

# Canadian Reserves of Selected Major Metals, and Recent Production Decisions

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## RESERVES OF SELECTED MAJOR METALS

Canadian reserves of copper, nickel, lead, zinc, silver and gold decreased significantly during 1997. Only molybdenum reserves were higher than in 1996 (Table 1).

Generally declining metal prices during 1997 caused many mining companies to make their ore reserve calculations at year-end based upon lower metal prices than they had used at the end of 1996. This resulted in reductions of ore reserves at most producing mines and a number of mine closures.

In Canada during 1998, there were only two announcements of new production decisions for the seven metals reviewed in this chapter. Given that metal prices continued to fall during 1998, it is probable that Canadian ore reserve levels for the major metals will continue to decline in the immediate future. The Voisey's Bay nickel-copper-cobalt deposit in Labrador is not presently included in Canadian reserves because there are several major issues to be resolved before production can begin. When a production decision is made, it will result in major increases in the reserves of nickel and copper.

### Reserves Policy

Canadian reserves are estimated from information contained in annual and other corporate reports, and from the responses of mining companies to the annual Federal-Provincial Survey of Mines and Concentrators.

Reserves reported here include only metal contained in material that is classified by companies as "proven" or "probable" (or their equivalents) at producing mines and in deposits that are firmly commit-

ted to production (Table 2). Metal contained in mineral resources classified by companies as "possible" (or its equivalents) is not included in national totals, nor is metal contained in deposits that have not advanced beyond the deposit appraisal phase (Figure 1). When available, only metal contained in mineable ore is included in Canadian totals so as to exclude losses inherent in the mining process. Every effort is made to achieve, from year to year, consistency in the reserves reported here; however, consistency ultimately depends on industry practice, which has evolved over the years. Imperial units reported by companies have been converted to metric units and the results have been rounded to the appropriate number of significant digits.

### Reserves by Commodity

#### Gold

There were 1510 t of gold contained in Canadian mine reserves in December 1997. This represents a decrease of 12% compared to revised totals for December 1996. The major components of this decrease were the downward revisions of reserves at the Ontario Division (-80 t) of Royal Oak Mines Inc. and the Dome mine (-28 t) of Placer Dome Inc. in Ontario. Most gold producers were unable to replace the ore mined during 1997, but the Doyon mine in Quebec and the Musselwhite mine in Ontario were notable exceptions with increases of 14 t and 21 t, respectively.

#### Silver

There were 16 697 t of silver contained in Canadian mine reserves in December 1997. This represents a decrease of 12% compared to revised totals for December 1996. The major components of this decrease were the downward revision of reserves at the Brunswick No. 12 mine (-943 t) in New Brunswick, and the closure of the Faro mine (-904 t) in the Yukon. The only silver-producing mines to significantly increase their reserves during 1997 were the LaRonde mine (+291 t) in Quebec and the Eskay Creek mine (+190 t) in British Columbia.

#### Zinc

During 1997, Canadian reserves of zinc decreased to about 10.6 Mt, down by about 22% compared to the

**Figure 1**  
**Generalized Model of the Process of Mineral Resource Development and Mining**

PHASES	MINERAL RESOURCE ASSESSMENT	MINERAL EXPLORATION					MINERAL DEPOSIT APPRAISAL				DEVELOPMENT OF MINE COMPLEX	MINERAL PRODUCTION	ENVIRONMENTAL RESTORATION
		MRA	EX-1	EX-2	EX-3	EX-4	EX-5	DA-1	DA-2	DA-3			
<b>STAGES</b>	Surveys, research, synthesis.	Exploration planning.	Regional reconnaissance and surveys.	Prospecting and ground survey of anomalies.	Verification of anomalies and showings.	Discovery and delimitation.	Deposit definition.	Project engineering.	Project economics.	Feasibility study. Production decision.	Construction of plant and infrastructure. Mine preparation.	Production, marketing, new development.	Mine closure. Site reclamation and restoration.
<b>OBJECTIVES</b>	Supply information and tools required to develop the mineral potential of the nation for economic benefit in the perspective of sustained development.	Select target commodities. Establish exploration objectives and strategies. Select target areas.	Find regional and more localized anomalies. Select significant targets.	Acquire properties. Confirm presence, exact location and characteristics of anomalies.	Acquire additional properties as required. Verify and confirm anomalies. Find mineral showings.	Discover, confirm and delimit a mineral deposit of economic interest. Evaluate technical and economic potential in a preliminary fashion.	Define the grade, limits, internal distribution, controls and the mineralogy-processing parameters of a mineral deposit. Acquire data to support engineering planning.	Establish technical feasibility. Prepare realistic plans, schedules, investment-cost and operating-cost estimates for all aspects of a project.	Establish parameters for economic and financial evaluation.	Ensure validity of project data, assumptions and evaluation results. Decide whether or not to undertake a mining project at this time. Obtain the required permits. Obtain financing.	Complete mine development and construction on schedule and within budget. Ensure efficient and timely mine and concentrator start-up.	Achieve planned rate and specifications of commercial production on schedule and within budget. Achieve mine profitability, company survival and sustained development.	Restore mine site to an environmentally acceptable condition.
<b>EVALUATION METHODS</b>	Geoscientific, mineral and economic surveys, research, compilations and synthesis by governments, research institutes and universities.	Metal and mineral market research. Review of geological and ore deposit information for various areas. Review legal and political context. Use of deduction and intuition.	Satellite imagery, aerial photography and airborne geophysics. Prospecting, geology and geochemistry. Appraisal, rating and selection of anomalies.	Ground-based geological, geochemical and geophysical prospecting and surveys. Review and selection of significant anomalies.	Geological mapping and other surveys. Trenching and sampling. Review of results and selection of targets.	Stripping, trenching, detailed mapping, sampling, drilling and down-hole geophysics. Preliminary deposit inventory and evaluation. Environmental characterization and site surveys.	Detailed mapping, sampling and drilling on surface or from underground. Systematic mineral processing tests. Detailed environmental and site surveys.	Pilot tests and engineering studies. Design and cost estimation for mining, ore concentration, metal extraction, infrastructure, protection of the environment and restoration.	Market, price, cost and other financial studies. Technical, environmental, economic, financial, social and political risk analysis.	Exhaustive due diligence review of geological, engineering, environmental, economic, legal and site data. Evaluation of profitability, risks and up-side factors of a project.	Project and quality management methods. Training program for personnel and detailed start-up plan.	Production management using continuous quality improvement methods. Exploration, appraisal and development of new ore zones, both on-property and off-property.	Mine closure and decommissioning. Environmental restoration and monitoring.
<b>RESULTS</b>	Geoscientific, mineral and economic data bases, maps and models.	Exploration projects.	Regional anomalies.	Local anomalies.	Mineral showings.	Mineral deposit.	Deposit appraisal project.			Mining project.	Mining plant.	Mineral production.	Restored site.
<b>FEASIBILITY STUDIES</b>							Expected margin of error of estimates at the 90% confidence level:						
						± 100%	± 60%	± 40%	± 20%	± 10%		± 5%	Full compliance
<b>INVESTMENT AND RISK</b>	Moderate	Low but increasing investment. Very high, but decreasing risk of failure and financial loss.				Much larger and increasing investment. High, but decreasing risk of failure.				Large industrial investment. Low to moderate industrial risk.			
<b>MINERAL INVENTORY</b>	Undelimited mineral resources					Delimited mineral resources					Ore reserves	Delimited mineral resources	
	Speculative	Hypothetical			Inferred	Indicated and measured				Proven and probable			

Sources: Modified by D.A. Cranstone, A. Lemieux and M. Vallée, February 25, 1994, from M. Vallée, 1992, *Guide to the Evaluation of Gold Deposits*, CIM Special Volume 45, p. 4, and *SOQUEM Annual Report*, 1976-77, pp. 4-5. Revised by M. Vallée March 8, 1996.

previous year. The major components of this decrease were the closures of the Faro mine (-889 t) in the Yukon and the Isle Dieu Mattagami mine (-499 t) in Quebec, as well as the downward revision of reserves at the Brunswick No. 12 mine (-864 t) in New Brunswick. The only zinc mines to significantly increase their ore reserves in 1997 were Gallen (+28 t) and LaRonde (+226 t) in Quebec.

### **Lead**

Canadian reserves of lead decreased by approximately 32% during 1997, largely as a result of the closure of the Faro mine (-542 t) in the Yukon and the downward reassessment of reserves at the Brunswick No. 12 mine (-358 t) in New Brunswick.

### **Copper**

In December 1997, Canadian reserves of copper were estimated at about 9 Mt, or down by about 7% from a year earlier. Copper reserves were reduced as a result of the closures of the Isle Dieu Mattagami (-51 t), Copper Rand (-12 t) and Portage (-3 t) mines in Quebec, and the Afton mine (-6 t) in British Columbia. However, the downward revision of reserves at Inco Limited's operations, and the closure of the Shebandowan mine in Ontario, had a much greater effect in reducing copper reserves during 1997.

### **Molybdenum**

Canadian reserves of molybdenum stood at 149 000 t in December 1997, or about 3% higher than in the previous year. This increase was largely due to successful exploration at the Endako mine in British Columbia.

### **Nickel**

In December 1997, there were some 5.1 Mt of nickel contained in Canadian mine reserves, down by approximately 9% from 1996 levels. This decrease is due largely to the downward revision of Inco's reserves. Falconbridge Limited's reserves increased as a result of successful exploration in the vicinity of the Raglan mine in Quebec.

Inco had some 4.2 Mt of nickel in Canadian reserves at the end of 1997, or about 82% of the national total. It is expected that development of the copper-nickel-cobalt deposits at Voisey's Bay in Labrador will make major additions to Canada's mineable reserves of these metals in the near future.

## **Canadian Reserves by Province and Territory**

Three provinces (Ontario, British Columbia and New Brunswick) held dominant positions in terms of Canada's proven and probable mineable reserves of major metals in December 1997 (Table 4).

Ontario had 66% of the nickel, 50% of the gold and 43% of the copper, plus 18% of the silver and 14% of the zinc.

British Columbia had 100% of the molybdenum, 41% of the copper and 32% of the silver, plus 13% of the lead, 10% of the zinc and 19% of the gold.

New Brunswick had 79% of the lead, 43% of the zinc and 32% of the silver, plus 2% of the copper and 2% of the gold.

Quebec had 20% of the zinc, 18% of the gold, 10% of the copper, 10% of the nickel and 14% of the silver.

Manitoba had 23% of the nickel, 5% of the zinc and 4% of the gold, plus 4% of the copper and 2% of the silver.

The Yukon Territory had less than 2% of the gold and the silver.

The Northwest Territories had 7% of the zinc, 6% of the lead and 4% of the gold.

## **Canadian Reserves by Industry**

Canadian mines are, to a large extent, polymetallic, a complexity that the Standard Industrial Classification (SIC) tends to oversimplify (Table 5).

Current mine reserves of gold in Canada are distributed through the various SIC classes as follows: gold mines, 77%; copper and copper-zinc mines, 16%; nickel-copper mines, 4%; and zinc-lead-silver mines, 3%. Current mine reserves of silver in Canada are distributed through the various SIC classes as follows: gold mines, 27%; copper and copper-zinc mines, 30%; nickel-copper mines, 8%; and zinc-lead-silver mines, 35%.

Current mine reserves of copper in Canada are distributed through the various SIC classes as follows: gold mines, 1%; copper and copper-zinc mines, 59%; nickel-copper mines, 38%; and zinc-lead-silver mines, 2%. Current mine reserves of molybdenum in Canada are contained in the SIC classes as follows: copper and copper-zinc mines, 41%; and molybdenum mines, 59%.

Current mine reserves of nickel in Canada are contained entirely in the SIC class of nickel-copper mines.

Current mine reserves of lead in Canada are contained in the SIC classes as follows: copper and copper-zinc mines, 3%; and zinc-lead-silver mines, 97%. Current mine reserves of zinc in Canada are contained in the SIC classes as follows: gold mines, 3%; copper and copper-zinc mines, 39%; and zinc-lead-silver mines, 58%.

## Apparent Life of Canadian Reserves

The apparent life (life index) of mine reserves is usually calculated by dividing the total amount of metals remaining in mine reserves at the end of a given year by the corresponding amount of metals contained in the ores produced during that year. Similar calculations are often applied at the national level.

At the national level, life indices are but a very rough measure of the expected life of aggregate mine reserves, and they are often misleading unless abnormal situations are recognized. Life indices based on proven and probable reserves do not make allowances for inferred extensions to reserves at current mines, gross additions that will accrue to current reserves from the likely development, in the foreseeable future, of known orebodies for which a production decision has yet to be made, or expected changes in production rates. Furthermore, life indices tend to overstate the apparent life of reserves when, for example, annual production is abnormally low due to strikes, cutbacks or suspensions at large establishments, or when significant increases in capacity resulting from new production decisions will be coming on stream, but only several years hence.

The apparent life indices for the major metals in Canada at the end of 1997 were 22 years for nickel, 13 years for copper, 11 years for molybdenum, 11 years for silver, 10 years for lead, 9 years for zinc, and 8 years for gold.

## Reserve Trends

Figure 2 and Table 6 show how Canadian reserves of copper, lead, molybdenum, nickel, silver and zinc have declined steadily since the early 1980s. In contrast, gold reserves increased substantially until 1988, before starting a gradual decline. In 1994, these trends began to be arrested or reversed. This reversal started with increases in Canadian reserves of zinc, gold and silver in 1994, followed by increases in Canadian reserves of zinc, gold and nickel in 1995, and increases in Canadian reserves of gold, nickel and molybdenum in 1996. Canadian reserves of gold in 1996 were higher than in any year since the peak year of 1988. The sharp decline in reserves during 1997 cancelled most of the gains of 1994 through 1996 so that, at the end of 1997, Canadian reserves of copper, nickel, lead and zinc were lower than at any time since Natural Resources Canada began keeping records, and reserves of molybdenum and silver were close to the historic lows that were realized in 1995 and 1993 respectively. Only Canadian reserves of gold remained near the historically high values of 1988 and 1996.

The annual aggregate change in Canadian reserves is the net result of three main factors affecting individual mines (Figure 3): additions to reserves, deletions to reserves, and production. Additions to reserves

are the result of new discoveries; of new geological, metallurgical, production or other information; of a decrease in production costs; or of a rise in commodity prices, all of which increase the quantity of mineral resources that are profitable to mine. Deletions to reserves are the result of new geological, metallurgical, production or other information; of increases in costs; or of decreases in commodity prices, all of which reduce the quantity of mineral resources previously counted in mine reserves that are now expected to be mined at a profit. Production is normally the main factor reducing the reserves at individual mines but, in 1997, declining metal prices were a significant factor in the reduction of ore reserves at producing mines.

## RECENT PRODUCTION DECISIONS

Several criteria need to be met for a project to be considered here to have reached the production decision stage. In general, there needs to have been a positive production feasibility study, all of the necessary permits must have been obtained, financing must have been arranged, and directors must have approved construction.

During 1998, production decisions were announced for the Konuto Lake mine at Creighton, Saskatchewan, and for the Black Dome mine near Clinton, British Columbia.

Inco Limited's Voisey's Bay deposit in Labrador is poised for a production decision, but it is not included as a 1998 production decision because not all of the necessary permits and agreements were in place at that time.

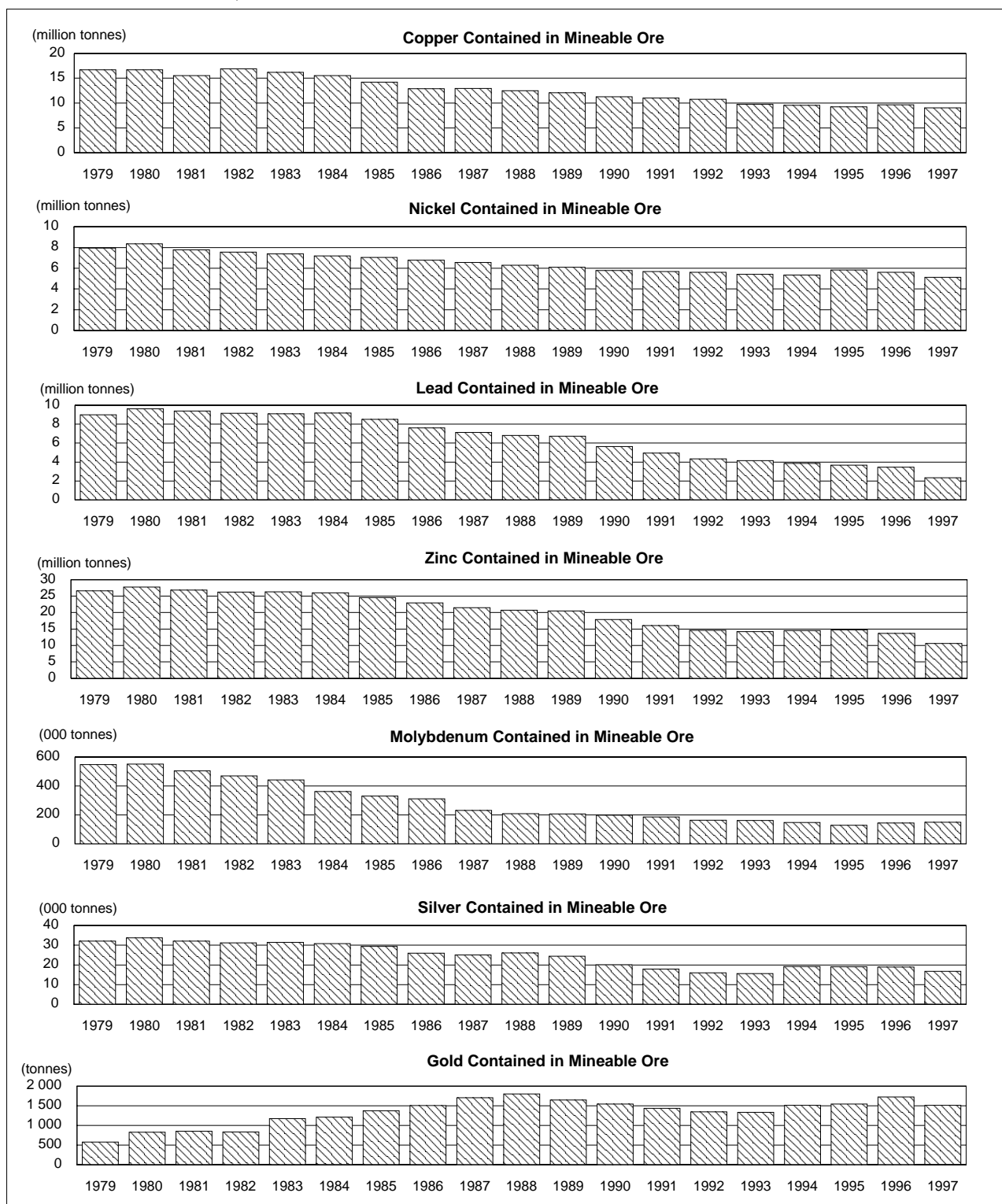
## OUTLOOK

Given that there were only two new production decisions announced in 1998, and that metal prices continued to decline during the year, it is highly probable that mine reserves of precious metals and base metals will decline further in 1999.

At the Voisey's Bay nickel-copper-cobalt deposit, Inco had established reserves and resources of 116 Mt at the end of 1998. If these figures are confirmed, Voisey's Bay will increase Canada's nickel reserves by about 28% and its copper reserves by about 9%.

*Note: Information in this review was current as of February 14, 1999.*

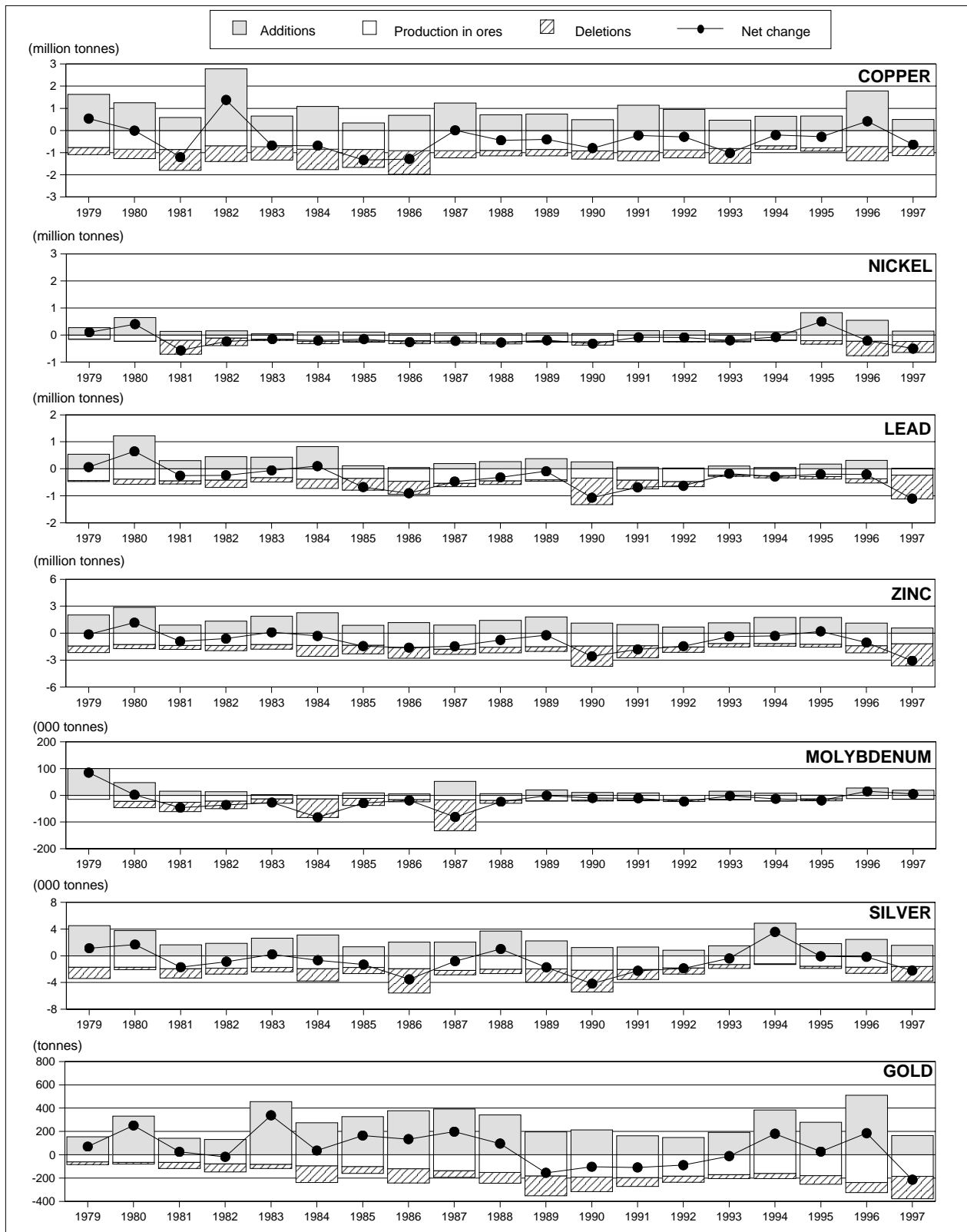
**Figure 2**  
**Canadian Reserves of Selected Major Metals, 1979-97**  
 Metal Contained in Proven and Probable Mineable Ore in Operating Mines and Deposits Committed to Production, as at December 31 of Each Year



Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.

Note: This series was revised during 1996.

**Figure 3**  
**Main Components of Change in Canadian Reserves of Selected Major Metals, 1979-97**



Source: Natural Resources Canada.

**TABLE 1. MAIN COMPONENTS OF CHANGE DURING 1997 IN CANADIAN RESERVES OF SELECTED MAJOR METALS**

Metal	Units	Revised Opening Metal Balance, January 1997	Metal in Ore Mined During 1997	Metal Apparently Written Off During 1997	Metal in New Reserves Found During 1997	Net Change During 1997	Closing Metal Balance, December 1997	% Change During 1997
Copper	000 t	9 667	-722	-409	496	-635	9 032	-6.6
Nickel	000 t	5 623	-231	-416	146	-502	5 122	-8.9
Lead	000 t	3 450	-232	-885	12	-1 106	2 344	-32.1
Zinc	000 t	13 660	-1 169	-2 470	567	-3 072	10 588	-22.5
Molybdenum	000 t	144	-14	-1	19	5	149	3.5
Silver	t	18 909	-1 582	-2 193	1 562	-2 212	16 697	-11.7
Gold	t	1 724	-186	-192	165	-214	1 510	-12.4

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.  
Note: May not balance due to rounding.

**TABLE 2. TONNAGES AND GRADES OF OPERATIONS INCLUDED IN CANADIAN RESERVES OF SELECTED MAJOR METALS, AS AT JANUARY 1, 1998**

Tonnages classified by companies as "possible" are not included where they are reported separately from proven and probable tonnages, nor are tonnages for deposits for which there is no firm production decision. Data reported in imperial units were converted to metric units and rounded to the corresponding number of significant digits. Confidential data have been suppressed from the details of this report.

	Tonnes	Grade						
		Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
<b>NEWFOUNDLAND</b>								
Nugget Pond Richmont Mines Inc. Mineable	431 000							12.
<b>NEW BRUNSWICK</b>								
Brunswick No. 12 Underground Noranda Mining and Exploration Inc. Proven	43 653 000	0.33		3.61	9.08		104.	..
Caribou Breakwater Resources Ltd. Proven and probable	5 838 000			4.0	7.3		96.	
Heath Steele Noranda Mining and Exploration Inc. Proven	546 000	0.95		1.55	5.49		60.	
Probable	1 494 000	0.66		1.84	6.66		75.	
<b>QUEBEC</b>								
Beaufor Aurizon Mines Ltd. Louvem Mines Inc. Proven	274 000						..	7.8
Probable	484 000						..	8.5
Bell Allard Noranda Mining and Exploration Inc. N/S	3 200 000	1.5			13.77		43.44	0.765
Bouchard-Hébert Cambior inc. Proven and probable	8 120 000	0.79			4.13		40.3	1.2
Bousquet No. 2 Barrick Gold Corporation Proven and probable	3 442 000	..					..	8.19
Copper Mountain Oxide Noranda Mining and Exploration Inc. Probable	19 152 000	0.45						
Doyon Barrick Gold Corporation Cambior inc. Proven and probable	10 534 000						..	6.9
Francoeur Richmont Mines Inc. Mineable	1 500 000						..	6.5
Gallen Noranda Metallurgy Inc. Probable	1 650 000	0.23			4.74		27.	0.9
Joe Mann Campbell Resources Inc. Mineable	502 000	0.27					..	8.16
Joubi Western Quebec Mines Inc. Proven and probable	60 740						..	5.89
Kiena McWatters Mining Inc. Proven	2 393 000						..	4.53
Probable	1 133 000						..	4.33
Langlois Cambior inc. Proven and probable	6 179 000	0.52			8.72		40.2	0.1



TABLE 2 (cont'd)

	Tonnes	Grade						
		Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
<b>QUEBEC (cont'd)</b>								
LaRonde								
Agnico-Eagle Mines Limited								
Proven	1 553 782	0.53			1.27		..	..
Probable	6 088 891	0.25			5.48		..	..
Louvicourt								
Aur Resources Inc.								
Novicourt Inc.								
Teck Corporation								
Mineable	10 700 000	3.48			1.59		27.4	0.86
Mouska								
Cambior inc.								
Stockpiles	10 046						..	14.94
Proven	84 224						..	16.33
Probable	125 500						..	15.48
Murdochville Townsite								
Noranda Mining and Exploration Inc.								
"E" Zone	1 209 000	3.38					16.48	..
Needle Mountain Open Pit								
Noranda Mining and Exploration Inc.								
..	..	..					..	
Raglan								
Falconbridge Limited								
Proven	6 515 000	0.89	3.38					
Probable	10 706 000	0.86	2.96					
Selbaie A1 Open Pit								
Billiton Metals Canada Inc. (Gencor Ltd.)								
Proven and probable	16 700 000	0.35		0.07	1.48		33.5	0.35
Sigma No. 1								
McWatters Mining Inc.								
Proven	2 188 000						..	5.05
Probable	1 358 000						..	5.51
Sleeping Giant								
Aurizon Mines Ltd.								
Cambior inc.								
Proven	228 000						..	10.6
Probable	347 000						..	12.8
Troilus								
INMET Mining Corporation								
Proven and probable	45 900 000	0.10					1.4	1.2
<b>ONTARIO</b>								
Aquarius								
Echo Bay Mines Ltd.								
Proven and probable	18 123 000							2.2
Campbell								
Placer Dome Inc.								
Proven and probable	4 193 000						..	16.5
David Bell								
Homestake Canada Inc.								
Teck Corporation								
Mineable	4 700 000						..	10.57
Detour Lake								
Placer Dome Inc.								
Proven and probable	2 016 000						..	3.4
Dome (including Paymaster)								
Placer Dome Inc.								
Proven and probable	32 880 000							1.7
Eagle River								
River Gold Mines Ltd.								
Proven and probable	1 164 000						..	10.91
Edwards								
River Gold Mines Ltd.								
VenCan Gold Corporation								
Proven and probable	156 100						..	12.09



TABLE 2 (cont'd)

	Tonnes	Grade						
		Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
<b>MANITOBA (cont'd)</b>								
Callinan								
Hudson Bay Mining and Smelting Co., Limited								
Proven	1 534 431	1.264			3.317		29.1	2.3
Probable	1 907 381	1.373			4.602		35.66	..
Inco Manitoba Division								
Inco Limited <sup>1</sup>								
..	..	..	..				..	..
Keystone								
Black Hawk Mining Inc.								
Mineable reserve	1 030 700						0.3	4.3
New Britannia (Nor-Acme/Snow Lake)								
High River Gold Mines Ltd.								
TVX Gold Inc.								
Reserves	4 040 000						..	4.7
Photo Lake								
Hudson Bay Mining and Smelting Co., Limited								
Proven	138 380	5.25			4.173		34.83	5.14
Probable	7 038	0.242			0.179		88.32	..
Ruttan								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	..	..			..		..	..
Trout Lake								
Hudson Bay Mining and Smelting Co., Limited								
Proven	3 235 507	1.60			5.170		20.5	1.7
Probable	1 340 144	2.02			4.430		14.3	1.4
<b>SASKATCHEWAN</b>								
Contact Lake								
Cameco Corporation								
Uranerz Exploration and Mining Limited								
Proven (Bakos)	96 000						..	6.55
Probable (Bakos)	85 500						..	6.38
Seabee								
Claude Resources Inc.								
Proven and probable	590 000						..	9.98
<b>BRITISH COLUMBIA</b>								
Endako								
Nissho Iwai Corp.								
Thompson Creek Mining Company								
..	..						..	
Eskay Creek								
Prime Resources Group Inc.								
Proven and probable	1 356 000						2 680.	58.05
Gibraltar Dumps (biological leach cathode)								
Gibraltar Mines Limited								
..	..	..						
Gibraltar Open Pit								
Gibraltar Mines Limited								
..	..	..					..	..
Golden Bear								
North American Metals Corp.								
Mineable (Ursa)	520 000							..
Mineable (Kodiak A)	473 000							..
Mineable (Kodiak B)	184 000							..

TABLE 2 (cont'd)

	Tonnes	Grade						
		Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
<b>BRITISH COLUMBIA (cont'd)</b>								
Highland Valley Cominco Ltd. Highmont Mining Company Rio Algom Limited Teck Corporation Proven and probable	497 000 000	0.42				..	..	..
Huckleberry Mitsubishi Corporation, Dowa Mining Co., Ltd., Furukawa Co. Ltd. and Marubeni Corporation Princeton Mining Corporation Mineable proven and probable	88 800 000	0.513				0.014	2.8	0.062
Kemess South Royal Oak Mines Inc. Proven and probable	201 202 000	0.215						0.62
Mount Polley Imperial Metals Corporation Sumitomo Corp. Mineable	82 300 000	0.3						0.418
Myra Falls Westmin Resources Limited Proven and probable	8 058 000	1.60		..	7.5		33.5	1.4
QR Kinross Gold Corporation Proven and probable	422 000						..	5.23
Snip Prime Resources Group Inc. Proven and probable	210 000						..	23.2
Sullivan Cominco Ltd. Proven and probable	7 100 000			4.0	7.2		23.	
<b>YUKON TERRITORY</b>								
Brewery Creek (heap leach) Viceroy Resource Corporation Proven	13 300 000						..	1.44
Mount Nansen B.Y.G. Natural Resources Inc. ..	..						..	..
<b>NORTHWEST TERRITORIES</b>								
Con Miramar Mining Corporation Proven and probable	2 434 000						..	10.54
Giant Open Pit - Giant Underground Royal Oak Mines Inc. Proven and probable	844 000						..	12.2
Lupin Echo Bay Mines Ltd. Proven and probable	1 831 000						..	9.22
Nanisivik Nanisivik Mines Ltd. Proven and probable	3 460 000			0.4	8.2		36.	
Polaris Cominco Ltd. Pine Point Mines Limited Proven and probable	3 500 000			3.6	13.2			

Source: Natural Resources Canada, based on published company reports.

.. Not available in published reports or estimated by author; N/S Not specified.

1 Inco Limited reports total Canadian ore reserves, including substantial reserves at Voisey's Bay, as 356 Mt grading of 1.58% nickel and 1.06% copper.

Notes: One tonne (t) = 1.1023113 short tons. One gram per tonne (g/t) = 0.02916668 troy ounces per short ton.

**TABLE 3. PRODUCTION DECISIONS ADDED TO CANADIAN RESERVE TOTALS AS AT DECEMBER 31, 1997**

Project	Operators and Major Partners	Province	Metals
There were no production decisions added to Canadian reserve totals during the year ending December 31, 1997.			

Source: Natural Resources Canada, based on company reports.

**TABLE 4. CANADIAN RESERVES OF SELECTED MAJOR METALS BY PROVINCE AND TERRITORY, AS AT DECEMBER 31, 1997**

Metal Contained in Proven and Probable Mineable Ore<sup>1</sup> in Operating Mines<sup>2</sup> and Deposits Committed to Production

Metal	Units <sup>3</sup>	Nfld.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	B.C.	Yukon	N.W.T.	Canada <sup>5</sup>
Copper	000 t	–	–	155	941	3 881	332	–	3 723	–	–	9 032
Nickel	000 t	–	–	–	537	3 406	1 179	–	–	–	–	5 122
Lead	000 t	–	–	1 842	10	52	–	–	304	–	136	2 344
Zinc	000 t	–	–	4 515	2 160	1 485	566	–	1 115	–	746	10 588
Molybdenum	000 t	–	–	–	–	–	–	–	149	–	–	149
Silver	t	–	–	5 263	2 294	3 159	401	0.3	5 424	23	133	16 697
Gold <sup>4</sup>	t	5	–	30	277	758	49	7	294	20	53	1 493

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.  
– Nil or less than one unit.

<sup>1</sup> No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. <sup>2</sup> Includes metal in mines where production has been suspended temporarily. <sup>3</sup> One tonne (t) = 1.1023113 short tons = 32 150.746 troy ounces. <sup>4</sup> Excludes metal in placer deposits because reserves data are generally unavailable. <sup>5</sup> May not balance due to rounding at the provincial level.

**TABLE 5. CANADIAN RESERVES OF SELECTED MAJOR METALS BY INDUSTRY, AS AT DECEMBER 31, 1997**

Metal Contained in Proven and Probable Mineable Ore<sup>1</sup> in Operating Mines<sup>2</sup> and Deposits Committed to Production

SIC no. <sup>5</sup>		Copper,		Nickel-Copper	Zinc-Lead-Silver	Molybdenum	Miscellaneous	Canada <sup>6</sup>
		Gold Mines	Copper-Zinc Mines	Mines	Mines	Mines	Metal Mines	
	(Units <sup>3</sup> )	0611	0612	0613	0614	0615	0619	
Copper	000 t	86	5 302	3 419	219	–	7	9 032
Nickel	000 t	–	–	5 115	–	–	7	5 122
Lead	000 t	–	82	–	2 262	–	–	2 344
Zinc	000 t	353	4 127	–	6 108	–	–	10 588
Molybdenum	000 t	–	61	–	–	88	–	149
Silver	t	4 428	5 062	1 328	5 879	–	–	16 697
Gold <sup>4</sup>	t	1 142	244	65	40	–	2	1 493

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.  
– Nil or less than one unit.

<sup>1</sup> No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. <sup>2</sup> Includes metal in mines where production has been suspended temporarily. <sup>3</sup> One tonne (t) = 1.1023113 short tons = 32 150.746 troy ounces. <sup>4</sup> Excludes metal in placer deposits because reserves data are generally unavailable. <sup>5</sup> SIC Standard Industrial Classification. <sup>6</sup> May not balance due to rounding at the SIC level.

**TABLE 6. CANADIAN RESERVES OF SELECTED MAJOR METALS AS AT DECEMBER 31 OF EACH YEAR, 1977-97**Metal Contained in Proven and Probable Mineable Ore<sup>1</sup> in Operating Mines<sup>2</sup> and Deposits Committed to Production

Year	Copper	Nickel	Lead	Zinc	Molybdenum	Silver	Gold <sup>3</sup>
	(000 t)	(000 t)	(000 t)	(000 t)	(000 t)	(t)	(t)
1977	16 914	7 749	8 954	26 953	369	30 991	493
1978	16 184	7 843	8 930	26 721	464	30 995	505
1979	16 721	7 947	8 992	26 581	549	32 124	575
1980	16 714	8 348	9 637	27 742	551	33 804	826
1981	15 511	7 781	9 380	26 833	505	32 092	851
1982	16 889	7 546	9 139	26 216	469	31 204	833
1983	16 214	7 393	9 081	26 313	442	31 425	1 172
1984	15 530	7 191	9 180	26 000	361	30 757	1 208
1985	14 201	7 041	8 503	24 553	331	29 442	1 373
1986	12 918	6 780	7 599	22 936	312	25 914	1 507
1987	12 927	6 562	7 129	21 471	231	25 103	1 705
1988	12 485	6 286	6 811	20 710	208	26 122	1 801
1989	12 082	6 092	6 717	20 479	207	24 393	1 645
1990	11 261	5 776	5 643	17 847	198	20 102	1 542
1991	11 040	5 691	4 957	16 038	186	17 859	1 433
1992	10 755	5 605	4 328	14 584	163	15 974	1 345
1993	9 740	5 409	4 149	14 206	161	15 576	1 333
1994	9 533	5 334	3 861	14 514	148	19 146	1 513
1995	9 250	5 832	3 660	14 712	129	19 073	1 540
1996	9 667	5 623	3 450	13 660	144	18 911	1 724
1997	9 032	5 122	2 344	10 588	149	16 697	1 510

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.

<sup>1</sup> No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. <sup>2</sup> Includes metal in mines where production has been suspended temporarily. <sup>3</sup> Excludes metal in placer deposits because reserves data are generally unavailable.

Note: One tonne (t) = 1.1023113 short tons = 32 150.746 troy ounces.