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Canadian Overview

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The total value of all mineral commodities produced in Canada, including metals, nonmetals and mineral fuels, decreased from the \$83.0 billion recorded in 2001 to an estimated \$77.0 billion in 2002.¹ This modest decline was due primarily to a fall in the prices of natural gas and natural gas by-products. The value of production of the non-fuel sector remained unchanged, as a slight decline in the value of metallic minerals was offset by a rise in the value of nonmetallic mineral production. (Note that Canadian mineral production reflects the production and value of domestically mined minerals and does not include the value of primary aluminum production because it is produced from imported bauxite ore, nor does it include the value of recycled material.)

The overall value of fuel production declined to \$59.0 billion in 2002 from \$65.0 billion in 2001. A decrease in the unit value of natural gas and natural gas by-products more than offset a rise in the volume and unit value of crude oil production. While the value of production of coal rose by 2.3% and the value of crude oil production increased by 22.3%, the value of natural gas production declined by 30.8% and the value of natural gas by-products fell by 28.1%.

The value of metal production from Canadian mines fell by 1.3% in 2002 to \$10.2 billion. The decrease was minimized by the strong rebound in the prices of two leading minerals, gold and nickel. Despite a drop in output, higher prices helped gold attain a value of \$2.3 billion, a 7.4% increase over 2001 and the highest value since 1998. Higher prices for nickel also caused the value of nickel production to increase by 6.0% to reach \$1.9 billion. Production increases for iron ore and silver further contributed to the value of metal produced. Uranium production remained stable, ensuring Canada's role as the world's largest producer of uranium. Copper, platinum group metals, cobalt, lead and zinc all experienced declines in value of production; nevertheless, these commodities together contributed over \$3.0 billion to mineral production. Canada ranks among the world leaders in the production of these metals.

¹The non-fuel production data presented in this Overview are based on Natural Resources Canada's Annual Census of Mines, Quarries and Sand Pits' shipments data and may differ from production figures cited elsewhere in this Canada paper. The 2002 data are preliminary annual figures released in February 2003.

Mineral Industry Value of Production (\$ millions)

	2001 (r)	2002 (p)	Change (%)
Metallic minerals	10 359.3	10 225.1	-1.3
Nonmetallic minerals	7 617.2	7 751.8	1.8
Total, non-fuels	17 976.5	17 976.9	0.0
Fuels	64 991.3	58 974.3	-9.3
Total minerals	82 967.8	76 951.1	-7.3

Sources: Natural Resources Canada; Statistics Canada.

(p) Preliminary; (r) Revised.

Note: Totals may not add due to rounding.

The value of nonmetal mining production (which includes structural materials such as cement and sand and gravel) realized an overall increase of 1.8% in 2002, reaching a record \$7.8 billion. Potash once again led the nonmetallic group in 2002 as Canada continued to rank first in the world in potash production. Increases in the values for cement, stone, clay products, lime, peat and gypsum more than offset declines in the values for salt, sand and gravel, and asbestos.

In 2002, diamond mining in Canada completed its fourth full year of production. Diamonds are now Canada's tenth largest non-fuel mineral commodity in terms of value of production. In 2002, diamond production increased by more than 34%, resulting in a value of \$802 million. The opening of the Diavik diamond project, Canada's second diamond mine, in 2003, and the expected opening of a third mine in 2006 or 2007, will further enhance Canada's emergence as a major force in world diamond production.

The Canadian non-fuel mineral industry is defined to include mining (including coal), smelting and refining, and the mineral manufacturing industries, but excludes the crude petroleum and natural gas industries. This industry accounted for \$36.4 billion, or 3.7%, of Canada's Gross Domestic Product (GDP) in 2002, measured at basic prices in chained 1997 dollars, an increase of 3.1% over 2001 levels. Mining contributed 26.0% of the industry's GDP while nonferrous smelting and refining and primary iron and steel production added a further 21.7% to the total. Metal and nonmetal mineral manufacturing accounted for the remainder.

According to preliminary data compiled by Natural Resources Canada, employment in the Canadian mining industry recorded a 6.1% decline in 2002, falling to 47 423 from 50 511 in 2001. All of the major components of the industry (metal mining, nonmetal mining and coal mining) experienced declines, most notably the metal mining sector where

employment declined by 2742 from 26 686 in 2001 to 23 944 in 2002. Two new mines were opened and seven mines re-opened in 2002. Balancing the mine openings and re-openings were seven mine closures and two mine suspensions. When the primary metals, nonmetallic mineral and metal fabricating industries are included, employment in 2002 reached an estimated 360 851, up from an estimated 359 489 in 2001. Increased employment in the metal fabricating industries offset declines in the other two sectors.

Exports of crude minerals (excluding petroleum and natural gas), coal, smelted and refined outputs, and mineral products contributed \$49.4 billion to the value of Canada's domestic exports in 2002, a 4.2% increase compared with 2001. This represented 13.5% of Canada's total domestic exports of \$365.1 billion. Metallic mineral and mineral product domestic exports accounted for 77.0% (\$38.1 billion) of the total non-fuel (including coal) value, nonmetal domestic exports (including structural materials) accounted for 19.3% (\$9.5 billion), and coal accounted for 3.7% (\$1.8 billion). The United States remains Canada's principal trading partner with domestic exports of non-fuel minerals and mineral products, including coal, to that country valued at \$37.9 billion. Exports to the European Union totalled \$4.7 billion, to Japan, \$1.8 billion, and to Mexico, \$0.3 billion.

Canadian imports of non-fuel minerals and mineral products, including coal, increased by 3.7% to \$48.5 billion, resulting in a merchandise trade surplus (total mineral exports minus total mineral imports) of \$2.4 billion in 2002, compared with a 2001 surplus of \$2.0 billion. The value of both total exports and total imports increased in 2002 compared with 2001, although the increase in exports was slightly greater.

The value of total exports of natural gas, natural gas by-products, petroleum and other fuels (excluding coal) declined to \$48.7 billion in 2002 from \$53.3 billion in 2001. The value of imports of those commodities also declined from \$17.6 billion in 2001 to \$16.6 billion in 2002. When the values for fuels are combined with the non-fuels, total exports for the mineral, mineral product and fuel sector reached \$99.5 billion in 2002, down from \$102.1 billion in 2001. As a result, in 2002, the mineral industry (fuels and non-fuels) contributed \$34.4 billion to Canada's overall trade surplus of \$47.9 billion.

Minerals and Metals Production (Shipments)

	Unit	1998	1999	2000	2001 (r)	2002 (p)
	(000)					
Aluminum	t	2 374	2 390	2 373	2 583	2 709
Antimony	kg	359	357	364	234	143
Asbestos	t	321	337	310	277	241
Bismuth	kg	186	217	202	258	189
Cadmium	kg	1 179	1 115	934	979	896
Cement	t	12 124	12 625	12 612	12 986	13 201
Coal	t	75 360	72 497	69 163	70 355	66 822
Cobalt	kg	2 262	2 014	2 022	2 112	2 027
Columbium (niobium)	kg	2 194	2 313	2 183	2 911	3 400
Copper	t	691	582	622	614	577
Diamonds	ct	203	2 429	2 435	3 716	4 984
Gold	g	164 773	157 617	(r)153 715	157 875	147 866
Gypsum	t	8 307	9 345	8 572	7 821	8 847
Iron ore	t	36 586	33 789	35 247	27 119	30 969
Lead	t	150	155	143	150	99
Lime	t	2 461	2 565	2 565	2 213	2 237
Molybdenum	kg	8 099	6 250	6 980	8 556	7 521
Natural gas	000 m ³	160 515	162 219	167 790	171 388	171 348
Nepheline syenite	t	636	676	717	710	724
Nickel	t	198	177	181	184	178
Peat	t	1 125	1 253	1 277	1 319	1 301
Petroleum	000 m ³	128	122	128	130	137
Platinum group	g	14 033	13 872	15 304	20 694	21 829
Potash (K ₂ O)	t	8 884	8 475	9 033	8 237	8 189
Quartz (silica)	t	1 771	1 461	1 508	1 613	1 556
Salt	t	13 034	12 686	12 164	13 725	12 313
Sand and gravel	t	225 338	243 251	238 901	236 486	229 535
Selenium	kg	398	359	335	238	226
Silver	kg	1 140	1 174	1 169	1 265	1 344
Stone	t	108 924	109 184	(r) 118 335	124 758	119 113
Sulphur, elemental	t	8 404	8 656	8 621	8 154	7 787
Sulphur in smelter gas	t	836	843	831	762	751
Tantalum	kg	70	66	70	94	71
Tellurium	kg	62	64	53	51	45
Uranium (U)	kg	9 992	10 157	9 921	12 991	13 056
Zinc	t	992	963	936	1 012	892

Sources: Natural Resources Canada; Statistics Canada.

(p) Preliminary; (r) Revised.

Canadian Exploration Scene

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After a decline in exploration and deposit appraisal expenditures from 1996 to 2000, activity began to improve in 2001. From the \$513 million recorded in 2001, preliminary results indicate successive increases of 4% and over 7% in 2002 and 2003, reaching \$534 million and \$574 million, respectively.

In 2002, increases in activity were recorded in seven provinces and one territory for a total increase of \$57 million in those jurisdictions. Ontario and Quebec contributed 67% of this increase.

Exploration expenditures accounted for 71% of total exploration and deposit appraisal expenditures in 2002, with an expected increase to 75% for 2003. Off-mine-site exploration expenditures alone, after a 4% decrease in 2002, are likely to increase by 14% in 2003, reaching \$371 million. Most of the increase in 2003 intentions occurred in Ontario, due in large part to the Nickel Rim South project where a major underground exploration program has been planned.

The share of the juniors in off-mine-site exploration continues to increase. Over the period 2000-03, their share rose from 41% (\$128 million) to 53% (\$196 million). Total expenditures by juniors are expected to top \$236 million in 2003.

Diamond expenditures contributed 25% of the total expenditures with \$133 million in 2002 and are expected to decline to 22% and \$125 million in 2003.

Expenditures on precious metals, the leading commodity group, have increased by 34% over the period 2001-03, reaching \$224 million in 2003 and contributing most of the anticipated increase in total expenditures in 2003.

Exploration for diamonds continues. In Ontario, De Beers has a feasibility study under way for the Victor kimberlite (37 Mt containing about \$94/t), west of James Bay.

At Fort-à-la-Corne, Saskatchewan, 1271.9 t of mini-bulk samples have been taken from the >500-Mt 140/141 kimberlite (Kensington Resources, 42.5%; De Beers, 42.5%; Cameco Corp., 5.5%; and UEM Inc., 10% carried interest). The heavy mineral concentrates have been shipped to Johannesburg for diamond recovery and evaluation. The largest diamond recovered is a gem-quality 3.34-ct stone.

At Jackson Inlet on Baffin Island, Nunavut, Twin Mining Corp. continues to explore the Freightrain kimberlite. Mini-bulk samples from test pits, 2.5 to 76.3 t in size with a total

weight of 228.19 t, yielded 46.21 ct of diamonds. The 30 largest diamonds are of gem quality and range from 0.25 to 1.56 ct.

In Quebec's Ungava peninsula, Twin Mining is exploring a kimberlite dyke system up to 2.3 m wide over an outcrop strike length of 37 km. A total of 1.01 t of grab samples from 900-m and 400-m dyke segments yielded average diamond contents of 0.3 ct/t. The five largest diamonds recovered from a 342-t bulk sample weigh 0.69, 0.57, 0.28, 0.27 and 0.2 ct.

At the Gahcho Kué (Kennady Lake) project, a joint venture by De Beers Canada Exploration Inc. (51%), Mountain Province Diamonds Inc. (44.1%) and Camphor Ventures Inc. (4.9%), a total of 1174 ct of diamonds were recovered from a 665.5-t kimberlite bulk sample from five 24-inch-diameter drill holes in the north lobe of the Hearne pipe. The largest diamonds recovered weigh 8.7, 6.4 and 4.9 ct. The 157 diamonds greater than half of a carat total proportionately greater (31%) than those in a 2001 bulk sample and 15% greater than those in a 1999 bulk sample. An 836-t sample from the 5034 diamond pipe yielded 1215 ct; the largest diamonds weigh 7.0, 6.6 and 5.9 ct. A significantly higher proportion of diamonds larger than 1.0 ct were recovered in 2002, compared with the 1999 and 2001 bulk samples. Diamonds recovered in 2002 from the Hearne and 5034 pipes in 2002 have been sent for valuation. Additional exploration drilling was carried out on the nearby Tuzo pipe (indicated and inferred resources of about 15 Mt).

In October 2002, there were some 300 other diamond exploration or diamond deposit appraisal properties in Canada.

In Nunavut, Miramar Mining Corp. continued exploration drilling of the Hope Bay gold property. A feasibility study for the Doris North area was positive and the company is in the process of permitting a 690-t/d operation to mine, mill and recover 311 000 oz of gold over a two-year period. The intention is to mine other deposits. The Hope Bay property's measured and indicated resources contain 1 636 000 oz of gold plus 2 703 000 oz in inferred resources. A major exploration program is planned for 2003.

Also in Nunavut, Cumberland Resources Ltd. continues exploration of its Meadowbank gold project with a feasibility study under way. The project could produce 250 000 oz/y of gold over an eight-year mine life at an estimated cash cost of US\$168/oz. Exploration expenditures of \$10.3 million are planned for 2003.

Starfield Resources Inc. continued exploration of the Ferguson Lake, Nunavut copper-nickel-platinum group metal deposit (discovered in 1952 by Inco Limited). Resources stand at 60 Mt averaging 0.59% nickel, 0.93% copper, 1.32 g/t palladium and 0.19 g/t platinum, up from the 7.3 Mt averaging 0.80% nickel and 0.70% copper established by Inco. Tests of dense media separation methods are yielding a sink fraction with a recovered grade of 20 g/t platinum plus palladium from a head grade of 3.13 g/t platinum plus palladium. Recoveries are 83% of the platinum and 74% of the palladium, with 88% weight rejection.

At Sudbury, Ontario, FNX Mining Co. (75%) and Dynatec Corp. (25%) are exploring former producing properties of Inco Limited. (McCreedy West, Victoria, Norman, Levack and Kirkwood) under an agreement whereby they can purchase these properties. In 2002, some 15 diamond drills completed approximately 107 000 m of drilling at the former McCreedy West mine. More than 1.8 Mt of relatively high-grade resources have been outlined there with additional resource potential at depth. Production is planned for 2003

at an initial rate of 900 t/d. Attractive intersections have also been obtained at the Norman and Victoria properties, where drilling continues.

In Saskatchewan, Cameco Corp. announced the discovery of the Millenium uranium deposit 600 m below surface. The tonnage and grade have not been released.

In British Columbia, exploration on the Kemess property outlined an additional 2.0 million oz of gold and 227 000 t of copper in the Kemess North deposit and the newly discovered Nugget zone. A feasibility study is in progress with the intention of providing mill feed for the concentrator after the Kemess South orebody has been mined out.

DRC Resources Corp. continued exploration on its Afton copper-gold project, near Kamloops, British Columbia, where a zone below and to the southwest of the former Afton mine open pit has been established to contain 38.4 Mt averaging 2.32% copper equivalent over a length of 1000 m. The deposit is open to the southwest and northeast. A scoping study by Behre Dolbear & Co. suggests that a 4080-t/d underground block-caving operation could yield a 32.3% internal rate of return. A prefeasibility study is in progress and diamond drilling continues.

Mineral Exploration and Deposit Appraisal Expenditures,⁽¹⁾ 2002 and 2003

Province/Territory	2002 (a)	2002 (a)	2003 (b)	2003 (b)
		Exploration Off-Mine-Site Only		Exploration Off-Mine-Site Only
(\$ million)				
Newfoundland and Labrador	35.7	15.2	13.3	11.5
Nova Scotia	3.4	1.9	8.9	7.5
New Brunswick	3.0	3.0	1.6	1.6
Quebec	114.3	70.4	122.2	80.8
Ontario	140.2	72.8	183.4	103.1
Manitoba	26.7	19.3	25.5	14.9
Saskatchewan	38.8	24.8	46.3	29.6
Alberta	5.8	4.7	5.0	3.8
British Columbia	34.1	27.2	44.8	29.2
Yukon	7.2	7.1	7.9	7.9
Northwest Territories	60.0	23.8	49.7	23.3
Nunavut	64.9	55.8	65.6	57.6
Total	534.1	325.9	574.0	370.9
Exploration	381.1		432.4	
Deposit appraisal	153.0		141.6	

Source: Natural Resources Canada, from a federal-provincial-territorial survey of exploration and mining companies conducted in the last quarter of 2002.

(a) Preliminary estimates; (b) Spending intentions.

(1) Includes on-mine-site plus off-mine-site activities.

Notes: Exploration covers activities up to and including the discovery and first delineation of a new mineral deposit of potential economic interest; deposit appraisal includes activities needed to bring a delineated deposit to the stage of detailed knowledge required for a feasibility study to support a production decision. Numbers may not add to totals due to rounding. Current as of March 2003.

Aluminum

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The production of primary aluminum increased 4.9% to 2.71 Mt in 2002, compared with 2.583 Mt in 2001, ranking Canada third after China and Russia in terms of world production. The increase reflects a full year's operation of Alcan Inc.'s new 400 000-t/y smelter in Alma, Quebec, which reached full operating capacity in September 2001.

Canada has 11 primary aluminum smelters. One is located in British Columbia and the other ten (approximately 90% of Canada's production capacity) are located in Quebec. The value of Canadian primary aluminum production in 2002 is estimated at \$5.7 billion, down slightly from the \$5.8 billion of production in 2001, reflecting the larger decrease in prices for aluminum when compared with the increase in production. Canada, the second largest aluminum-exporting country in the world after Russia, exported 2.1 Mt of unwrought aluminum valued at \$4.9 billion in 2002.

Alcan owns the 400 000-t/y Alma smelter in Alma, Quebec, the 248 000-t/y Arvida smelter in Jonquière, Quebec, the 196 000-t/y Grande-Baie smelter in La Baie, Quebec, the 219 000-t/y Laterrière smelter in Chicoutimi, Quebec, the 91 000-t/y Shawinigan smelter in Shawinigan, Quebec, the 50 000-t/y Beauharnois smelter in Melocheville, Quebec, and the 275 000-t/y smelter in Kitimat, British Columbia. Alcan also has a 40% interest in the Alouette smelter in Sept-Îles, Quebec. The total of Alcan-owned capacity in Canada is now about 1.54 Mt/y, approximately 56% of the total Canadian capacity of 2.79 Mt/y.

Alcoa Inc. owns the 240 000-t/y Deschambault smelter (Lauralco) located near Québec City and a 437 000-t/y smelter located at Baie Comeau, and has a 74.95% interest in the 390 000-t/y Aluminerie de Bécancour Inc. (ABI) smelter. Alcoa's partner in ABI is Pechiney Corp. of France (25.05%). In total, Alcoa controls approximately 35% of Canada's total primary aluminum smelting capacity.

Following the signing of a Covenant on voluntary reduction of greenhouse gas emissions in January 2002 between the Canadian aluminum industry and the Quebec government, the provincial government signed company-specific agreements with Alcan, Alcoa and Alouette. While the agreement proposes gradual, permanent reductions, it also allows for growth in the industry and acknowledges the importance of aluminum's life cycle and contribution to the collective effort to reduce greenhouse gas emissions. The company

agreements detail company-specific reduction targets. Specific details of the implementation of the federal government's ratification of the Kyoto agreement are not yet known.

Over the past year, aluminum producers have continued work on expansions of existing smelters as well as on greenfield smelter studies in several locations.

During the past year, plans and changes in Canadian operations have included:

- Aluminerie Alouette started construction of a \$1.4 billion expansion of capacity to 550 000 t/y. The first metal is expected in early 2005 with full capacity to be reached later in the year. After several ownership changes in 2002, partners in the smelter now are: Alcan Inc. (40%), Aluminium Austria Metall Québec (20%), Norsk Hydro ASA (20%), Société générale de financement du Québec (13.33%), and Marubeni Québec Inc. (6.66%).
- Alcoa signed an agreement with the Quebec government in December 2002 to upgrade the 437 000-t/y Baie-Comeau smelter. The agreement provides for the additional power required for the modernization of existing Söderberg technology and a 110 000-t/y expansion in capacity. Construction of the \$1.0 billion upgrade to the smelter will begin in 2003 with completion expected in 2010.
- Alcoa also signed an agreement with the Quebec government in early March 2003 to expand the Deschambault smelter (Lauralco) located near Québec City. Alcoa plans to expand the smelter from 240 000 t/y to 570 000 t/y. Construction of the \$1.0 billion expansion will start in 2006 with production in 2008. Approximately 250 jobs will be created in the expanded smelter and several hundred will be created in the ancillary processing facilities.
- Alcan signed a Memorandum of Understanding with Hydro-Québec in February 2002 to explore optimizing hydro-electric resources in the Saguenay–Lac-Saint-Jean region to support the eventual expansion of the Alma smelter.
- Alcoa Inc. and the Province of Newfoundland and Labrador terminated discussions without reaching agreement on a possible hydro-electric power expansion and an aluminum smelter located in that province.
- Alcan's 275 000-t/y Kitimat smelter in British Columbia continued to suffer from low water levels in the Nechako Reservoir. The smelter had been operating at a rate of 180 000-t/y when the company announced in June 2002 that it would start bringing 60 000 t of capacity back on line.
- Alberni Aluminium Co. was formed to continue work on a proposed 360 000-t/y aluminum smelter to be located in the province of British Columbia near Port Alberni. The company is doing environmental and engineering studies, and is seeking a long-

term power supply and investors in the project. The proposed US\$1.5 billion smelter would not be in production before 2007.

Copper

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Canadian copper mine production (recoverable copper in concentrate) was estimated at 634 000 t in 2002, up from 600 200 t in 2001; refined production was estimated at 494 000 t, down from 578 000 t in 2001. All production data below refer to the production of copper in concentrates in 2002 (with 2001 production data in parentheses) unless otherwise stated.

In **Quebec and Atlantic Canada**, Agnico-Eagle Mines Ltd. expanded the mill at its LaRonde gold mine to 6350 t/d, producing 4300 t (2100 t); the company is studying how to mine ore below its 2250-m-deep shaft. Aur Resources Inc. purchased the Duck Pond copper-zinc deposit, which could be developed to replace Aur's metal production from the Louvicourt mine, scheduled to close by mid-2005; Aur is to decide about Duck Pond by mid-2003. Breakwater Resources Ltd. produced 6100 t (6900 t) from its Bouchard-Hébert zinc mine and was considering re-opening its Langlois zinc mine. Barrick Gold Corp. closed its Bousquet gold mine in 2002. Campbell Resources re-opened the Joe Mann gold mine in April, producing 400 t. Inmet Mining Corp. produced 6800 t (7800 t) from its open-pit gold mine; in March 2003, Inmet announced increased reserves that will carry the mine through to 2010, a four-year extension. Falconbridge produced 6500 t (6900 t) at its Raglan operation, shipping it to Sudbury for smelting. Noranda's Bell-Allard zinc mine produced 7300 t (8600 t) while the Brunswick lead-zinc operation produced 8900 t (8500 t). Noranda Inc. permanently closed its Gaspé smelter in April. At its Horne smelter, workers went on strike in June. Management personnel kept Horne running at reduced capacity. Copper in anode production at Gaspé and Horne in 2002 was 29 600 t and 147 000 t, respectively; copper cathode production at CCR fell to 244 300 t (323 000 t). Les Mines Selbaie's zinc-copper mine produced 10 000 t of payable copper in concentrates; the mine has reserves until the end of 2003.

In **Ontario and Manitoba**, Falconbridge produced 27 800 t from its Sudbury mines and 46 900 t from its Kidd mines. Mine D development at Kidd continued; the new mine is to be in operation in late 2004 and will be between 2070 m and 3110 m deep. Falconbridge's Sudbury smelter sends copper-nickel matte to Norway for refining. The Kidd smelter imports concentrates to supplement its mine production; refined output in 2002 was 146 500 t (127 800 t). Hudson Bay Mining and Smelting Co. Ltd. mined higher grades at its zinc-copper operations in Flin Flon, producing 83 400 t (79 500 t) of copper in anode, about half of which was from Hudson Bay mines in 2002. While the company shut its

Ruttan mine in June, development of the new 777 mine was on schedule; the US\$276 million mine should start producing in 2003, reaching full production by mid-2004. Inco Limited produced 111 800 t of refined by-product copper from its nickel operations in Canada, below the target of 125 000 t owing to production problems in Inco's Ontario mines. North American Palladium produced 2400 t from its expanded palladium mine.

In **British Columbia**, Boliden AB re-opened the Myra Falls zinc-copper operation in March, producing 6700 t (13 200 t). Highland Valley Copper produced 204 200 t (209 000 t) from its open-pit operation. After a public environmental review, the mine received permission to discharge groundwater into a stream, thereby stabilizing pit walls and extending the pit life to 2009. Imperial Metals Corp. produced 35 000 t (36 400 t). Northgate Exploration Ltd. produced a record 33 100 t (30 100 t) at Kemess South; exploration near the mine continued and the option of milling ore from the Sustet deposit at Kemess was being considered.

The most significant new copper project is Voisey's Bay. Inco reached agreement with various parties, including the Province of Newfoundland and Labrador, to develop the open pit with initial production expected in 2006. Initial production from the 6000-t/d operation is scheduled at 31 800 t/y of copper in copper concentrates plus 6800 t/y of copper in nickel concentrates. The copper concentrates will be sold. Redfern Resources Ltd. received environmental permission to proceed with the Tulsequah project near the Alaska border. The underground zinc-copper operation could produce 10 400 t/y of copper in concentrates. As noted, Aur Resources expects to decide by July 2003 about developing its copper-zinc Duck Pond property in Newfoundland and Labrador, which could produce 16 000 t/y. Campbell Resources is developing its Copper Rand gold project in Quebec, intending to produce about 8000 t/y over 4.5 years from mid-2004. Taseko Mines Ltd. owns Gibraltar Mines Ltd. in British Columbia where the re-opening of the mine and construction of a 30 000-t/y hydrometallurgical operation is being studied.

Gold

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By the end of 2002, Canada had produced over 9550 t of gold since official production was first recorded in 1858. In 2002, Canadian gold production totaled 152 t, a decrease of 5% compared to the 2001 total of 160 t. The closure or suspension of operations at eight gold mines in 2001 is the main reason for the decline in gold production. A total of 13 gold mines closed since 2000 in response to depressed gold prices or ore exhaustion. This loss of production has been partly compensated for by the huge increase in gold production at the Red Lake mine and, to a lesser extent, at the LaRonde and Kemess South mines. For the next few years, production is expected to remain at the level of 150-154 t/y as no major openings, expansions or closures are anticipated, and will start to increase in the following years to the 160-t level when expansion at the Red Lake mine is completed.

Ontario accounted for 52% of Canada's total gold production, followed by Quebec (22%) and British Columbia (14%). The other provinces and territories combined contributed 12%. Approximately 93% of Canada's gold production in 2002 came from hard-rock underground and open-pit gold mines. Of the remainder, 6% was from base-metal mines and 1% was from placer mining operations. The value of gold exports (including gold contained in scrap and base-metal concentrates) increased by more than 22% to \$2.79 billion (about 173 t) due to higher prices and quantity shipped. Imports increased by 24% to \$805.5 million (about 63 t), also owing to higher prices and metal quantity delivered.

The average cash cost of production from Canadian underground and open-pit gold mines was about US\$175/oz, a level similar to the previous year despite a higher Canadian dollar value against the U.S. dollar. In relative terms, there was a reduction in average cash costs in Canadian dollars that was the result of the closure of higher-cost gold mines and the expansion of gold production at low-cost mines.

Two mines ceased operations due to ore depletion: McWatters Mining Inc.'s Kiena mine and Barrick Gold Corp.'s Bousquet mine. McWatters is carrying out an exploration program at Kiena to identify new economic reserves; it is also looking into the possibility of using the mill to process ore from the nearby East-Amphi property. Mining operations resumed at three gold mines: Campbell Resources' Joe Mann mine, Richmond Mines' Beaufort mine, and Kirkland Lake Gold's Macassa mine. At the Joe Mann mine, Campbell Resources Inc. expects to produce nearly 35 000 oz of gold in 2002 and could produce over 50 000 oz in 2003. In May, Kirkland Lake Gold Inc. resumed processing operations at the

Macassa mill using tailings and ore from surface inventories on the old Teck-Hughes and Lakeshore mining properties. Mining activities in the upper levels of the Macassa mine will resume early in 2003 with an expected annual production of about 80 000 oz of gold. In early 2002, mining activities resumed at the Beaufor mine operated by Richmond Mines Inc. after work to secure the mine due to instability in the mine pillars was completed.

In all, 27 gold mines were in production at the end of 2002, compared with 35 and 40 respectively at the ends of 2001 and 2000. A total of 6243 people were employed by gold producers in 2002, down 10% from the preceding year, in continuity with the declining trend since 1996.

For the second consecutive year, Goldcorp Inc. will produce more than 15 t of gold (500 000 oz) at the Red Lake mine at a direct production cost of close to US\$65/oz; this will place the mine, for the second year running, among the leading Canadian gold producers for volume of gold produced and among the producers with the lowest production costs in the world. At the end of 2002, a new reserves and resource estimate established proven and probable high-grade gold reserves at the Red Lake mine to be 1.96 Mt at a grade of 2.35 oz/t gold (80.5 g/t gold), for a total gold content of 4.6 million oz, and high-grade resources to be 603 000 t at a grade of 2.03 oz/t gold (69.6 g/t gold), for a total gold content of 1.2 million oz. Total high-grade reserves and resources are estimated to be 5.8 million oz. In addition, the Red Lake mine hosts another 3.0 Mt of refractory gold ore averaging 12.3 g/t gold, for a total gold content of more than 1.1 million oz.

In 2001, Agnico-Eagle inaugurated a new shaft on its LaRonde property. With a depth of 2250 m, it provides access to reserves of nearly 100 t of gold (3.3 million oz) and additional resources of 140 t (4.5 million oz). Agnico-Eagle also expanded its mill facilities from 2000 to 7000 t/d, which was completed in October 2002. With this expansion, annual gold production will increase to nearly 400 000 oz, a production level that could be reached in 2004. The ore at LaRonde also contains commercial ore-grade zinc, copper and silver, which will place this mine among those with the lowest production costs in Canada when the credits obtained for these metals are taken into account.

In January 2002, McWatters Mining Inc. (then under the protection of the *Companies' Creditors Arrangement Act*) had its restructuring plan accepted by its creditors and shareholders. Under this plan, the company transferred all of the Sigma-Lamaque property to a limited partnership in which it holds a 60% interest with SOQUEM INC. holding 40%. The Sigma-Lamaque mine will go into production in early 2003 and will have a production capacity of nearly 150 000 oz/y over six years.

Placer Dome North America and Kinross Gold Corp. have decided to set up a joint venture to which their respective mining properties will be transferred. These properties are in the Porcupine district in Ontario. A subsidiary of Placer Dome will manage the new company, which will operate the Hoyle Pond and Dome mines. The combined production will be around 13 or 14 t/y. Placer Dome will hold 51% of the new company and Kinross will hold 49%.

Iron Ore

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In 2002, as a result of the strengthening global economy, Canada's iron ore shipments reached 31.0 Mt, an increase of 14.2% compared with the previous year. In line with this growth, the value of Canada's production increased by 16.1% to \$1.38 billion. Likewise, Canada's iron ore exports registered a 16.6% hike to reach 25.6 Mt, with the pellet market registering an increase of 13.8%; the concentrate market fared even better by increasing 24.1%.

Agreements on iron ore prices were finally settled on the European and Japanese markets at the end of May 2002, the latest the industry ever experienced. Despite indications that demand for iron ore was recovering globally and that strong demand from Asia would exert some pressure on the availability of supplies, iron ore producers agreed on a price reduction for 2002. The price for Canadian concentrate bound for Europe and Japan was lowered by 3.01% while the price of pellets bound for Europe was reduced by 5.47%.

Iron ore is one of Canada's most important mineral products in terms of both tonnage and value. On that basis, Canada is the world's ninth largest iron ore producer and ranks fifth for exports. Production is concentrated in the Labrador Trough, a major geological belt extending through northern Quebec and Labrador. Its production in this area comes from three mining operations owned by Iron Ore Co. of Canada (IOC), Quebec Cartier Mining Co. (QCM), and Wabush Mines.

Since acquiring IOC in August 2000, Rio Tinto plc has been active in upgrading the Quebec and Labrador installations, as well as its load and haul fleet. In 2002, despite a five-week shut-down, IOC produced 14.7 Mt of ore, of which 11.6 Mt were fluxed pellets. The company started the implementation of a major cost-reduction program aimed at cutting \$120 million by 2005. It also initiated a tailings management program to comply with the new federal government Metal Mining Effluent Regulation. The first phase of that project is scheduled for completion by 2007.

Although details of the agreement were not made public by the end of the year, QCM co-owners, Caemi Mineração e Metalurgia SA and Dofasco Inc. (50:50), announced in December 2002 that they had reached a deal with unnamed investors to sell part of their respective share in the company. The inflow of capital will be used by QCM to finance

\$350 million of development work related to stripping heavy rock overburden to get open-pit access to higher-grade ore and to ensure continued operation of the mine at a capacity of 12 Mt/y for the next 15 years. Dofasco's future cash obligations to finance QCM will not exceed \$34.5 million until 2010. Affected by reduced sales, QCM shut down its Mt. Wright operation for six weeks early in the year.

Following up on the strategy it initiated at the end of 2001 in response to changes in the marketplace, Wabush operated only two of its three production lines in 2002, effectively scaling down its production level from 6.2 Mt to 4.5 Mt. This resulted in the company producing just under 4.6 Mt of ore in 2002, roughly the same amount as in the previous year. To help improve its competitiveness on a global scale, Wabush underwent a cost reduction and restructuring program during the year. It also proceeded with an important capital investment to address an ongoing operating concern regarding excess water in the pit due to the increasing depth of the operations.

Canadian shipments of iron ore are forecast to reach a level of around 32.6 Mt in 2003. Of that amount, Wabush expects to produce in the range of 4.8 Mt while QCM is planning a production level in the order of 12 Mt and IOC a level of 15.8 Mt.

Magnesium

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Canadian production¹ capacity for primary magnesium metal is expected to fall to approximately 55 000 t/y in 2003 as a result of the announced closure of Magnola Metallurgy Inc.'s Danville smelter. On a global basis, in 2002, Canada ranked second after China in magnesium production capacity. The value of Canadian exports of magnesium metal and metal products in 2002 was \$265 million.

Magnola Metallurgy Inc. has announced the closure of the 58 000-t/y magnesium metal plant at Danville, Quebec, scheduled for April 2003. The plant had a number of start-up problems but, by late 2002, many of the initial technical problems were reported to have been resolved. It was reported that the plant produced 24 648 t of magnesium in 2002 and the company expected to reach full production in 2003. The company cited low magnesium prices as the reason for the closure and indicated that prices needed to increase to the range of US\$1.30/lb to financially justify resumption of the operation.

Norsk Hydro ASA of Norway produces primary magnesium metal at a 48 000-t/y Bécancour, Quebec, plant using an electrolytic process. The plant also has a recycling capacity of 10 000 t/y, but that portion of the facility was reported as operating at 75% of capacity due to a shortage of scrap. The plant has been recently debottlenecked and future capacity increases at Bécancour will be based upon profitability. Norsk Hydro has been working on a series of new alloys for high-temperature applications and has started casting trials and testing as part of work done by the European Council for Automotive Research and Development (EUCAR).

Timminco Ltd. produces high-purity metal (up to 99.98% pure) for specialized markets at its 6000-t/y magnesium plant at Haley Station, Ontario. The company also produces highly corrosion-resistant magnesium die-casting alloys and extruded anode rods for hot-water heaters. In 2002, the company completed work to develop dual-casting capability and ramped up the new Haley casthouse to commercial production levels. During the year, the company continued to restructure its operations and, in February 2003, announced

¹ Canadian magnesium production data are confidential due to the limited number of companies reporting.

that Safeguard International Fund LP had agreed to purchase new and existing shares in the company after regulatory approval expected in April.

Globex Mining Enterprises Inc. has continued work on its Timmins-area magnesium-talc deposit 13 km south of Timmins, Ontario. Previous work has indicated the potential for production of both magnesium metal and high-quality talc from the deposit. Results of a scoping study conducted by Hatch Associates in 2001 were positive and indicated a good economic potential using available technology. The company has worked on financing both the recommended full bankable feasibility study, with an expected cost of US\$12 million, and a US\$1.0 billion construction cost. The project would include a mine-mill complex located near Timmins, Ontario, and a 95 000-t/y smelter located in Quebec west of Rouyn-Noranda.

Leader Mining International Inc. continued studies for a smelter using feed from the Cogburn ultramafic intrusive near Hope, British Columbia. Work has included: diamond drilling, initial work on environmental permitting, infrastructure studies, and bench-scale testing on composite samples. The company has signed a technology transfer agreement with the State Research and Design Titanium Institute (STI) of Zaporozhye, Ukraine and the Russian National Aluminium and Magnesium Institute (VAMI). A number of contractors, including Hatch Associates, were engaged to complete a study for a mine and a 120 000-t/y smelter project. Results are expected in early 2003.

Cassiar Resources Inc. maintained its interest in a project based on residues from asbestos mining in Cassiar in northern British Columbia. A fire in December 2000 destroyed the mill at that location, which remains closed. Company plans for reconstruction hinge on procuring financial partners.

Gossan Resources Ltd. maintained its interest in a dolomite property at Inwood, Manitoba. The dolomite resource is estimated at 67 Mt grading 21.6% MgO, with additional inferred resources. Gossan indicates that the next phase of activity would be a drill program, which could in turn lead to a prefeasibility study.

The town of Thetford Mines, Quebec, continued work on proposals to process mining residues from asbestos mines into magnesium metal and other products. The town reports that in excess of 300 Mt of material with a grade of approximately 24% magnesium are available for processing.

Nickel

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In 2002, Canadian production of nickel in concentrates was 188 100 t and refined nickel production was 144 500 t (Class I plus Class II production, per the International Nickel Study Group definition). All Canadian mines exploit sulphide ores in Quebec, Ontario and Manitoba. Fifteen mines, three smelting complexes and three refineries comprise the Canadian nickel industry. All production data below refer to 2002 (with 2001 production data in parentheses) unless otherwise stated.

Falconbridge Ltd.'s four mines in Sudbury and its Raglan mine in Quebec produced 52 500 t of nickel in concentrates (59 800 t), which were smelted at the company's Sudbury smelter and exported in matte to Norway for refining. Total nickel in matte production was 57 900 t (54 900 t), of which 4400 t (3400 t) of nickel was from recycled sources. The company will decide in 2003 on two important projects: first, whether to sink a shaft at its new Nickel Rim South exploration project, and second, whether to proceed with development of the Montcalm project near Timmins, Ontario. The former is targeted at resources of 6.3 Mt averaging 1.7% nickel and 3.4% copper plus precious metals; the latter would see 8000 t/y of nickel in concentrate produced starting in late 2004. Capital costs of \$63 million in 2003 were allocated for the possible Montcalm development.

Inco Limited produced 147 900 t (144 000 t) of finished nickel in Canada: 69% in Ontario and 31% in Manitoba where smelter feed also included nickel in imported concentrates. During 2002 in Ontario, Inco ran its nine mines, a concentrator, the twin smelters, the nickel refinery, and the copper refinery without a summer shut-down. Difficulties in Ontario due to ore-pass problems and ground conditions in various mines meant that nickel production was below forecast. This was compounded by difficulties at Inco's Thompson operation where lower grades and smaller stopes at the Thompson mine, plus increased magnesium levels in Birchtree ore, led to smelter difficulties. Nevertheless, Thompson's refined output was 95% plating-grade cathode, a form that commands a premium price. At the Clarabelle mill in Sudbury, Inco increased recoveries and this resulted in the recovery of an additional 4500 t, or an extra 4.5%, of nickel production.

Sherritt International Corp. ran its joint-venture refinery in Alberta at a record production of 31 700 t of nickel. The plant also produces by-product cobalt and fertilizer. Canmine Resources Corp. was commissioning its hydrometallurgical cobalt-nickel refinery in Ontario but was forced to stop operations due to financial problems. North American

Palladium Ltd. produced 1250 t (724 t) of nickel in concentrate at its palladium operation in Ontario.

Inco and the Province of Newfoundland and Labrador reached an agreement to permit the development of the Voisey's Bay nickel-copper-cobalt deposit. A mine and mill handling 6000 t/d of ore will be operational by mid-2006 when concentrate shipments to a pilot hydrometallurgical plant in the province and to existing Inco smelters will commence. An underground exploration program and R&D program are to proceed so that Inco can decide before 2009 whether to commercialize a proprietary hydrometallurgical process or a matte recovery operation before 2012 and very likely at Argentina. Inco agreed to replace nickel shipped out of the province and to process the incoming nickel to a finished product with a grade of at least 99.8% nickel. The province granted the mining lease on September 30, 2002.

Potash

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Canada, the world leader in potash production, increased its annual output by 4.3% from 8.15 to 8.5 Mt (K₂O) in 2002. Canadian production accounted for 32% of the world production of 26.47 Mt (K₂O). All producers saw a moderate increase in production. The largest Canadian producer, Potash Corp. of Saskatchewan, increased its output by 5% to 3.94 Mt (K₂O). However, the increase in Canadian production was less than projected, mainly because weather conditions worldwide limited increases in fertilizer usage.

Canada remained the largest potash exporter in the world in 2002. It exported 8.06 Mt (K₂O), an increase of 4.3% from the previous year's level of 7.73 Mt. Exports to Asia, Latin America and Western Europe increased while exports to the United States stayed the same. The United States remained Canada's largest export market, accounting for 55% of the total exports. Asia, including China, was Canada's second-largest export market, accounting for 29%. Other destinations were Latin America (11%), Australia (3.5%) and Western Europe (1.5%).

The Canadian potash industry is expected to increase production in 2003. As the world grain inventory was at its lowest level in nearly 30 years, world grain prices have increased. It is expected that this will prompt an increase in grain production, which will in turn push demand for fertilizer, including potash.

Uranium

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Canada retained its position as world leader in uranium production in 2002 with output totalling 11 607 tU (tonnes of uranium metal) valued at over \$500 million. As of January 1, 2003, Canada's "known" recoverable uranium resources amounted to 439 000 tU, sufficient for over 35 years of production at current rates of extraction. With over 85% of the resource base categorized as "low-cost," Canada is well positioned to continue its leadership in uranium production.

All operating mines are situated in the province of Saskatchewan. Two companies, both with head offices in the province, operate all four production facilities. Cameco Corp. wholly owns and operates Rabbit Lake and is the operator of the Key Lake and McArthur River joint ventures. COGEMA Resources Inc. (CRI) is the operator of the McClean Lake joint venture. The Cluff Lake facility, wholly owned and operated by CRI, closed at the end of December 2002 after milling the last of its remaining stockpiled ore.

Environmental management systems at the McArthur River mine and the Key Lake mill were certified under the ISO 14001 standard in 2002. The McClean Lake mine and mill, as well as the Blind River refinery and Port Hope conversion plant, have already achieved this internationally recognized standard, which outlines the key requirements that companies should comply with in order to operate in an environmentally responsible manner. Thus, the front end of the nuclear fuel cycle meets rigorous international standards in Canada.

McArthur River is the world's largest high-grade uranium deposit discovered to date (>175 000 tU with an average grade of 18% U). Mining high-grade uranium in a groundwater-saturated setting requires the use of ground freezing and high-tech mining methods. The use of remote-controlled mining, underground crushing and grinding facilities, and transportation of the ore in purpose-designed containers that are loaded and unloaded in specially designed, remote-controlled stations, minimize worker radiation exposure.

Saskatchewan is also host to the world's second largest high-grade uranium deposit, Cigar Lake (~90 000 tU at an average grade of 17% U). High-tech mining methods specifically adapted to the local geology have been developed through on-site test mining programs, and the mine could begin production as early as 2006. The exact schedule to complete construction and begin production is dependent upon market conditions and regulatory

approvals. Effective January 1, 2002, Cameco became the operator of the Cigar Lake mine which, until then, had been developed by the Cigar Lake Mining Corp.

Although local deposits at Key Lake were mined out in 1997, the mill is being used to process all ore from the McArthur River mine, which is located some 80 km north of Key Lake by road. The Key Lake mill produced a total of 7199 tU in 2002, up from the 2001 total of 6938 tU as the mine had its first full year of production at full commercial capacity. The small contribution to total 2002 mill production from Key Lake deposits (117 tU) came from stockpiled mineralized waste rock that is used to lower the grade of McArthur River ore to produce a mill feed of about 3.4% U. Production will decline in 2003, however, as a breach in a development drift at the 530-m level on April 6, 2003, led to some flooding at the base of the mine. It is expected that production will be curtailed for up to six months.

Production at Rabbit Lake in 2002 totalled 440 tU, down significantly from 2001 production of 1755 tU. This decline is a result of the decision to suspend operations temporarily in June 2001 after all stockpiled ore had been processed. After the mining plan for the Rabbit Lake Eagle Point underground mine was revised, mining resumed in August 2002.

In 2002, its final year of production, the Cluff Lake facility produced 1626 tU, up significantly from the 1288 tU produced in 2001. Mining was stopped in May 2002 and all stockpiled ore was milled by the end of December 2002, bringing to a close a long and successful chapter in Canadian uranium mining.

In its 22 years of operation, the Cluff Lake mine produced over 24 000 tU. The mine generated significant employment and business opportunities for residents of northern Saskatchewan and set high standards for uranium production and workplace safety. Once an environmental assessment of the decommissioning plan is completed and all regulatory approvals have been obtained, CRI will begin the decommissioning process.

McClellan Lake production totalled 2342 tU in 2002, down slightly from the 2540 tU produced in 2001. Mining operations were suspended in early 2002 after the Sue C deposit was mined out. The mill is currently fed by stockpiled ore from the Sue C and JEB deposits while plans for mining the remaining cluster of deposits on the property are finalized.

The Federal Court of Canada issued an order on September 23, 2002, quashing a 1999 McClellan Lake operating licence on the grounds that an environmental assessment (EA) under the *Canadian Environmental Assessment Act* (CEAA) had not been conducted prior to issuing the licence. An appeal court subsequently ordered the decision stayed pending the disposition of the appeal, which has not yet been heard. The Court decision is not about the environmental performance of the facility, but the transitional provision of the CEAA. The entire McClellan Lake operation was reviewed by an environmental review panel pursuant to regulatory requirements that preceded the CEAA.

Canadian uranium mining operators are not only world leaders in production and environmental management, but also in the decommissioning and reclamation of

production centres. Elliot Lake, Ontario, was the major uranium mining centre in Canada for over 40 years. Since the last facility closed in 1996, uranium mining companies have committed over \$75 million to decommission all mines, mills and waste management areas. A comprehensive environmental monitoring program has recently demonstrated the success of these efforts. Although the impact of mining remains discernible, mainly in the form of above-background levels of salts, total dissolved solids and some metals, the local fish, benthic invertebrates and wildlife are displaying no adverse effects.