical circuits in automobiles could provide a significant boost for copper demand. In recent years, there has been a noticeable increase in the intensity of copper use in residential applications in North America. Part of this change is attributable to the construction of larger houses and the growth of home-based offices.

**Figure 1**  
World Copper Consumption, 1985-2005



Source: Natural Resources Canada.

## CANADIAN PRODUCTION OUTLOOK

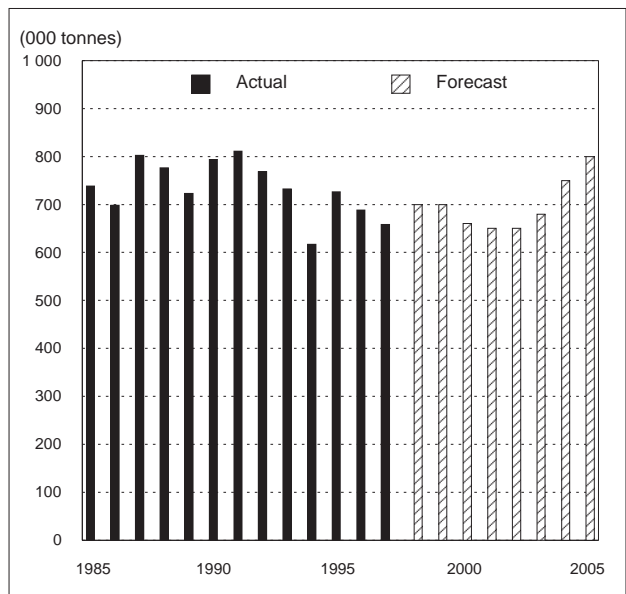
Depressed market conditions for the various nonferrous metals have resulted in the deferral of a number of exploration and development projects in Canada.

While Canadian copper mine production should remain constant or increase slightly in 1999, it is expected that there will be a slight decline in copper mine output beginning in 2000 as closures and cutbacks outweigh the effects from the start-up of a limited number of possible new operations, including the Kudz Ze Kayah and Minto projects in the Yukon and Tulsequah Chief in British Columbia.

The reduced output will largely result from the closure of Noranda's Gaspé and Heath Steele operations and reduced output at Inco's Canadian operations.

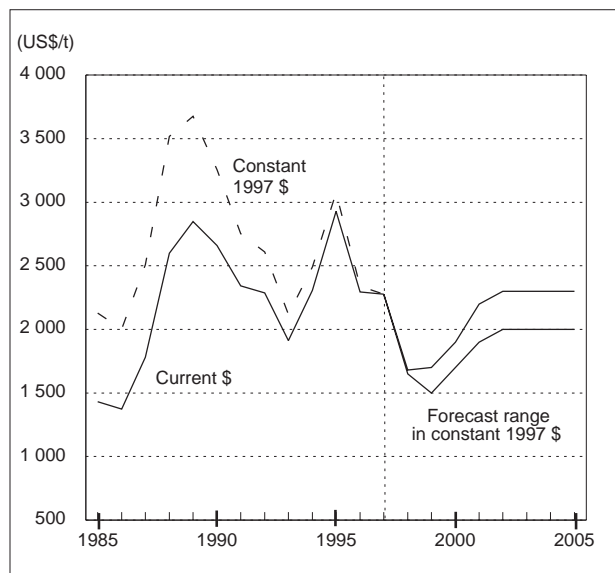
In the longer term, Canadian copper mine production should recover to annual output levels in excess of 800 000 t. Possible new projects include the Casino, Fyre Lake, and Wolverine prospects in the Yukon; Red Chris and Prosperity in British Columbia; Triple Seven in Manitoba; and the Voisey's Bay project in Labrador.

**Figure 2**  
Canadian Mine Production of Copper, 1985-2005



Source: Natural Resources Canada.

**Figure 3**  
Copper Prices, 1985-2005  
Annual LME Settlement



Source: Natural Resources Canada.

## PRICE OUTLOOK

While copper consumption is forecast to experience growth of about 2.5% in 1999, it is expected that further increases in world copper mine production capacity, particularly in South America and Australia, will continue to exert downward pressure on prices. An improvement in copper prices can be expected in 2000 when the growth of world production capacity is forecast to slow and demand for copper in Southeast Asia improves.

In 1999, copper is expected to trade within a range between US\$1500 and \$1700/t (US66¢ and 77¢/lb). For the first half of the next decade, copper prices are expected to trade in a range between US\$2000 and \$2300/t (US\$0.91 and \$1.04/lb) in constant 1997 dollars.



# Gold

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1997 mine production: \$2.5 billion  
 World rank: Fourth  
 Exports: \$3.5 billion  
 (includes exports from  
 Bank of Canada gold sales)

| Canada     | 1997         | 1998 <sup>e</sup> | 1999 <sup>f</sup> |
|------------|--------------|-------------------|-------------------|
|            | (000 tonnes) |                   |                   |
| Production | 168          | 165               | 160               |

<sup>e</sup> Estimated; <sup>f</sup> Forecast.

**G**old is valued for its rarity, lustrous beauty, ductility, high resistance to corrosion, and conductivity. It has been treasured for its decorative and monetary value for at least 8000 years. Gold has a high density, its weight being equal to 19.3 times an equivalent volume of water. The main industrial uses for gold are in jewellery (85%) and electronics (6%). Gold bullion coins, such as the Maple Leaf coin, are also important products.

## ANNUAL AVERAGE PRICES, LONDON BULLION MARKET ASSOCIATION

| 1994      | 1995 | 1996 | 1997 | 1998 <sup>e</sup> |
|-----------|------|------|------|-------------------|
| (US\$/oz) |      |      |      |                   |
| 383       | 384  | 388  | 331  | 295               |

<sup>e</sup> Estimated.

## CANADIAN OVERVIEW

- Royal Oak Mines Inc. commissioned the Kemess South project (6.6 t/y) in British Columbia in 1998.
- In Manitoba, the Bissett Gold mine (2.6 t/y) was re-opened in August 1998 by Harmony Gold.
- Claude Resources re-opened the old Madsen mine (1.5 t/y) in the Red Lake region.
- The Casa Berardi mine in Quebec was purchased by Aurizon Mines. Once the exploration program is completed, Aurizon will conduct a feasibility study to determine if the mine should be re-opened.

## WORLD OVERVIEW

- The world's production of gold over the next two years is expected to remain stable.
- By the year 2000, total production from the world's top five gold producers is likely to show a 100-t decrease. South Africa's production is expected to decrease by 20 t to 470 t/y, while the combined gold production of the United States, Australia and Canada will likely show an 80-t decrease. China's gold production should remain stable.
- Through to the end of the decade, important production increases are expected to come from emerging producing countries such as Indonesia, Peru, Papua New Guinea and Chile.

## MARKET OUTLOOK

Total world fabrication demand for gold in 1998 is expected to fall by around 5% to 3150 t. World gold fabrication is particularly affected by the poor demand in Asian countries, notably the Republic of Korea, China, Taiwan and Japan.

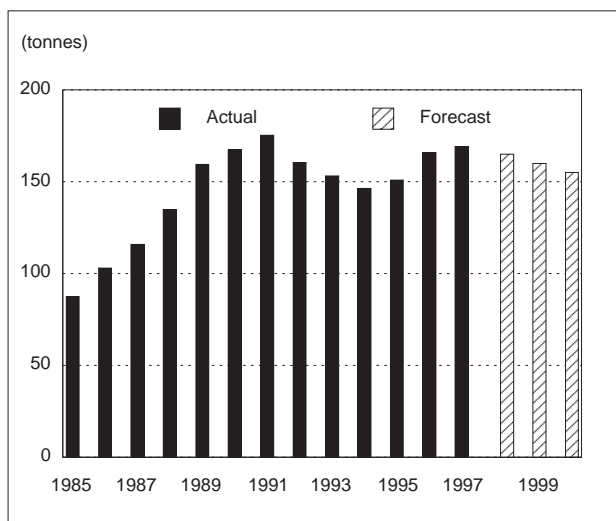
However, the downward trend in world fabrication demand in 1998 was dampened by the consumption increase in India. India, which was the world's largest gold consumer in 1997 with 737 t, is expected to have its consumption rate grow by around 20% in 1998.

Finally, the possibility that the Swiss National Bank may start selling 1200 t of gold by the year 2000, and the uncertainty surrounding the role of gold in view of the newly created European Central Bank, continue to generate a negative sentiment for the gold market.

## CANADIAN PRODUCTION OUTLOOK

Canadian gold production peaked at 176.6 t in 1991, declined to 145.5 t in 1994, and then increased to 168 t in 1997. As a result of several gold mine closures due to the depletion of ore reserves or the low gold price, Canadian gold production is expected to decrease to around 155 t/y by the year 2000.

**Figure 1**  
Canadian Gold Production, 1985-2000

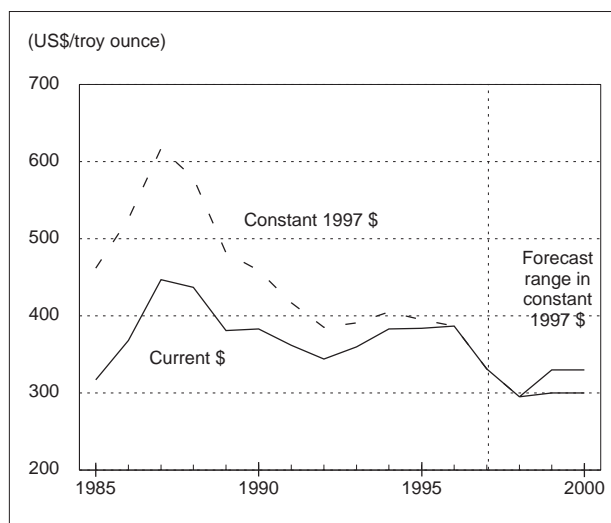


Source: Natural Resources Canada.

## PRICE OUTLOOK

In 1998, an average gold price of US\$295/troy oz is forecast, compared to \$331/oz in 1997 and \$388/oz in 1996. In the medium term, the increased demand for gold products, particularly in the jewellery sector, along with a stabilization of world gold production, should result in some strengthening in the price of gold. Until the end of the decade, an annual average gold price of between US\$300 and \$330/oz (in constant 1997 dollars) is forecast.

**Figure 2**  
Gold Prices, Annual Average, 1985-2000



Source: Natural Resources Canada.

# Nickel

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1997 mineral production: \$1.78 billion<sup>P</sup>  
 World rank: Second  
 1997 exports: \$2.1 billion

| Canada             | 1997     | 1998 <sup>e</sup> | 1999 <sup>f</sup> |
|--------------------|----------|-------------------|-------------------|
|                    | (tonnes) |                   |                   |
| Mine production    | 190 500  | 191 000           | 209 000           |
| Refined production | 131 600  | 129 000           | 142 000           |
| Consumption        | 17 000   | 17 500            | 16 800            |

<sup>e</sup> Estimated; <sup>f</sup> Forecast; <sup>P</sup> Preliminary.

Notes: Mineral production refers to recoverable content in concentrates shipped, whereas mine production refers to metal content in concentrates produced. "Refined" production refers to "primary" nickel production, which includes refined nickel, nickel in nickel oxide sinter, and nickel in nickel chemicals.

**N**ickel's resistance to corrosion, high strength over a wide temperature range, pleasing appearance, and suitability as an alloying agent are characteristics that make it useful in a wide variety of applications. Major markets for nickel include stainless steel (65%), nickel-based alloys, electroplating, alloy steels, foundry products, and copper-based alloys. Scrap is an important nickel source for stainless steel producers, accounting for 45% of their nickel inputs.

## ANNUAL AVERAGE SETTLEMENT PRICES, LONDON METAL EXCHANGE

| 1994      | 1995 | 1996 | 1997 | 1998 <sup>e</sup> |
|-----------|------|------|------|-------------------|
| (US\$/lb) |      |      |      |                   |
| 2.88      | 3.74 | 3.40 | 3.14 | 2.10              |

<sup>e</sup> Estimated.

## CANADIAN OVERVIEW

- An environmental panel evaluating Inco's Voisey's Bay project heard presentations from September to November 1998. The panel is expected to submit recommendations by mid-February 1999.
- Inco and the Government of Newfoundland and Labrador broke off negotiations on whether the mining licence for Voisey's Bay would include a requirement to smelt and refine the entire output in the province. The provincial government tabled amendments in the Legislative Assembly on November 17 to remove ambiguity about the Government's ability to order smelting and refining within the province. The amendments were also intended to reduce the Government's exposure to legal challenge.
- Inco continued cutting costs in 1998; work force reductions should total 1390 by year-end. In April, Inco announced plans to develop 5.9 Mt of ore grading 3.5% nickel and 3.1% copper to the 2500-m level at the Creighton mine. The company also shut down its Shebandowan and Whistle mines as previously scheduled. Others slated to close include: Levack/McCreedy West in late 1999, Froid and Crean Hill in 2000, and Coleman in 2001. The Birchtree deepening project, the Garson mine, and the low-grade area at the Stobie mine are tentatively operating after a worker-management agreement on "non-traditional" cost-cutting.

- In July, Inco announced that production from its Canadian mines would decline from 100 000 t/y to 80 000 t/y over two to three years. In October, Inco forecast its 1998 production at 425 million lb (192 800 t), down 20 million lb from the previous forecast.
- Inco and Jubilee Gold Mines of Australia agreed that Jubilee may elect to supply Inco with 10 000 t/y of nickel in concentrate or ore for three years. The plan is subject to Jubilee obtaining financing, licences, and native title agreements. Jubilee must make a decision before September 30, 1999.
- Falconbridge officially opened its new Raglan mine on July 15, 1998. Planning to increase production at Raglan was slowed by low metal prices.
- Sherritt continued de-bottlenecking its refinery in Fort Saskatchewan, Alberta. Its production reached a record level in the third quarter of 1998 as Sherritt continued to operate the plant to maximize cobalt output.
- Cobatec filed for protection under the Canadian *Bankruptcy and Insolvency Act* in October to give it time to restructure its finances and debt. Cobatec continued to expand its solvent extraction plant in Ontario, operating with feed from Cuba.
- January-September Russian nickel exports to non-C.I.S. destinations totalled 154 500 t, down 4.6% from the same period in 1997. Scrap exports declined due to low prices; merchants noted declining grades of scrap exported. Russia may tax its exports of nickel scrap in 1999.
- Other production cuts were announced in 1998. The major ones include an 8000-t cut at Falconbridge's Dominican Republic smelter and 10 000 t/y of closures at WMC in Australia.
- In September, Billiton made an offer for the outstanding shares of QNI Ltd. at a premium of over 30% above share value at the time.
- Falconbridge expanded its refinery capacity in Norway by 25% to 85 000 t/y. In New Caledonia, the company signed a joint-venture agreement with Société Minière du Sud Pacifique (SMSF) to investigate building a 54 000-t/y ferronickel smelter.
- Inco and BRGM (85% and 15%, respectively) are proceeding with construction of a pilot operation to test Inco's hydrometallurgical process on ore from their Goro deposit. Start-up is scheduled for mid-1999. A decision is expected in 2000 on whether or not to proceed with a plant with initial capacity of 27 000 t/y of nickel plus 2700 t/y of cobalt. Inco stated that it was seeking additional partners. Ore reserves are 165 Mt grading 1.60% nickel and 0.16% cobalt.

## WORLD OVERVIEW

- The progress of Australia's three nickel-cobalt laterite hydrometallurgical projects was closely followed by the nickel industry. Initial production is expected by year-end from the 8500-t/y Ni Cawse and 9000-t/y Bulong projects. The 45 000-t/y Murrin Murrin project is expected to produce initial metal early in 1999. Operators expect to reach full production capacity within 18 months.
- Anaconda Nickel announced its intentions to begin the second stage of the Murrin Murrin project to raise output to 115 000 t/y of nickel plus cobalt. The financing has not yet been raised.
- Calliope Metals plans to complete a bankable feasibility study, environmental study and financing arrangements in 1999 for a 35 000-t/y, US\$600 million nickel pressure acid leach refinery at Nakety, New Caledonia. The planned ore feed to the plant grades 1.47% nickel and 0.12% cobalt.
- A bankable feasibility study of the Ramu nickel-cobalt laterite deposit in Papua New Guinea was completed in October. The nickel output envisaged is 33 000 t/y from an orebody grading 1.01% nickel and 0.1% cobalt.

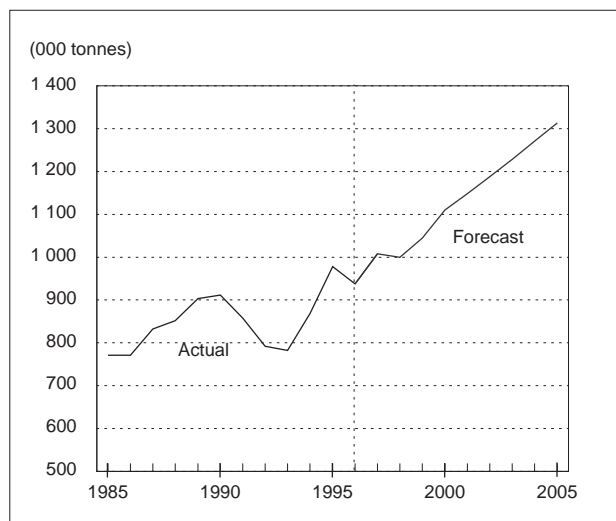
- Preston Resources bought the Bulong project for A\$319 million. It also owns the Marlborough lateritic nickel-cobalt project. The Queensland government approved six of ten mining leases at Marlborough; the remaining four require native claim issues resolution. Preston plans to seek financing for a 19 400-t/y nickel plus 1600-t/y cobalt facility in 1999.

## CONSUMPTION OUTLOOK

World primary nickel consumption is forecast at 1.0 Mt in 1998, a drop of 0.8% from the 1.08 Mt in 1997, reflecting the effects of the continued financial crisis that began in Asia in 1997. Stainless steel production in 1998 is expected to be up marginally to 16.75 Mt; anti-dumping actions further complicated the stainless steel market. Primary nickel consumption is expected to increase in 1999 to 1.05 Mt, reflecting increased stainless steel consumption, which will reach 17.5 Mt. Assuming world financial crises are largely solved by mid-1999, the consumption of stainless steel in 2000 may reach 18.5 Mt, thereby raising primary nickel consumption to 1.1 Mt. Thereafter, nickel consumption is projected to increase at an average rate of about 3.4%/y, with actual consumption in any year either above and below this trend line.



**Figure 1**  
World Nickel Consumption, 1985-2005



Source: Natural Resources Canada.

## PRODUCTION OUTLOOK

Canadian mine production of primary nickel is expected to reach 201 000 t in 1998. Thereafter, the level of Canadian production is dependent upon the direction of nickel prices. With low nickel prices expected to continue in 1999, Canadian nickel production is expected to decline as Inco closes mines between 1999 and 2000. Raglan's output in 1999 is expected to be higher than in 1998, its start-up year. Thereafter, the future is less clear.

At Voisey's Bay, if the environmental panel recommends proceeding with the mine and the mill, obstacles still remain: a decision is pending in a court case whether a nickel smelter and refinery should have also been evaluated; the province and Inco disagree about building a smelter and refinery in the province; land claims between the provincial and federal governments and the two Aboriginal groups in the area have not been resolved; and negotiations for separate impacts and benefits agreements between Inco and the two Aboriginal groups have not been completed.

Continued low prices threaten the ability of Canadian producers to maintain planned production levels and ore reserves. If costs cannot be controlled, cut-off grades will increase and ore reserves will decrease. Because of the uncertainties and because there are only two major producers, a quantitative forecast for production beyond 1999 is not included this year.

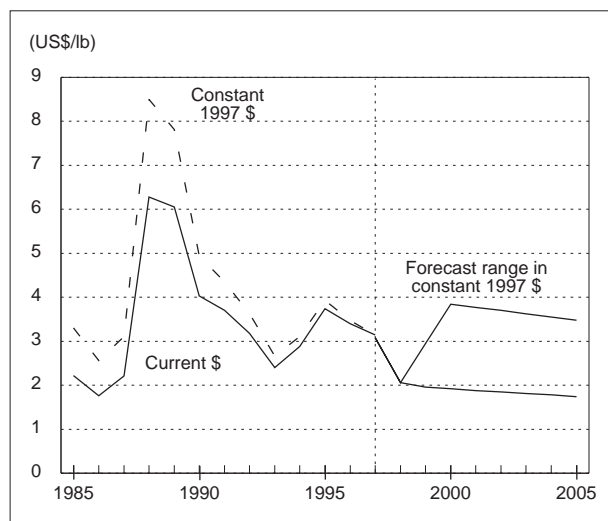
## PRICE OUTLOOK

Because inventories crept upward in late 1998, nickel prices are forecast to remain low in 1999, averaging US\$2.10/lb or US\$4630/t in current dollars (or \$2.06/lb in 1997 U.S. dollars). The most significant uncertainties with respect to prices are the success of the Australian start-ups, the level of Russian exports, and the economic recovery in Asia. If the Australian projects, Murrin Murrin in particular, encounter significant and sustained problems, prices may increase, boosting volatility.

Throughout 1998, while producers made painful and public choices to shut down or cut back operations, individual consumers of nickel and stainless steel quietly and independently were finding increased applications, thereby providing a base for healthy future increases in demand. The inevitable price increase that is expected to result from a contraction of supply concurrent with an expansion of demand will be tempered by the prospect of lower-cost nickel laterite production.

The nickel market is small compared to aluminum, copper or zinc markets. This translates into higher volatility than exists for other major nonferrous metals. Given this volatility, the long-term nickel price is not expected to remain outside a range of US\$2.00-\$4.00/lb (in 1997 U.S. dollars) for extended periods. Average long-term prices are projected at about US\$3/lb. Some decrease in costs and prices is expected due to increased technological efficiency; this is shown by the negative slope of the range of projected prices in Figure 2.

**Figure 2**  
Nickel Prices, 1985-2005  
Annual LME Settlement



Source: Natural Resources Canada.



# Zinc

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Nonferrous Division

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1997 mine production: \$1.9 billion  
 World rank: Second  
 Exports: \$1.8 billion

| Canada           | 1997  | 1998 <sup>e</sup> | 1999 <sup>f</sup> |
|------------------|-------|-------------------|-------------------|
| (000 tonnes)     |       |                   |                   |
| Mine production  | 1 069 | 1 060             | 1 075             |
| Metal production | 700   | 745               | 750               |
| Consumption      | 154   | 161               | 163               |

<sup>e</sup> Estimated; <sup>f</sup> Forecast.

**Z**inc is used in the automotive and construction industries for the galvanization of steel and manufacture of die-cast alloys, in the production of brass, in semi-manufactures such as rolled zinc, and in chemical applications. Promising new applications for zinc are in the manufacture of zinc-air batteries and in galvanized steel studs as an alternative to wood in residential construction. Secondary zinc has become an increasingly important source of the metal in recent years. Secondary zinc includes high-purity refined zinc, remelted zinc of a purity less than 98.5% zinc, and zinc scrap used in the production of zinc alloys. Canada currently produces only a minor

## ANNUAL AVERAGE PRICES, LONDON METAL EXCHANGE FOR SPECIAL HIGH GRADE ZINC

| 1994      | 1995 | 1996 | 1997 | 1998 <sup>e</sup> |
|-----------|------|------|------|-------------------|
| (US\$/lb) |      |      |      |                   |
| 45.3      | 46.8 | 46.5 | 59.8 | 46                |

<sup>e</sup> Estimated; <sup>f</sup> Forecast.

amount of secondary zinc exclusively from secondary feeds in primary zinc smelters. However, refined zinc from the processing of electric arc furnace dusts or from the de-zincing of galvanized steel scrap may become important in the future.

## CANADIAN OVERVIEW

- Agnico-Eagle started a new zinc circuit at the LaRonde mine in September. The zinc-rich zone is being developed in the existing gold mine in northwestern Quebec and is expected to produce 52 000 t/y of zinc in concentrate by 2000.
- In September, HBMS opened the \$17.1 million Chisel North zinc mine project, which effectively replaces the Photo Lake mine, which was closed due to ore exhaustion. In November, HBMS released information on its newest ore deposit near Flin Flon, Manitoba, called the Triple Seven deposit. Development of the Konuto Lake copper-zinc mine west of Flin Flon in northern Saskatchewan continued in 1998; it is expected to start commercial production in the first quarter of 1999. Konuto Lake will produce 3500 t of zinc annually.
- Breakwater Resources announced in August that it would extend indefinitely the five-week shut-down at its Caribou, New Brunswick, zinc-lead mine. The company cited metallurgical results that have been steadily improving but that have not reached the desired levels, and current weak metal prices, as factors that led to the shut-down.
- Anvil Range closed the Faro lead-zinc mine in the Yukon in February due to low metal prices. The company went into receivership in April.
- In November, Inmet announced it was suspending milling operations at its Winston Lake mine. In December, the company announced the suspension of all operations at Winston Lake as a result of low zinc prices. The company also announced that it had lowered its estimates for ore reserves in the lower Pick Lake zone. A decision on whether to permanently close the mine or put it on care and maintenance until zinc prices improve is expected in early 1999.

## WORLD OVERVIEW

- Rio Algom, Noranda and Teck announced in September that they will proceed with plans to develop the US\$2.2 billion Antamina copper-zinc mine project in Peru.
- Anglo American announced plans to develop a US\$980 million zinc mine and smelter project at the Gamsberg deposit in South Africa's Northern Cape province.
- The first phase of a two-phase expansion project was completed in October at the Cajamarquilla zinc refinery near Lima, Peru. The refinery, owned by Cominco of Canada (82%) and Marubeni Corporation of Japan (17%), expanded its production capacity to 120 000 t/y of refined zinc. The second phase will eventually double the plant's annual capacity to 240 000 t when completed.

## LEADING WORLD ZINC PRODUCERS

| Producers<br>Zinc in<br>Concentrate |                   | Producers<br>Zinc Metal |                   |
|-------------------------------------|-------------------|-------------------------|-------------------|
|                                     | 1998 <sup>e</sup> |                         | 1998 <sup>e</sup> |
|                                     | (000<br>tonnes)   |                         | (000<br>tonnes)   |
| China                               | 1 200             | China                   | 1 400             |
| Canada                              | 1 060             | Canada                  | 745               |
| Australia                           | 993               | Japan                   | 615               |
| Peru                                | 844               | United States           | 390               |
| United States                       | 730               | Korea (Rep. of)         | 387               |

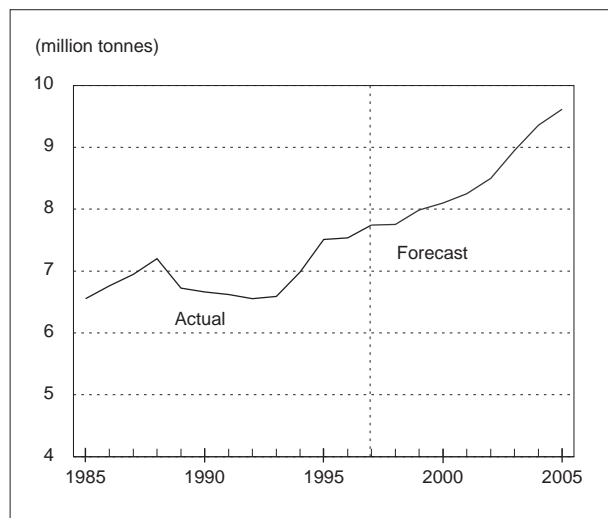
Source: International Lead and Zinc Study Group.  
<sup>e</sup> Estimated.

## CONSUMPTION OUTLOOK

An increase of 3.0% in world zinc consumption in 1999 to 7 990 000 t is forecast, following an estimated 0.1% increase in 1998. Slower but continued economic growth in North America should result in increased zinc demand of over 2% in 1998, with Europe also showing an increase of just over 2%. Demand in Japan is expected to fall by about 11%. In 1999, the growth in North America (3.5%) and Europe (1.9%) is expected to continue and demand should start to recover in Japan, the Republic of Korea and some Southeast Asian nations.

Beyond 1999, world zinc consumption is forecast to grow by an average 2.8%/y to 2005. Galvanizing will remain the dominant end use of zinc and exhibit the largest increase in consumption during the forecast period, followed by brass and die-cast alloys.

**Figure 1**  
World Zinc Consumption, 1985-2005



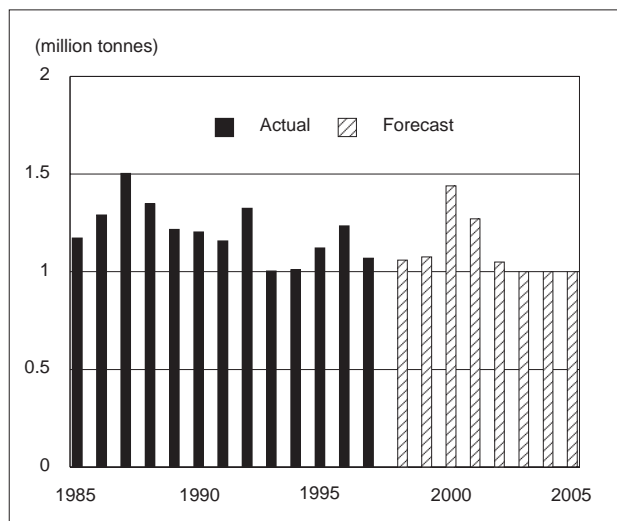
Source: Natural Resources Canada.

## CANADIAN PRODUCTION OUTLOOK

Canada's mine production of zinc is expected to reach 1 060 000 t in 1998, a decrease of 1% compared to 1997. The closure of Anvil Range's Faro operations and Breakwater's Caribou and Restigouche mines in mid-year was offset by increased mine production at existing mines and the start-up of the zinc circuit at Agnico-Eagle's existing gold mine in late September. For 1999, a 2% increase in zinc mine production is forecast as mines that opened late in 1998 complete a full year's production. Beyond 1998, production is predicted to remain at a level between 1 300 000 and 1 400 000 t/y to the year 2001. Mine production is then expected to gradually decrease as older mines become exhausted unless exploration, including that within existing mine infrastructures, leads to additional mineable reserves.

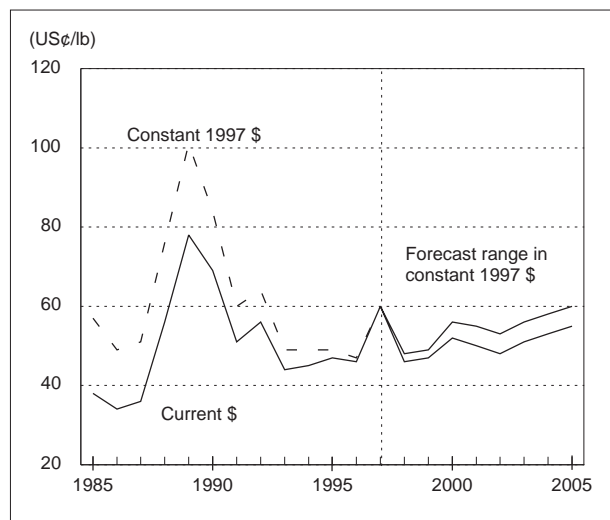
Zinc metal production in Canada was up 6% over last year as a result of the completion of the 20 000-t/y expansion projects at Cominco's Trail operations in British Columbia and at Noranda's Valleyfield zinc refinery in Quebec.

**Figure 2**  
Canadian Mine Production of Zinc, 1985-2005



Source: Natural Resources Canada.

**Figure 3**  
Zinc Prices, 1985-2005  
Annual LME Settlement



Source: Natural Resources Canada.

## PRICE OUTLOOK

Zinc demand is expected to remain strong throughout the rest of 1998 with limited additional Western World smelter capacity for increased metal production. A slight zinc metal deficit is forecast for Western World markets in 1998, primarily as the result of a substantial decrease in exports from China to the West. Despite the fall in LME stocks to levels well below 350 000 t, zinc prices are expected to remain weak for the remainder of 1998 and to average about US\$1025/t (46¢/lb) for the year.

For 1999, the zinc market is expected to remain fairly balanced, with a slight deficit forecast overall. The continued market weakness in Japan and other Southeast Asian nations is expected to continue to exert downward pressure on prices, which should average about US\$1000/t (45¢/lb).

Beyond 1998, investments made in the zinc industry in recent years are expected to result in large increases in mine and smelter capacity near the turn of the century. Continued growth in galvanizing markets, combined with a gradual recovery in overall markets, is expected in the remainder of the forecast period, with zinc prices rising to US55¢-60¢/lb by 2005.



**TABLE 1. CANADA, VALUE OF MINERALS AND MINERAL PRODUCTS (STAGES I TO IV), IMPORTS BY COMMODITY, 1996-98**

|                                   | 1996       | 1997       | 1998 <sup>a</sup> |
|-----------------------------------|------------|------------|-------------------|
|                                   | (\$000)    |            |                   |
| <b>METALS</b>                     |            |            |                   |
| Aluminum                          | 3 373 254  | 3 812 061  | 2 862 725         |
| Antimony                          | 11 916     | 11 007     | 6 485             |
| Barium                            | 2 754      | 5 083      | 3 845             |
| Beryllium                         | 908        | 567        | 47                |
| Bismuth                           | 2 102      | 3 043      | 1 844             |
| Cadmium                           | 1 502      | 1 340      | 364               |
| Calcium metals                    | 35 801     | 40 462     | 30 798            |
| Chromium                          | 94 366     | 97 569     | 62 473            |
| Cobalt                            | 72 289     | 66 804     | 45 565            |
| Copper                            | 1 651 541  | 1 808 499  | 1 048 846         |
| Gallium                           | 42         | 22         | 17                |
| Germanium                         | 5 654      | 8 267      | 4 156             |
| Gold                              | 1 077 646  | 1 434 641  | 1 102 874         |
| Hafnium                           | —          | 17         | ...               |
| Indium                            | 706        | 1 489      | 709               |
| Iron and steel                    | 10 246 501 | 12 880 721 | 9 979 460         |
| Iron ore                          | 334 255    | 356 472    | 222 909           |
| Lead                              | 498 419    | 558 379    | 373 130           |
| Lithium                           | 27 126     | 32 276     | 28 655            |
| Magnesium and magnesium compounds | 158 304    | 203 607    | 118 626           |
| Manganese                         | 197 771    | 166 926    | 127 212           |
| Mercury                           | 1 407      | 730        | 466               |
| Mineral pigments                  | 101 981    | 114 358    | 86 324            |
| Molybdenum                        | 38 652     | 40 407     | 31 317            |
| Nickel                            | 757 989    | 600 735    | 433 955           |
| Niobium                           | 15 864     | 20 964     | 16 352            |
| Platinum group metals             | 207 343    | 226 095    | 125 915           |
| Rare earth metals                 | 8 744      | 9 619      | 5 416             |
| Rhenium                           | 15         | 9          | 14                |
| Selenium                          | 447        | 390        | 277               |
| Silicon                           | 95 469     | 90 610     | 69 571            |
| Silver                            | 125 567    | 141 402    | 96 203            |
| Strontium                         | 1 337      | 1 874      | 1 291             |
| Tantalum                          | 3 576      | 963        | 607               |
| Tellurium                         | 371        | 59         | 65                |
| Thallium                          | 2          | 1          | 4                 |
| Tin                               | 56 635     | 59 378     | 41 676            |
| Titanium metals                   | 86 469     | 72 994     | 65 131            |
| Tungsten                          | 6 739      | 9 172      | 6 173             |
| Uranium and thorium               | 248 005    | 219 944    | 167 891           |
| Vanadium                          | 28 479     | 44 830     | 46 623            |
| Zinc                              | 153 792    | 275 638    | 115 523           |
| Zirconium                         | 39 160     | 39 005     | 28 928            |
| Other metals                      | 6 255 795  | 1 690 292  | 5 991 281         |
| Total metals                      | 26 026 695 | 31 148 721 | 23 351 743        |
| <b>NONMETALS</b>                  |            |            |                   |
| Abrasives                         | 300 147    | 349 030    | 285 092           |
| Arsenic                           | 892        | 416        | 214               |
| Asbestos                          | 75 220     | 84 981     | 51 633            |
| Barite and witherite              | 1 868      | 2 985      | 1 343             |
| Boron                             | 26 682     | 27 338     | 17 618            |
| Bromine                           | 1 907      | 2 197      | 1 119             |
| Calcium (industrial minerals)     | 5 574      | 7 035      | 4 523             |
| Chlorine and chlorine compounds   | 49 837     | 50 865     | 38 374            |
| Diamonds                          | 191 132    | 222 492    | 157 930           |

**TABLE 1 (cont'd)**

|  | 1996       | 1997       | 1998 <sup>a</sup> |
|--|------------|------------|-------------------|
|  | (\$'000)   |            |                   |
| <b>NONMETALS (cont'd)</b>                      |            |            |                   |
| Feldspar                                       | 258        | 315        | 337               |
| Fluorspar                                      | 45 784     | 42 489     | 28 870            |
| Glass and glassware products                   | 1 682 242  | 1 858 160  | 1 363 438         |
| Graphite                                       | 335 834    | 368 302    | 298 502           |
| Gypsum   | 24 855     | 31 008     | 23 724            |
| Iodine   | 9 768      | 18 363     | 12 988            |
| Mica   | 10 460     | 12 308     | 7 722             |
| Nepheline syenite                              | 52         | 12         | 2                 |
| Nitrogen                                       | 145 831    | 137 228    | 105 550           |
| Pearls   | 15 693     | 16 317     | 9 102             |
| Peat   | 764        | 1 418      | 1 258             |
| Perlite  | 9 343      | 10 553     | 8 581             |
| Phosphate and phosphate compounds              | 365 694    | 422 139    | 299 624           |
| Potash and potassium compounds                 | 35 424     | 39 007     | 30 161            |
| Salt and sodium compounds                      | 325 149    | 319 671    | 192 978           |
| Silica and silica compounds                    | 109 357    | 126 992    | 92 829            |
| Sulphur and sulphur compounds                  | 15 947     | 19 042     | 14 230            |
| Talc, soapstone and pyrophyllite               | 15 283     | 12 999     | 8 201             |
| Titanium oxides                                | 180 046    | 230 095    | 180 144           |
| Vermiculite                                    | 5 157      | 5 462      | 3 985             |
| Other nonmetals                                | 457 741    | 519 165    | 377 130           |
| Total nonmetals                                | 4 443 941  | 4 937 384  | 3 617 202         |
| <b>STRUCTURAL MATERIALS</b>                    |            |            |                   |
| Cement   | 157 933    | 186 408    | 137 071           |
| Clay and clay products                         | 669 653    | 761 614    | 569 715           |
| Dolomite                                       | 1 336      | 1 459      | 823               |
| Granite  | 35 058     | 35 565     | 33 403            |
| Lime   | 5 054      | 6 356      | 4 081             |
| Limestone flux and other limestone             | 17 382     | 18 079     | 11 869            |
| Marble, travertine and other calcareous stones | 32 489     | 39 329     | 33 577            |
| Olivine  | 488        | 527        | 461               |
| Sand and gravel                                | 16 299     | 17 581     | 12 018            |
| Sandstone                                      | 2 127      | 2 046      | 1 421             |
| Slate  | 5 604      | 8 605      | 6 120             |
| Other structural materials                     | 56 953     | 66 304     | 49 312            |
| Total structural materials                     | 1 000 376  | 1 143 873  | 859 871           |
| <b>FUELS</b>                                   |            |            |                   |
| Coal and coke                                  | 757 333    | 873 057    | 686 176           |
| Natural gas                                    | 111 361    | 137 290    | 83 487            |
| Natural gas by-products                        | 70 206     | 55 947     | 41 090            |
| Petroleum                                      | 9 724 328  | 11 740 902 | 6 339 658         |
| Other fuels                                    | 306 486    | 346 187    | 287 465           |
| Total fuels                                    | 10 969 714 | 13 153 383 | 7 437 876         |
| Total mining imports (including fuels)         | 42 440 726 | 50 383 361 | 35 266 692        |
| Total economy imports                          | 32 228 345 | 38 103 035 | 28 514 992        |

Sources: Natural Resources Canada; Statistics Canada.

– Nil; . . . Amount too small to be expressed.

<sup>a</sup> First nine months of 1998.

Note: Numbers may not add to totals due to rounding.



**TABLE 2. CANADA, VALUE OF MINERALS AND MINERAL PRODUCTS  
(STAGES I TO IV), EXPORTS BY COMMODITY, 1996-98**

|                                   | 1996       | 1997       | 1998a      |
|-----------------------------------|------------|------------|------------|
|                                   | (\$000)    |            |            |
| <b>METALS</b>                     |            |            |            |
| Aluminum                          | 6 328 775  | 7 113 025  | 5 363 147  |
| Antimony                          | 2 332      | 875        | 1 258      |
| Barium                            | 87         | 184        | -          |
| Beryllium                         | 614        | -          | -          |
| Bismuth                           | 1 517      | 1 415      | 1 565      |
| Cadmium                           | 8 198      | 5 612      | 2 501      |
| Calcium metals                    | 3 655      | 4 281      | 2 662      |
| Chromium                          | 29 370     | 33 642     | 25 435     |
| Cobalt                            | 385 335    | 431 368    | 354 815    |
| Copper                            | 3 028 916  | 2 929 108  | 1 823 370  |
| Gallium                           | -          | -          | -          |
| Germanium                         | 6          | 450        | 1 401      |
| Gold                              | 3 547 590  | 3 485 710  | 2 649 381  |
| Hafnium                           | -          | -          | -          |
| Indium                            | -          | -          | -          |
| Iron and steel                    | 8 232 608  | 8 491 884  | 7 176 031  |
| Iron ore                          | 1 032 860  | 1 258 693  | 1 024 362  |
| Lead                              | 430 810    | 334 083    | 215 848    |
| Lithium                           | 16         | -          | 38         |
| Magnesium and magnesium compounds | 221 788    | 252 921    | 200 994    |
| Manganese                         | 6 567      | 6 362      | 6 327      |
| Mercury                           | 1 688      | 170        | 16         |
| Mineral pigments                  | 57 534     | 69 910     | 53 499     |
| Molybdenum                        | 71 562     | 91 676     | 56 838     |
| Nickel                            | 2 339 044  | 2 119 750  | 1 454 643  |
| Niobium                           | 33 845     | 42 459     | 26 795     |
| Platinum group metals             | 158 116    | 182 857    | 139 981    |
| Rare earth metals                 | 683        | 1 124      | 207        |
| Rhenium                           | -          | -          | -          |
| Selenium                          | 5 560      | 5 324      | 3 676      |
| Silicon                           | 87 069     | 98 872     | 78 898     |
| Silver                            | 433 500    | 351 203    | 388 508    |
| Strontium                         | -          | 5          | -          |
| Tantalum                          | 36         | 79         | 784        |
| Tellurium                         | 1 772      | 3 097      | 871        |
| Thallium                          | -          | -          | -          |
| Tin                               | 20 261     | 17 267     | 9 644      |
| Titanium metals                   | 19 012     | 16 678     | 14 044     |
| Tungsten                          | 1 250      | 684        | 588        |
| Uranium and thorium               | 960 516    | 1 003 085  | 637 088    |
| Vanadium                          | 15 540     | 25 350     | 32 654     |
| Zinc                              | 1 486 297  | 1 789 170  | 1 196 169  |
| Zirconium                         | 2 849      | 3 047      | 2 232      |
| Other metals                      | 3 281 226  | 3 853 339  | 3 225 528  |
| Total metals                      | 32 238 404 | 34 024 759 | 26 171 798 |
| <b>NONMETALS</b>                  |            |            |            |
| Abrasives                         | 201 980    | 208 748    | 170 637    |
| Arsenic                           | 54         | 33         | -          |
| Asbestos                          | 353 188    | 308 350    | 196 611    |
| Barite and witherite              | 5 285      | 5 907      | 7 635      |
| Boron                             | 209        | 498        | 234        |
| Bromine                           | 16         | 148        | 23         |
| Calcium (industrial minerals)     | 72         | 33         | 83         |
| Chlorine and chlorine compounds   | 132 338    | 149 584    | 117 105    |

**TABLE 2 (cont'd)**

|  | 1996       | 1997       | 1998 <sup>a</sup> |
|--|------------|------------|-------------------|
|  | (\$000)    |            |                   |
| <b>NONMETALS (cont'd)</b>                      |            |            |                   |
| Feldspar                                       | 63         | 29         | 8                 |
| Fluorspar                                      | 4 941      | 43 784     | 55 503            |
| Glass and glassware products                   | 917 171    | 972 070    | 752 259           |
| Graphite                                       | 132 208    | 132 581    | 101 183           |
| Gypsum   | 230 768    | 288 927    | 256 261           |
| Iodine   | 3 739      | 10 683     | 10 502            |
| Mica   | 9 516      | 9 240      | 7 761             |
| Nepheline syenite                              | 43 919     | 50 498     | 40 237            |
| Nitrogen                                       | 834 604    | 981 713    | 674 049           |
| Pearls   | 771        | 1 577      | 1 403             |
| Peat   | 289 132    | 288 094    | 238 613           |
| Perlite  | —          | —          | —                 |
| Phosphate and phosphate compounds              | 30 192     | 26 169     | 22 430            |
| Potash and potassium compounds                 | 1 546 155  | 1 752 693  | 1 559 565         |
| Salt and sodium compounds                      | 543 287    | 503 537    | 399 934           |
| Silica and silica compounds                    | 13 995     | 18 370     | 12 129            |
| Sulphur and sulphur compounds                  | 495 545    | 466 797    | 281 516           |
| Talc, soapstone and pyrophyllite               | 7 607      | 8 010      | 7 031             |
| Titanium oxides                                | 152 332    | 172 758    | 158 399           |
| Vermiculite                                    | —          | —          | —                 |
| Other nonmetals                                | 423 594    | 447 076    | 310 981           |
| Total nonmetals                                | 6 389 475  | 6 861 567  | 5 387 608         |
| <b>STRUCTURAL MATERIALS</b>                    |            |            |                   |
| Cement   | 506 880    | 573 844    | 459 476           |
| Clay and clay products                         | 41 809     | 44 475     | 27 865            |
| Dolomite                                       | 11 628     | 11 973     | 10 163            |
| Granite  | 59 399     | 65 010     | 49 267            |
| Lime   | 24 701     | 27 203     | 18 060            |
| Limestone flux and other limestone             | 22 928     | 25 612     | 27 293            |
| Marble, travertine and other calcareous stones | 5 997      | 21 205     | 23 414            |
| Olivine  | —          | —          | —                 |
| Sand and gravel                                | 11 844     | 15 680     | 13 793            |
| Sandstone                                      | 42         | 200        | 192               |
| Slate  | 4 485      | 4 901      | 2 036             |
| Other structural materials                     | 49 807     | 57 682     | 70 882            |
| Total structural materials                     | 739 520    | 847 785    | 702 441           |
| <b>FUELS</b>                                   |            |            |                   |
| Coal and coke                                  | 2 620 374  | 2 733 209  | 1 902 140         |
| Natural gas                                    | 7 432 768  | 8 625 631  | 6 435 973         |
| Natural gas by-products                        | 1 154 199  | 1 161 236  | 612 608           |
| Petroleum                                      | 17 040 149 | 17 003 697 | 9 898 892         |
| Other fuels                                    | 251 406    | 257 592    | 204 940           |
| Total fuels                                    | 28 498 896 | 29 781 365 | 19 054 553        |
| Total mining exports (including fuels)         | 67 866 295 | 71 515 476 | 51 316 400        |
| Total economy exports                          | 26 640 197 | 22 612 217 | 12 326 230        |

Sources: Natural Resources Canada; Statistics Canada.

— Nil.

<sup>a</sup> First nine months of 1998.

Note: Numbers may not add to totals due to rounding.