THE MINERAL INDUSTRY OF

CANADA

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In 2002, Canada was the third largest economy in the Western Hemisphere with a population of about 31.9 million. The gross domestic product (GDP) was $724.6 billion,[1] or $923 billion in terms of purchasing power parity. Canada's GDP growth was 3.4% compared with 1.5% in 2001. Canada's economic slowdown in 2001 and subsequent recovery in 2002 were largely affected by the slowdown in its major markets (Europe, Japan, and the United States). Canada's currency devaluation helped moderate the upturn in economic growth of the second one-half of 2002 despite inflation at 2.2% and unemployment at 7.6% (U.S. Central Intelligence Agency, 2002§;[2] U.S. Energy Information Administration, 2002§; World Bank Group, 2002§). Overall, Canada's economic picture for 2002 showed that the country as a whole was doing well. Given its quality natural resources, the minerals, metals, and energy sectors contributed 7% to its GDP; the mineral industry played an integral part in Canada's technology-driven, knowledge-based economy (Mercer, 2003).

Because of the negative impact of the economic sluggishness in the United States during 2001 and 2002, the value of Canadian minerals production decreased to $48.1 billion, which was 7.3% lower than that of 2001 ($51.9 billion). Of this total, the Canadian nonfuels production was valued at $11.2 billion, which was about the same level as that of 2001; the values of fuel and metal outputs decreased by 9.3% and 1.3%, respectively, compared with those of 2001; and the value of industrial minerals (nonmetals) increased by 1.8% compared with that of 2001 (Natural Resources Canada, 2003a, b).

Changing prices in world markets affected mine openings and closings in Canada.[3] The value of production for base metals and nonmetals remained close to 2001 levels despite weakening prices. The value of nickel increased to $1.2 billion in 2002 from $1.1 billion in 2001. A significant decline in lead and zinc outputs and sharp price declines for cobalt, copper lead, platinum group, and zinc contributed to the decline in value of Canadian metals, from $6.5 billion in 2001 to $6.4 billion in 2002. The value of several metals increased by 17.1% for iron ore, 13.2% for silver, 7.4% for gold, and 6.0% for nickel; these partially offset the decrease of the metals value. In 2002, strong prices encouraged increases in gold and silver production, thus continuing the upward trend that started in 1998 and resulting in significant increases in value for gold ($1.4 billion) and silver ($197 million). Gold led the nonfuels group in 2002 in terms of value of production followed by nickel ($1.2 billion), potash ($1.0 billion), and cement, copper, and zinc ($875 million each).

Canada realized an overall increase of 1.8% in value for industrial minerals in 2002 compared with that of 2001. Production values increased by 20.9% for clay products, 17.5% for gypsum, 11.7% for diamond, and 2.9% for cement; these increases offset the declining values of other commodities in the nonmetals group. In 2002, the value of mineral fuels production decreased to $36.9 billion from $40.6 billion in 2001. Increases in the value of crude oil (22.3%) and coal (2.3%) offset the decreases in value of natural gas byproducts (28.1%) and natural gas (30.8%) (Natural Resources Canada, 2003a, b).

Government Policies and Programs

Canadian Provinces exercise the primary jurisdiction over mineral resources in the country. Through their mining acts, the Provincial governments regulate most aspects of exploration and mining. Exceptions have been the Yukon Territory, the Northwest Territories, and the Nunavut Territory, which, although still under the resource-management control of the Canadian Federal Government, were slowly accumulating more independent powers. For instance, the Federal, Territorial, and the First Nation negotiators initiated the Devolution Transfer Agreement (DTA) in September 2001. Under the DTA, the Federal Government will transfer its current responsibilities for managing most of Yukon's natural (mineral and energy) resources to the Government of Yukon on April 1, 2003.

On August 20, 2002, Quebec announced a very competitive refundable flowthrough share (FTS) tax credit for mineral resources, and senior and junior companies will be allowed a tax credit of up to 60% of exploration expenditures until 2007. In 2002, the Yukon Territory offered an FTS tax credit as a refundable mineral exploration tax of 25% on exploration expenditures for eligible individuals and companies that will be in effect until March 31, 2004; British Columbia's FTS tax credit program provided a 20% tax cut for flow-through financing for eligible grassroots exploration; and Saskatchewan had a temporary 10% tax credit for eligible FTS investors in mineral exploration firms active in the Province where the targeted commodities were diamond and uranium (Natural Resources Canada, 2002b, p. 78, 83, 95).

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[1]Where necessary, values have been converted from Canadian dollars (CAN$) to U.S. dollars at an average rate of CAN$1.6003=US$1.00 for 2002. All values in this report, unless otherwise specified, are expressed in U.S. dollars.

[2]References that include a section mark (§) are found in the Internet References Cited section.

[3]For more-detailed information on the mineral production in Canada, see the Canadian Minerals Yearbooks for 2000 and 2001, prepared by the Mining Sector, Natural Resources Canada, Ottawa, Canada, which were used extensively as source material for this report. The U.S. Department of the Interior has arranged to have these Canadian publications placed in selected depository libraries of the 50 States and Puerto Rico. Please note that any datum or statistic not referenced elsewhere may be assumed to be from either the Yearbook or the related series of separate, preliminary, topical papers that present information compiled by Statistics Canada and issued by Natural Resources Canada.

The Federal Department of Indian Affairs and Northern Development (DIAND) and the Northwest Territories Government merged their geoscience programs and jointly managed the C.S. Lord Northern Geoscience Centre in Yellowknife. The Centre is supported by the DIAND, the Government of the Northwest Territories, and the Geological Survey of Canada. In 1993, the largest Aboriginal land settlement took place in Canada, which resulted in the formation of the Territory of Nunavut on April 1, 1999. The land claim settlement allocated about 40,000 square kilometers (km^2) of Nunavut as "Inuit Owned Land" whereby surface rights are held by Regional Inuit Associations (RIAs), and subsurface rights are held by the Inuit people and administered by Nunavut Tunngavik Incorporated. An additional 320,000 km^2 is considered to be "Inuit Owned Land" whereby only surface rights are held by the Inuit and are administered by the RIAs, and subsurface rights are retained by the Crown and administered by the DIAND. In both cases, exploration and mining are allowed and subject to permitting through the respective RIAs.

Although Nunavut depended on the Federal Government for 90% of its budget of almost $400 million in 2001, it had a modest private sector that included mining, retail sales, and transportation. In recent years, exploration for metals and petroleum has tended to move north into Nunavut and has resulted in the development of Baffin Island's Nanisivik lead-zinc mine, which is located 750 kilometers (km) north of the Arctic Circle; Breakwater Resources Ltd (BRL) owned it. The Inuit have been generally receptive to mining proposals as a way of bringing more business and employment into their region (Natural Resources Canada, 2002b, p. 103-105).

Federal and Provincial policies (though not entirely consistent among Provinces) are generally stable and have traditionally favored the research and information services that relate to the mining industry. The Federal Government has negotiated multiyear Mineral Development Agreements, which fund initiatives intended to strengthen the mining industry in each region, with Provincial governments. Although environmental assessment legislation was passed in 1992, the Federal Government has been deliberate in producing regulations to implement such laws. One subsequent measure was the tax deductibility for funds set aside for the cleanup of closed mine sites, thus complementing emerging Provincial reclamation requirements.

The Canadian Securities Administrator (CSA) finalized National Instrument 43-101, which pertains to the Standards of Disclosure for Mineral Projects. This instrument, which was enacted into law in early 2001, will apply to all technical public disclosure on mineral projects and will require all technical disclosures to be based on the work of a professional or qualified person (QP) determined by the CSA by competitive sourcing. This law will preserve Canada's preeminent position in world mining exploration, development, and financing. A QP is to be responsible for scientific and technical matters, which will include not only exploration, development, definitions of resources and reserves, and mining matters, but also quality-control standards for analytical laboratories, the form of technical reports, professional supervision, corporate governance practices, regulatory oversight of the mining industry, and enforcement of securities laws. This instrument was a result of the Kalimantan, Indonesia, scandal in which many investors lost heavily when Bre-X Minerals Ltd. salted drill-core samples from its Busang property with gold in 1997 (McCombe, 2001, p. 4).

Since October 19, 2000, the Canadian Federal Government introduced a 15% nonrefundable tax credit, which will be in effect until 2004. The credit is in addition to the existing 100% deduction of eligible exploration expenditures from the Federal portion of investors' income tax and is equivalent to a 136.7% exploration expense deduction. The Federal Government tax credit and the Provincial governments' FTS constitute the "super" flowthrough tax credits for grassroots exploration. Both FTS investments will assist the sector in gaining new investments and stimulating minerals exploration activity in Canada. The Federal Government is laying a foundation for the sector by providing sound economic fundamentals, encouraging innovation and knowledge, and promoting sustainable development. Income tax benefits to individual investors for income tax purposes and marginal tax rate will vary depending on the taxpayer's residence. Quebec continued to offer the largest tax savings for FTS investments followed by the Yukon Territory, British Columbia, Ontario, and Saskatchewan (Heakes, 2002; Natural Resources Canada, 2002b, p. 29-113; Schroeter, 2002).

Environmental Issues

The Canadian Mining Association noted that the Canadian Environmental Assessment Act (CEAA) put several Federal departments in a position to review mining activity, a purview that had been limited to Provincial jurisdiction. The CEAA includes many provisions that bring Federal agencies into the review process to evaluate impacts on area fisheries and navigable rivers or where explosions or public works are involved. Because mining operations could affect at least one of these considerations, the Federal Government is now involved in any significant mining project. Overlapping Federal jurisdictions have made it difficult for investors to know what they have to do to secure approval for their projects. Observers believed that if the CEAA creates difficulties for raising capital, then investors could become wary of Canada's approval regime. They would invest their monies in other countries where regulations are more straightforward and transparent. In Canada, however, the Provincial and Territorial governments continued to support and promote exploration and deposit appraisal activities in their respective jurisdictions via various initiatives, such as fiscal incentives, resolution of land access issues, and the provision of state-of-the art geoscientific data (Natural Resources Canada, 2002b, p. 7).

In a further effort to define goals, approaches, and alternatives in the name of sustainable development, the Prospectors and Developers Association of Canada (PDAC), which is a private sector organization, has issued "Total Landscape Management (TLM): An Integrated Approach to Conservation Protection and Resource Development." The PDAC asserts that TLM goes beyond the growing reliance on multiple-use exclusive areas to achieve conservation objectives. This multiple-use concept, however, has produced unsatisfactory results

because the complex and changing needs of the landscape require a more-comprehensive and integrated approach. TLM acknowledges that access to land and certainty of title are crucial to resource development and that biological diversity, wilderness protection, and the preservation of unique and exceptional areas are fundamental to conservation objectives. TLM prescribes management of entire ecological landscapes by using the overarching principle of conservation diversity; a system of "floating reserves" designed to accomplish protection in a constantly changing, dynamic landscape; adaptive management that allows the flexibility to accommodate new information, evolving ecosystems, and natural disturbances; and comanagement that ensures the provision of local community input. Failure to understand local realities and to involve the community constructively creates the risk of costly delays or even termination of mineral exploration and development projects owing to disruption, confrontation, and conflict over cultural, environmental, and social issues (Thomson, 2002, p. 4).

Exploration

In 2002, overall exploration spending for Canada declined to $313.2 million, which was a decrease of almost 2.3% and 0.6% compared with that of 2001 ($320.5 million) and 1999 ($315.2 million), respectively; the downward trend reversed, however, compared with that of 2000 ($310.4 million). Although increases and decreases were not fairly characteristic of all the Provinces, increases were particularly apparent in, in order of importance, Ontario, Quebec, Nunavut, British Columbia, Saskatchewan, and Manitoba, which together accounted for about 72% of exploration expenditures for the entire country. Increases were equally apparent in, in order of importance, the Northwest Territories, Newfoundland, and Labrador, and Alberta (Natural Resources Canada, 2002b, p. 5; 2002§). Despite the decline in global exploration levels to $2.2 billion in 2002 from $2.6 billion in 2001, Canada's larger mining companies remained internationally active by continuing to spend 70% of their exploration budgets in other countries, particularly in, in order of importance, South America, the Caribbean, and eastern Europe, and 30% in Canada. Although a large number of Canadian mining companies have been exploring in other countries, such discoveries as Voisey's Bay nickel-copper-cobalt project and the Diavik, the Jericho, and the Snap Lake diamond projects reaffirmed that there is much still to be found in Canada (Natural Resources Canada, 2002b, p. 121-128).

According to Natural Resources Canada (2002b, p. 123) for 2003, spending for metals exploration would be flat or decline, and that for diamond exploration would increase by as much as 25%. After spreading to most of Canada, diamond exploration continued with some public excitement because of an increasing number of discoveries. In 2002, diamond production increased by 34.1% at a value of $501 million as the Ekati diamond mine completed its 4th full year of operation in the Northwest Territories. For the first time, the mine became a factor in world diamond markets. In 2003 and beyond, diamond was expected to be the most sought after mineral commodity in the country (Natural Resources Canada, 2003b, p. 3). The globalization of diamond demand has introduced unprecedented levels of volatility into the diamond supply and rough and polished diamond pricing; this takes into consideration increased levels of diamond mining activity and, in particular, the move to a more-competitive open market for rough diamonds (Rapaport, 2002; Natural Resources Canada, 2003b). As globalization of the mining industry continued, the merger of the California-based Homestake Mining Company with the Toronto-based Barrick Gold Corporation resulted in Barrick's largest portfolio to date and an increased worldwide exploration budget of more than $180 million in late 2001 (Natural Resources Canada, 2002b, p. 128).

According to Natural Resources Canada's survey of 2002, exploration and deposit appraisal disbursements have stabilized in recent years after declining considerably to a low of $311 million in 2000 from the peak of $576 million in 1997; the upward trend of such disbursements started in 2001 ($321 million) and continued, with a slight decrease of almost 2.5%, in 2002 ($313 million). This trend was the result of better gold prices in the open markets, the sustained and successful diamond exploration, and access to financing. Canada's mining companies (large and small firms, or senior and junior companies) were affected by the aftermath of the Bre-X scandal and the slowdown after 1997. The share of junior firms' spending remained an important part of total exploration-phase expenditures (grassroots exploration) of $131 million, or 40% in 2002, and $111 million, or 35% in 2001 (Natural Resources Canada, 2002b, p. 7; 2002§).

Environmental concerns continued to interact with mineral exploration and development activities throughout Canada. Mineral exploration search criteria seem to have become increasingly subject to legal and sociological influences in much of Canada. Land use, which had never been given much attention in the past, has become an issue. First Nation rights were receiving long-awaited consideration. Canada's Minister of Natural Resources stated that Federal and Provincial governments were working on legislative reforms that should afford an improved regulatory climate.

Canadian mining firms were acquiring mineral properties in Latin America where Governments offered incentives to attract foreign investment, their mining laws were coherent and reasonable, up to 100% of ownership was allowed, and profits could be repatriated. In 2001 (the latest year for which data are available), Canadian senior firms' exploration expenditures in Latin America and the Caribbean totaled about $494 million, or almost 32% of their $1.6 billion worldwide exploration budget. In Canada, an exploration company that has a minimum annual allotment of $3 million for exploration purposes is considered to be a Canadian senior firm (Natural Resources Canada, 2002b, p. 118-119).

Production

In 2002, the value of Canadian mineral production remained strong, which was principally attributed to very significant increases in the values of the output of crude oil (15%) and coal (2.3%) compared with those of 2001. Value production of metals decreased by 1.3% compared with those of 2001, and those of industrial minerals, which include structural materials, increased slightly to $4.9 billion in 2002 from $4.8 billion in 2001. The performance of the fuels group, which totaled about

$37 billion, showed a 14% decrease compared with $43 billion in 2001 primarily because of the lower energy prices for natural gas and byproducts. The value of crude oil climbed to $19.2 billion compared with $16.7 billion in 2001. Production of natural gas byproducts decreased by 28.1% and had a value of $2.1 billion compared with $2.9 billion in 2001. Natural gas output decreased by 30.8% and had a value of $14.6 billion compared with $21.1 billion in 2001. Finally, the value of coal production increased by about 2.3% to $1.0 billion in 2002 compared with $900 million in 2001 (Natural Resources Canada, 2003b).

In terms of value of production in 2002, the leading metal and industrial mineral commodities were gold at $1.4 billion; nickel, $1.2 billion; potash, $1.0 billion; cement, copper, and zinc, $875 million each; iron ore, $688 million; sand and gravel and stone, $625 million each; diamond, $500 million; uranium, $375 million; and platinum-group metals (PGM) and salt, $250 million each (Natural Resources Canada, 2003a, b).

Market prices played a changing role in the mineral commodity values. In 2002, the value of metals decreased by 1.5% to $6.4 billion from $6.5 billion in 2001 and by almost 7.0% than that of 2000. In 2002, much of that decrease was due to the decline in the value of zinc production from $900 million in 2001 to $700 million; increases in value for iron ore (17.1%), silver (13.2%), gold (7.4%), and nickel (6.0%), however, partially offset the decrease in the value of metals. Strong prices encouraged increases in the production of gold and nickel. Declines in output led to a decreased value of production for cobalt (39.5%), lead (35.4%), PGM (31.0%), zinc (23.6%), asbestos (17.5%), copper (7.6%), salt (3.3%), sand and gravel (1.4%), and potash (1.2%). The value of output for most other metals remained at about the 2001 levels despite abating prices (Natural Resources Canada, 2003a, b). That changes in production can be accompanied by robust increases in their value illustrates the compelling effect of market prices when higher demands for minerals are prevalent. Likewise, the negative effect of price decreases in relation to mineral production during periods of oversupply and price weakness will be harmful to the Canadian mineral sector.

Ontario, which was the leading producer of nonfuel mineral commodities, accounted for 32.0% of the total value followed by Quebec, 20.5%; Saskatchewan, 12.8%; British Columbia, 10.0%; Newfoundland and Labrador, 5.4%; Northwest Territories, 4.8%; Manitoba, 4.6%; New Brunswick, 3.5%; Alberta, 3.3%; Nunavut, 1.5%; Nova Scotia, 1.4%; and the Yukon Territory, 0.2%. Although the production of fuels tended to be concentrated in the western plains Provinces, the output of nonfuel mineral commodities was characterized by a much wider distribution throughout Canada (Natural Resources Canada, 2003a, b).

Trade

As the world's largest exporter of metals, industrial minerals, and fuel minerals, Canada enjoyed economic benefits from its mineral industry that included a significant contribution to its trade surplus and, hence, to its trade balance as well as major support of the national standard of living. In 2001 (the latest year for which more-detailed trade information is available), minerals (metals, industrial minerals, and fuel minerals) exports earned $65.9 billion, or 25.4% of all exports of $259.7 billion. The value of exports of nonfuel minerals, which included coal, was $31.5 billion; this was a decrease of 4.1% compared with that of 2000. The 2001 mineral exports represented 11.6% of Canada's total exports (Natural Resources Canada, 2002a, p. 1.16; Department of Finance Canada, 2002§).

Included in these exports were crude minerals and smelted and refined products. Prominent minerals exported were iron ore, potash, and sulfur to the United States; copper concentrates to Japan; and iron ore and zinc concentrates to the European Union (EU). Smelted and refined metals included aluminum, copper, gold, iron and steel, nickel, silver, and zinc to the United States; aluminum and gold to Japan; and copper and nickel to the EU. Most coal exports went to Japan.

Mineral imports were valued at $41.4 billion, or about 18.7% of all imports in 2001. In terms of net trade, the mineral surplus, which included fuels, was valued at $24.5 billion compared with $21.4 billion in 2000. Total trade between Canada and the United States exceeded that of any other two countries in the world. Exports of mineral commodities and mineral-related products, which included fuels, from Canada to the United States were $22.6 billion in 2001, or 76.3% of total exports, followed by the EU (9.7%), Japan (3.6%), Mexico (0.5%), and other countries (9.9%) (Natural Resources Canada, 2002a, p. 1.1-1.18).

Structure of the Mineral Industry

The Canadian mineral industry comprised about 3,000 domestic and perhaps 150 foreign companies, although less than 10% of these companies were actively engaged in actual mining. Many were engaged in exploration, some were in advanced stages of mine development, and some, especially very junior companies, were relatively dormant while they sought sources of investment or finance. Companies whose corporate voting rights were at least 50% non-Canadian were considered to be foreign, although other distinctions could apply in some large companies. More than 200 ferrous and nonferrous mine sites, which included coal, were active. Another 3,000 mines and quarries produced cement, sodium chlorate, sand and gravel, and other construction materials. About 40 smelters and refineries, as well as lixiviation plants, were operating in the metals and sulfuric acid industries. Foreign companies were subject to the same taxes as domestic companies, but repatriation of earnings was allowed (Giancola, 2002, p. 442-444).

Most of the Canadian mineral industry was privately owned with the notable exception of Government participation in potash and petroleum, but even these were in transition to private ownership. The Province of Saskatchewan had owned some companies, such as Potash Corp. of Saskatchewan Inc. (PCS) and part of Saskatchewan Oil & Gas Corp., which were based in Saskatoon. The Province of Alberta had owned part of Alberta Energy Co. Ltd. The proportion of Provincial government ownership was changeable, but the trend was also toward privatization in 2003. Petro-Canada (PC), which was owned partly by Federal and partly by Provincial governments, has been completely privatized in 2001. A large proportion of the total number of mining and petroleum companies had partial

public ownership with shares trading on various exchanges in Canada and the United States.

Overall, the mineral industry in Canada consisted of underground and open pit mines, leaching operations, concentrators, smelters, and refineries, as well as drilling and production operations characteristic of the petroleum industry. Table 2 lists the structure of the mineral industry, by sectors, of the major mineral commodities.

In 2001 (the latest year for which information is available), employment in the mining and mineral manufacturing industries, which included coal, was estimated to be 376,000, or a 3.4% decrease compared with that of 2000 (388,900 jobs) and a 10.9% decrease compared with that of 1989 when the number of jobs in those industries peaked at 422,000. The total number of employees in coal, metal, and nonmetal mining and quarrying decreased by almost 10%, or 46,400 compared with 51,500 in 2000. Employment in ferrous and nonferrous smelting and refining was estimated to be 83,800, or a decrease of 2.9% compared with the 2000 level. About 1,300 people also were employed in diamond drilling and other support services incidental to mining operations (Natural Resources Canada, 2002a, p. 1.7-1.8). These employment decreases in the mining sector, which was considered to be a pillar of the Canadian economy and a way of life for Canadians, were the result of the slowing down of the North American Free Trade Agreement (NAFTA) economies during 2001-02.

Commodity Review

Metals

Aluminum.—Production of primary aluminum was more than 2.7 million metric tons (Mt), which was an increase of 4.9% compared with that of 2001 (Natural Resources Canada, 2003a). This put Canada third with the United States after China and Russia in the world in volume of production. The volume of aluminum exports to the United States were Canada (60%), Russia (18%), Venezuela (4%), and Mexico (2%). The value of Canadian production increased to $3.6 billion from $3.4 billion in 2000, which reflects the increased metal price in 2001. Primary aluminum exports during 2001 were valued at $4.9 billion (Wagner, 2002a; Plunkert, 2003).

Alcan Aluminum Ltd. owned about 54% of the total Canadian primary aluminum smelter capacity with the completion of the Alma smelter in 2002. The $2.2 billion 400,000-metric-ton-per-year (t/yr) primary aluminum smelter started producing in mid-2001. The smelter's new capacity required 620 megawatts (MW) of power, 270 MW of which would come from Alcan's own grid, and 350 MW, from provincial utility Hydro-Quebec. In 2002, the company had negotiated a projected 22-year power-exchange project with Hydro-Quebec. With Hydro-Quebec furnishing additional power that Alcan may need for modernization and expansion of its various smelters in Quebec, Alcan's hydroelectric power system would accommodate Hydro-Quebec's requirements when feasible. Alcan projected that it would require an average market price of $1,400 per metric ton to meet its cost of capital. The new potlines would comprise 432 pots in two lines. The Alma facility would raise Alcan's overall primary aluminum capacity from all its plants to 1.9 million metric tons per year (Mt/yr), and Canada's production capacity would increase to 3 Mt/yr in 2005 (Wagner, 2002a).

Cobalt.—Mine production of cobalt amounted to 5.2 Mt, which was a decrease of almost 2.0% compared with 5.3 Mt in 2001. Cobalt prices continued to be depressed in spite of the slight increase in the value of nickel. Rising demand for cobalt for alloys, catalysts, magnets and batteries, and pigment, however, has focused new attention on Canadian cobalt resources led by the Voisey's Bay discovery of at least 40,000 metric tons (t) contained within the nickel-copper deposit; further results were expected as exploration and mine development progressed (Natural Resources Canada, 2003a). The expectations to proceed with a number of new hydrometallurgical nickel-cobalt laterite plants would further depress cobalt prices in the open market. The higher prices of the mid-1990s would be rather difficult to sustain in the future given the current (2002) market conditions and expectations (McCutcheon, 2002, p. 38.7).

Columbium (Niobium).—Columbium content in pyrochlore and tantalite concentrates increased by 6.8% to 3,412 t in 2002 from 3,195 t in 2001 (Natural Resources Canada, 2003a). Niobec, which was the only operating columbium mine in North America, was jointly owned (50% each) by Cambior Inc. and Teck Corp. Located near Chicoutimi, Quebec, the mine ranked as the world's third largest producer. The equal partners have undertaken a study of the feasibility of increasing production by 40% in at least two steps. Included in the upgrade would be an expansion of the crushing and grinding circuit by 20% to 50%. Columbium is used primarily as an alloying agent in specialty steels.

Copper.—Mine output of copper decreased by 5.3% to 600,187 t in 2002 from 633,531 t in 2001; this reflected the sharp world copper price decline that resulted in a 7.6% drop in value to $887 million in 2002 from $960 million in 2001 (Natural Resources Canada, 2003a, b). Canada exported $2.5 billion worth of copper during 2001 (Coulas, 2002).

After peaking in 1998, the decrease of copper prices began in the third quarter of 2000. A decline in economic activity in copper user countries in Asia, Europe, and the United States; weak market conditions; high copper inventories; sluggish world economy; and a poor economic outlook resulted in the reduction, suspension, and/or shutdown of some copper production. These reductions were responses to less demand for copper and low metal prices (Coulas, 2002). Mine outputs in 2001 and 2002 were low because of the temporary closures of the Highland Valley Copper (HVC) and the Mount Polley mines, closure of the Myra Falls Mine in British Columbia, the permanent closure of the Ruttan copper-zinc mine in Manitoba in May 2002, and lower ore grades at the Kidd Creek Mine (table 2; Giancola, 2002, p. 409, 444). No new copper mines were scheduled to come onstream until 2005. HVC mined copper at an average grade of 0.39% and processed about 45 Mt/yr to produce copper in concentrate at a cost of about $0.68 per pound (about $1.50 per kilogram).

The potential copper production at Voisey's Bay suggested that Canada, which ranked sixth after Chile, the United States, Indonesia, Peru, and Australia, will continue to be a major world copper producer (Edelstein, 2003). Expectations were that Voisey's Bay might yield 99,000 t/yr of contained copper, but because of a variety of administrative concerns with the Newfoundland Provincial Government described above, the mine was a long way from production. At Voisey's Bay's nickel-copper-cobalt deposit in Labrador, proven reserves were estimated to be 31 Mt of ore at a grade of 2.88% nickel, 1.69% copper, and 0.14% cobalt (Giancola, 2002, p. 195).

Gold.—Gold output decreased by 6.3% to 149 t in 2002 from 159 t in 2001. This decrease was primarily because of closures and suspension of activities by polymetallic producers. The value of gold production, despite a decrease in output, increased by 8.3% to $1.43 billion in 2002 from $1.32 billion in 2001 (Miron, 2002; Natural Resources Canada, 2003a, b). Ontario produced 49%; Quebec, 21%; British Columbia, 15%; Manitoba, 4%; and the Yukon Territory, the Northwest Territories, Saskatchewan, Newfoundland, Alberta, and New Brunswick, a total of 11%. Gold mines accounted for 90.8% of Canada's output, and 19 base-metal mines and numerous placers contributed with 7.5% and 1.7%, respectively, of production. Canada was the seventh largest gold producer after South Africa, the United States, Australia, China, Indonesia, and Russia. Canada exported $1.4 billion worth of gold in various forms during 2001. The principal gold refiners were Noranda Inc., which was Canada's largest mining company, in southern Quebec; the Royal Canadian Mint at Ottawa, Ontario; and Johnson Matthey Ltd. near Mississauga, Ontario (Giancola, 2002, p. 446-448; Miron, 2002; Amey, 2003).

Echo Bay Mines Ltd. put its Lupin gold mine in Nunavut on care and maintenance while it examined its options in the light of low market prices in 2000-01; the mine is located about 138 km south of the Arctic Circle. After nearly 2 years of shutdown, Echo Bay decided to reopen the Lupin Mine with $12 million of new financing and commercial production planned for 2002.

Gold still seemed to be the principal metal targeted for exploration virtually throughout Canada. With the threat of more gold mine closures, which were the result of a lack of market confidence, gold seemed to have lost at least some of its traditional luster. In September 2001, however, the European central banks' commitment to sell no more than 2,000 t of bullion during the ensuing 3 years caused a positive spike in the market price that subsided in the succeeding months as market hedging resumed (Natural Resources Canada, 2003b).

Iron Ore.—Output of iron ore increased to almost 31 Mt in 2002 from 27.1 Mt in 2001, and the value of production increased by 17.1% (Natural Resources Canada, 2003a, b). This category comprised concentrates, pellets, and sinter from hematite and siderite ores. Canada's production came from its major iron-ore-producing companies, which included Iron Ore Co. of Canada (IOC), Quebec Cartier Mining Co. (QCM), and Wabush Mines Ltd. The remaining production was from the byproduct recovery of magnetite from two base-metal smelters in British Columbia (Giancola, 2002, p. 443; Perron, 2002). Data for 2001 (the latest year for which data are available) give an approximation of the proportions of pellets and sinter versus concentrates. QCM produced 16.1 Mt of ore, 8.5 Mt of which was used for pelletization, and the remainder, for sinter feed. Shipments exceeded production so that stocks were drawn down to meet demand. IOC produced 15.9 Mt of ore, 10.8 Mt of which went to pelletization, and the remainder, to concentrates that were not used for pellets. Wabush Mines turned out 4.5 Mt of iron ore pellets (Perron, 2002).

In 2001, Canadian exports and imports of all classes of iron ore concentrates and agglomerates were 22 Mt at a value of $590 million and 5.8 Mt at a value of $208 million, respectively. Improvements of economic conditions in Asia, China, and Japan, in particular, will have marked impact on the iron ore and the steel world markets, and the Canadian iron ore industry would benefit as well. Exploration continued in various parts of Canada, such as the Peace River area of Alberta, the Roche Bay in the Northwest Territories, and the Ungava Bay and the Schefferville in Quebec (Perron, 2002).

Lead and Zinc.—As the world's third largest mine producer of zinc in 2002, Canada produced 913,185 t of zinc, and as the world's sixth largest producer of lead, the country produced 97,186 t of lead in concentrate. Zinc mine output showed a decrease of 14.2% in 2002 compared with that of 2001, and lead production decreased by 36.9% compared with that of 2001 (Chevalier, 2002; Natural Resources Canada, 2003a, b; Plachy, 2003; Smith, 2003). Zinc prices decreased sharply in 2001 because of continued poor demand in Japan, slow growth in Europe, and oversupply in the markets worldwide. New mine capacity in Australia, Ireland, and Peru; expansions in Chile, Peru, and the United States; and weak market prices continued to take their toll with a continued increase in stock levels (Chevalier, 2002).

Teck Cominco Limited began a series of production reductions (100,000 t/yr) at its Trail smelter in southern British Columbia and closed the Sullivan Mine after 92 years of continuous production. Boliden Ltd. temporally closed its Myra Falls Mine in Strathcona Provincial Park, British Columbia, in 2001, which resulted in a shortfall of about 30,000 t/yr of zinc concentrates (Chevalier, 2002).

BRL announced the closure of its Nanisivik Mine in Nunavut by September 2002. BRL's Caribou zinc mine remained on care and maintenance; reopening depends on better metal prices. Hudson Bay Mining and Smelting Co. Ltd. (a wholly owned subsidiary of Anglo American plc.) was developing its Chisel North underground zinc mine at Chisel Lake, Manitoba, which is not far from Snow Lake. A decline will be driven from the 140-meter (m) level of the main deposit to the north deposit for drilling and bulk sampling to confirm the surface-drill indicated resource of 2.4 Mt at a grade of 10.8% zinc. The $21 million capital investment was part of Hudson Bay's $260 million investment in the 777 deposit, which contains some 14.5 Mt of proven and probable zinc reserves, and included the refurbishment of the Snow Lake concentrator. Snow Lake's concentrates will be trucked 200 km southwest to the Flin Flon smelter. The 777 deposit was expected to enter into production in 2003. The construction of a $65 million electrolytic tank house also was completed. Work on a new zinc tank house at the Flin Flon smelter will increase capacity by 15% to 115,000

t/yr. Hudson Bay closed its Ruttan Mine in Manitoba at the end of May 2002 (Chevalier, 2002).

After closing its operations in the Matagami District of northern Quebec as a result of the exhaustion of the Isle Dieu and the Norita East zinc-copper mines, Noranda Inc. completed development of the $119 million Bell Allard zinc-copper mine, which also is located in the Matagami District. The underground operations would counter the exhaustion of Isle Dieu and Norita East. The Bell Allard Mine was expected to have a capacity of 80,000 t/yr of zinc and 5,000 t/yr of copper. Armed with local experience from two closed mines, Noranda pressed exploration in the Matagami District for further discoveries of copper-zinc deposits (Giancola, 2002, p. 265).

Noranda reported finding new sources of feed for milling and smelting operations in the Matagami District. A significant zinc-copper deposit of three ore zones (Equinox, Perseverance, and Perseverance West) was discovered in the existing Matagami mining camp. The Equinox deposit was 5 Mt of inferred resource with 16.8% zinc, 1.3% copper, 34 grams per metric ton (g/t) silver, and 0.4% g/t gold. Work continued to develop the four levels of polymetallic ore zones on the lower part of the Penna Shaft in the Equinox Mine. Agnico Eagle Mines Limited spent $104 million to complete the expansion of its LaRonde zinc mine in northwestern Quebec, which could produce 52,000 t/yr of zinc in concentrates in 2004 (Giancola, 2002, p. 20).

Magnesium.—Canada was the second largest producer of primary metal in the world after China. In 2002, Canada's metal output increased by 6% to 88,000 t compared with 83,000 t in 2001 (Wagner, 2002b; Kramer, 2003). Magnola Metallurgy Inc. [Noranda Inc. (80%) and Société Générale de Financement du Québec (20%)] completed construction of its 58,000-t/yr commercial magnesium plant in Danville, Quebec, after successfully completing a 250-t/yr pilot operation at a cost of $486 million. The tailings of 250 Mt will be the feedstock for the Danville plant. Magnola, which was the operator, was using a hydrochloric acid leaching process to treat the tailings. The resulting magnesium chloride solution was electrolyzed to yield magnesium metal, which amounted to 30,000 t in 2002. Full-capacity production was expected during 2003 (Wagner, 2002b).

Cassiar Magnesium Inc. held a 100% interest in the chrysotile project in Cassiar, British Columbia. The company had a stockpile of 23 Mt of serpentine tailings at 24% magnesium at the Cassiar Mine, which contained about 4 Mt of metal and 750,000 t of high-grade magnesium silicate chrysotile fibers. Cassiar was seeking potential investors and was planning to bring its 100,000-t/yr plant into production in 2003-04 (Giancola, 2002, p. 85; Wagner, 2002b, p. 32.4).

Nickel.—Mine output in concentrates decreased by about 3.2% to 178,338 t in 2002 from 184,300 t in 2001. Despite this decline, metal output increased by 2.8% to 144,476 t in 2002 from 140,591 t in 2001, and higher prices caused the value of nickel to increase by about 6% to $1.9 billion compared with that of 2001 ($1.8 billion). Nickel was the second most valuable metal following gold produced in Canada during the year (McCutcheon, 2003; Natural Resources Canada, 2003b).

Falconbridge Ltd. was the third largest producer of nickel in the world. Its operation included the Raglan Mine and mill in northern Quebec, the Sudbury operations (four mines, a mill, a smelter, and an acid plant) in Ontario, a refinery in Norway, and a mine and smelter in the Dominican Republic (McCutcheon, 2003).

The concentrate from the Craig, the Fraser, the Lindsley, and the Lockerby Mines in the Sudbury area and from the Raglan Mine was smelted in the firm's smelter near Sudbury. The matte, which contained 50% nickel from the smelter, was shipped to Falconbridge's Nikkelverk refinery in Norway where, in order of importance, nickel, copper, cobalt, and precious metals were recovered. The $360 million Raglan operation was scheduled to produce concentrates of about 20,800 t/yr of nickel and 5,200 t/yr of copper. Raglan concentrates were to be shipped from Deception Bay, which is located 100 km north of the mine, to Quebec City and to continue by rail to Falconbridge's Sudbury smelter in Ontario. In 2002, Inco Ltd. operated nickel mines, mills, smelters, and refineries in Sudbury, which produced 102,100 t of metal, and in Thompson, Manitoba, which produced 45,800 t of nickel, and a copper smelter and refinery in Sudbury. Inco produced refined nickel and nickel oxide sinter (McCutcheon, 2003).

Predictably, the world's biggest newsmaker in nickel continued to be Inco's nickel-copper-cobalt project at Voisey's Bay, where the saga, which has involved exploration, environmental activism, aboriginal claims, financial straits, and provincial politics, continued. In June 2002, Inco formalized an agreement with the Government of Newfoundland and Labrador on a $1.9 billion plan to develop the Voisey's Bay deposit. With the exploration program progressing in Labrador and at the Voisey's Bay site in 2001, Inco announced that the hydrometallurgical research and development work were to proceed and that Inco could decide to commercialize its hydrometallurgical process by 2009 or its matte recovery operation before 2012 in Argentia (McCutcheon, 2003).

In 2002, proved reserves at the site totaled 32 Mt at a grade of 2.83% nickel and 1.68% copper; indicated resources, 91 Mt at a grade of 1.25% nickel and 0.59% copper; and inferred resources, 14 Mt at a grade of 1.00% nickel and 0.70% copper. Of the resources noted, 95 Mt at a grade of 1.24% nickel and 0.59% copper would be minable by underground mining methods, and 10 Mt at a grade of 0.92% nickel and 0.72% copper would be minable by open pit. No cobalt grades were released for the Voisey's Bay deposit (Natural Resources Canada, 2003b).

Voisey's Bay Nickel Company Limited (VBNC) (a subsidiary of Inco and based in St. John's, Newfoundland) was established to develop the rich nickel, copper, and cobalt deposit on the Labrador Peninsula in eastern Canada. In June 2002, Inco had formalized an agreement with the Government of Newfoundland and Labrador on a plan to develop the Voisey's Bay deposit for $1.9 billion (Inco Limited, 2002§). The agreement will provide $470 million for an open pit and concentrator at the mine site, $120 million for the research and development program for a special hydrometallurgical process that could be used to treat the sulfide nickel ore found at Voisey's Bay, and $85 million for a demonstration plant at Argentia, Newfoundland. If the process is successful, then Inco will process the ore within the Province thus fulfilling the Provincial Government's key demand that the nickel ore be processed in Newfoundland before being

shipped out of the Province. According to VBNC's plans, the demonstration facility will be ready for feed when the mill starts producing concentrates in 2006 (Inco Limited, 2002§). With the strong recovery of nickel prices in 2002, the market will be favorable to nickel producers in Canada. Whether the timely development of Voisey's Bay and new nickel mines plus producers' destocking can provide sufficient supply to keep the nickel price in control remains to be seen, however (Rochon, 2002; Natural Resources Canada, 2003b).

Moa Nickel S.A. of Cuba, which was owned by Canada's Metals Enterprise Corp. [Sherrit International Corp. (50%) and General Nickel Company S.A. of Cuba (50%)], operated a lateritic nickel-cobalt mine in Moa, Cuba. The nickel-cobalt oxides were transformed into nickel-cobalt sulfides by leaching with sulfuric acid; the leaching is shipped to Nova Scotia and then railed to Metals Enterprise's hydrometallurgical nickel-cobalt refinery in Fort Saskatchewan, Alberta. The feed from Cuba enters Canada classified under the Harmonized System HS 2620.90, which records only gross tonnage and gross value (McCutcheon, 2002; 2003). During exploration about 120 km northeast of the town of Matagami in the Lac Rocher area, Nuinsco Resources Inc. found strong nickel-copper mineralization. This caused a staking rush into the region that included activity by major and junior mining companies.

Platinum-Group Metals.—Mine production of PGM increased by about 5.5% to 21,829 kilograms (kg) in 2002 from 20,694 kg in 2001; despite this increase in output, the value decreased by almost 31% because world PGM use decreased by 2.2% owing to lower demand for use mostly in autocatalysts and electronics during 2002 (Natural Resources Canada, 2003b). Most production has been from Inco's and Falconbridge's Sudbury nickel-cobalt mines and a smaller amount in Manitoba from Inco's Thompson Mine and from Hudson Bay's and Outokumpo Mines Ltd.'s Namew Lake Mine near Flin Flon, which was being decommissioned.

As an approximation based on past experience, Inco's ratio of PGM produced worked out to about 12 to 7.6 to 1 for palladium, platinum, and rhodium, respectively. Although rhodium amounted to only slightly more than one-twentieth of the PGM, its prices have traditionally been significantly higher than those for other members of the group; it has traded at more than $4,000 per ounce in recent years. The largest increase among the PGM was the price of palladium, which more than doubled at the beginning of 2000 ($1,000 per ounce). Canada ranked third behind South Africa and Russia in world PGM production (Hilliard, 2003a).

Silver.—Canada ranked sixth in world silver production after Mexico, Peru, Australia, China, and the United States (Hilliard, 2003b). Canadian silver production has been largely a coproduct of base-metal and gold mining and, therefore, subject to whatever mining incentive applied to the major product, whether gold, copper, and/or lead and zinc. Accordingly, silver output suffers when mines close or go on suspension for reasons that involve supply, demand, and pricing for the major mineral commodities. Production of silver increased by about 6.3% compared with that of 2001; the value of this production increased by about 13.2% (Natural Resources Canada, 2003b). Since Prime Resources Group Inc.'s Eskay Creek gold mine in British Columbia came onstream as the largest producer of silver in Canada in 1995, silver production has increased significantly; output of silver from this mine alone has been projected to be 28% of the total for the entire country (Miron, 2003).

Titanium.—Output of titanium mineral concentrates remained at the same level as that of 2001 (950,000 t) (Gambogi, 2003a). QIT-Fer et Titane Inc. of Canada invested $260 million in the construction of a plant at Sorel, Quebec, to produce an upgraded titanium slag that contains 95% titanium dioxide (TiO_2) compared with the previous Sorel slag that contained 80% TiO_2. The company aimed for extraction of 3 Mt/yr of ore. Mine output was used primarily to produce titaniferous slag. Reserves and reserve base are ilmenite. Canada, which exported 72,600 t of TiO_2 pigment to the United States, ranked first in world as a titanium supplier to the United States followed by Germany (12%), France (8%), Spain (6%), China (5%), and others (36%) (Gambogi, 2003b).

Uranium.—Production of uranium increased slightly by 0.5% to 13,056 t in 2002 from 12,991 t in 2001; the value of this production decreased by 12.8% to $380.2 million in 2002 from $436.2 million in 2001. Energy shortages in California and the focus on cleaner air and climate change have stimulated public debate on energy policy, which created a more-favorable attitude for nuclear power (Vance, 2002; Natural Resources Canada, 2003a, b). As the world's leading supplier of uranium, Canada was well placed in terms of resources, reserves, mining labor experience, and technology to maintain this position amidst increasing longer term world demand. As older mines were shut down in the Elliot Lake District of Ontario, newer ones were being developed and mined in the Cigar Lake, the Cluff Lake, the Key Lake, and the Rabbit Lake districts of Saskatchewan (table 2).

In 2002, Canada's recoverable uranium resources totaled 452,000 t of uranium, or a 3% increase compared with 437,000 t of uranium in 2001. Canadian uranium producers in northern Saskatchewan remained well positioned to capitalize on prospects for further nuclear power development in the United States and any market upturn because the transition to new production was being centered on tapping low cost high-grade uranium deposits in Canada (Vance, 2002).

Industrial Minerals

Asbestos.—Canadian asbestos value and production decreased by about 17.5% and 13%, respectively, compared with those of 2001 (Natural Resources Canada, 2003a, b). Owing to human health concerns, world production has declined since the early 1980s. Chrysotile is the only form of asbestos in the serpentine group. The amphibole group consists of actinolite, amosite, anthophyllite, crocidolite, and tremolite forms. Of these minerals, chrysotile is the least hazardous to human health and is the only asbestos mineral produced in Canada. After China and Russia, Canada was the third largest producer of asbestos and supplied about 96% of the U.S. demand (Virta, 2003). Total shipments for 2001 were estimated

to be 345,000 t at a value of $400 million. China's asbestos production was of almost exclusively short fibers for asbestos cement. China replaced Canada as the second largest producer and meeting demand in Asian markets, which could eventually threaten Russia's leading position.

Mounting concern regarding chrysotile substitutes was expected to benefit the chrysotile industry in the near to medium term. Marginal gains were expected in Latin American consumption of Canadian chrysotile; Asia, which was already a significant market (taking more than 50% of exports), was seen as expanding the demand for longer Canadian fibers. Asbestos-cement product demand was fairly steady because many users continued to favor this combination over substitute fibers and steel.

After a 6-year suspension of operations, Cassiar reopened its Cassiar asbestos mine in British Columbia in early 2000. Production increased to 24,000 t/yr from 18,000 t/yr; Cassiar was planning to increase output to 50,000 t/yr beginning in 2002 and to continue for the next 3 years (Giancola, 2002, p. 85). By far the greatest proportion of Canadian asbestos production was in Quebec in the region that includes the Thetford Mines of Bell Operations and the town of Asbestos. Principal operators were LAB Chrysotile Inc. and J.M. Asbestos Inc. Cassiar Resources Inc. indicated interest in an asbestos residues project in the Cassiar Mine in northern British Columbia. The production of metallic magnesium from asbestos mine waste materials should improve the economics of the asbestos industry and create better overall labor expectations, particularly in Quebec where decreased production has taken its toll (Wagner, 2003).

Cement.—Production of cement increased by about 1.7% from that of 2001 with a corresponding value increase of 2.9% in 2001. On the basis of preliminary data, shipments of cement in 2001 were estimated to have been 13.0 Mt at a value of $820 million compared with 12.6 Mt at a value of $790 million in 2000 (Vagt, 2002a; Natural Resources Canada, 2003a, b). This trend reflected continued strengthening of the export market in the midst of declining prices. Weakening of the Canadian dollar versus the U.S. dollar has made Canadian cement prices attractive to U.S. consumers. U.S. antidumping duties against gray portland cement and clinker from Mexico remained in effect in 2001 (Vagt, 2002a). The 1990 International Trade Commission ruling against the dumping of cement by Mexican producers essentially removed them as competitors and left the field to Canada as the principal foreign source. Total U.S. imports of cement, which excluded clinker, totaled 23 Mt in 2002 (van Oss, 2003). Canada and U.S. trade of cement and clinker varies from year to year depending on construction activity. In 2001, cement exports to the United States amounted to 4.5 Mt, which was about one-third of total Canadian production (Vagt, 2002a). For the immediate future, the success of Canadian cement producers seems to be based significantly on exports to the United States and, hence, upon the prospects for U.S. economic growth. Canadian growth and construction, particularly in Ontario, which was the largest cement market, will play the key role in determining a balance between domestic and U.S. consumption. According to the Canadian Construction Association, cement production was expected to be marginally higher mainly on the basis of lower interest rates and an increase of about 4% in the value of infrastructure to about $81.2 billion (Vagt, 2002a). Also, the Infrastructure Canada Program, which involves Federal, Provincial, Territorial, and municipal governments, will contribute about $4 billion across Canada in the coming decade (Vagt, 2002a).

The influx of Asian cement to the United States negatively affected Canadian exports between 1999 and 2001. The fact that Canada has been the major exporter to the United States has kept Canadian cement kilns operating at high rates throughout the past decade and has allowed for gains in pricing. Meanwhile, St. Lawrence Cement Inc., Inland Cement Ltd., and Ciment Quebec Inc. were considering expanding their production capacities as Canadian cement demand continued to increase (International Cement Review, 2003, p. 29).

Diamond.—Production of diamond increased by about 34.1% from that of 2001 with a corresponding value increase of 11.7% in 2002. In 2002, diamond mining completed its 4th full year of production. Diamond is now Canada's 10th largest nonfuel mineral in terms of value, which was about $501 million in 2002. The opening of the Diavik diamond project in 2003 and the startup of the Snake Lake project in 2006 will add to Canada's stature as a major producer of diamond worldwide (Natural Resources Canada, 2003a, b).

Canada's first commercial producer of diamond, BHP Diamonds Inc. (now BHP-Billiton, which has become the largest mining company in the world) acquired Dia Met Diamonds Inc. for $430 million to consolidate its interest in the Ekati diamond mine at 80%; the other owners were Charles Fipke and Stuart Blusson, each with 10% (Law-West, 2002). As operations became more efficient, production at Ekati's diamond mining complex ncreased by about 3.6% (2.63 million carats valued at $638.2 million) compared with that of 2000 (2.51 million carats valued at $606.3 million) with a corresponding value increase of 5.3% in 2001 (Giancola, 2002, p. 119). BHP-Billiton contracted to sell 35% of Ekati's production to the De Beers Group of South Africa through its subsidiary De Beers Canada Corporation (Giancola, 2002, p. 115-116).

De Beers Canada Ltd. acquired Winspear Diamonds Inc. in 2000 for $198 million and controlled 67.8% interest in the Snap Lake diamond project. In early 2001, De Beers purchased the remaining 32.2% interest in the project from Aber Resources Ltd. for $112 million. In August 2001, De Beers announced that production at the Snap Lake Mine will begin in 2006. In 2000, Diamond Trading Company (DTC) (a trading subsidiary of the De Beers Group) sold a record $3.7 billion worth of diamond. In 2001, DTC's sales were expected to be down substantially as sales in the first half were down by 26% to $1.7 billion, and the second half sales would be usually lower than the first half. Since June 1999, the first diamond cutting and polishing factory in the Northwest Territories began commercial production. Sirius Diamonds N.W.T. owned and operated the factory, and rough diamonds were supplied by BHP-Billiton (Law-West, 2002; Natural Resources Canada, 2003a, b).

BHP-Billiton reported that the quality of diamond recovered to date from the five kimberlite pipes at their Lac de Gras property compared favorably with the best pipes in other parts of the world; the property is located about 300 km northeast of Yellowknife. The five pipes were located under, in order

of importance, Panda, Koala, Misery, Fox, and Leslie Lakes and would be mined during a 30-year period. The centralized processing plant, which was southwest of the Koala pit, was to receive 9,000 metric tons per day (t/d) of ore during the first 9 years of operation and 18,000 t/d thereafter. The cutoff grade would be 0.01 carat. Processing was expected to involve mainly crushing, scrubbing, and dense-media separation, as well as high-intensity magnetic separation, x-ray concentration, and sorting. The construction phase workforce would reach 1,000 at its peak; after that, about 650 workers were to be employed during production. Future output was projected to be 3.5 million to 4.5 million carats per year, or about 5% of the world's diamond supply. Capital investment was to be in excess of $360 million, but observers expected that at least $4 billion would eventually be spent in association with the project. As early as May, BHP-Billiton noted that it would channel a portion of its production through the De Beers' Central Selling Organization (CSO). In July, De Beers Consolidated Mines Ltd. completed a sales contract to take 35% of Ekati's run-of-mine production for a period of 3 years (Giancola, 2002, p. 116; Birchfield, 2003).

In Canada, Monopros Limited (a wholly owned subsidiary of the De Beers Group) discovered more than 220 kimberlites, several of which have the potential to become diamond mines, such as the Snap Lake project that will be in full production by 2004 at a cost of $1 billion. This project will be De Beers' first mine outside of Africa, the first underground mine in Canada, and the first time that a kimberlite dyke will be mined on a large scale (Giancola, 2002, p. 250; Ralfe, 2002).

Diavik Diamond Mines Inc., which was the joint venture of Rio Tinto plc (60%) and Aber Resources (40%), received its regulatory permits that allowed construction to begin at the $850 million mine site and proceeded with plans for a 2-Mt/yr operation to begin production in early 2003 (Law-West, 2002). The Diavik diamond project is located about 35 km southeast of Ekati and 300 km northeast of Yellowknife in the Northwest Territories. The project would mine four separate kimberlite pipes with a projected production that could reach 8 million carats per year in the first year of an estimated mine life of from 16 to 22 years. At least 90% of Diavik's production would be of gem quality. The diluted proven and probable reserves were estimated to be 25.6 Mt of ore at a grade of 4.0 carats per metric ton. The Diavik diamond project was expected to produce at least 101.5 million carats at an average cost of $63 per carat during an economic cycle of about 13 years (Law-West, 2002).

More than 500 companies have been exploring for diamond, off and on, especially in the Northwest Territories but also in Alberta, British Columbia, Labrador, Manitoba, Ontario, Quebec, and Saskatchewan. The field seemed to be narrowing somewhat as various kimberlite pipes proved disappointing upon testing. BHP-Billiton supported the establishment of a facility to evaluate diamond in a community in the Northwest Territories to be used for training, basic sorting, and valuation for Government royalty purposes. This could lead to more-skilled and detailed sorting that would afford sales to qualified manufacturers in the northern region at prices, terms, and conditions similar to BHP-Billiton's other marketing arrangements in Europe and with the CSO. The First Canadian Diamond Cutting Works in Montreal became Canada's first fully integrated cutting and polishing factory with the aim of handling Canadian diamond production at a lower cost than European competitors; artisans were brought over from Belgium.

Gypsum and Anhydrite.—Production of gypsum and anhydrite increased to 8.8 Mt in 2002 from 7.8 Mt in 2001, but has not equaled the 1989 output of more than 12 Mt (Natural Resources Canada, 2003a).

Production has been mostly by Canadian subsidiaries of British and U.S. companies, such as National Gypsum (Canada) Ltd. and USG Corp., and has been governed by demand for wallboard in all building categories by consumers in Canada and the United States. Nova Scotia and Newfoundland produced the bulk of Canadian gypsum with lesser amounts from, in order of commodity value, Ontario, British Columbia, and Manitoba. Although gypsum occurs widely in Canada and the world, the high unit weight, low unit cost, and vulnerability to damage of wallboard combine to give gypsum products a relatively high place value, which discourages long-distance transportation. Instead, gypsum industries tend to develop in localities that serve developing construction requirements. As with the cement industry, gypsum production in Canada and the United States tends to develop in populous areas on both sides of the border in localized cross-border competition rather than among all the Provinces or all the States.

Production data for anhydrite are combined with those for gypsum but make up only about 2% or 3% of the total for the two materials. Heavier than gypsum and about twice as hard, anhydrite was produced in Nova Scotia by Fundy Gypsum Co. Ltd. at Wentworth and Little Narrows Gypsum Co. Ltd. at Little Narrows. In 2002, Canada was the world's third leading producer of gypsum after the United States and Iran; Canadian shipments totaled 8.1 Mt valued at about $60 million in 2001 compared with 8.6 Mt valued at about $66.1 million in 2000 (Vagt, 2002b; Olson, 2003).

Potash.—Potash production, which decreased by about 0.6% compared with that of 2001, totaled 8.2 Mt of potash, and its value decreased by 1.2%. Most of the production came from mines in Saskatchewan, but about 5% came from New Brunswick. Canada, which led the world in potash production, or 31% of the world production (26.5 Mt), probably has the largest reserve base of the material. Value of production decreased to about $1.6 billion in 2002 from $1.65 billion in 2001; this reflected lower market prices (Natural Resources Canada, 2003a, b).

Canada was the world's leading exporter of potash. Most Canadian potash was shipped to the United States (55%), Asia (29%), Latin America (11%), and Oceania and Western Europe (5%). Exports to the United States have risen steadily to satisfy agricultural needs, but lower prices for grains during 2001 and decreased production in Canada and the United States diminished the need for fertilizers. Exports to Asia, which climbed owing to an increase in shipments to China, accounted for about one-third of all seaborne exports of potash from Canada (Stone, 2003).

In January 2000, the U.S. International Trade Commission terminated the antidumping against Canadian potash producers that had been in effect since 1988. The United States imported 4.3 Mt of potash, or 93% of its total needs, and was the

dominant destination for Canadian potash in 2001 (Pearse, 2002; Searls, 2003).

Potash Corp. of Saskatchewan Inc. (PCS), which was the largest potash producer in the world, operated four mines in Saskatchewan and one underground mine and two mills in Sussex, New Brunswick. PCS's production milling capacity was estimated to be 8.2 Mt/yr of potash, which equated to 61% of Canada's total potash capacity (Giancola, 2002, p. 306).

Sulfur.—Production of all forms of sulfur decreased to 8.5 Mt in 2002 from 8.9 Mt in 2001. Sulfur from smelter gases decreased by 1.4% to 751,000 t with an accompanying increase in value of about 36.6%. Output of sulfur from, in order of importance, natural gas, crude oil, and byproducts decreased by about 4.5% to 7.8 Mt with a decrease in value of about 56.0% compared with those of 2001. Smelter-gas sulfur is converted to sulfuric acid. No Canadian production was derived from Frasch mining (Morel-à-l'Huissier, 2002; Natural Resources Canada, 2003a).

With a projected 16% share, Canada maintained its position as the world's largest producer of sulfur followed by the United States, Russia, and China and remained a leading exporter with roughly a 38% slice of world trade in sulfur. Most sulfur production was in Alberta, British Columbia, and Saskatchewan. Other provinces produced small amounts of sulfur mostly from oil refineries (Morel-à-l'Huissier, 2002; Ober, 2003).

Mineral Fuels

Coal.—Although coal production was still declining from the record high of about 78.9 Mt in 1997, it decreased by 5.0% to 66.8 Mt compared with that of 2001. The total value of production was $1.6 billion, which was an increase of 2.3% compared with that of 2001 and about 18% compared with that of 1997, because of a progressively lower conversion rate for the Canadian dollar (Natural Resources Canada, 2003a, b). In April, industry spokesmen noted that price slumps in hard coking coal for Japanese steel mill consumption were going to contribute to the worst export year in a decade for Canadian coal and that companies were going to have to be bargaining, chopping, and cutting on all fronts to keep mines open and operating. In 2001, fewer than 20 coal mines were operating in Canada, and the number was decreasing. At the same time, increased diversification and expansion into foreign markets were called for as a means to survive.

Canada's coal exports decreased to 26.8 Mt in 2002 from 30.1 Mt in 2001 as a result of weaker demand for metallurgical and thermal coal in the Japanese market; this caused Canada to slide to the world's seventh largest exporter position from the fifth largest. All exports were from western Canada, and coking coal remained Canada's major coal export, which was 24.5 Mt compared with 27.1 Mt in 2001 (Stone and Boyd, 2002; Downing, 2003). Domestic coal consumption decreased to 61.8 Mt in 2002 from 64.0 Mt in 2001, and much of the demand from eastern Canadian was being supplied by imports. The Appalachian region of the United States and the Cerrojón coal mine of Colombia were supplying bituminous coal for the Canadian steel and electricity industries, and Western U.S. subbituminous coal was being delivered to Manitoba and Ontario. Imports of coal into Canada during 2002 were about 22.1 Mt compared with 23.6 Mt in 2001, of which Colombia supplied about 14.1 Mt and the United States furnished the remainder (Natural Resources Canada, 2002a; Stone and Boyd, 2002; Downing, 2003).

Luscar, Ltd., which was Canada's largest coal producer, operated 10 coal mines in the Provinces of Alberta, British Columbia, and Saskatchewan with a production capacity of 38 Mt/yr intended to open the Cheviot Mine, which is located 65 km south of Hinton, Alberta, as a replacement for the Luscar Mine to be closed in 2004, which is located 42 km south of the town of Hinton; both mines are in the foothills of the Rockies (Giancola, 2002, p. 228; Downing, 2003). A consortium of environmental groups led by the Sierra Club Legal Defense Fund vigorously opposed the Cheviot opening and won a preliminary ruling that Luscar's environmental assessment was incomplete. The previously approved Cheviot project was overturned, and the Sierra Club faction urged that the region shift from dependence on mining to other sources of income, such as tourism. Environmental air and climate change issues are priorities for coal mining companies and industries that use coal and will affect coal production and consumption in the future. The Zero Emission Coal Alliance, which had been formed by coal companies and stakeholders and was led by the Coal Association of Canada, was pursuing long-term solutions to coal-related environmental issues and concerns. Canada ratified the Kyoto Protocol late in 2002, which confired its commitment to limit future greenhouse gas emissions (Natural Resources Canada, 2001a; Downing, 2003).

Canadian coal demand increased continuously from 58 Mt in 1998 to 62.5 Mt in 2001. About 90% of coal was used by 28 coal-fired plants to generate electricity, and the remaining 10% was used by the steel industry across Canada. Ontario and eastern Canada relied largely on U.S. imports of thermal coal and domestic supplies. Canada was a major exporter and a major importer of coal (Stone and Boyd, 2002). This paradox reflects transportation costs between mines and consumers and is one more example of the natural integration of U.S. and Canadian interests in mineral commodities; others include cement and gypsum.

Natural Gas.—The value of natural gas ($14.6 billion) decreased by 30.8% compared with that of 2001, and natural gas byproducts ($2.1 billion) decreased by 28.1% compared with that of 2001 as both products responded to supply-and-demand imbalances and decreased prices. Canada ranked third in the world after Russia and the United States in output of natural gas. Increasingly, the production of natural gas has played a major role in the mineral economy of Canada and has had a palpable effect on the GDP. Gross output remained about the same level as that of 2001 and increased to about 201 billion cubic meters from 195 billion cubic meters in 2000. Production of marketed gas remained at about the same level as that of 2001 (172 billion cubic meters) compared with that of 2000 (162 billion cubic meters) (Natural Resources Canada, 2003b). Marketed gas is gross production minus reinjected gas, shrinkage, and producer consumption (plant use).

About 89.4 billion cubic meters of natural gas, or roughly 10% of the U.S. supply, was exported to the United States

in 2001. Gas exports to the United States were expected to increase to about 100 billion cubic meters by 2006 in anticipation of the increasing inability of U.S. domestic production to meet the demand. In 2001, Canada's natural gas reserves were projected to be about 1.7 trillion cubic meters, which was a net decrease of 2.3% compared with those of the preceding year (Natural Resources Canada, 2003a).

Spurred by increasing U.S. demand, exploration for new discoveries of natural gas primarily in Alberta and Saskatchewan continued the expansion that began at least two decades ago. Chevron Canada Resources Ltd. (a unit of ChevronTexaco Corp.) had one of the largest natural gas strikes in recent history near Fort Laird, Northwest Territories, where projections by the company showed between 11.3 billion and 17.0 billion cubic meters (400 billion and 600 billion cubic feet) of gas in place in more than 400 meters (1,200 feet) of pay zone. Accessing Canada's abundance of fuels, particularly oil in northern Alberta and natural gas in the Northwest Territories, has become economically feasible because of new technology and rising fuel prices (Natural Resources Canada, 2001c). Opposition to natural gas exploration, production, and transmission, however, has grown in recent years. Environmental groups opposed construction of proposed pipelines to feed demand in the United States and the Rocky Mountain Ecosystem Coalition attempted to slow the expansion of natural gas exploration and production activities in northern Alberta. A National Energy Board report, which assessed supplies and demand to 2025, put known natural gas reserves in Canada's "northern frontier" at 680 billion cubic meters (24 trillion cubic feet) with reserves estimated to be 4.8 trillion cubic meters (170 trillion cubic feet) (Natural Resources Canada, 2001c). The United States consumed almost 609 billion cubic meters (21.5 trillion cubic feet) per year of gas, and demand was expected to grow by about 2% per year for the next 20 years (Washington Times, 2001).

Petroleum.—Production of petroleum reached a new record high of 864 million barrels (Mbbl) in 2002 compared with 817 Mbbl in 2001, 804 Mbbl in 2000, and 808 Mbbl in 1998; this was an increase of about 5.8% in 2001 and almost 7% in 1998. The value of the production in 2002 increased by 22.3% compared with that of 2001, which reflected the worldwide effect on market pricing of the coordinated decrease in production by the exporting states of the Organization of Petroleum Exporting Countries during 2000-01. Value of the crude oil produced in 2002 amounted to $192.5, which was down from $25.9 billion in 2001 and $31.5 billion in 2000 (Natural Resources Canada, 2003a, b).

After selling 30% of PC, the Government continued with privatization by offering much of the other 70% with the aim of reducing its share to perhaps 20%. During 2000-01, PC relinquished conventional crude production in western Canada when it shifted its interest to, in order of importance, oil sands, natural gas, and offshore projects. PC was lauded as the model for a state-owned oil company. It owned a 25% share of the immense Hibernia petroleum field offshore Newfoundland and a 25% share in Terra Nova field adjacent to Hibernia in the Jeanne d'Arc Basin, for which PC can claim discovery. After Terra Nova, the White Rose field, also in the Jeanne d'Arc Basin, was considered for development.

The Hibernia field, which is under 75 meters (m) of water, was initially thought by its operators to contain about 615 Mbbl of light waxy oil. The field was being developed in a $6.5 billion project by PC and a consortium of companies that included Mobil Oil Canada Ltd. (ExxonMobil Corporation), Chevron Canada Resources (ChevronTexaco), and Murphy Oil Company Ltd.; the Government provided large subsidies. The offshore platform, which was put on location in early 1998, used new and unique technical design features to resist damage by icebergs. ExxonMobil, which owned 33% of the project, predicted that output will increase to 180,000 barrels per day (bbl/d) and upped its reserve estimate for the Hibernia field to 750 Mbbl out of about 3 billion barrels (Gbbl) in place (Natural Resources Canada, 2001b).

The Athabasca oil sands (bitumen) north of Fort McMurray, Alberta, played an increasingly important role in Canadian oil production. Output from bitumen plus synthetic crude was 215 Mbbl in 2001, which was about 25% of Canada's total production. Technological development and increased operating efficiencies have steadily reduced production costs by Suncor Energy Inc. and Syncrude Canada Ltd., which were the two major operators, at their sites in northern Alberta and Saskatchewan, respectively. These operations, which accounted for more than one-fifth of Canada's crude oil, were in the process of substantial expansion. Suncor's operating costs at its oil sands plant in Alberta dropped to below $12 per barrel in 1998 from $14 per barrel in 1995 and was projected to have dropped to $9 per barrel in 2000. Hence, the crude from the Athabasca sands sold for $6 or $7 more than the cost of production. Canada's National Energy Board predicted that the oil sands could contribute 50% of national production by 2010 (Natural Resources Canada, 2001b).

The Athabasca, the Peace River, and other bitumen and heavy oil deposits in Alberta amount to 2.5 trillion barrels of oil in place, which is about 40% of the world's known bitumen. As of 1996, the 300 Gbbl considered to be recoverable exceeded the 265-Gbbl reserves of Saudi Arabia, but the latter could be extracted for less than $1 per barrel. The Province of Alberta lowered its royalty on oil sand crude late in 1995 and stipulated that it be 1% on all production until companies pay off capital costs and earn a return that matches interest rates for long-term bonds. They would then pay a 25% royalty on each barrel produced (Natural Resources Canada, 2001b).

Syncrude's North Mine expansion will increase bitumen production to support output of 260,000 bbl/d of synthetic crude oil, and further expansions will increase crude oil production to 460,000 bbl/d by 2007. Suncor's Steepbank and new Millennium Mines could increase production by more than 80% if crude oil production increases to 220,000 bbl/d by 2003. The total capital investment in these large surface mines would be about $6.5 billion from 2000 through 2007. The Athabasca oil sands mining region could become a hub of mining technology innovation and equipment advances that could have an impact on open pit mining worldwide (Natural Resources Canada, 2001b).

Reserves

Table 3 lists the levels of Canadian reserves of copper, gold, lead, molybdenum, nickel, silver, zinc, and other selected mineral commodities on or about January 1, 2003. Data are shown in terms of metal contained in ore for the base and precious metals or recoverable quantities of other mineral commodities, which included industrial minerals and mineral fuels. These mineral reserves represent "proven" and "probable" categories and exclude quantities reported as "possible." Reserves were defined as being well-delineated and economically minable ore from mines committed to production.

Yearly changes in the assessment of reserves are, in simplest terms, the arithmetic result of additions to reserves, deletions from reserves, and production. A complication in Canada is that a large number of mines produce more than one metal, thus necessitating close attention to market price and processing costs for two or possibly several mineral commodities simultaneously to enable production as coproducts.

During 2000 and 2001, reserves of the leading base and precious metals increased significantly. The only exception was lead, which decreased by 13.5%. Other metals increased—copper, 19%; nickel, 15.8%; zinc, 7.8%; and gold, 5.6%. Other than for gold, reserves of major metals, such as iron ore and lead, fell steadily from the 1980s through 2001. During this period, gold reserves trebled from about 500 t to more than 1,500 t as rising prices and the possibility of more price increases provided a strong incentive to exploration. Silver reserves increased to about 47,000 t from about 17,000 t during the same period (Reed, 2002).

Reserves of major metals were distributed unevenly throughout Canada and were mostly the result of mineralization in the Precambrian shield, the Rockies (Cordillera), and the Coast Ranges. Several Provinces dominated the reserves position in terms of proven and probable minable reserves of major metals. From east to west, New Brunswick had 76% of the lead reserves, 35% of the zinc, and 25% of the silver; Quebec had 26% of the zinc, 20% of the gold, 18% of the silver, 10% of the nickel, and 9% of the copper; Ontario had 72% of the nickel, about 51% of the gold, 50% of the copper, 22% of the silver, and 18% of the zinc; Manitoba had 18% of the nickel, 6% of the zinc, and 4% each of copper and gold; and British Columbia had 100% of the molybdenum, about 35% of the copper, 32% of the silver, and 19% of the gold. Future discoveries will alter the distribution of reserves among the Provinces and the Territories (Natural Resources Canada, 2003a, b).

Infrastructure

With a total land area of about 9.2 million square kilometers, which is slightly larger than the United States, Canada had networks of highly developed infrastructure and vast areas of trackless wilderness. The country had 902,000 km of roads that comprised 318,400 km of paved highway, which included 16,600 km of expressways, and 584,000 km of unpaved gravel or other loose-surface roads. Bulldozed temporary roads have been established for mining exploration in many remote places, but these deteriorate readily where not maintained.

A total of 36,114 km of standard-gauge railroads included two main systems—the Canadian National and the Canadian Pacific. The country also has about 3,000 km of inland waterways, which included the Saint Lawrence Seaway (one of the busiest in the world), that lead into the Great Lakes and mark the boundary with the United States in many places. Principal ports were Halifax, Montreal, Quebec, St. John (New Brunswick), St. John's (Newfoundland), and Toronto in the east and Vancouver in the west. Canada's merchant marine comprised about 114 ships of 1,000 or more gross registered tons.

The country had 1,417 airports. Among these, 517 had permanent-surface runways—18 had runways longer than 3,047 m; 15, runways from 2,438 to 3,047 m long; 151, runways from 1,524 to 2,437 m long; 244, runways from 914 to 1,523 m long; and 89, runways under 914 m long. Civil aviation included about 636 major transport aircraft; Air Canada was the major carrier (U.S. Central Intelligence Agency, 2002§).

Canada generated electrical power from coal, natural gas, and nuclear fuels, as well as massive hydroelectric facilities. Total capacity was roughly 114 gigawatts. About 576.2 net terawatthours, which was significantly less than capacity, was produced in 2000 (the last year for which complete data are available). Hydroelectric plants generated 61% of Canada's electricity; coal and fossil fuel, 25%; nuclear reactors, about 12%; and others, 2%. Quebec and Ontario produced the most electricity, 154 and 141 megawatthours, respectively. Nearly 97% of Quebec's electricity came from hydroelectric plants, and the remaining 3% was produced mainly by nuclear facilities. In contrast, about 61% of Ontario's electric power was derived from nuclear plants, and the remainder from, in order of importance, hydroelectric and coal-fired plants. Most of Canada's electricity exports originated in New Brunswick, Ontario, and Quebec and were sold to consumers in New England and New York. British Columbia and Manitoba also exported large amounts of electricity, mainly to California, Minnesota, Oregon, and Washington. Except for Alberta, all Canadian Provinces that border the United States had transmission links to the neighboring systems. Canada was a net exporter of, in order of importance, crude oil, natural gas, coal, uranium, and hydropower and was the main source of U.S. energy imports (U.S. Central Intelligence Agency, 2002§; U.S. Energy Information Administration, 2002§).

An extensive system of pipelines connected oil- and gas-producing and consuming areas in Canada and the United States. The system was dominated by the Interprovincial Pipe Line, which delivered oil from Edmonton, Alberta, east to Montreal, Quebec, and the U.S. Great Lakes region, and the TransMountain Pipe Line, which delivered oil mainly from Alberta west to refineries and terminals in the Vancouver area and to the Puget Sound area of Washington. Canadian natural gas was transported largely by TransCanada Pipe Lines Ltd. of Calgary, Alberta, which owned 13,600 km of mainline gas pipelines in Canada and 56 compressor stations that linked western Canadian gas producers with consumers in eastern Canada and the United States. The Canadian pipeline network included about 24,000 km for crude oil and refined products and 75,000 km for transmission of natural gas. Alberta's network represents the greatest length for any Province (U.S.

Central Intelligence Agency, 2002§; U.S. Energy Information Administration, 2002§).

Outlook

Canada continued on the path of its economic recovery after a decline during most of 2001 and the first half of 2002. Canada was a net exporter of metals, industrial minerals, fuel minerals, uranium, and hydropower. Canada's mineral industry has been encouraged by the Federal Government to work with the minerals sector to improve the permitting process. The goal is to allow exploration and mining companies to comply with the regulatory requirements in a timely and efficient way and at the same time to operate within high environmental and social standards. Progress is being made toward improving the regulatory regime in northern Canada. Government and industry are enthusiastic about the concept of a Northern Mines Ministers Conference to be held each year to report on progress, to identify challenges, and to network with all concerned stakeholders to reestablish an attractive investment climate and to reverse any economic difficulties (in particular, those of the Yukon Territory) after having been battered by economic and environmental factors (Excell, 2002; Steele, 2002a, b).

If Canada's weakened dollar continues, presumably this could assist exports, but it could discourage imports of certain necessary commodities, specialized equipment, and ad hoc professional expertise to enhance the Canadian mineral industry. The new law, Standards of Disclosure for Mineral Projects, was instituted in 2001 and will be implemented across Canada between 2001 and 2003; this instrument was expected to avert future scandals, such as Bre-X. The value of metal production in 2001 and 2002 remained almost identical after declining for the past 2 years. This can be attributed to a significant increase in the value of, in order of importance, crude oil, natural gas and byproducts, gold, nickel, potash, copper, iron ore, diamond, and uranium. In 2002, the overall value of fuel minerals production remained stable with a small decrease of 9.3%. Despite the overall increases in the volume of most fuels, except natural gas, lower energy prices caused the record high value in 2000 ($41.0 billion) and decreases in 2001 ($40.6 billion) and in 2002 ($37.0 billion). Increases in the values of production for crude oil (22.3%) and coal (2.3%) were offset by declines in the value of natural gas (30.8%) and natural gas byproducts (28.1%) (Natural Resources Canada, 2003b).

The Hibernia offshore oil project began production with the promise of rich payoffs. After Hibernia will come the Terra Nova and the White Rose fields in the Jeanne d'Arc Basin. Comparisons of the Canadian offshore and the development of the now-legendary North Sea fields continue to be heard.

The nickel-copper-cobalt discovery at Voisey's Bay and the diamond discoveries at Diavik, Jericho, and Snap Lake make an impressive case for more exploration in Canada, no matter how attractive and lucrative the opportunities could be in Asia, Australia, and/or Latin America. New prospects have been found for gold in many parts of Canada since current (2002) market pricing promises more encouragement for the future.

The concerted effort to reconcile conflicting interests in, in order of importance, the formulation of policy concerning ownership, aboriginal issues, mining development, social instabilities, environmental constraints and remediation, and economic necessity in furthering the concept of sustainable development has been difficult to assess or predict. Active engagement of these issues among the private sector, the Government, and communities (stockholders and stakeholders) will probably help provide outcomes that would support the future of the Canadian mining industry.

In June 2002, Inco formalized an agreement with the Government of Newfoundland and Labrador to develop the Voisey's Bay deposit during a 30-year mine life with an investment of $1.9 billion. Mine development started in July. First concentrate is expected to be produced in 2006. The full support by the Federal Government will assure sustainable economic development of the Provinces (Inco Limited, 2002§).

Canada continues to be well-positioned in terms of its mineral-resource base and its access to NAFTA, Europe, Japan, and other markets worldwide. It's mineral industry is primarily export oriented with as much as 92% of the production of some commodities going to world markets. The United States should continue to be a major market for Canada's minerals. In this regard, the industry's export capability is enhanced significantly by a lower exchange rate for the Canadian dollar.

Canada cannot escape the realities of globalization and internationalization especially from developing countries that have better mineral-resources and liberalized economic and political systems to attract foreign investment. Canada's greatest long-term asset may be the achievement of a popular consensus in support of sustainable development that respects the interests of mining companies, First Nation peoples, and the preservation of the environment.

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Chamber of Mines of Eastern British Columbia
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Nelson, British Columbia V1L 5X4
Canada
Mining Association of British Columbia
P.O. Box 12540, 860,
1066 West Hastings St.
Vancouver, British Columbia V6E 3X1
Canada
Alberta Chamber of Resources
1410 Oxford Tower, 10235 101 St.
Edmonton, Alberta T5J 3G1
Canada

Saskatchewan Mining Association Inc.
1740 Avord Tower
Regina, Saskatchewan S4P 0R7
Canada
The Mining Association of Manitoba
700-305 Broadway
Winnipeg, Manitoba R3C 3J7
Canada
Ontario Mining Association
1114-111 Richmond Street West
Toronto, Ontario M5H 2G4
Canada
Quebec Asbestos Mining Association
410-1140 Sherbrooke St. West,
Montreal, Quebec H3A 2M8
Canada
Quebec Mining Association Inc.
942-2635 Boulevard
Hochelaga, Ste. Foy
Quebec G1V 4W2
Canada
The New Brunswick Mining Association
Suite 312-236 St. George St.
Moncton, New Brunswick E1C 1W1
Canada
Chamber of Mineral Resources of Nova Scotia
202-5525 Artillery Place
Halifax, Nova Scotia B3J 1J2
Canada

Major Publications

Canadian Geoscience Council, annual report.
Canadian Institute of Mining and Metallurgy, Bulletin, 10 issues per year.
Canadian Mineral Analysts, monthly.
Canadian Mining Journal.
Natural Resources Canada:
Canadian Minerals Yearbook, annual.
Canadian Mineral Industry Reports, monthly.
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TABLE 1
CANADA: PRODUCTION OF MINERAL COMMODITIES [1]

(Metric tons unless otherwise specified)

Commodity		1998	1999	2000	2001	2002[p]
METALS						
Aluminum:						
Alumina, gross weight	thousand tons	1,229	1,233	1,200 [e]	1,200 [e]	1,200 [e]
Metal:						
Primary		2,374,118	2,389,835	2,373,460	2,582,746	2,708,910
Secondary		111,000	112,000	148,000	180,000	180,000
Total		2,485,118	2,501,835	2,521,460	2,762,746	2,888,910
Antimony[2]		428	357	433	234 [r]	143
Arsenic trioxide[e, 3]		250	250	250	250	250
Bismuth[2]		219	311	243	258 [r]	189
Cadmium:						
Mine output, Cd content[2]		1,361	1,390	1,051	979 [r]	896
Metal, refined		2,000	1,911	1,941	1,429	1,400 [e]
Calcium	kilograms	W	224,864 [r]	170,246 [r]	133,200 [r]	135,000
Cobalt:						
Mine output, Co content[2]		5,861	5,324	5,298	5,334	5,200
Metal:						
Shipments[4]		2,262	2,015	2,022	2,112 [r]	2,027
Refined, including oxide		4,415	3,972	4,079	4,063	4,100
Columbium (niobium) and tantalum:						
Pyrochlore concentrate:						
Gross weight		5,110	5,140	5,070	7,070	7,550
Nb content		2,300	2,313	2,280	3,180	3,400
Tantalite concentrate:						
Gross weight		238	208	228	308	232
Ta content		57	66	57	77	58
Nb content		11	13	11	15	12
Copper:						
Mine output, Cu content[2]		703,245	581,583	633,855	633,531 [r]	600,187
Electrowon		1,800	--	--	--	--
Total		705,045	581,583	633,855	633,531 [r]	600,187
Metal:						
Smelter:						
Primary, blister		553,133	542,439	545,514	552,512	538,790
Secondary and scrap		71,338	66,782	66,800	74,128	74,000
Total		624,471	609,221	612,314	626,640	612,790
Refined:						
Primary		489,941	476,079	551,393 [r]	567,720 [r]	494,273
Secondary		72,635	72,484	61,300 [r]	42,800 [r]	25,770
Total		562,576	548,563	612,693 [r]	610,520 [r]	520,043
Gold, mine output	kilograms	165,599	157,617	156,207	158,875 [r]	148,860
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand tons	37,808	33,900	35,247 [r]	26,981	30,969
Fe content	do.	24,082	21,650	22,744	17,186	19,820
Metal:						
Pig iron	do.	8,937	8,783	8,900	8,780	8,800
Direct-reduced iron	do.	1,240	920	920 [e]	920 [e]	920 [e]
Ferroalloys, electric arc furnace:[e]						
Ferrosilicon	do.	56	56	56	56	56
Silicon metal	do.	30	30	30	30	30
Ferrovanadium	do.	1	1	1	1	1
Total	do.	87	87	87	87	87
Crude steel	do.	15,930	16,300	15,900	16,300	16,300 [e]

See footnotes at end of table.

TABLE 1--Continued
CANADA: PRODUCTION OF MINERAL COMMODITIES [1]

(Metric tons unless otherwise specified)

Commodity		1998	1999	2000	2001	2002[p]
METALS--Continued						
Lead:						
Mine output, Pb content		189,752	162,180	148,769	153,932 r	97,186
Metal, refined:						
Primary		129,750	137,172	143,303	127,007 r	133,815
Secondary		135,737	129,243	141,030	103,921 r	117,449
Total		265,487	266,415	284,333	230,928 r	251,264
Lithium, spodumene[e]		22,500	22,500	22,500	22,500	22,500
Magnesium, metal, primary[e]		77,109 [5]	80,000	80,000	83,000 r	88,000
Molybdenum, mine out, Mo content		8,469	6,250	7,457	8,556 r	7,521
Nickel:						
Mine output, Ni content[2]		208,302	176,749	190,793	184,300 r	178,338
Refined[6]		146,755	124,260	134,225	140,591	144,476
Platinum-group metals, mine output	kilograms	16,408	13,872	16,110	20,694 r	21,879
Selenium, refined[7]	do.	398,000	359,000	335,000	238,000 r	226,000
Silver:						
Mine output, Ag content		1,195,943	1,174,000	1,212,000	1,265,000 r	1,344,000
Refined		1,579,030	1,246,000	1,188,000	1,224,400	1,344,400
Tellurium, refined[7]		62,000	64,000	53,000	51,000 r	45,000
Titanium, Sorel slag[e, 8]		950,000	950,000	950,000	950,000	950,000
Uranium oxide, U content		12,896	10,157	10,683	12,991 r	13,056
Zinc:						
Mine output, Zn content		1,061,645	963,321	1,002,242	1,012,048 r	894,399
Metal, refined, primary		745,131	776,927	779,892	661,172 r	793,475
INDUSTRIAL MINERALS						
Asbestos		302,000	337,000	307,000	277,000 r	241,000
Barite		90,000	123,000	121,000	23,000 r	13,000
Cement, hydraulic[9]	thousand tons	12,124	12,625	12,612	12,986	13,200
Clay and clay products[10]	value, thousands	$91,579	$164,718	$175,449	$194,580 r	$235,189
Diamond	carats	300,006	2,429,000	2,533,750	3,716,000 r	4,984,000
Diatomite[e]		10,000	10,000	10,000	10,000	10,000
Gemstones, amethyst and jade		136	218	235	148 r	348
Gypsum and anhydrite	thousand tons	8,967	9,345	9,232	7,821 r	8,847
Lime[9]	do.	2,514	2,565	2,525	2,213 r	2,237
Magnesite, dolomite, brucite[e]		180,000	180,000	180,000	180,000	180,000
Mica, scrap and flake[e]		17,500	17,500	17,500	17,500	17,500
Nepheline syenite		636,000	676,000	717,000	710,000 r	724,000
Nitrogen, N content of ammonia		3,899,900	4,134,900	4,129,000	3,438,700	3,440,000
Potash, K_2O equivalent	thousand tons	9,201	8,475	9,202	8,237 r	8,189
Pyrite and pyrrhotite, gross weight[e]		5,000	5,000	5,000	5,000	5,000
Salt	thousand tons	13,296	12,686	11,994	13,725 r	12,313
Sand and gravel	do.	229,780	242,369	238,494	236,486 r	229,535
Silica, quartz[11]	do.	1,905	1,702	1,514	1,613 r	1,556
Sodium compounds, n.e.s.:[e]						
Sodium carbonate, soda ash	do.	300	300	300	300	300
Sodium sulfate, natural[12]	do.	320 [5]	305 [5]	305	305	305
Stone[13]	do.	129,057	130,226	139,188	124,758 r	119,113
Sulfur, byproduct:						
Metallurgy	do.	836	843	849	762 r	751
Petroleum	do.	8,404	8,656	8,621	8,154 r	7,787
Total	do.	9,240	9,499	9,470	8,916 r	8,538
Talc, pyrophyllite, soapstone	do.	71	79	90 r, e	90 r, e	90 e

See footnotes at end of table.

TABLE 1--Continued
CANADA: PRODUCTION OF MINERAL COMMODITIES [1]

(Metric tons, unless otherwise specified)

Commodity		1998	1999	2000	2001	2002[p]
MINERAL FUELS AND RELATED PRODUCTS						
Carbon black[e]		165,000	165,000	165,000	165,000	165,000
Coal, run-of-mine:						
Bituminous and subbituminous	thousand tons	63,596	60,834	58,037	59,042	55,622
Lignite	do.	11,790	11,663	11,126	11,319	11,200
Total	do.	75,386	72,497	69,163	70,361	66,822
Coke, high-temperature	do.	3,142	3,307	3,307	3,300	3,300 [e]
Natural gas:						
Gross	million cubic meters	204,022	190,912	195,457	200,709 [r]	200,890
Marketed	do.	173,359	162,219	166,078	171,388 [r]	171,348
Natural gas liquids:						
Pentanes plus	thousand 42-gallon barrels	68,370	67,735	67,700	66,000	66,000 [e]
Condensate	do.	2,827	2,930	2,900	2,800	2,800 [e]
Total	do.	71,197	70,665	70,600	68,800	68,800 [e]
Peat		1,125	1,253	1,277	1,319 [r]	1,301
Petroleum:						
Crude[14]	thousand 42-gallon barrels	807,612	768,934	803,919	816,505 [r]	863,972
Refinery products:[e]						
Propane, butane, naphtha, liquefied petroleum gas	do.	14,990 [5]	12,700	13,300	13,700	14,000
Gasoline:						
Aviation	do.	933 [5]	790	900	850	900
Other	do.	256,372 [5]	218,000	228,000	235,000	242,000
Petrochemical feedstocks	do.	33,530 [5]	28,500	29,800	30,800	32,000
Jet fuel	do.	34,953 [5]	29,700	31,100	32,100	33,500
Kerosene	do.	1,995 [5]	1,700	1,700	1,800	2,000
Distillate fuel oil, diesel and light	do.	196,511 [5]	167,000	175,000	180,000	184,000
Lubricants including grease	do.	7,884 [5]	6,700	7,000	7,200	7,100
Residual fuel oil, heavy	do.	50,736 [5]	43,100	45,100	46,500	48,000
Asphalt	do.	26,007 [5]	22,100	23,200	23,900	25,000
Petroleum coke	do.	7,207 [5]	6,200	6,500	6,700	7,000
Unspecified	do.	26,489 [5]	22,500	23,600	24,300	25,500
Refinery fuel and losses[15]	do.	25,601 [5]	21,800	22,800	23,500	24,000
Total	do.	683,208 [5]	581,000	608,000	626,000 [3]	645,000

[e]Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. [p]Preliminary. [r]Revised.
W Withheld to avoid disclosing proprietary data. -- Zero.

[1]Table includes data available through July 2003.

[2]Metal content of concentrates produced.

[3]Revised July 2004.

[4]Cobalt content of all products derived from Canadian ores, which includes cobalt oxide shipped to the United Kingdom for futher processing and nickel-cobalt matte shipped to Norway for refining.

[5]Reported figure.

[6]Nickel contained in products of smelters and refineries in forms, which are ready for use by consumers. Natural Resources Canada has revised all refined nickel figures to conform with International Nickel Study Group (INSG) guidelines.

[7]From all sources, which includes imports and secondary sources. Excludes intermediate products exported for refining.

[8]Refined Sorel slag has been upgraded to 95% titanium oxide.

[9]Producers' shipments and quantities used by producers.

[10]Includes bentonite products from common clay, fire clay, stoneware clay, and other clays. Values are in current Canadian dollars.

[11]Producers' shipment of quartz.

[12]Excludes byproduct production from chemical plants.

[13]Crushed, building, ornamental, paving, and similar stone.

[14]Includes synthetic crude, from oil shale and/or tar sands.

[15]Refinery fuel represents total production of still gas, which includes a small amount sold.

TABLE 2
CANADA: STRUCTURE OF THE MINERAL INDUSTRY IN 2002

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum	Alcan Aluminum Ltd.	Smelter in Laterriere, Quebec	204.
Do.	do.	Smelter in Isle-Maligne, Quebec	73.
Do.	do.	Smelter in Beauharnois, Quebec	48.
Do.	do.	Smelter in Shawinigan, Quebec	84.
Do.	do.	Smelter in Grande-Baie, Quebec	180.
Do.	do.	Smelter in Arvida, Quebec	232.
Do.	do.	Smelter in Kitimat, British Columbia	272.
Do.	Alcan Inc. (Alcan Aluminium Ltd., 54%; Aluisuisse Lonza Group Ltd., 46%)	Smelter in Alama, Quebec	400.
Do.	Aluminiere de Becancour Inc. (Pechiney Corp., 25%; Quebec Government, 24.95%)	Smelter in Beacancour, Quebec	360.
Do.	Canadian Reynolds Metals Co. Ltd. (Reynolds Metals Co., 100%)	Smelter in Baie-Comeau, Quebec	400.
Do.	Aluminerie Alouette Inc. (Vereinigte Aluminum-Werke (VAW), Germany, 20%; Corus Group plc, Netherlands, 20%; Austria Metall (AMAG), Austria, 20%; La Société Générale de Financement, Canada, 20%; Kobe Steel, 13.3%; Marubeni Corp., Japan, 6.7%)	Smelter in Sept-Iles, Quebec	218.
Do.	Aluminerie Lauralco Inc. (Alumax Inc., United States)	Deschambault, Quebec	215.
Asbestos	Lac d'Amiante du Quebec, Ltee (LAQ) (Jean Dupere, President of LAB Chrysotile, Inc.; Connell Bros. Co. Ltd.)	Black Lake, Quebec	160 (fiber).
Do.	Bell Operations (Mines D'Amiante Bell)	Thetford Mines, Quebec	70 (fiber).
Do.	JM Asbestos Inc.	Jeffrey Mines at Asbestos, Quebec	250 (fiber).
Cement	Lafarge Canada Inc.	Bath, Ontario	1,045 (dry-process).
Do.	do.	Exshaw, Alberta	1,029 (dry-process).
Do.	do.	Kamloops, British Columbia	194 (dry-process).
Do.	do.	Richmond, British Columbia	474 (wet-process).
Do.	do.	St. Constant, Quebec	991 (dry-process).
Do.	do.	Brookfield, Nova Scotia	527 (dry-process).
Do.	St. Lawrence Cement Inc. (Independent Cement Inc.)	Joliette, Quebec	991 (dry-process).
Do.	do.	Mississauga, Ontario	1,876 (wet and dry).
Do.	ESSROC Canada Inc.	St. Basile, Quebec	1,124 (dry-process).
Do.	North Star Cement Ltd.	Corner Brook, Newfoundland	152 (dry-process).
Do.	Federal White Cement Ltd.	Woodstock, Ontario	170 (dry-process).
Do.	St. Marys Cement Corp.	Bowmanville, Ontario	1,550 (dry-process).
Do.	do.	St. Marys, Ontario	645 (dry-process).
Do.	Inland Cement Ltd. (S.A. Cimenteries CBR)	Edmonton, Alberta	726 (dry-process).
Do.	Tilbury Cement Ltd. (S.A. Cimenteries CBR)	Delta, British Columbia	1,040 (dry-process).
Coal	Quinsam Coal Corp. (Hillsborough Resources Ltd., 63%; Marubeni Corp., 33%; unknown, 4%)	Quinsam Coal Mine at Campbell River, British Columbia	14,400 (open pit and underground).
Do.	Cape Breton Development Corp. (Government of Canada, 100%)	Sydney, Nova Scotia	2,000 (underground).
Do.	Luscar, Ltd.	Obed Mountain Mine in Hinton, Alberta	13,500 (open pit).
Do.	do.	Cheviot Mine in Hinton, Alberta	14,000 (open pit).
Do.	Gregg River Resources Ltd. (Gregg River Coal Inc., 60%; seven Japanese Companies, 40%)	Gregg River Mine in Hinton, Alberta	3,960 (open pit).
Do.	Manalta Coal Ltd. (Transalta Utilities Corp.)	Highvale Mine at Seba Beach, Alberta	11,610 (open pit).
Do.	Smoky River Coal Ltd. (Smoky River Holdings Ltd., 100%)	Grande Cache, Alberta	3,600 (open pit and underground).
Columbium	Niobec Ltd. (Cambior Inc., 50%; Teck Corp., 50%)	Niobec Mine, Chicoutimi, Quebec	3,500 (underground).

See footnotes at end of the table.

TABLE 2--Continued
CANADA: STRUCTURE OF THE MINERAL INDUSTRY IN 2002

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Copper	Cassiar Mining Corp. (Princeton Mining Corp., 100%)	Similcom Mine in Princeton, British Columbia (suspended in 1996)	9,000.
Do.	Falconbridge Ltd. (Noranda Inc., 50%; Trelleborg AB, 50%)	Sudbury operations, Sudbury, Ontario	4,250.
Do.	do.	Strathcona and Timmins operations in Timmins, Ontario	4,860.
Do.	Falconbridge Ltd. (Noranda Inc., 50%; Trelleborg AB, 50%)	Smelter in Timmins, Ontario	440.
Do.	Gibraltar Mines Ltd.	McLease Lake, British Columbia (suspended)	29.
Do.	Highland Valley Copper (Cominco Ltd., 50%; Billiton plc., 33.6%; Teck Corp., 13.9%; Highmont Mining Co., 2.5%)	Logan Lake, British Columbia (suspended)	4,500.
Do.	Inco Ltd.	Thompson district, Manitoba	Variable (polymetallic).
Do.	do.	Smelter in Sudbury, Ontario	500.
Do.	do.	Refinery in Sudbury, Ontario	170.
Do.	Noranda Inc.	Smelter in Thompson, Manitoba	686 (projected).
Do.	do.	Mines Gaspe, Murdochville, Quebec	4,000 (ore).
Do.	do.	Horne Smelter in Noranda, Quebec	770.
Do.	Huckleberry Mines Ltd. (Imperial Metals Corp., 50%; Japanese consortium, 50%)	Huckleberry Mine in Omineca, southeast of Houston, British Columbia	37,000 (Cu contained).
Do.	Imperial Metals Corp.	Mount Polley Mine at Williams Lake, British Columbia	17,000 (Cu contained).
Do.	Northgate Exploration Ltd.	Toodogone River, British Columbia	28,000 (Cu contained).
Diamond carats	Dia Met Minerals Ltd. (BHP-Billiton, 80%; Charles Fipke, 10%; Stuart Blusson, 10%)	Ekati Mine in Lac de Gras region, Northwest Territories	1,350,000.
Gold	Barrick Gold Corp.	Holt-McDermott Mine at Harker Township, Ontario	405 (ore).
Do.	do.	Bosquet Mines 1 and 2, northwestern Quebec	954 (ore).
Do.	do.	Macassa Mine at Teck Township, northern Ontario	473 (ore).
Do.	Princeton Mining Corp.	Similco Mine in Princeton, British Columbia (suspended)	450 (kilograms metal).
Do.	Echo Bay Mines Ltd.	Lupin Mine in Contwoyo Lake, Northwest Territories (suspended)	612 (ore).
Do.	Royal Oak Mines Inc.	Giant Mine in Yellowknife, Northwest Territories	407 (ore).
Do.	do.	Giant mill-tailings in Yellowknife, Northwest Territories	3,265 (ore).
Do.	Hemlo Gold Mines Inc. (Noranda Inc., 44.1%)	Golden Giant Mine in Hemlo, Ontario	1,080 (ore).
Do.	Placer Dome Inc.	Campbell Mine in Red Lake, Ontario	584 (ore).
Do.	do.	Detour Lake Mine in Northeast Ontario	1,278 (ore)
Do.	do.	Dome Mine in South Porcupine, Ontario	9.8 (tons metal).
Do.	do.	Sigma and Kiena Mines in Val d'Or, Quebec	730 (ore).
Do.	Teck-Corona Corp. (Teck Corp., 100%)	David Bell Mine in Hemlo, Ontario	456 (ore).
Do.	Huckleberry Mines Ltd. (Imperial Metals Corp., 50%; Japanese consortium, 50%)	Huckleberry Mine in Omineca, southeast of Houston, British Columbia	250 (kilograms metal).
Do.	Imperial Metals Corp.	Mount Polley Mine in Williams Lake, British Columbia	3,100 (kilograms metal).
Do.	Northgate Exploration Ltd.	Toodogone River, British Columbia	8,700 (kilograms metal).
Graphite	Strategic Exploration Inc.	Kearney Lake, Ontario	W.

See footnotes at end of the table.

TABLE 2--Continued
CANADA: STRUCTURE OF THE MINERAL INDUSTRY IN 2002

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Gypsum	Atlantic Gypsum Resources Inc.	Fischell Brook at St. George's, Newfoundland	1,300.
Do.	Georgia-Pacific Corp.	River Denys, Sugar Camp, Nova Scotia	1,460.
Do.	Little Narrows Gypsum Co. Ltd. (USG Corp., 100%)	Little Narrows, Nova Scotia	1,640.
Do.	National Gypsum (Canada) Ltd. (Aancor Holdings Corp., 100%)	Milford, Nova Scotia	3,300.
Do.	Westroc Industries Ltd.	Windermere, British Columbia	1,170.
Iron and steel	Iron Ore Company of Canada (North Ltd., 56.1%; Mitsubishi Corp., 25%; Labrador Iron Ore Royalty Income Fund, 18.9%)	Carol Lake, Labrador	8,800 (concentrate), 10,300 (pellets).
Do.	Quebec Cartier Mining Co. (Dofasco Inc., 50%)	Mount Wright, Quebec	16,950 (concentrate), 7,500 (acid pellets), 657 (sinter).
Do.	Wabush Mines (Stelco Inc., 37.9%; Dofasco Inc., 24.2%; Cliffs Mining Co., 22.8%; Acme Steel Co., 15.1%)	Wabush, Labrador, and Pointe Noire, Quebec	6,200 (concentrate).
Do.	Dofasco Inc.	Hamilton, Ontario	3,642 (pig iron), 4,500 (crude steel).
Lead	Brunswick Mining and Smelting Corp. Ltd. (Noranda Inc., 63.3%)	No. 12 Mine in Bathurst and smelter in Belledune, New Brunswick	72 (Pb contained).
Do.	Hudson Bay Mining and Smelting Co., Ltd. (Anglo American plc., 100%)	Flin Flon and Snow Lake, Manitoba	60 (Pb-Zn contained).
Do.	Teck Cominco Limited	Trail, British Columbia	95 (refined lead).
Do.	do.	Sullivan Mine in Kimberly, British Columbia	3,600 (ore).
Do.	do.	Polaris Mine on Cornwallis Island, Northwest Territories	1,000 (ore).
Do.	Breakwater Resources Ltd.	Nanisivik Mine on Baffin Island, Northwest Territories	785 (ore).
Limestone	Lafarge Canada Inc.	Steep Rock, Manitoba	906 (quarry).
Do.	Atlantic Industrial Minerals Inc.	Iris Cove, Sydney, Nova Scotia	720.
Do.	Inland Cement Ltd. (CBR Materials Corp.)	Cadomin, Alberta	2,160.
Do.	do.	do.	2,160 (quarry).
Do.	Havelock Co. (Kickenson Mines Co., 100%)	Havelock, New Brunswick	864 (limestone).
Do.	Continental Lime Ltd.	Faulkner, Manitoba	1,440 (crushed stone).
Magnesium	Magnola Metallurgy Inc. (Noranda Inc., 80%; Societe Generale de Financement du Quebec, 20%)	Asbestos, Quebec	58 (asbestos waste).
Molybdenum	Huckleberry Mines Ltd. (Princeton Mines Corp., 60%; Japanese consortium, 40%)	Southeast of Houston, British Columbia	635 (Mo contained).
Nickel	Falconbridge Ltd. (Noranda Inc., 46.4%; underwriting syndicate, 28.3%)	Fraser, Lockerby, Onaping, and Strathcona in Sudbury district, Ontario	30 (metal contained).
Do.	do.	Raglan Mine in Ungave, Quebec	21 (metal contained).
Do.	do.	Smelter in Falconbridge, Ontario	45 (rated capacity).
Do.	Inco Ltd.	Frood, Stobie, Creighton, Copper Cliff North and South, Garson-Offsets, McCreedy East and West, Coleman, Crean Hill, and Totten in Sudbury district, Ontario	106 (metal contained).
Do.	do.	Smelter in Sudbury, Ontario	110 (metal contained).
Do.	do.	Refinery in Sudbury, Ontario	57 (metal contained).
Do.	do.	Refinery in Port Colborne, Ontario	30 (metal contained).
Do.	do.	Thompson, Birchtree Mines in Manitoba	62 (metal contained).
Do.	do.	Smelter in Thompson, Manitoba	82 (metal contained).
Do.	Sherritt International Corp.	Refinery in Fort Saskachewan, Alberta	24 (metal contained).

See footnotes at end of the table.

TABLE 2--Continued
CANADA: STRUCTURE OF THE MINERAL INDUSTRY IN 2002

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Sodium chlorate production using salt	Dow Chemical Canada Inc. (Dow Chemical Co., 100%)	Fort Saskatchewan, Alberta	524 (caustic soda).
Do.	do.	Sarnia, Ontario	350 (caustic soda).
Do.	General Chemical Canada Ltd.	Amherstburg, Ontario	363 (sodium carbonate).
Sulfur:			
Petroleum refinery capacities	Consumer's Cooperative Refineries Ltd. (Federated Cooperatives Ltd., 100%)	Regina, Saskatchewan	54.
Do.	Esso Petroleum Canada (ExxonMobil Corp., 100%)	Sarnia, Ontario	50.
Do.	Sulconam Inc. (Petro Canada, 7.6%)	Montreal, Quebec	108.
Main sulfur extraction plants (sour gas and oil sands)	Amoco Canada Petroleum Co., Ltd. (Amoco Corp., 100%)	East Crossfield-Elkton, Alberta	650.
Do.	Canadian Occidental Petroleum, Ltd.	East Calgany-Crossfield, Alberta	610.
Do.	Chevron Canada Resources Inc. (ChevronTexaco Corp., 100%)	Kaybob South III, Alberta	1,281.
Do.	Husky Oil Ltd.	Ram River, Ricinus, Alberta	1,646.
Do.	Shell Canada Ltd.	Waterton, Alberta	1,120.
Principal SO_2 and H_2SO_4 production capacities	Canadian Electro Zinc Ltd. (CEZ) (Noranda Inc., 90.17%)	Valleyfield, Quebec	430 (H_2SO_4).
Do.	Inco Ltd.	Copper Cliff, Ontario	950 (H_2SO_4).
Do.	Falconbridge Ltd. (Noranda Inc., 50%; Trelleborg AB, 50%)	Kidd Creek, Ontario	690 (H_2SO_4).
Do.	ESSO Chemical Canada (ExxonMobil Corp., 100%)	Redwater, Alberta	910 (H_2SO_4).
Titanium	QIT-Fer et Titane Inc.	Sorel, Quebec	950 (concentrates).
Uranium	Cogema Resources Inc.	Cluff Lake, Saskatchewan	1,815 (metal).
Do.	Cameco Corp.	Cigar Lake, Saskatchewan	6,500 (oxide).
Do.	do.	Key Lake, Saskatchewan	6,395 (oxide).
Do.	do.	Rabbit Lake, Saskachewan	5,445 (oxide).
Zinc	Breakwater Resources Ltd.	Nanisivik Mine on Baffin Island, Northwest Territories	60 (Zn contained).
Do.	do.	Bathurst, New Brunswick	1,100 (Zn in concentrate).
Do.	Brunswick Mining and Smelting Corp. Ltd. (Noranda Inc., 100%)	Bathurst, New Brunswick	232 (Zn in concentrate).
Do.	Falconbridge Ltd. (Noranda Inc., 49.9%)	Timmins operations and smelter in Timmins, Ontario	212 (Pb-Zn contained), 133 (slab zinc).
Do.	Hudson Bay Mining and Smelting Co. Ltd. (Anglo American plc., 100%)	Snow Lake concentrator, Manitoba	1,125 (Pb-Zn ore).
Do.	do.	Flin Flon Mine and Smelter in Manitoba	85 (slab zinc).
Do.	Teck Cominco Limited	Sullivan Mine in Kimberley, British Columbia	70 (Pb-Zn contained).
Do.	do.	Smelter in Trail, British Columbia	300 (slab zinc).
Do.	Boliden Ltd.	Myra Falls Mine in Strathcona Provincial Park, British Columbia	110 (Zn ore).
Do.	Noranda Inc.	Bell Allard Mine in Matagami, Quebec	85 (Pb-Zn ore).

W Withheld to avoid disclosing company proprietary data.
[1]Projections of annual capacity involve matching decline curves against later discoveries and are generalized extrapolations only based on data presented in the Canadian Oil and Gas Handbook, 2001 and subsequent years. Ownership of various companies and proportionate participation in various leaseblocks and/or joint ventures changes continually. The ownership proportions shown here must be considered to be illustrative only.

TABLE 3
CANADA: RESERVES OF MAJOR MINERALS IN 2002 [1]

(Thousand metric tons unless otherwise specified)

Commodity		Reserves
Asbestos, fiber		35,700 e
Coal, all types		6,220,000 e
Copper		10,000
Gold	metric tons	1,500 [2]
Gypsum		450,000 e
Iron ore		1,700,000 e
Lead		1,600
Molybdenum		450
Natural gas	billion cubic meters	1,700 e
Nickel		6,600
Petroleum crude	million barrels	6,700 e
Potash, K_2O equivalent	million metric tons	4,400 e
Salt	thousand short tons	264,000 e
Silver	metric tons	35,000
Sodium sulfate	thousand short tons	84,000 e
Sulfur		160,000 e
Uranium		420 [3]
Zinc		11,000

eEstimated; estimated data are rounded to three significant digits.
[1]2000 and 2001 Canadian Minerals Yearbook, Natural Resources Canada, except for natural gas and petroleum crude.
[2]Excludes metal in placer deposits.
[3]Recoverable at prices of $100 or less per kilogram of uranium.