Preface

This report is prepared annually, on behalf of the Intergovernmental Working Group on the Mineral Industry (IGWG), for presentation to federal, provincial and territorial mines ministers. It contains the latest information on exploration expenditure levels in Canada, a review of current exploration and development activities in the provinces and territories, and commentaries on and analysis of current domestic and international trends that affect the Canadian mineral exploration sector.

The data contained in this report are current as of April 1998 unless indicated otherwise, and the views expressed by the various authors have been assembled and agreed upon by IGWG. The Minerals and Metals Sector of Natural Resources Canada (NRCan) was responsible for compiling, editing, producing and distributing the report.

Throughout the report, the expression “mineral exploration” refers to grassroots and advanced exploration for metallic minerals, nonmetallic minerals, coal and uranium. It does not refer to petroleum-related exploration.

This document can be accessed on the Internet at:

http://www.nrcan.gc.ca/mms/efab/invest/exploration.

To obtain additional information on exploration activities in Canada, you can also contact the federal, provincial and territorial government offices listed on the following page.

NOTE TO READERS

This report has been prepared on the basis of information available at the time of writing. The authors make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

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Executive Summary

According to preliminary figures, $804 million was spent on mineral exploration in Canada in 1997. Although down from the $895 million spent in 1996, this amount still represents the second highest total of the 1990s. Company spending intentions, as compiled in January 1998, reveal that $767 million could be spent on mineral exploration in Canada in 1998. The 1998 forecast expenditures are almost $120 million below those recorded in 1997, but they still point to sustained interest on the part of the mining industry in Canada's mineral discovery potential. It should be noted, however, that in light of current base-metal and gold prices, the Asian crisis, and the financing difficulties encountered by some companies, actual exploration expenditures may well fall below the forecast that was established in early 1998.

In 1997, Ontario, the Northwest Territories, Québec and British Columbia were Canada's most actively explored jurisdictions. In comparison to 1996 expenditure levels, exploration spending increased in only four provinces: Alberta, Saskatchewan, Québec and Nova Scotia. The largest declines occurred in the Northwest Territories, Newfoundland and Labrador, and Ontario. In 1998, the Northwest Territories, Québec, Ontario and British Columbia are expected to account for 71% of total exploration expenditures in Canada. Spending is expected to increase in six provinces and territories, with the greatest increases occurring in Alberta, Québec and British Columbia.

According to the redesigned Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures, approximately 75% of 1997 exploration expenditures in Canada were directed at grassroots exploration as opposed to deposit appraisal work. Spending by junior exploration companies stood at $298 million in 1997, accounting for 37% of total expenditures. Junior company expenditures are expected to increase by 5% to reach $312 million in 1998. Senior company spending amounted to $506 million in 1997, and is expected to decline to $456 million in 1998.

One of the highlights for 1997 was the claim-staking rush that took place in Alberta. Renewed interest in the search for diamonds in that province resulted in new mineral claims covering a total area of 37 million hectares and will likely result in a significant increase in exploration activity in 1998. The 44 million hectares of new mineral claims recorded for Canada as a whole represented the largest area of mineral claims ever recorded in a one-year period in this country, surpassing the impressive totals established during 1992 and 1993 at the peak of the diamond-staking rush in northern Canada.

Exploration for diamonds continues at a rapid pace in many regions of Canada. Although diamond exploration expenditures were lower in 1997, substantial amounts were spent on mine development. The Ekati diamond mine is scheduled to begin production in the fall of 1998, and the Diavik project could be in production in 2002. Work also continues on several other promising properties. The positive outlook for diamond mining in Canada remains a bright spot for Canadian mineral exploration.

Globally, Canada remains one of the world's top mineral exploration targets. Canada's standing as a destination for exploration investment from worldwide sources is remarkable given the rapid growth that has occurred since the early 1990s in mineral exploration activity in many developing countries.

Canadian companies are also continuing to increase their exploration and mining activities abroad. They now conduct more than one third of the world's exploration programs by larger companies for precious-metal, base-metal and diamond exploration, and they hold the dominant share of that market in Canada, Latin America, Europe and the Former Soviet Union.

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Last updated July 23, 1999

1. Mineral Exploration Expenditures in Canada

1.1 INTRODUCTION

This section highlights the 1997 preliminary survey results for exploration expenditures and the 1998 company spending intentions for Canada, as obtained through the redesigned federal-provincial survey of mining and exploration companies. This survey, now known as the *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures*, is described in the Appendix. As mentioned in the Appendix, new definitions were implemented for the 1997 preliminary estimates and 1998 forecast survey. As a result, new types of information are collected by the survey but are only briefly described in this year's report. For this transition year, the analysis reconciles to some extent the new data with those of previous years by using only a sub-group of data. A more thorough analysis of exploration expenditures in Canada will be possible in coming years as comparable data are accumulated and compiled.

This section also describes the results of a statistical model, designed by NRCan's Minerals and Metals Sector, to predict the amount of junior and senior company mineral exploration spending that could occur in 1998. Finally, a review of some recent and significant mineral exploration successes confirms Canada's mineral discovery potential for high-quality mineral deposits.

1.2 1997 EXPLORATION EXPENDITURES

1.2.1 Statistical Summary

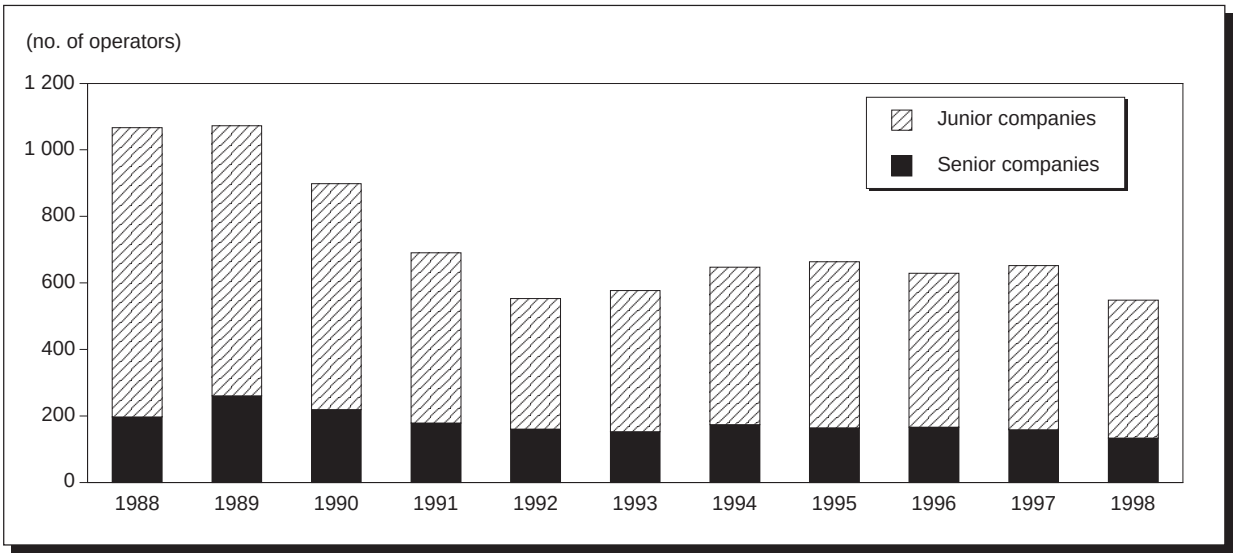
In 1997, 652 companies (project operators) and some prospectors spent $804 million on mineral exploration in Canada (**Figure 1**). That number of companies represented an increase of 4% from the 1996 total of 629 companies (expenditures of $895 million). A total of 130 companies (compared to 143 in 1996) spent $1 million or more each on exploration (**Table 1**); these companies' expenditures accounted for 85% of the total expenditures for 1997. In general, the major spenders had lower exploration budgets in 1997 than in 1996.

Compared to 1996, spending decreases totaling $109 million were recorded in most provinces and territories (**Figure 2**). Major decreases occurred in the Northwest Territories (39% of the $109 million), Newfoundland and Labrador (22%), and Ontario (20%). Increases were recorded in Alberta, Saskatchewan, Québec and Nova Scotia, for a total of $18 million. In decreasing order of amounts spent on exploration, Ontario, the Northwest Territories, Québec and British Columbia accounted for 70% of all exploration expenditures in Canada.

In 1997, expenditures for general (off-property) exploration activity decreased by 18% from 1996. Overall, $652 million, or 81% of all exploration expenditures, was for general exploration activity. The Northwest Territories ranked first in general exploration activity with 22% of the total, followed by Ontario and Québec with 19% and 16%, respectively.

Mine-site exploration expenditures increased by 53% to $153 million from the 1996 level of $100 million. They accounted for up to 10% of the respective exploration totals recorded for Nova Scotia, British Columbia, the Northwest Territories, and Newfoundland and Labrador; up to 20% for New Brunswick and the Yukon; and around 30% for Québec, Ontario, Manitoba, Saskatchewan and Alberta.

Figure 1
Project Operators Active in Exploration in Canada, 1988-98



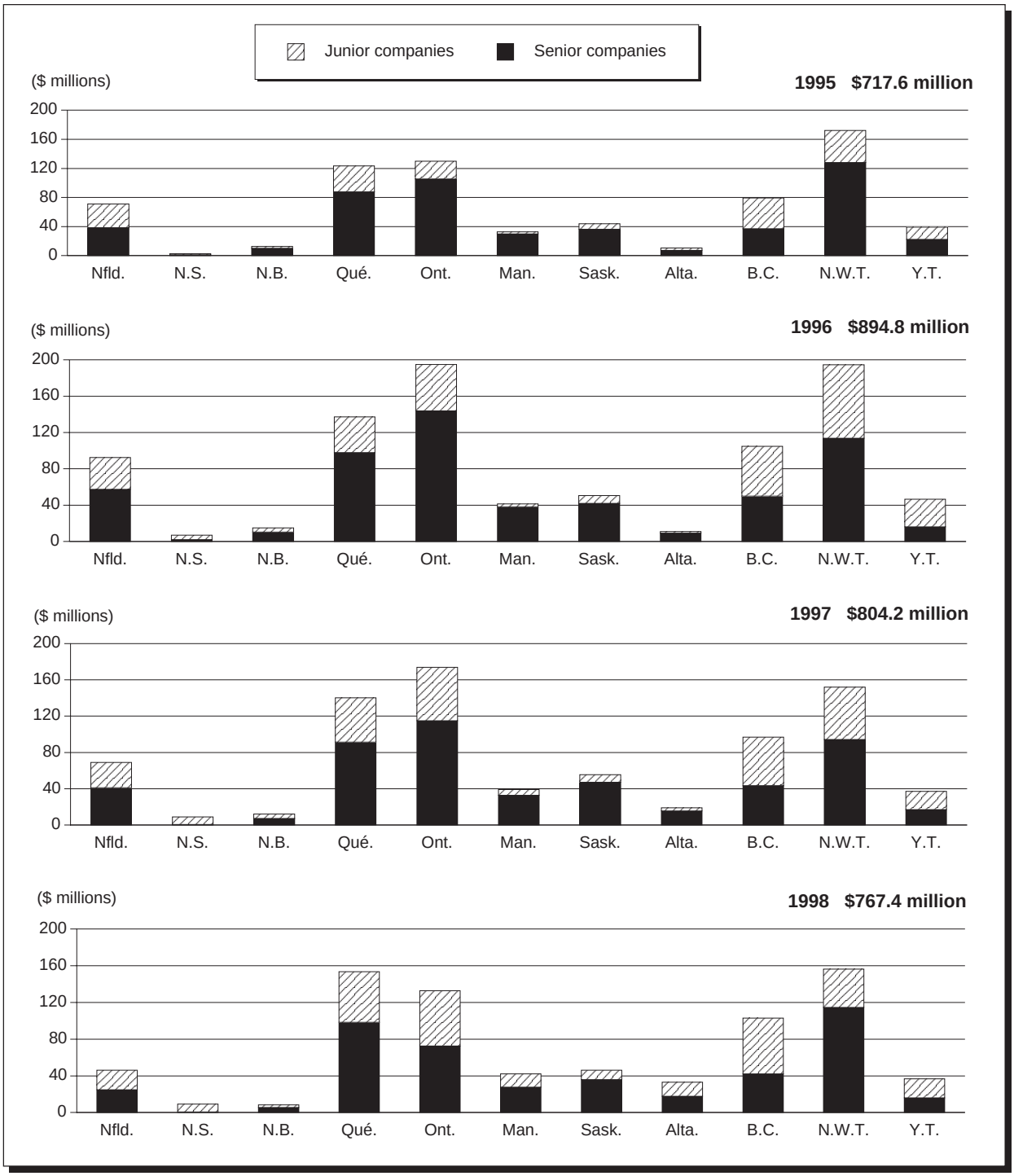
Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: Data exclude prospectors. 1997 data are preliminary; 1998 data are based on company spending intentions as compiled in January 1998.

TABLE 1. EXPLORATION EXPENDITURES BY RANGE OF EXPENDITURES AND BY TYPE OF COMPANY, 1997 AND 1998

Range of Expenditures	Junior			Senior			Total		
	Companies	Expenditures	Percentage of Total Expenditures	Companies	Expenditures	Percentage of Total Expenditures	Companies	Expenditures	Percentage of Total Expenditures
($)	(number)	($000)	(%)	(number)	($000)	(%)	(number)	($000)	(%)
1997									
>10 million	1	16 490	5.53	19	327 469	64.70	20	343 959	42.77
5 million - 10 million	9	55 891	18.75	12	77 896	15.39	21	133 787	16.64
1 million - 5 million	59	129 165	43.34	30	79 421	15.69	89	208 586	25.94
500 000 - 1 million	58	38 486	12.91	16	11 607	2.29	74	50 093	6.23
200 000 - 500 000	106	34 953	11.73	21	6 088	1.20	127	41 041	5.10
100 000 - 200 000	76	10 414	3.49	14	1 791	0.35	90	12 205	1.52
50 000 - 100 000	57	4 014	1.35	20	1 303	0.26	77	5 317	0.66
0 - 50 000	128	2 118	0.71	26	578	0.11	154	2 696	0.34
Subtotal	494	291 531	97.82	158	506 153	100.00	652	797 684	99.19
Prospectors	76	6 498	2.18	–	–	–	76	6 498	0.81
Total 1997	570	298 029	100.00	158	506 153	100.00	728	804 182	100.00
1998									
>10 million	1	11 078	3.55	14	269 783	59.21	15	280 861	36.60
5 million - 10 million	13	86 219	27.66	11	83 885	18.41	24	170 104	22.17
1 million - 5 million	69	133 406	42.80	32	84 212	18.48	101	217 618	28.36
500 000 - 1 million	57	35 512	11.39	11	7 562	1.66	68	43 074	5.61
200 000 - 500 000	89	27 837	8.93	24	7 682	1.69	113	35 519	4.63
100 000 - 200 000	60	7 608	2.44	13	1 483	0.33	73	9 091	1.18
50 000 - 100 000	41	2 456	0.79	10	715	0.16	51	3 171	0.41
0 - 50 000	85	1 393	0.45	18	335	0.07	103	1 728	0.23
Subtotal	415	305 509	98.02	133	455 657	100.00	548	761 166	99.19
Prospectors	48	6 186	1.98	–	–	–	48	6 186	0.81
Total 1998	463	311 695	100.00	133	455 657	100.00	596	767 352	100.00

Source: Natural Resources Canada.
– Nil.
Note: Data for 1997 are preliminary estimates; 1998 data are based on company spending intentions as compiled in January 1998.

Figure 2
Exploration Expenditures in Canada by Junior and Senior Companies, by Province and Territory, 1995-98



Sources: Natural Resources Canada and Statistics Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: 1997 data are preliminary estimates; 1998 data are company spending intentions as compiled in January 1998. Overhead expenditures are included.

1.2.2 Spending by Junior and Senior Firms

The analysis within this report often distinguishes between senior and junior mining companies. In general terms, a senior mining company derives its income from mining or other business ventures and can direct part of that income towards its exploration projects. Junior companies, on the other hand, usually have no regular source of income and must finance their exploration activities through the issuance of treasury shares. Junior and senior mining companies are described further in the Appendix.

A total of 158 senior project operators accounted for 63% ($506 million) of all exploration expenditures in 1997 (**Figures 1** and **2**). Their proportional share of total exploration expenditures was about the same as in 1996 when 166 senior project operators spent $580 million.

About 70% of the expenditures reported by senior firms occurred in Ontario, the Northwest Territories, Québec and Saskatchewan (in decreasing order). Senior firms decreased their expenditures in 1997 in most provinces and territories, excluding Saskatchewan, the Yukon and, most significantly, Alberta where they increased by 69%.

Senior companies were the main contributors to exploration expenditures in all provinces and territories except the Yukon, Nova Scotia and British Columbia. In British Columbia, senior company expenditures almost equaled spending by the juniors. The share of senior expenditures exceeded 80% of total expenditures in each of Alberta, Manitoba and Saskatchewan.

The number of junior project operators rose to 494 in 1997, an increase of 7% over the 463 recorded in 1996. Prospectors are not counted in this total because only aggregated prospectors' expenditures are provided by provincial survey partners and because some provinces do not survey prospectors. Prospectors account for, at most, about 2% of total Canadian exploration expenditures.

Altogether, junior companies and prospectors spent $298 million in 1997, a decrease of 5% over 1996. Decreases in junior expenditures were recorded in the Yukon, the Northwest Territories, Newfoundland and Labrador, and British Columbia. Junior exploration expenditures roughly doubled in Manitoba and Alberta. Other increases varied between 9% and 64%, with the low end of the range being registered in New Brunswick and the high end in Québec. In decreasing order of expenditures, Ontario, the Northwest Territories, British Columbia and Québec accounted for 73% of all junior expenditures in 1997.

1.2.3 Main Exploration Targets

The two main exploration properties or groups of properties (based on reported exploration expenditures) for each province and territory in 1997 are listed in **Table 2**. Expenditures on the projects listed in this table totaled $186 million and represented 23% of all exploration expenditures in Canada for that year. In fact, by themselves, 22 companies accounted for $220 million, or 27% of all exploration expenditures in Canada in 1997. About 80% of those expenditures were made by senior companies. Emphasis was still placed on diamond exploration in the Lac de Gras area of the Northwest Territories, and on nickel-copper-cobalt exploration in the Voisey's Bay area of Labrador.

1.2.4 New Mining Investment Expenditures

The new breakdown of exploration expenditures (**Figure 3, Table 3**) by grassroots work (exploration) and advanced work (deposit appraisal), including other related project costs such as engineering, economic and feasibility studies, and environmental and land access costs, shows that grassroots exploration amounted to $679 million in 1997 (76% of the $897 million total). More than 90% of the total expenditures were reported as grassroots work in each of Manitoba, Newfoundland and Labrador, the Yukon and New Brunswick; between 70% and 75% in Ontario, Québec, the Northwest Territories and Nova Scotia; and between 65% and 70% in

Saskatchewan, Alberta and British Columbia. The latter provinces likely were the sites of a higher proportion of more advanced work on promising deposits. In terms of ranking by total grassroots expenditures, the Northwest Territories placed first followed by Ontario, Québec, and Newfoundland and Labrador. For advanced work, Ontario ranked first followed by the Northwest Territories, Québec and British Columbia.

The other related project costs that are collected in the redesigned survey constitute about 12% of the overall expenditures reported, the balance being almost equivalent to what the total exploration expenditures would have amounted to under the previous survey's definitions.

The mine complex development component (including other related project costs) totaled $1 billion and most of the expenditures occurred in Québec, Ontario, Manitoba and Saskatchewan.

TABLE 2. TWO MAIN EXPLORATION PROPERTIES OR GROUPS OF PROPERTIES, BY CANADIAN PROVINCE OR TERRITORY, 1997

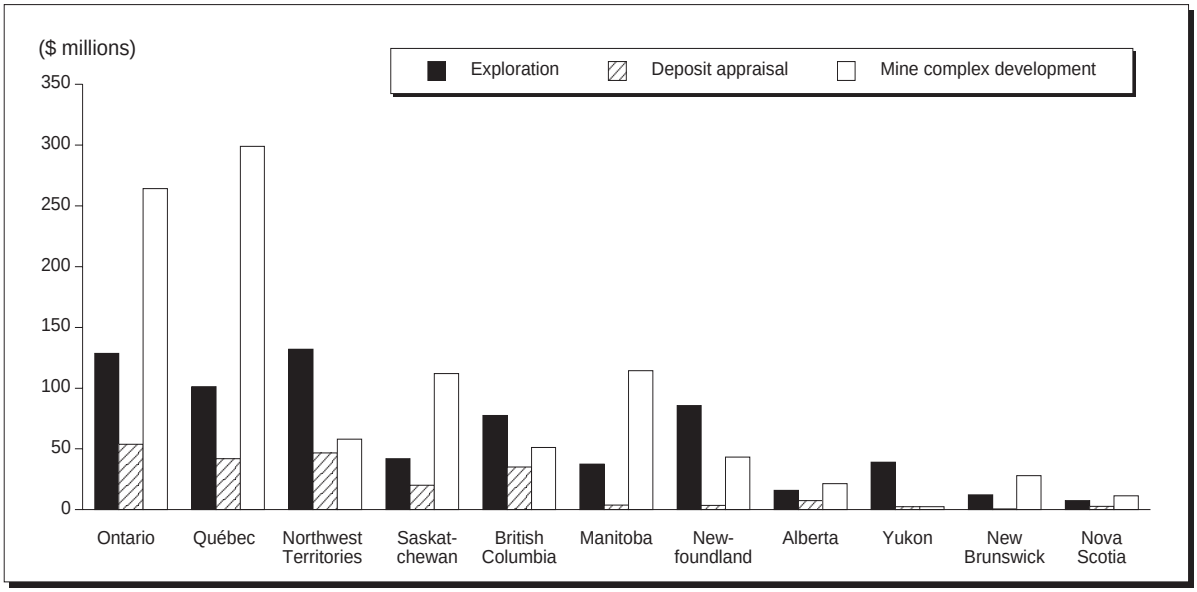
Province/Territory	Company	Main Project	Commodity
Newfoundland and Labrador	Voisey's Bay Nickel Company Ltd.	Voisey's Bay	Nickel, copper, cobalt
	Donner Minerals Limited	Voisey's Bay South	Nickel
Nova Scotia	Kaoclay Resources Inc.	Musquodoboit, Shubenacadie and Stawrache Valleys	Kaolin clay
	Savage Resources Canada	Scotia Mine, Gays River	Lead, zinc
New Brunswick	Noranda Mining and Exploration	Heath Steele mine and Brunswick mine[1]	Zinc, lead
	Chapleau Resources	Single Gulch, Sewell Brook, Costigan projects	Zinc, lead
Québec	Barrick Gold Corporation	Doyon mine[1]	Nickel, base metals
	Société Minière Raglan Du Québec Ltée	Raglan project	Nickel
Ontario	Inco Limited	Victor deposit	Nickel, copper, zinc, gold
	Goldcorp Inc.	Red Lake mine[1]	Gold
Manitoba	Hudson Bay Exploration & Development Ltd.	Snow Lake, Flin Flon, Ruttan, Minago River area	Copper, zinc
	Inco Limited	Thompson mine[1]	Nickel, copper
Saskatchewan	Cameco Corporation	McArthur River project[1]	Uranium
	Cogema Resources Inc.	Close Lake, Douglas River, Wolly, Shea Creek projects	Uranium
Alberta	Smoky River Coal Ltd.	Smoky River Coal mine[1]	Coal
	Ashton Mining of Canada Inc.	Buffalo Hills project, Peace River region	Diamonds
British Columbia	Taseko Mines Limited	Prosperity property, Fish Lake area	Copper, gold
	Boliden Westmin Ltd.	Myra Falls mine[1]	Gold, silver, copper, zinc
Yukon	Viceroy Minerals Corp.	Brewery Creek mine[1]	Gold
	Columbia Gold Mines Ltd.	Fyre Lake project	Gold, copper, cobalt
Northwest Territories	Diavik Diamond Mines Inc.	Diavik property, Lac de Gras	Diamonds
	Lytton Minerals Limited	Jericho project, Lac de Gras	Diamonds

	Preliminary Expenditures ($ millions)	% of Total Canadian Expenditures
Total for these junior projects[2]	63.3	7.9
Canadian total for these junior companies	63.3	7.9
Total for these senior projects[2]	123.1	15.3
Canadian total for these senior companies	156.4	19.5
Total for these projects	186.4	23.2
Total for these companies[3]	219.7	27.3

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
[1] Mine-site exploration project. [2] A junior project is a project operated (managed) by a junior company; a senior project is a project operated (managed) by a senior company. [3] Total expenditures in Canada of the companies listed in this table only.

Figure 3

Provincial/Territorial Distribution of Mining Investment,[1] Excluding That for Structures, Machinery and Equipment, Preliminary 1997



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.

[1] Mining investment includes: on- and off-property expenditures for field work, engineering, economic and feasibility studies, overhead costs, environmental characterization, permits and protection costs, restoration costs, land access agreements, permits and damages.

TABLE 3. TOTAL MINING INVESTMENTS (ON-MINE-SITE PLUS OFF-MINE-SITE), 1997 AND 1998

	Exploration		Deposit Appraisal		Mine Complex Development		Grand Total	
	1997	1998	1997	1998	1997	1998	1997	1998
	($000)							
Field work and overhead costs[1]	643 843	586 639	160 339	180 713	951 705	924 705	1 755 887	1 692 057
Engineering, economic and feasibility studies	16 744	7 392	37 867	74 545	16 179	15 886	70 790	97 823
Environment	16 696	3 501	19 234	12 460	36 296	39 669	72 226	55 630
Land Access	2 089	2 260	668	3 179	4 322	2 288	7 079	7 727
Total	679 372	599 792	218 108	270 897	1 008 502	982 548	1 905 982	1 853 237
Capital expenditures[2]	8 470	9 490	82 330	150 428	1 797 401	1 511 746	1 888 201	1 671 664
$ for environmental protection and restoration	41	12	226	176	23 660	40 759	23 927	40 947
Repair and maintenance expenditures[2]	74 465	1 511	23 371	29 399	1 086 010	1 030 554	1 183 846	1 061 464
$ for environmental protection and restoration	1 053	39	78	1 015	28 468	26 994	29 599	28 048
Total	82 935	11 001	105 701	179 827	2 883 411	2 542 300	3 072 047	2 733 128
Grand total	762 307	614 803	323 809	450 724	3 891 913	3 524 848	4 978 029	4 590 375
Total environment	17 790	3 552	19 538	13 651	88 425	107 421	125 752	124 625
Environment as a percentage of grand total	3.19	1.13	11.79	6.16	2.62	3.27	2.82	2.85

Sources: Natural Resources Canada and Statistics Canada, from the federal-provincial survey of mining and exploration companies.
[1] Exploration plus deposit appraisal total can be compared to some extent with previous exploration expenditures series. [2] Includes structures, machinery and equipment.
Notes: Exploration and deposit appraisal activities include only the search for new mines; they do not include work for extensions of deposits already being mined or committed to production. Overhead expenditures include land costs, field administration costs and project-related head office expenses. Numbers may not add to totals due to rounding.

1.3 1998 EXPLORATION EXPENDITURES — AN OUTLOOK

1.3.1 Statistical Summary

In 1998, 548 companies (project operators) and some prospectors intend to spend $767 million on exploration in Canada (**Figure 1**). Despite a 16% reduction in the number of companies, expenditures are expected to decrease by only 5% over 1997. A total of 140 companies (130 in 1997) each intend to spend $1 million or more (**Table 1**). These 140 companies expect to spend a total of $669 million, or 87% of total intended expenditures for 1998.

More than 70% of the total exploration expenditures will be reported, in decreasing order, by the Northwest Territories, Québec, Ontario and British Columbia (**Figure 2**). Increases in exploration expenditures are expected in six provinces and territories for a total increase of $41 million. Those provinces/territories are Alberta, Québec, Manitoba, British Columbia, the Northwest Territories and Nova Scotia. Altogether, increases in Alberta, Québec and British Columbia should account for 82% of the $41 million.

Total decreases of $78 million are foreseen for Ontario, Newfoundland and Labrador, New Brunswick, Saskatchewan and the Yukon. About 83% of the total decrease is expected to occur in Ontario and in Newfoundland and Labrador.

Company spending intentions (**Table 22**, Appendix) indicate that expenditures on general exploration are expected to decrease by less than 1% from $652 million in 1997 to $646 million in 1998. This type of expenditure is expected to account for 84% of total spending. Due mainly to the temporary suspension of activity at some major projects, mine-site expenditures are expected to decrease by 20% to reach $122 million in 1998.

1.3.2 Spending by Junior and Senior Firms

In the federal-provincial survey compiled in January 1998, 133 senior companies indicated their intention to spend $456 million, representing 59% of total forecast 1998 exploration expenditures and a 10% decrease in senior company expenditures from 1997.

Most of the expenditures by senior firms are expected to occur in the Northwest Territories, Québec and Ontario. In 1998, senior company expenditures are expected to exceed 70% of total exploration expenditures in Saskatchewan and in the Northwest Territories. In the remaining provinces and territory, expenditures by senior companies are expected to amount to less than 70% of their total respective exploration expenditures. Expenditures by senior companies are forecast to decrease in most regions except the Northwest Territories, Alberta and Québec.

The number of junior company project operators is expected to decrease by 16% in 1998. However, this reduced number of companies is expected to contribute a slightly higher level of expenditures than in 1997. Junior companies are expected to spend $312 million in 1998, a 5% increase from the $298 million spent in 1997. The amount spent by juniors is expected to increase in most provinces and territories. The extent of the increase is expected to vary between 1% in Nova Scotia and 338% in Alberta. Decreases are expected in New Brunswick (down by 45%), the Northwest Territories (27%), and Newfoundland and Labrador (24%).

In 1998, 83 junior companies (compared to 69 in 1997) each intend to spend $1 million or more on exploration. They are expected to account for 29% ($231 million) of all exploration expenditures, compared to 25% ($202 million) in 1997. Fifty-seven senior companies (61 in 1997) each intend to spend $1 million or more in 1998. These companies are expected to account for 57% ($438 million) of total exploration expenditures, compared to 60% ($485 million) in 1997.

1.3.3 Main Exploration Targets

The two main exploration properties or groups of properties (based on reported spending intentions) for each province and territory in 1998 are listed in **Table 4**. Planned expenditures for

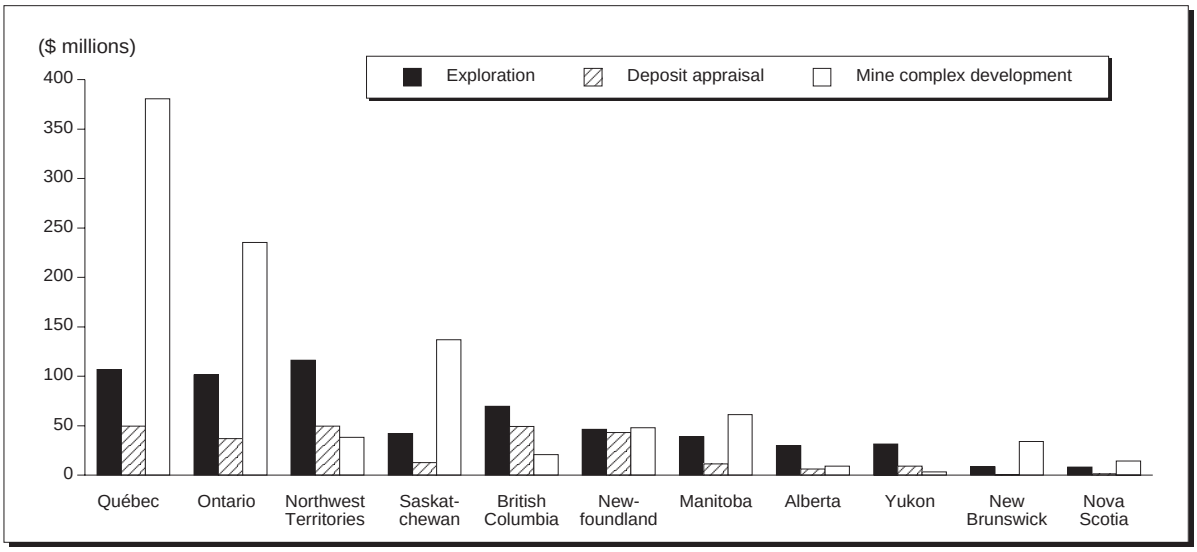
TABLE 4. TWO MAIN EXPLORATION PROPERTIES OR GROUPS OF PROPERTIES, BY CANADIAN PROVINCE OR TERRITORY, 1998

Province/Territory	Company	Main Project	Commodity
Newfoundland and Labrador	Voisey's Bay Nickel Company Ltd.	Voisey's Bay	Nickel, copper, cobalt
	Donner Minerals Limited	Voisey's Bay South	Nickel
Nova Scotia	Kaoclay Resources Inc.	Musquodoboit, Shubenacadie and Stawrache Valleys	Kaolin clay
	Savage Resources Canada Ltd.	Scotia Mine, Gays River	Lead, zinc
New Brunswick	Noranda Mining and Exploration	Heath Steele mine and Bathurst mining camp (various properties)	Zinc, lead
		Heath Steele mine and Brunswick mine[1]	Zinc, lead
Québec	Barrick Gold Corporation	Bousquet No. 2 mine[1]	Nickel, base metals
	Société Minière Raglan Du Québec Ltée	Raglan mine[1]	Nickel
Ontario	Exall Resources Ltd.	Glimmer mine	Gold, silver
	Armistice Resources Ltd.	Virginiatown property	Gold
Manitoba	Hudson Bay Exploration & Development Ltd.	Snow Lake, Flin Flon, Ruttan, Minago River area projects	Copper, zinc
	Canmine Resource Corp.	Maskwa, Binco and Osik properties	Nickel
Saskatchewan	Cogema Resources Inc.	Close Lake, Douglas River, Shea Creek projects	Uranium
	Claude Resources Inc.	Amisk/Laural Lake projects	Gold, base metals
Alberta	Pure Gold Resources Inc.	Lethbridge project	Diamonds
	Ashton Mining of Canada Inc.	Buffalo Hills project, Peace River region	Diamonds
British Columbia	R.H. Stanfield Holdings Ltd.	Gallowai Bull River property	Feldspar, copper, gold, silver
	Redfern Resources Ltd.	Tulsequah Chief deposit	Zinc, copper, gold, silver lead
Yukon	United Keno Hill Mines Ltd.	Bellekeno and Silver King	Silver, lead, zinc
	Viceroy Minerals Corp.	Brewery Creek mine[1]	Gold
Northwest Territories	Diavik Diamond Mines Inc.	Diavik property, Lac de Gras,	Diamonds
	WMC International Limited	Meliadine and Kivalliq properties	Gold

	Forecast Exploration ($ millions)	% of Total Canadian Expenditures
Total for these junior projects[2]	131.7	17.2
Canadian total for these junior companies[3]	131.7	17.2
Total for these senior projects[2]	76.9	10.0
Canadian total for these senior companies	81.1	10.6
Total for these projects	208.6	27.2
Total for these companies[3]	212.8	27.8

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
[1] Mine-site exploration project. [2] A junior project is a project operated (managed) by a junior company; a senior project is a project operated (managed) by a senior company. [3] Total expenditures in Canada of the companies listed in this table only.

Figure 4
Provincial/Territorial Distribution of Mining Investment,[1] Excluding That for Structures, Machinery and Equipment, Forecast 1998



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.

[1] Mining investment includes: on- and off-property expenditures for field work, engineering, economic and feasibility studies, overhead costs, environmental characterization, permits and protection costs, restoration costs, land access agreements, permits and damages.

these projects total $209 million, or 27% of all intended exploration expenditures. For Canada as a whole, 21 companies reported $213 million, or 28% of all intended expenditures for 1998. About 80% of those expenditures will be incurred by senior companies. As in 1997, the main exploration targets are diamond deposits in Canada's North, mainly the Diavik project, and base-metal deposits in Labrador. In 1998, the two main projects for Newfoundland and Labrador again are expected to represent more than 50% of total exploration for that province; the same is true for Alberta, New Brunswick and Nova Scotia.

1.3.4 New Mining Investment Expenditures

The new breakdown of exploration expenditures (**Figure 4, Table 3**) by grassroots work (exploration) and advanced work (deposit appraisal), including other related project costs such as engineering, economic and feasibility studies, and environmental and land access costs, shows that grassroots exploration could amount to $600 million in 1998 (70% of the $871 million total). More than 70% of the total intended expenditures were reported as grassroots work in each of New Brunswick, Nova Scotia, Alberta, Saskatchewan and Ontario. In British Columbia and in Newfoundland and Labrador, the shares of the expenditures for grassroots activity are the lowest (58% and 52% respectively), indicating that more advanced work is being conducted in those provinces. In terms of ranking by total grassroots expenditures, the Northwest Territories placed first, followed by Québec, Ontario, British Columbia, and Newfoundland and Labrador. For advanced work, the Northwest Territories ranked first, followed closely by Québec, British Columbia, and Newfoundland and Labrador.

The other related project costs that are now collected in the redesigned survey constitute about 14% of the overall expenditures reported, the balance being equivalent to what the total exploration expenditures would have amounted to under the previous survey's definitions.

Compared to 1997, grassroots expenditures are expected to decline in most provinces and territories except Alberta (up by 88%), Québec (up by 5%) and Manitoba (up by 4%). In contrast, deposit appraisal spending is expected to increase in most provinces, excluding Ontario, Saskatchewan and Alberta.

As in 1997, the mine complex development component (including other related project costs) totaled $1 billion, and the expenditures occurred mainly in Québec, Ontario, Saskatchewan and Manitoba.

1.3.5 Outlook for Exploration Based on Statistical Estimation

1.3.5.1 Methodology

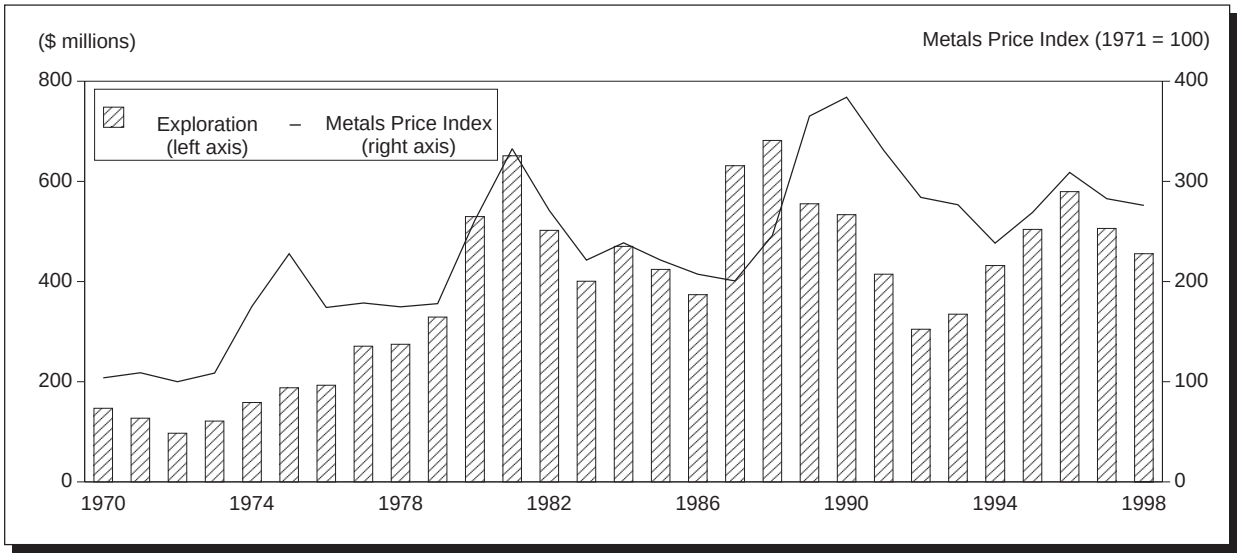
In this section, an attempt is made to predict the level of exploration for 1998 using standard statistical estimation techniques. Exploration spending is estimated by linking historical exploration spending to factors for which historical data are available.

An analysis of historical data indicates that the level of expenditures on mineral exploration in a given year can be linked to the previous year's metal prices. This may be because companies view exploration as an investment, with expected returns from that investment being dependent on expected revenues from the subsequent mining of discovered deposits. Expected future revenues would obviously depend on future mineral and metal prices, and expectations of future prices would likely be influenced by current prices. As well, metal prices influence a mining company's revenues and profits, and are an important determinant of the amount of internal funds available for spending on mineral exploration.

Changes in exploration spending are likely to lag changes in metal prices because exploration activity in a particular year is the result of a budgeting process that takes place in the preceding year. Budget allocations in a given year are therefore likely to reflect the metal prices and company profits of the preceding year.

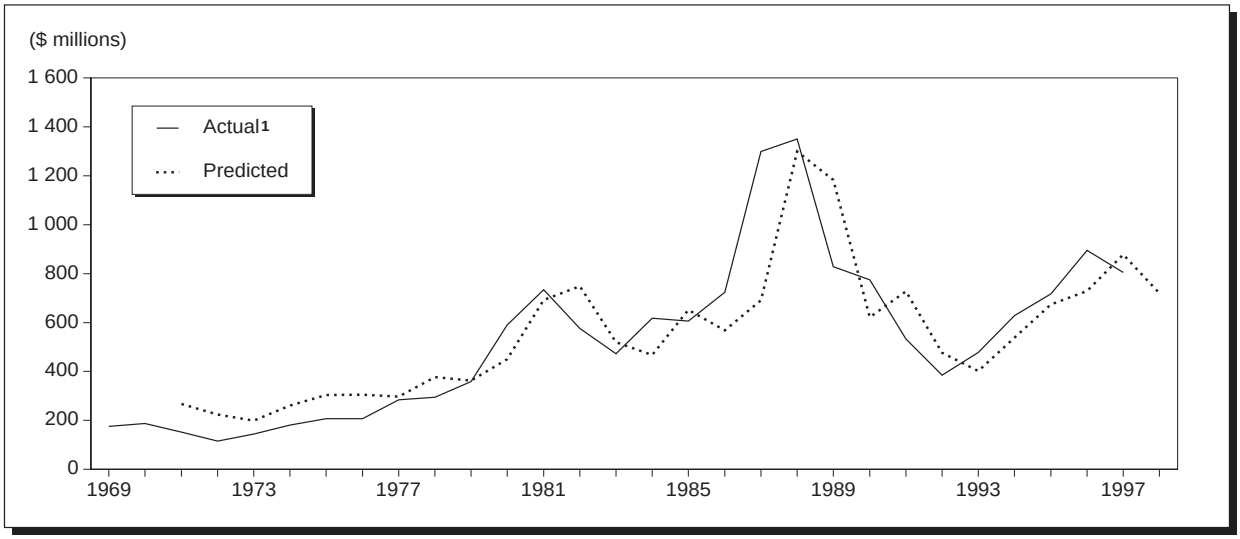
To capture this relationship between exploration and metal prices, the NRCan yearly metals price index, lagged one year, was included in the estimating equation. This index is a Fisher Ideal Index, based on the prices of six metals: gold, silver, copper, zinc, lead and nickel. **Figure 5** shows the relationship between historical exploration expenditures by senior companies and the NRCan price index, lagged one year.

Figure 5
Exploration Expenditures in Canada by Senior Companies, and the Metals Price Index Lagged One Year, 1970-98



Sources: Natural Resources Canada and Statistics Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: 1997 exploration data are preliminary; 1998 data are company spending intentions as compiled in January 1998. Overhead expenditures are included. "Lagged" means that the 1970 Metals Price Index is compared to 1971 exploration expenditures, and so on.

Figure 6
Actual and Predicted Exploration Expenditures in Canada, 1969-98



Source: Natural Resources Canada.
1 For 1997, preliminary expenditures are shown because actual expenditures were not available.

Mineral exploration is a multi-stage process that usually proceeds over a relatively long period of time as information is gathered from geological mapping, geophysical and geochemical surveying, diamond drilling, and so on. At various stages, this information is used by exploration companies to decide on where to concentrate further exploration activity and, indeed, whether to proceed at all. If early stages of exploration are successful in discovering promising mineralization, the exploration company has a strong incentive to proceed with more detailed, and more costly, drilling and analysis, thereby increasing the amount it spends on exploration. It can therefore be argued that exploration in a given period is related to exploration spending in previous periods. To capture this relationship, a lagged dependent variable was also included in the equation.

1.3.5.2 Results

Using data for the years 1969-97, the statistical equation predicts that senior companies will spend about $460 million on mineral exploration in 1998. For junior companies, the estimated equation predicts exploration expenditures of about $255 million. For all companies, expenditures of about $720 million are predicted (**Figure 6**).

1.4 RECENT MINERAL EXPLORATION SUCCESSES

Historical production data for the Canadian minerals and metals industry show that this industry experienced tremendous growth starting in the early 1950s. Concurrent with a growing world economy, this was the beginning of a remarkable 30-year period characterized by intensive metals exploration efforts and successes.

An analysis of Canadian mineral exploration success[1] reveals that there was a considerable drop in the mineral deposit discovery rate in the early 1980s. From 1981 to 1987, the discovery cost per dollar of metal discovered became very high. There was notable improvement in the

[1] Analysis by D.A. Cranstone, A. Lemieux, and M. Vallée referred to in "Canadian Mineral Exploration," Chapter 5 of the 1994 *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, 1995, pp. 5.14-5.16.

three-year period 1988-90, but the cost of discovering this much metal far exceeded the same costs for the 1950s, 1960s and 1970s, even after adjustment for inflation. For the period 1991-93, indications are, on the basis of incomplete information, that the discovery record was mediocre at best. However, the period 1994-96 appears to have been one of the most successful three-year discovery periods since the 1970s. Post-1996 discoveries in Canada point to a good discovery success rate for the coming years.

Some of the most significant recent discoveries and developments are summarized below. When summarizing recent mineral discoveries in Canada, one cannot overlook Inco Limited's Voisey's Bay nickel-copper-cobalt deposit in Labrador. By the end of 1997, 116 million tonnes (Mt) of mineralization had been identified on this property.

In Sudbury, Ontario, Falconbridge Limited has found the relatively high-grade Onaping Deep deposit, initially intersected by drilling in 1994. This deposit is distinct from the one currently being mined at the company's Onaping operation on the northwestern rim of the Sudbury intrusion. Also in the Sudbury area, Falconbridge has discovered the Norman West deposit, a deep deposit on the northeast rim that Falconbridge had initially intersected by drilling in 1996. Still in the Sudbury area, Inco has also announced the discovery of two new nickel deposits in the vicinity of the Copper Cliff South mine. These are the Kelly Lake deposit, located south of the mine at a depth of 1370 metres (m), and an unnamed high-grade deposit to the north of Copper Cliff South at a depth of 900 m. Inco is also conducting underground exploration at its Victor No. 2 copper-nickel deposit (discovered in 1990) on the eastern rim of the Sudbury intrusion.

In Manitoba, Falconbridge continues to drill the recently discovered Williams Lake nickel deposit along the southwestern extension of the Thompson Nickel Belt. In southeastern Manitoba, Canmine Resources Corporation has discovered the Maskwa nickel-copper deposit in the Bird River region, near the site of the former Dumbarton mine.

In Québec, an aggressive exploration program on Falconbridge's Raglan property in the Ungava Nickel Belt, where production began in 1997, is discovering additional nickel-copper ore. Also in Québec, Noranda discovered the deep Porphyry Mountain copper-molybdenum deposit at its Gaspé Copper operation. This deposit contains some 200 Mt that average 0.73% copper and 0.08% molybdenum (with the copper and molybdenum values together corresponding to a copper-equivalent grade of 1%) at depths of between 1000 and 1700 m.

The recently discovered Separation Rapids pegmatite deposit, some 60 km north of Kenora, Ontario, and 60 km along strike to the east of the Tanco mine at Bernic Lake, Manitoba, is being explored by Avalon Ventures Limited. This deposit is yielding attractive results. The "Big Whopper" pegmatite on this property has been traced over a strike length of 1.2 km and ranges from 15 to 80 m in thickness. The deposit contains at least 7 Mt containing 30-60% of the mineral petalite ($LiAlSi_4O_{10}$) and 25-30% of a rubidium-rich potassium feldspar. The deposit has lithium grades in the range of 1.3-1.7% Li_2O and rubidium grades in the range of 0.25-0.35% Rb_2O. Petalite is used in ceramics.

In Saskatchewan's Athabasca Basin, exploration continues for high-grade uranium orebodies such as the world-class Cigar Lake and McArthur River deposits that were discovered in 1981 and 1989, respectively. Nine or more new uranium mines in the Athabasca Basin, including Cigar Lake and McArthur River, are currently being either developed for production or are in the final approval process.

Diamond exploration continues to locate promising new diamondiferous kimberlite pipes in the vicinity of the Ekati mine, the Diavik project, the Jericho project and the AK-5034 deposit. Winspear Resources Ltd. and Aber Resources have discovered an attractive diamondiferous kimberlite dike at Snap Lake, Northwest Territories. At Fort à la Corne, Saskatchewan, 80 kimberlites have been discovered, about half of them diamondiferous, including several diamond deposits that are very large but low in grade. In Alberta's Buffalo Hills, a joint

exploration venture of Ashton Mining Canada Inc. (42.5%), Alberta Energy Corporation (42.5%) and Pure Gold Resources Inc. (15%) has discovered 23 kimberlite intrusions since early 1997, with a number of other geophysical targets yet to be tested by drilling. Although relatively low in grade, several of the kimberlites have potentially economic diamond values.

In the Yukon, work continues on the Kudz Ze Kayah, Wolverine and Wolf copper-zinc-lead-silver-gold deposits and on the Fyre Lake copper-cobalt-gold deposit. In addition to the ongoing diamond exploration activities in the Northwest Territories, WMC International Ltd. continues to drill the large Meliadine West gold deposit, which could produce as much as 400 000 oz of gold annually for at least 10 years. Other attractive gold deposits are being further explored in various parts of Canada. These include the Boston gold project (BHP Minerals Canada Ltd.), the George Lake project (Kit Resources Ltd.) and the Meadowbrook project (Cumberland Resources Ltd.), all of which are in the Northwest Territories.

2. Diamond Drilling

2.1 INTRODUCTION

Diamond drilling is an essential component of exploration for nearly all mineral properties in Canada, from the anomaly investigation stage to the deposit delineation and deposit definition stages. As such, diamond drilling statistics constitute a valuable indicator of recent levels of Canadian mineral exploration activity.

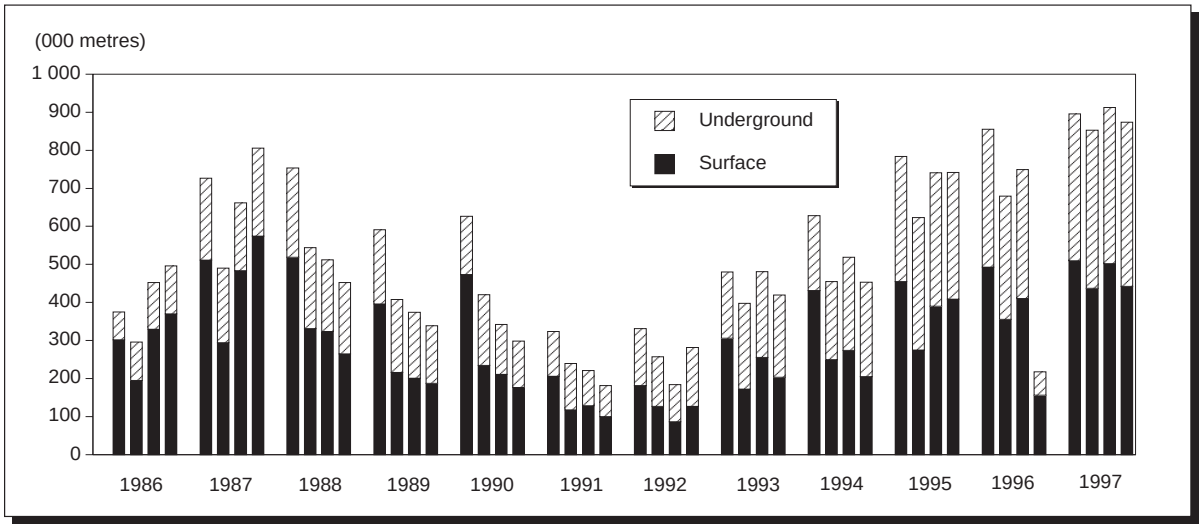
2.2 OVERVIEW OF DRILLING ACTIVITY

2.2.1 Statistical Background

The Canadian Drilling Association (CDA) gathers monthly diamond drilling statistics from its member companies. Available CDA statistics cover about 50-60% of total Canadian contract diamond drilling activity. Although incomplete, they provide a reasonable and up-to-date indication of recent national mineral exploration trends. Quarterly drilling statistics by the CDA are depicted in **Figure 7**.

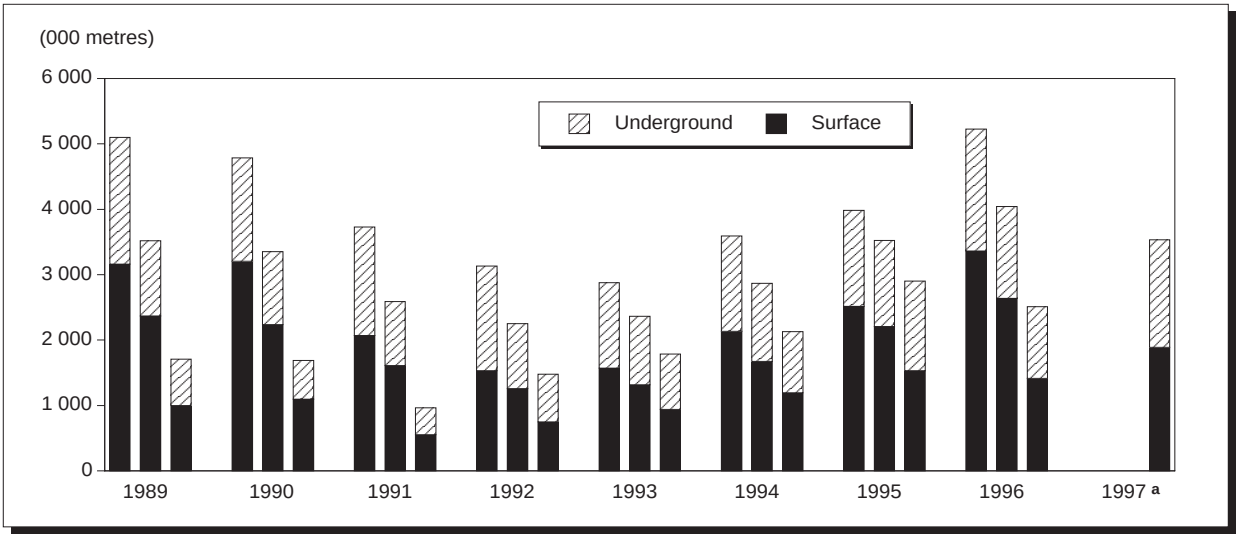
In addition, two other drilling surveys are compared with the CDA data in **Figure 8**. They consist of: total Canadian contract drilling, as reported annually to NRCan by drilling contractors and published in Statistics Canada's catalogue no. 26-201; and the federal-provincial survey of mining and exploration companies, which includes all metres drilled and expenditures reported by companies for their "own account" (drilling they did themselves) and for contracted drilling work. Exploration

Figure 7
Surface and Underground Drilling in Canada, by Quarter, 1986-97



Source: Canadian Drilling Association (CDA).
Notes: CDA data are incomplete because not all member companies report their drilling. Data for 1996 are even more incomplete because the survey was never completed.

Figure 8
Comparison of Three Surveys of Canadian Diamond Drilling, 1989-97



Sources: Federal-provincial survey of mining and exploration companies (left bar in each cluster); contract diamond drilling survey (middle bar in each cluster); Canadian Drilling Association (CDA) (right bar in each cluster).
[a] Only CDA data were available for 1997.
Note: All data include mine-site development drilling.

and development drilling have been aggregated in the federal-provincial survey to allow a fair comparison with the other two sets of statistics. Mine-site development drilling (mainly underground) consists of drilling aimed at establishing replacement ore reserves at producing mines.

Although these three sources of statistics provide different annual results, the same overall trends are observable in the three surveys over the period 1990-96.

2.2.2 Canadian Drilling Association Results

As can be seen from **Figure 7**, each of the four years (1988, 1989, 1990 and 1991) exhibited a similar pattern of diminishing diamond drilling throughout the year, with the number of metres drilled in the first quarter of each year being higher than the number of metres drilled in the final quarter of the previous year. This general quarterly decline in drilling throughout the years continued until the third quarter of 1992 when metres drilled in the fourth quarter increased relative to the third quarter.

From 1988 to 1996, drilling peaked consistently during the first quarter of each year. The explanation is twofold: first, in each of those years, flow-through share funds from the previous year were carried over into January and February; and second, much of the drilling must be done during the winter months on frozen lakes and on areas of muskeg that are generally inaccessible to drilling equipment at other times of the year. The former is likely to become less relevant because the "look-back" period for flow-through-share-financed exploration was extended from 60 days to 365 days in the 1996 federal budget. As a result, exploration companies now have more time in which to spend flow-through share money that was raised during the previous calendar year.

The general pattern of decreasing quarterly drilling throughout the year in 1988, 1989, 1990 and 1991 contrasts with the pattern of 1986 and 1987 when diamond drilling levels in the second half of the year were higher than in the first half because of the increasing availability of flow-through share funding during the heyday of the Mining Exploration Depletion Allowance (MEDA).

The total metres drilled in 1993 were considerably higher than in 1992, with further increases in 1994, 1995 and 1997 (**Figure 7**). The metres drilled during 1997 were 22% higher than the metres reported in 1995 (the 1996 survey was never completed).

2.2.3 Exploration Drilling

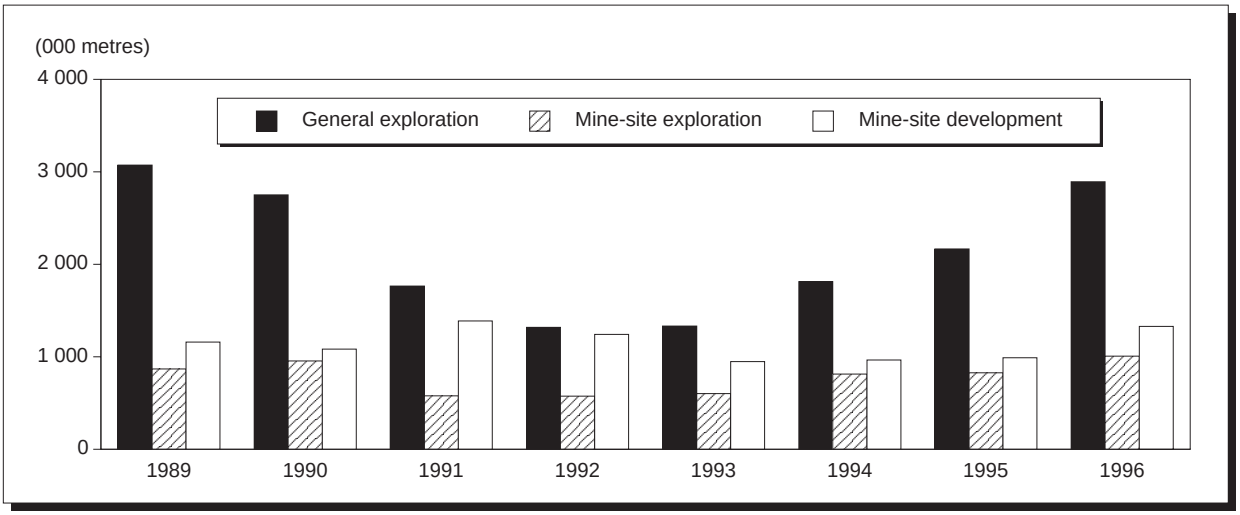
In 1996, 3 193 617 m of surface exploration drilling were carried out in Canada (**Figure 9, Table 5**), up by 21% from the 2 641 649 m drilled in 1995. Diamond drilling (3 040 573 m) constituted 95% of the total metres of surface drilling. Ontario, Québec, British Columbia and the Northwest Territories, in decreasing order of importance, were the busiest provinces and territories, jointly accounting for 70% of total surface drilling activity (**Figure 10**). Underground exploration drilling (both diamond drilling and other types of underground exploration drilling) totaled 872 968 m, up by 38% from the 631 648 m drilled in 1995. Ontario (326 331 m), Québec (265 908 m), British Columbia (92 224 m) and Manitoba (86 217 m) together accounted for 88% of total underground exploration drilling.

In the case of surface diamond drilling, 62% of the total metres were drilled by senior companies and 38% by junior companies. Underground diamond drilling was principally undertaken by senior companies who reported 95% of this activity. Of the total surface metres drilled (diamond drilling), 50% was undertaken in the search for precious metals, 33% for base metals, 8% for nonmetals and 3% for uranium. Most of the underground drilling was carried out in the search for precious metals (69%) and base metals (27%).

As shown in **Figure 9**, some 50% of the total diamond drilling activity was dedicated to general exploration, while close to 20% was dedicated to mine-site exploration. The remaining metres were reported under the mine-site development category.

Current dollar costs per metre of exploration drilling in Canada can be calculated for the period 1986-96 inclusive, using data from the federal-provincial survey of mining and exploration companies (**Table 5**). These costs may exceed the actual amounts paid to drilling contractors as some companies may have included costs associated with drilling such as geological logging and assaying of core. These average drilling costs include both surface and underground drilling expenditures; costs for surface drilling are normally significantly higher than those for underground drilling.

Figure 9
Surface and Underground Diamond Drilling in Canada, by Type of Work, 1989-96



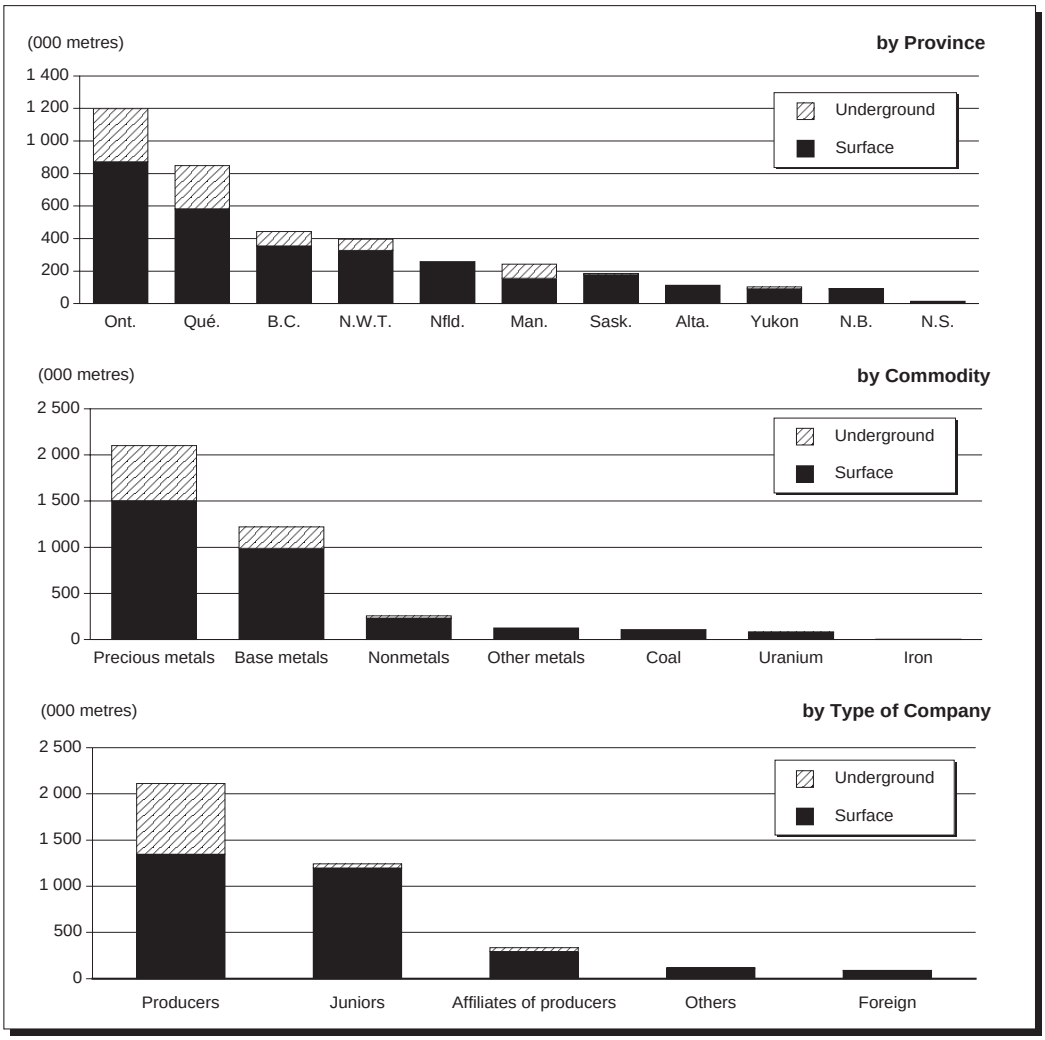
Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.

TABLE 5. SURFACE AND UNDERGROUND EXPLORATION DRILLING IN CANADA, 1986-96

Year	Diamond Drilling			Other Drilling[1]		
	Metres Drilled	Total Cost	Cost Per Metre	Metres Drilled	Total Cost	Cost Per Metre
	(000)	($000)	($)	(000)	($000)	($)
1986	3 616	248 579	69	55	3 385	62
1987	6 221	509 950	82	262	18 544	71
1988	6 206	477 509	77	211	10 466	50
1989	3 940	291 399	74	297	9 471	32
1990	3 702	281 982	76	241	12 575	52
1991	2 341	174 789	75	234	13 133	56
1992	1 889	140 765	75	139	6 544	47
1993	1 932	146 780	76	282	12 879	46
1994	2 626	184 068	70	213	12 592	59
1995	2 993	260 543	87	280	11 960	43
1996	3 898	324 823	83	169	12 047	71

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
[1] Drilling methods such as percussion exploration drilling, reverse circulation drilling for overburden, and rotary drilling (such as used in petroleum exploration) employed in exploration for coal, potash, salt, gypsum and similar layered mineral commodities.

Figure 10
Surface and Underground Exploration Diamond Drilling in Canada, 1996



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Note: Exploration includes general plus mine-site exploration, which includes only the search for new mines.

3. Claim Staking and Exploration Intensity

3.1 INTRODUCTION

The area of new mineral claims staked in Canada in 1997 (**Table 6**) totaled some 44 million hectares (ha), the largest area of new mineral claims ever recorded in this country and an increase of 232% compared to 1996. The largest yearly totals of new mineral claim areas recorded previously had been 33 million ha in 1992 and 27 million ha in 1993.

3.2 NEW CLAIMS STAKED AND CLAIMS IN GOOD STANDING

In 1997, the area of new mineral claims staked in Alberta was 37.2 million ha, which is more than six times the area recorded in 1996 and 85% of the total area of new mineral claims in Canada. While the total area of new claims staked in Canada increased by 30.7 million ha in 1997, it increased by 31.9 million ha in Alberta alone. Saskatchewan and Québec were the only other two provinces to record an increase. Saskatchewan's area of new mineral claims increased by 103% over 1996 and Québec's increased by 10%. The mining recorders of Alberta and Saskatchewan have explained their provinces' respective increases by a strong interest in exploration for diamonds. Furthermore, there has been renewed interest in staking for uranium in Saskatchewan.

The areas staked in 1997 were down by 51% in Nova Scotia, by 43% in New Brunswick, by 34% in the Northwest Territories, by 23% in British Columbia, and by 20% in Newfoundland and Labrador. Smaller decreases occured in the Yukon, Ontario and Manitoba. In general, the effect of low commodity prices, combined with the post-Voisey's Bay staking rush slow-down, had an impact on the overall level of staking activity. In the Northwest Territories, bad weather conditions hampered staking activity.

TABLE 6. AREA OF NEW MINERAL CLAIMS[1] STAKED IN CANADA, 1996 AND 1997

Province/Territory	1996		1997	
	(hectares)	(%)	(hectares)	(%)
Newfoundland	417 575	3.1	334 075	0.8
Nova Scotia	424 815	3.2	208 191	0.5
New Brunswick	93 760	0.7	53 760	0.1
Québec	954 967	7.2	1 050 629	2.4
Ontario	903 488	6.8	855 584	1.9
Manitoba	196 900	1.5	191 330	0.4
Saskatchewan	469 040	3.5	950 253	2.2
Alberta	5 328 000	40.2	37 200 000	84.5
British Columbia	997 740	7.5	765 257	1.7
Yukon	514 483	3.9	459 507	1.0
Northwest Territories	2 956 017	22.3	1 953 191	4.4
Total	13 256 785	100.0	44 021 777	100.0

Source: Provincial and territorial mining recorders.
[1] Excludes coal.
Note: Percentages do not add to 100 due to rounding.

The total area occupied by claims in good standing in Canada amounted to approximately 5.5% of the total land mass in 1997, compared to 3.9% in 1996 (**Table 7**). As predicted in the 1996 edition of this report, this increase is attributable to the staking rush for diamonds in Alberta. Over 30% of the area of that province is now occupied by claims in good standing. Newfoundland and Labrador, the Yukon and Nova Scotia are the other Canadian jurisdictions that have the largest proportion of their land mass occupied by claims in good standing, although the Northwest Territories stands out in terms of the number of hectares covered by such claims.

TABLE 7. AREA OCCUPIED BY CLAIMS IN GOOD STANDING IN CANADA, 1996 AND 1997

Province/Territory	Total Area	Area of Claims in Good Standing	Area of Claims/ Total Area
	(hectares)		(%)
1996			
Newfoundland	40 572 000	4 777 025	11.8
Nova Scotia	5 549 000	457 401	8.2
New Brunswick	7 344 000	344 048	4.7
Québec	154 068 000	2 246 875	1.5
Ontario	106 858 000	2 927 599	2.7
Manitoba	64 995 000	1 752 120	2.7
Saskatchewan	65 233 000	2 378 236	3.6
Alberta	66 119 000	4 370 000	6.6
British Columbia	94 931 000	4 378 664	4.6
Yukon	48 345 000	1 706 406	3.5
Northwest Territories	342 632 000	13 091 150	3.8
Total Canada	996 646 000	38 429 524	3.9
1997			
Newfoundland	40 572 000	3 041 309	7.5
Nova Scotia	5 549 000	365 504	6.6
New Brunswick	7 344 000	342 256	4.7
Québec	154 068 000	4 017 412	2.6
Ontario	106 858 000	2 903 808	2.7
Manitoba	64 995 000	984 959	1.5
Saskatchewan	65 233 000	2 772 802	4.3
Alberta	66 119 000	20 200 000	30.6
British Columbia	94 931 000	4 305 000	4.5
Yukon	48 345 000	3 353 476	6.9
Northwest Territories	342 632 000	12 888 558	3.8
Total Canada	996 646 000	55 175 084	5.5

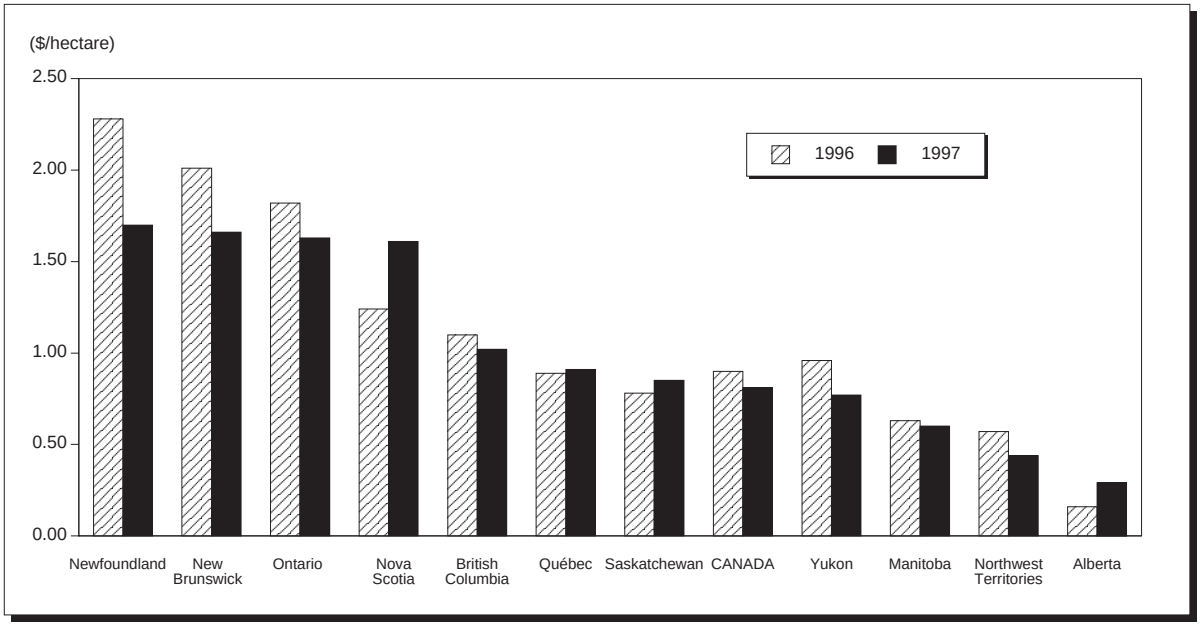
Sources: Natural Resources Canada; provincial/territorial mining recorders offices.
Note: Data for Prince Edward Island are excluded.

3.3 EXPLORATION INTENSITY

There is considerable variation in the level of exploration expenditures across Canada's provinces and territories. For example, 1997 exploration expenditures amounted to $174 million (preliminary) in Ontario, but were essentially zero in Prince Edward Island. There is also great variation in the land areas of individual provinces and territories. The smallest, Prince Edward Island, has an area of only 5560 km^2 while the largest, the Northwest Territories, covers 3 426 320 km^2, or more than one-third the area of Canada. Because of the size differences, it can be misleading to compare provinces and territories on the basis of exploration expenditures alone.

A more complete measure of exploration intensity can be obtained by looking at exploration expenditures per unit of area. Newfoundland and Labrador, New Brunswick and Ontario recorded the greatest exploration expenditures per hectare of this total area in both 1996 and 1997 (**Figure 11**). Alberta had the lowest spending per hectare for both years, although the staking rush for diamonds resulted in a remarkable 81% increase from 1996 to 1997. Nova Scotia is the other province that experienced a significant increase in the amount spent per hectare.

Figure 11
Canada, Total Exploration Expenditures Per Hectare, by Province and Territory, 1996 and 1997

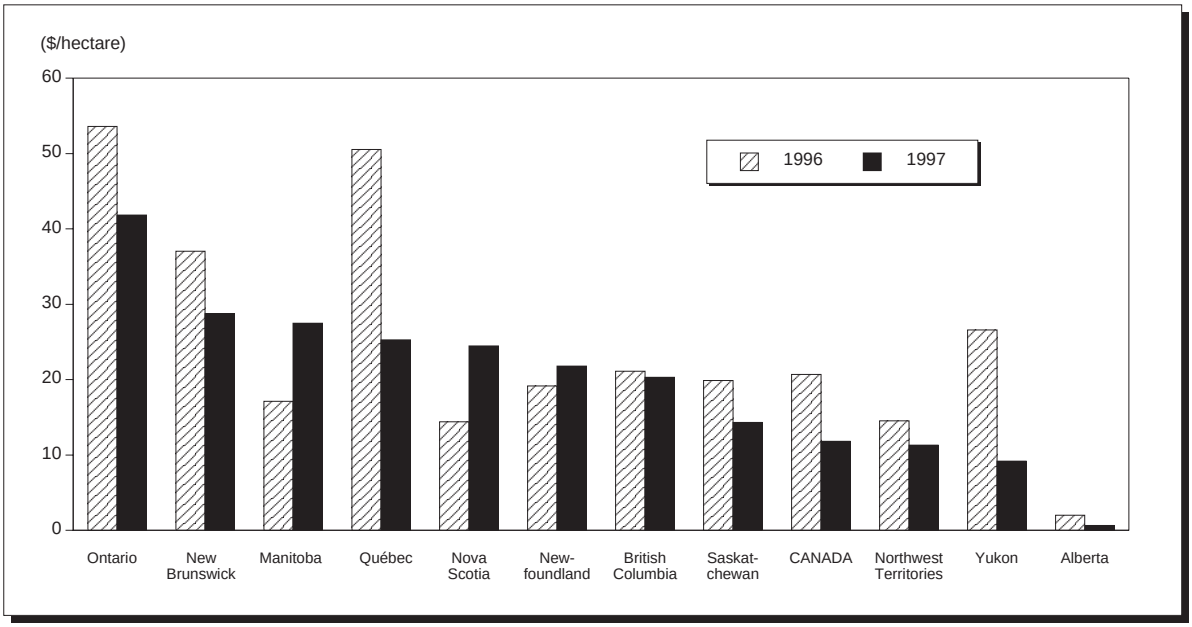


Source: Natural Resources Canada, based on the National Atlas Information Service and the federal-provincial survey of mining and exploration companies.
Note: 1997 exploration expenditures data are preliminary.

Although not all exploration expenditures in any jurisdiction are spent on existing mineral claims (some expenditures are incurred on unclaimed land or on mining leases), general exploration expenditures (off-property) per unit of area of mineral claims in good standing constitute another useful measure of exploration intensity. The data for 1996 (**Figure 12**) show that Ontario, Québec and New Brunswick enjoyed the highest levels of general exploration expenditures per hectare of claims in good standing. For 1997, Ontario remained in first place ahead of New Brunswick and Manitoba. Along with Manitoba, Nova Scotia experienced the most dramatic increase, while Québec, the Yukon, Ontario and New Brunswick all suffered significant decreases compared to 1996. Once again, Alberta was at the lower end of the spectrum, a situation that can be explained by the huge increase in claims in good standing that the province recorded in 1997 and that increasing exploration expenditures could not compensate for.

For Canada as a whole, exploration spending per hectare of claims in good standing decreased substantially from about $21/ha in 1996 to about $12/ha in 1997. This decrease can be attributed to an increase in the area occupied by claims in good standing in Alberta and to a decrease in total exploration expenditures in Canada.

Figure 12
Canada, General Exploration Expenditures Per Hectare of Claims in Good Standing, by Province and Territory, 1996 and 1997



Sources: Federal-provincial survey of mining and exploration companies; provincial/territorial mining recorders offices.
Notes: General, or off-property, exploration excludes mine-site exploration. "Claims in good standing" excludes mining leases. 1997 data are preliminary.

4. Exploration for Diamonds in Canada

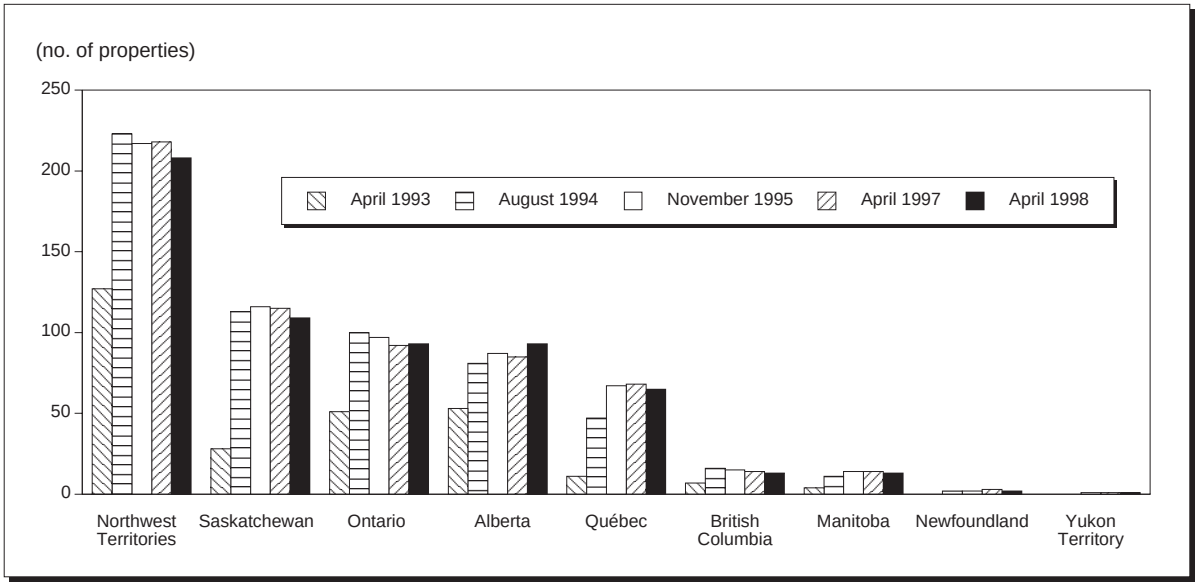
4.1 DIAMOND EXPLORATION HIGHLIGHTS

Diamond exploration activity in Canada continued at a rapid pace in 1997 and 1998. In April 1998, there were some 600 diamond exploration properties in Canada. The provincial/territorial distribution of those properties is depicted in **Figure 13**.

There have been a number of notable diamond exploration/discovery events in Canada since the 1997 edition of this report was prepared (pages 19 and 20 of that report contain a brief summary of the evolution of diamond exploration in Canada).

New discoveries of kimberlite intrusions and of attractive diamondiferous kimberlites continue to be made in the Northwest Territories. In the vicinity of the Ekati diamond mine, six additional diamondiferous kimberlites have been reported with diamond contents that appear to lie within the range of diamond contents being mined at world mines. Three new interesting diamondiferous kimberlites have been discovered by De Beers on the AK property of Mountain Province Mining Inc., near the 5034 deposit. A mini-bulk sample from a diamondiferous dike at Snap Lake, in the Camsell Lake area, has yielded highly encouraging results. At the Diavik project, a mini-bulk sample of the A-11 North kimberlite has yielded diamonds, the largest of which is a 3.01-carat (ct) gem-quality stone.

Figure 13
Provincial/Territorial Distribution of Diamond Exploration Properties in Canada, 1993-98



Source: Natural Resources Canada, based on MIN-MET CANADA database, and used under licence.

Several diamondiferous kimberlites have been discovered in the Buffalo Hills of northwestern Alberta where 23 separate kimberlites had been found by the end of March 1998 and a considerable number of promising geophysical targets remained to be tested. The diamond contents of the most attractive of the Alberta kimberlites appear to be considerably lower than those of the Northwest Territories' deposits, but gem-size, gem-quality diamonds are present. The available grades (based on very small-sized samples) do fall within the range of grades of the world's diamond mines. The potential economic significance of these Alberta discoveries will not be clear until larger bulk samples are taken from them and a sufficient quantity of diamonds is recovered to permit diamond valuation.

Exploration continues in the Fort à la Corne region of Saskatchewan, to the east of Prince Albert, where the first kimberlite discovery was made in 1988. Several companies that are active there have discovered more than 80 kimberlite intrusions. Some of them are exceptionally large and a relatively large proportion, perhaps as many as half of them, are diamondiferous. The best available information indicates that their diamond contents are low, but some of them are close to the diamond contents of the world's lowest-grade diamond mines. Diamond exploration continues in various other parts of Canada, but what is somewhat surprising is that there is so little of this exploration going on in the extensive areas of Saskatchewan, Manitoba, Ontario and Québec that would appear to offer discovery potential that is just as favourable as the Northwest Territories was prior to the initial diamond discoveries there.

In March 1998, Diavik Diamond Mines filed a project description with the Government of Canada for its proposed $875 million Diavik diamond mine at Lac de Gras. In 2002, when the Ekati diamond mine and the Diavik mine are both in full operation, these two mines together are expected to have a combined annual revenue of about $1.3 billion. This will place Canada in fourth or fifth position in the world in terms of annual diamond production value. At the time of writing, at least 29 diamondiferous kimberlite deposits had been announced in Canada at five separate exploration properties that appear, from the information available, to be potential diamond mines. These deposits were all discovered in a time period of less than seven years. Additional diamond mines from already-known diamond deposits and from likely future diamond discoveries in Canada seem almost certain, and Canada can therefore expect to become an even more important diamond producer.

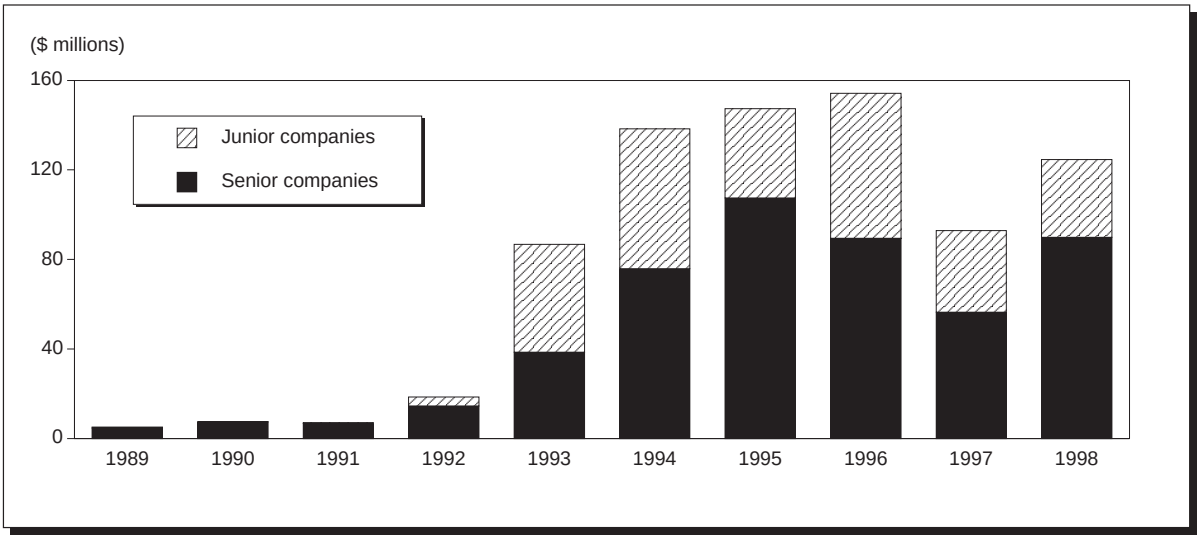
4.2 STATISTICAL SUMMARY

Expenditures dedicated to exploration for diamonds in Canada by senior and junior companies since 1989 are shown in **Figure 14**. The higher diamond exploration expenditures in 1993 and subsequent years reflect not only an increase in the number of companies exploring for diamonds and an increased number of active diamond exploration projects, but also the high cost of underground and large-diameter drill hole bulk sampling of various diamondiferous kimberlite intrusions discovered since 1991 in the Lac de Gras area. To bring a deposit into production is also very costly. For example, BHP Minerals Canada Ltd. has likely spent a total of $900 million to date on the Ekati project from the exploration stage to the pre-production stage.

Over the six-year period 1993-98, a total of $744 million will have been spent on diamond exploration in Canada, representing between 15 and 20% of total exploration expenditures in each of those years. Company spending intentions for diamond exploration in Canada for 1998 are about $125 million, up from $93 million in 1997 (**Figures 14** and **15**), but still lower than the record high of $154 million in 1996.

Exploration expenditures for diamonds were lower in 1997 in part because money spent by BHP Minerals Canada Ltd. was, to a larger extent, directed toward mine development at the Ekati project. In 1998, Diavik Diamond Mines is expected to spend a significant amount on its advanced Diavik project. Also in 1998, the Buffalo Hills and Lethbridge properties in Alberta are being intensely explored by the project operators, Ashton Mining of Canada Inc. and Pure Gold Resources Inc., thus contributing to the expected $22 million to be spent on diamond exploration in that province.

Figure 14
Diamond Exploration Expenditures in Canada by Junior and Senior Project Operators, 1989-98



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Note: 1997 data are preliminary estimates; 1998 data are company spending intentions as compiled in January 1998.

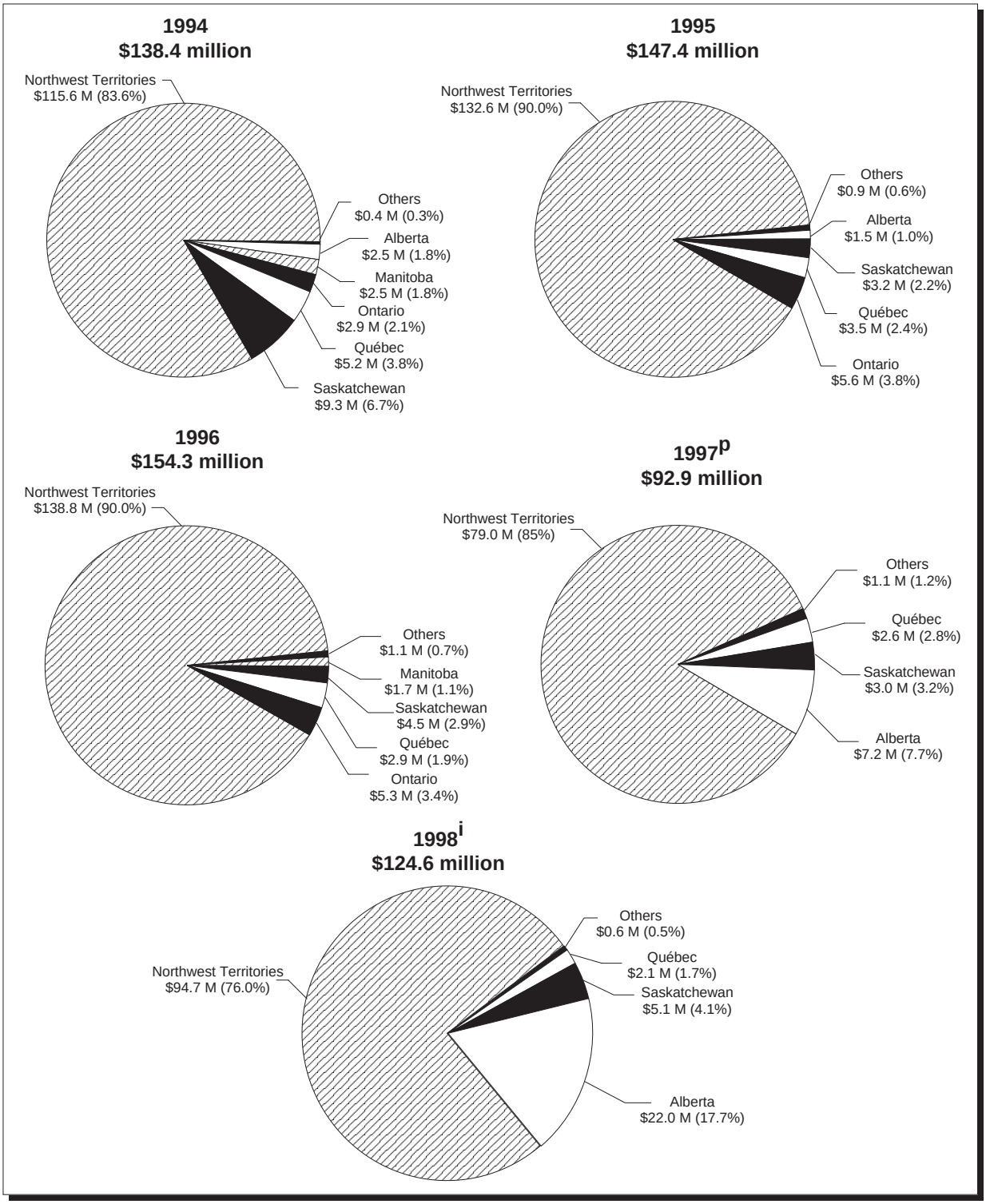
In 1996, 49 companies (39 juniors and 10 seniors) were operators of diamond exploration projects, down from the 61 operators (51 juniors and 10 seniors) reported in 1995 (**Figure 16**). Although the number was lower, project operators spent a total of $154 million in 1996, up slightly from the $147 million spent in the previous year. Junior companies accounted for 42% of total Canadian diamond exploration expenditures in 1996 (up from 24% in 1995).

In 1996, companies spent $139 million on diamond exploration in the Northwest Territories, which amounts to 90% of the total $154 million spent on the search for diamonds in all of Canada during that year. Some $5 million (3%) of this total was spent in each of Ontario and Saskatchewan and $3 million (2%) was spent in Québec. The remaining $2 million was spent in Manitoba, Alberta, British Columbia, and Newfoundland and Labrador.

During 1996, three major project operators, each spending more than $30 million and active principally in the Northwest Territories, contributed about 64% of total diamond exploration expenditures in Canada. Advanced exploration work, managed by BHP Minerals Canada Ltd., took place in the Lac de Gras area of the Northwest Territories. It was decided, in 1997, to commit five pipes to production (Koala, Panda, Fox, Misery and Sable), with Koala expected to start producing diamonds in 1998. Intense work was also performed on the pipes of the Diavik project operated by Diavik Diamond Mines, and production is anticipated for the year 2002. Lytton Minerals Limited also carried out important exploration work on the Jericho project. Most of the diamond exploration expenditures were spent in the Slave geological province.

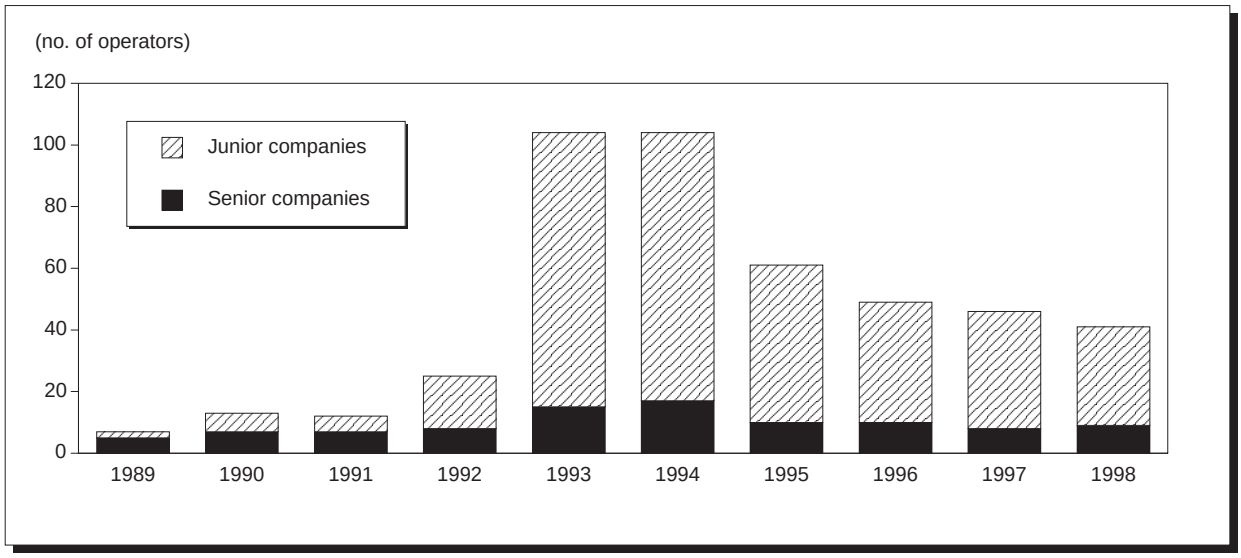
A preliminary estimate of $93 million in exploration expenditures for 1997 and a forecast of $125 million for 1998 show that interest in diamond exploration will continue to be strong in the near future. About 45 companies are project operators in each of those years; on average, 80% are juniors. For 1997, about 60% of the expenditures were reported by senior project operators, an amount comparable to the 58% of expenditures reported in 1996. For 1998, 70% of intended expenditures were reported by senior companies.

Figure 15
Diamond Exploration Expenditures in Canada, by Province and Territory, 1994-98



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
[i] Company spending intentions as compiled in January 1998; [p] Preliminary estimate.
Note: "Others" includes Newfoundland and either British Columbia or Manitoba.

Figure 16
Junior and Senior Project Operators Active in Diamond Exploration in Canada, 1989-98



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Note: 1997 data are preliminary; 1998 data are based on company spending intentions as compiled in January 1998.

4.3 ADVANCED PROJECTS[2]

The five diamond exploration properties described below are all in the Northwest Territories. These properties account for a good proportion of the advanced exploration work that has been performed in recent years in the search for diamonds in Canada.

4.3.1 Ekati Diamond Mine

BHP and its associates are developing the Ekati diamond mine for production to begin in the fall of 1998. A total of 100 kimberlite intrusions have now been found on this property, including 23 that were discovered in 1997. The most interesting of the 1996 discoveries are the comparatively small Koala North and Beartooth kimberlites. Diamond contents and values for these kimberlites are listed in **Table 8**. Of the twenty-three 1997 kimberlite discoveries, the 97-A, 97-B, 97-C and 97-D kimberlites are the most promising. The grades for these four kimberlites, with recovered diamond contents that range from 1.12 carats per tonne (ct/t) to 5.52 ct/t, are based on core samples that vary from only 57 kg to 668 kg in weight. Larger mini-bulk or bulk samples will be required to provide meaningful grades. Exploration continues on this large property, and the potential for the discovery of additional diamond orebodies remains excellent. Current mining plans, based on production from the Panda, Misery, Koala, Fox and Sable deposits (**Table 9**), should support an initial mine life of some 17 years. An operation with a life of at least 25 years, and probably longer, seems probable based on the other orebodies that have already been discovered.

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2 The information provided in this section was current as of June 1998. The reader is cautioned that reported grades may be based on samples that are not necessarily representative of the entire deposit.

TABLE 8. SELECTED DATA ON CANADA'S MOST PROMISING DIAMOND DEPOSITS

Pipe	Total Tonnes Sampled	Total Carats Recovered	Average Grade	Average Value	Average Value
			(carats/tonne)	(US$/carat)	(US$/tonne)
BHP/BLACKWATER GROUP[1]/ LAC DE GRAS PROPERTIES					
Panda	3 402	3 244	0.95	130	124
Misery	1 030	4 313	4.19	26	109
Koala	1 550	1 465	0.95	122	116
Koala North	201.7	126.58	0.63	200	126
Fox	8 223	2 199	0.27	125	34
Leslie[2]	680	233	0.33	89	29
Pigeon[2]	154	60	0.39	51	20
Jay[2]	237.6	476.8	2.01	..	..
Sable	1 096	1 070	0.98	64[a]	63
Beartooth	189.3	227.09	1.20	79	95
Point Lake	160	90+	0.56	..	..
97-A	0.0669	0.261	3.90	..	..
97-B	0.4070	0.662	1.63	..	..
97-C	0.0572	0.316	5.52	..	..
97-D	0.232	0.260	1.12	..	..
DIAVIK PROPERTY					
A-154 South	2 900	12 800	4.41	67	296
A-154 North	71.72	156.81	2.19	35	77
A-418	3 000	8 275	2.76	56	166
A-21	30.5	90	2.95	38	112
A-11 North	29[b]	7.6	0.26	..	..
JERICHO PROPERTY					
JD/OD-1	9 400[c]	10 539	1.12	60	67
JD/OD-3	10.53	7.34	0.697	..	..
AK PROPERTY					
5034 (1st sample)[d]	104	257	2.48	55	136
5034 (2nd sample)[e]	55.8	101	1.81	..	..
Hearne	62.6	205	3.28	..	..
Tesla	60	25.9	0.43	..	..
Tuzo	48	108	2.24	..	..
CAMSELL LAKE					
Snap Lake Dyke	199.7	226.7	1.14	301	344
BUFFALO HILLS PROPERTY					
K-6	13.95	0.876[f]	0.06	..	..
K-14	27.42	4.86[g]	0.18	..	..
K-91	0.85	0.301	0.35	..	..

Source: Natural Resources Canada, from company reports.
.. Not available.
a The $64/ct value includes a gem-quality diamond weighing 9 ct. If this stone is excluded, the average value is $48/ct and the average value per tonne is $47. **b** Includes a 3.01-ct gem diamond. **c** A 15 000-t bulk sample was mined, but only 9400 t of it was processed.
d Eighteen stones weighing more than 1 ct, including gem-quality stones weighing 10.87, 8.43 and 6.03 ct. **e** Diamond content of the second sample taken by Monopros Limited (De Beers Consolidated Mines) does not include diamonds that passed through a 1-mm^2 screen. **f** Probably not a representative sample. Includes a clear yellow diamond weighing 0.76 ct.
g Includes a 0.6-ct diamond and more than five other diamonds larger than 0.18 ct.
1 The Blackwater Group's 49% interest in this project can be broken down as follows: Dia Met Minerals Ltd., 29%; C. Fipke, 10%; and S. Blusson, 10%. **2** The Leslie, Pigeon and Jay deposits are not currently scheduled for mining.

TABLE 9. PRE-PRODUCTION MINING RESERVES FOR THE EKATI DIAMOND MINE

Reserves Classification	Panda Pit	Misery Pit	Koala Pit	Fox Pit	Sable Pit	Panda UG	Koala UG	Total
Proven (Mt)	8.6	4.8	10.0	8.1	11.0	–	1.0	43.5
Probable (Mt)	4.0	0.7	4.6	8.6	1.9	0.8	1.8	22.4
Total (Mt)	12.6	5.5	14.6	16.7	12.9	0.8	2.8	65.9
Grade (ct/t) (diluted basis)	1.09	4.26	0.76	0.40	0.93	0.97	1.63	1.09
Average value (US$/ct)	130	26	122	125	64	130	122	84

Source: Dia Met Minerals Ltd. Annual Report 1996-1997.
– Nil; UG Underground.

4.3.2 Diavik Project

The Diavik project is operated by Diavik Diamond Mines Inc., which has a 60% interest in the project. The company is a wholly owned subsidiary of the large multinational mining company Rio Tinto Zinc PLC of London, England, as is Kennecott Canada Inc., which previously held Rio Tinto's 60% interest in the property. The remaining 40% of the project is owned by Aber Resources Limited of Vancouver, British Columbia. Aber has put up 40% of the costs and retains the right to market its 40% share of diamond production.

To the end of 1997, a total of 50 kimberlite pipes had been discovered on the Diavik property, of which 20 are known to contain diamonds. Four pipes, A-154 South, A-154 North, A-418 and A-21, currently appear to be the most promising. In March 1998, Diavik Diamond Mines filed the project description for the Diavik mine with the federal government, thus commencing the government's environmental assessment process for this proposed $875 million (± 25%) project. Diavik is located 300 km northeast of Yellowknife and 35 km southeast of the BHP Ekati diamond mining operation. The company hopes to receive the necessary approvals by the fall of 1999 and to begin construction soon thereafter, with production planned for 2002. This schedule is to be refined during the feasibility study that is now in progress. Annual ore production of 2 Mt is planned (prefeasibility study), with a conventional diamond recovery plant using heavy medium separation, followed by X-ray diamond recovery. The mine's annual diamond production will increase to the range of 6 million to 8 million ct, declining to 3 million to 4 million ct beyond year 15. The life of the operation is currently expected to be between 16 and 22 years. Mining and production figures and timetables are subject to revision upon completion of the feasibility study, which is expected in the fourth quarter of 1998. When production is achieved, direct employment for the project will be between 300 and 400.

The resources at Diavik comprise an estimated 123 million ct of diamonds, of which 104 million ct, or 83% of the total resource, have been included in the current estimated mineable reserve. The kimberlite pipes at Diavik are under shallow water adjacent to a 20-km^2 island in Lac de Gras. Temporary dikes will be required to isolate the pipes from the lake for mining. While exact sequencing of the dike construction is not yet final, the prefeasibility mining plan contemplates the initial construction of a dike around the A-418 pipe and then, using the granite waste that will be produced from the mining of this orebody, another dike will be constructed around the A-154 South and A-154 North pipes.

A 29-t mini-bulk sample taken in 1998 on the recently discovered A-11 North kimberlite yielded 7.6 ct of diamonds (0.26 ct/t), including a 3.01-ct gem-quality diamond.

Exploration of the Diavik property continues. In 1998, up to $9 million will be spent, including up to $4.3 million for drilling on previously identified pipes other than the four main pipes.

4.3.3 Jericho Project

Lytton Minerals Limited and its various partner companies have discovered at least seven diamond-bearing kimberlites on their properties in the Northwest Territories. On the Jericho property of Lytton and New Indigo Resources Inc., a 14 500-t bulk sample was extracted during the winter of 1996/97 from underground workings in the JD/OD-1 kimberlite and hauled 30 km by truck to Lytton's bulk sampling plant located at the Lupin gold mine. A representative 9400-t sample of this material, covering all phases within the pipe, was processed to yield 10 539 ct of diamonds (1.12 ct/t) with an average value of US$60/ct. The remaining 5100 t were not processed because of the predictability of the diamond grades that were obtained from the 9400 t that were processed. The largest diamond recovered weighed just over 40 ct; the largest gem-quality diamond weighed 23.99 ct. An unusual number of larger diamonds were recovered. The JD/OD-1 pipe has a surface area of 1.2 ha. Resources to a depth of 300 m are presented in **Table 10**.

TABLE 10. RESOURCES OF THE JD/OD-1 PIPE, JERICHO PROJECT

Resource Classification	Tonnage	Grade
	(Mt)	(ct/t)
Indicated	5.0	0.93
Inferred	1.1	1.0
Total	6.1	0.94

Source: Based on published corporate data.

An open pit to a depth of 180 m would recover a mineable resource of 3.8 Mt averaging 1.01 ct/t with a stripping ratio of 4.2:1. Preliminary scoping studies, based on mining the higher-grade phases first, suggest that the mining rate should be about 1650 tonnes/day (t/d) at a capital cost of approximately $50 million.

The 1.8-ha JD/OD-3 kimberlite, which is located under a small lake some 7 km west of JD/OD-1, has resources of 10.5 Mt, to a depth of 350 m, averaging 0.7 ct/t. This estimate is based on the 7.34 ct of diamonds recovered from a 10.53-t large-diameter core sample (0.697 ct/t). A 30-t mini-bulk sample that was taken in early 1998 is to be treated at Lytton's plant located in North Vancouver, British Columbia. A bulk sampling program, along with further delineation drilling, is planned for the JD/OD-3 pipe in early 1999. Exploration continues for additional kimberlites on the property, with many targets still to be tested by drilling in 1998.

4.3.4 AK Property

On the AK property, located 150 km southeast of Lac de Gras, Mountain Province Mining Inc. (90%) and its partner Camphor Ventures Inc. (10%) have the AK-5034 kimberlite pipe that was discovered in 1995. Drilling has indicated some 20 Mt of diamondiferous kimberlite to a depth of 350 m. A 104-t mini-bulk sample of this kimberlite, which was taken with a large-diameter drill, yielded 2.48 ct/t of diamonds. De Beers has valued the diamonds that are 7 points (0.07 ct) or larger in size from this mini-bulk sample, which yielded a grade of 1.5 ct/t valued at US$55/ct, or US$82.50/t.

The Canadian subsidiary of De Beers, Monopros Limited, has entered into a joint exploration venture with the two partners and can earn a 60% interest in the AK/CJ property by funding exploration, undertaking a bulk sampling program on one or more kimberlites, completing a feasibility study, and funding the development of a mine.

A second mini-bulk sample of the AK-5034 pipe was recently taken and processed by Monopros Limited. It yielded 101 ct of diamonds, for a grade of 1.81 ct/t. The largest diamonds recovered weighed 1.90 and 1.69 ct. Direct comparison of these results with those from the earlier 104-t mini-bulk sample (completed in 1996) is not possible because there was no bottom cut-off in the earlier results (all the diamonds recovered, large and small, were weighed), whereas Monopros recovered only those diamonds that were sufficiently large to be caught on a 1-mm^2 mesh screen. Also, the previous sample was of drill core, which contrasts with the reverse circulation drill sample gathered by Monopros.

In 1997, De Beers discovered an additional three diamondiferous kimberlite pipes on the property. The Telsa, Hearne and Tuzo pipes are all within 1.1 km of the AK-5034 kimberlite and are under a lake, but close to shore. Mini-bulk samples taken from each of these pipes during the winter of 1997/98 have all yielded attractive diamond grades (**Table 8**). Monopros anticipates that additional ore tonnages that might result from these three new discoveries could significantly improve the economics of production from the property.

4.3.5 Camsell Lake Area

On a peninsula in the northwestern part of Snap Lake, Winspear Resources Ltd. (57.3%) and Aber Resources Ltd. (42.7%) have discovered a kimberlite dike that was intersected by drilling over a strike length of 1000 m and 500 m down dip. The dike has a true thickness that averages 2.47 m and dips at 12-15˚. Two holes drilled in 1998 intersected kimberlite material down dip, another 1100 m further to the east.

A 199.7-t mini-bulk sample from the dike, collected from two surface pits located 235 m apart, has yielded 226.7 ct of cleaned diamonds (1.14 ct/t) using a slotted screen measuring 1 x 0.9 mm in processing, which is equivalent to a 1.2-mm^2 mesh cut-off. The three largest stones recovered weigh 10.87, 8.43 and 6.03 ct, and are described as gem-quality. Eighteen of the diamonds weigh more than 1 ct. The average value of the diamonds recovered was US$301.43/ct, or US$343.63/t. With three large gem-quality diamonds included in this bulk sample, it is clear that a significantly larger bulk sample will be required to obtain more representative values for this deposit.

Drill hole data are limited, and a considerable amount of definition drilling will be required to determine the size and average grade of the deposit, which is located 110 km south of the original BHP/Dia Met Point Lake discovery at Lac de Gras and roughly 60 km west of the AK property of Mountain Province Mining Inc., Camphor Ventures Inc. and Monopros Limited.

4.4 OTHER DIAMOND EXPLORATION PROJECTS

In addition to the five properties described in detail above, there are roughly 600 other diamond properties in Canada. Of these 600 properties, the following currently appear to be the most interesting (based on public information).

4.4.1 Buffalo Hills, Alberta

Ashton Mining of Canada Inc. (42.5%) is the operator of a diamond exploration project in the Buffalo Hills of northwestern Alberta. The other partners are Alberta Energy Company (42.5%) and Pure Gold Resources Inc. (15%). Since early 1997, a total of 23 kimberlite intrusions have been discovered on this property, several of them diamondiferous. The best results obtained to date are those for the K-6, K-14 and K-91 kimberlites (**Table 8**). Although the

average diamond contents for these kimberlites are considerably lower than those for the 18 most interesting deposits currently known in the Northwest Territories, they are within the grade range of the world's diamond mines. The determination of diamond values for such small samples would not be meaningful. A bulk sample in excess of 500 t is to be taken from the K-14 complex. Between 70 and 80 additional drilling targets are currently recognized on the Buffalo Hills property where exploration is still in its early stages.

4.4.2 ICE Claims LI-201 Kimberlite

Kennecott Canada Inc. has the right to earn a 50% interest in certain claims jointly owned by Lytton Minerals Limited and New Indigo Resources Inc. This agreement excludes the Jericho property. Kennecott has discovered the LI-201 diamondiferous kimberlite (which is entirely land-based) on the ICE claims. A 281.1-kg sample from this kimberlite has returned 60 diamonds that each weigh more than 0.15 ct.

4.4.3 Fort à la Corne, Saskatchewan

The first kimberlite discovery at Fort à la Corne (65 km east of Prince Albert) was made in 1988. Several companies have been exploring the region since that time and approximately 90 to 100 kimberlites have now been discovered; some of them are exceptionally large in size, with the largest being 1.6 km in diameter.

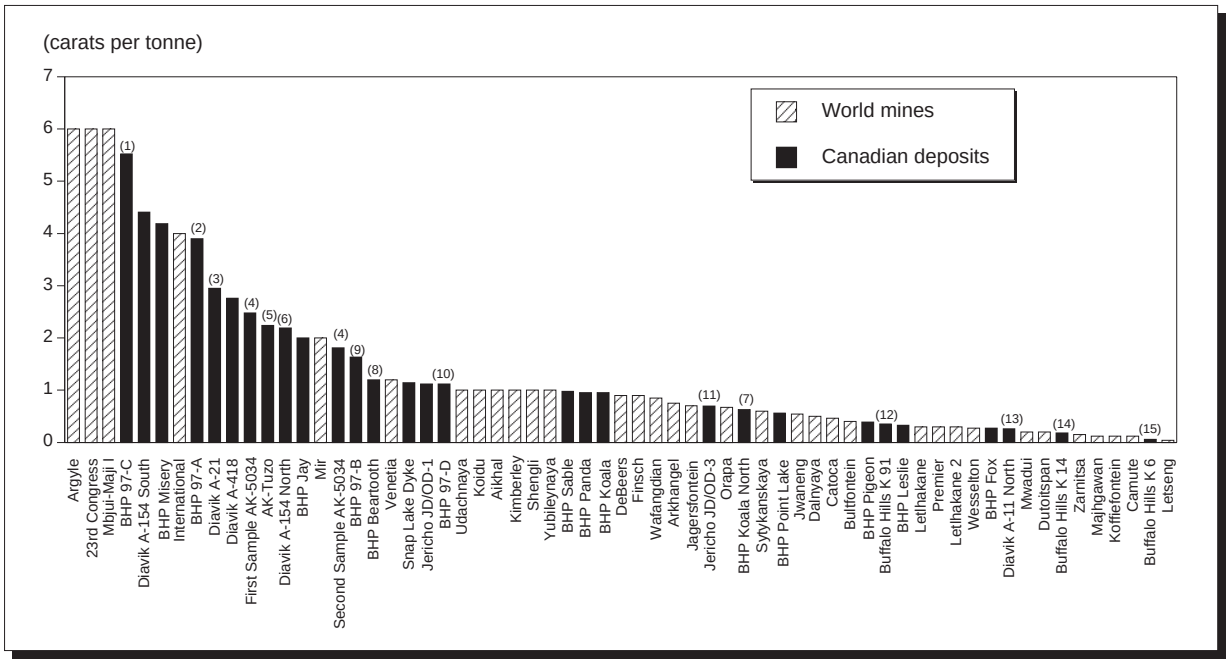
A diamond exploration joint venture between Cameco Corporation (30%), Monopros Limited, a subsidiary of De Beers (30%), Kensington Resources Limited (30%) and Uranerz Exploration and Mining Limited (10% carried interest) includes 71 of these kimberlites, roughly half of which are diamondiferous. The highest reported diamond contents are lower than those for most of the kimberlites in the Northwest Territories and lower than those for all but one of the three best diamondiferous kimberlites discovered to date in Alberta. The diamond contents for the Fort à la Corne kimberlites that are available to the writer are equivocal and so are not quoted here.

4.5 COMPARISON OF DIAMOND GRADES AND VALUES OF CANADIAN DIAMOND DEPOSITS WITH WORLD MINES

Recoverable diamond grades for the 25 Canadian diamond-bearing kimberlites for which unequivocal recoverable diamond content is publicly available appear to fall toward the higher-grade range of world diamond mines (**Figure 17**). On the other hand, most, if not all, of the currently known Canadian diamond deposits are on the small side relative to the orebodies of the world's largest diamond mines. Recoverable diamond values for currently known Canadian diamond deposits also appear to fall towards the higher value range for world diamond mines (**Figure 18**).

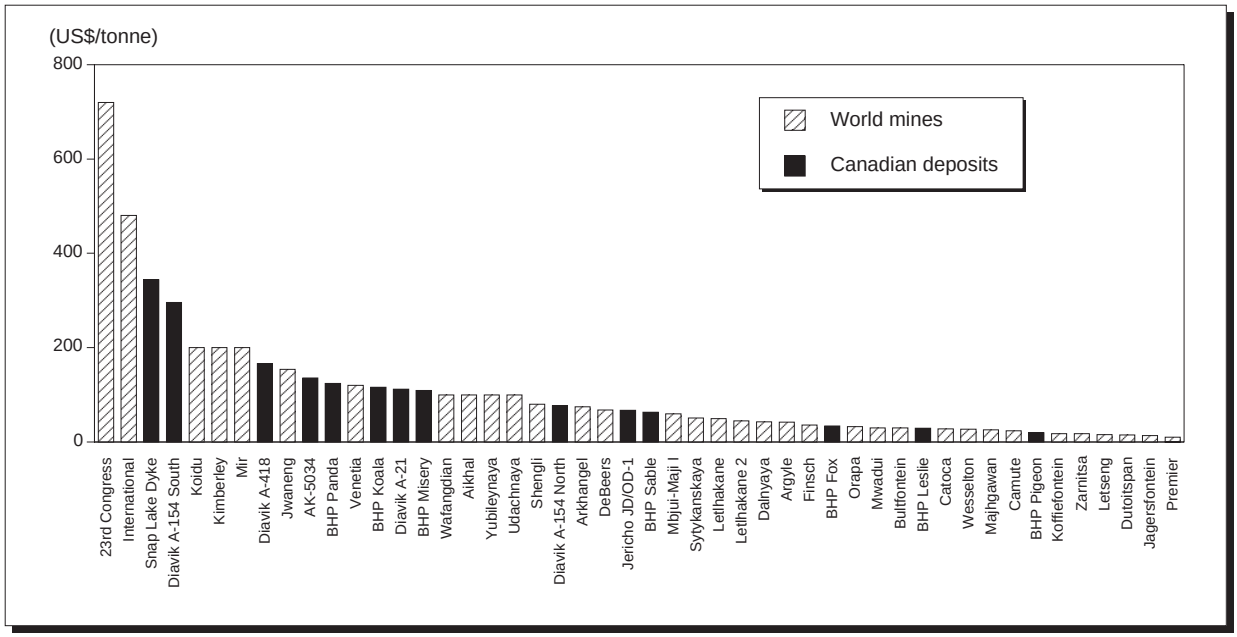
However, it is important to recognize that the sample sizes used for determination of diamond contents are small, especially in the case of the four deposits for which the sample size is less than 1 t (BHP 97-C, BHP 97-A, BHP 97-B and BHP 97-D - refer to **Figure 19**); consequently, the actual recoverable diamond contents and values for some deposits are likely to turn out to be considerably different once more appropriately sized bulk samples are taken.

Figure 17
Recoverable Diamond Grades From World Diamond Mines and Canadian Diamond Deposits



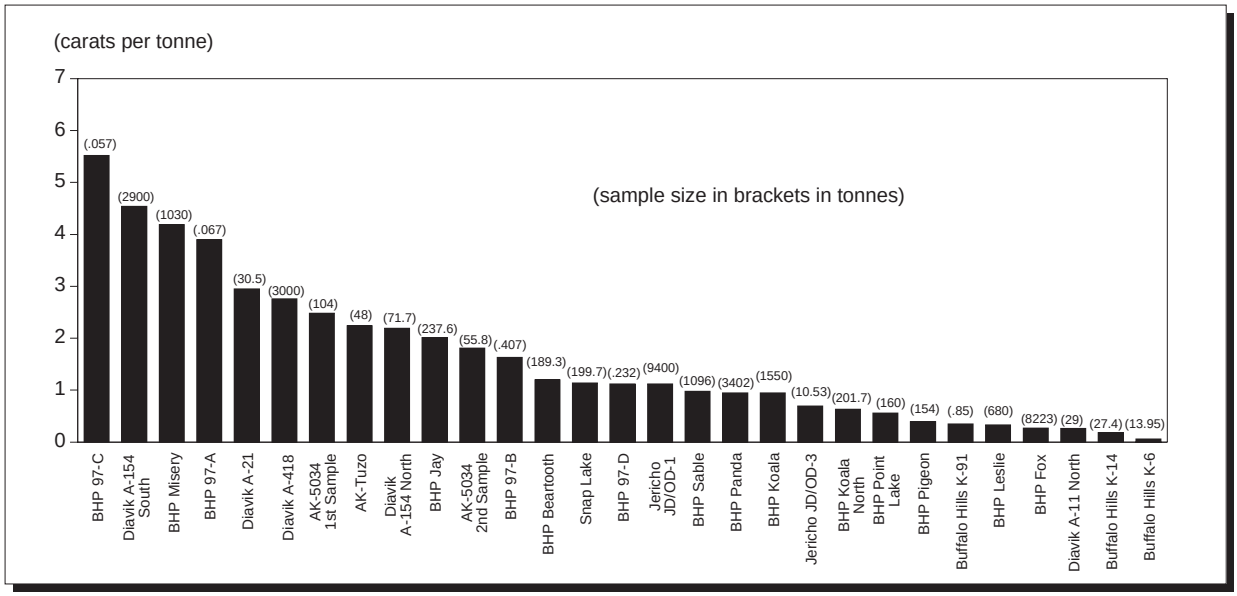
Source: Natural Resources Canada, based on published data.
(1) BHP 97-C based on a sample of only 0.057 t of drill core. (2) BHP 97-A based on a sample of only 0.067 t of drill core. (3) Diavik A-21 grade based on a sample of only 30.5 t of drill core. (4) Two samples have been processed from the AK-5034 deposit and cannot be combined because a 1-mm^2 screen was used to remove small diamonds from the second sample weighing 55.8 t. The first sample weighed 104 t. (5) AK-Tuzo based on a sample of only 48 t of drill core. (6) Diavik A-154 North grade based on a sample of only 71.7 t of drill core. (7) BHP Koala North based on a sample of only 201.7 t of drill core. (8) BHP Beartooth based on a sample of only 189.3 t of drill core. (9) BHP 97-B based on a sample of only 0.407 t of drill core. (10) BHP 97-D based on a sample of only 0.232 t of drill core. (11) Jericho JD/OD-3 based on a sample of only 10.53 t of drill core. (12) Buffalo Hills K-91 based on a sample of only 0.85 t of drill core. (13) Diavik A-11 North based on 29 t of drill core. (14) Buffalo Hills K-14 based on a sample of only 27.42 t of drill core. (15) Buffalo Hills K-6 based on a sample of only 13.95 t of drill core.

Figure 18
Recoverable Diamond Values for World Diamond Mines and Canadian Diamond Deposits



Source: Natural Resources Canada, based on published data.

Figure 19
Grades of Selected Canadian Diamond Deposits



Source: Natural Resources Canada, based on published data.

5. Regional Outlook

5.1 INTRODUCTION

This section presents comments from provincial and territorial officials on recent exploration activity in their respective jurisdictions and gives an indication of what they expect for 1998. Some of the exploration expenditure data mentioned by the different provincial and territorial authorities may differ from those reported under Sections 1 and 6 of this report (official federal-provincial/territorial figures released by NRCan). The figures reported by Québec include expenditures by the Québec Department of Natural Resources that are excluded from all NRCan published totals and the junior/senior analysis is based on different criteria. The exploration survey for Saskatchewan is not based on the same set of definitions as was used for the national survey.

5.2 NEWFOUNDLAND AND LABRADOR

Overview

Expenditures on mineral exploration in Newfoundland and Labrador in 1997 were $69 million, a decrease of approximately 26% from the all-time high levels established in 1996 (**Table 11**). All of the major exploration indicators reflect this decrease.

In 1997, approximately 90% of the mineral exploration dollars were directed towards base-metal exploration, with the remainder being spent on precious-metal exploration; 81% of the 1997 expenditures were in Labrador. In 1997, the senior Canadian and international mining companies led the way in exploration efforts, with the junior sector and prospectors following a close second, indicating a possible return to the pre-Voisey's Bay exploration days. It is anticipated that this trend will continue in 1998.

TABLE 11. NEWFOUNDLAND AND LABRADOR EXPLORATION STATISTICS, 1989-98

	1989	1990	1991	1992	1993	1994	1995	1996	1997p	1998f
						(dollars)				
Annual exploration expenditures	36 200 009	23 274 537	12 064 993	11 140 752	8 905 864	12 396 462	71 100 000	92 546 708	68 985 000	45 989 000
Field exploration expenditures										
Base metals	8 141 579	8 065 645	7 022 790	5 948 578	3 719 325	5 216 623	64 226 300	83 737 940	61 420 000	. .
Precious metals	16 420 301	9 195 651	1 876 256	1 285 629	1 867 878	3 613 526	5 371 500	6 395 873	5 228 072	. .
Other	1 364 328	1 520 051	550 502	1 192 898	1 192 898	884 000	1 241 000	2 412 895	2 336 828	. .
						(number)				
Claim staking										
Claims staked	17 571	10 421	7 411	5 118	6 955	22 256	248 707	15 299	13 363	11 000
In good standing	65 223	45 427	33 297	24 002	22 910	37 084	280 750	168 815	126 766	100 000
						(metres)				
Diamond drilling[1]										
Production/development	16 355	8 884	6 850	819	16 982	7 260	8 107	9 424	13 318	. .
Exploration	104 493	82 833	39 067	21 923	29 528	42 225	120 803	226 208	141 320	. .
Total diamond drilling	120 848	91 717	45 917	22 742	46 510	49 485	128 910	235 632	154 638	150 000

Source: Newfoundland Department of Mines and Energy.
. . Not available; f Forecast; p Preliminary.
1 Based on a special provincial diamond drilling survey.

Claim-staking in 1997 came in at less than 1996 levels, but maintained a more typical level of 13 363 claims after the 1995 staking rush sparked by the Voisey's Bay discovery. At the end of 1997, there were 126 766 claims in good standing in Newfoundland and Labrador.

Diamond drilling reflected a healthy exploration year. The 154 638 metres of diamond drilling for 1997 is still above the pre-Voisey's Bay trends.

New Mines

Richmont Mines Inc. began commercial production at its Nugget Pond gold deposit on April 1, 1997, after a very successful construction and site development phase. Approximately 34 800 oz of gold were produced in 1997. The mine is expected to increase production during 1998 to 48 000 oz. The project has an estimated life of four years.

Roycefield Resources Ltd., which acquired full ownership of the Beaver Brook antimony deposit from Noranda Mining and Exploration Inc. in 1994, began underground mining in July 1997, and milling commenced in December. Also in December, the company began testing a process to convert antimony sulphide into the higher-priced antimony trioxide. The mine has reserves of 2 388 078 t grading 4.08% antimony (using a 1.5% cut-off) in its East zone and 159 699 t grading 5.28% antimony (using a 1.5% cut-off) in its Central zone. A downturn in market prices for this product, however, dictated that the company suspend production in early 1998.

In 1997, Dimension Stone Inc. began exporting granite blocks from its quarry near Goobies, and extracted test blocks from its site near Terrenceville. The company is also evaluating sites near Gambo and Lewisporte.

International Granite Corporation and Ebony Granite Limited, associate companies, quarry black gabbro in the Mount Peyton area of central Newfoundland. The companies began exporting blocks of stone from their Jumpers Brook quarry in 1996 to supply North Atlantic Stone, a dimension stone manufacturing plant in Buchans. In January 1998, Cabot Granite Fabricators Inc., a subsidiary of International Granite, finished constructing its slab and polishing facility at the Jumpers Brook quarry. Initial shipments of products have been made and commissioning of the plant is ongoing.

Phoenix Minerals Corp. began producing barite from its operations at Collier Point, Trinity Bay, in April 1998. The barite is mined using open-pit methods and is being trucked to Halifax where it is processed and sold as a drilling mud to the offshore oil industry in eastern Canada. Processing is expected to begin on site in August of this year. Forecasts by the company are that production in 1998 will be valued at $4.5 million.

Development Stage Projects

Voisey's Bay Nickel Company Limited continues exploration at Voisey's Bay, with about $20 million to be expended in 1998. Drilling to date indicates that the Ovoid deposit contains 31.7 Mt grading 2.83% nickel, 1.68% copper and 0.12% cobalt. The Eastern Deeps deposit contains 52.5 Mt grading about 1.36% nickel, 0.67% copper and 0.09% cobalt. The Western Extension and the Southeast Extension add approximately 32 Mt to the reserves.

Burin Minerals has completed an engineering review of the fluorspar mines and mill at St. Lawrence and has completed the first stage of private financing. A feasibility study of a deep-water port at St. Lawrence concluded that the outer harbour is an ideal site capable of handling 40 000-t ships. The proposed production level of the operation at St. Lawrence will be approximately 180 000 t/y, and customers have signed a letter of intent covering 90% of this production for the first two years. On July 24, 1998, the Government of Newfoundland and Labrador announced that it would invest $10 million in wharf- and port-related facilities at St. Lawrence pending the results of a $2 million project feasibility study to be completed by Burin Minerals Ltd. The feasibility study includes the completion of a 28 000-m diamond drilling program in 1998 to further upgrade existing fluorspar reserves at the Blue Beach North and Tarefare No. 2 deposits.

United Bolero Development Corporation plans to reactivate the Buchans barite plant, which operated in the 1980s, to produce barite for offshore drilling. The two tailings ponds at Buchans contain approximately 1.5 Mt of recoverable material with an average grade of about 30% barite.

Torngait Ujanniavingit Corporation (TUC), a subsidiary of the Labrador Inuit Development Corporation, quarries anorthosite at Ten Mile Bay near Nain, Labrador. In 1997, the company increased shipments to 1000 m^3, a significant increase from 1996. The company plans to develop a second quarry in the Tabor Island area and to start construction of a stone plant in Hopedale in early 1998.

Midatlantic Minerals Inc. proposes to start a dolomite and limestone operation at Aguathuna on the Port au Port Peninsula. The company plans to develop an open-pit quarry and produce various sizes of limestone/dolomite for export.

10324 Newfoundland Limited has submitted a proposal to mine the 100 000-t Ronan barite-celestite deposit. This project is currently under environmental review and has an anticipated start date of September 1998. Processing of the barite, to be used in the offshore oil industry in eastern Canada, will occur in nearby Aguathuna.

Shabogamo Mining & Exploration Limited is currently assessing the silica deposits in the Labrador City area. After a diamond drilling program was completed in early 1997, the company entered into an agreement with SKW of Bécancour, Québec. The company is in the process of obtaining a mining lease and completing environmental studies in preparation for the start-up of mining operations.

Exploration

In October 1997, Donner Resources Limited (now Donner Minerals Limited) announced the results of diamond drill hole 97-75 from its property located 90 km south of Voisey's Bay. It contained a 1.1-m interval grading 11.75% nickel, 9.70% copper and 0.43% cobalt. Later in the year, the results of a second hole (97-96) were announced as a 15.7-m intersection indicating 1.13% nickel, 0.78% copper and 0.20% cobalt. Donner has a joint-venture partnership with Teck Corporation and Northern Abitibi Mining Corp., among others, on a large area of mineral licences known collectively as Voisey's Bay South. Drilling was suspended over the winter and resumed in May. The 1998 exploration program for this project has a budget of $14.8 million.

On July 23, 1998, Major General Resources Ltd. and McWatters Mining Inc. signed a letter of intent to allow development and production of the Hammerdown and Rumbullion gold deposits located in central Newfoundland. Resource estimates by company geologists have outlined a drill-indicated resource of approximately 356 000 oz of gold in 614 000 t grading 18.01 g/t gold at a cut-off grade of 5 g/t gold. Mineable reserves will be calculated during a feasibility study to be completed by McWatters. In addition, Major General Resources Ltd. also optioned to Rio Algom Exploration Inc. about 600 claims around the Hammerdown deposits. These claims will be explored for base metals.

In late 1997, Celtic Minerals Limited announced grades of 3.06% zinc, 0.61 g/t gold and 0.81 g/t silver over a 10.84-m intersection on its Hungry Hill property. The intersection represents a massive sulphide interval with local sections of altered volcanic clasts described as debris flow breccias. On August 6, 1998, Celtic Minerals Limited announced the signing of a letter of intent with Rio Algom Exploration Inc. whereby Rio can earn a 51% interest over a four-year period by making $350 000 in cash payments and incurring $4 million in exploration expenditures.

Noveder Inc. has outlined an electromagnetic conductive zone on the Cabot property located north of Baie Verte. The zone extends to either side of a copper-cobalt showing discovered by PNL Ventures in 1997 for a distance of 600 m. Surface samples have returned values ranging from 1.13% to 6.80% copper. A diamond drilling program has been completed.

Buchans River Limited has a 100% interest in 758 claims around the former high-grade Buchans zinc-lead-copper mine in central Newfoundland. A geological compilation of the entire Buchans camp is ongoing. Diamond drilling is planned for the latter part of 1998.

Vulcan Minerals Inc. completed a seismic survey near Flat Bay in western Newfoundland prior to a summer drilling program for petroleum. This company also holds mineral rights to both base- and precious-metal targets throughout the province. Exploration programs are planned on these properties during 1998.

Government Incentives

A total of $100 000 has been allotted by the Government of Newfoundland and Labrador for the 1998/99 fiscal year to provide grants and training for resident prospectors.

The *Mineral Act* and the *Quarry Materials Act* will be amended in 1998 and, when proclaimed, the amendments will result in dimension stone being defined as a mineral with land tenure administrated under the *Mineral Act*.

5.3 NOVA SCOTIA

Overview

In 1997, exploration expenditures in Nova Scotia were estimated at $8.9 million, up from $6.9 million in 1996 and $2.8 million in 1995 (**Table 12**). Exploration levels in 1997 were the highest since 1990 (at the end of the gold exploration boom in the 1980s that was fueled by flow-through share financing). Exploration highlights in 1997 included exploration for gold, base metals and industrial minerals such as gypsum, kaolin and silica sand. Current forecasts predict a continuation in the trend of increasing exploration for 1998 with projected expenditures of $9.1 million.

Exploration drilling increased in 1997 with a preliminary estimate of 21 800 m drilled, compared with 15 600 m in 1996. A preliminary estimate of 22 691 new and re-issued claims for 1997 represents a decrease from the 1996 level of 34 265 claims.

TABLE 12. NOVA SCOTIA MINERAL EXPLORATION STATISTICS, 1991-98

	1991	1992	1993	1994	1995	1996	1997[p]	1998[f]
Exploration expenditures (field + overhead, general + mine-site) ($)	4 532 000	3 258 000	1 797 000	1 714 000	2 843 000	6 892 000	8 950 000	9 065 000
Claim staking (new and reissued) (general + special licences) (no. of claims)	18 777	12 229	10 759	14 614	16 407	34 265	22 691	18 000
Exploration diamond drilling (metres)	11 504	12 710	6 221	7 725	8 000	15 600	21 800	. .

Source: Nova Scotia Department of Natural Resources.
. . Not available; [f] Forecast; [p] Preliminary.

New Mines

Tusket Mining Limited and partner Knauf have delineated a gypsum resource exceeding 300 Mt at their Murchyville deposit in the Musquodoboit Valley of central Nova Scotia. The companies have received all necessary permits and approvals, completed preliminary site preparation, and plan to commence shipments of gypsum in 1998. Work is still required at the load-out shipping facility in Sheet Harbour.

Lynx Minerals Corp. has acquired the mineral rights and purchased the surface rights for the Lake Ainslie barite-fluorite deposit (1.7 Mt $BaSO_4$, 0.86 Mt CaF_2) from Conwest Exploration Company Ltd. and has acquired the mineral rights for the Scotsville barite deposit. Lynx will evaluate the viability of the deposits for various uses including mud-grade barite for the offshore oil and gas industry, fluorite by-products, calcium carbonate, and pharmaceutical-grade barite.

Prospector Assistance Program

The Nova Scotia government embarked on a new Prospector Assistance Program (PAP) in the fall of 1997. The PAP is a four-year, $600 000 program that will continue until the year 2001. Funding is provided by the Canada-Nova Scotia Cooperation Agreement on Economic Diversification through the Atlantic Canada Opportunities Agency and the Nova Scotia Department of Economic Development and Tourism. The program is designed to give assistance to prospectors and has three components.

The training component provides funding for basic and advanced prospecting courses. These courses are normally held at various locations in the province as demand warrants. In addition, this component will support the continuing education of prospectors through seminars, workshops and field trips. Basic training courses in the fall of 1997 and spring of 1998 were attended by 41 and 56 prospectors, respectively, and 12 prospectors received advanced training in the spring of 1998.

The component of greatest interest to prospectors is prospector assistance. Through this component, prospectors can obtain funding to help in their search for minerals. Individual prospectors, or a prospector's company, are eligible for up to a $5000 contribution from PAP as long as the prospector also contributes funding to the project. Broadly speaking, projects from grassroots exploration to diamond drilling are eligible for support.

The third component is marketing assistance. The program encourages funding assistance to prospectors to market their mineral properties to junior and senior mining companies in local and national trade show venues. This component of the program will help fund individual prospectors to travel to trade shows and display information about their properties. In addition, the PAP funding will assist with the expenses of renting display hardware and space.

5.4 NEW BRUNSWICK

Mineral Statistics

The 1997 value of mineral production (including coal) in New Brunswick is estimated to be $936.6 million, representing a decrease of approximately 2% from the final value of $954.7 million for 1996. The decrease can be attributed to reduced production in the nonmetals sector, in particular to half a year of lost production at the flooded Potacan Mining Company potash mine in southern New Brunswick. The improved performance in the metals sector was not sufficient to offset the drop in revenue from potash.

The value of metals production during the year was $660.6 million, which represents 71% of the province's value of mineral production. The price of zinc was the most significant factor affecting revenues in the metals sector as the average zinc price rose almost 29% between 1996 and 1997. In addition, the Caribou Mines Division of CanZinco Ltd. began operating in mid-1997 producing zinc and lead concentrates.

New Brunswick continues to rank first among Canadian provinces and territories in its value of production for zinc, lead, bismuth and peat, and second for silver, antimony and potash.

New Brunswick's mineral exploration statistics are shown in **Table 13**.

TABLE 13. NEW BRUNSWICK MINERAL EXPLORATION STATISTICS, 1990-97

	1990	1991	1992	1993	1994	1995	1996	1997
Exploration expenditures (general plus mine-site) ($ millions)[1]	16.5	15.8	12.2	11.1	10.0	12.7	14.7	12.4[a]
Mineral claims recorded (no.)	4 361	4 571	3 444	2 351	3 980	3 779	5 860	3 360
Total claim equivalents in effect (no.) (includes leases and agreements)	30 215	30 641	28 555	22 500	23 859	24 866	28 604	27 869

Source: New Brunswick Department of Natural Resources and Energy.
[a] Preliminary survey results.
[1] Current dollars; includes overhead expenses.

Exploration Highlights

Northern New Brunswick

Exploration expenditures in the northern half of the province for 1997 were approximately $11.5 million, a decrease of approximately $800 000 over the previous year. The largest expenditures were made by Noranda Mining and Exploration Inc. ($6.1 million) and Chapleau Resources Limited ($1.4 million).

The number of new claims recorded in the region was approximately 1937, while the number of claims in effect was 17 545, slightly lower than in 1996.

In 1997, the active major companies were Noranda Mining and Exploration Inc., Teck Exploration Ltd., Inmet Mining Corporation, and Breakwater Resources Ltd. Collectively, these companies spent approximately $8 million. Other major companies holding ground but not actively exploring included BHP Minerals Canada Ltd., Homestake Mining (Canada) Limited, and Falconbridge Limited.

Inside the Bathurst mining camp, Noranda spent approximately $5.6 million on its extensive land holdings, which is $1.6 million less than in 1996. Much of Noranda's exploration expenditures in 1997 have been in the Brunswick and Heath Steele belts, largely in proximity to its mining properties.

In late 1996, Noranda drilled into a new discovery, called the Camel Back property, located in the northern part of its Wedge-Indian Lake claim belt. The discovery hole 96-6, drilled in December, intersected a 4.3-m section of massive sulphides grading 8.95% zinc, 3.94% lead, 0.08% copper, and 41.9 g/t silver, as well as a 12.3-m stringer zone grading 2.05% copper. Subsequent holes showed that the massive sulphide lens is not very large but is in the right stratigraphic position to be equivalent to the Brunswick Horizon. The Camel Back discovery is significant for several reasons: (1) it was found as a result of the multiparameter airborne survey in the part of the camp that previously was thought to have little exploration potential; (2) Noranda has spent approximately $1 million in exploration on the area since the discovery (notably, the cost of the entire airborne survey was less than $1 million); (3) the area is structurally complex but there is plenty of room along strike and down dip to find the continuation of the discovery lens or brand new lenses; (4) the new discovery is not in the same structural block or nappe as the Wedge deposit; and (5) several geophysical anomalies similar to the Camel Back signature occur in the vicinity of this new showing.

Outside the Bathurst mining camp, Noranda spent approximately $520 000 exploring for porphyry copper/skarn and manto-style mineralization in and adjacent to the Aroostook-Matapedia zone.

A number of junior companies, both listed and unlisted on the stock exchange, were active in northern New Brunswick in 1997. Collectively, they spent about $3.5 million. The listed companies include: Cimarron Minerals Limited, Chapleau Resources Limited, Connecticut Development Corporation, Eastmain Resources Inc., Fancamp Resources Ltd., Major General Resources Limited, Mountain Lake Resources Inc., Neary Resources Corp., Pathfinder Resources Ltd., PGE Resource Corp., and Stratabound Minerals Corp. Unlisted companies include: Bathurst Exploration Ltd., Black Bull Resources, Golden Bay Resources, Good Fellow Enterprises Limited, Lewis Brook Resources, Log House Construction Ltd., Miramichi Minerals Ltd., Northeast Exploration Services Limited, and Slam Exploration Ltd.

Other companies holding ground but who did not actively explore in 1997 include: Bathurst Silver Mines, Brancote Canada Limited, Heron Mines Limited, Key Anacon Mines Limited, Marshall Minerals Corp., Nebex Resources Ltd., and NovaGold Resources Inc. (including its subsidiary Murray Brook Resources Inc.).

Although most of the exploration activity in northern New Brunswick in 1997 was concentrated either within or immediately adjacent to the Bathurst mining camp, there continued to be significant activity in the western region in and around the Plaster Rock area.

Southern New Brunswick

Exploration in southern New Brunswick continued for various commodities, including platinum-palladium, nickel-cobalt-copper, gold, antimony, and base-metal sulphides. It is estimated that approximately $900 000 was spent on exploration in this region in 1997. As of December 1, the number of claims in effect in southern New Brunswick was 3555 and the number of new claims staked was 689. The number of claims in effect remained about the same, but the number of new claims recorded declined by about 200.

Mineralization related to mafic and ultramafic intrusions received extensive exploration in 1997 with companies such as Wild Horse Resources Ltd. and Cobrun Mining Corporation working on their Mechanic Settlement and St. Stephen Nickel properties.

Among the juniors exploring for precious metals, including antimony, were companies such as Chilean Gold Ltd., Southfield Resources Ltd., Fosters Resources Ltd., Pro-Max Resources Inc., PGE Resource Corp., Gammon Lake Resources, and Freewest Resources Canada Inc.

Besides the activity in the base- and precious-metals sector, exploration for industrial minerals, particularly limestone and gypsum, involved several companies such as Havelock Lime, a Division of Goldcorp Inc., and Maritime Resource Research Limited.

Development Highlights

Metallic Minerals

In 1997, New Brunswick saw the opening of a new base-metal mine and the re-opening of another. The Caribou Mine Division of CanZinco Ltd. (formerly East West Caribou Mining Limited), a wholly owned subsidiary of Breakwater Resources Ltd., commenced production from its two properties in mid-1997, with the first ore going through the mill in July.

At the Caribou underground mine, the existing concentrator has been extensively modified and expanded since it last operated in 1990. It will now produce separate zinc and lead concentrates, rather than a bulk concentrate as in the past. The recommencement of operations involved a capital expenditure of $58 million and the hiring of 208 employees. Zinc concentrate is being shipped from the port of Belledune, while lead is being trucked to Noranda's Belledune smelter.

At its other mine, the Restigouche deposit, which CanZinco started to prepare in late 1996, an open pit has been developed and ore production began in the spring of 1997. All of the ore from the Restigouche site is trucked to the Caribou mine site for processing. Extensive measures have been put in place at Restigouche to protect the sensitive local environment.

Noranda continued mine production from its two properties in northern New Brunswick despite having to deal once again with seismic activity at each site. At the larger Brunswick Mining Division property, the company had already reduced target production to 9000 t/d from the previous target of 10 500 t/d; however, by the end of 1997, production was well over the 9000-t/d mark and the average for the year was close to what was planned.

In 1997, Brunswick Mining Division announced its decision to convert its backfilling operations from conventional rock fill to a paste fill system. In addition to offering environmental and cost benefits, paste fill is expected to enable better ground control.

Zinc accounts for approximately 70% of Brunswick's production. Lead, copper and silver comprise the remainder. Both the mine and the smelter ran uninterrupted throughout the year.

After a two-week shut-down in November 1996, Noranda's other mine, Heath Steele, gradually returned to its normal level of operation and was producing at its target rate of 2700 t/d by May 1997. However, in October, heightened seismic activity caused the suspension of mining operations in the B mine. Extensive rehabilitation measures were taken and production returned to normal in November.

The company continues work on an extensive program to address environmental concerns associated with the site. A new water treatment plant was commissioned in October and work is in progress on associated infrastructure. The company has budgeted an estimated $25 million over a two-year period for environment-related projects.

In 1997, ADEX Mining Corporation received a consultant's feasibility study for the development of the Mount Pleasant tin-indium-zinc-bismuth-tungsten deposit. The conclusions were disappointing as the estimated capital costs were too high to justify a production decision at this time. The company then began investigating alternatives that would reduce capital and operating costs. Meanwhile, the major investor (Malaysian Smelting Corporation) remains interested in the project.

Despite hopes that the antimony price would recover sufficiently in 1997 to allow a resumption of operations at Lake George, the APOCAN Inc. property remained closed. High metal inventories in global markets continued to depress the price and, at year's end, the mine was still in care and maintenance mode.

Murray Brook Resources Inc., a wholly owned subsidiary of NovaGold Resources Inc., conducted bioleaching tests during the summer of 1997 on the copper ore presently stored at its Murray Brook site. The results of the tests were sufficiently favourable that the company intends to do further testing in 1998; if these tests are successful, there may be an eventual resumption of copper mining in the pit.

Nonmetallic Minerals

In 1997, there were approximately 15 major nonmetallic mineral producers (excluding mineral aggregate producers) working in New Brunswick who accounted for 24%, or $220.9 million, of the total value of mineral production. This value represented a decrease of 27% from the 1996 value mainly because of a major event that took place at one of the largest contributors to the nonmetallic minerals sector.

Potacan Mining Company (PMC) reported a serious water inflow of several thousand cubic metres a day at its Cassidy Lake mine located 25 km south of Sussex. The company immedi-

ately embarked on a grouting strategy that officials hoped would be successful in reducing the inflow to a manageable level. Unfortunately, the program failed to produce the desired results and PMC's parent company, the Potash Company of Canada (Potacan), announced on October 30, 1997, that it would be closing the Cassidy Lake mine with the subsequent loss of nearly 500 jobs.

Late in 1997, the Potash Corporation of Saskatchewan Inc. announced that it was initiating a process to acquire the shares of Potacan. PCS intends to utilize the former Potacan mill facility to add value to potash product shipped from its mining operations in Saskatchewan. Upon closing the deal, company officials indicated the possibility of expanding production at its other Sussex area mine.

Exploration Incentive Programs

Mineral Exploration Stimulation Program (MESP)

In 1997, the Province of New Brunswick continued its support for the popular prospector incentive program called MESP (Mineral Exploration Stimulation Program). During the course of its five-year existence, the program has provided more than $220 000 to assist prospectors in conducting grassroots exploration on their claim groups. In 1997, 39 grants were provided for a total of $50 000; similar funding will be available for 1998.

New Brunswick Exploration Assistance Program (NBEAP)

Recognizing the need to stimulate junior mining sector activities in the province, a federal-provincial assistance program was initiated in 1994. Providing financial assistance of 50% of project costs (to a maximum of $40 000 per company), the NBEAP (New Brunswick Exploration Assistance Program) infused more than $1.2 million into the mineral exploration industry, which resulted in another $5.5 million being spent by grant recipients. The Province of New Brunswick will continue the NBEAP in 1998 and will underwrite its total cost of $350 000.

EXTECH-II

EXTECH-II is a five-year EXploration and TECHnology collaborative project between the Geological Survey of Canada and the New Brunswick Department of Natural Resources and Energy (Geological Surveys Branch) that was initiated in 1994 in the Bathurst mining camp. Its principal objective is to address problems of declining base-metal reserves by developing integrated and multi-disciplinary approaches to exploration, and by improving the geoscience knowledge base in the camp. In order to better understand the geological setting of sulphide deposits and processes of sulphide formation and degradation, a host of projects have been carried out since 1994 that developed, tested and applied geological, geophysical and geochemical methods for detecting buried sulphide deposits.

Airborne Geophysical and Geochemical Survey (Restigouche)

Following on the heels of a successful airborne multiparameter geophysical survey flown over the Bathurst mining camp in 1996, a multiparameter airborne geophysical and multi-element geochemical survey was conducted in 1997 in the northwestern part of the province. This $540 000 survey, covering part of the Restigouche geological zone, represented Phase I of a proposed two-part program whose objective is to provide much-sought-after geoscience products that will help stimulate exploration in this area while at the same time assisting the private sector to evaluate the potential of northwestern New Brunswick. The 1996 Bathurst mining camp survey resulted in more than $3 million in exploration activity and several targets being identified for follow-up detailed groundwork. The exploration community is anxiously awaiting the results of the 1997 survey that will be released in the third quarter of 1998.

5.5 QUÉBEC

Overview

Preliminary data for total exploration and development expenditures in Québec in 1997 ($154.6 million) indicate a 4.4% increase over 1996. Of the $154.6 million total, $115.8 million was accounted for by off-property expenditures and $38.8 million by on-property expenditures. In comparison with 1996, off-property expenditures decreased by 7% while on-property expenditures increased by 64%.

The reduction in off-property exploration expenditures is attributable to some extent to a withdrawal by senior companies, which invested only $39.7 million in 1997 (compared to $56.5 million in 1996). Faced with the substantial drop in the gold price, senior companies applied more of their financial resources to the rationalization and consolidation of their mining operations. Off-property expenditures by junior companies were $50.7 million in 1997, compared to $45.3 million in the previous year, an increase of 12%.

The rise in on-property exploration investment in 1997 can be explained primarily by the desire of senior companies to increase their knowledge of promising mineralized zones on existing mining properties. Such development work precedes the feasibility study stage and any decision to bring new zones into production.

As in the past few years, the Northern Québec and Abitibi-Témiscamingue regions received most of the exploration and development expenditures in 1997. Thus, more than 40% of exploration and mineral deposit development expenditures were directed to the Northern Québec region last year, while some 33% of these expenditures went to the Abitibi-Témiscamingue region.

In 1997, exploration and development expenditures allocated to the search for base metals increased by 25% over 1996, rising from $55 million to $69 million. The corresponding expenditures in the precious-metals sector decreased by 7%. The latter nevertheless benefited from $78 million in investment, accounting for more than 50% of total exploration expenditures. The search for other minerals declined by 11% in 1997 relative to 1996, with recorded expenditures of $8 million.

Exploration Highlights in 1997

In 1997, more than 20 135 claims were recorded, compared to 19 994 in 1996. There were also 41 958 renewals, as well as the issuance of 61 operating licences and 311 licences to explore for surface minerals. In addition, diamond drilling totaled 968 032 m in 1997, compared to 1 013 309 m in 1996.

In the James Bay region, Virginia Gold Mines has discovered new gold showings on the La Grande Sud property. The best values vary between 8.53 and 69.64 g/t gold over widths of 2 m in one of the zones, while in another zone the best values were 6.75 g/t gold over 11.25 m. The company estimates the geological inventory of the latter to be 2.1 Mt grading 2.89 g/t gold.

As a result of work on the La Grande Nord property (optioned from Virginia Gold Mines) in 1997, Noranda discovered new base-metal showings. The Sommet 4 showing consists of a copper-silver-cobalt-nickel mineralization enclosed in locally hematized basalt along a structure oriented 225°/60°, with best values of 55.24% silver, 25.75% copper, 3.43% cobalt and 1.88% nickel. Approximately 60 m to the south, a breccia body of limited extent has yielded values ranging from 18.57 to 41.92 g/t gold, from 2.7 to 14.37 g/t platinum, and from 1.24 to 13.78 g/t palladium.

In the Rouyn-Noranda district, 75% of the exploration for polymetallic deposits was carried out in the Abitibi belt between Brouillant and Matagami. The main exploration highlights were

the gold discoveries of Altavista Mines (La Reine Township), Ressources Coleraine (Perron Township) and Santa Fe/Globex (Duparquet Township).

The recent discovery in the Normétal mining camp north of Rouyn-Noranda (the Perron project) brings a new perspective to gold exploration. The gold-bearing structure consists of three concordant mineralized zones. The gold mineralization is associated with highly carbonatized and sericitized zones containing biotite, varying amounts of pyrite and sphalerite, and numerous quartz vein injections. The mineralization is also characterized by the common occurrence of visible gold. The gold values vary between 0.62 and 78.14 g/t with widths varying from 0.4 to 4.0 m. The best intersection returned a value of 12.22 g/t gold over 3.95 m. The geological units hosting the mineralized zones have been traced for a distance of nearly 4 km.

In the Chibougamau district, McKenzie Bay Resources has signed a partnership agreement with SOQUEM regarding its iron-titanium-vanadium property, the inventory of which is estimated to be 72 Mt grading 31.2% iron and 0.5% V_2O_5. The company has performed systematic sampling and will undertake a drilling program to define the mineralized zones at depth.

Malarctic-Sud has discovered a porphyritic copper deposit in Fournière Township (grading 0.27% copper over 78 m). This is the first time in 20 years that exploration has been carried out for this type of deposit near Val-d'Or. The area is now attracting more than 10 exploration companies.

The Urban-Barry belt has been little explored until quite recently. Because of the work done by Murgor Resources, there has been an increase in mineral exploration activity in this region. In association with Teck Corporation, Murgor Resources has defined a near-surface deposit containing probable resources of 0.56 Mt grading 7 g/t gold. Xemac, a junior company, has also obtained impressive results in this area (13.5 g/t gold over 13.2 m).

Also worthy of mention are the Bonnefond project of Ressources Aur (2.2 g/t gold over 43.6 m) and the Comtois project of Cameco-Osborne, a massive sulphide horizon. The Desjardins project, near Lebel-sur-Quévillon, has a mineralized zone identified over a length of more than 800 m and down to a depth of 600 m. With a cut-off grade of 3.0 g/t gold and a minimum horizontal width of 1.5 m, the geologic resource would be more than 2.0 Mt grading 5.15 g/t gold.

Public Financing of the Québec Mining Industry

Funds raised in the Québec capital markets for financing the mining industry totaled $110.1 million in 1997, representing a reduction of about 30% from 1996.

This decline can be attributed, on the one hand, to the sustained drop in the gold price in 1997 and, on the other, to the alleged fraud perpetrated by the Bre-X Corporation on the Busang property in Indonesia that was exposed in late March 1997. Other events also tarnished the image of the mineral exploration sector, particularly the Delgratia affair (sampling on a property in Nevada) and other administrative irregularities.

Although total financing for the mining sector declined in 1997, the proportion of funds directed to the Québec mining industry increased substantially compared to 1996. More than $70 million was raised for investment in Québec, a 45% increase over 1996. On the other hand, a lower proportion of the funds raised in 1997 was directed outside Québec. About $40 million was invested outside of Québec in 1997, whereas more than $110 million was invested abroad in 1996.

The impact of the fraud in Indonesia very likely enabled the Québec mining industry to retain more of the funds raised in the Québec capital markets.

The amounts raised under the flow-through share regime totaled $22.9 million in 1997, a decline of 16% from 1996. The drop in the gold price had a negative effect on flow-through share financing in 1997 (**Tables 14** and **15**).

TABLE 14. QUÉBEC, FLOW-THROUGH SHARE FINANCING AND EXPLORATION EXPENDITURES, 1994-98

	1994	1995	1996	1997	1998e
			($ millions)		
Value of flow-through share issues	18.4	26.4	27.4	22.9	. .
Exploration and development expenditures	136.6	131.6	148.2	154.6p	167.6
Off-property	113.5	105.8	124.5	115.8	121.9
On-property	23.1	25.8	23.6	38.8	45.7

Source: Service de la recherche en économie minérale, Ministère des Ressources naturelles du Québec.
. . Not available; e Estimates derived from the survey conducted in the fall of 1997; p Preliminary data.

TABLE 15. QUÉBEC, $1000 FLOW-THROUGH SHARE INVESTMENT FOR SURFACE EXPLORATION[1]

Taxable Income	Marginal Tax Rate			Tax Saving			Net Investment Cost	After-Tax Break-Even
	Federal	Québec	Total	Federal (1)	Québec (2)	Total (1+2)	$1000 - (1+2)	Point[2]
		(%)			($)		($)	($)
$40 000	22.49	24.61	47.10	225	431	656	344	414
$50 000	22.49	25.68	48.17	225	449	674	326	392
$60 000	25.09	26.40	51.49	251	462	713	287	354
$70 000	26.54	26.40	52.94	265	462	727	273	341

Source: Ministère des Ressources naturelles du Québec.
1 New issues often comprise flow-through shares and common shares sold as units. In such cases, the tax deduction will be proportionate to the number of flow-through shares included in each unit. 2 The break-even point takes into account current income tax provisions relating to capital gains and the exemption available for them in Québec by means of the special account that shelters the deemed capital gain from taxation.
Notes: Flow-through shares for surface exploration entitle the holder to a deduction of 175% at the provincial level and 100% at the federal level. The table reflects income tax provisions applicable for the 1996 calendar year for a Québec taxpayer who is an individual and who is not subject to the minimum alternative tax. Marginal tax rates take into account provincial and federal surtaxes, the Québec tax reduction (2% of the amount over $10 000 of tax payable net of non-refundable tax credits), and basic personal non-refundable credits of $1098 at the federal level and $1180 at the provincial level. Issue expenses are not taken into account.

Tax Measures Favouring the Mining Industry

In 1997, the tax deductions provided under the flow-through share regime and the exemption on deemed capital gains were extended to December 31 of the year 2000. Under these measures, an individual can benefit from a deduction of up to 175% of his or her investment when the proceeds of the issue are invested in surface exploration in Québec. The maximum savings in Québec income tax for an individual is $462 for each $1000 invested in flow-through shares (**Table 15**).

The overall tax system governing Québec mining companies is competitive when compared with tax systems in other provinces and other countries. Corporate income tax, mining taxes and non-profit taxes make up the tax environment for mining companies in Québec.

The mining tax system in Québec is characterized by a refundable loss credit ("crédit de droits remboursable pour perte," or CDRPP), which is unique in Canada. This credit amounts to 12% of actual losses. In addition, the system provides for a mining tax holiday for the first 10 years of operation of a new mine located north of 55° N latitude.

In the budget speech of March 31, 1998, the Québec Minister of Finance announced new tax measures to stimulate exploration in the northern areas of Québec. An additional 25% for exploration will be allocated to the mining tax system for such work undertaken in the Near North and Far North areas of Québec. This measure brings the deduction for exploration to 175%.

The *Taxation Act* will also be amended to improve the exploration deduction by 25% when such expenditures are incurred in the northern areas of Québec.

Non-profit taxes, particularly payroll and capital taxes, are the most strongly criticized by the industry. The 1998 budget announced a reduction in the payroll tax to take effect in July 1999. This change will mostly benefit small capital companies, particularly a number of junior exploration firms. In addition, the capital tax on partnerships exploiting a mineral resource has been reduced.

Other Mining Exploration Incentives

In the last budget speech, the Québec Minister of Finance announced that the Québec Department of Natural Resources would have access to $18 million over three years ($6 million per year) to support studies and work aimed specifically at the discovery of new mineral deposits.

The Department's financial assistance program for mining exploration was provided with an annual budget envelope of $3 million for three years, beginning April 1, 1997. The objective of this program is to provide financial and technical assistance to prospectors and exploration companies. It has three components: assistance for independent prospectors, assistance for companies, and the creation of regional mining funds.

The regional exploration funds are legally incorporated organizations governed by specific agreements between regions and the Québec Department of Natural Resources. They have access to an overall annual budget of $800 000. A maximum of $200 000 is available for each fund covered by an agreement. There are currently three regional exploration funds covering the Lower St. Lawrence, Saguenay and Gaspé regions. An agreement to create a fourth regional fund for the Chaudière-Appalaches region is imminent.

In addition, to promote the search for new deposits in the northern areas of Québec, financial assistance for companies is provided under the program for mineral exploration in Québec's Near North. Companies can be reimbursed for 50% of eligible expenditures up to a maximum of $100 000 per project.

Late in 1996, SOQUEM and Capital d'Amérique CDPQ created Sodémex, a limited partnership. With initial capital of $7 million provided by the two partners ($3.5 million each), Sodémex acquired the "PSIM" portfolio that had belonged to SOQUEM. In 1997, Capital d'Amérique CDPQ undertook to invest a further $15 million to create Sodémex II. Following the example of the first limited partnership, Sodémex II will acquire interests in small mining companies that are active in Québec.

5.6 ONTARIO

Overview

Exploration activity in 1997 remained close to the high level attained in 1996 with gold the primary target commodity. A total of 877 exploration programs were carried out across the province.

Ontario's preliminary estimate for general and mine-site exploration expenditures in 1997 is $173.9 million, down moderately from $194.4 million in 1996. The 1998 forecast for exploration dollars spent in Canada indicates that Ontario's share would decline to $132.7 million. In 1996, 36% of general and mine-site field exploration dollars were spent on base-metal exploration and 59% on precious-metal exploration. In 1995, 32% of exploration dollars were spent on base metals and 63% on precious metals.

Exploration expenditures by senior mining companies are expected to account for 54% of total expenditures in 1998, down from 68% in 1997 and 74% in 1996.

Mine-site development expenditures for 1998 are forecast at $228 million, down from the $260 million preliminary estimate in 1997 and $279 million in 1996. These data include overhead expenditures. In 1996, 58% of mine-site development expenditures were spent on precious-metal projects and 39% on base-metal projects. This compares to 61% for precious-metal projects and 22% for base-metal projects in 1995.

There were 181 488 active claim units at the end of 1997, down slightly from the record level of 183 299 claim units in 1996. During 1997, a reported $53.8 million in exploration work was recorded for assessment credits, up from $37.3 million in 1996. Most of this was spent on diamond drilling, as in previous years.

On the exploration front, gold continued to command substantial interest as the commodity of choice for exploration in Ontario during 1997. Recent base-metal discoveries in the traditional mining camps are attracting numerous companies to these areas. The search for diamonds continued in 1997 with the hunt concentrating in the Temiskaming, Wawa and James Bay Lowlands areas.

The 1997 forecast for capital expenditures on structures, machinery, equipment and mine-site development by mining companies is estimated at $680 million, up 6% from the 1996 preliminary figure.

New Mines

Placer Dome Inc. brought the Musselwhite mine into commercial production in 1997 at a cost of $190 million. The mine is located 500 km north of Thunder Bay and is expected to produce 200 000 oz of gold annually.

River Gold Mines, under an option agreement with Vencan Gold Corporation, began production from the Edwards gold mine in 1997. This mine is located close to their Eagle River mine near Wawa and should produce 15 000 to 20 000 oz of gold annually.

Glimmer Resources Inc. began commercial production in January from the Glimmer mine, located near Kirkland Lake. Reserves are estimated at 275 000 oz at an average grade of 12.9 g/t gold.

Claude Resources acquired Madsen Gold in 1997 and continues to produce from the Madsen gold mine. The company is refurbishing the mine and exploring the mine-site area south of Red Lake.

Mine Expansions

Placer Dome is continuing work on the $70 million Depth Development Program at its Campbell gold mine near Red Lake. The work includes a new shaft to access deep reserves.

Inmet Mining is spending $26.3 million to access and develop the Pick Lake ore zone from its Winston Lake zinc-copper mine north of Schreiber.

Goldcorp's Red Lake gold mine is increasing reserves by continuing exploration at the mine despite a labour dispute. The company is reviewing plans for a project to increase reserves and reduce costs that would take two years to complete at a cost of $115 million.

Inco Limited announced earlier this year that it will spend $177 million to develop a 6-Mt nickel deposit at the Creighton mine near Sudbury. The deposit's grade is estimated at 3.5% nickel. Production from the deposit should begin by 2001.

Mine Development

Agrium Inc. of Calgary will spend $70 million to develop a high-quality phosphate deposit near Kapuskasing in northeastern Ontario. The open-pit mine is expected to produce for 20 years beginning in the summer of 1999. It will create about 100 permanent jobs.

Falconbridge is continuing work on the Lockerby nickel-copper mine that re-opened in early 1996. Full production is scheduled for this year.

Inco continues to work on the McCreedy East project west of Sudbury. The mine began producing in 1996 and is scheduled for full production by 1999.

Advanced Exploration

Inco is working on the Sudbury area Victor nickel-copper deposit. The $72 million predevelopment program will culminate with a feasibility study in 1999.

Armistice Resources completed extensive drilling on its Virginiatown property in 1997 and continued to encounter several mineralized zones.

Kinross Gold completed a $1 million resource drilling program on its Vogel property near Timmins in 1997.

Vedron Gold is continuing work on the Fuller property near Timmins after obtaining positive results from a drill program earlier in 1997.

Pentland Firth conducted a drill program on its Marlhill deposit near Timmins in 1997 and plans to continue work on the property.

Pentland Firth's drilling on the Hammond Reef property near Atikokan indicated the open-pit potential for mineralization at the property.

Madoc Mining Company continues to work on its Bannockburn gold property in southeastern Ontario. It is currently shipping ore for processing to Noranda and St. Andrews.

Major Exploration Projects

Currie Rose Resources continued diamond drilling at the former Scadding gold mine in Scadding Township. To date, four holes containing visible gold in the core have outlined a steeply dipping zone south of the South zone.

Inco has announced the discovery of two new high-grade zones in the Sudbury camp: the Kelly Lake deposit south of the South mine, and a new deposit north of the South mine. Inco plans to spend $8.4 million exploring in the Sudbury camp.

Band Ore Resources is continuing its exploration programs on two of the company's 100%-owned properties in the Timmins camp. An updated resource calculation, including the results from the aforementioned exploration programs, will be available in 1998.

Drilling by Cross Lake Minerals on its Sheraton-Timmins property has returned some encouraging base-metal values. Earlier results indicated high-grade lead-zinc-silver mineralization.

Holmer Gold Mines is active on its Bristol Township property near Timmins where it continues to add to the gold mineralization.

Queenston Mining and joint-venture partner Franco-Nevada Mining have intersected gold on the Princeton property in Gauthier Township near Kirkland Lake. They are conducting a $2.5 million drill program and the inferred resource is 2.9 million short tons (st) of ore grading 0.18 oz/st of gold.

St. Andrew Goldfields Ltd. extended the gold mineralization on its West Porphyry zone property, west of Timmins, when the company announced drill results for 1997. Over 75% of the drill holes on the West Porphyry zone intersected gold grades of 0.20 oz/st or greater.

River Gold Mines has purchased the Mishi Gold project near Wawa. The main zone is reported to contain open-pit mineable reserves of 772 000 t grading 3.3 g/t gold.

Patricia Mines continues to drill its Island Gold project, north of Wawa. The company is reporting that all of the intersected holes show visible gold mineralization.

Avalon Ventures' exploration program on its Separation Rapids pegmatite property in the Kenora region intersected significant thicknesses of mineralized pegmatite in all holes drilled in its current program. Assays confirmed consistent mineralization of lithium and rubidium, as well as anomalous values for tantalum and cesium.

Nuinsco Resources encountered gold anomalies in its drilling program on its Richardson Township property near Kenora. The company is continuing to work on the property.

Houston Lake Mining and Inca Mining will continue to explore their McLennan Claims-Dogpaw group of properties near Kenora after encountering a new shear zone during their 1997 program. The assays on the zone range from 29.84 to 74.62 g/t gold.

Corona Gold and Teck Corporation are continuing their drill program on the Thunder Lake West property in the Kenora area to determine its resource estimate. Earlier results outlined an inferred mineral resource of 3.65 Mt grading 7.28 g/t gold.

Battle Mountain Gold continues to explore gold properties close to the Hemlo camp, including the Golden Sceptre property. Surface work identified porphyry zones and the company is continuing to drill on the property.

Romios Gold Resources is conducting exploration work on the Lundmark-Akow Lakes gold property near the Musselwhite mine in northwestern Ontario. Positive assay results released late last year provided the impetus to continue exploration.

Cameco Gold began drilling on its Black Lake gold property in northwestern Ontario after completing an induced polarization (IP) survey in 1997.

Mineral Exploration Incentive Programs

The Ontario Prospectors Assistance Program (OPAP) provides financial assistance to qualified individuals and companies involved in mineral exploration in Ontario. The grants provide 100% of approved eligible expenses to a maximum of $10 000 per individual per year. The OPAP budget allocated for 1998 is $2 million. About 205 of 390 applicants will be approved for OPAP assistance in 1998. In 1997, 215 of 357 applicants were approved for assistance.

5.7 MANITOBA

Overview

Mineral exploration expenditures during 1997 are estimated at $39.3 million, compared to $41.2 million in 1996. Surface diamond drilling in 1997 is estimated at 358 000 m compared to 153 000 m in 1996. The total area of claims, exploration permits and special exploration permits recorded in 1997 was 922 419 ha (295 316 ha in 1996). The total area of mineral dispositions in good standing at the end of 1997 was 1 947 125 ha compared to 1 756 121 ha at the end of 1996.

Exploration Highlights

Hudson Bay Mining and Smelting Co. Limited (HBMS) continued an aggressive exploration program in its effort to find base-metal deposits in the Flin Flon, Snow Lake and Ruttan areas.

HBMS is proposing a business plan to extend the life of the Flin Flon mining and metallurgical complex to the year 2012. In early May 1998, the company made public the discovery of the Triple 7 zone located on the deeper extension of the Flin Flon/Callinan mine horizon. HBMS is currently mining the Callinan deposit under an agreement with Callinan Mines Limited. Total indicated and inferred geological resources of the Triple 7 zone are estimated at 13 Mt grading 2.71 g/t gold, 37.71 g/t silver, 3.32% copper and 5.78% zinc.

Falconbridge Limited continued its extensive nickel exploration effort in the William Lake area on the Thompson Nickel Belt, 225 km southwest of Thompson. The company announced that it has signed an option/joint-venture agreement with Minorco's subsidiary, HBMS, whereby HBMS has the right to earn a 50% interest in the William Lake Trend property and a 25-50% interest in Falconbridge's other holdings in the William Lake-Grand Rapids area by providing substantial exploration funding over the next five years. Falconbridge remains the project operator.

Aur Resources Inc. with partners Thunderwood Resources and Consolidated Abitibi Resources stepped up exploration efforts in 1997 in the Flin Flon-Snow Lake and Lynn Lake belts. Encouraging gold-copper mineralization was obtained from a drilling program at Leo Lake, 20 km east of Flin Flon.

Near Thompson, Inco Limited completed the surface exploration program at the Pipe 2 mine. Significant new nickel mineralization was discovered below the 2400 level. Further exploration at Pipe 2 will be from underground when a decision is made to re-enter Pipe for the purpose of mining.

At Snow Lake, TVX Gold Inc. and partner High River Gold Mines Ltd. announced that gold production for 1997 was 2843 kg, surpassing the goal of 2643 kg. Cash operating costs continued to decline. The exploration program conducted on the 3000-ft level confirmed the continuity of both the Dick and Ruttan zones from the 2300 level down to the 3150-ft level. The ore zone structures remain open at depth and show every indication that they will continue below the 3000-ft level.

At Lynn Lake, Black Hawk Mining made steady improvements at the Keystone Gold project throughout 1997. The drop in production costs was attributed to ongoing improvements in development and operations at the Farley Lake open pit.

On December 15, 1997, Rea Gold Corporation declared bankruptcy proceedings and shut down the Bissett gold mine at Bissett in southeastern Manitoba only five months after pouring the first gold. Early in April 1998, the Court-appointed receiver KPMG Inc. accepted a $14.3 million offer for the bankrupt Bissett operation from Harmony Gold Mine Co. of South Africa. The sale of the mine was approved by the Court of Queen's Bench on June 11, 1998.

Prospectors Assistance Program

The Government of Manitoba will reimburse 50% of the prospecting expenditures of qualifying self-employed prospectors to a maximum annual grant of $7500 on pre-approved projects. In fiscal year 1997/98, 40 applications for grants were received, of which 33 were approved. Twenty-nine projects were completed, resulting in the payment of $122 223 in provincial funding.

Mineral Exploration Assistance Program (MEAP)

The Mineral Exploration Assistance Program (MEAP) was established in the fall of 1995 to increase exploration and stimulate activities that may lead to the development of new mines. Funding of $1 million was allocated to the program for its first offering on October 1, 1995; $3 million was offered for each of the following three fiscal years. Companies/individuals may qualify for 25-35% of pre-approved eligible exploration expenditures up to a maximum of $300 000 to $400 000 per recipient per fiscal year, depending on the region of exploration. In

consideration of the Northern Superior region's remoteness, its high cost of operation and limited infrastructure, a higher percentage of assistance (35%) is offered to companies/individuals exploring in this region of Manitoba. Since the program's inception, 63 companies have participated under MEAP, representing 180 projects. Thirty-four of the 63 companies are recorded as new to Manitoba. Proposed exploration expenditures during this period amounted to $39.9 million and allocated assistance funds totaled $9.5 million. To date, reported actual exploration expenditures under the program total $22.8 million. This relates to $5.2 million in paid assistance funds and illustrates that every $1 million paid in assistance funds generates $4.4 million in exploration expenditures. All program funds for 1998/99 are committed.

Land Use

Program activities for land use in 1997 were centred on the implementation of the Network of Special Places Action Plan. An intensive candidate site selection process for identifying protected lands was conducted through the MELC (Mineral Exploration Liaison Committee) industry-government land use committee process. Industry consensus was achieved on many sites, and no valid mineral dispositions were compromised as a result of the process.

Also in 1997, several Wildlife Management Areas were evaluated for mineral potential and candidate sites for the endangered spaces campaign were identified.

A new land access map outlining encumbrances for mineral exploration in Manitoba was prepared and released in November 1997.

5.8 SASKATCHEWAN

Overview

The annual survey of mineral exploration expenditures carried out by the resident geologists indicated that mineral exploration expenditures in 1997 were $43 million, an increase of $8 million (23%) over figures recorded in 1996 (**Table 16**). Expenditures for uranium rose by 37%, continuing an upswing that began in 1993, while those for base metals nearly doubled. Exploration expenditures in 1998 are estimated to be $39 million, reflecting a leveling off of uranium exploration activity and a decrease in that for gold and base metals. These figures exclude uranium, base-metal and gold test mining and underground exploration costs of $269 million in 1997 and estimated expenditures of $298 million in 1998.

TABLE 16. SASKATCHEWAN EXPLORATION EXPENDITURES, 1988-98

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998e
	($ millions)										
Precious metals	42	20	11	5	6	2	4	8	7	4	3
Base metals	6	7	7	6	4	4	4	4	5	9	6
Uranium	20	21	12	10	8	7	11	13	17	27	27
Other	–	2	2	3	4	11	10	4	6	3	3
Total	68	50	32	24	22	24	29	29	35	43	39

Source: Resident Geologists' Survey, Saskatchewan Department of Energy and Mines.
– Nil; e Estimated.
Note: "Other" includes some industrial mineral activity, but predominantly diamond exploration.

The total number of metallic mineral dispositions in good standing at the end of 1997 increased to 4014 (covering 3.0 million ha) compared to 3422 (covering 2.8 million ha) at the end of 1996. In 1997, 2194 new dispositions were recorded, marking a threefold increase in the number of new dispositions and doubling the number of new hectares under disposition to 1 103 790 when compared to 1996. The increase in the amount of land under disposition in 1997 primarily reflects the strong interest in uranium exploration in the Athabasca region, which was spurred on by junior exploration companies. Diamond exploration in south-central Saskatchewan and continued interest in base-metal exploration in the Flin Flon, Attiti-Kisseynew and Wollaston Domain areas of northern Saskatchewan also contributed to the increase in the amount of land under disposition. The number of dispositions for industrial minerals (potash, coal, and alkali minerals) has remained fairly constant, compared to previous years, covering an additional 285 000 ha located primarily in central and southeastern Saskatchewan.

Uranium

The year saw a continued increase in uranium activity, although the average spot price for uranium fell. Ten companies, including some that are joint-venture consortiums, continued to explore for uranium in the Athabasca Basin. While discovery potential remains high, no significant new finds were reported last year.

The Joint Federal-Provincial Panel on Uranium Mining Development in northern Saskatchewan recommended the approval of the $360 million McArthur River and the $410 million Cigar Lake projects. Following approval by the Atomic Energy Control Board, construction has started at McArthur River. Cogema completed first-phase construction at the $250 million McClean Lake project and, with the licensing of the JEB Tailings Management Facility (TMF), expects to be in production by the second half of 1998. McArthur River's proven reserves are 72 600 t of uranium (189 million lb U_3O_8) at an average grade of 15.9% uranium (18.7% U_3O_8) and a resource of 87 600 t of uranium (227.8 million lb U_3O_8).

Following the depletion of ore reserves stockpiled from the Deilmann open pit at Key Lake, McArthur River will provide feed for the Key Lake mill, which produces about 5423 t of uranium (14 million lb U_3O_8) per year. With the approval of the JEB TMF, ore from the Cigar Lake project will be processed at McClean Lake's expanded mill. At Midwest, mining will be integrated with the development of the McClean Lake orebodies. These projects ensure that production at the Key Lake and McClean Lake mills will last until 2020 and 2038, respectively.

In 1997, Cogema maintained Cluff Lake's production at 2020 t of uranium (5.3 million lb U_3O_8). The mill started continuous operation in October 1995 and ran at full capacity in 1997. Production should drop off after 1998. The Dominique-Peter mine, and the Dominique-Janine underground and extension open-pit mines, provided 1997 ore for this expansion. At Rabbit Lake, which continues to operate at less than full capacity, 1997 production increased again to about 4616 t of uranium (12 million lb U_3O_8). Ore was produced in 1997 from the Eagle Point underground mine and the D zone, which was exploited as the third Collins Bay open pit. Mining will continue until reserves are depleted early in the next century.

Gold

With the exception of Claude Resources Inc.'s Seabee mine, the province's gold sector is in decline. Since its opening in November 1991 to the end of December 1997, the Seabee gold mine produced in excess of 307 000 oz of gold and processed more than 1 Mt of ore. Mill throughput totaled 211 481 t for an average of 580 t/d. This was a 9% increase over 1996. By year-end, a $3.5 million shaft and hoist, to a depth of 395 m, was fully operational. In a February 1998 report to the company, A.C.A. Howe International estimated reserves in the proven and probable categories of 590 000 t at an average grade of 9.98 g/t (0.29 oz/st) gold.

Elsewhere, the picture is not so bright. Cameco reported that production from the Contact Lake mine was 53 000 oz of gold, down from over 60 000 oz produced in 1996. This decrease

was attributed to lower-than-expected ore grades that resulted in reduced production levels and higher unit costs. Underground drill programs have failed to replace mined reserves and the operation is expected to close in mid-1998.

Production at the Komis mine, which is operated by a subsidiary of Golden Rule Resources Ltd., fell far short of feasibility estimates in the last four months of 1996. Following a new ore reserve calculation and an assessment of mine economics resulting from the change to an exclusively shrinkage stope mining method, the mine closed. The Jolu mill, 60 km to the south, continued to operate until August using stockpiled Komis ore.

While these mines illustrate that gold discoveries can be made in the province, fewer than 10 companies conducted exploration programs. Most of these efforts were in the La Ronge and Glennie domains.

At Laural Lake, Claude Resources has increased resources from 425 000 t grading 11.3 g/t gold (0.33 oz/st) to 1 500 000 t grading 13.7 g/t gold (0.4 oz/st) (uncut). The execution of a spring 1998 underground sampling program depends on the gold price. Greater Lenora Resources Corporation was not active this year at its Goldfields project near Uranium City. Kristo Gold Inc. will not reprocess gold from the copper-gold tailings of the old Anglo-Rouyn mine at present prices.

Base Metals

Base-metal exploration expenditures nearly doubled from $5 million in 1996 to $9.4 million in 1997. Hudson Bay Mining and Smelting Co. Limited (HBMS) will complete a $7.5 million Phase I underground exploration program at Konuto Lake. If the orebody is confirmed, the company will invest approximately $40 million more over 18 months to bring the Konuto project into production. The mine, with geological reserves of 1.44 Mt grading over 6% copper and 2.5 g/t gold, is expected to operate for five or six years. Most of the 1997 production from HBMS's Callinan mine came from the North and East zones in Manitoba, although mining the Saskatchewan side of the North zone did begin this year.

Base-metal exploration, involving less than 10 companies, continued in Shield and sub-Phanerozoic terranes west and southwest of Flin Flon. Leader Mining International Inc. delineated increased open-pit mineable resources of 79 Mt grading 1% equivalent copper (i.e., 0.69% copper, 0.017% cobalt, 0.16 g/t gold and 0.39 g/t silver) at Knife Lake in a greenstone belt identified as a higher metamorphic grade, northward extension of the Flin Flon volcanics. A $6 million exploration program sought to enlarge the Knife Lake deposit and define deep volcanogenic massive sulphide deposit targets and other base-metal prospects with potential in the same domain.

In the Wollaston domain, Far West Mining Ltd. continued its exploration program for zinc-lead mineralization in the vicinity of the George Lake deposit, and Noranda drilled recently discovered copper-silver showings near Janice Lake.

The Clearwater nickel project, a joint venture between Uranerz Exploration and Mining Limited (operator) and Kensington Resources Ltd., postponed a second drill program in the Clearwater Anorthosite Complex of the Western Craton because of poor ice conditions. Three companies are involved in two nickel-copper-cobalt plays in the Archean Tantato domain north of Lake Athabasca. One play has sub-Athabasca Group targets.

Diamonds

The amount of land under disposition for diamonds declined to less than 400 000 ha. This compares with some 4 million ha under disposition at the height of the diamond boom in 1994. Three companies staked a total of 232 508 ha in the Wood Mountain area of southern Saskatchewan in October 1997.

On Kennecott Canada Inc.'s Candle Lake properties, which were optioned from the War Eagle Mining Company and Great Western Gold Corporation, the company plans to use a large drill to complete a 22.7-t bulk test from two cased holes drilled in 1997 to the top of kimberlite #C29/30. On kimberlite #C28, the company completed eight diamondiferous drill holes. If results from the bulk test on kimberlite #C29/30 are positive, the company may proceed to take a bulk sample from kimberlite #C28.

The Fort à la Corne diamond project is a joint venture between Uranerz Exploration and Mining Limited (operator), Cameco Corporation, Monopros Limited (a wholly owned subsidiary of DeBeers Consolidated Mines Ltd.) and Kensington Resources Ltd. The 1997 Fort à la Corne exploration program focused on further evaluating higher-grade kimberlite bodies. Drilling consisted of two rotary drill holes and three reverse circulation airblast and under-ream (RCA/UR) drill holes. The results of macrodiamond analyses of mini-bulk samples (68.045 t) taken from the 1997 drilling are expected by year-end.

Shore Gold Inc. has a 100% working interest in a 4662-ha diamond project at the south end of the Fort à la Corne kimberlite trend where two kimberlites have been identified. The "western" kimberlite has a promising, visually distinct, higher-grade zone near the top of the kimberlite/sediment sequence. A Phase II drill program took a mini-bulk sample of several tonnes while continuing the program of definition and exploratory drilling.

Mining Lands Initiatives

To maintain the competitiveness of Saskatchewan in the resource sector and ensure relevant regulations are in place to address evolving exploration technology, a number of regulations will be reviewed this year, including The Quarry Regulations 1957, The Subsurface Mineral Regulations 1960, and The Alkali Mineral Regulations 1954. Consultation with industry remains a critical part of all regulatory reviews. Revisions to The Mineral Disposition Regulations, 1986 are expected this year following additional consultation with industry.

The pilot project of digitizing disposition maps is in its final stages and it is anticipated that all maps will be converted and available to the public in digital form by year-end. To assist companies and individuals in their mineral exploration and development plans, a document outlining provincial and federal regulatory requirements for mineral exploration and development is being prepared. The Department of Energy and Mines is also working with Natural Resources Canada to establish a one-window approach to collecting mineral statistics and is actively involved in a number of integrated land-use planning projects whereby mineral assessment of the area is undertaken prior to land designation. The Treaty Land Selection process is continuing smoothly, and the Department has reviewed all outstanding Crown Reserves initially identified under the Treaty Land Entitlement process and has re-opened those that were no longer required.

5.9 ALBERTA

Exploration Review

Diamond exploration continues to be the driving force in Alberta's mineral sector. The Department of Energy received a record number of permit applications in 1997, surpassing the totals of the previous staking rush in 1992/93. In 1997, there were 4135 applications for permits filed with the Department covering an area of over 37 million ha. This brought the total lands under permit or application to over 45 million ha, or almost 90% of the available Crown lands.

Ashton Mining of Canada, with partners Pure Gold Minerals and Alberta Energy Company (AEC), continue to explore on their 11 million ha block of permits in the Buffalo Head Hills in northern Alberta. By the end of the 1997/98 winter drilling season, Ashton had discovered 23 kimberlites, many of which were diamondiferous. In initial sampling, two of the more

promising pipes were K-14 and K-91. K-14 produced a rough grade of 36 ct/100 t from a sample of 8.17 t, while K-91 produced 80 microdiamonds and 12 macrodiamonds from 117 kg of core. Through various drilling methods, Ashton has collected bulk samples from these two kimberlites. The smaller 40-t sample from K-91 was sent to Ashton's North Vancouver laboratory for processing, while the 450-t sample from K-14 was stored awaiting the installation of a sample treatment plant on site. Work continues this summer on a number of previously discovered pipes and other anomalies.

New Claymore Resources has significant mineral holdings in the area surrounding the Ashton discovery. The company has entered into joint-venture agreements with a number of other companies including Abaddon Resources, Lucero Resource Corporation, Everest Mines and Minerals, Primero Resources, and Blackrun Ventures, and they have conducted airborne geophysics over much of the area. New Claymore is proceeding with a drilling program on the northern part of the Buffalo Head Hills this summer.

Monopros Limited started the first diamond-related staking rush in Alberta in late 1992. After finding the Mountain Lake diatreme in 1993, however, the company diverted its efforts to other parts of Canada. Monopros has now returned to exploration in the province through a joint venture with Troymin Resources. Troymin has a number of permit blocks around the Ashton/Pure Gold/AEC discoveries.

A number of other independents and junior companies are also conducting work on lands throughout the province. Birch Mountain Resources continues to explore the metallic potential of its properties north of Fort McMurray, having conducted geochemical and aeromagnetic surveys in 1997. Tintina Mines has also conducted extensive exploration and assessment work on holdings in this area, concentrating on black shale sequences containing large, low-grade metal enrichment zones situated around volcanic centres.

It is expected that exploration activity in Alberta in 1998 will be the highest it has been in many years with diamond exploration expenditures possibly reaching $20 million to $25 million.

Sayers Securities Limited reported that the oil and gas industry raised $318.3 million through flow-through shares in 1997. This was a 14.8% rise from the 1996 level of $277.2 million. Flow-through shares appear to continue to be a popular method of raising equity funds for the industry. The level of financing indicates that the changes introduced in the March 6, 1996, federal budget did not have a substantial negative impact on the use of flow-through shares.

5.10 BRITISH COLUMBIA

Summary and Outlook

The new and more comprehensive federal-provincial survey format has resulted in a significant change in the reporting of exploration expenditures in British Columbia (B.C.). **Table 17** compares both the “old” and “new” survey-based results covering 1996 and 1997 expenditures and 1998 projected spending.

By either survey base, this chart indicates that B.C.'s exploration spending during the last two years (1996 and 1997) and its projected spending in 1998 is around $100 million, fluctuating by ±10% year on year. The difference between the “old” and “new” figures is explained by the newly included exploration spending category covering engineering, economic and feasibility studies.

The new federal-provincial survey projects $119 million of exploration spending in 1998 (**Table 17**). When this exploration survey was conducted at the end of 1997 and the beginning of 1998, many companies provided exploration projections “subject to” raising financing in the spring of

TABLE 17. BRITISH COLUMBIA, ANNUAL EXPLORATION SPENDING AND PERCENT CHANGE, 1996-98

		1996 Actual	1997 Preliminary	1998 Projected
Old survey	$ million	105	97	103
% change		. .	–8	+7
New survey	$ million	. .	113	119
% change		. .	. .	+5

Source: British Columbia Ministry of Employment and Investment Statistics.
. . Not available.

1998. At that time, increases in gold and copper price levels were expected to occur. Prices have remained low and the tracking of the first half of 1998 exploration activities by the B.C. Mineral Development Office (MDO) in Vancouver indicates that spending may be down considerably. Mid-year estimates indicate that total exploration expenditures may be 25% to 50% of the projected $119 million.

New Mining Initiatives in British Columbia

In recognition of the challenges facing the mining industry, and after consulting with industry, labour, other government ministries and stakeholders, the Government of B.C. announced four new mining initiatives on April 21, 1998:

- The *Mining Rights Amendment Act*, recognizing the right to mine, and assuring access to mineral tenures, the right to compensation when tenures are expropriated for parks, and timely permitting;

- The *Mineral Exploration Code*, creating a one-agency approach for permit approvals, and applying environmental protection standards designed specifically for exploration;

- Creating a Mining Advocate position; and

- Introducing a refundable Mineral Exploration Tax Credit worth up to $9 million annually.

In addition, the new mine allowance that provides a one-third gross-up of capital costs for new mines in B.C. for mineral tax purposes was extended to all new mines that begin production before January 1, 2010, rather than 2000.

The high mineral endowment of B.C.'s Cordillera and the existence of both high-grade mines such as Eskay Creek (1-2 oz/st, 34-68 g/t) and large-volume developments such as Kemess (45 000 t/d for over 15 years) will continue to attract exploration dollars to B.C. Therefore, as mineral commodity prices rise, exploration spending is expected to accelerate.

The proof of a successful exploration process lies in the development of new mines. The provincial government has assisted in some cases with loan financing for mineral developments and infrastructure that have totaled more than $175 million over the past year and a half. Three new mines, Golden Bear, Mt. Polley and Huckleberry, came on stream last year and a fourth, Kemess, has begun production. Its official opening is expected later this year. In addition, the completion of an on-site mill at the Eskay Creek mine will further increase the province's value of mineral production.

Statistical Analyses

The analyses of 1996 and 1997 exploration activities and the anticipated expenditures in 1998 highlight four points:

- Lower gold and copper price levels, sustained from the latter part of 1997 through to mid-year 1998, have had an impact on exploration spending.

- B.C. may be experiencing a trend towards reduced grassroots or generative exploration spending, which would adversely impact a long-term, sustainable mining industry. The MDO has estimated that the share of total exploration dollars on generative projects dropped from 12% in 1996 to 6% in 1997. While the share of grassroots spending may increase in 1998, the dollar level may remain the same as in 1997.

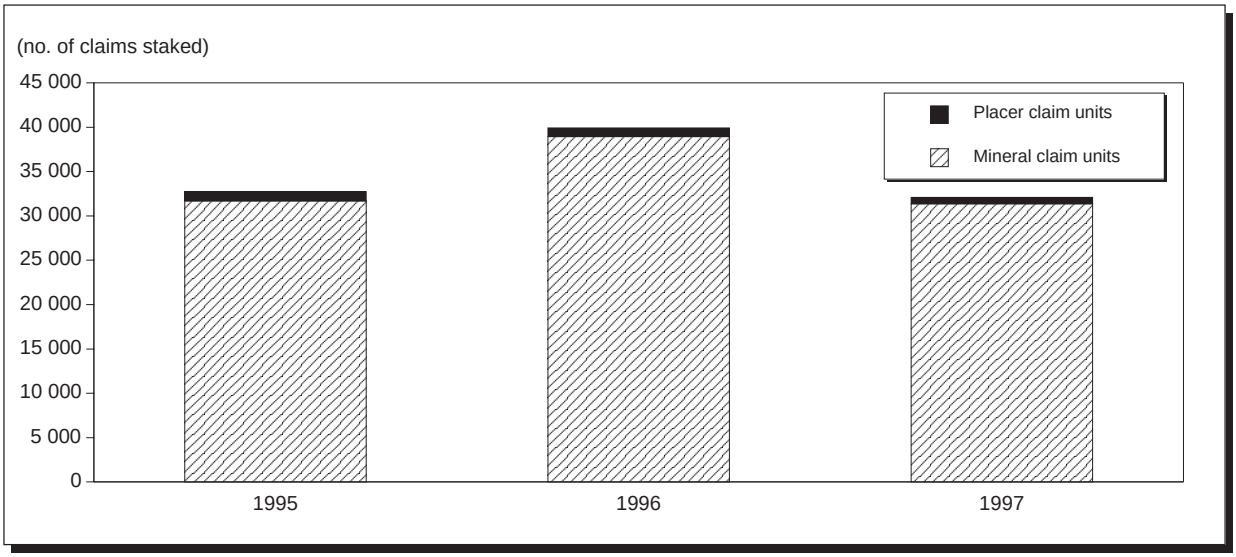
- Alternately, 15 years of recorded B.C. exploration spending shows that it is highly variable from one year to the next. To a large extent, exploration activity is driven by gold and copper (base-metal) price levels and financial incentives. In the event that these price levels increase, and with recently announced government incentives, exploration can be expected to increase over the longer term, maintaining a viable mining economy. To a lesser extent, increases in lead, zinc, silver and coal price levels will also improve exploration spending in B.C.

- B.C. has over $25 billion in known mineral inventory associated with currently active advanced exploration projects, and is in a reasonably competitive position internationally to attract sustained exploration activity.

Table 17 shows an 8% reduction in exploration spending from 1996 to 1997 (from $105 million to $97 million). Coinciding with this decrease is a reduction in both claim staking and the issuing of Free Miner Certificates (**Figures 20** and **21**).

In the first five months of 1998, both claim units staked and Free Miner Certificates issued are lower than those during the same period in the previous three years. These lower activity levels may persist, along with lower mineral price levels, for the balance of 1998; however,

Figure 20
Mineral and Placer Claim Units Staked in British Columbia, 1995-97



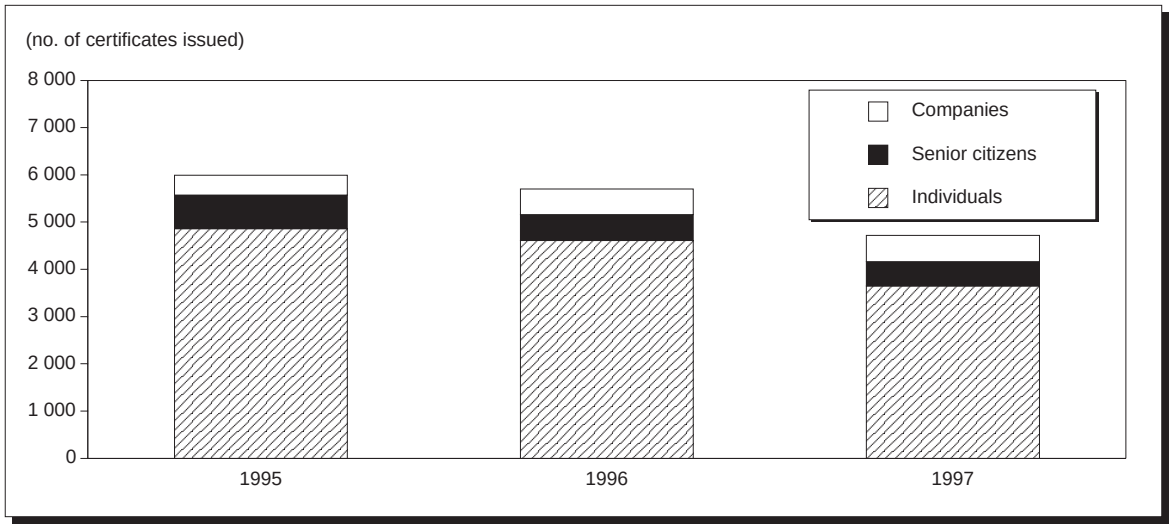
Source: British Columbia Ministry of Energy and Mines, Mineral Titles Branch.

increased exploration might also take place since the bulk of claim staking is carried out during the summer months and there may be a near-term response to the new government incentives being implemented during the summer of 1998.

Figures 22 and **23** show exploration spending by deposit type and by region in 1996 and 1997.

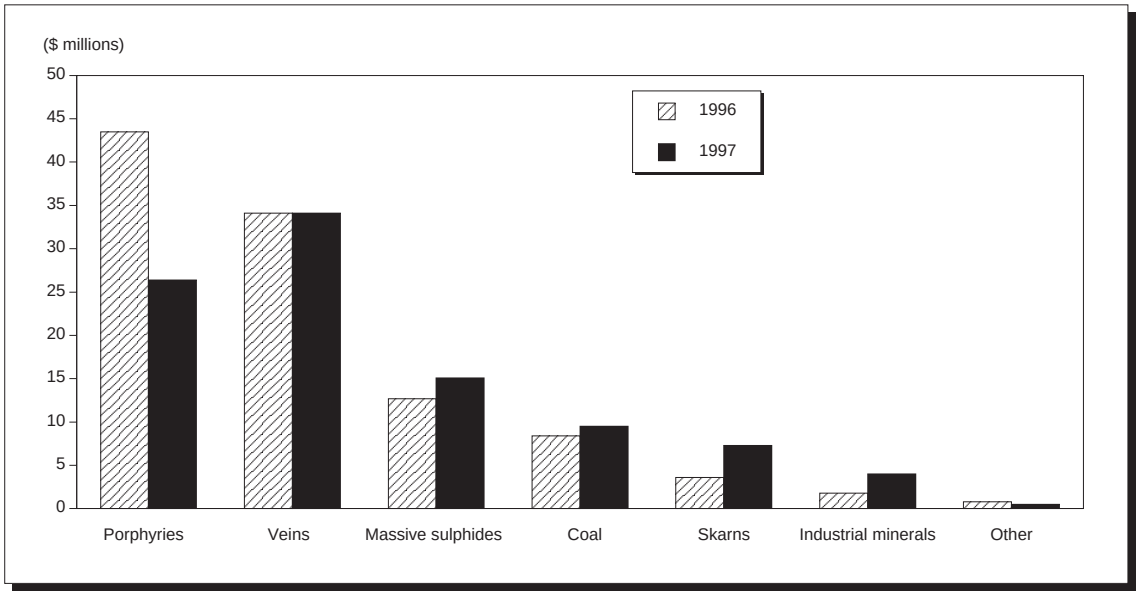
As indicated in **Figure 22**, the majority of spending in both years was focused on metals discoveries, rather than on coal and industrial minerals. This further supports the fact that exploration

Figure 21
Free Miner Certificates Issued in British Columbia, 1995-97



Source: British Columbia Ministry of Energy and Mines, Mineral Titles Branch.

Figure 22
Exploration Spending by Deposit Type in British Columbia, 1996 and 1997



Source: British Columbia Ministry of Energy and Mines, Geological Survey Branch (Information Circular 1998-1).

spending in B.C. is heavily dependent on gold and copper (or base-metal) price levels. Although the right-most bar (see "other" category) on this chart is the smallest, it represents an important indicator of metals diversity in B.C. since it includes significant spending on magmatic nickel deposits. Comparing the two years, spending on porphyry targets is down and spending on skarns is up. This reflects the search for higher-grade deposits during a period when gold and copper price levels are low.

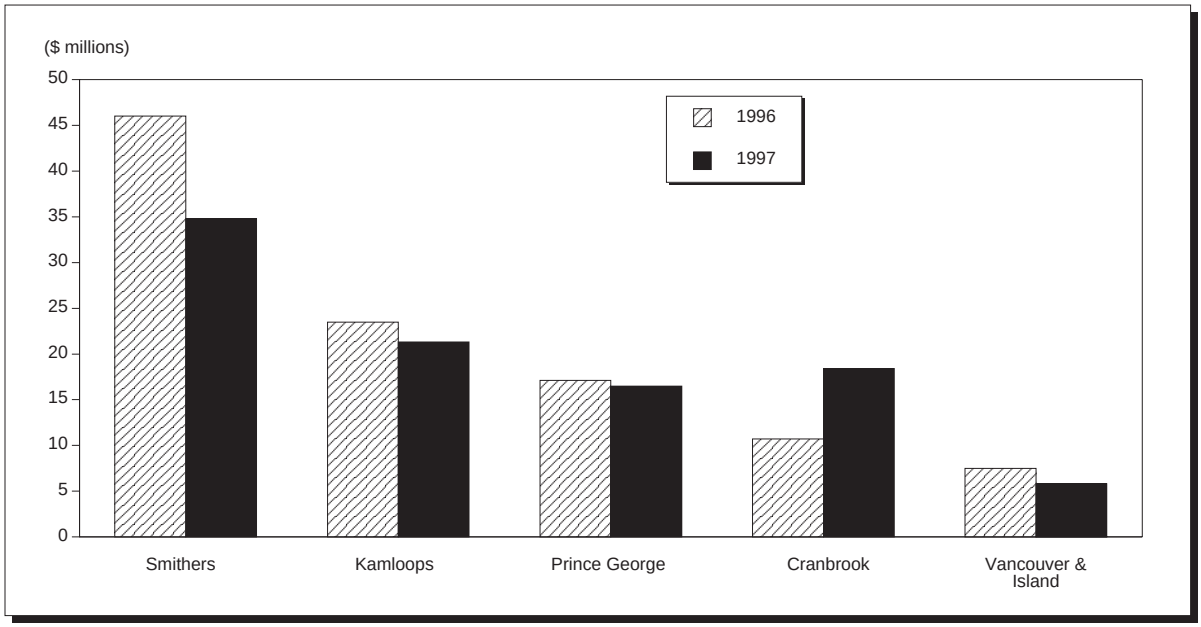
Figure 23 shows a significant increase in spending in the Cranbrook region and a decrease in the Smithers region between 1996 and 1997. While metallogenic potential is well known in both regions, the Cranbrook region is more road accessible, which helps to lower exploration costs when financing is tight. This region also holds potential for another Sullivan-type deposit.

The next three diagrams are future oriented, comparing 1997 expenditures with those projected for 1998. **Figures 24** and **25** contain information from the new federal-provincial survey. Although interpretation of this information is limited in the first year of the survey, after a few years of scrutiny, the ratios of "Exploration to Deposit Appraisal to Mine Complex Development" and "off-mine-site to on-mine-site" spending are expected to be valuable indicators of industry activities.

Total exploration, deposit appraisal and mine complex development spending is expected to drop by 14% from $163 million in 1997 to a projected $140 million in 1998. **Figure 24** shows deposit appraisal spending increasing substantially (by $15 million) and spending on mine complex development decreasing (by $30 million). Since the change in deposit appraisal is accounted for by only five projects, and that of mine complex development by only four major projects, it is apparent that significant volatility can be expected in year-on-year expenditures in each of these categories. The broadly based dollar decrease ($8 million) in the exploration category reflects the actions of many companies and is consistent with the MDO's mid-year forecast of decreased exploration in 1998.

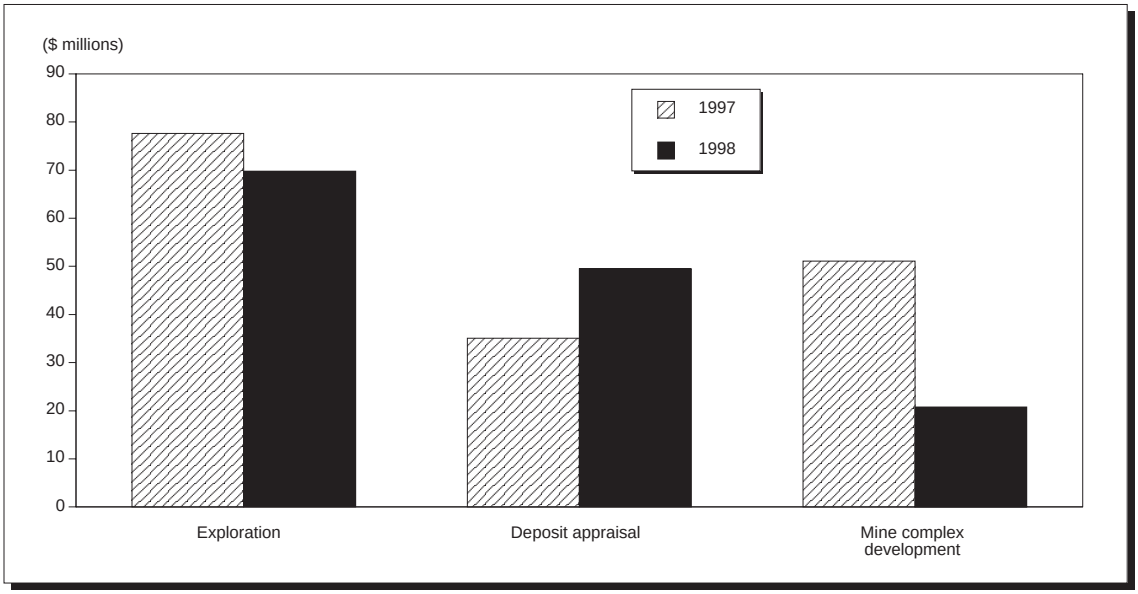
Figure 25 indicates that most of the exploration dollars spent on general exploration and deposit appraisals in B.C. went to "off-mine-site" projects. This indicates that most exploration dollars are targeted at either new deposits or rejuvenating old mining camps and shelved mineral deposit inventories.

Figure 23
Exploration Spending by Region in British Columbia, 1996 and 1997



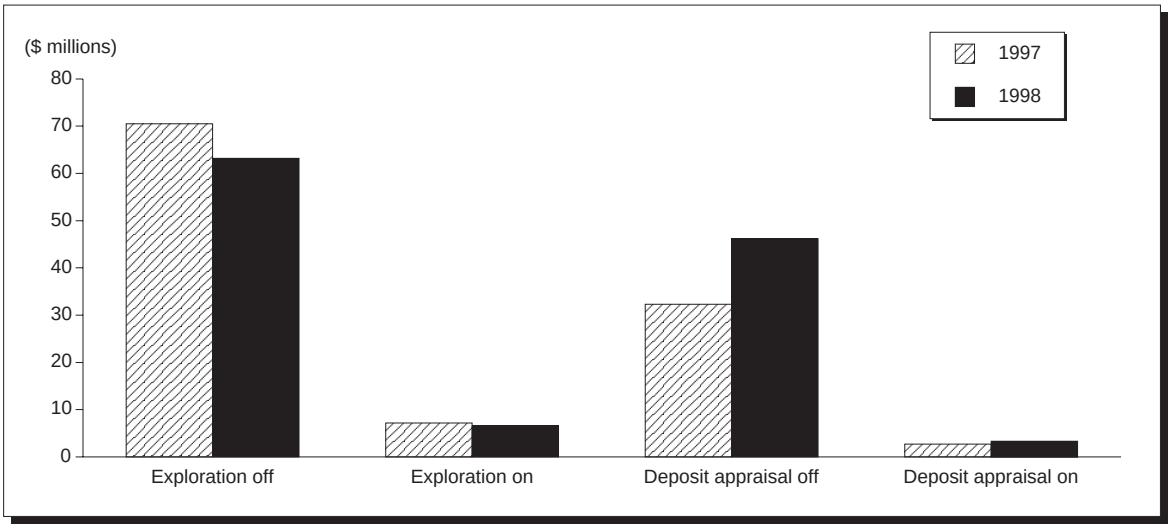
Source: British Columbia Ministry of Energy and Mines, Geological Survey Branch (Information Circular 1998-1).

Figure 24
Exploration and Development Spending[1] in British Columbia, 1997 and 1998 (Projected)



Source: British Columbia Ministry of Energy and Mines.
[1] Categories defined by new exploration survey.

Figure 25
"On" and "Off" Mine-Site Spending in British Columbia, 1997 and 1998 (Projected)

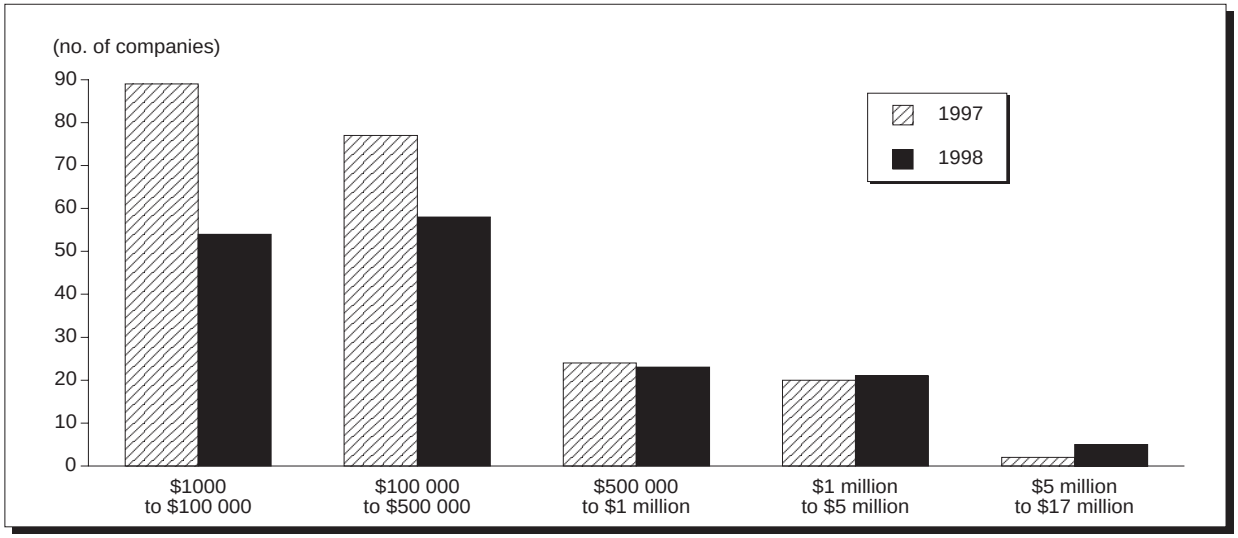


Source: British Columbia Ministry of Energy and Mines.

Figure 26 also compares 1997 spending with that projected in 1998. If a decline in the number of companies completing grassroots spending persists (as indicated by the two lower-expenditure categories), then fewer generative projects over a number of years could lead to an unsustainable mining economy.

In **Figure 26**, the total number of companies surveyed are grouped into five categories according to their total expenditures. There is an appreciable fall-off in spending (between 1997 and

Figure 26
Number of Companies in Each Category of Exploration Spending in British Columbia, 1997 and 1998 (Projected)



Source: British Columbia Ministry of Energy and Mines.

1998) in the two lowest expenditure categories. This reflects a definite drop in grassroots or generative spending compared with more advanced exploration and development projects in the three highest spending categories.

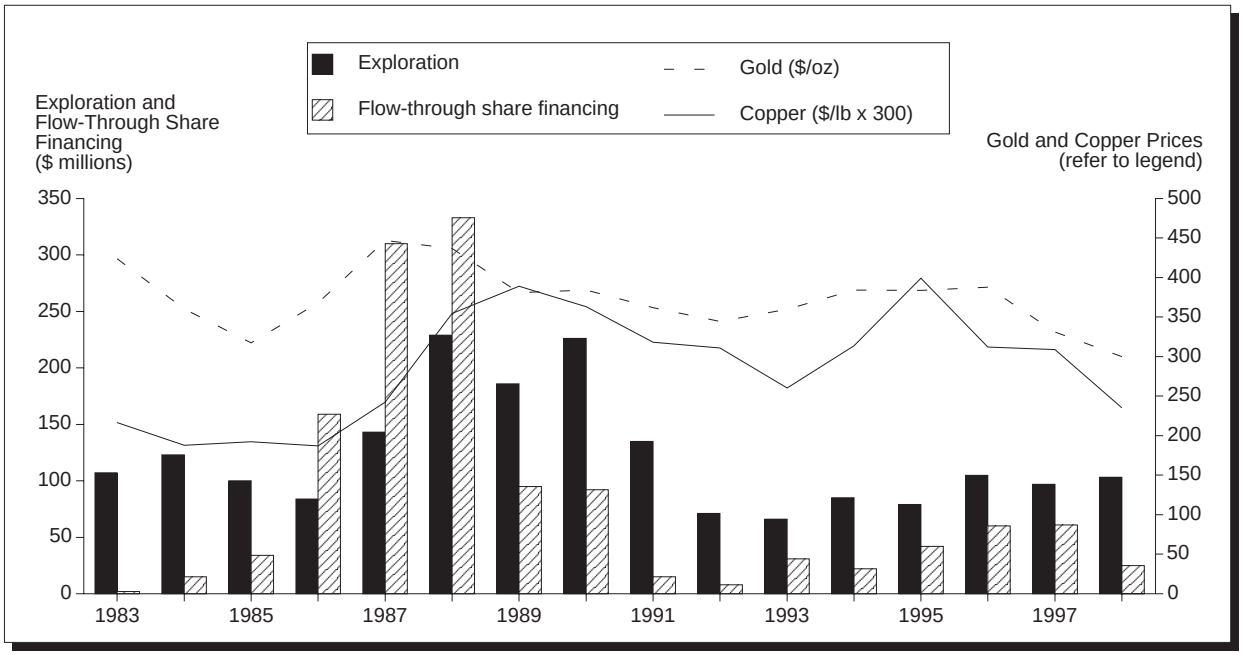
Taking a long-term view, the analysis of the last 15 years of exploration spending (1983 to 1997) plus projected 1998 expenditures shows that exploration in this province is highly variable year-on-year and correlates with gold and copper price levels and financial incentives. This is illustrated in **Figure 27**. The two price series (gold and copper) are shown as lines and both exploration spending and flow-through share financing are shown as bars. Minimum to maximum annual spending has ranged widely from $66 million to $229 million, and the average annual spending at $121 million has a standard deviation range of ±$51 million.

An analysis of this time series data reveals that exploration expenditures are most highly correlated with financial incentives and then gold and copper (or base-metal) price levels, in that order. The correlation coefficients of exploration spending with flow-through share financing, the gold price and the copper price are .59, .45 and .41 respectively. The correlation coefficient between flow-through share financing and the gold price is .63, indicating that increasing gold prices encourage companies to take advantage of financial packages. This is one of the reasons that the B.C. government has implemented the Mining Exploration Tax Credit.

Two important "natural" factors give strong assurance for long-term exploration successes in B.C. The first is the province's endowment of highly diversified mineral deposit terranes (in terms of metals and industrial and energy minerals), and the second is the substantial mineral endowment of the Cordilleran crust. These strengths are indicated in **Figure 28**, which shows the estimated "in-ground values" (i.e., IGV = grade x tonnage x price) of B.C.'s advanced exploration projects (metals and coal only). Prices used in the calculations were $300/oz of gold, $5/oz of silver, $0.75/lb of copper, $4/lb of molybdenum, $0.25/lb of lead, $0.45/lb of zinc and $40/t of coal. Note that the Prosperity gold-copper project is missing from the chart since its total in-ground value of $5.4 billion ($2.8 billion of gold and $2.6 billion of copper) would plot at over two times the height of the current chart.

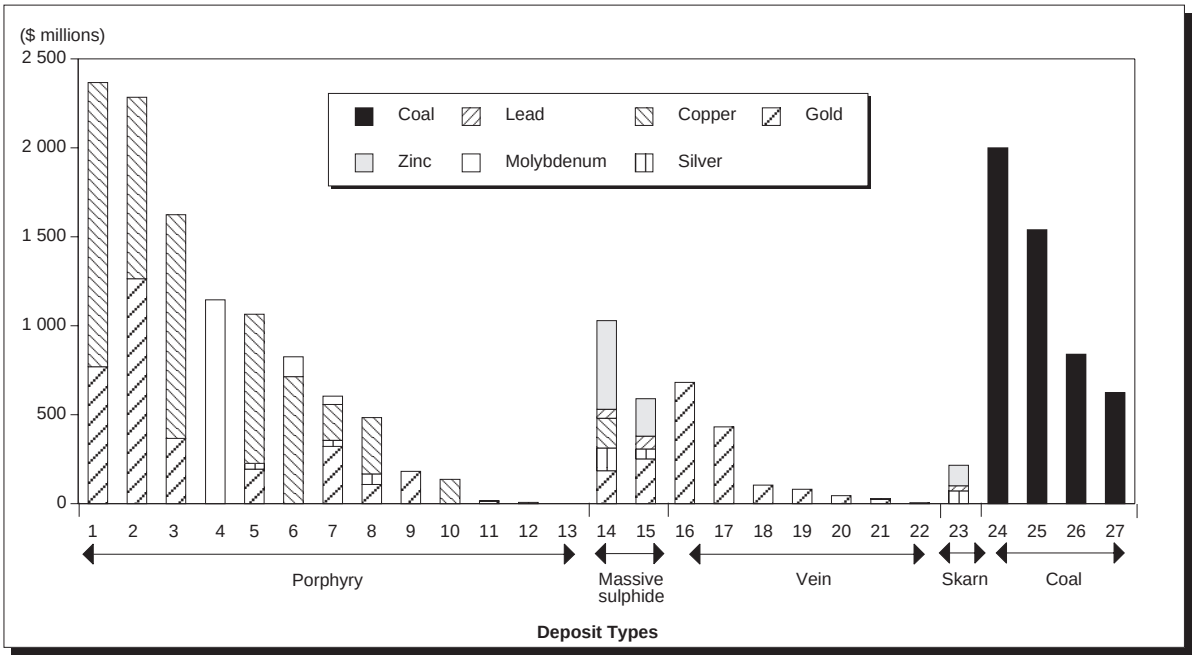
This "mineral inventory," which totals $25 billion (at today's lower commodity prices), only represents advanced projects that are currently being explored. In addition, B.C. hosts substantial

Figure 27
Correlation of Exploration Expenditures and Flow-Through Share Financing with Gold and Copper Price Levels, 1983-98



Source: British Columbia Ministry of Energy and Mines.

Figure 28
In-Ground Value of British Columbia's Advanced Exploration Projects At June 1998 Prices



Source: British Columbia Ministry of Energy and Mines, Statistical Section and Geological Survey Branch (Information Circular 1998-1).
Note: The Prosperity project (gold, $2832 million; copper, $2634 million) is not shown since it would distort the graph.

additional values in its other less advanced current exploration activities and other known resources of "shelf inventory." The implications are that the province has considerable mineral inventory that is internationally competitive, and that B.C. should continue to attract and retain globally oriented exploration companies.

New Mines, Operational Expansions and Development-Stage Projects

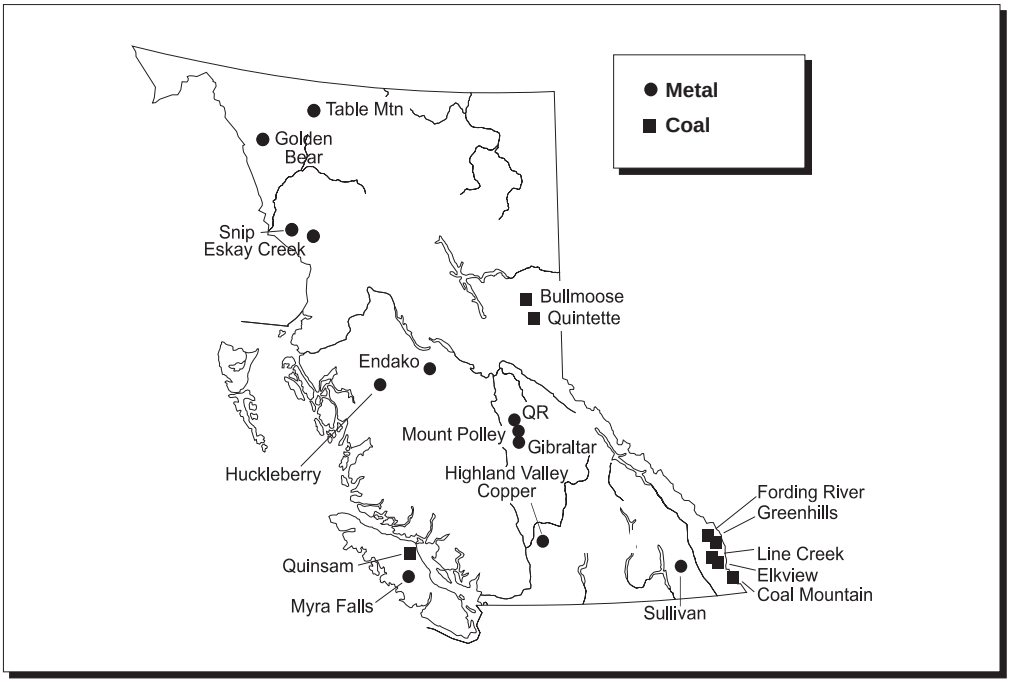
Two new open-pit porphyry copper-molybdenum-gold mines (Mt. Polley and Huckleberry), one heap-leach gold operation (Golden Bear), and one significant mill expansion (Eskay Creek) highlighted metal mine developments in 1997. The total capital cost for these projects was approximately $284 million, and about 430 jobs were created.

In addition, final phases of construction at the Kemess South porphyry gold-copper mine in the Toodoggone district are almost complete and production has begun. This mine is owned and operated by Kemess Mines Inc., a wholly owned subsidiary of Royal Oak Mines Inc. The capital cost of this project, which includes a new 380-km, 230-kilovolt electric transmission line, is estimated at $470 million.

The three location maps (**Figures 29, 30** and **31**) separate two groups of revenue producers, i.e., the operating metal and coal mines of **Figure 29** and the industrial mineral operations of **Figure 30**, from the advanced exploration and development projects of **Figure 31**. In order to complete the picture, two additional maps locate the less advanced coal and metal exploration projects of **Figure 32** (i.e., where only preliminary grades and tonnages have been estimated, if at all) and the industrial mineral developments and intermittent mining projects of **Figure 33**.

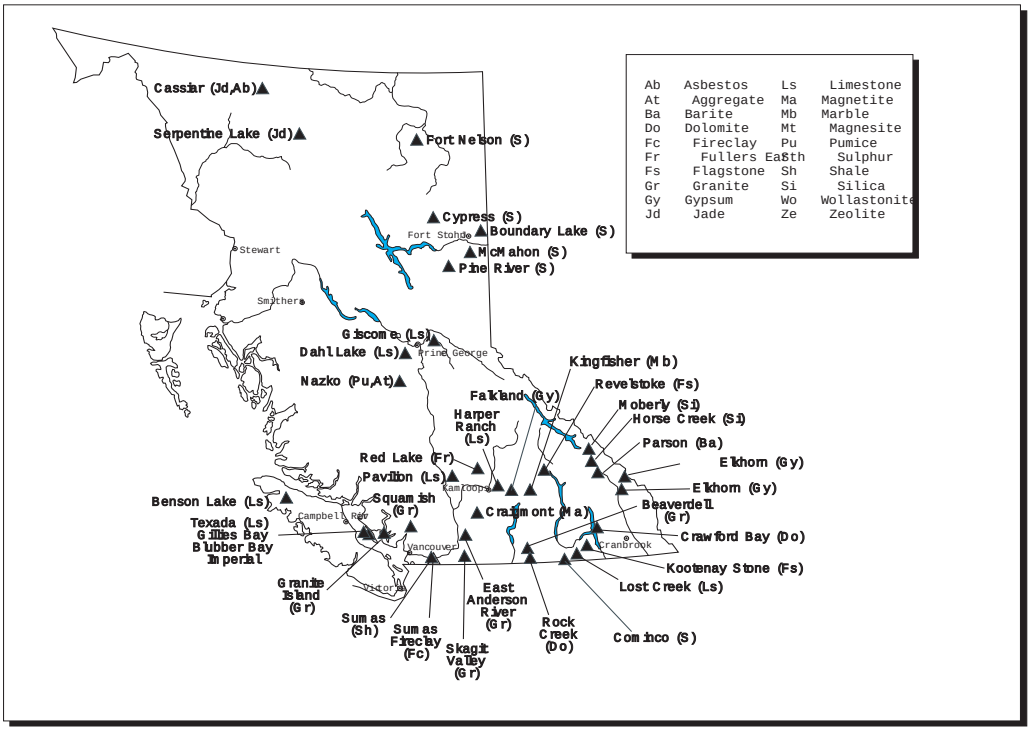
Note that detailed descriptions of current activities covering all of B.C.'s mining operations and exploration projects are documented in *British Columbia's Mineral Exploration Review 1997*, Information Circular 1998-1, prepared by the Ministry of Employment and Investment's Energy and Minerals Division.

Figure 29
Metal and Coal Mining Operations in British Columbia, 1997



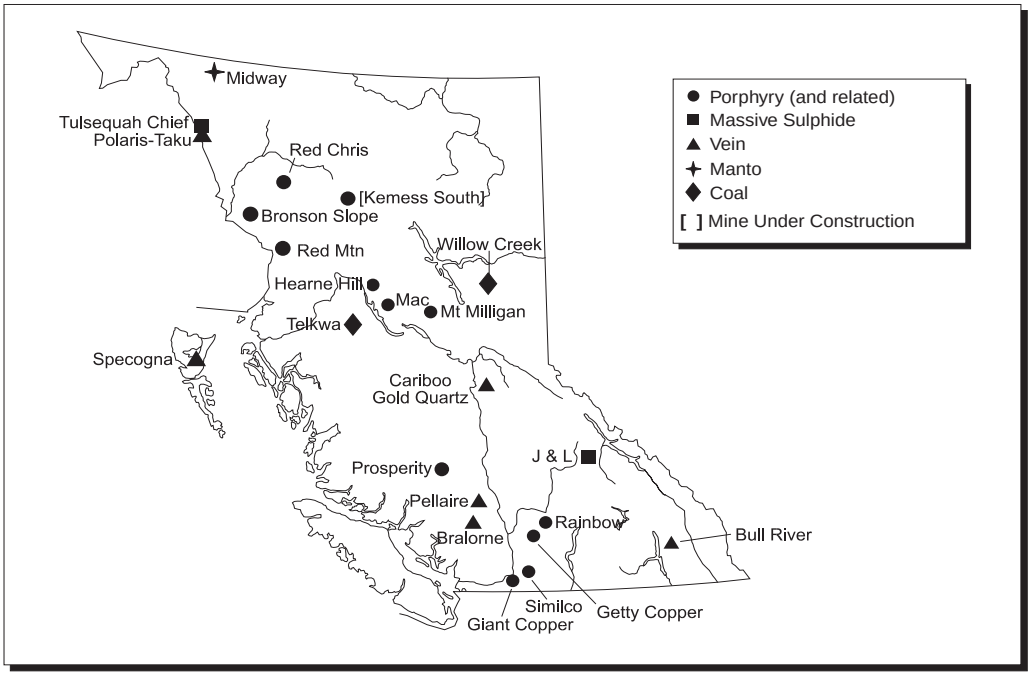
Source: British Columbia Ministry of Energy and Mines.

Figure 30
Industrial Minerals Operations in British Columbia, 1997



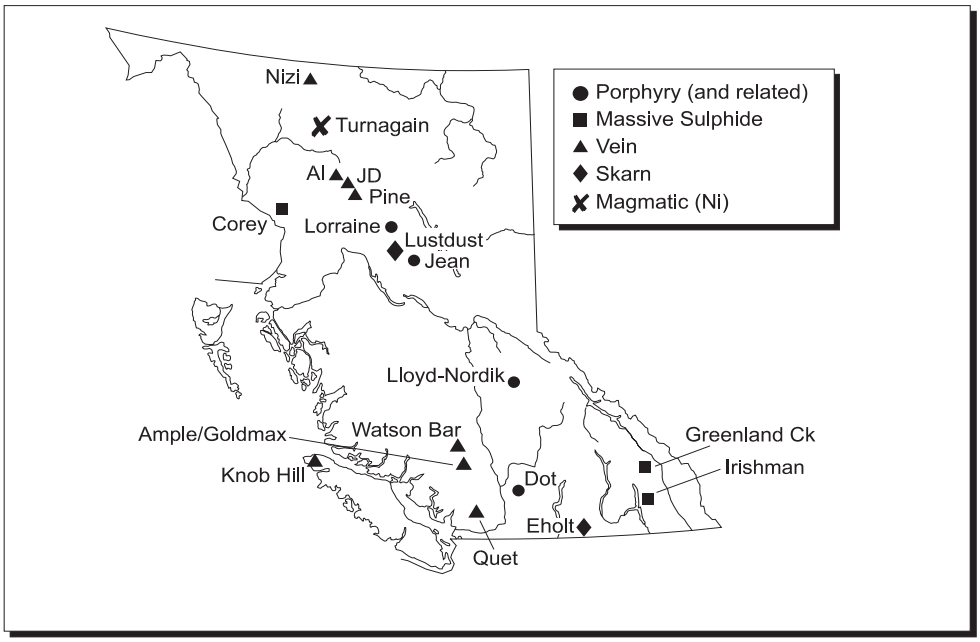
Source: British Columbia Ministry of Energy and Mines.

Figure 31
Metal and Coal Advanced Exploration and Development Projects in British Columbia, 1997



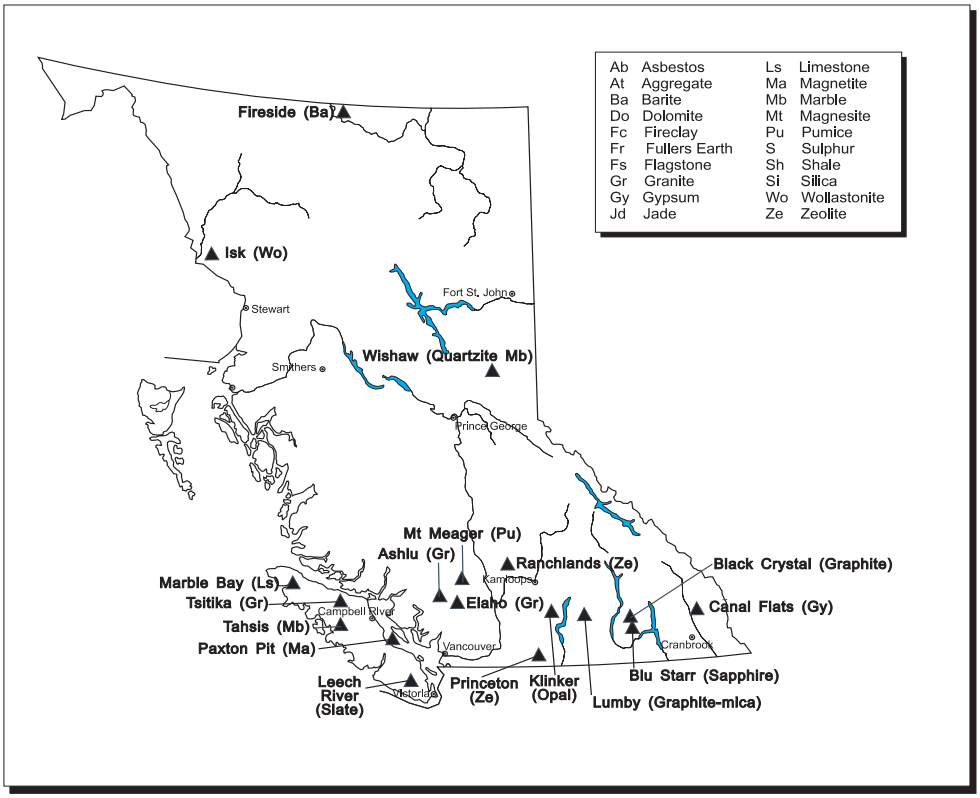
Source: British Columbia Ministry of Energy and Mines.

Figure 32
Metal and Coal Exploration Projects in British Columbia, 1997



Source: British Columbia Ministry of Energy and Mines.

Figure 33
Industrial Minerals and Intermittent Projects in British Columbia, 1997



Source: British Columbia Ministry of Energy and Mines.

Metal Exploration Projects

Advanced Exploration Projects

The largest exploration program was on the Prosperity porphyry gold-copper deposit where approximately $5 million was spent. Other large programs (of over $3 million) included Specogna, Getty Copper and Polaris-Taku. Several significant bulk sampling projects were carried out, for example, on the Pellaire, Telkwa and Debbie projects.

The Tulsequah Chief, Bronson Slope, Red Chris, Red Mountain, Prosperity, Telkwa and Willow Creek projects are in the environmental assessment process. The Cirque and Mt. Milligan gold-copper porphyry deposits have received Mine Development Certificates and await production decisions. Several other advanced projects are in the feasibility stage (e.g., Cariboo Gold Quartz, Specogna [Harmony], Getty North Copper, Hearne Hill, Isk, J+L, Silvertip [Midway], Giant Copper, and Polaris-Taku).

Exploration Projects

In addition to the advanced exploration projects, a large number of generally lower-budget programs took place, comprising an estimated 6% of total exploration expenditures in 1997. The majority of these projects targeted gold-enriched porphyry copper and porphyry-related gold deposits, polymetallic massive sulphide deposits, and vein deposits (epithermal and mesothermal). The remainder targeted metalliferous concentrations in skarns and mantos, and less traditional deposits such as ultramafic-hosted nickel and redbed copper.

Although most of the programs were focused in and around areas with mines, mines under construction, or new showings and existing infrastructure, several new, relatively low-budget regional programs were conducted throughout the province. The diversity of targets from large, world-class deposits to smaller but profitable targets, and the profitability of these smaller, higher-grade deposits, such as Eskay Creek and Snip, continue to make B.C. a good place to explore.

The less advanced metals and coal exploration projects are located on **Figure 32**.

Coal Exploration Projects

There were at least five coal exploration programs in 1997 that took place outside existing mine leases. Expenditures are estimated at approximately $1.8 million. Predictions for stronger thermal coal markets have led to renewed interest in coal deposits close to existing infrastructure, or in the case of Tsable River, close to tidewater. There is also a trend in demand away from hard coking coals to weak and semi-soft coking coals. Exploration was dominated by the Telkwa coal project, although significant programs were carried out at Willow Creek in the northeast and by Fording Coal Limited in the southeast.

The Tulameen program is an example of an opportunity for small players to move into the coal business, especially when larger companies drop coal licences because they are no longer interested in the prospective ground. Markets such as cement plants exist for small quantities of thermal coal in B.C. and Washington State.

Industrial Mineral Exploration Projects

Industrial mineral projects and intermittent mining situations are both numerous and diversified (in terms of the number of different mineral commodities being looked at). In 1997, industrial mineral exploration expenditures are estimated at approximately $3 million. **Figure 33** locates many of the industrial mineral projects.

Advanced Exploration Projects

Whitegold Resources Corporation conducted extensive field and laboratory programs on its Isk wollastonite property on Zippa Mountain in the Iskut River area. Quinto Mining Corporation Ltd. and IMP Industrial Park Mining Corporation continued market studies for graphite-sericite and graphite from their Lumby and Black Crystal (near Slocan) properties, respectively. Anglo Swiss Resources Inc. continued sampling and evaluating the economic potential of the Blu Starr/Blu Moon sapphire properties and other prospects in the Slocan Valley. Okanagan Opal Inc. continued small-scale test mining and marketing of precious opal from the Klinker locality near Vernon during 1997. A new precious opal find, hosted in vesicles of the Kamloops Group basalt, was made by Lloyd Nelson in the Vernon area.

Mining companies, as well as individual prospectors, are evaluating new dimension stone properties. A pilot plant to recover short-fibre asbestos from the Cassiar Asbestos tailings (16 Mt) has been assembled by BC Chrysotile Corporation. The company operated the plant for four days in late October producing 8 t of product, enough for its market testing.

On Texada Island, Consolidated Vananda Gold Ltd. constructed a processing mill and has approval to process a 10 000-t bulk sample of magnetite from the Paxton pit area. The mill will initially produce magnetite as a heavy medium for use in the coal industry. Magnetite has also been successfully tested as a sandblasting abrasive; it may be a substitute for silica sands in this application.

Exploration Projects

Many other less advanced industrial mineral projects were conducted, including projects targeting future production of bentonite, feldspar, feldspathic sand, glass wool insulation, silica sand, barite, diatomite, fluorite and other minerals.

Initiatives for Exploration and Mining in British Columbia

Mining Initiatives

In April 1998, the B.C. government announced four new mining initiatives aimed at creating jobs and investment in this sector.

- *The Mining Rights Amendment Act*, recognizing the right to mine, and assuring access to mineral tenures, right to compensation when tenures are expropriated for parks, and timely permitting;
- *The Mineral Exploration Code*, creating a one-agency approach for permit approvals, and applying environmental protection standards designed specifically for exploration;
- Creating a Mining Advocate position; and
- Introducing a refundable Mineral Exploration Tax Credit worth up to $9 million annually.

New Provincial Government Structures

In February 1998, the provincial government re-established a separate Ministry of Energy and Mines.

Also established within the past few months is the Ministry of Energy and Mines' Mineral Development Office in Vancouver. Its mission is "to attract, stimulate and promote mineral exploration, development and investment in British Columbia." Accordingly, the office acts as a point of contact and source of technical information for the exploration and mining industry.

Further, in recognition of the Province's goal of creating greater certainty for industry and investors, as well as for the First Nations, a new Aboriginal Relations Branch was established in January, located in the Ministry of Energy and Mines. Staff are dedicated to addressing First Nations' issues as they pertain to mineral and energy resource development.

Financial Assistance

Also significant are the government financings tied to new mine development, which have totaled over $175 million in the past 18 months. Numerous other government incentives have assisted, or are assisting, the viability and business health of this sector. For example, the Job Protection Commission, reporting to the Job Protection Commissioner, assists in preventing mine closures during periods of adverse business conditions and mineral commodity markets. Another initiative called "Power for Jobs" is a program that gives discounts in electricity rates in return for new investment and new jobs. Companies are invited to bid on power rates that are amenable to their proposed mineral developments.

Within the land-use programs, over 80% of B.C.'s land usage has been, or is currently being, planned. With the approval of each new plan comes greater certainty of areas open to exploration where active programs can take place, with assurances that tenures will not be withdrawn for park purposes.

The Prospectors Assistance Grant Program, budgeted at $500 000, was designed to promote grassroots prospecting. Forty-seven grants were awarded in 1997 and an additional $40 000 was issued to six industry organizations to help them deliver training programs for prospectors.

Geological Survey

The Geological Survey Branch's projects focused on regions where significant mineral potential is indicated. (These include Gataga North, Devono-Mississippian massive sulphide deposits in northern B.C., Toodoggone Southeast-McConnell, Babine, Sitlika, Kootenay Terrane [Eagle Bay] and Yahk-Creston.) A new project is investigating the existence of and potential for Carlin-type deposits. A modest new project examined the province's nickel potential. Results of these programs are expected to encourage base- and precious-metal exploration in these areas and elsewhere. Several smaller-scale projects were carried out on coal and industrial minerals. The most immediate indicator of the success of these programs is the acceleration in claim-staking activity at the time that new geological information is released.

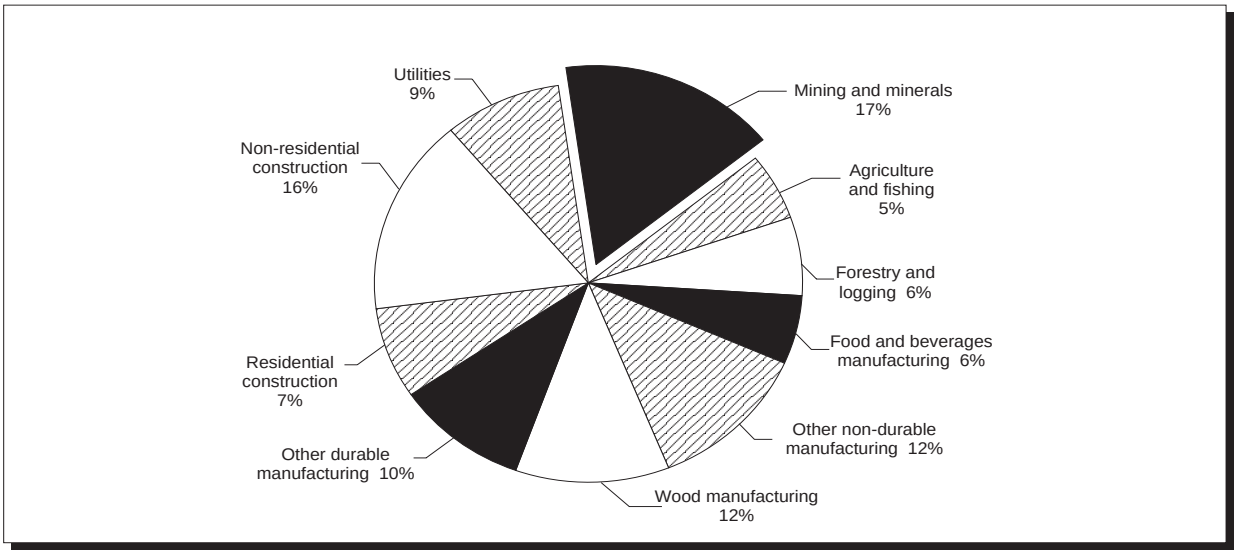
The Geological Survey Branch also plays an important role in bringing exploration people together through the "Pathways 98" meeting, an international forum held in Vancouver in January each year.

Conclusion

As shown in **Figure 34**, the mining and minerals industry comprises 17% of the provincial business economy (1996 GDP calculation). In recognition of the importance of the mining sector to British Columbia's economy, it is a key objective of the provincial government to maintain and encourage a sustainable mineral sector.

This requires vibrant and effective exploration programs and development projects. With the province's new mining initiatives and an "in-ground mineral inventory" of over $25 billion from currently active advanced exploration projects alone, the province is competitively positioned among the world's top mining jurisdictions to continue to attract exploration dollars.

Figure 34
Business Sector Gross Domestic Product (GDP) in British Columbia, 1996



Sources: British Columbia Ministry of Energy and Mines; British Columbia Statistics (Ministry of Finance).

5.11 NORTHWEST TERRITORIES

1997 Mineral Production Summary

The low gold prices took their toll on production in the Northwest Territories (N.W.T.) in 1997, leading to the closure of two gold mines. However, the N.W.T. maintained an 8% share of Canada's gold production in 1997, compared to 8.2% in 1996. The total N.W.T. share of Canadian metal production value was up to 4.7% from 4.4% in 1996 due to an increase in the base-metal (zinc and lead) production share. The N.W.T. produced 16.5% of Canada's zinc, 14.7% of its lead and 1.5% of its silver.

The total value of metal shipments from the N.W.T. increased to $535 million in 1997 from $521 million in 1996. Gold and zinc remain the primary metallic products of the N.W.T.

The N.W.T. remains the fourth largest gold producer in Canada, despite a decline in its total production value from $221 million in 1996 to $200 million in 1997, representing 37.3% of the total value of N.W.T. metal production. Part of this decline may be attributed to a lower realized gold price in 1997. Zinc is still the most valuable metal commodity produced in the N.W.T. with a 1997 value of $310 million, representing 57.8% of total N.W.T. metal value. The N.W.T. is Canada's third largest zinc producer. Lead shipments decreased in value to $21 million, compared with $30 million in 1996. Silver production in the N.W.T. remains minor with a total value of $3.8 million in 1997.

1997 Exploration Summary

Total exploration spending in the N.W.T. decreased in 1997 for the first time in the last seven years to $152 million from $195 million in 1996. The N.W.T. ranked second in Canada for total expenditures.

A total of 2291 claims covering 2 million ha were staked in 1997. The number of claims in good standing at the end of December 1997 was 15 456 claims covering 12.9 million ha, a net decrease of 1705 claims. Ninety-seven new mining leases were issued in 1997, for a total of 977 mining leases in good standing at the end of the year covering 0.4 million ha. A total of 84 prospecting permits were issued in 1997, with 549 permits in good standing at December 31, 1997, covering 11.5 million ha.

Slave Province: Diamonds

BHP Diamonds Inc. and Dia Met Minerals Ltd. began construction of mine infrastructure at their Lac de Gras project. The project was named the Ekati mine in October and production is expected to begin in the latter part of 1998. Five pipes are scheduled for development over the 17-year mine life. These are the Fox, Koala, Misery, Panda and Sable pipes. Exploration work in 1997 discovered 23 additional pipes; 100 pipes are now known to exist on the property. Sampling and delineation drilling were conducted on the Beartooth and Koala North pipes. Initial results showed microdiamonds comparable to those of Koala and Panda. Future bulk sampling of these relatively small pipes is likely.

Diavik Diamond Mines and Aber Resources Ltd. began an $80 million prefeasibility study of the Diavik project considering the four pipes: A-154 North, A-154 South, A-418 and A-21. Reserves were re-evaluated as the result of a 1996 3000-t bulk sample from A-418 and large-diameter core (LDC) drilling in A-154 South and A-21. Five LDC holes were drilled into each of the two pipes. In July 1997, an updated resource was issued (**Table 18**).

TABLE 18. RESOURCE INFORMATION FOR THE DIAVIK PROJECT, JULY 1997

Pipe	Resource	Resource Classification	Grade	Value per Carat
	(Mt)		(ct/t)	(US$)
A-154 North	11.5	Indicated/inferred	1.9	35
A-154 South	11.4	Measured	4.6	63
A-418	8.9	Measured	3.8	60
A-21	5.5	Indicated/inferred	2.7	. .

Source: N.W.T. Department of Resources, Wildlife and Economic Development, based on company data.
. . Not available.

Resources are cut off at sea level, a depth of approximately 400 m. A-154 South and A-418 have an additional 10% inferred resource below this cut-off.

In addition, an LDC hole drilled on the A-10 pipe recovered four diamonds, totaling 0.11 ct, from 6.66 t of kimberlite. Further work is planned for this pipe. Exploration drilling resulted in the discovery of four pipes: the A-840, the T-107, the diamondiferous A-11 North pipe, and a pipe on the boundary of the Diavik/BHP claim groups.

Ground geophysical surveys were conducted over 75 other targets, and till sampling continued across the property.

Lytton Minerals and New Indigo Resources Inc. continued their evaluation of the JD/OD-1 pipe on the Jericho property north of Contwoyto Lake. Nine thousand, four hundred and one tonnes (9401 t) of a 15 000-t bulk sample were processed at a pilot plant located at the Lupin mine. The sample yielded 10 539 ct with an average grade of 1.18 ct/t with a range of 0.30 to 1.96 ct/t. Sixty-seven diamonds larger than 5 ct were recovered, including one non-gem-quality stone of 41 ct and a gem-quality stone of 23.89 ct. A sample of 6550 ct was appraised by the Central Selling Organization (CSO) and evaluated at an average value of US$61.71/ct.

A preliminary study suggests that the JD/OD-1 pipe could be profitably mined with a 1650-t/d operation. Lytton and New Indigo also collected a 10.53-t mini-bulk sample from the JD/OD-3 pipe, located 7 km west of JD/OD-1. Kimberlite was sampled using PQ diamond drilling and

returned 7.34 ct for an average grade of 0.697 ct/t. Delineation drilling of the pipe outlined a preliminary resource of 10.5 Mt to a depth of 350 m.

Sampling and evaluation of geochemical and geophysical targets took place across the Jericho property.

Monopros Ltd. became the operator on the AK and CJ claim group, where it can earn a 60% interest from Glenmore Highlands Inc., Mountain Province Mining Inc. and Camphor Ventures Inc. Monopros collected 3600 till samples, mapped surficial geology, and flew 14 500 line-km of closely spaced heliborne geophysical survey over the southern AK claims. These data, when combined with previously known indicator mineral trains, led to the discovery of the Tesla pipe, 1.8 km northwest of the AK-5034 pipe. A total of 109 microdiamonds were recovered from 66 kg of core, with 8 not passing a 0.5-mm^2 mesh screen.

Two further pipes, the Tuzo and Hearne pipes, were discovered within 2 km of AK-5034. A total of 324 diamonds were recovered from 132 kg of Hearne kimberlite; 33 of these did not pass a 0.5-mm^2 mesh screen. Two of these were 0.2 ct each; twelve others exceeded 0.1 ct. A total of 403 diamonds were recovered from 124 kg of Tuzo kimberlite, including 36 larger than a 0.5-mm^2 mesh screen. Thirteen stones larger than 0.1 ct were recovered, including a 1.56-ct stone. Mini-bulk sampling on all pipes is planned for the 1997/98 winter season.

Slave Province: Gold and Base Metals

Kit Resources Ltd. spent an estimated $6 million over several properties in the Back River area. At the iron-formation-hosted George Lake gold deposit, a 143-hole, 15 450-m drill program was completed to confirm the previously determined resource of 3.16 Mt grading 13.4 g/t gold. A feasibility study was initiated in June to examine the economics of on-site versus off-site ore processing for a future mine. H.A. Simons Ltd. is undertaking a new resource calculation due to the changing gold market. The geological resource has been estimated at 1.4 Mt grading 13.8 g/t gold.

At Goose Lake, Kit Resources conducted a 26-hole, 4030-m drill program. Gold assay results from some holes include 214.39 g/t gold over 2.26 m, 28.34 g/t over 2.41 m, and 12.28 g/t over 13.92 m.

Kit Resources also drilled 15 holes (1620 m) on the Boot Lake property, and made a discovery at Llama Lake, 6 km west of the George Lake property.

Echo Bay Mines Ltd. drove and mapped a ramp at the Ulu project in the High Lake volcanic belt, and began underground drilling on the project. Work was suspended in the summer of 1997 due to low gold prices.

BHP Minerals Canada Ltd. proceeded with underground exploration at the Boston project in the Hope Bay volcanic belt. A preliminary gold resource of 93 000 kg (3 million oz) has been released.

BHP Minerals also conducted regional exploration at the Windy and Wolverine camps, 30 km north of Boston. Diamond drilling was undertaken on a number of claims.

Quest International Resources Corporation spent $1.5 million at the Damoti Lake project, located in the Indin Lake volcanic belt. A 21-hole late winter drill program discovered a new gold zone in the Bif Island area and expanded the Horseshoe zone. A summer program of 52 holes (8000 m) of diamond drilling was undertaken to further define the Horseshoe zone resource. Mineralization up to 274 m in depth was discovered, with high-grade intersections including 57.2 g/t gold over 5.71 m and 41.0 g/t over 14.52 m. The Horseshoe zone represents 3% of the iron formation on the property, and the geological resource is currently estimated at 7899 kg of contained gold. A fall drilling program as well as engineering and environmental studies were planned for late 1997.

Royal Oak Mines Inc. undertook a deep drilling project at the Colomac mine and associated showings. The discovered gold mineralization included intersections of 11.3 g/t gold over 6.36 m and 12.0 g/t over 43.3 m. At the Cass deposit, drilling returned wide intersections of 5-8.5 g/t gold.

GMD Resource Corp. spent $5.2 million at the Discovery gold mine project in the Yellowknife volcanic belt. A total of 80 000 m of diamond drilling in 86 holes was completed. Definition drilling was used to create a new resource for the Ormsby zone. Exploration drilling intersected volcanic and sediment-hosted quartz veins in the Ormsby area. Significant gold intersections include 110.36 g/t gold over 2.9 m, 69.64 g/t over 5.79 m, and 17.5 g/t over 14.02 m. High-grade channel samples were collected along a 121-m ramp into the deposit. In addition, 40 line-km of ground magnetics, 20 line-km of very low frequency electromagnetics (VLF-EM) and 1:2400 mapping were completed around the deposit.

Kivalliq Region

Comaplex Minerals Corp. drilled for gold in the Noomut project area, east of South Henik Lake. Drilling was concentrated in the Esker zone, in which gold mineralization is associated with quartz veins within gabbro dikes. Drill intersections included 8.18 g/t gold over 13.27 m and 2.35 g/t over 70.95 m. The Esker zone lies within a structure sub-parallel to the Napartok, Ironside and River zones of sheared, gold-bearing iron formation.

Cumberland Resources Ltd. drilled 13 600 m in 65 holes at its wholly owned Meadowbank River project, 65 km north of Baker Lake. Four iron formation-hosted gold zones were tested. The Third Portage zone has been extended beyond the previous resource estimate of 3.4 Mt grading 6.5 g/t gold. Extension has been to the west and at depth, and remains open. This drilling has also extended the near-surface resource potential. The Bay zone, a flat-lying, near-surface zone, was discovered during the 1997 drilling program. Intercepts up to 37.37 g/t gold over 4.3 m have been described. Preliminary engineering studies conducted at the end of 1996 suggest that 90% of the Third Portage zone could be mined using open-pit methods with a stripping ratio of 7.1:1.

At the Goose Island zone, 800 m south of the Third Portage zone, Cumberland intersected gold mineralization at 425 m below surface, grading 15.44 g/t gold over 3.2 m. Preliminary calculations for the Goose Island zone give a resource estimate of 977 000 t grading 11.46 g/t gold. Mapping on a scale of 1:5000 and 40 line-km of ground magnetometer survey were also undertaken. New resource calculations and metallurgical and engineering studies are under way.

Cumberland also drilled 22 holes totaling 2633 m on the Meliadine East property, 20 km north of Rankin Inlet, which is jointly owned with Comaplex. Geological mapping and 112 line-km of ground magnetometer survey were undertaken across the property. Frost boil, till sampling and lithogeochemical surveys were undertaken.

WMC International Inc., in a joint venture with Cumberland and Comaplex, drilled 103 holes totaling 32 770 m on the Meliadine West property, 30 km northwest of Rankin Inlet. The Tiririnak Central zone consists of two parallel mineralized zones, the Upper Contact zone and the Lower Shear zone, with an estimated gold content of over 35 000 kg. Drilling in 1997 has extended the Upper Contact zone, including intersections of 33.77 g/t gold over 9.0 m and 65.29 g/t gold over 2.69 m. In the Lower Shear zone, intersections of 11.9 g/t gold over 11.6 m and 23.5 g/t gold over 2.3 m were found.

Further drilling on the F zone and Wolf zone also returned good gold intersections. In addition, 1:5000 scale mapping and 2250 line-km of ground magnetic survey were carried out, and 2500 till samples were taken for gold grain analysis.

WMC plans to spend $5.9 million in 1998 for further diamond drilling and engineering as part of a prefeasibility study on the Tiririnak, Wolf and F zones. A further 3000 m of drilling are

planned for another segment of the Meliadine structural trend, including the Arseno Lake, VG Lake, Maggot Lake and Farwest showings. Grab samples from these zones taken in 1997 returned good gold values.

Baffin Island Region

International Capri Resources Ltd. drilled three zinc-lead showings on Baffin Island in 1997. It also conducted ground electromagnetic and magnetometer surveys over the three properties, plus 1:1000 scale mapping and soil sampling.

At the Fault Scarp showing, located near Keltie Bay, four holes totaling 72 m were drilled.

At the Nanuk volcanogenic massive sulphide occurrence on Ilikok Island, four holes totaling 156 m were drilled. The best intersection was 0.66% copper, 0.65% nickel and 13.03 g/t silver over 1.1 m. The nearby CP claim block was also prospected.

Two holes totaling 26 m were drilled in the 3-2 showing (formerly called the Burning Bush) on Cumberland Peninsula. On the nearby SNOWY claims, prospecting and ground electromagnetic and magnetometer surveys were performed. Further prospecting between the Nanuk and the 3-2 showings was undertaken.

Bear Province

Fortune Minerals Limited drilled 72 holes for a total of 10 500 m on the cobalt-bismuth-gold-copper-tungsten NICO property located near the Snare hydro-electric complex, 160 km northwest of Yellowknife. Significant polymetallic mineralization was intersected over a zone of between 45 and 139 m in width. The best combined grades are 2.0 g/t gold, 0.320% copper, 0.281% cobalt, 0.496% bismuth and 0.643% WO_3 over 3.28 m.

The drilling program tested the Bowl, East and John zones. Fortune reports an initial resource calculation for the NICO property based on 25 drill holes and trench samples. The resource calculation estimates 69.9 Mt grading 0.534 g/t gold, 0.073% bismuth, 0.069% cobalt, 0.065% copper and 0.028% WO_3. The Bowl zone has been further subdivided into a gold-rich resource of 9.8 Mt grading 3.385 g/t gold, a cobalt-bismuth-rich resource of 31.8 Mt grading 0.120% bismuth and 0.113% cobalt, and a copper-rich resource of 7.6 Mt grading 0.30% copper.

The deposit is amenable to open-pit mining techniques. Studies by Lakefield Research suggest that ore could be processed on site. Further resource calculations are in progress.

Fortune drilled 5000 m in 16 holes at the Sue-Dianne deposit, 20 km north of NICO. Drilling was undertaken to increase the previous resource estimate of 8.16 Mt grading 0.8% copper and 5.52 g/t silver. Good intersections for copper and silver were found, plus molybdenum, bismuth and copper. The deposit remains open at depth and along strike.

Rhonda Mining Corporation drilled 114 holes totaling 7905 m on the Esker zinc-lead property, 80 km south of Kugluktuk. Eighteen holes returned an average grade of 7.1% combined zinc-lead over 2.95 m. Rhonda also drilled the Harley copper-gold project, 60 km south of Kugluktuk. Average intersections of up to 2.55% copper plus 61.38 g/t gold over 3.6 m and 2.40% copper plus 99.10 g/t silver over 4.10 m were seen.

Cordilleran Orogen and Inner Platform

Darnley Bay Resources Limited contracted an 18 000 line-km aeromagnetic survey over the Darnley Bay gravity anomaly, exploring for Norilsk-style copper-nickel-platinum group elements mineralization. In 1998, Darnley Bay plans to undertake the second phase of this exploration, including ground geophysics and rock sampling.

San Andreas Resources Corp. carried out underground and surface exploration work at the Prairie Creek zinc-lead-silver deposit. The work included detailed channel sampling on the 870, 930 and 970-m levels, mapping of the vein structure, drill core examination and sampling. The southern claim group was mapped at a 1:2000 scale.

Current metallurgical research includes a detailed mineralogical study of vein ore, plus scoping tests to determine whether heavy liquids may be used to pre-concentrate ore prior to mill processing. An independent resource estimate of 1.846 Mt grading 12.5% zinc, 10.1% lead and 161 g/t silver was prepared for Zone 3.

5.12 YUKON

Overview

Exploration expenditures in 1997, at $35 million, were down from the $54 million spent in 1996. The exploration season was very successful, highlighted by a combination of new discoveries, positive results from several advanced projects, and a significant amount of claim staking as a result of grassroots exploration programs.

Mine development expenditures were $23 million, compared to the $54 million incurred in 1996. Development expenditures were incurred at the Yukon's three operating mines in 1997: the Faro lead-zinc-silver mine, the Brewery Creek gold mine, and the Mt. Nansen gold-silver mine. Development work also took place at the Minto copper-gold-silver project and a number of other projects that are in the final stages of permitting.

The number of quartz claims (hard rock mining) reached a new historical high of 72 723, with 9628 new claims recorded in 1997.

Production Summary

Brewery Creek Mine

The Brewery Creek mine was opened by Viceroy Resource Corporation in November 1996 and has proven to be a technical success. The mine successfully produced gold during its first winter of operation by utilizing heap leach technology in the extremes of a cold northern climate. Gold production during the first two months of operation, November and December 1996, totaled 316 kg (10 175 oz). A total of 2251 kg (72 387 oz) of gold were produced in 1997. A total of 13.3 Mt grading 1.44 g/t gold of mineable reserves remained as of March 1998. The eight low-grade oxide gold deposits at Brewery Creek are distributed over a 7-km linear trend underlain by Cretaceous Tombstone Suite quartz-monzonite sills and Devono-Mississippian greywacke of the Earn Group.

Mount Nansen Mine

In 1997, B.Y.G. Natural Resources produced 617 kg (19 829 oz) of gold and 3068 kg (98 654 oz) of silver from its Mt. Nansen mine, which also opened in November 1996. Milling operations at the shear zone-hosted vein deposit were temporarily shut down in November 1997 to increase water treatment capacity and rectify water balance problems in the tailings pond. The mine resumed full production in early 1998.

Grum Mine

Anvil Range Mining Corporation shut down production from its Grum open-pit lead-zinc-silver mine near Faro, Yukon, in December 1996. In August 1997, Anvil Range started a $15 million stripping program at the Grum deposit, which contained open-pit mineable reserves of 16.9 Mt grading 3.0% lead, 4.9% zinc, 47 g/t silver and 0.7 g/t gold prior to mining, which began in 1995.

Production resumed and lead and zinc concentrates were shipped starting in November 1997, until the mine ceased operations in January 1998. The future status of the now-dormant mine site is uncertain. The Grum sedimentary exhalative deposit is one of several known orebodies distributed in an arcuate belt along the south flank of the Anvil Range batholith in central Yukon.

Placer Mining Industry

The Yukon placer mining industry continued to be an important part of the Yukon's economy in 1997. A total of 183 operations, directly employing 700 people, mined in 10 major placer mining areas. The unglaciated Klondike, Indian River, West Yukon (Fortymile, Sixtymile and Mooseshorn Range) and Lower Stewart River tributaries produced approximately 80% of the total, while the remainder was produced from the variously glaciated Clear Creek, Mayo, Dawson Range, Kluane and Livingstone areas.

The Yukon's 1997 placer gold production total of over 116 000 crude oz was up approximately 6% over 1996; however, due to the drastic drop in the world market gold price, the total value of this gold was just over $42 million, compared to nearly $46 million for 1996. The reason for this may be that some producers were forced to sell stockpiles of placer gold to offset its lesser value in order to pay production costs.

The number of placer mining operations in outlying (non-traditional) areas has increased in recent years, with renewed mining on Henderson Creek, Canadian Creek and other parts of the Dawson Range. Teck Corporation, which operated one of the largest placer mines in the Yukon on Gold Run Creek in the Klondike, ceased production in September after 10 years of mining. Over 90 000 oz were credited to this mine over its 10-year production life.

1997 Advanced Development Summary

Minto Explorations received a positive Screening Report from the Regional Environmental Review Committee in April 1997 for the Minto copper-gold-silver project and signed a cooperation agreement with the Selkirk First Nation. The porphyry deposit hosts open-pit mineable reserves of 6.51 Mt grading 2.13% copper, 0.62 g/t gold and 9.3 g/t silver. In anticipation of receiving its Class "A" Water Licence, which was signed in April 1998, Minto Explorations began site construction. The remaining 12.8 km of access road were upgraded, the camp and mill sites were excavated, peripheral access roads were constructed, and two grinding mills were moved to the site. Minto Explorations is in a joint-venture agreement with Asarco Inc. to develop the project.

Western Copper Holdings Limited continued engineering studies on the Carmacks copper project. The project hosts an open-pittable 14.1-Mt oxidized porphyry copper-gold deposit grading 1.01% copper and 0.51 g/t gold. The project, which is being reviewed under the Environmental Assessment and Review Process (EARP), is slated to recover copper using solvent extraction-electrowinning technology. Western Copper cleared and grubbed the access road, leach pad site and plant site in 1997. A bulk sample was also extracted to conduct column tests on run-of-mine ore that may allow the elimination of a crusher in the mine plan, resulting in substantial capital and operating cost reductions.

Cominco Ltd. announced in August 1997 that the Sa Dena Hes zinc-lead mine may re-open by mid-1998; however, by mid-December, it announced that current market conditions did not support re-opening the mine. Preparations for a possible start-up included upgrading the haul road, camp renovations, recommissioning of power plants, and rehabilitation of mine openings. The mine, formerly operated by Curragh Resources, ceased operation in December 1992. High-grade zinc-lead-silver skarn zones were mined. The Sa Dena Hes mine is owned jointly by Cominco Ltd. (25%), Teck Corporation (25%) and Korea Zinc Co., Ltd. (50%), with Cominco as the operator of the project.

The Kudz Ze Kayah project of Cominco Ltd. received a positive screening report under the *Canadian Environmental Assessment Act* (CEAA) in mid-December 1997. No production decision has been made. The ABM volcanogenic massive sulphide deposit, the first major discovery in the Finlayson Lake district, hosts open-pit mineable reserves of 11 Mt grading 5.9% zinc, 0.9% copper, 1.5% lead, 130 g/t silver and 1.3 g/t gold. Cominco conducted exploration geochemistry and geophysics programs on the property in 1997.

The former producing mines of United Keno Hill Mines Limited were placed on care and maintenance during 1997 while the company focused on renewing its water licence, which was signed in 1998, and obtaining financing to re-open. The 30 veins in the Keno and Galena hills have produced over 200 million oz of silver in the past 70 years. Underground mineable reserves, mostly in the Bellekeno and Silver King veins, stand at 415 000 t grading 1145 g/t silver, 7.5% lead and 5.6% zinc. Late in 1997, United Keno Hill and NDU Resources announced a binding merger agreement between the two companies that was completed in 1998. NDU contributes two substantial mineral deposits, the Marg polymetallic volcanogenic massive sulphide deposit and the Blende Mississippi Valley-type zinc-lead-silver deposit, while United Keno Hill contributes the mineral deposits outlined above and the mine infrastructure at Elsa.

New Millenium Mining Ltd., whose principal asset is the Dublin Gulch deposit 51 km north of Mayo, announced positive results from a feasibility study on this Fort Knox-style deposit, which hosts open-pit mineable reserves of 50.4 Mt grading 0.93 g/t gold. In 1997, the company completed the feasibility study, continued environmental monitoring and baseline studies, and underwent a comprehensive review of the project for permitting under the CEAA.

Base-Metal Exploration Highlights

Base-metal exploration highlights include the discovery of volcanic hosted massive sulphides (VMS) in Mississippian pyritized felsic tuffs of Pelly-Cassiar Platform at the Wolf property of Atna Resources. The discovery hole intersected 6.9% zinc, 2.8% lead and 138.6 g/t silver over 25.2 m and resulted in an immediate increase in exploration activity in this belt of rocks. The continuing evaluation of massive sulphide deposits of Yukon-Tanana Terrane in the Finlayson district at the Wolverine project, which is jointly owned by Atna Resources and Boliden Limited, and Columbia Gold's Fyre Lake deposit was successful in expanding reserves. At the Wolverine project, a new massive sulphide body in the Sable zone, approximately 2 km southwest of the Wolverine-Lynx deposit, was intersected by exploratory drilling. Similarly, the Ice occurrence owned by Expatriate Resources in the Campbell Range Belt was further delineated by drilling.

In the northern Yukon, Blackstone Resources and Glenhaven Resources made a significant discovery of stratabound nickel-zinc at the Taiga project. There, the Devono-Mississippian Earn Group argillites and shales host stratabound mineralization that yielded a 5.3-m drill intersection grading 1.42% nickel and 0.70% zinc.

Precious-Metal Exploration

Gold exploration was conducted mainly in the area of the mid-Cretaceous Tombstone suite intrusive belt that spans central Yukon from Dawson in the west to MacMillan Pass in the east. Tombstone suite intrusive rocks host the Fort Knox deposit in Alaska, the Brewery Creek mine near Dawson, and the Dublin Gulch deposit north of Mayo. Focused exploration programs in that belt included: the Brewery Creek mine site, the 66 000-ha Oki Doki project of International Kodiak Resources north and east of the Brewery Creek mine, and the Scheelite Dome project of Kennecott, subsequently optioned by La Teko Resources. Several reconnaissance programs also took place in the belt in 1997 and the largest resulted in more than 1100 claims being staked by Viceroy Resource Corporation.

The largest gold exploration program in the Yukon was conducted on the Goddell Shear property in the Mt. Skukum area 85 km south of Whitehorse. Omni and Trumpeter Yukon Gold Inc.

each hold a 35% interest in the property and Arkona Resources holds 30%. Exploration on the Goddell shear zone, in the mid-Cretaceous Carbon Hill Granite, was investigated by extension of the underground adit by 182 m, and by more than 8500 m of underground drilling in 37 holes. An indicated reserve of 824 594 t grading 7.15 g/t gold was calculated from drill results. These exploration highlights illustrate continued confidence in the Yukon's mineral potential and illustrate that much of the territory remains under-explored.

Exploration and Development Forecast for 1998

The Yukon Chamber of Mines conducted a survey of exploration companies doing work in the Yukon during 1998. A total of 25 companies responded with expenditure forecasts. Total forecast expenditures are $14 million for exploration and approximately $1 million for development. These estimates are usually the minimum figures and can optimistically be expected to increase if results are positive. These numbers are down considerably from last year's expenditures.

Yukon Government Programs

The Yukon government currently has three programs to encourage the development of the Yukon's mineral and energy resources: the Yukon Mining Incentives Program (YMIP), the Yukon Industrial Support Policy (YISP), and the Energy Infrastructure Loans for Resource Development Program.

Yukon Mining Incentives Program

The Yukon Mining Incentives Program is designed to promote and enhance mineral prospecting, exploration and development activities in the Yukon. The program's function is to provide a portion of the risk capital required to locate and explore mineral deposits. Grassroots programs (Prospecting and Grubstake categories) are conducted on open ground (Crown land) and Target Evaluation programs are conducted on newly discovered prospects and targets covered by mineral claims, placer prospecting leases and claims, and coal licences and leases. Technical assistance is offered to prospectors upon request. Technical program funding for 1997/98 was $378 000. The number of grants approved in each category was 16 in the Grassroots programs and 15 in the Target Evaluation programs.

Yukon Industrial Support Policy (YISP)

The Yukon government recognizes the lack of infrastructure in many regions of the Yukon. This policy supports the development of an infrastructure base that encourages private-sector investment in the Yukon. The Yukon government may enter into a development agreement with the resource development sector for projects that require road improvement or construction, energy supply, grid connections, or related training programs for Yukon residents. No development agreements were approved for 1997.

Energy Infrastructure Loans for Resource Development Program

This program assists the resource development sector in the Yukon by helping to defer the capital cost of building energy infrastructure. The program provides loans to companies to help them create infrastructure to meet their energy needs. No projects were approved under this program in 1997.

6. Historical Review of Mineral Exploration Spending in Canada

6.1 INTRODUCTION

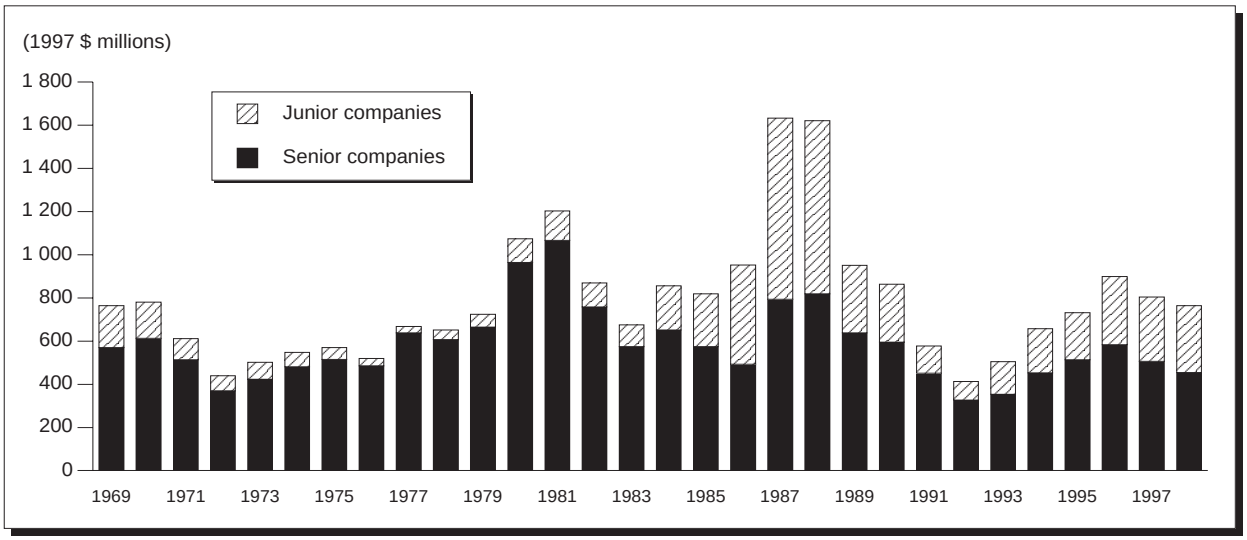
This section presents an historical review of patterns of exploration spending based on results from the federal-provincial survey of mining and exploration companies.

6.2 HISTORICAL SUMMARY

Figure 35 depicts (in constant 1997 dollars) Canadian exploration expenditures over 30 years from 1969 through 1998. Above-normal exploration expenditures in the 1980-82 period resulted from high prices for gold, silver and copper over much of that period. Exploration expenditures declined somewhat in 1983, but generally rose from 1984 to 1988 as a result of the introduction by the federal government, in 1983, of the Mining Exploration Depletion Allowance (MEDA). MEDA was replaced in 1989 and 1990 by the Canadian Exploration Incentive Program (CEIP). By 1987 and 1988, exploration expenditures had reached unprecedented high levels because of MEDA and the high gold prices that had existed until the end of 1987. However, exploration fell dramatically after 1988. Exploration expenditures decreased between 1989 and 1992, when they reached their lowest level since 1967.

Exploration activity picked up in the 1993-96 period. Exploration expenditures increased by 118% over the 1992-96 period and the 1996 level was the highest since 1988. Although data

Figure 35
Exploration Expenditures in Canada by Junior and Senior Companies, 1969-98



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: Total exploration expenditures for 1975-81 are overstated by an average of about 17% relative to earlier and later years because of changes to the methodology used by Statistics Canada over the years. Overhead expenditures are included. Data for 1997 are preliminary; data for 1998 are company spending intentions as compiled in January 1998.

from the 1997 preliminary estimate and the 1998 forecast survey indicate lower levels of expenditures of $804 million and $767 million respectively, they still represent a relatively strong level of exploration activity. The relatively higher expenditures since 1992 have been driven principally by important discoveries of diamond deposits, leading some companies to invest in advanced exploration or deposit appraisal projects, and recently, in 1997 and 1998, in mine development activities. Canada's first diamond mine, the Ekati mine at Lac de Gras in the Northwest Territories, is scheduled to start producing in late 1998. Since 1993, expenditures dedicated to diamond exploration have accounted for between 15 and 20% of total Canadian exploration expenditures.

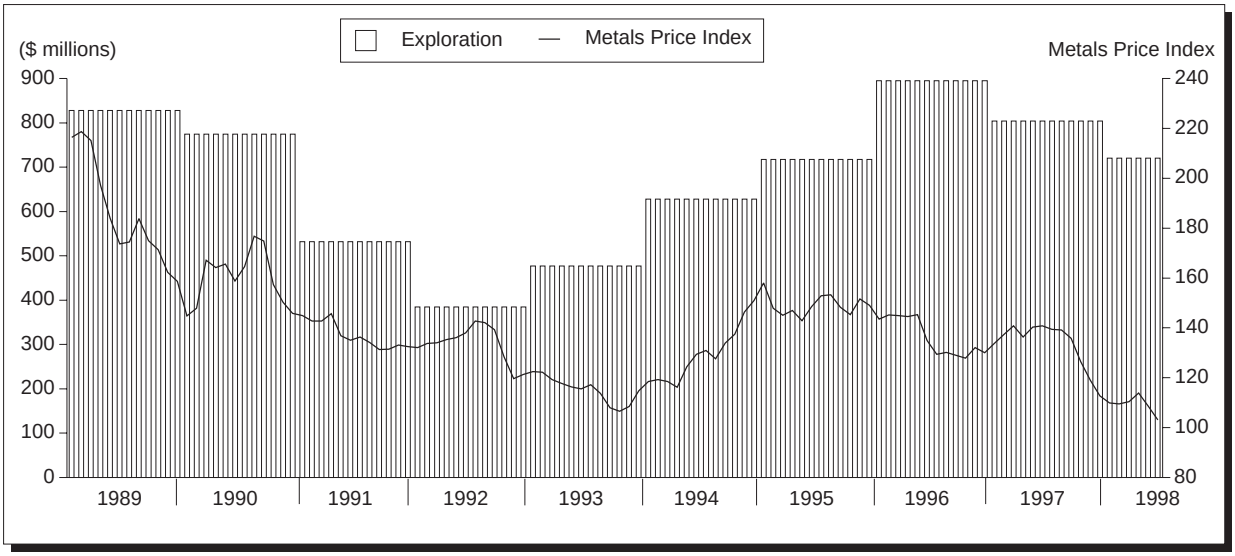
In late 1994, the nickel-copper-cobalt discovery at Voisey's Bay, Labrador, a result of exploration for diamonds in that area, attracted the attention of many mining companies, particularly junior exploration companies. This deposit is potentially the most important base-metal find in Canada in decades. The resulting flurry of exploration activity in the area had a strong impact on expenditures, particularly in 1995 and 1996.

6.3 METAL PRICES AND EXPLORATION LEVELS

In Section 1 of this report, metal prices were shown to be an important factor in determining the level of exploration activity (**Figure 5**). For example, between 1993 and 1995, copper, nickel and lead prices increased by over 60%, while zinc and gold prices increased by 14%. Over the same time period, exploration expenditures increased by over 40%. However, since early 1995, metal prices have generally been on a downward trend as reflected by NRCan's Monthly Metals Price Index (**Figure 36**). After peaking in January 1995, the index fell 35% by June 1998 to a level not seen since early 1987. Exploration expenditures peaked in 1996, fell in 1997, and are expected to be somewhat lower in 1998 than in 1997.

The current price weakness generally reflects world production in excess of world demand and has been worsened by the fallout from the Asian crisis, which has dramatically cut demand for primary materials in Asian countries. Market fundamentals for most metals are expected to remain weak in 1998. However, some analysts expect zinc prices to firm somewhat in the second half of 1998, and some are predicting that copper prices may recover by year-end because of a drop in refined copper output due to a shortage of concentrate feed to smelters. The longer-

Figure 36
Exploration Expenditures and Monthly Metals Price Index, 1989-98



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.

term outlook for copper remains bleak because of expected over-capacity due to a number of large low-cost projects coming on stream. The outlook for nickel, with current prices around US$2.00/lb, is uncertain. Nickel markets are being hit with continued high levels of Russian exports, expected production increases (adding to an overall world supply surplus), and flat demand exacerbated by slowing Asian consumption.

The outlook for gold prices is also uncertain. Prices fell during 1997 because of the increased supply that came on the market through producer hedging, fund short selling, and central bank sales. These factors are still causing concerns about oversupply, which are preventing any rally in price. In addition, the strengthening of the U.S. dollar against other currencies has meant higher gold prices in domestic currency terms in the major consuming and producing regions outside the United States. This has inhibited demand, but has not discouraged cutbacks in production.

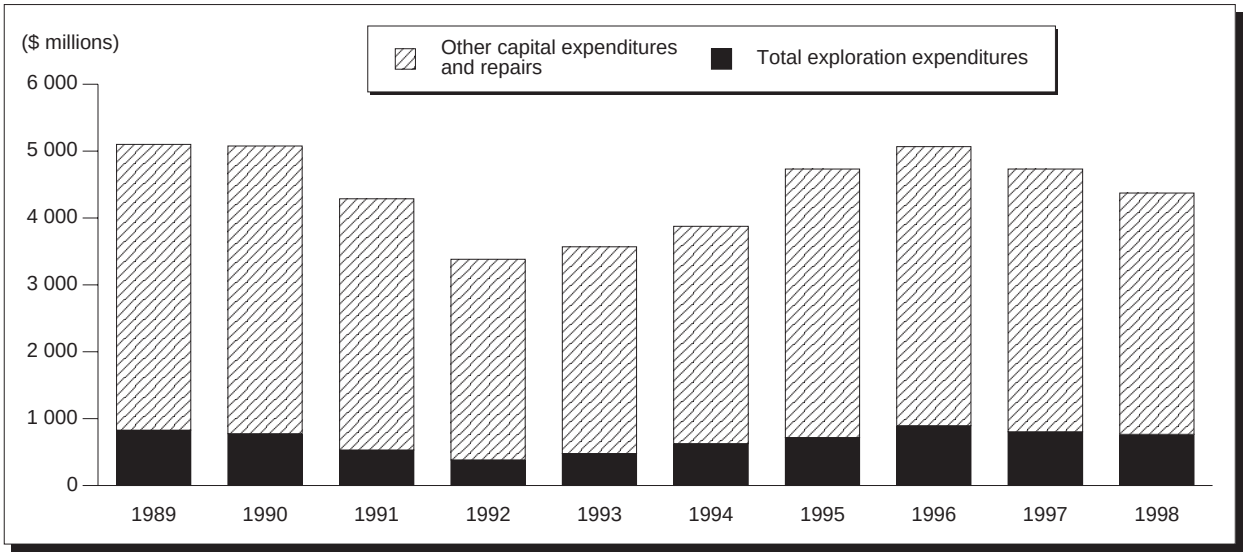
6.4 EXPLORATION AS PART OF TOTAL MINING INVESTMENT

General exploration, mine-site exploration, mine-site development, other capital expenditures (structures, machinery and equipment), and repairs totaled $5 billion in 1996, up from $4.7 billion in 1995 (**Figure 37**). Between 1992 and 1996, the total capital and repair investment increased by almost 50%. In 1997, total capital and repair expenditures returned to the same level as in 1995 ($4.7 billion). For 1998, these expenditures are expected to decline further to approximately $4.4 billion. As for the total exploration expenditure component, it has generally represented about 15% of total mining investment.

6.5 EXPLORATION EXPENDITURES BY PROVINCE AND TERRITORY

Table 19 shows current dollar expenditures on mineral exploration in Canada by province and territory for the 1986-98 period. **Table 20** reports the same information, but in constant 1997 dollars. **Table 21** presents these data as percentages.

Figure 37
Total Exploration Expenditures Relative to Total Capital and Repair Expenditures in Canada, 1989-98



Sources: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies; Statistics Canada.
Notes: 1997 data are preliminary estimates; 1998 data are company spending intentions as compiled in January 1998. Overhead expenditures are included. "Other capital expenditures" includes expenditures on on-property development, structures, machinery and equipment.

TABLE 19. MINERAL EXPLORATION EXPENDITURES IN CANADA, BY PROVINCE AND TERRITORY, 1986-98 (CURRENT DOLLARS)

Province/Territory	Field Work Only			Total Exploration[1]									
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997p	1998f
	($ millions)												
Newfoundland	12.3	27.7	37.7	36.2	23.3	12.1	11.1	8.9	12.4	71.1	92.5	69.0	46.0
Nova Scotia	17.2	41.6	46.7	21.4	11.0	4.5	3.3	1.8	1.7	2.8	6.9	9.0	9.1
New Brunswick	10.8	9.1	13.8	13.6	16.5	15.8	12.2	11.1	10.0	12.7	14.8	12.2	8.4
Québec	241.4	415.5	328.2	185.0	196.4	138.1	94.1	106.1	130.3	123.4	137.2	140.3	153.6
Ontario	136.8	308.1	343.6	217.8	152.6	109.7	77.4	75.6	113.0	129.7	194.9	173.9	132.7
Manitoba	26.3	40.0	30.0	37.0	41.2	29.7	32.0	27.4	40.5	32.6	41.2	39.3	42.1
Saskatchewan	36.8	63.5	61.1	63.3	42.2	31.5	25.9	53.1	50.6	43.8	50.6	55.5	46.2
Alberta	3.0	2.5	4.3	6.2	10.7	6.6	5.4	7.3	9.4	10.6	10.8	19.1	33.0
British Columbia	63.1	142.6	196.8	186.6	226.5	135.7	71.6	66.0	85.0	79.4	104.9	96.8	103.1
Yukon Territory	27.9	29.0	38.6	15.1	18.4	16.5	9.7	19.2	25.7	39.3	46.4	37.2	36.8
Northwest Territories	35.8	59.0	66.5	45.7	36.0	31.6	42.7	100.7	149.5	172.2	194.5	151.9	156.4
Total field work (excluding overhead)	611.4	1 138.6	1 167.3	703.5	660.3	439.2	323.5	410.1	540.5	608.1	776.9	722.4	705.8
Total exploration[2] (including overhead)	723.3	1 300.0	1 350.0	827.9	774.7	531.8	385.3	477.3	628.1	717.6	894.8	804.2	767.4

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
f Forecast; **p** Preliminary estimate.
1 "Total exploration" includes related overhead expenditures. **2** For the years 1986-88, totals with overhead were calculated by multiplying the field expenditures by the ratio total/field from Statistics Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 20. MINERAL EXPLORATION EXPENDITURES IN CANADA, BY PROVINCE AND TERRITORY, 1986-98 (1997 DOLLARS)

Province/Territory	Field Work Only			Total Exploration[1]									
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997[p]	1998[f]
	($ millions)												
Newfoundland	16.2	34.8	45.3	41.6	26.0	13.1	11.9	9.4	13.0	72.5	93.0	69.0	45.8
Nova Scotia	22.6	52.2	56.1	24.6	12.3	4.9	3.5	1.9	1.8	2.9	6.9	9.0	9.0
New Brunswick	14.2	11.4	16.6	15.6	18.4	17.1	13.1	11.7	10.5	13.0	14.9	12.2	8.3
Québec	317.6	521.7	394.0	212.4	218.9	149.8	100.8	112.2	136.3	125.7	137.8	140.3	152.9
Ontario	180.0	386.8	412.5	250.0	170.1	119.0	82.9	80.0	118.2	132.2	195.8	173.9	132.1
Manitoba	34.6	50.2	36.0	42.5	45.9	32.2	34.2	29.0	42.4	33.2	41.4	39.3	41.9
Saskatchewan	48.4	79.7	73.4	72.7	47.0	34.2	27.7	56.2	52.9	44.6	50.8	55.5	46.0
Alberta	3.9	3.1	5.2	7.1	11.9	7.2	5.8	7.7	9.8	10.8	10.9	19.1	32.8
British Columbia	83.0	179.0	236.3	214.2	252.4	147.2	76.7	69.9	88.9	80.9	105.3	96.8	102.6
Yukon Territory	36.7	36.4	46.3	17.3	20.5	17.9	10.4	20.3	26.9	40.0	46.6	37.2	36.6
Northwest Territories	47.1	74.1	79.8	52.5	40.1	34.3	45.8	106.6	156.4	175.4	195.5	151.9	155.7
Total field work (excluding overhead)	804.5	1 429.5	1 401.5	807.6	735.9	476.6	346.4	434.0	565.3	619.7	780.6	722.4	702.6
Total exploration[2] (including overhead)	951.7	1 632.1	1 620.8	950.4	863.4	577.0	412.7	505.1	657.0	731.3	899.0	804.2	763.8

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
f Forecast; **p** Preliminary estimate.
1 "Total exploration" includes related overhead expenditures. **2** For the years 1986-88, totals with overhead were calculated by multiplying the field expenditures by the ratio total/field from Statistics Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 21. MINERAL EXPLORATION EXPENDITURES IN CANADA, BY PROVINCE AND TERRITORY, 1986-98 (PERCENT DISTRIBUTION)

Province/Territory	Field Work Only			Total Exploration									
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997p	1998f
							(%)						
Newfoundland	2.0	2.4	3.2	4.4	3.0	2.3	2.9	1.9	2.0	9.9	10.3	8.6	6.0
Nova Scotia	2.8	3.7	4.0	2.6	1.4	0.8	0.8	0.4	0.3	0.4	0.8	1.1	1.2
New Brunswick	1.8	0.8	1.2	1.6	2.1	3.0	3.2	2.3	1.6	1.8	1.7	1.5	1.1
Québec	39.5	36.5	28.1	22.3	25.4	26.0	24.4	22.2	20.7	17.2	15.3	17.4	20.0
Ontario	22.4	27.1	29.4	26.3	19.7	20.6	20.1	15.8	18.0	18.1	21.8	21.6	17.3
Manitoba	4.3	3.5	2.6	4.5	5.3	5.6	8.3	5.7	6.5	4.5	4.6	4.9	5.5
Saskatchewan	6.0	5.6	5.2	7.6	5.4	5.9	6.7	11.1	8.1	6.1	5.7	6.9	6.0
Alberta	0.5	0.2	0.4	0.7	1.4	1.2	1.4	1.5	1.5	1.5	1.2	2.4	4.3
British Columbia	10.3	12.5	16.9	22.5	29.2	25.5	18.6	13.8	13.5	11.1	11.7	12.0	13.4
Yukon Territory	4.6	2.5	3.3	1.8	2.4	3.1	2.5	4.0	4.1	5.5	5.2	4.6	4.8
Northwest Territories	5.9	5.2	5.7	5.5	4.6	5.9	11.1	21.1	23.8	24.0	21.7	18.9	20.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
f Forecast; **p** Preliminary estimate.
Notes: The percentages from 1986-88 are calculated on field work only, but those from 1989-97 are based on total expenditures, which include related overhead.
Numbers may not add to totals due to rounding.

From 1986 to 1992, Québec, Ontario and British Columbia were the most actively explored provinces/territories. In 1993, for the first time since 1982, exploration spending in Ontario and Québec combined fell below 40% of the Canadian total, having peaked at 64% in 1987. In 1994 and 1995, the Northwest Territories was the most actively explored jurisdiction in Canada. In 1996, the Northwest Territories ranked just below Ontario with exploration expenditures of $194.5 million, compared to $194.9 million for Ontario. The high levels of diamond exploration expenditures have helped maintain the Northwest Territories' national contribution at over 20% starting in 1993. These are the highest percentages for the Northwest Territories since Canadian exploration statistics were first collected in 1946. Before 1993, the Northwest Territories had ranked either fourth or fifth nationally.

In 1993 and 1994, Ontario fell to third place behind the Northwest Territories and Québec. However, from 1994 to 1997, the situation improved for Ontario. As mentioned above, Ontario led the nation in exploration expenditures in 1996, and preliminary estimates indicate that it did again in 1997.

Activity has also resumed strongly in British Columbia with an expected 39% increase in exploration expenditures over the 1993-97 period. In 1997, Ontario, the Northwest Territories and Québec led the country in exploration expenditures. For 1998, the Northwest Territories followed by Québec and Ontario are expected to be the most explored jurisdictions in Canada. As a consequence of the Voisey's Bay exploration rush, Newfoundland and Labrador also improved its national ranking from eighth in 1994 to fifth in 1995 and 1996, with 10% of total Canadian exploration expenditures. In each year since 1995, between 80% and 90% of Newfoundland and Labrador's exploration expenditures were directed at Labrador.

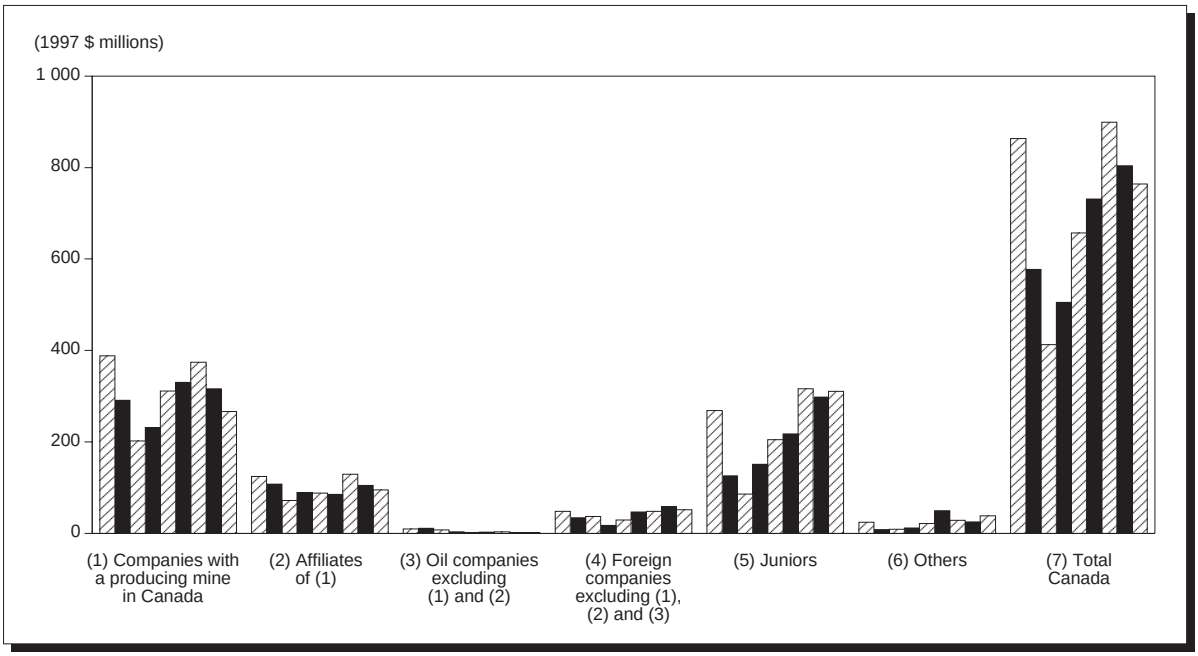
6.6 EXPLORATION EXPENDITURES BY TYPE OF COMPANY

Figure 38 depicts exploration expenditures (field work plus overhead) by type of company for 1990 to 1997 (preliminary) and 1998 (intentions). Producers and their affiliates usually represent 80-85% of the total senior companies category. In constant 1997 dollar terms, exploration by producing companies and their affiliates peaked in 1987 and 1988, declined until 1992, and then increased again until 1996. In reality, the period of decline may not be as large as it appears because considerable contributions were made in the 1986-88 period by junior companies to joint-venture projects operated by senior companies. These contributions were counted as part of senior companies' spending, thus overstating senior expenditures and understating junior expenditures during the 1986-88 period. Expenditures by senior companies have continued to increase during 1996, thus showing a total increase of about 78% in constant dollar terms for the 1992-96 period. Expenditures by senior companies are expected to decline in both 1997 and 1998.

Exploration expenditures by junior companies followed the same pattern as those by senior companies (**Figures 35** and **38**), peaking in 1987 and 1988, and then decreasing until 1992 (the lowest amount since 1980). Junior company expenditures have risen constantly since 1992, reaching $316 million in 1996 (a 45% increase over the $218 million recorded in 1995) and an expected $298 million in 1997 and $312 million in 1998. The change in exploration trends by junior companies is attributable to a variety of factors. The exploration rush for diamonds that began in 1993, and which has been sustained since that time, accounted for about one third of total junior exploration expenditures in 1993 and 1994, 20% in 1995 and 1996, and about 10% in 1997 and 1998. Roughly 5% of all junior exploration expenditures for each of the years 1995, 1996, 1997 and likely 1998 are a result of the Voisey's Bay nickel-copper-cobalt discovery in late 1994.

In 1983, junior companies accounted for about 15% of total Canadian exploration expenditures but, by 1987, this proportion had increased to more than 51%. In 1988, expenditures by the juniors began to decline. The decline continued through 1992, when the lowest amount since 1980 was recorded. Junior expenditures accounted for: 21% of total exploration expenditures in 1992; around 30% in 1993, 1994 and 1995; 35% in 1996; and likely 37% and 41% respectively for 1997 and 1998.

Figure 38
Exploration Expenditures in Canada, by Type of Company, 1990-98



Source: Compiled by Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: The years 1990 to 1998 are represented in each group. The left bar represents 1990; the right bar represents 1998. 1997 data are preliminary estimates; 1998 data are company spending intentions as compiled in January 1998. Overhead expenditures are included. The company classification system is explained in the Appendix.

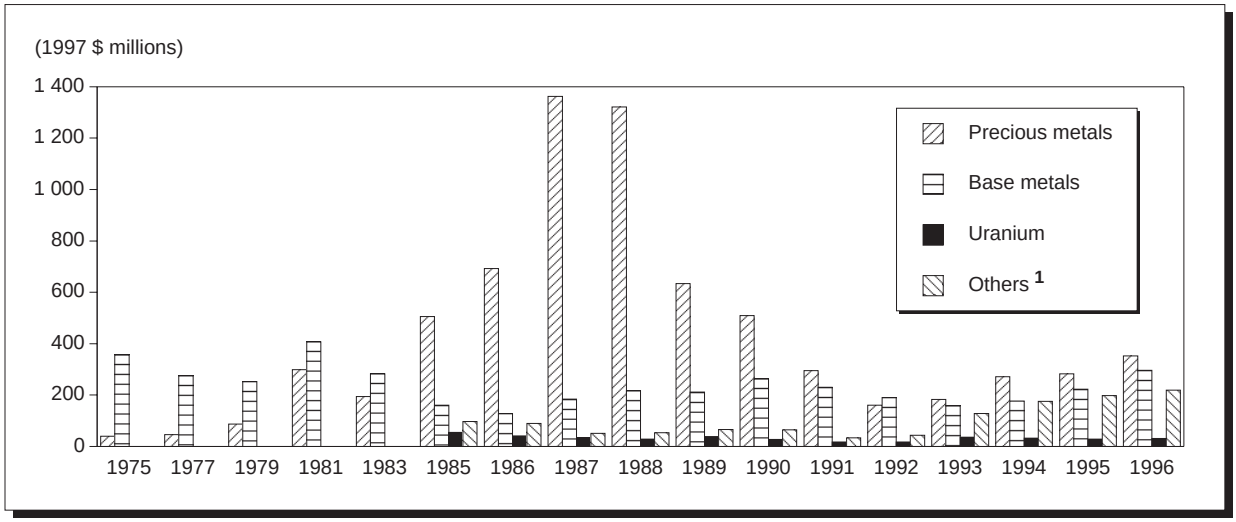
6.7 EXPLORATION EXPENDITURES BY TYPE OF COMMODITY SOUGHT

Exploration for precious metals (95% of which was for gold) peaked in 1987 (**Figure 39**) and subsequently declined as the availability of flow-through share capital decreased and as the gold price declined after the end of 1987. Expenditures for precious metals rose again during 1993, 1994, 1995 and 1996, years in which the gold price was up.

After reaching a low in 1986, exploration expenditures for base metals increased until 1990. They declined again in 1991 through 1993. During 1992, the decrease in precious-metal exploration was much more severe than that in base-metal exploration. Consequently, total expenditures for base-metal exploration exceeded those for precious metals for the first time since 1983. By October 1993, the inflation-adjusted prices of nickel, copper, zinc and lead were at all-time lows. They then recovered quite strongly, leading to increases in base-metal exploration expenditures. In fact, between 1993 and 1996, base-metal exploration increased by 88%.

In 1987 and 1988, exploration expenditures for all non-petroleum mineral commodities other than base and precious metals (**Figure 39**) accounted for only about 3% of total Canadian exploration expenditures. In 1989 and 1990, expenditures directed at other mineral commodities (excluding uranium) more than doubled in percentage terms, but did not actually increase significantly in constant dollar terms. In 1991, expenditures for "other" (excluding uranium) reached a low in both percentage and constant dollar terms. They increased again in 1992, both in percentage and dollar terms, and they increased significantly in 1993 to reach between 25% and 27% of the total expenditures for four years in a row ($128 million in 1993, $176 million in 1994, $198 million in 1995, and $220 million in 1996). The search for diamonds contributed the most to the increase in the level of expenditures in this "other" minerals and metals category.

Figure 39
Exploration Expenditures in Canada, by Commodity Sought, 1975-96



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
[1] Includes ferrous metals, other metals, nonmetals (including coal and diamonds), and "not specified."
Notes: Overhead expenditures are included. Data were not compiled by commodity for 1976, 1978, 1980, 1982 and 1984. For 1975, 1977, 1979, 1981 and 1983, only a precious-metal/base-metal breakdown is available.

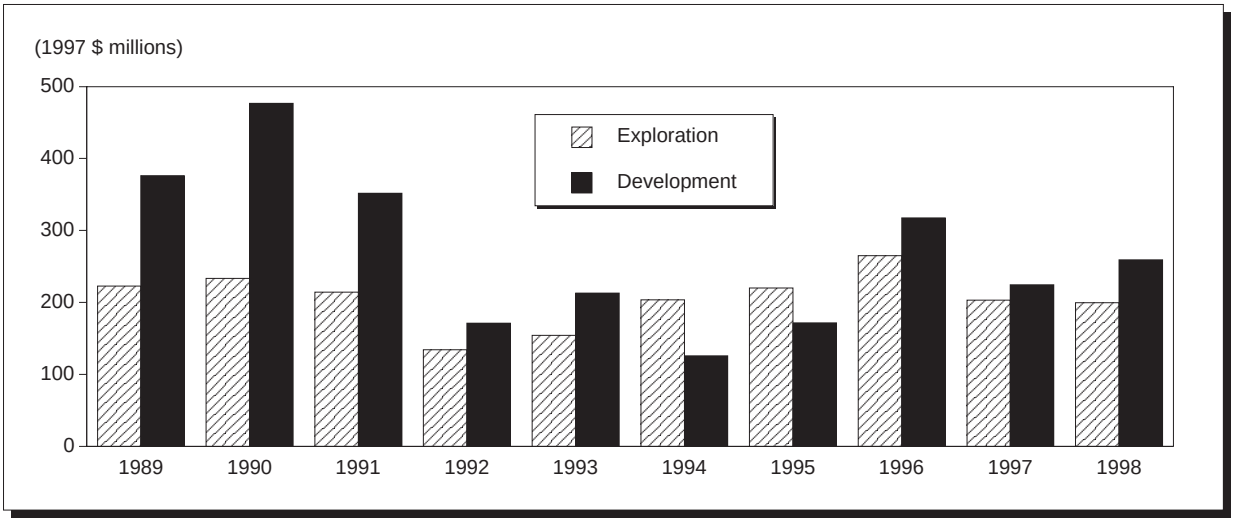
6.8 EXPLORATION AND DEVELOPMENT EXPENDITURES BY FOREIGN-CONTROLLED FIRMS

Foreign companies have long recognized Canada's mineral potential and have been contributing significantly to both mineral exploration and development in Canada. The survey of mineral exploration, deposit appraisal and mine complex development expenditures reveals that, since 1989, foreign-controlled companies have accounted for about 27% of spending on mineral exploration in Canada and for a similar proportion of development expenditures.

In 1997, foreign firms spent $203 million (**Figure 40**) on mineral exploration in Canada, some $63 million less than they did in 1996. A good proportion of this decrease can be explained by an increase in development expenditures, particularly in the diamond sector where major foreign investments were shifted from exploration to the development of deposits. (A large amount of work was required to prepare the Ekati diamond mine, which has a large Australian ownership component, for production.) Exploration expenditures by foreign-controlled companies are expected to drop slightly to $199 million in 1998. In terms of development expenditures, spending by foreign firms reached $224 million in 1997 and is forecast to reach $259 million in 1998, an increase of 16% that once again can be explained largely by investments in the diamond sector.

The actual amounts spent by foreign firms on exploration and development in Canada are likely higher than those reported in the survey because many foreign firms do not have a controlling interest in the Canadian-based partnerships in which they participate. As a result, expenditures from these partnerships are reported to the survey under the name of the controlling Canadian partner (project operator) and are counted as expenditures of Canadian companies.

Figure 40
Mineral Exploration and Development Expenditures in Canada by Foreign-Controlled Firms, 1989-98



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies, and on Statistics Canada's CALURA database.
Note: 1997 data are preliminary estimates; 1998 data are company spending intentions as compiled in January 1998.

7. Canada's Standing As A World Exploration Target

7.1 INTRODUCTION

In 1996 and 1997, and most probably again in 1998, Canada remained one of the world's top mineral exploration targets, ranking second (after Australia) in each of those three years, thus continuing the close contest of the past three or more decades between those two countries. The United States, based on the limited and poor-quality exploration statistics available for that country, appears to have been a strong contender for first place up until about 1980, but has been consistently in third position since then.

Based on official Canadian and Australian government surveys of company exploration expenditures, Canada ranked first every year from 1981 through 1990, and was probably also first in 1991. Canada ranked second, after Australia, from 1992 through 1997 (**Figure 41**). In 1997, and most likely in 1998, Australia and Canada continued their close contest for the world's top destination for exploration capital from worldwide sources. In fact, 1997 exploration expenditures in each of Australia and Canada were again much greater than those in any other single country. This is expected to continue to be the case in 1998.

Figure 41
Top Three Country Destinations of Mineral Exploration Capital from Worldwide Sources, 1972-97

Year	Rank		
	First	Second	Third
1997	Australia	**Canada**	United States
1996	Australia	**Canada**	United States
1995	Australia	**Canada**	United States
1994	Australia	**Canada**	United States
1993	Australia	**Canada**	United States
1992	Australia	**Canada**	United States
1991	**Canada**	Australia	United States
1990	**Canada**	Australia	United States
1989	**Canada**	Australia	United States
1988	**Canada**	Australia	United States
1987	**Canada**	Australia	United States
1986	**Canada**	Australia	United States
1985	**Canada**	Australia	United States
1984	**Canada**	Australia	United States
1983	**Canada**	Australia	United States
1982	**Canada**	Australia	United States
1981	**Canada**	Australia	United States
1980	Australia	**Canada**	United States
1979	Australia	United States	**Canada**
1978	Australia	United States	**Canada**
1977	United States	**Canada**	Australia
1976	**Canada**	United States	Australia
1975	United States	**Canada**	Australia
1974	**Canada**	United States	Australia
1973	Australia	United States	**Canada**
1972	United States	Australia	**Canada**

Source: Natural Resources Canada, based on official Canadian and Australian statistics and the best available data for the United States.
Notes: Australian expenditures were 6.5% higher than those for Canada in 1983 and 3.3% higher in 1991; however, correcting the reported Australian totals for substantial mine development expenditures, which are not included in Canadian statistics, ranks Canada first in 1983 and 1991. No data are available for the former Soviet Union.

7.2 DISCREPANCY BETWEEN EXPLORATION SURVEY RESULTS

The confusion concerning Canada's relative share of worldwide non-petroleum mineral exploration activity continues. The results of the proprietary annual survey of worldwide mineral exploration expenditures prepared by the Metals Economics Group (MEG) of Halifax, Nova Scotia, which represents a partial survey, has generally ranked Canada considerably lower than does the more comprehensive federal-provincial survey of mining and exploration companies. MEG ranked Canada first in 1991, third in 1993, fifth in 1994, third in 1996, and fifth again in 1997 (after Latin America, Australia, Africa, and

Pacific-Southeast Asia). This relatively low ranking is partly because Canada, a single country of 10 million km^2, is being compared with multi-country continental areas such as Latin America (20.5 million km^2) and Africa (30.3 million km^2). Also, Latin America and Africa each have total values of mineral production that are considerably higher than that of Canada, so it would hardly be surprising if more were spent on mineral exploration in these areas than in Canada.

Canada's actual position in terms of exploration expenditures, compared to single countries rather than geographic areas, was first in 1991 and second, after Australia, from 1992 to 1997 inclusive. No other single country comes close to matching Canada, especially when all exploration expenditures, including those of the smaller junior companies that are not included in the MEG survey, are taken into account.

The MEG survey of exploration budgets for 1997 covers almost all countries. The survey is invaluable because Canada and Australia are the only two countries in the world that have official, comprehensive, government-run surveys of non-petroleum mineral exploration expenditures. Therefore, despite being incomplete, the MEG survey provides the only source of information for all other countries of the worldwide exploration activities of the world's larger companies.

The only exploration expenditure statistics available in the public domain for the United States for the years 1970 through 1979 are rough estimates by Schreiber and Emerson[3] and, as a result, the relative position of the United States among the top three contenders for global exploration investment (**Figure 41**) is especially uncertain for the years 1970-79. U.S. exploration statistics for the 1980-91 period are from incomplete annual surveys that were carried out by the American Bureau of Metal Statistics (ABMS) on behalf of the Society of Economic Geologists. However, the ABMS survey no longer provides useful exploration expenditure statistics. Therefore, since 1992, the MEG survey, with its limitations, has been the only source of aggregate exploration statistics for the United States as well.

Statistics provided by Canada's annual federal-provincial survey of mining and exploration companies provide a much more complete source of information for ranking Canadian exploration activity than does the MEG survey, as do similar statistics gathered and published by the Australian Bureau of Statistics for ranking Australian activity. More than 98% of the companies that are sent Canadian exploration survey questionnaires return those questionnaires completed. It is unlikely that any of the companies that fail to respond have significant mineral exploration programs. Hence, it is likely that more than 99% of total exploration expenditures of all the companies surveyed are gathered by this federal-provincial survey.

7.2.1 Differences Between Canadian and Australian Statistics

Official Canadian and Australian exploration expenditure statistics are not completely comparable because Australian exploration statistics include some costs that are excluded from Canadian statistics. Canadian exploration statistics have excluded all expenditures at producing mines directed at the search for extensions, to depth and laterally, of the orebodies being mined. Such expenditures have been included in "development expenditures." On the property of an existing mine, only exploration for a *new mine* (additional deposit) has been counted as exploration expenditures in Canada. In Australia, on the other hand, all expenditures involved in the search for additional ore on production leases, including expenditures on such work in producing mines, are included in exploration expenditures, whereas in Canada at least some of this work would be counted as "development."

As a result, Australian exploration expenditure statistics are somewhat inflated relative to Canadian exploration expenditure statistics. This is demonstrated by the fact that, over the six

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3 Schreiber, Hans and Emerson, Mark, 1984: North American Hardrock Gold Deposits: An Analysis of Discovery Costs and the Cash Flow Potential, *Engineering and Mining Journal*, October 1984, pp. 50-57.

fiscal years 1990/91 to 1995/96 inclusive, exploration expenditures on production leases averaged 22.1% of total exploration expenditures in Australia, while in Canada, over the eight calendar years from 1990 to 1997 inclusive (including "preliminary" 1996 and "company spending intentions" 1997), "on-property" or "mine-site" exploration averaged only 12.9% of total exploration expenditures. Also in Canada, such expenditures can be anywhere on a company's entire property surrounding its mines, and not only on ground equivalent to the more restricted Australian "production leases." If Canadian "on-property" exploration expenditures were reported and compiled using the Australian system, some of these Canadian expenditures would not be included as "production lease" expenditures, but as exploration expenditures not on production leases, so that the Canadian percentage would be significantly lower than 12.9% and the percentage difference would be greater than 22.1% in Australia minus the 12.9% in Canada.

These percentages differ for many reasons. What is clear is that, because of structural reporting differences, aggregate mineral exploration expenditures reported for Australia are higher, by an unknown but significant amount, relative to how the same exploration expenditures would be reported in Canada. Therefore, in recent years, exploration expenditures in Australia have not actually exceeded exploration expenditures in Canada by as much as a simple comparison of each country's respective statistics would suggest.

The value of Australian production of non-petroleum minerals is roughly one third greater than that of Canadian production. For this reason alone, it would be expected that annual exploration expenditures in Australia would normally exceed annual exploration expenditures in Canada.

7.2.2 Differences Between Official Canadian Exploration Statistics and Metals Economics Group Exploration Statistics for Canada

The annual exploration statistics produced by MEG substantially understate both annual exploration expenditures in Canada and the share of worldwide exploration activity directed at Canada. There are several reasons for this. First, MEG's 1997 exploration expenditure totals account for only about two thirds of total exploration expenditures in Canada. In 1997, this survey covered only 84 companies exploring in Canada, a number that is substantially less than the 617 companies that were actively engaged in mineral exploration in Canada that year. For the survey years 1993 to 1995, MEG used increasing exploration budget cut-offs to limit the universe of companies it had to survey. The exploration budget cut-off was US$1 million for 1993 and prior years. This was raised to US$2 million in 1994, and then to US$3 million in 1995. It decreased to US$2.9 million in 1996, and remained at US$2.9 million in 1997.

Because of the relatively high cut-offs (US$2.9 million, equivalent to C$4 million in 1997), the MEG survey has consistently and substantially under-estimated exploration activity in both Canada and Australia. This has been because, at least until recently, the contribution made by junior exploration companies has been so much greater in Canada and Australia than it has been in all other countries. Canada and Australia both have hundreds of smaller producing companies and non-producing (junior) companies that individually have spent less on exploration annually than the MEG cut-off but that, as a group, have accounted for, and still account for, a substantial amount of domestic exploration activity in these two countries.

In 1997, MEG reported aggregate exploration budgets for Canada of US$435.9 million on the basis of 84 company returns. In addition to the 84 larger companies that it surveyed, MEG surveyed another 71 companies that expected to explore in Canada in 1997 but were to spend less than US$2.9 million on exploration worldwide that year. These smaller company exploration totals were reported by MEG in a table of companies with individual exploration expenditures of less than US$2.9 million worldwide (the MEG cut-off value), so they were not included in MEG's worldwide exploration totals. The 71 companies reported exploration spending intentions for Canada of US$61.7 million (C$84.5 million) in addition to the US$435.9 million for the 84 companies counted by MEG. A company-by-company comparison of the companies surveyed by MEG for 1997 with individual company spending intentions for Canada from the 1997 federal-provincial survey of mining and exploration companies shows that in addition to the 84 companies

plus 71 companies surveyed by MEG, another 462 companies with exploration expenditures in Canada were not covered by the MEG survey. According to Canadian federal-provincial statistics, the 462 companies covered by the federal-provincial exploration survey, but not by MEG, planned to spend US$199.4 million exploring for the commodities included in the MEG survey. This amount, plus the US$61.7 million for 71 smaller companies surveyed by MEG but not included in its totals because they spent less than US$2.9 million worldwide, add up to an additional US$261 million, relative to the MEG total of US$435.9 million for exploration in Canada. Of the US$199.4 million of exploration dollars in Canada not picked up by MEG, some US$47.1 million was to be spent by 12 companies that each had reported to the federal-provincial survey planned 1997 exploration expenditures in Canada greater than the 1997 MEG survey cut-off of US$2.9 million. None of these 12 companies appear to have been surveyed by MEG. This means that MEG should probably have reported exploration expenditures in Canada of roughly US$483 million for companies with exploration expenditures of US$2.9 million or more, instead of US$435.9 million.

Furthermore, the MEG survey does not cover exploration for all of the mineral commodities actually sought by companies. For example, the most recent worldwide exploration statistics for uranium, compiled by the International Atomic Energy Agency, indicate that uranium exploration in Canada accounted for roughly 30% of the US$107 million of uranium exploration expenditures worldwide. The 1997 MEG survey has Canada accounting for only 10.8% of worldwide exploration spending of US$4.03 billion for the commodities covered by the MEG survey, which is much less than the 30% for uranium. But for a comprehensive exploration comparison for all mineral commodities worldwide, exploration expenditures for all of the other mineral commodities not covered by the MEG survey, chiefly the industrial minerals (other than diamonds, which are included by MEG), iron ore, bauxite and coal would have to be included in addition to those for uranium.

Another difficulty with the MEG survey is that exploration expenditures compiled by that survey are not comparable across all companies. In addition to including surface exploration expenditures, some companies are including the search for extensions to orebodies in producing mines in the budgets that they report to MEG, but others are not. Other companies are including the costs of feasibility and engineering studies, but most companies are not. Because of these inconsistencies in what is included, it is difficult to assess the validity of comparisons by MEG of exploration expenditures across countries, or the validity of comparing MEG totals for exploration in Canada to exploration expenditure totals from the federal-provincial exploration survey (which has clearly excluded both the search for new ore in producing mines and in deposits committed for production, as well as expenditures on feasibility studies and engineering studies at such properties).

As already discussed, some MEG rankings compare total exploration budgets in individual countries such as Australia, Canada and the United States with those in vast geographical regions such as Latin America, Africa, Pacific-Southeast Asia and “Rest of World.” Some of these comparisons are arbitrary and therefore constitute misleading comparisons. Latin America, for example, consists of more than 20 separate countries that jointly have an area on two continents that is more than double that of Canada, the United States or Australia taken individually. The area of Africa is triple or more the areas of each of these three important mining countries. Both Latin America and Africa have mineral industries with annual values of non-petroleum mineral production approximately double that of Canada and, therefore, it would not be unexpected for total Latin American exploration expenditures to be double those of Canada, yet when *all* companies are taken into account, including companies with worldwide exploration expenditures lower than US$2.9 million, this is probably not the case.

The relative positions of countries in world exploration as reported by MEG have shifted from one year to the next, in part because of the changing methodology used by MEG, not only because of changing exploration expenditure cut-offs, but also because of MEG’s separation (in 1995) of Africa from “Rest of World.” Until 1995, “Rest of World” had an area about 10 times that of Canada, 10 times that of the United States, and about 12 times that of Australia.

The separation of Africa from "Rest of World" in 1995 resulted in a 30% decrease in the area of "Rest of World" and, consequently, in a substantial decrease in exploration expenditures for "Rest of World" as follows: in 1994, the MEG exploration survey reported that "Rest of World" accounted for 15% of total world exploration expenditures of US$2.050 billion, that is, for US$308 million; in 1995, a redefined "Rest of World" accounted for only 6.7% of total world expenditures of US$2.690 billion, or US$180 million. This change helped shift Canada's world position in terms of exploration activity (according to MEG) from fifth in 1994 to third in 1995. However, if Canada, the United States and Mexico, as well as the Central American portion of Latin America, had been combined by MEG into a region called North America, then North America would have been consistently first in terms of worldwide exploration activity for the past few decades. This indicates some of the problems of comparing exploration expenditures for individual countries with expenditures combined by geographical region.

8. Globalization of the Mining Industry

8.1 INTRODUCTION

This section provides an overview of Canadian exploration activity abroad. It also highlights the domestic and foreign components of the larger-company exploration market in Canada. The information in this review[4] was current as at December 31, 1997.

8.2 THE GLOBAL MARKET FOR MINERAL EXPLORATION

During 1997, the worldwide market for precious-metal, base-metal and diamond exploration was expected to grow by 11% to $7.0 billion (US$5.1 billion), up from $6.3 billion (US$4.6 billion) in 1996.

Global trends in worldwide mineral exploration activity are based on data for the world's larger companies,[5] defined here as those with annual exploration budgets greater than $4 million (US$3 million). In 1997, there were 279 such companies, up from 223 in 1996 and only 154 in 1995. During 1997, the larger companies were expected to undertake programs worldwide worth $5.5 billion (US$4.0 billion), which represents about 80% of the global market for mineral exploration.

8.3 LARGER CANADIAN-BASED COMPANIES

In 1996, mining companies listed on Canadian stock exchanges raised over $6 billion in equity financing.[6] As a result, the number of Canadian-based companies that planned to spend more than $4 million on exploration around the world grew to 141 during 1997, up from 94 in 1996 and only 55 in 1995. Many of these larger companies have no substantial revenues from mineral production, and they rely entirely on the stock market to finance their exploration programs.

In 1997, the larger Canadian-based companies planned to spend $1.9 billion on mineral exploration in both Canada and elsewhere around the world, up from $1.4 billion in 1996. In contrast, the larger companies based in Australia, the source of the second-largest exploration programs in the world, planned to spend about $1.4 billion worldwide, about half of it at home. Canadian-based companies now control 35% and the dominant share, by far, of the exploration

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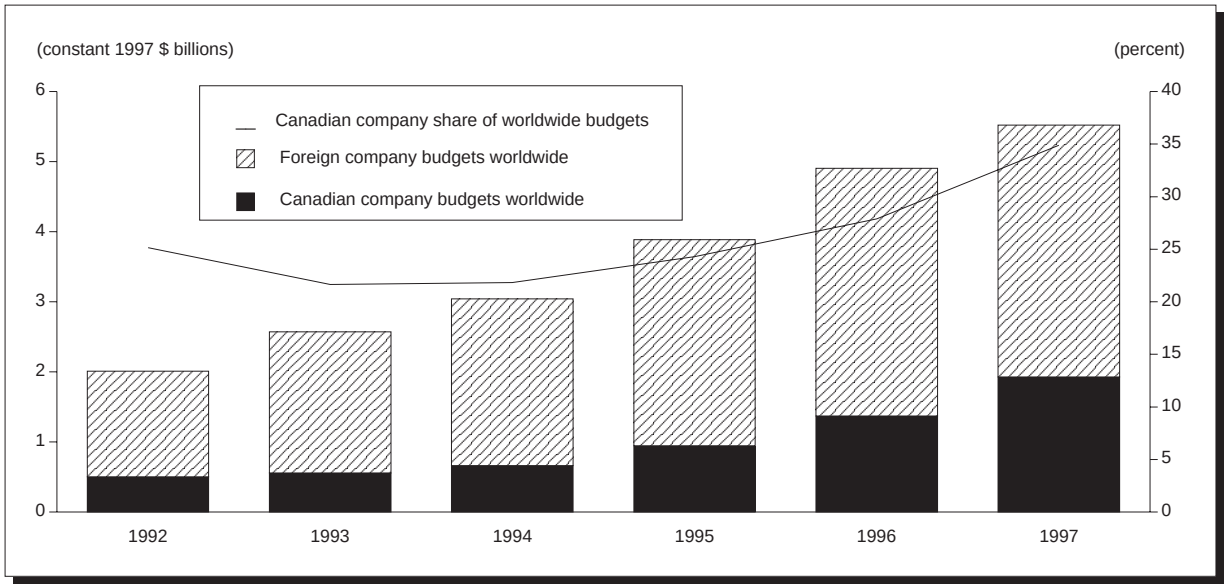
[4] Section 8 is based on an article from the 1997 *Canadian Minerals Yearbook*, published by Natural Resources Canada.

[5] Most of the information on the larger-company exploration market worldwide is based on *Corporate Exploration Strategies: A Worldwide Analysis*, published annually by the Metals Economics Group, Halifax, Nova Scotia.

[6] Keither J. Brewer and André Lemieux, *Canada's Global Position in Mining - Canadian Financing of the International Mining Industry*, Metals Finance 4th International Conference, Toronto, May 7-9, 1997, Natural Resources Canada, Ottawa, 53 pp.

Figure 42
Exploration Budgets of the World's Larger Companies, by Country of Origin, 1992-97
Companies with Worldwide Budgets of at Least $4 Million (US$3 Million)
For Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: Worldwide exploration budgets of companies that intended to spend less than $4 million (US$3 million) annually are excluded. Worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

programs planned by all of the world's larger companies, up from 28% in 1996 (**Figure 42**). In 1997, the larger Canadian-based companies had worldwide exploration budgets with a mean of $13.7 million and a median of $6.4 million.

At the end of 1997, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of more than 8000 exploration or producing properties[7] (**Figure 43**) located in more than 100 countries around the world. Most of this portfolio is at the exploration stage.

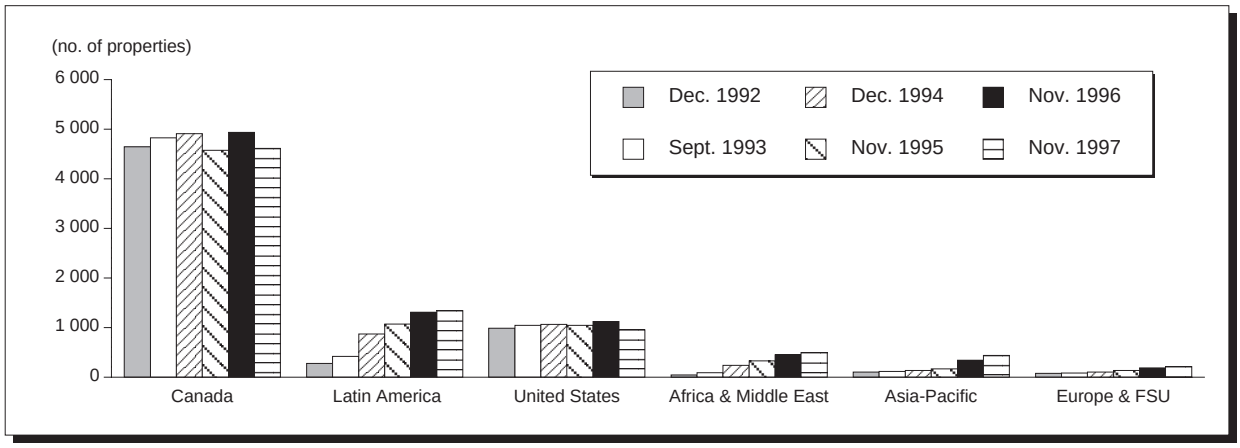
Canadian companies are continuing to assume increasing amounts of geological and country risk abroad. The ratio of exploration properties to the total number of exploration and producing properties held outside Canada has increased steadily since the early 1990s. In late 1992, that ratio was 0.82 for Latin America, 0.79 for Africa, 0.78 for Europe and the former Soviet Union (FSU), and 0.67 for Asia-Pacific. By late 1997, it had increased to 0.93 for both Latin America and Africa, to 0.88 for Asia-Pacific, and to 0.86 for Europe and the FSU. In comparison, the ratio of exploration properties to the total number of properties held in Canada has remained roughly constant at 0.96 over at least the past six years.

8.4 LARGER-COMPANY EXPLORATION MARKET IN CANADA

In 1997, the larger-company mineral exploration market in Canada was valued at almost $600 million (**Figure 44**), or 11% of the $5.5 billion larger-company market worldwide. The larger-company market in Canada accounts for about 70% of the total domestic mineral exploration market; the remaining 30% is held mainly by smaller companies. The activities of smaller companies are not addressed here.

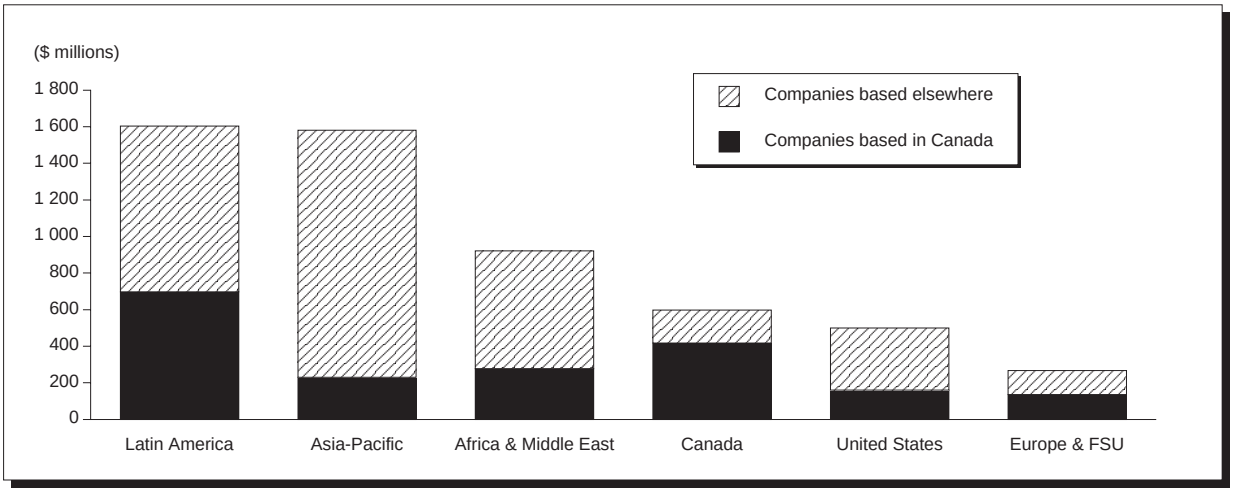
[7] Most of the information on the mineral property portfolio of companies of all sizes listed on Canadian stock exchanges is derived from the *MIN-MET CANADA* database, ROBERTSON INFO-DATA Inc., Vancouver, British Columbia.

Figure 43
Canadian Mineral Property Portfolio Worldwide, by Region, 1992-97
Companies of All Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* database, ROBERTSON INFO-DATA Inc., Vancouver, British Columbia, and used under licence.

Figure 44
Exploration Budgets of the World's Larger Companies for Selected Regions of the World, 1997
Companies with Worldwide Budgets of at Least $4 Million (US$3 Million)
For Precious-Metal, Base-Metal or Diamond Exploration

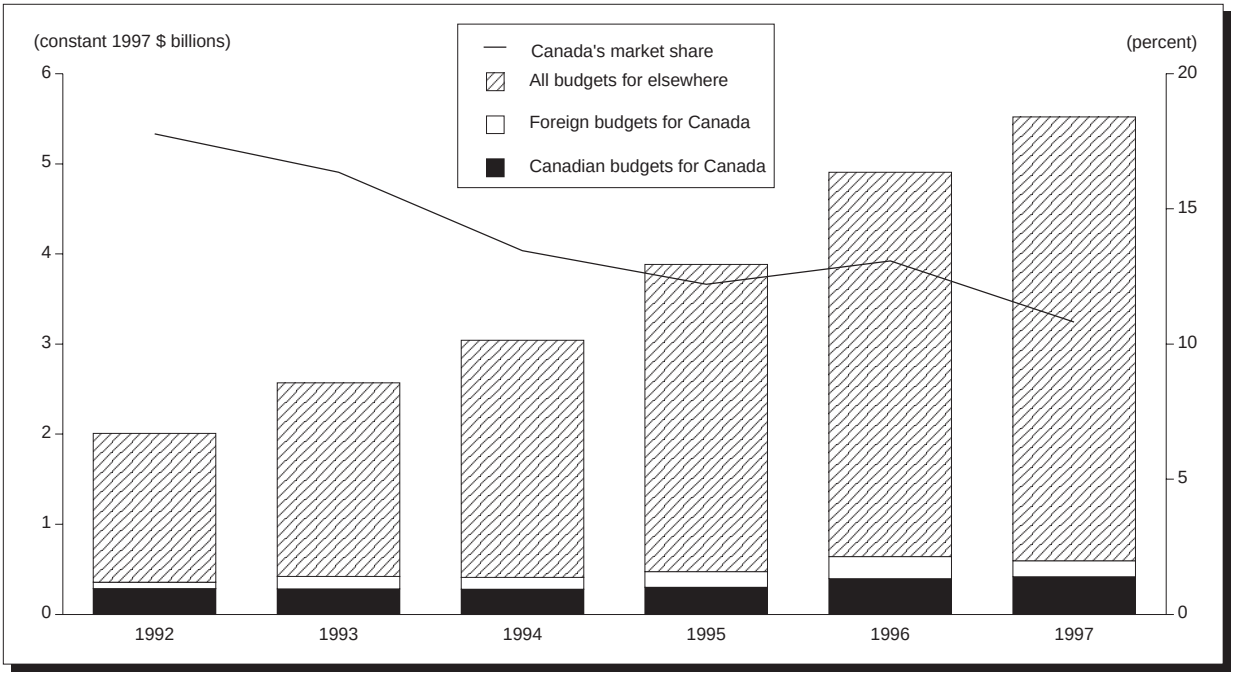


Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: Worldwide exploration budgets of companies that intended to spend less than $4 million (US$3 million) annually are excluded. Worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

The budgets of the world's larger domestic-based and foreign-based companies allocated to exploration in Canada in 1997 were down by about $45 million, or 7%, compared with those in 1996. Although the budgets of these companies for Canada have risen almost every year since 1991, the proportion of worldwide budgets allocated to Canada has fallen gradually from 18% in 1992 to 11% in 1997 (**Figure 45**) because of the mammoth increase in exploration activity that has occurred in Latin America, Asia and Africa since the early 1990s.

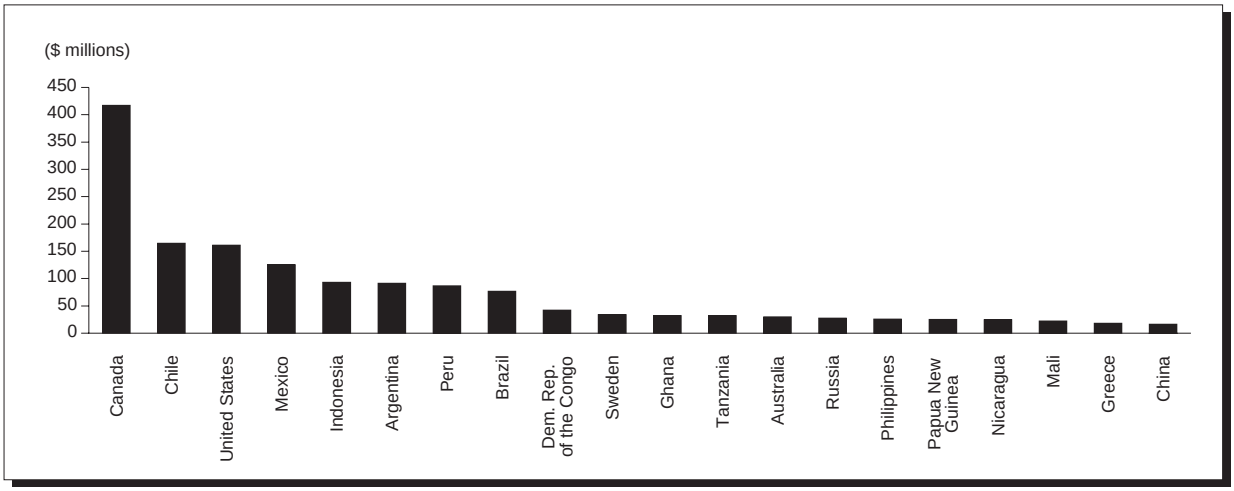
Canada remains, by far, the country where the larger Canadian-based companies spend the most on exploration (**Figure 46**). During 1997, these companies were expected to spend $417 million in Canada, up by more than $20 million, or 5%, from the $395 million that they

Figure 45
Exploration Budgets of the World's Larger Companies, by Destination, 1992-97
Companies with Worldwide Budgets of at Least $4 Million (US$3 Million)
For Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: Worldwide exploration budgets of companies that intended to spend less than $4 million (US$3 million) annually are excluded. Worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

Figure 46
Exploration Budgets of the Larger Canadian-Based Companies, 1997 – Countries Accounting for 80% of Budgets
Companies with Worldwide Budgets of at Least $4 Million (US$3 Million)
For Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: Worldwide exploration budgets of companies that intended to spend less than $4 million (US$3 million) annually are excluded. Worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

had budgeted in 1996. These Canadian companies control 70% of the larger-company market in Canada. The situation is identical in the United States and Australia where American- and Australian-based companies control the largest share of their respective domestic larger-company markets for mineral exploration.

In contrast, in 1992, Canadian-based companies controlled 80% of the larger-company exploration market in Canada. However, with increasing globalization, their share of the market has fallen gradually as foreign-based companies increased their activities in this country. The share of the exploration market controlled by the larger domestic firms has also declined in the United States and in Latin America. In Australia, on the other hand, Australian-based companies still control over 80% of their domestic market.

At the end of 1997, companies of all sizes listed on Canadian stock exchanges held more than 4600 mineral properties in Canada, about 7% fewer than in 1996, but about the same number as they held in the early 1990s (**Figure 43**). In early 1997, there were more than 170 mineral projects in Canada at the deposit appraisal stage.[8]

Globalization of the mining industry is not only providing benefits to developing countries. During 1997, the larger foreign-based multinationals were expected to spend $180 million on mineral exploration in Canada. Compared with 1996, the budgets of larger foreign-based companies for Canada decreased by about 25%. This is, in part, because Australian-based BHP Minerals Pty Ltd. has advanced its Ekati diamond project at Lac de Gras in the Northwest Territories to the mine construction stage, and such investment is not counted as exploration. Nonetheless, the budgets of the larger foreign-based companies represent 30% of the exploration programs planned for Canada by all of the world's larger companies, including those based in Canada. In 1992, the budgets (adjusted for inflation) of the larger foreign-based companies for exploration in Canada totaled only $70 million.

The larger foreign-based companies active in Canada include WMC Limited, the Ashton Group, and Savage Resources Limited, all based in Australia; Echo Bay Mines Ltd., the Homestake Group, Royal Oak Mines Inc., Battle Mountain Gold Company, Phelps Dodge Corporation, Cyprus Amax Minerals Company, Newmont Gold Company, AMAX Gold, and Vista Gold Corp., all based in the United States; the Minorco Group, and Outokumpu Metals and Resources Oy, both based in Europe; Nord Pacific, based in Bermuda; the Gencor Group and the De Beers Group, both based in Africa; First Dynasty Mines, based in Singapore; and Korea Zinc.

8.5 LARGER CANADIAN-BASED COMPANIES ABROAD

In 1997, the larger Canadian-based companies planned to spend $1.5 billion on mineral exploration outside of Canada. Since 1992, their foreign exploration budgets (adjusted for inflation) have increased at an average annual compound rate of 47%, up from roughly $220 million in 1992. The proportion of their total budgets allocated to foreign exploration programs rose to over 78% in 1997, up from 43% in 1992. Twenty countries spread around the globe account for 80% of the budgets of the larger Canadian-based companies (**Figure 46**).

At the end of 1997, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of more than 3400 mineral properties located abroad (**Figure 43**). Foreign properties now represent more than 40% of the total mineral property portfolio held by these companies, up from about 25% in 1992. Between 1992 and 1997, the average annual compound rate of growth in their holdings of foreign mineral properties was almost 18%.

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[8] For trends in mineral deposit appraisal activity in Canada over the interval 1982-97, and for a list of projects at the deposit appraisal stage in early 1997, see André Lemieux, "Canada's Global Mining Presence," in the 1996 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 8.9 and 8.11-8.22.

Apart from the United States, where companies of all sizes listed on Canadian stock exchanges have a substantial mining presence, two dozen other nations, spread across the globe, account for 80% of the balance of their mineral property portfolio held abroad.

8.5.1 United States

In 1997, the larger-company mineral exploration market in the United States was valued at about $500 million (**Figure 44**), or 9% of the $5.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend about $160 million in the United States, up from about $145 million in 1996. They held over 30% of the larger-company market there, up from about 20% in 1992. Adjusted for inflation, the annual exploration budgets of the larger Canadian-based companies for the United States have grown at an average annual compound rate of about 13% since the early 1990s.

Between 1992 and 1997, companies of all sizes listed on Canadian stock exchanges held about 1000 mineral properties in the United States (**Figure 43**). At the end of 1997, there were some 400 such companies active in that country. These companies had projects in 34 states, but mainly in the western part of the country in Nevada, California, Arizona, Alaska, Idaho, Montana, Washington, Utah, Colorado, New Mexico, Wyoming and South Dakota. Nevada alone accounted for over 300 properties, or for more than one third of the Canadian portfolio in the United States.

Although Canadian companies have expanded their activities considerably to Latin America, Africa and Asia since the early 1990s, the United States is likely to remain, for the foreseeable future, the foreign country where they hold their largest portfolio of mineral properties. At the end of 1997, the United States accounted for 28% of all properties held abroad by these companies.

Of all the Canadian-based companies, Placer Dome Inc., Barrick Gold Corporation and Cominco Ltd. planned the largest exploration programs in the United States during 1997. Together they were expected to spend over $87 million. Placer Dome is focussing its deposit appraisal and feasibility study programs on the South Pipeline gold project located on the Battle Mountain-Eureka gold trend in Nevada, as well as on the Donlin Creek gold project in Alaska; the company is focussing its grassroots exploration programs on properties in Alaska, Arizona, Montana and Nevada, and its mine-site exploration programs on Cortez and Bald Mountain in Nevada and on Golden Sunlight in Montana. Cominco is focussing on properties in Alaska, Arizona, Idaho, Minnesota, Montana, South Carolina and Washington, while Barrick is concentrating on Goldstrike and on other properties located on the Carlin gold trend in Nevada.

8.5.2 Latin America and the Caribbean

In 1997, the larger-company mineral exploration market in Latin America and the Caribbean was valued at some $1.6 billion (**Figure 44**), or roughly 30% of the $5.5 billion larger-company market worldwide. That region of the globe hosts the largest concentration of Canadian mineral exploration activity outside of Canada. During 1997, the larger Canadian-based companies planned to spend almost $700 million in the region, an increase of more than $200 million, or over 40%, compared with their budgets for 1996.

Adjusted for inflation, the exploration budgets of the larger Canadian-based companies for Latin America and the Caribbean have grown at an average annual compound rate of over 50% between 1992 and 1997. In 1997, these companies held about 45% of the larger-company market in the region, by far the largest share. In addition, they held the dominant share in Mexico, South America, Central America, and the Caribbean.

At the end of 1997, companies of all sizes listed on Canadian stock exchanges held interests in over 1300 mineral properties in the region. Since 1996, the total number of mineral properties held there by Canadian companies has exceeded the number held in the United States.

8.5.2.1 Mexico

In 1997, the larger-company mineral exploration market in Mexico was valued at over $250 million, or roughly 5% of the $5.5 billion larger-company market worldwide. Two dozen of the larger Canadian-based companies planned to spend a total of more than $125 million in that country, equivalent to half of the market.

Mexico remains, by far, the country of Latin America where Canadian companies are the most active. During 1994, there was a significant increase in the average size of the mineral property portfolio held in that country by Canadian companies of all sizes listed on Canadian stock exchanges.[9] At the end of 1994, these companies held interests in projects in at least half of Mexico's 31 states. At the end of 1997, there were 125 such companies in Mexico with projects in 19 states.

Farallon Resources Ltd. planned the largest Canadian exploration program in Mexico during 1997. That company planned to spend its entire budget of $25 million on the Campo Morado gold-silver project located in the state of Guerrero.

8.5.2.2 South America

In 1997, the larger-company mineral exploration market in South America was valued at about $1.2 billion, or over 20% of the $5.5 billion larger-company market worldwide. More than 100 of the larger Canadian-based companies planned to spend $480 million in total in the region, equivalent to more than 40% of the market. These companies held the dominant share in Argentina, Bolivia, Chile, Colombia, Peru and Uruguay.

Seven Canadian-based companies planned the largest exploration programs in four countries of South America: Essex Resource Corporation and Orvana Minerals Corp. in Bolivia; Bema Gold Corporation and Barrick in Chile; Bolivar Goldfields Ltd. and Latingold Ltd. in Colombia; and Rea Gold Corporation in Uruguay.

At the end of 1997, at least 280 companies of all sizes listed on Canadian stock exchanges held more than 900 mineral properties throughout South America. They held more than 150 properties in Peru, and more than 100 in each of Chile, Argentina and Venezuela.

8.5.2.3 Central America

In 1997, the larger-company mineral exploration market in Central America was valued at about $70 million, or 1% of the $5.5 billion larger-company market worldwide. Two dozen of the larger Canadian-based companies planned to spend a total of $58 million in the region, equivalent to roughly 90% of the market. They held the dominant share in Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama.

In 1997, ten Canadian-based companies planned the largest programs in five countries of Central America: Placer Dome and Inmet Mining Corporation in Costa Rica; Kinross Gold Corporation in El Salvador; Tombstone Explorations Co. Ltd. in Guatemala; Breakwater Resources Ltd., Geomaque Explorations Ltd., and Greenstone Resources Ltd. in Honduras; and Tiomin Resources Inc., Teck Corporation, Madison Enterprises Corp. and Inmet in Panama.

At the end of 1997, companies of all sizes listed on Canadian stock exchanges held almost 100 mineral properties throughout Central America. They held 20 or more in each of Panama, Honduras and Costa Rica.

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[9] For more detailed information on the penetration of the Mexican mineral exploration market by Canadian companies, see André Lemieux, "Canadian Mining Activity in Mexico," *World Mineral Notes*, Vol. 11, No. 1, March 1995, Natural Resources Canada, Ottawa, pp. 23 and 24.

8.5.2.4 Caribbean

In 1997, the larger-company mineral exploration market in the Caribbean was valued at about $25 million. The larger Canadian-based companies planned to spend about $15 million there, equivalent to roughly 60% of the market. Canadian companies held the dominant share in Cuba and Haiti. MacDonald Mines Exploration Ltd., Holmer Gold Mines Limited and KWG Resources Inc. planned the largest exploration programs in these two countries.

At the end of 1997, companies of all sizes listed on Canadian stock exchanges held about 40 mineral properties in the Caribbean, about two thirds of them in Cuba.

8.5.3 Europe and the Former Soviet Union

In 1997, the larger-company mineral exploration market in Europe and the FSU was valued at about $270 million (**Figure 44**), or roughly 5% of the $5.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend $135 million there, equivalent to half the market. At the end of 1997, 70 companies of all sizes listed on Canadian stock exchanges held over 200 mineral properties in the region.

8.5.3.1 Western Europe

In 1997, the larger-company mineral exploration market in western Europe was valued at over $100 million, or about 2% of the $5.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend over $55 million there, equivalent to more than half the market. They held the dominant share in Finland, Greenland, Ireland and Sweden.

In 1997, four Canadian-based companies planned the largest programs for two countries of western Europe: Dia Met Minerals Ltd. and Aber Resources in Greenland, and Boliden Limited and William Resources Inc. in Sweden.

At the end of 1997, companies of all sizes listed on Canadian stock exchanges held almost 90 mineral properties in western Europe. They held more than 10 in each of Greenland and the United Kingdom.

8.5.3.2 Eastern Europe

In 1997, the larger-company mineral exploration market in eastern Europe was valued at $40 million, or roughly 1% of the $5.5 billion larger-company market worldwide. The larger Canadian-based companies planned almost all of the programs in the region.

Five Canadian-based companies planned large programs in eastern Europe: TVX Gold Inc. in Greece; Argosy Mining Corp. in Slovakia; and Inco Limited, Cominco and Eldorado Gold Corporation in Turkey.

At the end of 1997, companies of all sizes listed on Canadian stock exchanges held about 40 mineral properties in eastern Europe. In Slovakia alone, they held about one dozen.

8.5.3.3 Former Soviet Union

In 1997, the larger-company mineral exploration market in the FSU was valued at over $100 million, or 2% of the $5.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend almost $40 million in these countries. They held the dominant share in Russia.

Since the early 1990s, there has been growing Canadian interest in participating in mineral opportunities in the FSU. At the end of 1997, there were almost 40 companies of all sizes listed on Canadian stock exchanges with interests in 65 mineral properties in seven countries of the FSU. The current strategy of most of these companies appears to be to target a single country.

Russia is by far the country of the FSU where Canadian companies are the most active. In 1997, the larger Canadian-based companies planned to spend almost $30 million on exploration in that country. The number of properties held there by companies of all sizes listed on Canadian stock exchanges increased significantly starting in 1996 and now stands at almost 40. At the end of 1997, there were at least a dozen Canadian companies active in Russia. Gold and, to a lesser extent, diamonds are the main exploration targets of Canadian companies there.

Kazakstan also is becoming increasingly attractive to Canadian companies. During 1997, the portfolio of mineral properties held in that country by companies of all sizes listed on Canadian stock exchanges doubled to about two dozen.

8.5.4 Africa and the Middle East

In 1997, the larger-company mineral exploration market in Africa and the Middle East was valued at about $920 million (**Figure 44**), or 16% of the $5.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend over $265 million in Africa, equivalent to about 30% of the market on that continent. In addition, they planned to spend $10 million in the Middle East.

In 1997, the budgets of the larger Canadian-based companies for Africa were more than double those of 1996, and more than five times those of 1995. These companies held the dominant share of the market in Angola, Botswana, Burkina Faso, Chad, the Democratic Republic of the Congo (Zaire), Côte d'Ivoire, Lesotho, Niger, Sierra Leone and Swaziland.

During 1997, 14 of the larger Canadian-based companies each planned mineral exploration programs in Africa valued at over $15 million. Tenke Mining Corp. planned to spend almost $29 million on the appraisal and study of the production feasibility of its Fungurume copper-cobalt deposit in the Democratic Republic of the Congo. Sutton Resources Ltd. planned to spend much of its $23 million African budget on its Bulyanhulu gold deposit in Tanzania. SouthernEra planned to spend about $22 million, mainly on diamond projects in South Africa and Angola. Emerging Africa Gold Inc. planned to spend more than $8 million on gold projects in Guinea.

Between 1992 and 1997, the number of mineral properties held in Africa by companies of all sizes listed on Canadian stock exchanges grew at an average annual compound rate of 60%. As a result, at the end of 1997, some 180 of these companies held almost 500 properties in 29 countries there. They held about 100 in Ghana alone, about 70 in Tanzania, and 40 or more in each of Zimbabwe, South Africa and Burkina Faso.

Although gold is the primary target of Canadian companies in Africa, there is nonetheless a considerable variety in the mineral commodities that they seek there.[10] Some of the commodities of interest to Canadians on that continent are not currently produced or are not widely explored for in Canada.

8.5.5 Asia-Pacific

In 1997, the larger-company exploration market in Asia-Pacific was valued at about $1.6 billion (**Figure 44**), or roughly 30% of the $5.5 billion larger-company market worldwide. The Asia-Pacific market is now as large as the one in Latin America and the Caribbean. The larger Canadian-based companies planned to spend about $230 million in Asia-Pacific, equivalent to about 15% of the market. They held the dominant share in East Asia, and an equal and dominant share in Southeast Asia with Australian-based companies.

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[10] For an overview of Canadian mineral exploration in Africa during 1995, see André Lemieux, "Canada and the Globalization of the Mining Industry," *Mineral Industry Review*, Fall 1996, Natural Resources Canada, Ottawa, pp. 32 and 33.

At the end of 1997, there were 150 companies of all sizes listed on Canadian stock exchanges active in the region with interests in about 270 mineral properties.

8.5.5.1 Southeast Asia

In 1997, the larger-company mineral exploration market in Southeast Asia was valued at about $550 million, or 10% of the $5.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend about $160 million, equivalent to almost 30% of the market. They held the dominant share in Papua New Guinea. In Indonesia alone, about 100 of the larger Canadian-based companies planned to spend about $90 million, equivalent to 30% of that market.

At the end of 1997, companies of all sizes listed on Canadian stock exchanges held about 280 mineral properties in the region. They held over 180 in Indonesia and about 50 in the Philippines.[11]

8.5.5.2 East Asia

In 1997, the larger-company mineral exploration market in east Asia, which includes China, Japan, Mongolia, Taiwan and the Republic of Korea, was valued at about $50 million, or 1% of the $5.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend roughly $30 million, equivalent to more than half the market. They held the dominant share in China and Mongolia.

Over the past four years, China has become increasingly attractive to Canadian mining companies. In late 1997, there were 30 companies of all sizes listed on Canadian stock exchanges with interests in 50 mineral properties in that country. About half of their projects involved gold. The other half involved copper-lead-zinc and a variety of other targets including diamonds, rare earths and zeolites.

8.5.5.3 South-Pacific

In 1997, the larger-company exploration market in the South-Pacific was valued at almost $970 million, or roughly 18% of the $5.5 billion larger-company market worldwide. Australia alone accounted for $920 million, or 95% of that market.

The larger Canadian-based companies planned to spend about $40 million in the region, about three quarters of it in Australia and the balance in the Solomon Islands. In 1997, the larger Canadian-based companies held about 3% of the Australian market.

At the end of 1997, companies of all sizes listed on Canadian stock exchanges held over 90 properties in Australia.

8.6 OUTLOOK

During 1996 and 1997, a record amount of equity financing was raised in Canada for Canadian exploration companies. As a result, these companies had the capital to conduct, during 1997, more mineral exploration programs worldwide than those of any other nation.

Canadian expertise at raising risk capital from investors in Canada, the United States, Europe, Asia and elsewhere has facilitated the penetration by Canadian companies of the exploration market around the world. As a result, Canadian companies have diversified their portfolio of

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[11] *The Mining Journal*, London (January 9, 1998, p. 24) reported that, according to the Philippines Mines and Geoscience Bureau, total exploration expenditures in that country in 1997 were US$120 million. Exploration expenditures in 1998 were expected to reach US$200 million.

mineral projects to well over 100 countries. They conduct more than one third of the world's programs for precious-metal, base-metal and diamond exploration, and they carry out the dominant share of exploration activity in Canada, Mexico, South America, Central America, Europe and the FSU. Nonetheless, Canada remains the country where they are, by far, the most active.

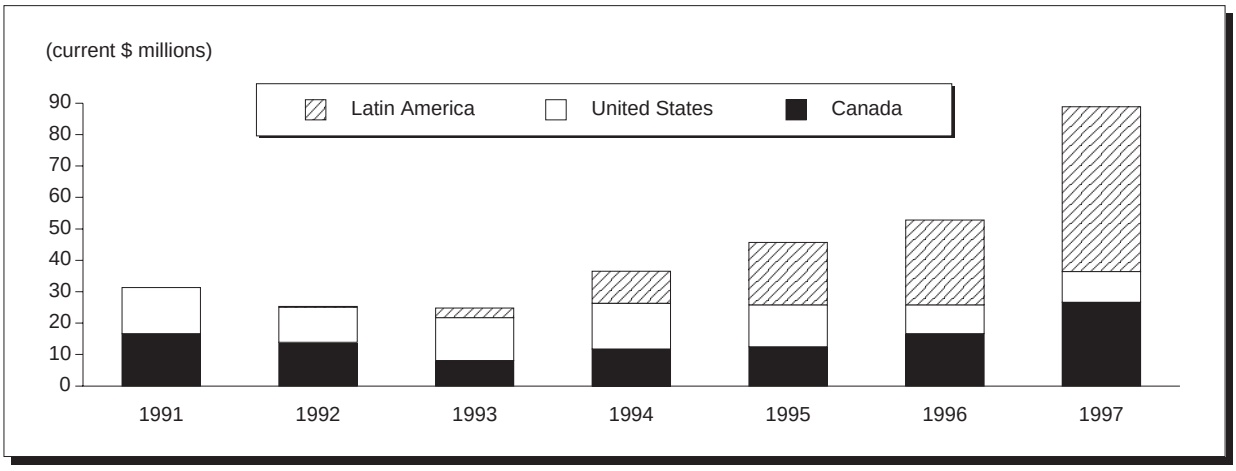
Although exploration expenditures in Canada have shown some growth since the early 1990s, Canada's domestic share of the worldwide market for mineral exploration has fallen from 18% in 1992 to 11% in 1997. However, Canada's standing as a destination for exploration investment from worldwide sources remains remarkable given the mammoth growth that has occurred since the early 1990s in mineral exploration activity in many developing countries.

Canadian companies have a vast number of grassroots, deposit appraisal, feasibility study, construction and production projects around the world. As a result, Canadian suppliers of all types of goods and services are experiencing unprecedented opportunities to make further gains in international markets. While the mineral projects of Canadian companies are helping strengthen the economies of developing countries, they are also creating jobs for Canadians, in both Canada and abroad, in industries related directly to mining as well as in other industries that are related only indirectly. Major Drilling Group International Inc. (**Figure 47**) is a good example of a company that, early on, saw the opportunities presented by the globalization of the mining industry.

In mid-1997, new mines under construction and those expected to be built in the near future around the world were valued at some US$34 billion (**Figure 48**). At the time of writing in late December 1997, there was still plenty of momentum in mineral exploration and development around the world. However, investor uncertainty created by the decline in the price of some mineral commodities, by a number of corporate scandals, and by economic problems in Asia has depressed exploration finance markets.

To what extent exploration programs will have fallen short of budgets during 1997 because of investor uncertainty remains to be seen. However, it is clear that financing new exploration programs was becoming increasingly difficult as 1997 progressed.

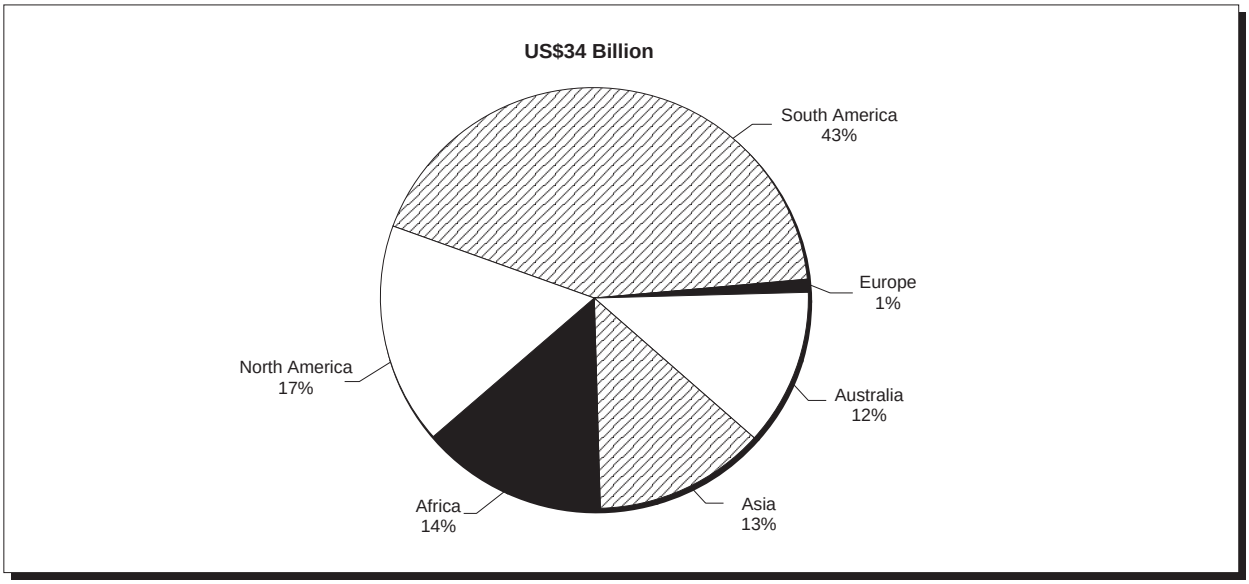
Figure 47
Major Drilling Group International Inc.,
Revenues by Geographic Market Segment, Year Ending April 30, 1991-97



Source: Natural Resources Canada, based on company annual reports.
Note: The company that is based in Moncton, New Brunswick, completed an initial public offering in March 1995.

As working capital becomes depleted, many of the smaller companies will be forced to curtail their exploration and development plans until financial markets recover. Those companies that have no substantial revenues from production will be especially vulnerable. The incidence of restructuring, issuer bids for their own stock, adoption of "poison-pill" provisions, mergers and acquisitions, as well as joint ventures between large companies with sufficient working capital and smaller companies with properties of superior mineral potential, will likely accelerate for the foreseeable future.

Figure 48
Worldwide Mine Construction Projects Planned as at Mid-1997



Source: Natural Resources Canada, based on page 3 of the *Mining Journal*, August 1, 1997.

APPENDIX

Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures

HISTORY OF CANADIAN EXPLORATION STATISTICS

In Canada, mineral exploration statistics have been collected, in one form or another, since 1946. From 1946 to 1963, Statistics Canada compiled "cost of prospecting" data for metal mines for Canada and the provinces. Companies were surveyed from 1964 to 1966, but the data were not compiled. However, using the filled-out survey questionnaires for those three years, NRCan was able to estimate expenditures for that period. From 1967 to 1987, Statistics Canada compiled and published both mine-site and general exploration expenditures, as well as mine-site development expenditures and other capital and repair expenditures. From 1985 to 1987, NRCan collected detailed field work expenditures. Since 1988, NRCan has been fully responsible for the survey of non-producing entities that have any type of exploration expenses. Statistics Canada continued to survey producing firms until 1997. Since then, NRCan has been totally responsible for the preliminary and forecast survey, and partially responsible for the annual survey for non-producing as well as producing firms.

The survey of mining and exploration companies was redesigned in 1997 to better describe the full mineral development cycle and to provide more comprehensive measures of investment in the Canadian minerals and metals industry. It is now called the "Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures." New statistics are now available and include detailed information on feasibility studies and other more technically related costs that were previously excluded. A clearer distinction between the primary exploration and deposit appraisal phases, and additional information on associated environmental costs, are geared to improve the monitoring of the mineral development cycle.

SURVEY PROCESS

Two questionnaires are distributed each year. For example, for the survey period 1997/98, the *preliminary* survey was conducted during the last quarter of 1997 and January 1998, while the more detailed *final* survey questionnaires were distributed in early 1998. Results of this *final* survey will be compiled during the course of 1998. The *preliminary* survey provides preliminary results on 1997 exploration activity and a forecast for 1998 that is based on company spending intentions. The *final* survey provides a wealth of project-specific information, including specific commodities explored for, type of field work undertaken, related overhead expenditures, type of company involved, joint-venture partners, and other details.

A total of 2486 questionnaires (preliminary survey) were distributed in October 1997. Some companies receive more than one questionnaire depending on the number of provinces/territories in which they have activities. To avoid duplicate reporting, joint-venture partners who are not project operators do not report expenditures on such joint-venture exploration. Companies are now asked to report exploration expenditures for the calendar year surveyed.

The survey is a full census of all the companies involved in mineral exploration in Canada. Generally, only about 2% of questionnaires are not completed. When this happens, estimates to replace missing values are provided by the province or territory concerned. However, this 2% usually represents small or inactive operations; therefore, virtually all exploration expendi-

tures are covered by the survey. To protect the confidential data provided by respondents, only aggregate statistics are released. However, specific project information can be added when such information has already entered the public domain.

DISCREPANCIES BETWEEN PRELIMINARY AND FINAL RESULTS

The time lag between the 1998 preliminary survey conducted in late 1997 and January 1998 and the final survey conducted throughout 1998 may give rise to discrepancies between the two surveys.

Spending intentions, which are compiled in the preliminary survey, may often be modified by events that can limit the availability of funds for conducting exploration, such as changing commodity prices, stock market conditions and general economic conditions, as well as the impact of new mineral discoveries and company-specific factors. As shown in **Table 22**, the results of this survey cannot be interpreted as being an accurate reflection of the exploration that will ultimately be performed in 1998.

Table 22 shows intentions, as well as preliminary and actual expenditures, when available, for mine-site and general exploration for the years 1986-98. This table demonstrates that, for the periods 1986-88 and 1993-95, total final expenditures (actual basis) exceeded intentions and preliminary results reported earlier for the same period. For the period 1989-92 and in 1996, this pattern was reversed. A possible explanation for the 1986-88 period could be that more flow-through share exploration funding became available than companies had originally anticipated but, starting in 1989, there was an unexpected decline in the availability of those flow-through share funds. Similarly, for the period 1993-95, exploration funding was probably more readily available than originally expected as a result of the interest generated by discoveries of diamonds in Canada's North and of nickel-copper-cobalt at Voisey's Bay in Labrador. Since the 1997 and 1998 data in this table were collected using revised definitions, a subset of data was extracted to provide a continuation of the previous statistical series that were based on pre-1997 definitions.

DEFINITIONS USED IN THE NEW SURVEY

A number of new definitions were introduced in the new survey to more closely reflect the current realities of Canadian mineral exploration and development activities. These definitions were developed and agreed upon by federal, provincial/territorial and industry representatives, and they were tested by companies that volunteered to ensure their relevance and applicability.

Mineral Development Phases (Work Phases)

Exploration expenditures represent all activities and support, including capital expenditures, carried out (on- or off-mine-site) to search for, discover and carry out the first delineation of a previously unknown mineral deposit to establish its potential economic value (tonnage and grade) and to justify further work.

Deposit appraisal expenditures represent all activities and support, as well as capital expenditures carried out (on- or off-mine-site), to bring a delineated deposit to the stage of detailed knowledge required for a production feasibility study to support a production decision and the investment required.

Mine complex development expenditures include all mine development, construction, and machinery and equipment expenditures carried out on a mine property that is in production or committed to production.

Mine development expenditures include all activities and support carried out on a property that is in production or committed to production to outline, block out, and gain access to the ore and

TABLE 22. CANADA, COMPARISON OF INTENTIONS, PRELIMINARY AND ACTUAL EXPLORATION EXPENDITURES, 1986-98

Exploration Expenditures	Intentions	Preliminary	Actual	Actual/Intentions
		($ millions)		(%)
1986				
Mine-site	87.5	110.2	108.6	
General	431.2	483.6	589.3	
Total	518.7	593.8	697.9	+35
1987				
Mine-site	122.6	121.5	161.0	
General	583.2	849.6	1 139.0	
Total	705.8	971.1	1 300.0	+84
1988				
Mine-site	154.7	138.7	143.0	
General	891.0	1 107.9	1 207.0	
Total	1 045.7	1 246.6	1 350.0	+29
1989				
Mine-site	111.7	160.0	115.3	
General	832.2	766.7	712.5	
Total	943.9	926.7	827.8	–12
1990				
Mine-site	150.0	107.7	112.4	
General	633.0	643.5	662.3	
Total	783.0	751.2	774.7	–1
1991				
Mine-site	97.9	80.4	67.3	
General	548.3	514.4	464.4	
Total	646.2	594.8	531.7	–18
1992				
Mine-site	71.2	75.4	59.4	
General	426.3	344.2	325.9	
Total	497.5	419.6	385.3	–23
1993				
Mine-site	70.1	78.1	64.0	
General	364.5	404.9	413.2	
Total	434.6	483.0	477.2	+10
1994				
Mine-site	66.0	68.3	72.3	
General	470.9	561.8	555.8	
Total	536.9	630.1	628.1	+17
1995				
Mine-site	67.9	76.9	86.4	
General	586.8	686.6	631.2	
Total	654.7	763.5	717.6	+10
1996				
Mine-site	79.4	98.3	99.6	
General	865.8	774.2	795.2	
Total	945.2	872.5	894.8	–5
1997				
Mine-site	104.8	152.6		
General	771.2	651.6		
Total	876.0	804.2	. .	. .
1998				
Mine-site	121.5			
General	645.9			
Total	767.4	. .	. .	. .

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
. . Not available.

prepare it for production. Mine development also includes drilling, rock work and support to extend the known mineral deposits in production or committed to production.

Location of Activity

On-mine-site expenditures represent all activities, support and capital expenditures applied to exploration or deposit appraisal for an additional and separate mineral deposit on an existing mine site in production or committed to production.

Off-mine-site expenditures represent all activities, support and capital expenditures applied to exploration or deposit appraisal that are not located on a mine site that is in production or committed to production. (Off-mine-site includes the sites of closed mines.)

A *mine site* is an area that can be accessed and exploited from the current or committed installations; hence, the size of this area will vary depending on the commodity under consideration, attitude (horizontal vs. vertical), type and extent of the deposit(s), and the mining method(s) in use.

For a mine site to be *committed to production*, all of the following criteria must be met: (i) a production feasibility study has been completed; (ii) a formal production decision has been made by the organization; (iii) the necessary financing is on hand or has been arranged; (iv) all required authorizations and permits have been obtained; and (v) major pieces of production equipment have been purchased or ordered.

Surface and Underground Field Surveys and Work (Includes Field Overhead)

Surface and underground field surveys include expenditures associated with geoscientific surveys, drilling, rock work, other field costs, and engineering, economic and feasibility studies. It includes wages, salaries, fringe benefits, food, accommodation and other services, equipment rentals, all vehicle expenses, transportation costs (for people and equipment), and all related technical activities/services. Direct field supervision and project management costs, and all costs of field work carried out on contract, are also included. All surveys and work done for environmental purposes are entered under the environment section. This would apply, for example, to geochemical or geophysical surveys performed to characterize or monitor the environment.

Engineering studies include all expenditures related to the additional studies, tests and pilot work (mining, milling, dewatering, etc.), plans, designs and appraisals required to establish the technical feasibility of a mining project.

Economic studies include all expenditures for economic studies (markets, prices, financing, etc.) required to establish the economic feasibility of a mining project.

Feasibility studies include all expenditures related to prefeasibility project reviews and to the production feasibility studies required to develop and mine a deposit, and to obtain the required leases, permits and authorizations (excluding environmental and land access expenditures).

Environment-Related Expenditures

Environmental characterization includes all costs of environmental characterization and assessment (including environmental impact studies) that form part of exploration and deposit appraisal activities.

Environmental permits include all costs related to the process of meeting the legal and regulatory requirements of environmental assessment and of obtaining permits (including pre-production permits) required for the work program under consideration.

Environmental protection includes costs for monitoring (additional to normal practices) and complying with regulations and guidelines related to air emissions, liquid effluents, ground pollution, and wildlife and habitat protection. Environmental fines, if any, are included in this category.

Environmental restoration includes all costs of decommissioning, reclaiming and restoring, and monitoring, if required, after the completion of exploration and deposit appraisal field work.

Land Access-Related Expenditures

Land access agreements, permits, and damages include all costs related to establishing impact benefit statements, socio-economic agreements, and other requirements for mine complex development and mine production, and the costs of rights of way, damages and permits for exploration and deposit appraisal work, including all associated legal fees, but excluding all environment-related costs.

Capital, Repair and Maintenance Expenditures

Capital expenditures for non-residential construction, machinery and equipment include expenditures by the company for work performed by contractors or by the company for its own account, such as salaries and wages, materials and supplies, and other charges such as engineering and consulting fees. Environmental-related capital expenditures for protection and site restoration are included in this category.

Non-capitalized *repair and maintenance expenditures* consist of the gross non-capitalized repair expenditures on non-residential buildings, other structures and machinery, the costs of maintaining the restored mine site, and the routine care of assets, including environmental monitoring of the restored mine site.

CLASSIFICATION OF COMPANIES

Some of the analysis within this report is carried out according to the following six company types:

1) **Producers**: Companies with a producing mine or part ownership in a producing mine in Canada, and companies that own more than 50% of the shares of a producing mining company. Also includes oil companies or foreign companies with a producing Canadian mine.

2) **Affiliates of producing mining companies**: Wholly owned or majority-owned incorporated subsidiaries of producers.

3) **Oil companies**: Oil companies, both domestic and foreign, with non-petroleum exploration projects in Canada. Oil companies with producing mines are included with producers.

4) **Foreign companies**: This group excludes foreign-owned oil companies and foreign-owned companies with a producing mine in Canada.

5) **Junior companies and prospectors**: This group excludes all of the other categories.

6) **Other companies**: Canadian-owned companies engaged in mineral exploration, including forestry, construction and consulting firms, and government-owned mining companies that do not own a producing mine. This category also includes Canadian-owned companies with operating mines only in countries other than Canada.

A company is classified into the first of these groups in which it fits. For example, exploration statistics reported by an oil or foreign company with a producing Canadian mine would be included in Category 1 (producers), rather than in Category 3 (oil companies) or Category 4

(foreign companies). Exploration by foreign-owned oil companies would appear in Category 3 (oil companies), and not in Category 4 (foreign companies).

Other sections of the report only distinguish between junior and senior companies. In general terms, a senior mining company derives its income from mining or other business ventures and can direct part of that income towards its exploration projects. Junior companies, on the other hand, usually have no regular source of income and must finance their exploration activities through the issuance of treasury shares.