THE MINERAL INDUSTRY OF CANADA

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In 2004, increases in metal prices boosted Canada's mineral industry, which ranked among the top 5 global producers for more than 10 major minerals and metals. As a result, the value of metal production increased by 29.6%; industrial minerals, 12.6%; and coal, 7.1% (Natural Resources Canada, 2005). The country remained among the leading world producers of such mineral commodities as potash followed by, in order of importance, Russia, Belarus, and Germany; diamond after, in order of output, Botswana, Australia, and Russia; nickel after, in order of output, Russia and Australia; selenium after Japan; columbium (niobium) after Brazil; and zinc after, in order of output, China, Peru, and Australia (Cunningham, 2005; George, 2005; Kuck, 2005; Olson, 2005; Plachy, 2005; Searls, 2005).

With a population about 31.9 million in 2004, Canada had a gross domestic product (GDP) based on purchasing power parity of $1.023 trillion.[1] Canada's GDP growth was moderate (about 2.8% compared with 2.0% in 2003). Canada's currency increase relative to the U.S. dollar helped moderate the upturn in economic growth from the second half of 2004 into 2005. In 2004, Canada's metals, industrial minerals, and energy sectors contributed 5% of its GDP, inflation was 1.8%, and unemployment decreased to 7.2% from 7.6% in 2003 (Department of Finance Canada, 2005§[2]; Government of Canada, 2005§; Statistics Canada, 2005d§; U.S. Central Intelligence Agency, 2005§). Canadian mineral production totaled $18.6 billion, which was 20.8% higher than that of 2003 ($15.4 billion). The Canadian nonfuels mineral production was valued at $17.3 billion, which was 21.0% higher than that of 2003 ($14.3 billion); the values of metal and coal production increased by 29.6% and 7.1%, respectively, compared with those of 2003; and the value of nonmetals increased by 12.6% compared with that of 2003 (Natural Resources Canada, 2005).

Some remarkable increases in the value of mineral production[3] were as follows: nickel ore output increased by 17.0%, and its value increased by 56.8%; copper ore output increased by less than 0.1%, and its value increased to 56.2%; diamond output increased by 17.3%, and its value increased by 34.8%; potash (K_2O content) increased by almost 17%, and its value increased by 20%; and zinc ore output decreased by 2.9%, and its value increased by 12.9%. In 2004, in terms of value, the leading mineral commodities produced were nickel, which increased to $2.5 billion in 2004 from $1.4 billion in 2003; gold, to $1.7 billion from $1.6 billion; diamond, to $1.6 billion from $1.2 billion; copper, to $1.5 billion from $929 million; potash, to $1.5 billion from $1.1 billion; cement and coal, to $1.2 billion from $1.1 billion each; iron ore, to $1.1 billion from $1.0 billion; sand and gravel and stone, to $850 million from $714 million each; and zinc, to $770 million from $643 million (Natural Resources Canada, 2005).

In 2004, the Prospectors and Developers Association of Canada (PDAC) and the Mining Association of Canada (MAC) used the Metals Economics Group's Corporate Exploration Strategies (CES) as an essential tool for gathering information on global exploration trends. The CES was the principal source of data on exploration and was used by financial groups worldwide for investment decision strategies (Andrews, 2005).

The revival of Canadian senior and junior (large and small companies) exploration spending worldwide was largely driven by the recovery of prices for mineral commodities in late 2003 and early 2004. Budget increases continued for most of the senior firms, and greater availability of capital for the juniors continued to advance exploration on a global scale in 2004. For example, after 5 years of declining exploration budgets for Canadian companies, from a high of $4.6 billion in 1997 to a low of $1.7 billion in 2002, or an overall decline of about 63%, exploration budgets increased to $2.1 billion in 2003 and $3.4 billion in 2004. Exploration budgets for junior companies amounted to $1.6 billion in 2004. Similarly, exploration and deposit appraisal spending for Canada has rebounded and gained momentum since 2001 from $366.4 million to $409.3 million in 2002, $488.6 million in 2003, and $752.4 million in 2004. Of that total (2004), the exploration process allocated $601.9 million, or 80%, for mineral exploration and deposit appraisals, and $150.5 million, or 20%, for permitting, land accessing, and other licenses (Goulden, 2005).

Between 2000 and 2004, expenditures increased by 97.2%; Ontario had the largest share on an annual basis. Ontario's total exploration and deposit appraisal spending for 2004 was 25.4% followed by Quebec (17.7%), the Nunavut Territory (15.9%), the Northwest Territories (11.3%), British Columbia (11.0%), and Saskatchewan (6.0%), which together accounted for 87.3% of exploration and deposit appraisal expenditures for the entire country. Expenditures were equally apparent in Newfoundland and Labrador (3.4%), Manitoba (3.3%), and the Yukon Territory (2.6%) (Bouchard, 2004, p. 13-14, 20-26; Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 5).

Factors that contributed to this recovery trend were increased metal prices owing to the strong demand for most mineral commodities that was driven by increased consumption by the industrial sectors of the United States and the growing economies of such countries as China and India. In 2004, the price of copper increased by about 65%; platinum-group metals

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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$1.3015=US$1.00 for 2004. 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]More-detailed information on the mineral production in Canada can be found in the Canadian Minerals Yearbooks for 2002 and 2003 prepared by Natural Resources Canada, and the Information Bulletin for 2003 and 2004 compiled by Statistics Canada and issued by Natural Resources Canada, Ottawa, Ontario, Canada, which were used extensively as source material for this report. The U.S. Department of the Interior has arranged for these Canadian publications to be placed in selected depository libraries of the 50 States and Puerto Rico.

(PGM), 20%; and gold, 13%. Other factors that contributed to revitalize mineral exploration ventures in Canada were timely tax incentives, positive exploration results, and better access to the capital markets (Bouchard, 2004, p. 27).

Canada's larger mining companies remained internationally active by continuing to spend 76% of their exploration budgets for precious and base metals or diamond in other countries, such as, in order of spending, Africa, the Middle East, Australia, the European Union (EU), the Commonwealth of Independent States (CIS), the United States, Latin America and the Caribbean, and Asia and the Pacific region. Although a large number of Canadian mining companies have been exploring in other countries, such discoveries as Voisey's Bay copper-nickel project, the Kelex Nickel Zone, the Sudbury Basin's PGM-rich deposits, and the Diavik, the Jericho, and the Snap Lake diamond projects confirmed that Canada is rich in mineral resources (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 135-137).

According to Natural Resources Canada's projections, spending for precious-metals exploration continued to dominate Canadian exploration. Spending for diamond exploration outpaced that for base metals for the third year in a row. In 2004 and beyond, diamond was expected to be the most sought after mineral commodity in the country. The globalization of diamond demand and economics have introduced unprecedented levels of volatility into the diamond supply and the pricing of rough and polished diamond; this takes into consideration increased levels of diamond mining activity and the move to a more-competitive open market for rough diamond in particular. Considerably more resources have been invested in diamond mines development, and this sector has continued to generate news across the country and in all stages of the mineral development cycle (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 15-16, 157-158).

In 2004, Inco Limited spent $16 million in Labrador at the Voisey's Bay site continuous exploration program. Inco reported Voisey's Bay's estimated mineral reserves and resources and related data as of December 31, 2004, to be as follows: open pit proven and probable reserves of 32 million metric tons (Mt) at grades of 2.82% nickel, 1.54% copper, and 0.14% cobalt; underground indicated resources, 50 Mt at grades of 1.66% nickel, 0.78% copper, and 0.10% cobalt; and underground inferred resources, 12 Mt at grades of 1.70% nickel, 0.70% copper, and 0.10% cobalt (Inco Limited, 2005a§, c§; Voisey's Bay Nickel Company Ltd, 2005§).

Inco's $5 billion Voisey's Bay Mine was expected to start producing by late 2005. The mine was expected to produce almost 50,000 metric tons (t) (110 million pounds) of nickel in 2006; this will increase Inco's overall nickel output to about 245,000 t (540 million pounds) compared with its forecast of 222,000 t (490 million pounds) to 227,000 t (500 million pounds) in 2005 (Heinzl, 2005).

Participation by Canada's active mining companies in exploration and deposit appraisal increased. Spending by junior firms remained quite important to total exploration-phase expenditures (grassroots exploration). The spending trend was $111 million in 2001, $131 million in 2002, $200 million in 2003, and $375 million in 2004. The 2004 total would bring junior companies almost on par with senior companies whose spending was forecast to be $377 million (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 2-3).

Environmental concerns continued to influence mineral exploration and development activities throughout Canada, and the mineral exploration process seems to have become increasingly subject to legal considerations and more community involvement in much of Canada. Land use, which had never been given much attention in the past, has become an issue. For instance, First Nation rights were receiving much consideration. The Minister of Natural Resources stated that Federal and Provincial Governments were working on legislative reforms that were expected to afford an improved regulatory climate. The Investment Tax Credit for Exploration (ITCE) introduced in October 2000, was extended in the 2003 and 2004 Federal budgets following recommendations from Canada's Mines Ministers. The Canadian Intergovernmental Working Group on the Mineral Industry (IGWG) subworking group on taxation concluded that the ITCE had been successful in maintaining access to exploration financing and, with the aid of a stronger gold price and interesting diamond discoveries, that Canada had achieved higher exploration levels. The findings remained valid when the Mines Ministers met in Iqaluit, Nunavut Territory, in summer 2004 in the midst of the best field seasons since 2000. The ITCE and related tax incentives acted as catalysts for mineral exploration investment when the prices of base and precious metals finally recovered (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 30-31).

During 2003 (the latest year for which data were available), investors were much more willing to take risks in exploration than in previous years, and according to Natural Resources Canada, more than $8.7 billion (CAN$12.7 billion) in equity financing was available for international exploration and development projects. More than 45% of that total was raised for companies listed in the Canadian stock exchanges, mostly in Toronto, Ontario, and Vancouver, British Columbia. Worldwide budgets for base metals, diamond, and precious-metals exploration programs increased to $2.4 billion (CAN$3.5 billion) in 2003, or by 14.3%, from $2.1 billion in 2002. The number of companies that reported exploration programs, defined here as those with budgets of at least $100,000, increased to 917 in 2003, or by 26.7%, from 724 companies in 2002. Of those 917 firms, 585, or 63.8%, were based in Canada and the remaining were based globally (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 135).

At the end of 2003, companies of all sizes listed on Canadian exchanges held about 220 mineral properties in the CIS and the EU; 110 in western Europe, 30 in Sweden, and 15 or more in Finland, Greenland, and Spain each; 45 in six countries of the CIS, and 20 in Russia; almost 550 in 36 countries on the African continent, 90 in South Africa, almost 50 in Tanzania, 40 in Burkina Faso, Ghana, and Mali each, and more than 20 in Botswana, Guinea, and Zambia; 390 in Asia and the Pacific region; 145 in Southeast Asia, 70 in Indonesia, and more than 40 in the Philippines; and 160 in the South Pacific, roughly 90%

of which are located in Australia. Companies of all sizes were planning to explore in Australia, China, India, New Caledonia, Pakistan, and Sri Lanka in 2003. In 2003, the larger Canadian-based companies (those with a minimum allotment of $3 million for exploration purposes) planned to spend $137 million in Asia and the Pacific region; $93 million in the South Pacific; $43 million in Africa; $39 million in the EU; $25 million in the CIS; $6 million in western Europe; $4 million in eastern Europe (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 146-149).

At the end of 2003, Canadian mining firms of all sizes held interests in more than 1,000 mineral properties in Latin America and the Caribbean and 630 mineral properties throughout South America; these are roughly the same numbers as those of 2002. They held almost 280 mineral properties in Mexico, 150 in Argentina, 140 in Peru, more than 100 in Brazil, 85 in Chile, 40 in the Caribbean, 30 in Bolivia, the Dominican Republic, and Venezuela each, more than 20 in Ecuador and Guyana each, and 10 in Cuba. In 2003, the larger company mineral exploration market in Latin America and the Caribbean was valued at $635 million, or 26.5% of the $2.4 billion larger company market worldwide. The larger Canadian-based companies planned to spend $183 million in the region (slightly more than in 2002), $20 million in Mexico, and $6 million in Central America (all of it in El Salvador) (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 144-146).

Government Policies and Programs

The Canadian Provinces exercise the primary jurisdiction over mineral resources. Through their mining acts, the Provincial Governments regulate most aspects of exploration and mining in Canada. 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, the Territorial, and the First Nation negotiators initiated the Devolution Transfer Agreement (DTA) in September 2001. The DTA is the transfer of the Federal Government's current responsibilities for managing most of the Yukon Territory's natural (mineral and energy) resources to the Government of the Yukon Territory, which was effective on April 1, 2003.

The Government, which recognizes the benefits of the ITCE, extended it until 2006. The ITCE program was named super flow-through-shares (FTS) by investors when first introduced in October 2000. This Federal and Provincial tax credit boosted the FTS' financing process and stimulated Canada's exploration program. In March 2004, the Federal Government announced an extension of the 15% federal tax credit for mineral exploration to the end of 2006; this has been requested by the MAC and the PDAC. 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 two types of FTS investments are the super flow-through, or additional Federal tax credits, for "grassroots" exploration and the regular flow-through plus Provincial and Territorial harmonization initiatives. Both FTS investments will continue to assist the sector in gaining new investments and stimulating minerals exploration activity in Canada.

More than 60% of the world's mining companies are based in Canada. In 2003, almost 45% ($3.9 billion) of the $8.7 billion (CAN$12.7 billion) in equity capital raised around the world was for the mineral exploration and development projects of companies listed on the Canadian stock exchanges. At the end of 2003, Canadian companies held a portfolio of 6,400 mineral properties in Canada and in 100 other countries, which were distributed almost equally between Canada and abroad. Canadian companies are likely to continue "for the near future at least" to dominate minerals exploration worldwide (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 1, 149-150; McMullen and Birchfield, 2004, p. 1.10-1.12; Dimmell, 2005§; Prospectors & Developers Association of Canada, 2005§).

On August 20, 2002, Quebec announced a very attractive refundable FTS tax credit for mineral resources; senior and junior companies will continue to be allowed a tax credit of up to 60% of exploration expenditures until 2007. An additional deduction of 50% of qualifying exploration expenses, such as surface exploration and underground drilling on land that is not under a mining lease or mining concession and/or has had no production in the previous 5 fiscal years, may also be granted under the Mining Duties Act up to a limit of 50% of annual profit.

In 2003, the Yukon Territory offered an FTS tax credit as a refundable mineral exploration tax of 25% on exploration expenditures for eligible individuals and companies, which will be in effect until March 31, 2005, and the Yukon Mining Incentives Program (YMIP), which will be offered to 66 applicants for a total of more than $1.0 million—12 of the successful applicants in the grassroots prospecting module stage, 21 in the focused regional module stage, and 33 in the target evaluation module stage. Of the successful YMIP applicants, 70% was exploring for gold, which included 20% for alluvial gold; of the remaining; 27%, mainly for copper; and 3%, for gemstones and other commodities.

British Columbia's FTS tax credit program provided a 20% tax cut for flow-through financing for eligible grassroots exploration, which was extended to December 31, 2005, and combined with the Federal Government's 15% mining tax credit, this will become one of the best exploration tax credit programs in Canada.

Saskatchewan had a temporary 10% tax credit for eligible FTS investors of mineral exploration firms active in the Province where the targeted commodities were diamond and uranium (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 51, 56, 75, 88, 91-92, 102-104).

The Northwest Territories Geoscience Office (NTGO), a partnership of Indian and Northern Affairs Canada (INAC), the Northwest Territories' Geology Division of the Department of Resources, Wildlife and Economic Development, and the Geological Survey of Canada (GSC), is funded and staffed by the partners and managed internally with input from them. The NTGO's geoscience programs aim to contribute to a prosperous and sustainable resource-based economy, make significant contribution to Canada's energy supply, and increase

the informed use of geosciences for land use, land claims, and resource management policies (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 112).

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 with Provincial Governments to fund initiatives intended to strengthen the mining industry in Canada. 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; this complemented emerging Provincial environmental restoration requirements.

The Canadian Securities Administrators' National Instrument 43-101, which pertains to the "Standards of Disclosure for Mineral Projects," was enacted into law in early 2001. This instrument will continue to be applied to all technical public disclosure on mineral projects and to require that all technical disclosure to be based on the work of a qualified person (QP). The QP will continue to be responsible for scientific and technical matters, which 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. The Federal Government is laying a foundation for the sector by providing sound economic fundamentals, encouraging innovation and knowledge, and promoting sustainable development (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 150).

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 operation 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 mining investors to know what they have to do to secure approval for their projects. As a result, all surveys and work done for environmental purposes are related, for example, to geochemical or geophysical surveys performed to characterize or monitor the environment, which includes environment-related expenditures such as:

- Environmental characterization includes all costs of environmental characterization and assessment, which includes environmental impact studies.
- Environmental permits include all costs related to the process of meeting the legal and regulatory requirements or guidelines for environmental assessment and for obtaining permits, which include preproduction permits, required for the work program under consideration.
- Environmental protection includes expenses for monitoring (additional to normal practices) and complying with laws, regulations, and guidelines related to air emissions, liquids effluents, ground pollution, and wildlife and habitat protection. Environmental fines, if any, are included in this category. And
- Environmental restoration includes all costs of decommissioning, reclaiming and restoring, and monitoring, if required, after the completion of exploration and deposit appraisal field work.

In Canada, the Provincial and Territorial Governments 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 (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 157, 160).

The PDAC's Total Landscape Management (TLM) multiple-use concept to achieve conservation protection and resource development objectives has thus far produced unsatisfactory results because the complex and changing needs of the landscape require a more-comprehensive and integrated approach to sustainable development and mining with environmental protection.

The TLM concept 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. But, land access, permits, and disturbances including all costs related to establishing impact-benefit and socioeconomic agreements, and other requirements for prospecting, exploring, mine development, and production activities, including costs of right of ways, disturbances, and permits for exploration and deposit appraisal work, and environmental-related capital expenditures for protection and site restoration, and associated legal fees became complex issues. Mostly, failure to understand local realities and to involve the community constructively could create the risk of costly delays or even termination of mineral exploration and development projects.

TLM recommends, however, management of entire ecological landscapes by employing the overarching principal of conservation diversity; a system of "floating reserves" designed to accomplish protection in a 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 (Canadian Intergovernmental Working Group on the Mineral Industry, 2004, p. 161; Thomson, 2005, p. 4).

Production

Canada, a nation rich in mineral resources, was one of the leading mining countries in the world. The increase in metal prices provided a boost to the mining sector in 2004. In 2004, the value of metals increased to $9.6 billion from $6.9 billion in 2003, which included increases in the production of, in order of

value, nickel, copper, diamond, and potash (Natural Resources Canada, 2005).

Ontario's mineral output amounted to 29.8% of the total value followed by Quebec, 16.5%; British Columbia, 14.9%; Saskatchewan, 11.7%; the Northwest Territories, 8.9%; Manitoba, 5.1%; Alberta, 5.0%; Newfoundland and Labrador, 3.4%; New Brunswick, 3.1%; Nova Scotia, 1.2%; the Yukon Territory, 0.3%; and the Nunavut Territory, 0.1%. 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, 2005).

Trade

As the world's leading exporter of minerals and metals, Canada enjoyed economic benefits from its mineral industry that included a significant contribution to its trade balance. In 2004, Canada's total exports, imports, and trade balance amounted to $330.7 billion, $279.0 billion, and $51.7 billion, respectively, compared with those of 2003, which were $285.7 billion, $244.2 billion, and $41.6 billion, respectively (Statistics Canada, 2005b§).

In 2004, Canadian exports included energy products ($53.2 billion) [crude petroleum ($20.2 billion), natural gas ($21.4 billion), and coal and others ($11.6 billion)] and industrial goods and materials ($59.6 billion) [crude minerals and ores ($5.7 billion), chemicals and fertilizers ($20.7 billion), metals and alloys ($19.2 billion), and industrial minerals ($14.0 billion)]. Imports included energy products ($19.1 billion) [crude petroleum ($12.7 billion) and others ($6.4 billion)] and industrial goods and materials ($56.4 billion) [crude minerals and ores ($16.1 billion), chemicals ($20.6 billion), and industrial minerals ($19.7 billion)] (Statistics Canada, 2005a§, b§).

Prominent among the crude minerals exported were iron ore, potash, and sulfur to the United States; copper concentrates to Japan; and iron ore and zinc concentrates to the EU. Exports of 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. Coal exports went mostly to Japan. In terms of net trade, the mineral surplus, which included fuels and industrial minerals, amounted to $10.1 billion higher than that of 2003. Total trade between Canada and the United States exceeded that of any other two countries in the world. In 2004, almost 82% of Canadian exports ($270.4 billion) and 69% of Canadian imports ($192.1 billion) were with the United States followed by, in order of value, Japan, the United Kingdom, the EU, Mexico, and other countries (Statistics Canada, 2005c§).

Structure of the Mineral Industry

The Canadian mineral industry comprised about 3,000 domestic and perhaps 200 foreign companies; more than 9% of these companies were actively engaged in actual mining. Major and junior companies were engaged in exploration, some of which were in advanced stages of mine development and expansions. 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 2,500 mine sites, which included coal, were active (Giancola, 2005, p. 13-19). Another 3,000 mines and quarries produced sand and gravel and other construction materials. About 40 smelters and refineries and other processing plants were operating in the cement, sodium chlorate, and sulfuric acid industries. Foreign companies were subject to the same taxes as domestic companies, and repatriation of earnings was allowed.

The Canadian mineral industry was privately owned with shares trading publicly on various exchanges in Canada and, in many cases, 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 Canadian mineral industry by leading mineral commodities and major operating companies.

In 2003 (the latest year for which data were available), employment in the mining and mineral manufacturing industries, which included coal, increased to 388,898 from 386,469 in 2002. The mineral industry accounted for about 3.0% of the national employment level of 12.8 million. The total number of employees in coal, metal, and nonmetal mining and quarrying decreased by almost 1.0% to an estimated 47,305 compared with the 2002 level (47,633 jobs). Employment in metal mining decreased by 2.2% to 24,539, nonmetal increased 5.6% to about 18,363, and coal declined by 14.8% to about 4,403 in 2003. About 1,300 people were also employed in diamond drilling (McMullen and Birchfield, 2004, p. 10; Natural Resources Canada, 2005b§).

Commodity Review

Metals

Aluminum.—Production of primary aluminum was about 2.6 million metric tons (Mt), which was a decrease of 7.2% compared with that of 2003. Alcan Inc.'s output was reduced because of the closure of Söderberg capacity at the Arvida smelter and a strike at the 25% owned Aluminerie Bécancour smelter, both of which were located in Quebec (Alcan Inc., 2005§; Natural Resources Canada, 2005a§, c§). This put Canada third, after China and Russia, in the world in volume of production and first, with Russia second and Venezuela third, in volume of exports to the United States. In 2004, the value of Canadian production decreased slightly by 2.3% compared with that of 2003 ($4.3 billion), and the country remained the second leading primary aluminum exporter ($3.5 billion) after Russia (Wagner, 2004, p. 9.1, 9.29; Plunkert, 2005).

Alcan owned 51.1% of the total Canadian primary aluminum smelter capacity of about 2.7 million metric tons per year (Mt/yr), or almost 1.4 Mt/yr, followed by Alcoa (25.2%), and others (23.7%) (Wagner, 2004, p. 9.2; Alcan Inc., 2005§; Alcoa Inc., 2005§). This capacity included Alcan's closing of 90,000 metric tons per year (t/yr) of Jonquière's smelter capacity in April 2004. Alcan's 275,000-t/yr smelter in Kitimat, British Columbia, operated at almost full capacity. Alcan announced

the construction of an 80,000-t/yr facility in the Saguenay-Lac-Saint region of Quebec in 2006; this plant will use the first commercial application of Alcan's new low-caustic leaching and liming process. Following Alcan's acquisition of Pechiney of France in early 2004, the company continued to fulfill conditions imposed by regulatory agencies regarding the takeover; this included the sale of assets in the EU and the United States. Alcan's 405,000-t/yr Alma smelter in Quebec required 620 megawatts (MW) of power; 350 MW came from Provincial utility Hydro-Québec, and 270, from Alcan's own grid. The company had negotiated a projected 22-year power-exchange project with Hydro-Québec for additional power that Alcan may need for expansion and modernization of its seven smelters in Quebec (Wagner, 2004, p. 9.3; Alcan Inc., 2005§).

Alcoa was planning to expand its Lauralco-Deschambault smelter near Quebec City to 570,000 t/yr from 250,000 t/yr. Construction will start in 2006, initial production will begin in 2008, and full capacity will be reached in 2013. In early 2004, Alcoa and the Province of Quebec were negotiating on the capacity upgrade of the Baie-Comeau smelter, which would increase to 547,000 t/yr from 437,000 t/yr by 2010 at an investment of about $1 billion (Wagner, 2004, p. 9.11; Alcoa Inc., 2005§).

Aluminerie Alouette Inc. [Alcan (40%), Aluminium Austria Metall Québec (20%), Hydro Aluminum (20%), Société Générale de Finacement du Québec (13.33%), and Marubeni Québec Inc. (6.67%)] continued with the $1.1 billion expansion of its smelter to 550,000 t/yr from 245,000 t/yr. Preliminary work started in early 2003, and the metal output is expected in late 2005. Aluminerie de Bécancour Inc., which had a capacity of 395,000 t/yr, was owned by Alcoa (75%) and Alcan (25%) after its takeover of Pechiney (Wagner, 2004; Alcan Inc., 2005§; Alcoa Inc., 2005§).

Bauxite and Alumina.—Production of alumina (Al_2O_3) was almost 1.2 Mt, which was an increase of 5.5%, and alumina (hydrate) was more than 1.3 Mt, which was an increase of 4.6% compared with those of 2003 (table 1). In 2004, Alcan owned 100% of the total Canadian alumina refinery capacity of almost 1.2 Mt/yr. This capacity included Alcan's smelter-grade alumina refinery in Vaudreuil, Quebec, and two specialty alumina refineries in Brockville, Ontario (18,000 t/yr) and in Vaudreuil (160,000 t/yr). In 2004, Canada imported more than 2.8 Mt of bauxite from Brazil, 63%; Guinea, 22%; Ghana, 10%; and others, 5%. Bauxite ore can be refined into two grades of alumina—smelter and specialty chemical; the former is used in the production of primary aluminum, and the latter is used in various products, such as absorbents, ceramics, fire retardants, and refractory bricks. Alcan developed specialty alumina that has been used in public water treatment programs, such as arsenic contained in well waters in Bangladesh and India (Alcan Inc., 2005§; United Nations, 2005§).

Cobalt.—Mine production of cobalt amounted to 5,197 t, which was an increase of 20.1% compared with that of 2003 (4,327 t). Refined cobalt production increased to 5,144 t in 2004 from 4,233 t in 2003; the value of shipments remained at about the same level as that of 2003 ($51.0 million). Cobalt prices improved in parallel to the increase in the value of nickel. Rising demand for cobalt for alloys, catalysts, magnets and batteries, and even pigment, however, has focused new attention on cobalt resources in Canada led by the Voisey's Bay discovery of at least 40,000 t contained within the nickel-copper deposit (Natural Resources Canada, 2005; Cobalt Development Institute, 2004§; Inco Limited, 2005c§).

In 2004, Sherritt International Corporation owned 50% of Metals Enterprise Limited, which operated the Cobalt Refining Company Inc. in Fort Saskatchewan, Alberta. The refinery produced cobalt and nickel metal; more than 95% of its feed was from Metal Enterprise's mine and leach plant at Moa Bay, Cuba, where a nickel-cobalt sulfide residue was produced from a laterite nickel feed. The expectations of continued high prices could lead to a new wave of laterite investments. A number of new hydrometallurgical nickel-cobalt laterite plants would, however, affect cobalt prices in the open market in the foreseeable future. In 2003, Canadian imports and exports of cobalt were valued at $25 million and $16 million, respectively, which resulted in net imports of cobalt of $10 million (McCutcheon, 2004, p. 38.8, 38.17, 38.61; Cobalt Development Institute, 2004§).

Columbium (Niobium) and Tantalum.—Mine output of columbium (niobium) content increased to 3,450 t in 2004 from 3,270 t in 2003; this was an increase of about 5.5%. The country remained the second ranked columbium (niobium) producer after Brazil. In 2004, the Niobec columbium (niobium) mine situated in Saint Honoré de Chicoutimi, Quebec, was the only operating mine in North America and was owned by Cambior Inc. The mine was the world's third ranked producer. The Niobec Mine's life was about 18 years based on current reserves of 22.6 Mt at an average grade of 0.65% Nb_2O_5 and mill capacity of 3,500 metric tons per day (t/d). Cambior has 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 about 50%. Columbium (niobium) is used primarily as an alloying agent in specialty steels (Cunningham, 2005; Cambior Inc., 2004§, 2005§; Natural Resources Canada, 2005a§).

Copper.—Mine output of copper content increased to 563,471 t in 2004 from 557,082 t in 2003. Refined metal production increased to 526,967 t from 454,866 t, which reflected the world copper price increase, which caused the value of metal production to increase to $2.0 billion in 2004 from $1.3 billion in 2003, or by about 54%. Canada exported $2.0 billion worth of copper during 2003 (Natural Resources Canada, 2004a, 2005).

Copper prices remained robust and averaged $1.30 per pound, which was up from $0.81 per pound in 2003. They may increase to new record highs into 2005 because of strong demand; increase in economic activity in copper user countries in Asia, Europe, and the United States; and lower copper inventories owing to the release of strategic stockpiles of Chile's Corporación Nacional del Cobre and China's State Reserve Bureau that will affect the supply/demand balance in 2005 (Natural Resources Canada, 2004a).

In Canada, four Provinces accounted for the majority of copper production, or 96.4%. In 2004, British Columbia was the leading copper-producing Province; its share amounted to about 44.5%; Ontario's, 32.5%; Quebec's, 12.1%; and Manitoba's, 7.3%. The copper output of the Highland Valley Copper

Mine was 177,493 t, or 31.5% of the total. The mine, which is located south of Kamloops, British Columbia, was owned by Teck Cominco Limited, 63.9%; BHP Billiton Ltd., 33.6%; and others, 2.5%. Ontario owed much of its importance to the Sudbury and the Timmins regions where copper is recovered in conjunction with nickel. Large-scale copper mining in Quebec was centered mostly around the Falconbridge Limited's Raglan, BHP Billiton's Selbale, Noranda Inc.'s Bell Allard, and Teck Cominco's Louvicourt copper mines. Manitoba's importance revolved around Inco Limited's Thompson and Hudson Bay's Chisel and Trout Lake copper mines and its smelter in Flin Flon (Natural Resources Canada, 2004a).

On June 30, 2004, Falconbridge and Noranda completed their merger. The joint venture, however, continued under the transition name "Falconbridge Limited." Falconbridge, which was the transition company, was a leading aluminum, cobalt, copper, gold, lead, nickel, silver, and zinc producer. Noranda's interest in Falconbridge was 58.9% in 2004 (Falconbridge Limited, 2005, p. 15-16; Noranda Inc., 2005, p. 30-31).

In 2004, Inco announced that the Voisey's Bay mine will produce copper as a byproduct of nickel-cobalt ore starting in late 2005. Having an estimated life of about 30 years, the potential copper production of 38,600 t/yr will contribute to the future role of Canada, which ranked sixth after Chile, Indonesia, the United States, Australia, Peru, and Russia (Edelstein, 2005; Voisey's Bay Nickel Company, 2005§).

Gold.—Gold output decreased to 129 t in 2004 from 141 t in 2003 and 152 t in 2002, or by 8.5% and 15.1%, respectively. These decreases were primarily because of mine closures, the suspension of mining activities by polymetallic producers, and the depletion of gold reserves in the Nunavut Territory, Ontario, and Quebec. The value of gold production decreased by 4.4% ($1.7 billion) in 2004 compared with that of 2003 (Natural Resources Canada, 2005; 2005a§). Ontario produced 55% of the national total; Quebec, 19%; British Columbia, 16%; Manitoba, 4%; and the Yukon Territory, the Northwest Territories, Saskatchewan, Newfoundland, Alberta, and New Brunswick, a total of 6%. Operating gold mines accounted for 92.5% of Canada's output, and 19 base-metal mines (gold as byproduct) and numerous gold placers contributed 6.0% and 1.5% of the remaining output, respectively. Canada was the eighth ranked gold producer after South Africa, Australia, the United States, China, Russia, Peru, and Indonesia. Canada exported $2.7 billion worth of gold in various forms during 2003. The increase in the price of gold to $409 per troy ounce in 2004 from $363 per troy ounce in 2003 provided gold companies better access to risk capital, which would translate into increased spending in exploration and the funding of new gold resources in Canada (Chevalier, 2004a, 24.1, 24.10; Amey, 2005; Natural Resources Canada, 2005a§, c§).

Iron Ore.—Output of iron ore decreased by 15.2% compared with that of 2003, and the value of production increased by 7.0% (Natural Resources Canada, 2005). The iron content 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 Company of Canada, Québec Cartier Mining Co., and Wabush Mines Ltd. The remaining production was from the byproduct recovery of magnetite from two base-metal smelters in British Columbia. Labrador and Newfoundland produced 53%; Quebec, 46%; and British Columbia, 1% of a total output of 28.3 Mt in 2004. Canada was the second ranked iron ore producer after China. Shipments exceeded production so that stocks were drawn down to meet demand. Canada exported 23.1 Mt of iron ore; of that amount, 5.7 Mt went to the United States in 2004 (Jorgenson, 2005; Natural Resources Canada, 2005, 2005c§).

Lead and Zinc.—Canada was the world's fourth ranked mine producer of zinc at 790,737 t of zinc and the world's sixth ranked producer of lead at 76,727 t of lead in concentrate. Zinc mine output showed a slight increase of less than 1.0% in 2004 compared with that of 2003, and lead production decreased by 5.6% compared with that of 2003. Decreased prices for zinc continued because of poor demand in Japan, slow growth in Europe, and oversupply in zinc markets worldwide. New mine capacity in Australia, Ireland, and Peru; expansions in Chile, Peru, and the United States; increased exports from China; and weak market prices continued to take their toll with a continued increase in stock levels (Natural Resources Canada, 2005, 2005a§, c§; Gabby, 2005; Plachy, 2005).

In 2004, Noranda's operations at the Brunswick Mine near Bathurst, New Brunswick, were the largest lead producer with a capacity of 74,000 t/yr. Teck Cominco's Trail operations in southern British Columbia were the world's largest fully integrated smelter and refinery complex and had a zinc production capacity of 300,000 t/yr. Hudson Bay Mining and Smelting Co., Limited. (HBMS) was acquired by HudBay Minerals Inc. from Anglo American plc. on December 21, 2004 (HudBay Minerals Inc., 2005§). HBMS was expanding its Chisel North underground zinc mine at Chisel Lake, Manitoba, which is located near Snow Lake. 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 ore reserves, and included the refurbishment of the Snow Lake concentrator. Snow Lake's concentrates will be trucked 200 kilometers (km) southwest to the Flin Flon smelter. The 777 deposit was expected to enter into full production by early 2005. The construction of a $65 million electrolytic tank house and work on a new zinc tank house at the Flin Flon smelter increased capacity by 35% to 115,000 t/yr from 85,000 t/yr (Natural Resources Canada, 2004b, c).

In 2003, Canadian exports and imports of lead were 212,453 t valued at $157.3 million and 126,300 t valued at $158.1 million, respectively; exports and imports of zinc were 939,300 t valued at $1.03 billion and 441,600 t valued at $278.1 million, respectively (Natural Resources Canada, 2004b, c).

Nickel.—Mine output increased by about 14% from that of 2003. Higher metal output and prices caused the value of nickel to increase by 56.8%, or $2.5 billion compared with that of 2003. Nickel was the most valuable mineral commodity produced in Canada during the year followed by, in order of value, gold, diamond, copper, and potash (Natural Resources Canada, 2005).

The Sudbury Basin in Ontario and the Thompson nickel belt in Manitoba were the most significant nickel production areas in Canada. Falconbridge was the third ranked producer of nickel in the world. Falconbridge's operations included the Raglan

nickel mines and mill in northern Quebec; four mines, a mill, a smelter, and an acid plant in the Sudbury area of Ontario; a refinery in Norway; and a mine and smelter in the Dominican Republic (McCutcheon, 2004, p. 38.2, 38.8).

Falconbridge's Craig, Fraser, Lindsley, and Lockerby underground nickel/copper mines in Sudbury and the Raglan Mine in Quebec produced 49,154 t of nickel in concentrates, which was smelted in the firm's smelter near Sudbury. The matte, which contained about 54% nickel from the smelter, was shipped to Falconbridge's Nikkelverk refinery in Norway where cobalt, copper, nickel, and precious metals were recovered. The $360 million Raglan operation produced concentrates of 26,552 t of nickel and 6,867 t of copper. Raglan concentrates were shipped from Deception Bay, which is located 100 km north of the mine, to Quebec City to continue by rail to Falconbridge's Sudbury smelter in Ontario. Falconbridge's exploration at the Nickel Rim South property resulted in an increased resource of 13.4 Mt at grades of 1.8% nickel, 3.3% copper, 0.04% cobalt, 1.8 grams per metric ton (g/t) platinum, 2.0 g/t palladium, and 0.8 g/t gold by late 2004 (McCutcheon, 2004, p. 38.8; Falconbridge Limited, 2005§).

In 2004, Inco produced nickel from 10 underground mines, 8 of which are located in Sudbury, Ontario, and 2, in Thompson, Manitoba, and operated nickel mills, smelters, and refineries in Sudbury and the Port Colborne refinery in Ontario, which produced 109,000 t of finished nickel, and the Thompson operations, which produced 53,000 t of nickel. Inco produced refined nickel and nickel oxide sinter (Inco Limited, 2005a§,b§).

The Voisey's Bay Nickel Company Limited (a subsidiary of Inco and based in St. John's, Newfoundland and Labrador) was established to develop the rich nickel, copper, and cobalt deposit on the Labrador Peninsula. Inco formalized an agreement with the Government of Newfoundland and Labrador to build a mine and concentrator in Voisey's Bay, Labrador, and a nickel-cobalt processing facility in Argentia, Newfoundland. Inco accelerated the project's schedule in Labrador by 6 months to begin the Voisey's Bay prestripping of the "Ovoid" open pit and the building of the enclosed concentrator in the third quarter of 2005. The advanced hydrometallurgical research and development program, which included design, engineering, and construction of the demonstration plant in Argentia continued in 2004 (Inco Limited, 2005a§, b§).

Inco had an agreement with Nuinsco Resources Ltd. of Toronto whereby Nuinsco can acquire 100% of Inco's Mel nickel property in the Thompson area of Manitoba by spending $6 million during a 5-year period to delineate 1 Mt at a grade of 1.6% to 2.0% nickel for open pit in 2004. Inco could reacquire up to 51% of the equity in the Mel project. In 2003, Canadian exports and imports of nickel were valued at $1.8 billion and $623 million, respectively, which resulted in net exports of Canadian nickel of almost $1.2 billion. Inco and Falconbridge continued to be the world's second and third ranked nickel producers, respectively (McCutcheon, 2004, p. 38.3; Heinzl, 2005).

Platinum-Group Metals.—Mine production of PGM increased by about 22.5% compared with that of 2003, as a result of the normalcy of Inco's operations in Sudbury after a 3-month strike in 2003, and the 22% and 15% increases in the prices of platinum and palladium, respectively, in 2004. PGM use increased by almost 7% owing to higher demand in the autocatalyst and the electronic industries in 2004. Platinum alloys tend to be used in jewelry; platinum, palladium, and copper-gold-silver alloys are used in dentistry. North American Palladium Limited produced PGM as its main product from the Lac des Iles open pit, which is located west of Thunder Bay in Ontario. Most production of PGM has been as byproducts from Inco's and Falconbridge's nickel-cobalt operations in Sudbury. Falconbridge also recovered PGM from its Raglan Mine in Quebec. Inco's Sudbury, Ontario, operation accounted for the majority of primary PGM output, with a small amount from its Birchtree and Thompson, Manitoba, operations (Chevalier, 2004b, p. 41.1-3, 41.11; Inco Limited, 2005b§; Natural Resources Canada, 2005a§).

The nickel sulfide ores yield creditable byproducts, such as, in order of value, copper, cobalt, gold, silver, PGM, selenium, tellurium, sulfuric acid, and liquid sulfur dioxide. Falconbridge shipped its PGM, which were contained in copper-nickel matte, to the firm's Nikkelverk refinery. Inco's PGM refinery in Acton, United Kingdom, processed primary and secondary materials from its Ontario ores. Canada ranked third behind South Africa and Russia in world platinum production and fourth after South Africa, Russia, and the United States in world palladium production (Chevalier, 2004b, p. 41.2; Hilliard, 2005a).

Silver.—Canada ranked fifth in world silver production after Mexico, Peru, China, and Australia (Hilliard, 2005b). 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. In 2004, silver-in-concentrate production from base-metal mines accounted for 42% of the total output, and gold mines contributed the remaining 58%. An increase in industrial demand in China and the rest of the world as economic conditions continue to improve coupled with lower Chinese silver stockpile sales could make for better prices into 2005 (Chevalier, 2004c, p. 48.1-3; Natural Resources Canada, 2005).

Titanium.—QIT-Fer et Titane, Inc. (QIT) (a wholly owned subsidiary of the British-Australian Rio Tinto Group) operated an ilmenite deposit at Lac Tio, which is located near Havre-Saint-Pierre, Quebec (QIT-Fer et Titane, Inc., 2005§). QIT's metallurgical complex in Sorel-Tracy, which was the only one of its kind in the world, extracted high-quality titanium dioxide, pig iron, and steel from the iron-bearing ore. The primary product was a titanium dioxide feedstock to make pigments for paints, surface coatings, plastics and paper, and iron and zircon byproducts. QIT's proprietary process technology had the production capacity to supply sulfate (1.1 Mt/yr of SORELSLAG titanium slag) and chloride (250,000 t/yr of UGS titanium slag) pigments. SORELSLAG had a titanium dioxide content of about 80%, which was sold to pigment producers that used the sulfate process. UGS slag, which was QIT's newest product, contained 94.5% of titanium dioxide and was supplied to the growing market of pigment producers that used the chloride process. To meet such potential demand, the

UGS titanium plant could be increased to 600,000 t/yr from its current (2004) capacity of 250,000 t/yr. The company aimed for extraction of 3 Mt/yr of ore (QIT-Fer et Titane, Inc., 2005§).

Canada, which exported 79,100 t of titanium dioxide pigment to the United States, ranked third as a titanium supplier to the United States following South Africa and Australia (Gambogi, 2005).

Uranium.—Production of uranium (U content) in 2004 amounted to 11,948 t U, which increased by more than 14% compared with that of 2003 (10,456 t U), mainly owing to normalized output from the Rabbit Lake production center and the McArthur River Mine, which were affected by unstable ground and flooding conditions, respectively, and the return to service of the Bruce A [1500-megawatt electrical (MWe)] and the Pickering A (515-MWe) nuclear power stations. The McArthur River Mine, which was the world's largest high-grade uranium mine, resumed operations in July 2003, and the Key Lake's mill continued processing its uranium ore, which was blended to a mill-feed of about 3.4% U. The Cigar Lake deposit contained the world's second largest high-grade uranium ore discovered to date; its uranium reserves totaled more than 85,000 t U at an average grade of more than 17% U (table 2; Vance, 2004, p. 58.1, 58.4-6; Natural Resources Canada, 2005a§).

In 2004, the value of uranium production increased by almost 3%; the uranium spot market price, which had increased during 2003, remained remarkably stable in 2004 because concerns about cleaner air and climate change and public debate on energy policy created a more-favorable attitude for nuclear power. 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 considering expected improvement on longer term world demand. The main importers of Canadian uranium continued to be, in order of value, the United States, France, and Japan (Vance, 2004, p. 58.9; Natural Resources Canada, 2005a§, c§).

As of January 1, 2004, Canada's identified recoverable uranium resources totaled 432,000 t U, or almost a 2% decrease compared with that of January 1, 2003 (439, 000 t U). In general, Canadian uranium producers in northern Saskatchewan remained well positioned to capitalize on current market conditions and prospects for further nuclear power development in, for example, France, Japan, and the United States. In Canada, the transition to new production was being centered on tapping high-grade and low-cost uranium deposits with continued success in bringing environmentally sustainable operations, such as the Cigar Lake Mine, which would ensure that Canada remained the world's leading uranium supplier. This mine was expected to begin production in 2007, pending on the necessary licenses and favorable market conditions (Vance, 2004, p. 58.1, 58.5).

Industrial Minerals

Asbestos.—Canadian asbestos value and production increased by 6% and by less than 1%, respectively, compared with those of 2003. The asbestos industry continued to be affected by competition for market share with, in order of tonnage, Russia, China, Brazil, and Kazakhstan and by liability issues because of the adoption of governmental regulations by a number of countries owing to human health concerns (Perron, 2004a, p. 18.1-18.2; Natural Resources Canada, 2005). 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 was the only form of asbestos produced in Canada. After Russia and China, Canada was the third ranked producer of asbestos and supplied about 98% of the U.S. demand. Total shipments for 2003 were estimated to be 241,000 t at a value of $98 million (Perron, 2004a, p.18.2; Virta, 2005). China produced almost exclusively short-fiber asbestos for asbestos cement and replaced Canada as the second ranked producer; China could eventually threaten Russia's leading position. As a result of the ban on movement in Europe and regulatory changes in other developed countries, asbestos use will remain low in the foreseeable future. In some developing countries, the benefits and safety of chrysotile-cement products continued to be recognized despite increasing competition from substitute fibers, PVC, and galvanized steel. The chrysotile-cement pipes are essential for water transportation and irrigation in the developed countries because the abruptness of terrain and economic conditions, but are not yet conducive to substitute products, such as PVCs (Perron, 2004a, p. 18.2).

The introduction of new chrysotile-containing products to address current health concerns and the gradual recognition by regulatory bodies of the potential toxicity of the substitute fibers may turn chrysotile asbestos markets around in the 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 (Perron, 2004a, p. 18.3).

The Canadian chrysotile industry was concentrated in Quebec. Production came from the Bell underground mines and the Black Lake open pit, which were operated by LAB Chrysotile, Inc. and located near Thetford Mines, and the Jeffrey Mine, which was operated by Jeffrey Mine Inc. and located near the town of Asbestos (table 2; Perron, 2004a, p. 18.1). Canadian exports of chrysotile-based products in 2003 were valued at $188.4 million, which represented a 23.7% decrease compared with that of 2002. The production of metallic magnesium from asbestos mine waste materials was expected, however, to improve the economics of the asbestos industry and create better overall labor expectations, particularly in Quebec in 2004 (Perron, 2004a, p. 18.1).

Cement.—Production of cement increased by about 4.9% to 14.9 Mt in 2004 from 14.2 Mt in 2003 with a corresponding increase in value of about 8.5% from that of 2003 ($1.5 billion). On the basis of preliminary data, shipments of portland cement in 2004 were estimated to have been 14.88 Mt at a value of $1.62 billion compared with 14.19 Mt at a value of $1.49 billion in 2003 (Panagapko, 2004a, p. 15.1; Natural Resources Canada, 2005; 2005a§, c§). This trend reflected continued strengthening of the export market in the midst of declining prices. The continued demand for raw materials in China has caused a dramatic increase in shipping rates that has affected

the importation of cement to the Americas from Asia. Total U.S. imports of cement, which excluded clinker, totaled 23 Mt in 2004 (van Oss, 2005). Canadian and U.S. trade of cement and clinker varies from year to year depending on construction activity. In 2003, cement exports to the United States amounted to 5 Mt, which was almost 100% of total Canadian production (Panagapko, 2004a). This implies that for the immediate and perhaps the foreseeable future, the success of Canadian cement producers would be based significantly on exports to the United States and, hence, for its 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 (Panagapko, 2004a, 15.5).

According to the Canadian Construction Association and the Minerals and Metals Sector, Natural Resources Canada, cement production was expected to be marginally higher as a result of an increase of about 11% in the value of infrastructure to about $89 billion. Also, the "Infrastructure Canada Program," which involves Federal, Provincial, Territorial, and municipal governments, will contribute about $4 billion across Canada in the coming decade. An increase in mortgage interest rates, however, could slow down the residential construction and cause increases in the cost of new homes, and ease the demand for cement from other components, such as nonresidential and engineering construction programs (Panagapko, 2004a, p. 15.6).

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. During 2000-03, the United States' main import sources for hydraulic cement and clinker were Canada (21%), China (11.6%), Thailand (10.1%), Venezuela (9.1%), Greece (7.2%), and others (41%) (International Cement Review, 2004, p. 30; Panagapko, 2004a, p. 15.5; van Oss, 2005).

Diamond.—Production of diamond increased by about 14.3% to 12.6 million carats from that of 2003 (10.8 million carats) with a corresponding value increase of 31.3% ($2.1 billion) in 2004 compared with that of 2003 ($1.6 billion). In 2004, diamond mining completed its sixth full year of production and was Canada's second ranked nonfuel mineral commodity after nickel ($2.5 billion). The opening of the Diavik diamond project in July 2003 and the startup of the Snake Lake project in 2007 will add to Canada's stature as a major producer of diamond worldwide. In 2004, Canada's diamond output contributed almost 8% of the world's production of natural rough diamond, which was estimated to be 12.6 million carats valued at about CAN$2,110 million and made Canada the third ranked producer, by value, following Botswana and Russia (Perron, 2004b, p. 23.1; Natural Resources Canada, 2005).

On January 1, 2003, the Kimberley Process Certification Scheme (KPCS) was implemented internationally. Under the KPCS, all Government participants agreed that all imports and exports of rough diamond would be accompanied by a certificate, and trade would take place only between participants, each of which must have adequate legislation to enforce the terms and conditions of the KPCS. Canada joined with 35 other countries in implementing the KPCS. Canada's Parliament passed the Export and Import of Rough Diamonds Act and regulations, which provided the Government with the authority to control trade of rough diamond, which must be reported to the Minister of Natural Resources Canada (Perron, 2004b, p. 23.6; Natural Resources Canada, 2005).

Canada's first open pit and underground diamond mine and commercial producer of diamond was the Ekati Mine. It was a joint venture between BHP Billiton Diamonds Inc. (80%), which was owned by BHP Billiton Group of Australia, and Charles Fipke and Stewart Blussom (10% each). The mine, which is located near Lac de Gras about 300 km northeast of Yellowknife, and the Diavik Mine, which is located in Yellowknife in the Northwest Territories, were the leading diamond producers during 2003-04. BHP Billiton Diamonds announced the Ekati Mine's expansion, which is called the Panda Underground Project, at a cost of $182 million. Initial output was expected to begin in early 2005 with full production of 4.7 million carats expected in early 2006. BHP Billiton Diamonds had chosen not to renew its 3-year rough diamond contract with De Beers Group of South Africa through its subsidiary De Beers Diamond Trading Company (Perron, 2004b, p. 23.1; BHP Billiton Diamonds Inc., 2005§).

BHP Billiton Diamonds officials 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 five pipes, in order of value, were located under Panda, Koala, Misery, Fox, and Leslie Lakes and would be mined during a 30-year period. The centralized processing plant, which is located southwest of the Koala pit, was to receive 9,000 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 per metric ton. Processing was expected to involve mainly crushing, scrubbing, and dense-media separation, as well as high-intensity magnetic separation, x-ray concentration, and sorting. Future output was projected to be 4.5 million carats per year, or about 5% of world diamond production. Capital investment was expected to be at least $4 billion in association with the five pipes (BHP Billiton Diamonds Inc., 2005§).

First production from the second Canadian diamond mine, the Diavik Mine, which is located about 35 km southeast of Ekati and 300 km northeast of Yellowknife, the Northwest Territories, began in January 2003. The Diavik Mine was an unincorporated joint venture between Diavik Diamond Mines Inc. (DDMI) (60%) (a wholly owned subsidiary of Rio Tinto plc of the United Kingdom) and Aber Diamond Mines Ltd. (40%) (a wholly owned subsidiary of Aber Diamond Corporation of Toronto, Ontario, Canada); DDMI was the operator of the mine. By yearend 2004, Diavik's reserves included 29.8 Mt of ore at 3.2 carats per ton, and its diamond production amounted to 7.6 million carats. Between 2000 and 2004, total construction and operations expenditures were $1.7 billion; of this total, $1.3 billion (74%) was with northern businesses, and $771 million (45%) was with northern Aboriginal businesses (Perron, 2004b, p. 23.2; Diavik Diamond Mines Inc., 2005§).

The Diavik diamond mine would mine four separate kimberlite pipes with a projected production that could reach 8 million carats per year; at least 90% of Diavik's production would be of gem quality. The Diavik Mine could produce about 101.5 million carats at an average value of $62 per carat

during its life of about 13 years (Perron, 2004b, p. 23.2; Diavik Diamond Mines Inc., 2005§).

The Snap Lake diamond deposit, which is located 220 km northeast of Yellowknife in the Northwest Territories, was 100% owned by De Beers Canada Inc. (part of the De Beers Group, which is headquartered in South Africa). On June 1, 2004, De Beers Canada was granted its final permit to proceed with the development of the Snap Lake Mine. This project will be De Beers' first mine outside of Africa and the first time that a kimberlite dike (tabular-shaped structure) will be mined on a large scale. The project development will take place in three phases. Phase 1 (preproduction development) will include the mine engineering plan, process plant design, and equipment selection and begin in early 2005; Phase 2 (construction) will focus on preparation of the site, which will include major earthworks and foundations for infrastructure; and Phase 3 will be mining. De Beers planned to use a modified room-and-pillar underground mining method so the lake will not be drained or disturbed. The Snap Lake project contains more than 18.3 Mt at an average grade of 1.46 carats per ton of diamond as defined (minable) reserves. The Snap Lake project was expected to produce about 1.5 million carats per year by early 2008 and to have a mine life of more than 20 years at a cost of $1 billion. The average value per carat was estimated to be $109 (Perron, 2004b, p. 23.3; Antwerp Facets Online, 2005§; De Beers Canada, 2005b§).

The Jericho diamond project, which is located in the Nunavut Territory about 400 km northeast of Yellowknife, was wholly owned by Tahera Diamond Corporation. Tahera will develop the project as the Nunavut Territory's first diamond mine. In June 2004, Tahera received Federal approval for its Jericho diamond project, which will be followed by the water license and land lease in early 2005. Open pit development will be completed by the end of 2005, and full production will begin in 2006 (Tahera Diamond Corporation, 2005a§). Tahera's base plan indicated that more than 4.7 million carats will be produced during a 9-year mine life. The Jericho project contains more than 2.6 Mt at an average grade of 1.2 carats per ton of diamond as defined (minable) reserves and 5.5 Mt at an average grade of 0.84 carat per ton of diamond as total resources. On June 8, 2004, De Beers Canada announced a partnership with Tahera in the Nunavut Territory. The Tahera De Beers joint venture is called the Polar Project; it is adjacent to the Jericho project (Perron, 2004b, p. 23.3; Antwerp Facets Online, 2005§; De Beers Canada, 2005a§; Tahera Diamond Corporation, 2005a§-c§).

More than 500 companies, off and on, have been exploring for diamond, especially in the Northwest Territories, but also in Alberta, British Columbia, Labrador, Manitoba, the Nunavut Territory, Ontario, Quebec, and Saskatchewan. The field seemed to be narrowing somewhat as various kimberlite pipes proved disappointing upon testing. BHP Billiton Diamonds has supported the establishment of a diamond-sorting-valuation facility in the Northwest Territories, which 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 Diamonds' other marketing arrangements in Europe. 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 factories; artisans were brought over from Belgium.

Gypsum and Anhydrite.—Production of gypsum and anhydrite increased to 9.2 Mt in 2004 from 8.4 Mt in 2003, or an increase of 9.5%. According to preliminary data, Canadian mines exported 5.7 Mt of raw gypsum to the United States at a value of $2.2 million compared with 5.2 Mt at a value of $2 million in 2002, according to final data. The reported 9.6% increase in sales was due to decreased apparent consumption of gypsum in Canada, or 26% in 2003 compared with that of 2002 (Panagapko, 2004b; Natural Resources Canada, 2005a§, c§).

Production has been mostly by Canadian subsidiaries of United Kingdom and U.S. companies, such as USG Corp. and National Gypsum (Canada) Ltd., and governed by demand for wallboard manufacturing for all building categories by consumers in the United States and Canada. Nova Scotia and Newfoundland and Labrador produced the bulk of Canadian gypsum with lesser amounts from, in order of commodity value, Ontario, Manitoba, and British Columbia. Although gypsum occurs widely in Canada and the world, its high unit weight, low unit cost, and the vulnerability to damage of wallboard combine to give gypsum products a relatively high in-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 Company at Wentworth and Little Narrows Gypsum Company at Little Narrows. In 2004, Canada was the world's third ranked producer of gypsum after the United States and Iran (Panagapko, 2004b; Founie, 2005).

Potash.—The dominant potash product is potassium chlorite (KCl), which is reported as potassium oxide/oxide of potash (K_2O) equivalent. Potash production totaled about 10.2 Mt; this was an increase of 10.9% compared with that of 2003 (9.2 Mt, revised data). The value of production increased to about $1.5 billion in 2004 from $1.25 billion in 2003; this was an increase of 20%. Most of the output came from mines in Saskatchewan, but about 5% came from New Brunswick. Canada has probably the largest identified potash resource, which was estimated to be about 60 billion metric tons (Gt), and a reserve base of almost 10 Gt (Stone, 2004b; Natural Resources Canada, 2005; Searls, 2005).

Canada was the world's leading producer and exporter of potash. Canadian potash was exported to the United States (42%), Brazil (11%), China (10%), India and Malaysia (4% each), Japan (3%), and others (26%). Exports to the United States have risen steadily to satisfy agricultural needs, but lower prices for grains and decreased production in the United States diminished the requirement 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. The United States imported 4.9 Mt of potash, and 91% of its total needs was dominantly provided mainly by Canada between 2000 and 2003. Canada, Russia, Belarus, Germany, Israel, and the United States, in order of tonnage, dominated production with 88% of the world total (Stone, 2004b; Searls, 2005).

Potash Corporation of Saskatchewan Inc. (PotashCorp), which was based in Saskatoon, Saskatchewan, was one of the world's leading publicly owned potash producers. It had the following divisions, in order of importance: Allan, Cory, Lanigan, New Brunswick, Rocanville, and Patience Lake (a solution mine). PotashCorp owned 25% of the reserves at Esterhazy, Saskatchewan, which were mined by IMC Esterhazy Canada Limited Partnership under a long-term agreement. PotashCorp had a production capacity of 12.1 Mt/yr of KCl equivalent, which was equal to more than 60% of Canada's total potash capacity (Stone, 2004b).

Sulfur.—Production of all forms of sulfur increased by 4.6% compared with that of 2003. Sulfur from smelter gases increased by 1.1% to 621,000 t, and sulfur from natural gas, crude oil, and byproducts increased by about 4.8% to 8.3 Mt compared with that of 2003. Smelter-gas sulfur is converted to sulfuric acid. No Canadian production was derived from Frasch mining (Natural Resources Canada, 2005a§).

With a projected 13.5% share, Canada maintained its position as the world's second ranking producer of sulfur after the United States and followed by Russia, China, and Japan and remained a leading exporter with roughly a 38% share of world trade in sulfur. The Chinese markets became an important destination for Canadian sulfur producers. Most of the producers were located in, in order of importance, Alberta, Ontario, Quebec, and Saskatchewan. Other Provinces produced small amounts of sulfur, mostly from oil refineries (Stone, 2004c; Ober, 2005).

Mineral Fuels

Coal.—At the end of 2004, Canada's coal reserves amounted to almost 6.6 Gt (table 3). Although coal production was still declining from the record high of about 78.9 Mt in 1997, it increased by 6.3% to about 66.0 Mt compared with that of 2003 (62.1 Mt). The total value of production was $1.2 billion, which was an increase of 7.1% compared with that of 2003 and about 18% compared with that of 1997 because of a progressively lower conversion rate for the Canadian dollar (table 1; Natural Resources Canada, 2005; 2005a§, c§; BP p.l.c., 2005a§). In 2004, fewer than 25 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 for Canadian coal companies to survive. In 2004, Canada accounted for only about 2% of the world's coal production; it exported less than one-half of that production, thus making it the world's fifth ranked exporter after Australia, the United States, China, and South Africa. All exports were from the lower cost exporters in western Canada; metallurgical coal remained the country's major export (23.7 Mt). Domestic coal consumption remained high at about 61.5 Mt, and much of the eastern Canadian demand was supplied by imports. The Appalachian region of the United States and the Cerrejón coal mine of Colombia supplied bituminous coal for the Canadian steel and electricity industries, and subbituminous coal from the United States was delivered into Ontario. In 2003, Canadian coal exports amounted to 25.1 Mt valued at $1.2 billion, and imports of coal into Canada were about 22.8 Mt valued at $690 million, of which 95% was imported by, in order of tonnage, Ontario, Nova Scotia, and New Brunswick. Coal imports were mainly for energy generation (80%), and the remainder (20%) was used by the steel and other industries. The United States supplied more than 19 Mt, and Colombia furnished the remaining 3.8 Mt (Stone, 2004a; Natural Resources Canada, 2005; 2005a§, c§).

In 2004, Elk Valley Coal Partnership operated the Coal Mountain, the Elkview, the Fording River, the Greenhills, and the Line Creek Mines in British Columbia and the Cardinal River Mine in Alberta. In 2003, the Elk Valley, which was the second ranked metallurgical coal operating unit in the world, was established by the joint venture of Consol Energy Inc., Fording Inc., and Luscar Energy Partnership (59%) and Teck Cominco (41%). Luscar Coal Ltd., which was owned by the Luscar Energy Partnership (Canada's leading coal producer) operated surface mines, in order of tonnage, the Coal Valley, the Obed Mountain, the Highvale, the Paintearth, the Sheerness, the Whitewood, and the Genesee in Alberta and the Poplar River, the Boundary Dam, and the Bienfait in Saskatchewan. These coal mines have a combined production capacity of 40 Mt/yr of bituminous, subbituminous, and lignite thermal coal used mainly for domestic electric power generation (Stone, 2004a, p. 20.1-20.2; Elk Valley Coal Partnership, 2005§; Teck Cominco Limited, 2005§).

Canada's apparent coal consumption was 59 Mt in 2004. Canada's major consumption of coal was as a fuel for its 23 coal-fired electricity power generation plants, which accounted for about 93% of Canada's coal consumption. The Canadian steel industry consumed about 5% of the total and other industrial and domestic consumers used 2%. 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. This paradox reflected transportation costs between mines and consumers and was one more example of the natural integration of Canadian and U.S. interests in mineral commodities; others included cement and gypsum (Stone, 2004a, p. 20.4).

Late in 2002, Canada ratified the Kyoto Protocol to limit emissions of greenhouse gases and carbon dioxide. The ratification would impact future Canadian coal usage. To that end, the Canadian Government and the coal industry have been investing in research and development of clean coal technologies and greenhouse gas emission mitigation and, at the same time, enhancing the efficiency and the environmental acceptability of coal production, preparation, and consumption (Stone, 2004a, p. 20.5).

Natural Gas.—The value of natural gas ($14.6 billion) increased by 4.3% compared with that of 2003, and that of natural gas byproducts ($2.3 billion) increased by 9.5% compared with that of 2003. Both products, however, responded to supply-and-demand imbalances and increased 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 increased to about 195.6 billion cubic meters from 194.5 billion cubic meters in 2003 and decreased from 200.9 billion cubic meters in 2002 as a result of natural gas consumption in the United States, which was the world's largest consumer, decreasing to about 629.8 billion cubic meters from 661.9 billion cubic meters in 2003, or by almost 5% because of higher prices and industrial restructuring (BP p.l.c., 2005b§; Natural Resources Canada, 2005a§, c§). Marketed gas is gross production minus reinjected gas, shrinkage, and producer consumption.

Canada remained the leading foreign supplier of natural gas to the United States. About 102.1 billion cubic meters of natural gas, which was more than 20% of the U.S. consumption, was exported to the United States in 2004. These exports were expected to increase to about 105 billion cubic meters by 2006 in anticipation of the increasing inability of U.S. domestic production to meet demand. In 2004, Canada's natural gas proven reserves were estimated to be about 1.7 trillion cubic meters, which remained at about the same level as that of the preceding year (table 3; BP p.l.c., 2005b§; U.S. Energy Information Administration, 2005§).

Exploration for new discoveries of natural gas that began at least two decades ago continued in Alberta and Saskatchewan. Chevron Canada Resources Ltd. (a unit of ChevronTexaco Corporation) 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 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" (Chevron Corporation, 2005§). 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, particularly, in the United States [from $3.33 per million British thermal units (Btu) in 2002 and $5.63 per million Btu in 2003 to $5.85 per million Btu in 2004] (Chevron Corporation, 2005§; Natural Resources Canada, 2005d§).

Opposition to natural gas exploration, production, and transmission, however, has grown in recent years. Environmental groups opposed to the 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 estimated reserves at 4.8 trillion cubic meters (170 trillion cubic feet) (BP p.l.c., 2005b§).

Petroleum.—Production of crude oil (petroleum) reached a new record high of 940.1 million barrels (Mbbl) in 2004 compared with 908.2 Mbbl in 2003 and 861.7 Mbbl in 2002; these increases of about 3.5% and 9.1%, respectively, were mostly the result of new Athabasca oil sands production (600.1 Mbbl) in Alberta and increased offshore Newfoundland and Labrador production (121.4 Mbbl). The value of the production was $36 billion in 2004 compared with that of 2003 ($26.2 billion); the oil prices in 2004 were the highest in the past 30 years (average $38.27 per barrel). In 2004, with a projected 15% share, Canada maintained its position as the Americas' third ranked producer of crude oil after, in order of volume, the United States and Mexico and followed by Venezuela and Brazil and remained a leading exporter with a more than 16% share of U.S. crude oil imports (BP p.l.c., 2005c§; Statistics Canada, 2005b§).

In 2004, petroleum exports and imports increased by 2.5% and 2.4%, respectively, compared with those of 2003. Exports amounted to almost 20% (784 Mbbl) of the total petroleum production, which was a result of the strong demand from the United States. Canadian imports amounted to 341 Mbbl; a significant volume (more than 55%) was supplied by Europe and the Middle East (BP p.l.c., 2005c§; Statistics Canada, 2005b§).

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 June 2005. 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 assessment of reserves are, in simplest terms, the arithmetic result of additions to reserves, deletions from reserves, and production. A complication is that in Canada 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 and/or byproducts as credits.

Reserves of major metals were distributed unevenly throughout Canada and were the result mostly by mineralization of the Precambrian shield, the Rockies (Cordillera), and the Coast Ranges. Four Provinces dominated the reserves position in terms of proven and probable (minable) reserves of major metals—Ontario had 56% of the nickel, about 57% of the gold, 55% of the copper, 29% of the zinc, and 26% of the silver; British Columbia had 100% of the molybdenum, about 28% of the copper, 26% of the silver, 15% of the gold, 8% of the zinc, and 6% of the lead; New Brunswick had 88% of the lead reserves, 28% of the zinc, and 20% of the silver; Quebec had 29% of the zinc, 28% of the silver, 24% of the gold, 11% of the nickel, and 6% of the copper; and Manitoba had 16% of the nickel, 6% of the zinc, 2% of the copper, and 1% each of gold and silver. Future discoveries will alter the distribution of reserves among the Provinces and the Territories (Reed, 2004).

Infrastructure

With a total land (9.094 million square kilometers) and freshwater (891,163 square kilometers) area of about 9.985 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 1.409 million kilometers of roads that comprised 497,300 km of paved highway, which included 16,900 km of expressways and 911,500 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 (Natural Resources Canada, 2005e§; U.S Central Intelligence Agency, 2005§).

A total of 48,910 km of standard-gauge railroads included two main systems, the Canadian National and the Canadian Pacific. The country also had about 3,000 km of inland waterways, plus the 3,770-km Saint Lawrence Seaway (one of the busiest in the world), which included the 3,060-km Saint Lawrence River that leads into the Great Lakes and is shared with the United States. Principal ports and harbors were Bécancour (Quebec), Churchill (Manitoba), Halifax (Nova Scotia), Montreal (Quebec), Prince Rupert (British Columbia), Quebec (Quebec), Saint John (New Brunswick), St. John's (Newfoundland), Sept Isles (Quebec), Sydney (Nova Scotia), Trois-Rivieres (Quebec), Thunder Bay (Ontario), Toronto (Ontario), Vancouver (British Columbia), and Windsor (Ontario). Canada's merchant marine comprised about 169 ships of 1,000 or more gross registered tons (Natural Resources Canada, 2005e§; U.S Central Intelligence Agency, 2005§).

The country had 1,326 airports. Among these, 503 had permanent-surface runways—18 had runways from 2,438 to 3,047 meters (m) long; 15 had runways from 1,524 to 2,437 m long; 150 had runways from 914 to 1,523 m long; and 245 had runways under 914 m long. Canada had about 823 major transport aircraft; Air Canada was the major carrier (Natural Resources Canada, 2005e§; U.S. Central Intelligence Agency, 2005§).

Canada generated electrical power from coal, natural gas, nuclear fuel, and massive hydroelectric facilities. Total capacity was roughly 114 gigawatts. About 548.9 net terawatt hours, which was significantly less than capacity, was produced in 2002 (the last year for which complete data were available). Hydroelectric plants generated 57% of Canada's electricity; coal and fossil fuel, 28%; nuclear reactors, about 13%; and other renewables, 2%. Quebec and Ontario produced the most electricity (154 and 141 terawatt hours, 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 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 value, crude oil, natural gas, coal, uranium, and hydropower, and was the main source of U.S. energy imports (Statistics Canada, 2005a§; U.S. Central Intelligence Agency, 2005§; U.S. Energy Information Administration, 2005§).

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 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, 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 represented the greatest length for any Province (18,900 km, or almost 20% of the total pipeline network) (U.S. Central Intelligence Agency, 2005§; U.S. Energy Information Administration, 2005§).

Outlook

Canada continued to be a very important trading partner of the United States; this partnership enhanced investment and trade among the members of the North America Free Trade Agreement (NAFTA). The United States absorbed more than 85% of Canadian exports, which benefited the Canadian economy. The continued economic recovery in the United States and increased metal prices has given a boost to the Canadian mining industry and the probability of sustained economic growth in 2005 and beyond. Canada, which is rich in mineral resources, ranked among the top five world suppliers for more than 10 important minerals and metals and was a net exporter of fuel minerals, hydropower, industrial minerals, metals, and uranium. Canada's mineral industry is encouraged by the Federal Government to work towards the improvement of 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. Exploration is key to assuring a long-term supply of Canadian minerals. The 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 stakeholders to reestablish an attractive investment climate and to reverse any economic difficulties, such as the costs of socioeconomic and Impact Benefit Agreements with local aboriginal groups being deductible from royalties and eligible as exploration investment (Andrews, 2005).

In 2004, the high energy consumption regionally and globally and the high energy prices had a timely impact on new developments, such as the White Rose fields in the Jeanne d'Arc Basin and expansions of the Hibernia and the Terra Nova oilfields in the near future. Comparisons between the Canadian offshore field oil resources and the development of the now-legendary North Sea fields continue to be heard. Canadian uranium companies are effectively positioning themselves at the forefront of uranium producers worldwide that are vying for the chance to discover additional uranium resources to meet the growing domestic and global demand for nuclear energy.

Over time, Canada has become the focus of global minerals exploration. In spite of declining exploration budgets for Canadian companies, from a high of $4.6 billion in 1997 to

$3.4 billion in 2004, exploration and deposit appraisal spending in Canada rebounded and gained momentum since 2001 from $366.4 million to $752.4 million in 2004. To that effect, the Voisey's Bay nickel-copper-cobalt deposit (in Newfoundland and Labrador) and the diamond deposits at Diavik, Ekati, and Snap Lake (in the Northwest Territories), and Jericho (in the Nunavut Territory) are recent exploration successes, which made an impressive case for more exploration in Canada, considering alternative exploration opportunities in Asia, Australia, and/or Latin America. In fact, because of Voisey's Bay's development and Diavik and Ekati diamond mines' production, which amounted to about 15% of the world's supply of rough diamond by value, exploration activity is being positively driven by the continuing exploration interest for diamond and encouraged by the significant recent diamond findings, such as at the Jericho Project in the Nunavut Territory and the Victor Project in Ontario. Across Canada, diamond exploration will continue in, in order of economic importance, the Northwest Territories, the Nunavut Territory, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Newfoundland and Labrador.

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

Canada is expected to continue to be well-positioned in terms of its metals and minerals fuel resources base and its access to, in order of economic importance, the NAFTA, Europe, Japan, China, and other global markets. Canada's mineral industry is primarily export oriented; as much as 92% of the production of some mineral commodities goes to world markets. The United States will 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's continuous challenge will be to face the realities of globalization and internationalization, especially with respect to developing countries that have more competitive mineral resources and are more avidly open 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' rights, and the preservation of the environment.

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TABLE 1
CANADA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		2000	2001	2002		2004[p]
METALS						
Aluminum:						
Alumina:						
Al_2O_3		1,023,000	1,036,000	1,125,400	1,108,500	1,169,836
Hydrate		1,197,400	1,196,470	1,283,000	1,269,600	1,328,842
Metal:						
Primary		2,373,460	2,582,746	2,708,910	2,791,915	2,592,160
Secondary		148,000	180,000	180,000	51,964 r	49,701
Total		2,521,460	2,762,746	2,888,910	2,843,879 r	2,641,861
Antimony[2]		433	278 r	173 r	153 r	112
Bismuth:						
Mine output, Bi content[2]		243	258	189	145	185
Metal, refined[e]		250	250	250	250	250
Cadmium:						
Mine output, Cd content[2]		1,051	1,098 r	1,027 r	814 r	801
Metal, refined		1,941	1,493 r	1,706 r	1,759 r	1,888
Calcium	kilograms	170,246	133,200	135,000 e	135,000 e	135,000 e
Cobalt:						
Mine output, Co content[2]		5,298	5,326 r	5,148	4,327 r	5,197
Metal:						
Shipments[3]		2,022	2,112	2,065	1,842 r	2,126
Refined, including oxide		4,364 r	4,378 r	4,625 r	4,233 r	5,144
Columbium (niobium) and tantalum:						
Pyrochlore concentrate:						
Gross weight		5,070	7,070	7,410	7,270	7,670
Nb content		2,280	3,180	3,333	3,270	3,450
Tantalite concentrate:						
Gross weight		228	308	232	220	276
Ta content		57	77	58	55	69
Nb content		11	15	12	11	10
Copper:						
Mine output, Cu content[2]		633,855	633,531 r	603,498 r	557,082 r	563,471
Metal:						
Smelter:						
Primary, blister		543,593 r	601,359 r	513,934 r	430,116 r	446,221
Secondary and scrap		60,109 r	41,640 r	24,761 r	26,789 r	29,982
Total		603,702 r	642,999 r	538,695 r	456,905 r	476,203
Refined:						
Primary		551,393	567,720	494,522	454,866	526,967
Secondary		61,300	42,800	24,800	26,800	26,800
Total		612,693	610,520	519,322	481,666	553,767
Gold, mine output	kilograms	156,207	158,875	151,904	140,861 r	128,504
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand metric tons	35,247	27,119 r	30,902	33,322 r	28,256
Fe content	do.	22,744	17,186	19,684	20,993	17,801
Metal:						
Pig iron	do.	8,900	8,780	8,800	8,800 e	8,800 e
Direct-reduced iron[e]	do.	920	920	920	920	920
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.	15,900	16,300	16,300 e	17,000 r	17,000 e

See footnotes at end of table.

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

(Metric tons unless otherwise specified)

Commodity		2000	2001	2002	2003	2004[p]
METALS--Continued						
Lead:						
Mine output, Pb content		148,769	153,932	97,178 r	81,264 r	76,727
Metal, refined:						
Primary		159,192 r	127,007	136,896 r	118,506 r	131,015
Secondary		125,141	103,921	114,664 r	104,927 r	110,382
Total		284,333 r	230,928	251,560 r	223,433 r	241,397
Lithium, spodumene[e]		22,500	22,500	22,500	22,500	22,500
Magnesium, metal, primary[e]		80,000	83,000	88,000	54,000	54,000
Molybdenum, mine output, Mo content		7,457	8,233 r	8,043 r	9,092 r	9,544
Nickel:						
Mine output, Ni content[2]		190,793	194,058 r	189,297	163,244 r	186,546
Refined[4]		134,225	140,591	144,476	124,418	151,518
Platinum-group metals, mine output:						
Palladium	kilograms	5,708	7,243	8,530	6,480	7,813
Platinum	do.	10,402	14,540	17,124	15,048	18,551
Total	do.	16,110	21,783 r	25,654 r	21,528 r	26,364
Selenium, refined[5]	do.	335,000	238,000	175,000 r	253,000	277,000
Silver:						
Mine output, Ag content	do.	1,212,386 r	1,320,030 r	1,407,558	1,310,153 r	1,335,828
Refined	do.	1,831,787 r	1,623,140 r	1,855,979 r	1,558,105 r	1,837,724
Tellurium, refined[5]	do.	53,000	51,000	39,000	40,000	69,000
Titanium, Sorel slag[6]		950,000 e	1,014,000 r	890,000 r, e	873,000 r	863,000
Tungsten, mine output, W content		--	--	2,295	3,636	--
Uranium oxide, U content		10,683	12,487 r	11,607 r	10,456 r	11,948
Zinc:						
Mine output, Zn content		1,002,242	1,064,744 r	916,220 r	788,063 r	790,737
Metal, refined, primary		779,892	661,172	793,410 r	761,199	805,077
INDUSTRIAL MINERALS						
Asbestos		307,000	277,000	242,241	240,500	241,000
Barite		121,000	23,000	17,000	23,000	21,000
Cement, hydraulic[7]	thousand metric tons	12,612	12,986	13,710	14,190 r	14,884
Clay and clay products[8]	value, thousands	$175,449	$194,580	$233,244	$234,000 r	$229,971
Diamond	carats	2,533,750	3,716,000	4,936,616 r	10,755,654 r	12,618,080
Diatomite[e]		10,000	10,000	10,000	10,000	10,000
Gemstones, amethyst and jade		235	148	246	114	105
Graphite		31,000	35,000	25,000 e	25,000 e	28,000 e
Gypsum and anhydrite	thousand metric tons	9,232	7,821	8,809	8,378 r	9,249
Lime[7]	do.	2,525	2,213	2,248	2,221 r	2,410
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		717,000	710,000	717,000	697,000	702,000
Nitrogen, N content of ammonia		4,129,000	3,438,700	3,440,000	3,440,000	3,440,000 e
Potash, K_2O equivalent	thousand metric tons	9,202	8,237	8,361	9,229 r	10,181
Pyrite and pyrrhotite, gross weight[e]		5,000	5,000	5,000	5,000	5,000
Salt	thousand metric tons	11,994	13,725	12,736	13,952 r	14,125
Sand and gravel	do.	238,494	236,486	238,120	235,574	248,159
Silica, quartz[9]	do.	1,514	1,613	1,540	1,586	1,690
Sodium compounds, n.e.s.:[e]						
Sodium carbonate, soda ash	do.	300	100 r	-- r	-- r	--
Sodium sulfate, natural[10]	do.	305	305	305	305	305
Stone[11]	do.	139,188	124,758	124,746	119,356	127,559
Sulfur, byproduct:						
Metallurgy	do.	831 r	762	703	614 r	621
Petroleum	do.	8,621	8,154	7,671	7,891 r	8,271
Total	do.	9,452 r	8,916	8,374	8,505 r	8,892
Talc, pyrophyllite, soapstone[e]	thousand metric tons	90	90	90	90	90

See footnotes at end of table.

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

(Metric tons unless otherwise specified)

Commodity		2000	2001	2002	2003	2004[p]
MINERAL FUELS AND RELATED MATERIALS						
Carbon black[e]		165,000	165,000	165,000	165,000	165,000
Coal, run-of-mine:						
Bituminous and subbituminous	thousand metric tons	58,037	59,042	55,408	50,929	54,793
Lignite	do.	11,126	11,319	11,200	11,200 [r]	11,200 [e]
Total	do.	69,163	70,361	66,608	62,129 [r]	65,993
Coke, high-temperature	do.	3,307	3,300	3,300 [e]	3,300 [e]	3,300 [e]
Natural gas:						
Gross	million cubic meters	195,457	200,709	200,890	194,487 [r]	195,815
Marketed	do.	166,078	171,388	171,348	166,072 [r]	167,021
Natural gas liquids:						
Pentanes plus	thousand 42-gallon barrels	67,700	66,000	66,000 [e]	66,000 [e]	66,000 [e]
Condensate	do.	2,900	2,800	2,800 [e]	2,800 [e]	2,800 [e]
Total	do.	70,600	68,800	68,800 [e]	68,800 [e]	68,800 [e]
Peat		1,277	1,319	1,385 [r]	1,341	1,180
Petroleum:						
Crude[12]	thousand 42-gallon barrels	803,919	816,505	861,730	908,213 [r]	940,066
Refinery products:[e]						
Propane, butane, naphtha, liquefied petroleum gas	do.	13,300	13,700	14,800	14,900	15,500
Gasoline:						
Aviation	do.	900	850	1,050	1,000	1,000
Other	do.	228,000	235,000	255,000	260,000	270,700 [13]
Petrochemical feedstocks	do.	29,800	30,800	33,700	34,100	35,500
Jet fuel	do.	31,100	32,100	35,300	35,700	37,200
Kerosene	do.	1,700	1,800	2,100	2,100	2,200
Distillate fuel oil, diesel and light	do.	175,000	180,000	194,000	19,500	20,100
Lubricants including grease	do.	7,000	7,200	7,500	7,600	7,900
Residual fuel oil, heavy	do.	45,100	46,500	50,600	51,200	53,300
Asphalt	do.	23,200	23,900	26,300	26,100	27,200
Petroleum coke	do.	6,500	6,700	7,400	7,500	7,800
Unspecified	do.	23,600	24,300	26,800	27,200	28,800
Refinery fuel and losses[14]	do.	22,800	23,500	25,300	25,600	27,000
Total	do.	608,000	626,000	680,000	513,000	534,000

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

[1]Table includes data available through January 2006.

[2]Metal content of concentrates produced.

[3]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.

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

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

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

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

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

[9]Producers' shipment of quartz.

[10]Excludes byproduct production from chemical plants.

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

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

[13]Reported figure.

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

TABLE 2
CANADA: STRUCTURE OF THE MINERAL INDUSTRY IN 2004

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum	Alcan Inc.	Smelter in Laterriere, Quebec	219.
Do.	do.	Smelter in Beauharnois, Quebec	50.
Do.	do.	Smelter in Shawinigan, Quebec	91.
Do.	do.	Smelter in Grande-Baie, Quebec	198.
Do.	do.	Smelter in Arvida, Jonquiere, Quebec	163.
Do.	do.	Smelter in Kitimat, British Columbia	275.
Do.	do.	Smelter in Alma, Quebec	400.
Do.	Aluminiere de Bécancour Inc. (Alcoa, 75%; Alcan, 25%)	Smelter in Becancour, Quebec	403.
Do.	Canadian Reynolds Metals Co. Ltd. (Alcoa, 100%)	Smelter in Baie-Comeau, Quebec	438.
Do.	Aluminerie Alouette Inc. (Alcan, 40%; Aluminium Austria Metall Québec, 20%; Hydro Aluminum, 20%; Société générale de financement du Québec, 13.33%; Marubeni Québec Inc., 6.67%)	Smelter in Sept-Iles, Quebec	244.
Do.	Aluminerie Lauralco Inc. (Alcoa, 100%)	Deschambault, Quebec	249
Alumina	Alcan Inc.	Refinery in Vaudreuit, Quebec	1,169 (smelter-grade).
Asbestos	LAB Chrysotile, Inc. (private, 100%)	Black Lake, Quebec	160 (fiber).
Do.	do.	Bell Mine, near Thetford Mines, Quebec	70 (fiber).
Do.	Jeffrey Mine Inc.	Jeffrey Mines at Asbestos, Quebec	250 (fiber).
Cement	Lafarge Canada Inc.	Bath, Ontario	1,176 (dry-process).
Do.	do.	Woodstock, Ontario	814 (wet-process).
Do.	do.	Exshaw, Alberta	1,422 (dry-process).
Do.	do.	Kamloops, British Columbia	324 (dry-process).
Do.	do.	Richmond, British Columbia	1,319 (wet-process).
Do.	do.	St. Constant, Quebec	1157 (dry-process).
Do.	do.	Brookfield, Nova Scotia	621 (dry-process).
Do.	St. Lawrence Cement Inc. (Holcim AG of Swiss)	Joliette, Quebec	1,475 (dry-process).
Do.	do.	Mississauga, Ontario	2,000 (wet and dry).
Do.	Ciment Québec Inc. (Esssroc Group, 50%, and private, 50%)	Saint-Basile, Quebec	1,571 (dry-process).
Do.	ESSROC Canada Inc. (Italcementi Group)	Picton, Ontario	792 (wet and dry).
Do.	Federal White Cement Ltd.	Woodstock, Ontario	544 (dry-process).
Do.	St. Marys Cement (Canada) Inc. (Votarantim Ciment)	Bowmanville, Ontario	1,377 (dry-process).
Do.	do.	St. Marys, Ontario	645 (dry-process).
Do.	Lehigh Inland Cement Ltd. (Heidelberg Cement Group)	Edmonton, Alberta	1,380 (dry-process).
Do.	do.	Delta, British Columbia	1,356 (dry-process).
Coal	Elk Valley Coal Partnership (Consol Energy Inc., Fording Inc., and Luscar Energy Partnership, 59%, and Teck Cominco Limited, 41%)	Coal Mountain Mine at Sparwood, British Columbia	2,500 (open pit), 3,200 (plant).
Do.	do.	Elkview Mine near Sparwood, British Columbia	6,000 (open pit).
Do.	do.	Fording River Mine near Elkford, British Columbia	10,000 (open pit), 9,500 (plant).
Do.	do.	Greenhills Mine near Elkford, British Columbia	4,500 (open pit), 5,000 (plant).
Do.	do.	Line Creek Mine near Sparwood, British Columbia	9,000 (open pit).
Do.	do.	Cardinal River Mine near Hinton, Alberta	8,000 (open pit).
Columbium (niobium)	Cambior Inc.	Niobec Mine, Chicoutimi, Québec	3,450 tons Nb content.

See footnotes at end of the table.

TABLE 2--Continued
CANADA: STRUCTURE OF THE MINERAL INDUSTRY IN 2004

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Copper	Boliden Westmin (Canada) Limited	Myra Falls Mine, British Columbia	9,000.
Do.	Falconbridge Limited (Noranda Inc., 58.9%, and Falconbridge Limited, 41.1%)	Sudbury Division, Sudbury, Ontario	4,250.
Do.	do.	Strathcona and Timmins operations in Timmins, Ontario	4,860.
Do.	do.	Smelter in Timmins, Ontario	440.
Do.	do.	Kidd Creek Mine, Timmins, Ontario	4,000 (ore).
Do.	do.	Montcalm Mine in Timmins, Ontario	2,000 (ore).
Do.	do.	Raglan Mine, Quebec	2,000 (ore).
Do.	do.	Louvicourt Mine, Quebec	2,000 (ore).
Do.	do.	Smelter in Thompson, Manitoba	686 (projected).
Do.	do.	Bell Allard Mine, Murdochville, Quebec	4,000 (ore).
Do.	do.	Horne Smelter in Noranda, Quebec	770.
Do.	Highland Valley Copper (Teck Cominco Limited, 63.9%; BHP Billiton Ltd., 33.6%; others, 2.5%)	Kamloops, British Columbia	4,500.
Do.	Inco Limited	Thompson district, Manitoba	Variable (polymetallic).
Do.	do.	Smelter in Sudbury, Ontario	500.
Do.	do.	Refinery in Sudbury, Ontario	170.
Do.	Huckleberry Mines Ltd. (Imperial Metals Corp., 50%, and Japanese consortium, 50%)	Huckleberry Mine in Omineca, southeast of Houston, British Columbia	37 (Cu contained).
Do.	Imperial Metals Corporation	Mount Polley Mine at Williams Lake, British Columbia	17 (Cu contained).
Do.	Northgate Exploration Limited	Kermss Mine, British Columbia	28 (Cu contained).
Diamond carats	BHP Billiton Diamonds Inc., 80% (BHP Billiton Group); Charles Fipke, 10%; Stewart Blussom, 10%)	Ekati Mine in Lac de Gras region, Northwest Territories	5,350,000.
Do. do.	Diavik Diamond Mines Inc., 60% (Rio Tinto plc); Aber Diamond Mines Ltd., 40% (Aber Diamond Corporation)	Diavik Mine in Yellowknife region, Northwest Territories	6,000,000.
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.	Kirkland Lake Gold Inc.	Macassa Mine at Teck Township, northern Ontario	473 (ore).
Do.	Princeton Mining Corp.	Similco Mine in Princeton, British Columbia (suspended)	450 (kilograms metal).
Do.	Kinross Gold Corporation	Lupin Mine in Contwoyo Lake, Northwest Territories (suspended)	612 (ore).
Do.	Miramar Mining Corporation	Giant Mine in Yellowknife, Northwest Territories	407 (ore).
Do.	do.	Giant mill-tailings in Yellowknife, Northwest Territories	3,265 (ore).
Do.	Newmont Canada Limited	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, Québec	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%, and 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 2004

(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 (Rio Tinto Ltd., 58.72%; Mitsubishi Corporation, 26.18%; Labrador Iron Ore Royalty Income Fund, 15.1%)	Carol Lake, Labrador	16,000 (concentrate), 12,000 (pellets).
Do.	Québec Cartier Mining Co. (Dofasco Inc., 50%)	Mount Wright, Quebec	16,950 (concentrate), 7,500 (acid pellets), 657 (sinter).
Do.	Wabush Mines Ltd. (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., 100%)	No. 12 Mine in Bathurst and smelter in Belledune, New Brunswick	74 (Pb contained).
Do.	Hudson Bay Mining and Smelting Co., Limited (HudBay Minerals Inc., 100%)	Flin Flon and Snow Lake, Manitoba	60 (Pb-Zn contained).
Do.	Teck Cominco Limited	Trail, British Columbia	120 (refined lead).
Do.	Breakwater Resources Ltd.	Nanisivik Mine on Baffin Island, Northwest Territories	785 (ore).
Do.	Boliden Limited	Myra Falls, British Columbia	800 (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	Timminco Limited	Haley Station, Ottawa, Ontario	6 (smelter).
Do.	Norsk Hydro Canada Inc.	Bécancour, Quebec	48 (smelter).
Molybdenum	Huckleberry Mines Ltd. (Princeton Mines Corp., 60%; Japanese consortium, 40%)	Southeast of Houston, British Columbia	635 (Mo contained).
Nickel	Falconbridge Limited (Noranda Inc., 58.9%, and Falconbridge Limited, 41.1%)	Craig, Fraser, Lindsley, and Lockerby in Sudbury district, Ontario	54 (metal contained).
Do.	do.	Raglan Mine in Ungave, Quebec	21 (metal contained).
Do.	do.	Smelter in Falconbridge, Ontario	45 (rated capacity).
Do.	do.	Montcalm Mine in Timmins, Ontario	2,000 (ore).
Do.	Inco Limited	Gertrude, 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 Saskatchewan, Alberta	24 (metal contained).

See footnotes at end of the table.

TABLE 2--Continued
CANADA: STRUCTURE OF THE MINERAL INDUSTRY IN 2004

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Petroleum:[1]				
Gas	million cubic meters	BP Canada Inc. (BP plc, United Kingdom, 100%)	Noel Area, northern Alberta; Chauvin, Sibbald, North Pembina, Alberta	47.
Crude	million 42-gallon barrels	do.	do.	12.
Gas	billion cubic meters	do.	do.	1.8.
Crude	thousand 42-gallon barrels	Imperial Oil Ltd. (Exxon Mobil Corp., 70%, and others, 30%)	Judy Creek, Cold Lake, Alberta; Mackenzie Delta, Beaufort Sea, Yukon and Northwest Territories	670.
Gas	million cubic meters	do.	do.	36.4.
Crude	million 42-gallon barrels	Mobil Oil Canada Ltd. (Exxon Mobil Corp., 100%)	Hibernia, Grand Banks, southeast of Newfoundland and Sable Island, Nova Scotia, and others in Alberta	26.1.
Gas	billion cubic meters	do.	do.	3.0.
Crude	million 42-gallon barrels	do.	Terra Nova, near to Hibernia, Jeanne d'Arc Basin, Newfoundland	25.0.
Gas	billion cubic meters	do.	do.	2.0.
Crude	million 42-gallon barrels	Norcen Energy Resources Ltd. (Hollinger Inc., 59%, and Hees International, 41%)	Pembina, Bodo, Majorville, Alberta	12.1.
Do.	do.	Oakwood Petroleums Ltd. (Sceptre Resources Ltd., 100%)	Grantham, Hays Ronalane, Peace River, Normandville, Randell, Alberta; and Grizzly Valley, British Columbia	24.6.
Do.	do.	PanCanadian Petroleum Ltd. (Canadian Pacific Enterprises, 87%, and others, 13%)	Rycroft, Wembley, Elk Point, Rio Bravo, Alberta	19.7.
Gas	billion cubic meters	do.	do.	3.53.
Crude	million 42-gallon barrels	Shell Canada Ltd. (Shell Investments, 79%, and others, 21%)	Dimsdale, Little Smoky Lake, Sousa, Alberta; Midale, Benson, Saskatchewan	22.2.
Gas	billion cubic meters	do.	do.	6.53.
Crude	million 42-gallon barrels	Suncor Inc. (Sun Co. Inc., United States, 75%, and Ontario Energy Resources, 25%)	Kidney, Zama Lake, Cosway, Albersun Prevo, and Medicine River, Alberta; and Leitchville, Unwin, Saskatchewan	4.1.
Crude	thousand 42-gallon barrels	Texaco Canada Petroleum Inc. (Texaco Inc., United States, 78%, and others, 22%)	Eaglesham, Virgo, Alberta; and Desan, British Columbia	158.
Gas	million cubic meters	do.	do.	67.3.
Crude	million 42-gallon barrels	UNOCAL Canada Ltd. (UNOCAL Corp., United States, 100%)	Calgary, Alberta	14.7.
Potash (K_2O equivalent):		Potash Corp. of Saskatchewan Inc. (PotashCorp) (private, 100%)	Lanigan, near Lanigan, Saskatchewan	3,828 (KCl).
Do.		do.	Rocanville, southeast Saskatchewan	2,295 (KCl).
Do.		do.	Allan Division, Allan, Saskatchewan	1.885 (KCl).
Do.		do.	Cory, near Saskatoon, Saskatchewan	1,361 (KCl).
Do.		do.	Patience, near Saskatoon, Saskatchewan	1.033 (KCl).
Do.		do.	Sussex, New Brunswick	785 (KCl).
Do.		International Minerals & Chemical Corp. (Canada) Ltd. [IMC Fertilizer Corp., 75%, and Potash Corp. of Saskatchewan Inc. (PotashCorp.), 25%]	Esterhazy, southeast Saskatchewan	953 (KCl).
Do.		Agrium Products Inc.	Vanscoy, Saskatchewan	1,750 (KCl).
Salt and brine operations		The Canadian Salt Co.	Pugwash, Nova Scotia	1,400 (rock salt and brine salt).
Do.		do.	Iles-de-la-Madeleine, Quebec	1,625 (rock salt).
Do.		do.	Ojibway, Ontario	2,600 (rock salt).
Silver		Prime Resources Group Inc.	Eskay Creek Mine in British Columbia	340.
Do.		Breakwater Resources Ltd.	Caribou Mine in Bathurst, New Brunswick	7.5 (tons mill feed).
Do.		Kirkland Lake Gold Inc.	Macassa Mine in Ontario	438 (mill feed).
Do.		Barrick Gold Inc.	Holt-McDermott Mine in Ontario	876 (mill feed).

See footnotes at end of the table.

TABLE 2--Continued
CANADA: STRUCTURE OF THE MINERAL INDUSTRY IN 2004

(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 (Exxon Mobil 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 Limited (Noranda Inc., 50%; Trelleborg AB, 50%)	Kidd Creek, Ontario	690 (H_2SO_4).
Do.	ESSO Chemical Canada (Exxon Mobil Corp., 100%)	Redwater, Alberta	910 (H_2SO_4).
Titanium slag	QIT-Fer et Titane, Inc. (Rio Tinto Group, 100%)	Sorel-Tracy, Quebec	1,100 (Sorelslag), 250 (UGS slag).
Uranium	Cameco Corp. (Cameco, 50.025%; COGEMA Resources Inc., 37.1%; Idemitsu Inc., 7.875%; TEPCO Inc., 5.0%).	Cigar Lake, Saskatchewan	6,500 metric tons (oxide).
Do.	do.	Key Lake, Saskatchewan	6,395 metric tons (oxide).
Do.	do.	McArthur River Mine, Saskatchewan	5,751 metric tons (oxide).
Do.	do.	Rabbit Lake, Saskatchewan	5,445 metric tons (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 Limited (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., Limited (HudBay Minerals Inc., 100%)	Snow Lake concentrator, Manitoba	1,125 (Pb-Zn ore).
Do.	do.	Flin Flon Mine and Smelter in Manitoba	115 (slab zinc).
Do.	Teck Cominco Limited	Smelter in Trail, British Columbia	300 (slab zinc).
Do.	Boliden Limited	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 2004

(Thousand metric tons unless otherwise specified)[1]

Commodity		Reserves
Asbestos, fiber		35,700 [e]
Coal (anthacite, bituminous, and lignite)		6,578,000 [2]
Copper		10,000
Gold	metric tons	1,500 [3]
Gypsum		450,000 [e]
Iron ore		1,700,000 [e]
Lead		1,600
Molybdenum		450
Natural gas	billion cubic meters	1,660 [2]
Nickel		6,600
Petroleum crude	million barrels	16,800 [2]
Potash, K_2O equivalent	million metric tons	4,400 [e]
Salt	thousand short tons	264,000 [e]
Silver	metric tons	47,000
Sodium sulfate	thousand short tons	84,000 [e]
Sulfur		160,000 [e]
Uranium		420 [4]
Zinc		11,000

[e]Estimated; estimated data are rounded to three significant digits; may not add to totals shown.

[1]2003 and 2004 Canadian Minerals Yearbook, Natural Resources Canada, except for natural gas and petroleum crude; U.S. Geological Survey's Mineral Commodity Summaries 2005.

[2]BP Statistical Review of World Energy June 2005.

[3]Excludes metal in placer deposits.

[4]Recoverable at prices of $100 or less per kilogram of uranium.