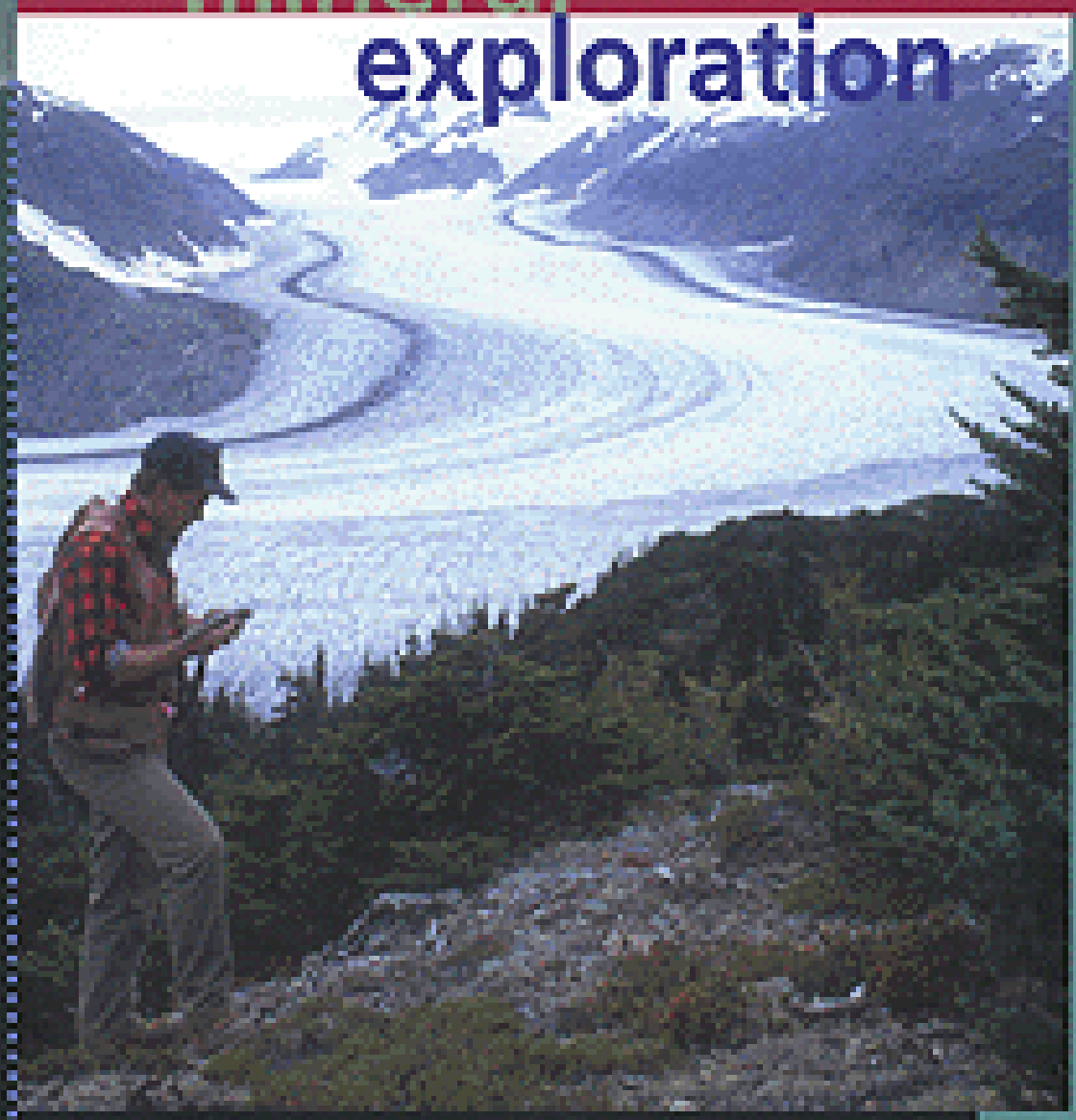
Overview of Trends in

Canadian mineral exploration



CANADIAN INTERGOVERNMENTAL WORKING GROUP ON THE MINERAL INDUSTRY

1999

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 information on exploration and deposit appraisal expenditure levels in Canada, a review of current exploration and deposit appraisal activities in the provinces and territories, and analyses of current domestic and international trends affecting the Canadian mineral exploration sector.

Unless indicated otherwise, the information contained in this report is current as of May 1999 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.

This report covers exploration and deposit appraisal activities for metallic minerals, non-metallic minerals, coal and uranium. It does not refer to petroleum-related work.

On April 1, 1999, the new Canadian territory of Nunavut was created by dividing the land mass previously known as the Northwest Territories into two distinct territories: Nunavut and the Northwest Territories. Since the data presented in this report were collected prior to this event, Nunavut does not have its own section in this year's edition of the report. However, Chapter 1 and the Northwest Territories' section in Chapter 5 contain some information that is clearly identified as pertaining to Nunavut.

This document is also available on the Internet at http://www.nrcan.gc.ca/mms/efab/invest/exploration.

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

After peaking at $895 million in 1996, exploration and deposit appraisal expenditures in Canada began a downward trend. In 1997, they fell to $820 million and preliminary figures for 1998 show an even stronger decline as exploration and deposit appraisal spending amounted to $601 million. Barring a significant and sustained increase in metal prices, this downward trend is expected to continue in 1999. According to company spending intentions that were collected through the *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures* in January 1999, only $489 million was intended to be spent on exploration and deposit appraisal activities in Canada in 1999. In constant 1998 dollars, this level of spending would be the lowest since 1992 and the third lowest of the past 30 years.

The trend of declining exploration expenditures in Canada and elsewhere can mainly be attributed to the low gold and base-metal prices that persisted through at least the first half of 1999, the ongoing Asian crisis, and the resulting general feeling that conditions were unlikely to improve in the short term.

In 1998, spending decreases were recorded in all provinces and territories except Alberta. The largest decreases were recorded in the Yukon, British Columbia, Ontario and New Brunswick. Despite a 30% decrease in exploration and deposit appraisal expenditures in Ontario, that province still ranked second in Canada, behind Québec and ahead of the Northwest Territories. A provincial/territorial breakdown of spending intentions for 1999 once again reveals the Canada-wide extent of the situation. The forecast for 1999 includes spending reductions in nearly all Canadian jurisdictions.

Approximately 75% of 1998 exploration and deposit appraisal expenditures in Canada were for off-mine-site activities, and that proportion should be maintained in 1999. Spending by junior exploration companies stood at $197 million in 1998, accounting for 33% of total expenditures. According to company spending intentions compiled in January 1999, junior company expenditures were expected to decrease by 14% in 1999 to $169 million. Senior company spending amounted to $405 million in 1998 and was expected to decline to $320 million in 1999.

Other indicators of exploration activity, such as those related to claim staking and drilling, tend to confirm the declining interest in mineral exploration. While the amounts spent on the search for diamonds appear to have leveled out, considerable sums have been shifted to mine development and construction, and the emerging Canadian diamond industry appears to be building a solid base.

On April 1, 1999, the territory of Nunavut was created. A first look at exploration activities in this territory confirms that Nunavut will become a major player in the Canadian mineral exploration sector. Its large land mass, mining history and potential for the discovery of gold, base-metal and diamond deposits should contribute to the establishment of Nunavut as a prime exploration location.

Globally, Canada remains one of the world's top mineral exploration targets, garnering 11% of the exploration budgets of the world's larger exploration and mining companies in 1998. With their 3300 foreign mineral properties, Canadian companies are also very active abroad, accounting for about 30% of all larger-company exploration programs in the world in 1998. They not only dominate the Canadian exploration sector, but also the exploration sectors of the United States, Mexico, South and Central America, and Europe.

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1. Mineral Exploration and Deposit Appraisal Expenditures in Canada

1.1 INTRODUCTION

The first section of this report presents data and analyses on mineral exploration and deposit appraisal expenditures in Canada for 1998 and 1999. The preliminary estimates for 1998 and company spending intentions for 1999 (compiled in January 1999) were obtained from the federal-provincial *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures*, which is described in the Appendix. This section also describes the results of a statistical model, designed by the Minerals and Metals Sector of Natural Resources Canada, to predict the amount of junior and senior company mineral exploration and deposit appraisal spending that could occur in 1999. Finally, a special section has been added to this chapter of the report to mark the creation of Nunavut, Canada's newest territory.

1.2 RECONCILING TWO SETS OF DATA

The *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures* was redesigned in 1997 and, as a result, now provides a more comprehensive breakdown of the mineral development cycle in Canada. While this more detailed survey offers new and expanded analytical possibilities, these are limited by the fact that only three years of data currently exist (final 1997, preliminary 1998, and forecast 1999). For establishing historical comparisons and for monitoring existing trends that began before 1997, which are main objectives of this report, the analysis must be performed on a subset of data that can be accurately compared with the data collected under the previous survey's definitions.

Therefore, two types of analysis are presented herein. The first, which is the one more frequently used in this version of the report, relies on comparable data from the old and new surveys and allows a continuation of the analysis that has been presented in previous editions of this report. The second type uses the additional information collected in the new survey to help create a more detailed and comprehensive picture of the mineral development cycle and its exploration, deposit appraisal and mine complex development components. In the future, once data from the new survey have been collected for a sufficient number of years, the analysis will focus primarily on the latter type of analysis. At that point, it will be possible to calculate what adjustments are needed to the pre-1997 data so that they can be compared to the data in the time series that were created using the new survey's definitions.

The more detailed cost breakdown of the new survey provides exploration and deposit appraisal expenditures that are generally higher than the ones obtained in the old survey simply because cost categories like environment, feasibility studies and land access were not previously accounted for. Only field work and overhead costs were counted and these constitute the comparable subset of data that is extracted from the new survey results.

Hence, unless indicated otherwise,[1] the analysis in this report consists of comparisons of data that include field work and overhead costs, as collected under both the old and new surveys,

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[1] A different set of definitions is used in Chapter 7, which is based on data from the Metals Economics Group.

and the terms "exploration" and "deposit appraisal" (from the new survey) are combined for comparison with what was known as exploration (grass-roots and advanced) in the old survey. In the new survey, exploration is defined as the work carried out 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 includes the work carried out to bring a delineated deposit to the stage of detailed knowledge required for a production feasibility study. Where the term "exploration" is used by itself in this report, it generally includes both exploration (grass-roots) and deposit appraisal (advanced). Similarly, the *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures* is often referred to as the federal-provincial survey of mining and exploration companies.

1.3 1998 EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES

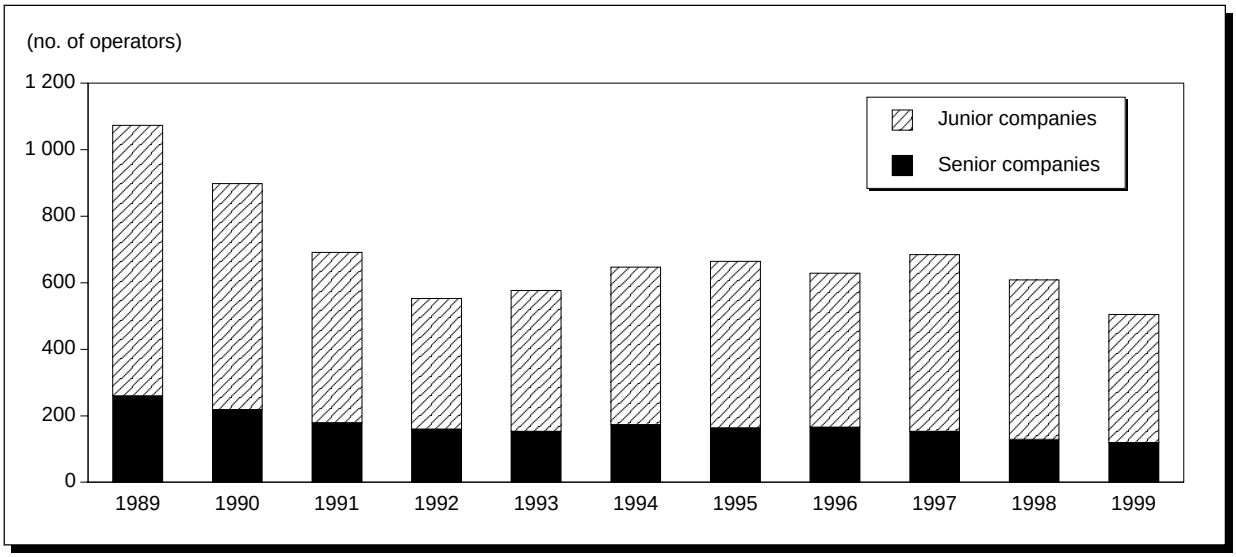
1.3.1 Statistical Summary

In 1998, 609 companies (project operators) and some prospectors spent $601 million on mineral exploration and deposit appraisal (field and overhead expenditures) in Canada (**Figure 1**). That number of companies represented a decrease of 11% from the 1997 total of 685 companies (expenditures of $820 million). A total of 102 companies (compared to 129 in 1997) spent $1 million or more each **(Table 1)**; these companies' expenditures accounted for 83% of the total expenditures for 1998.

Compared to 1997, spending decreases totaling $223 million were recorded in all provinces and territories except Alberta, which recorded an increase of $4.3 million (**Figure 2**). Major decreases occurred in Ontario (23% of the $223 million total decrease), British Columbia (21% of the $223 million), the Northwest Territories (17% of the $223 million) and Québec (17% of the $223 million).

The largest year-to-year decreases in expenditures were experienced by the Yukon (-62%), British Columbia (-49%), Ontario (-30%) and New Brunswick (-29%). In decreasing order of

Figure 1
Project Operators Active in Exploration and Deposit Appraisal in Canada, 1989-99



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: Data exclude prospectors. Data for 1998 data are preliminary; 1999 data are based on company spending intentions as compiled in January 1999.

TABLE 1. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES BY RANGE OF EXPENDITURES[1] AND BY TYPE OF COMPANY, 1998 AND 1999

Range of Expenditures	Junior			Senior			Total		
	Companies	Expenditures	Percentage of Total Junior Expenditures	Companies	Expenditures	Percentage of Total Senior Expenditures	Companies	Expenditures	Percentage of Total Expenditures
($)	(number)	($000)	(%)	(number)	($000)	(%)	(number)	($000)	(%)
1998									
>10 million	2	24 928	12.7	10	179 101	44.3	12	204 029	33.9
5 million - 10 million	1	7 900	4.0	16	124 462	30.8	17	132 362	22.0
1 million - 5 million	39	78 620	40.0	34	85 303	21.1	73	163 923	27.3
500 000 - 1 million	47	32 227	16.4	10	7 852	1.9	57	40 079	6.7
200 000 - 500 000	99	32 557	16.6	16	4 974	1.2	115	37 531	6.2
100 000 - 200 000	51	7 718	3.9	13	1 944	0.5	64	9 662	1.6
50 000 - 100 000	57	4 475	2.3	7	603	0.1	64	5 077	0.8
0 - 50 000	184	3 260	1.7	23	425	0.1	207	3 685	0.6
Subtotal	480	191 684	97.6	129	404 663	100.0	609	596 347	99.2
Prospectors[2]	42	4 792	2.4	–	–	–	42	4 792	0.8
Total 1998	522	196 477	100.0	129	404 663	100.0	651	601 140	100.0
1999									
>10 million	–	–	–	7	117 518	36.8	7	117 518	24.1
5 million - 10 million	1	6 500	3.8	14	111 721	34.9	15	118 221	24.2
1 million - 5 million	36	75 130	44.5	30	72 809	22.8	66	147 939	30.3
500 000 - 1 million	52	36 028	21.3	12	9 095	2.8	64	45 123	9.2
200 000 - 500 000	100	35 033	20.7	17	5 436	1.7	117	40 468	8.3
100 000 - 200 000	33	5 241	3.1	14	2 126	0.7	47	7 367	1.5
50 000 - 100 000	50	4 394	2.6	6	505	0.2	56	4 899	1.0
0 - 50 000	113	2 173	1.3	20	490	0.2	133	2 663	0.5
Subtotal	385	164 498	97.4	120	319 701	100.0	505	484 199	99.1
Prospectors[2]	33	4 369	2.6	–	–	–	33	4 369	0.9
Total 1998	418	168 867	100.0	120	319 701	100.0	538	488 568	100.0

Source: Natural Resources Canada.
– Nil.
[1] On-mine-site plus off-mine-site; includes field work and overhead expenditures only. [2] Data for prospectors are incomplete.
Notes: Data for 1998 are preliminary estimates; 1999 data are based on company spending intentions as compiled in January 1999. Numbers may not add to totals due to rounding.

amounts spent on exploration and deposit appraisal, Québec, Ontario, the Northwest Territories, Newfoundland and Labrador, and British Columbia accounted for 78% of all such expenditures in Canada in 1998.

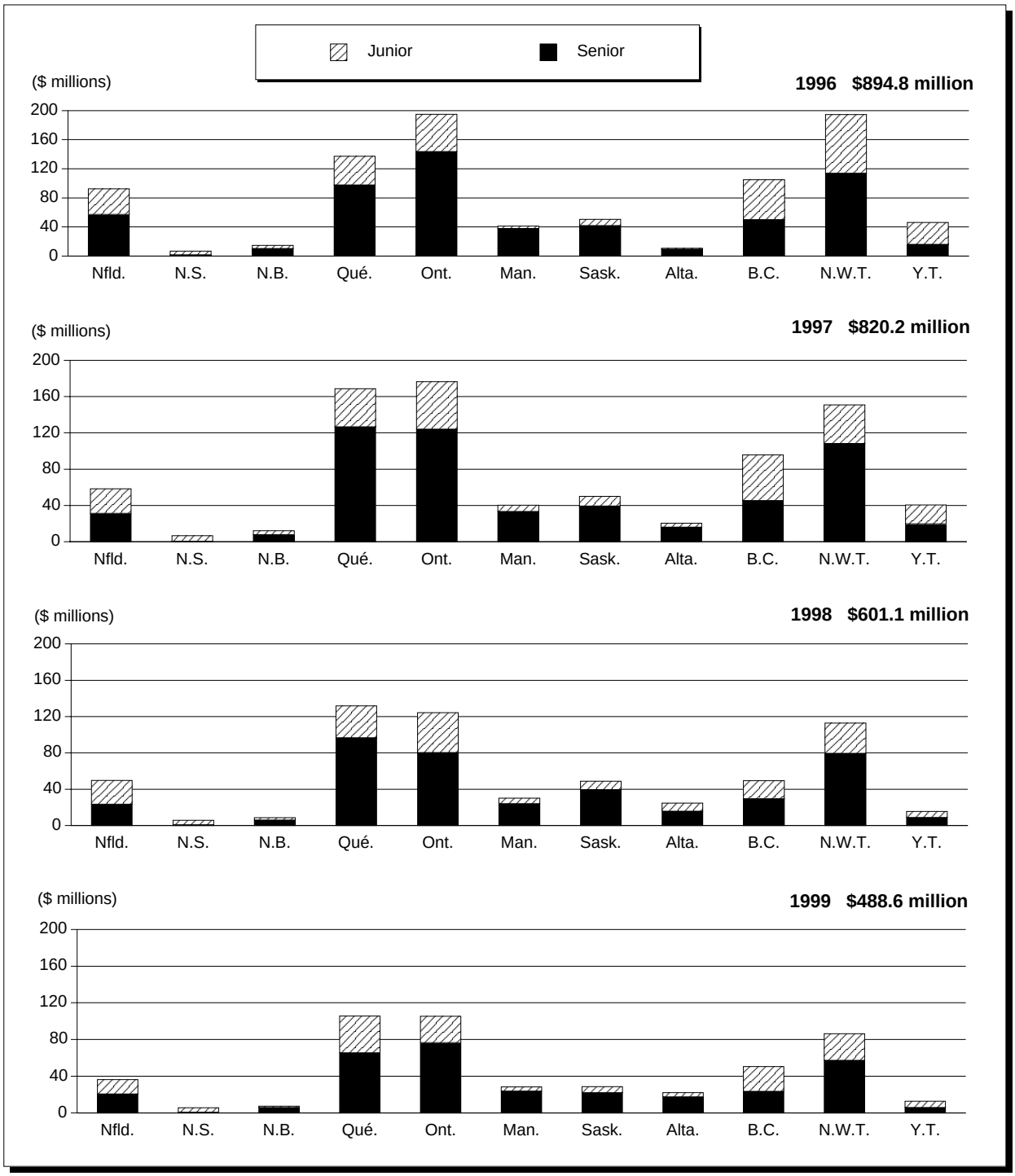
Expenditures for off-mine-site exploration and deposit appraisal activity decreased by 31% from the 1997 level of $667 million (**Figure 3**). Overall, $459 million, or 76% of all exploration and deposit appraisal expenditures in 1998, was for off-mine-site activity. The Northwest Territories ranked first in off-mine-site spending with 23% of the total for that category, followed by Ontario and Québec with 19% and 18%, respectively.

On-mine-site exploration and deposit appraisal expenditures decreased by 7% to $142 million from the 1997 level of $153 million. They accounted for more than 30% of the respective exploration and deposit appraisal totals recorded for Québec and Manitoba, and for between 20% and 30% of the respective totals recorded for Ontario, Saskatchewan, the Yukon and Alberta.

1.3.2 Spending by Junior and Senior Firms

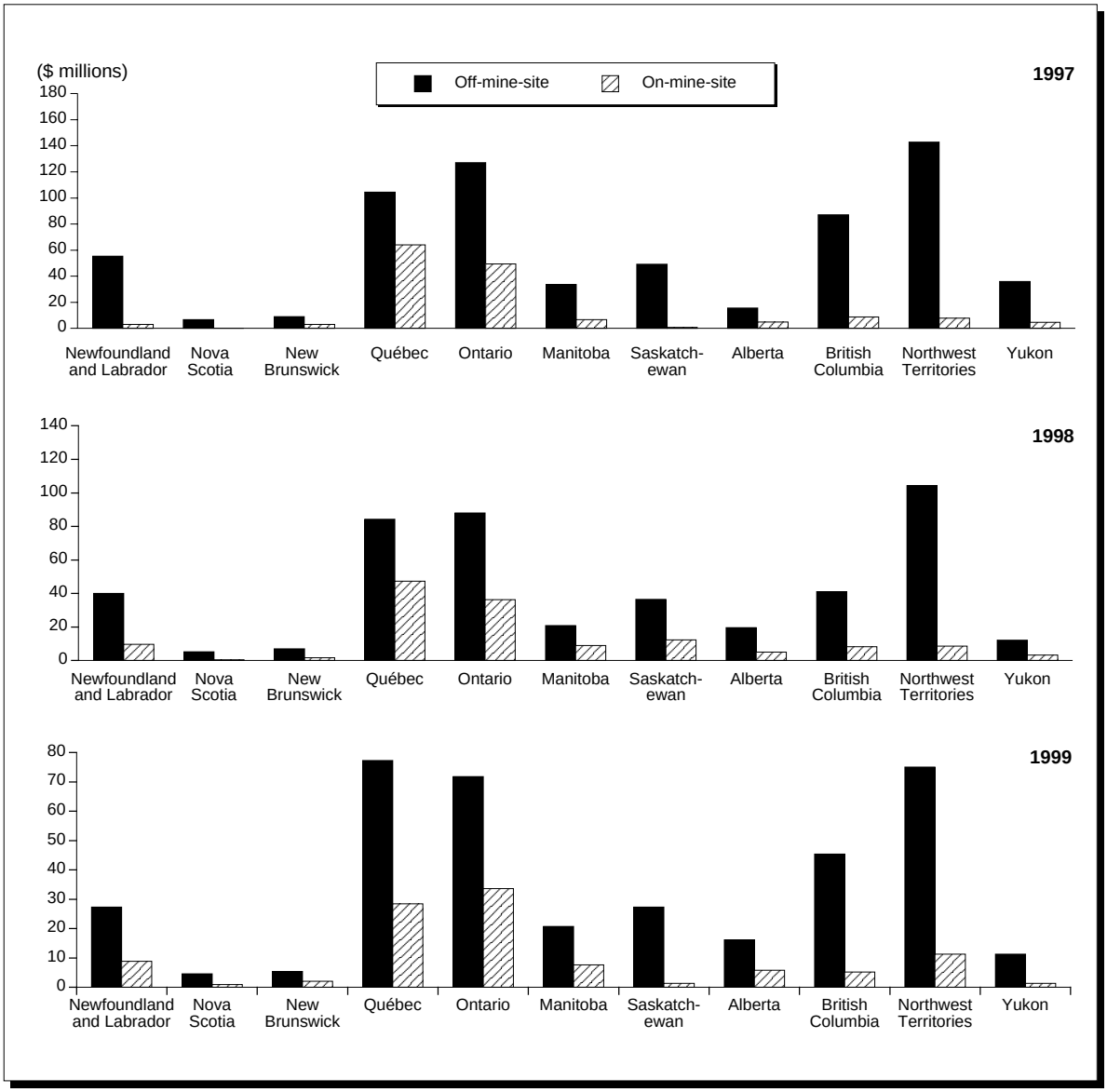
The analyses within this report often distinguish between senior and junior companies. In general terms, a senior company derives its income from mining or other business ventures and can direct part of that income towards its exploration and deposit appraisal projects. Junior companies, on the other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

Figure 2
Exploration and Deposit Appraisal Expenditures in Canada by Junior and Senior Companies, by Province and Territory, 1996-99



Sources: Natural Resources Canada and Statistics Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: Data for 1998 are preliminary estimates; 1999 data are company spending intentions as compiled in January 1999. For comparison with pre-1997 years, the data include only off- and on-mine-site field and overhead expenditures.

Figure 3
On-Mine-Site and Off-Mine-Site Exploration and Deposit Appraisal Expenditures, by Province and Territory, 1997-99



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
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. Exploration and deposit appraisal activities include costs incurred for field work and overhead only. Data for 1998 are preliminary; 1999 data are company spending intentions as compiled in January 1999.

In 1998, 129 senior project operators (non-junior companies) accounted for 67% ($405 million) of all exploration and deposit appraisal expenditures (**Figures 1** and **2**). Their proportional share of total exploration and deposit appraisal expenditures was about the same as in 1997 when 153 senior project operators spent $553 million.

About 73% of the expenditures reported by senior firms in 1998 were incurred in Québec, Ontario, the Northwest Territories and Saskatchewan (in decreasing order). Senior firms decreased their expenditures in 1998 in all provinces and territories, except for slight increases in Nova Scotia and Saskatchewan.

Senior companies were the main contributors to exploration and deposit appraisal expenditures in all provinces and territories except Newfoundland and Labrador, and Nova Scotia. Senior company expenditures exceeded 70% of total expenditures in each of Saskatchewan, Manitoba, Québec, New Brunswick and the Northwest Territories.

The number of junior project operators dropped to 480 in 1998, down by 10% from the 532 recorded in 1997. 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 and deposit appraisal expenditures.

Altogether, junior companies and prospectors spent $197 million in 1998, a decrease of 26% over 1997. Decreases in junior expenditures were recorded in all provinces and territories except Alberta. In percentage terms, the largest decreases occurred in the Yukon (-69%), British Columbia (-61%) and New Brunswick (-43%). In terms of magnitude, British Columbia (-$30 million), the Yukon (-$14 million), and the Northwest Territories (-$9 million) suffered the largest decreases in junior spending. In decreasing order of expenditures, Ontario, Québec, the Northwest Territories, and Newfoundland and Labrador accounted for 70% of all junior expenditures in 1998.

With the exception of the large number of junior companies spending less than $50 000, junior company spending in 1998 most frequently fell in the $200 000 to $500 000 interval (**Table 1**). As for senior companies, the most commonly reported range of exploration and deposit appraisal expenditures was $1 million to $5 million.

1.3.3 Main Exploration and Deposit Appraisal Properties

The two main exploration or deposit appraisal properties, or groups of properties (based on reported expenditures), for each province and territory in 1998 are listed in **Table 2**. Expenditures on the projects listed in this table totaled $134 million and represented 22% of all exploration and deposit appraisal expenditures in Canada for that year. In fact, by themselves, the 21 companies listed in the table accounted for $186 million, or 31% of all exploration and deposit appraisal expenditures in Canada in 1998. About 78% of the expenditures incurred for the projects listed in **Table 2** were made by senior companies.

1.3.4 Breakdown of Exploration- and Deposit Appraisal-Related Expenditures Using New Survey Definitions

A breakdown of expenditures (**Figure 4, Table 3**) by exploration, deposit appraisal and mine complex development spending, including other project costs such as those related to engineering, economic and feasibility studies, the environment, and land access, is now possible due to the redesign of the survey in 1997. These other related project costs constitute about 11% of the overall exploration and deposit appraisal expenditures reported, the balance being almost equivalent to what total exploration expenditures would have amounted to under the previous survey's definitions.

Such a breakdown shows that, including these previously unsurveyed costs, exploration expenditures (in the strict sense) amounted to $493 million in 1998 (73% of the $678 million total for exploration and deposit appraisal). In 1997, exploration, including other project costs, had amounted to $634 million. More than 90% of the total 1998 exploration and deposit appraisal expenditures (including the other costs mentioned above) were reported as exploration work in each of New Brunswick, Newfoundland and Labrador, and Nova Scotia; between 80% and 90% in Manitoba, Alberta and the Yukon; and between 60% and 80% in the Northwest Territories, British Columbia, Québec, Saskatchewan and Ontario. Hence, the latter provinces likely were the sites of a higher proportion of deposit appraisal work on promising deposits. In terms of

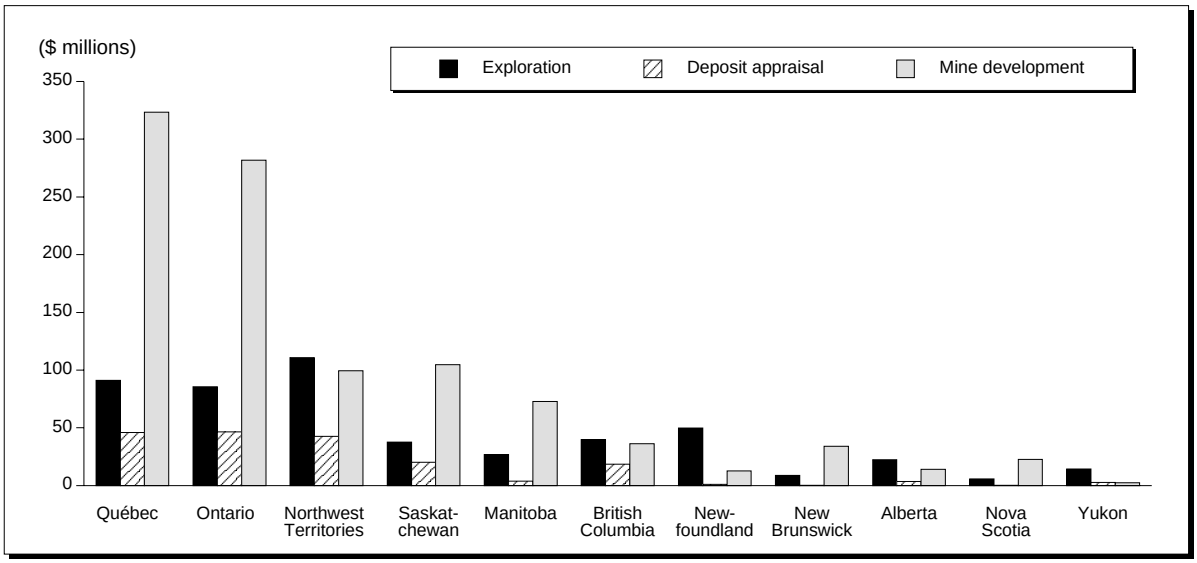
TABLE 2. TWO MAIN EXPLORATION AND DEPOSIT APPRAISAL PROPERTIES OR GROUPS OF PROPERTIES, BY CANADIAN PROVINCE OR TERRITORY, 1998

Province/Territory	Company	Main Project	Commodity
Newfoundland and Labrador	Voisey's Bay Nickel Company Ltd.	Voisey's Bay deposit	Nickel, copper, cobalt
	Donner Resources Ltd.	South Voisey	Nickel
Nova Scotia	Kaoclay Resources Ltd.	Musquodoboit, Shubenacadie valleys	Kaolin
	Cape Breton Development Corp.	Phalen Colliery, New Waterford[1]	Coal
New Brunswick	Noranda Mining and Exploration Inc.	Brunswick mine and Heath Steele mine[1]	Zinc, lead, silver, copper
		Bathurst mining camp (various)	Zinc, lead, silver, copper
Québec	Société Aurifère Barrick	Doyon and Bousquet No. 2 mine[1]	Gold
	Société Minière Raglan du Québec Ltée	Raglan	Nickel
Ontario	Goldcorp Inc.	Red Lake mine[1]	Gold
	Exall Resources Ltd.	Glimmer	Gold, silver
Manitoba	Falconbridge Limited	William Lake, Thompson Nickel Belt	Nickel
	Hudson Bay Exploration & Development Co., Ltd.	Snow Lake, Flin Flon, Ruttan mine and Minago River areas	Copper, nickel, zinc
Saskatchewan	Cogema Resources Inc.	Close Lake, Douglas River, Shea Creek, East and West Athabasca	Uranium
	Hudson Bay Mining & Smelting Co., Limited	Konuto Lake mine[1]	Copper, zinc
Alberta	Ashton Mining of Canada Inc.	Buffalo Hills	Diamonds
	Smoky River Coal Ltd.	Smoky River Coal mine[1]	Coal
British Columbia	R.H. Stanfield Holdings Ltd.	Gallowai Bull River and Aberfeldie	Copper, feldspar, gold, silver
	Prime Resources Group Inc.	Eskay Creek mine[1] and south of Snip mine	Gold
Yukon	Viceroy Minerals Corporation	Brewery Creek mine[1]	Gold
	Blackstone Resources Inc.	Taiga property, Dawson/Mayo district	Base metals, precious metals
Northwest Territories	BHP Minerals Canada Ltd.	Hope Bay project, Hope Bay Volcanic Belt	Gold
	WMC International Limited	West Meliadine and Kivaliq	Gold, nickel

	Preliminary Expenditures ($ millions)	% of Total Canadian Expenditures
Total for junior projects listed in this table[2]	29.5	4.9
Canadian total for junior companies listed in this table	29.5	4.9
Total for senior projects listed in this table[2]	104.4	17.4
Canadian total for senior companies listed in this table	156.8	26.1
Total for projects listed in this table	133.9	22.3
Total for all projects of companies listed in this table[3]	186.3	31.0

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
[1] Exploration or deposit appraisal on mine-site. [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
Exploration, Deposit Appraisal and Mine Development Expenditures, by Province and Territory, Preliminary 1998



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: Exploration, deposit appraisal and mine development expenditures include costs incurred off and on mine site for field work; engineering, economic and feasibility studies; overhead; the environment; and land access. Investments for structures, machinery and equipment are excluded. Data for 1998 are preliminary.

TABLE 3. EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT EXPENDITURES,[1] 1998 AND 1999

Expenditure Category	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal		Mine Complex Development		Grand Total	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
					($000)					
Field work and overhead[2]	469 800	378 189	131 340	110 379	601 140[a]	488 568[a]	972 062	872 514	1 573 202	1 361 082
Engineering, economic and pre- or production feasibility studies	7 002	4 681	39 753	56 719	46 755	61 400	14 229	22 371	60 984	83 771
Environment	14 257	7 214	11 556	11 144	25 813	18 358	16 871	17 100	42 684	35 458
Land access	2 016	1 430	2 150	11 655	4 166	13 085	1 156	1 847	5 322	14 932
Subtotal	493 075	391 512	184 799	189 897	677 874	581 409	1 004 318	913 832	1 682 192	1 495 242
Off-mine-site[3]	425 641	334 504	94 575	137 945	520 216	472 449	n.a.	n.a.	520 216	472 449
On-mine-site[3]	67 433	57 009	90 224	51 952	157 657	108 961	1 004 318	913 832	1 161 976	1 022 793
Capital[4]	1 901	2 567	80 801	64 152	82 702	66 719	1 103 426	1 069 908	1 186 128	1 136 627
$ for environmental protection and restoration[5]	59	12	303	287	362	299	27 254	28 452	27 617	28 752
Repair and maintenance[4]	227	1 001	24 342	25 570	24 569	26 571	1 207 515	1 165 195	1 232 084	1 191 766
$ for environmental protection and restoration[5]	123	165	704	704	827	869	88 190	142 958	89 017	143 827
Subtotal	2 128	3 569	105 143	89 722	107 271	93 291	2 310 941	2 235 103	2 418 212	2 328 393
Grand total	495 202	395 081	289 942	279 619	785 144	674 700	3 315 260	3 148 935	4 100 404	3 823 635
Total environment	14 439	7 391	12 563	12 135	27 002	19 526	132 316	188 511	159 318	208 037
Environment as a percentage of grand total	2.9	1.9	4.3	4.3	3.4	2.9	4.0	6.0	3.9	5.4

Sources: Natural Resources Canada and Statistics Canada, from the federal-provincial survey of mining and exploration companies.
n.a. Not applicable.
[a] This total can be compared to some extent with exploration expenditures prior to 1997.
[1] Incudes on-mine-site plus off-mine-site activities; exploration and deposit appraisal activities include only the search for and appraisal of deposits and do not include work for extensions of known reserves. [2] Overhead expenditures include mineral leases, claims and rental costs and project-related head office expenditures. [3] Amount of exploration and deposit appraisal expenditures dedicated to off-mine-site and on-mine-site activities. [4] Includes construction, and machinery and equipment expenditures. [5] As part of capital expenditures or repair and maintenance expenditures.
Note: Numbers may not add to totals due to rounding.

ranking by total exploration expenditures (excluding deposit appraisal and mine complex development spending), the Northwest Territories placed first followed by Québec and Ontario. For deposit appraisal, Ontario ranked first followed closely by Québec and the Northwest Territories. Most of the exploration spending (86%), inclusive of other project costs, was recorded as off-mine-site while deposit appraisal was almost evenly divided between off-mine-site and on-mine-site activities.

An interesting feature of the redesigned survey is its ability to track exploration and deposit appraisal expenditures that are dedicated to environment-related items, such as characterization, permits, protection and restoration. In 1997, a total of $47 million was recorded as environment-related expenditures, or 5% of all exploration and deposit appraisal expenditures (under the new survey definitions) for that year. This percentage decreased to 4% in 1998 with $26 million spent on environment-related items out of total exploration and deposit appraisal expenditures of $678 million.

As for the mine development component (inclusive of other related project costs), it totaled $1 billion and most of these expenditures occurred in Québec, Ontario and Saskatchewan.

1.4 1999 EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES – AN OUTLOOK

1.4.1 Statistical Summary

In 1999, 505 companies (project operators) and some prospectors intend to spend some $489 million on exploration and deposit appraisal (field and overhead expenditures) in Canada (**Figures 1** and **2**). That number of companies intending to explore in 1999 represents a 17% decrease from the 1998 total of 609 companies (expenditures of $601 million). A total of 88 companies (102 in 1998) each intend to spend $1 million or more (**Table 1**). These 88 companies expect to spend a total of $384 million, or 79% of total intended expenditures for 1999.

More than 60% of the total exploration and deposit appraisal expenditures for 1999 will be reported, in decreasing order, by Québec, Ontario and the Northwest Territories (**Figure 2**). The difference in spending between Québec and Ontario is expected to be insignificant. Nearly all provinces and territories are expected to experience a decrease in exploration and deposit appraisal spending.

In terms of magnitude, the largest decreases in exploration and deposit appraisal spending compared to 1998 are expected to occur in the Northwest Territories, Québec, Saskatchewan and Ontario. Together these four jurisdictions should account for 80% of the total decrease of $114 million. In terms of percentages, Saskatchewan, Newfoundland and Labrador, and the Northwest Territories are expected to experience the largest decreases.

Company spending intentions (**Figure 3**) indicate that off-mine-site exploration and deposit appraisal expenditures are expected to decrease by 17% from $459 million in 1998 to $382 million in 1999. This type of expenditure is expected to account for 78% of total spending in 1999. Québec is expected to rank first in off-mine-site exploration and deposit appraisal activity with 20% of the total spending intentions for that category, followed very closely by the Northwest Territories and Ontario with 20% and 19%, respectively.

On-mine-site exploration and deposit appraisal expenditures are expected to decrease by 25% to reach $106 million in 1999. They are expected to account for more than 25% of total expenditures in Ontario, Québec, New Brunswick, Manitoba and Alberta, and for almost 25% in Newfoundland and Labrador.

1.4.2 Spending by Junior and Senior Firms

In the *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures* compiled in January 1999, 120 senior companies (**Figure 1**) indicated their intention to spend $320 million, representing 65% of total forecast 1999 exploration and deposit appraisal expenditures and a 21% decrease in senior company expenditures compared to 1998.

Most of the expenditures by senior firms are expected to occur in Ontario, Québec and the Northwest Territories (**Figure 2**). In 1999, senior company expenditures are expected to exceed 70% of total exploration and deposit appraisal expenditures in Manitoba, New Brunswick, Alberta, Saskatchewan and Ontario. In the remaining provinces and territories, expenditures by senior companies are expected to range between 46% and 67% of total spending, with the notable exception of Nova Scotia where senior companies are expected to account for only 13% of total expenditures. Expenditures by senior companies are forecast to decrease in all Canadian jurisdictions except Alberta, where senior spending should increase by 11%.

The number of junior company project operators is expected to decline to 385 in 1999, a drop of 20% from the 480 junior project operators recorded in 1998. These junior companies intend to spend $169 million in 1999, a 14% decrease from the $197 million spent in 1998. The amount spent by juniors is expected to decrease in most provinces and territories. Alberta, Newfoundland and Labrador, and New Brunswick will experience the largest decreases in terms of percentages while Ontario and Newfoundland and Labrador will register the largest decreases in terms of magnitude. Only British Columbia, Québec, the Yukon and Nova Scotia will experience increases in junior spending and, in the case of the latter two, these will not be significant.

In 1999, 37 junior companies (compared to 42 in 1998) each intend to spend $1 million or more on exploration and deposit appraisal (**Table 1**). These junior companies are expected to account for 17% ($82 million) of all such expenditures, compared to 19% ($111 million) in 1998. Fifty-one senior companies (60 in 1998) each intend to spend $1 million or more in 1999. These companies are expected to account for 62% ($302 million) of total exploration and deposit appraisal expenditures, compared to 65% ($389 million) in 1998.

Once again, most of the junior companies that reported significant exploration and deposit appraisal budgets were in the $200 000 to $500 000 range. The typical budget for senior companies is expected to match the 1998 tendency, with 1999 spending intentions most frequently falling in the $1 million to $5 million interval.

1.4.3 Main Exploration and Deposit Appraisal Properties

The two main exploration or deposit appraisal properties or groups of properties (based on reported spending intentions) for each province and territory in 1999 are listed in **Table 4**. Planned expenditures for these projects total $140 million, or 29% of all intended exploration and deposit appraisal expenditures. For Canada as a whole, the 21 companies listed in the table reported $155 million, or 32% of all intended expenditures for 1999. Almost 95% of expenditures on these main properties or groups of properties will be incurred by senior companies.

1.4.4 Breakdown of Exploration- and Deposit Appraisal-Related Expenditures Using New Survey Definitions

A breakdown of expenditures (**Figure 5, Table 3**) by exploration, deposit appraisal and mine complex development, including other project costs such as those related to engineering, economic and feasibility studies, the environment, and land access, is now possible due to the redesign of the survey in 1997. For 1999, these other related project costs constitute about 16% of the overall exploration and deposit appraisal expenditures reported, the balance being equivalent to what total exploration expenditures would have amounted to under the previous survey's definitions.

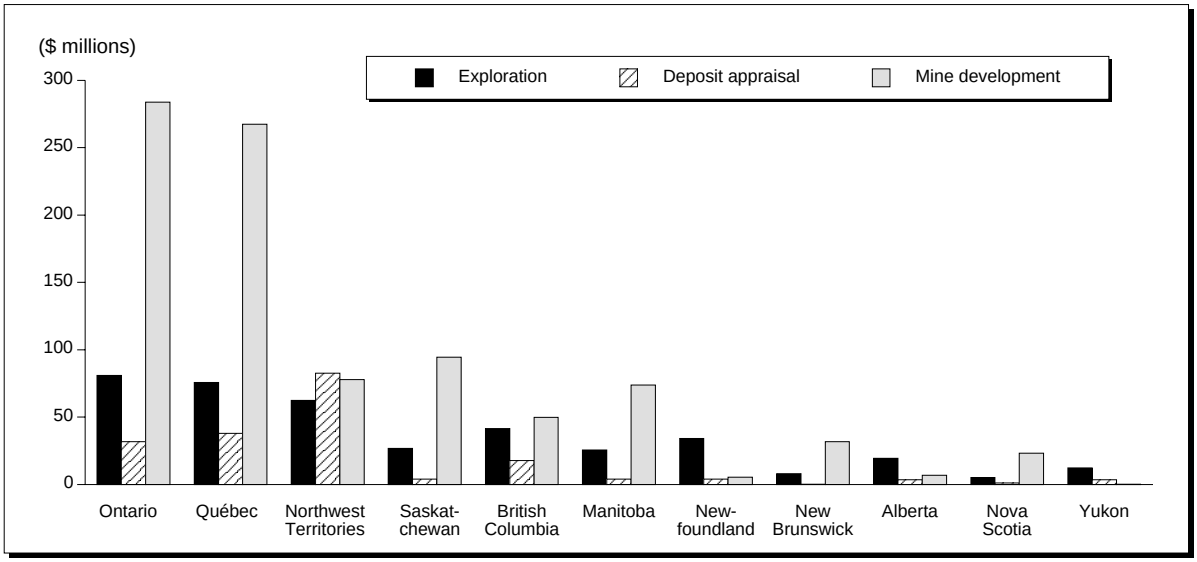
TABLE 4. TWO MAIN EXPLORATION AND DEPOSIT APPRAISAL PROPERTIES OR GROUPS OF PROPERTIES, BY CANADIAN PROVINCE OR TERRITORY, 1999

Province/Territory	Company	Main Project	Commodity
Newfoundland and Labrador	Voisey's Bay Nickel Company Ltd.	Voisey's Bay deposit	Cobalt, copper, nickel
	Donner Resources Limited	South Voisey	Nickel
Nova Scotia	Kaoclay Resources Inc.	Musquodoboit, Shubenacadie valleys	Kaolin
	Champlain Resources inc.	Mount Cameron property	Gold, titanium, zinc, rare metals, base metals
New Brunswick	Noranda Mining and Exploration Inc.	Brunswick mine and Heath Steele mine[1]	Zinc, lead, silver, copper
		Brunswick Belt and Bathurst mining camp (various)	Zinc, lead, silver, copper
Québec	Mines Agnico-Eagle Limitée	Laronde mine[1]	Gold, silver, copper
	Société Aurifère Barrick	Doyon mine[1]	Gold
Ontario	Goldcorp. Inc.	Red Lake mine[1]	Gold
	Placer Dome Inc.	Musselwhite mine[1]	Gold
Manitoba	Inco Limited	South of Thompson, Thompson Nickel Belt	Nickel
	Hudson Bay Exploration & Development Co., Ltd.	Snow Lake, Flin Flon, Ruttan mine and Minago River area	Copper, nickel, zinc
Saskatchewan	Cogema Resources Inc.	Close Lake, Douglas River, Shea Creek, East and West Athabasca	Uranium
	Cameco Corporation	Dawn Lake, Rabbit Lake, Read Lake, Wheeler Lake and Park Creek	Uranium
Alberta	Ashton Mining of Canada Inc.	Buffalo Hills	Diamonds
	Smoky River Coal Ltd.	Smoky River Coal mine[1]	Coal
British Columbia	R.H. Stanfield Holdings Ltd.	Gallowai Bull River and Aberfeldie	Copper, feldspar, gold, silver
	Prime Resources Group Inc.	Eskay Creek mine[1] and Eskay Creek area (various)	Gold
Yukon	Cominco Ltd.	Kudz Ze Kayah, Pelley Mountain area	Zinc, copper, lead, gold, silver
	Atna Resources Ltd.	Wolf, Finlayson Lake area	Silver, zinc, lead
Northwest Territories	Monopros Limited	Kennady Lake	Diamonds
	BHP Minerals Canada Ltd.	Ekati mine[1]	Diamonds

	Forecast Exploration ($ millions)	% of Total Canadian Expenditures
Total for junior projects listed in this table[2]	7.9	1.6
Canadian total for junior companies listed in this table	7.9	1.6
Total for senior projects listed in this table[2]	132.5	27.1
Canadian total for senior companies listed in this table	146.8	30.0
Total for projects listed in this table	140.4	28.7
Total for all projects of companies listed in this table[3]	154.7	31.6

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
[1] On-mine-site exploration or deposit appraisal. [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 5
Exploration, Deposit Appraisal and Mine Development Expenditures, by Province and Territory, Forecast 1999



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: Exploration, deposit appraisal and mine development expenditures include costs incurred off and on mine site for field work; engineering, economic and feasibility studies; overhead; the environment; and land access. Investments for structures, machinery and equipment are excluded. Data for 1999 are company spending intentions as compiled in January 1999.

Such a breakdown shows that, including these previously unsurveyed costs, exploration expenditures (in the strict sense) could amount to $392 million in 1999 (67% of the $581 million total for exploration and deposit appraisal). As for deposit appraisal expenditures, they are expected to reach $190 million. These numbers represent sizeable decreases from 1998 levels (a 21% decrease for exploration and a 14% decrease for exploration and deposit appraisal taken together). More than 85% of the total 1999 exploration and deposit appraisal expenditures (inclusive of other project costs) were reported as exploration work in each of New Brunswick, Newfoundland and Labrador, Saskatchewan and Manitoba; between 75% and 85% in Alberta, Nova Scotia and the Yukon; and between 65% and 75% in Ontario, British Columbia and Québec. In the Northwest Territories, only 43% of intended spending for 1999 is slated for exploration. The Northwest Territories, Québec, British Columbia and Ontario are thus the provinces/territories where a larger proportion of funds will be dedicated to the appraisal of promising deposits. In terms of ranking by total exploration expenditures (inclusive of other project costs), Ontario is expected to place first followed by Québec and the Northwest Territories. For deposit appraisal work, the Northwest Territories is expected to clearly rank first followed by Québec and Ontario.

Most of the exploration work (85%) will be recorded as off-mine-site expenditures while 73% of the deposit appraisal work will be conducted on promising deposits located off mine sites as well. Compared to 1998, exploration expenditures (inclusive of other project costs) are expected to decline in nearly all provinces and territories. In percentage terms, major declines in exploration spending are expected in the Northwest Territories (-44%), Newfoundland and Labrador (-32%) and Saskatchewan (-29%). In contrast, deposit appraisal spending (inclusive of other project costs) is expected to increase in the Northwest Territories, Newfoundland and Labrador, Nova Scotia, the Yukon and Manitoba. The shift to more advanced work is particularly evident in the Northwest Territories where deposit appraisal spending is expected to increase by 94% in 1999.

Environment-related costs, such as expenditures for characterization, permits, protection and restoration, are expected to total $18 million in 1999 (3% of total exploration and deposit appraisal spending). Based on the data available for 1997, 1998 and 1999, environment-related costs appear to follow the general trend of decreasing exploration and deposit appraisal expenditures.

As in 1997 and 1998, the mine development component (inclusive of other related project costs) will total close to $1 billion and the expenditures will occur mainly in Ontario, Québec, Saskatchewan, the Northwest Territories and Manitoba.

1.4.5 Outlook for Exploration and Deposit Appraisal Based on Statistical Estimation

1.4.5.1 Methodology

In this section, an attempt is made to predict the level of exploration and deposit appraisal spending for 1999 using standard statistical estimation techniques. Expenditures are estimated by linking historical exploration and deposit appraisal spending (field and overhead expenditures) to factors for which historical data are available.

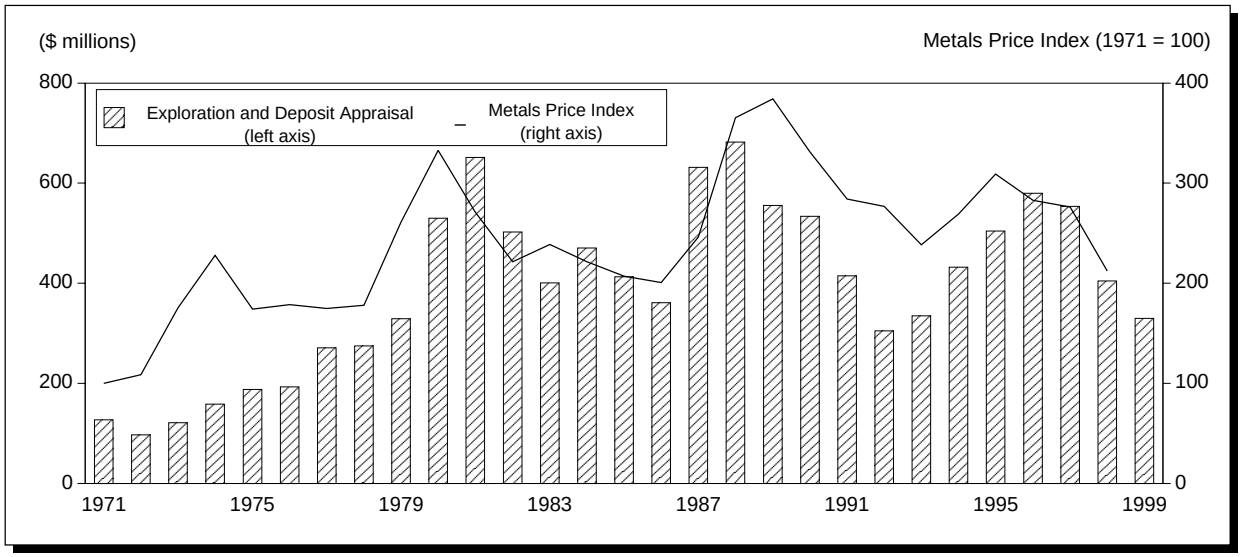
An analysis of historical data indicates that the level of expenditures on mineral exploration and deposit appraisal in a given year can be linked to the previous year's metal prices. This may be because companies view exploration and deposit appraisal as an investment, with expected returns to that investment 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 the level of a mining company's revenues and profits and are an important determinant of the amount of internal funds available for spending on exploration and deposit appraisal.

Changes in spending are likely to lag changes in metal prices because exploration and deposit appraisal 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, deposit appraisal 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 6** shows the relationship between historical exploration and deposit appraisal expenditures by senior companies and the NRCan price index, lagged one year.

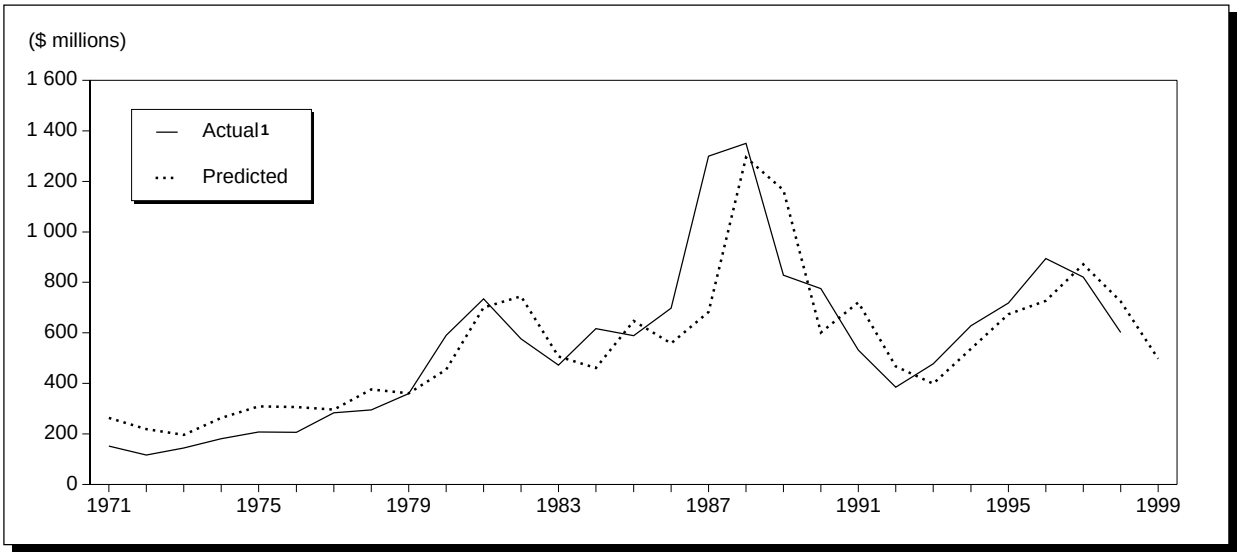
Mineral exploration is a multi-stage process that usually proceeds over a relatively long period of time as information is gathered from geological mapping, geophysical and geochemical surveying, diamond drilling, and so on. At various stages, this information is used by companies to decide on where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

Figure 6
Exploration and Deposit Appraisal Expenditures in Canada by Senior Companies, and Natural Resources Canada's Metals Price Index Lagged One Year, 1971-99



Sources: Natural Resources Canada and Statistics Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: Data for 1998 are preliminary; 1999 data are company spending intentions as compiled in January 1999. For comparison with pre-1997 years, the data include only off- and on-mine-site field and overhead expenditures. "Lagged" means that the 1971 Metals Price Index is compared to 1972 exploration and deposit appraisal expenditures, and so on.

Figure 7
Actual and Predicted Exploration and Deposit Appraisal Expenditures in Canada, 1971-99



Source: Natural Resources Canada.
1 For 1998, preliminary expenditures are shown because actual expenditures were not available. For comparison with pre-1997 years, the data include only off- and on-mine-site field and overhead expenditures.

1.4.5.2 Results

Using data for the years 1971-98, our statistical equation predicts that senior companies will spend about $330 million on mineral exploration and deposit appraisal in 1999. For junior companies, the estimated equation predicts expenditures of about $160 million. For all companies, expenditures of about $495 million are predicted (**Figure 7**).

1.5 EXPLORATION AND DEPOSIT APPRAISAL SPENDING IN NUNAVUT – A FIRST LOOK

1.5.1 Creation of a New Territory

On April 1, 1999, the new Canadian territory of Nunavut was created by dividing the land mass previously known as the Northwest Territories into two distinct territories: Nunavut and the Northwest Territories.

Nunavut occupies the central and eastern portions of the former Northwest Territories. With its creation, the area of the former Northwest Territories, which stretched from the Yukon east to Baffin Island and included all of the Arctic archipelago, was reduced from 3 426 320 km^2 to 1 171 918 km^2. With an area of over 2 million km^2, Nunavut, with its mining history and its potential for further discoveries of base metals, gold and diamonds, will continue to attract the attention of explorationists.

1.5.2 Distribution of Exploration and Deposit Appraisal Spending Between the Two New Territories

Since this report presents statistics that were collected prior to the creation of the two separate territories, the data and analysis are reported for what was the former Northwest Territories. However, with the collaboration of officials from the two new territories, a first attempt was made at separating expenditures between them. The results of this analysis are presented in **Table 5** where exploration and deposit appraisal expenditures are shown for the two new territories as well as for the former Northwest Territories. For the sake of clarity, the new Northwest Territories is listed in the table as the western Northwest Territories.

TABLE 5. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES IN CANADA'S TWO NEW TERRITORIES: NUNAVUT AND THE NORTHWEST TERRITORIES, 1998 AND 1999

	Exploration		Deposit Appraisal		Total	
	1998	1999	1998	1999	1998	1999
	($000)					
Nunavut	56 300	27 014	845	1 764	57 146	28 778
Western Northwest Territories only[1]	46 048	33 794	9 690	23 678	55 737	57 472
Total Northwest Territories[2]	102 348	60 808	10 535	25 442	112 883	86 250

Source: Natural Resources Canada, from the federal-provincial survey of mining and exploration companies, and from discussions with territorial government officials.
[1] As of April 1, 1999, the western part of the former Northwest Territories is known as the Northwest Territories.
[2] Total for the former territory known as the Northwest Territories. Includes respective totals of the two new territories: Nunavut and the Northwest Territories.
Notes: Data for 1998 are preliminary estimates; 1999 data are based on company spending intentions as compiled in January 1999. Includes off- and on-mine-site field and overhead expenditures.

Based on this preliminary analysis of the two territories' exploration and deposit appraisal expenditures, it is evident that Nunavut is a major Canadian jurisdiction in terms of exploration and deposit appraisal spending. More than 50% of the 1998 exploration and deposit appraisal expenditures recorded in the former Northwest Territories were incurred in what is now Nunavut. For 1999, Nunavut's share of the joint total is expected to decline to 33%, but this lower proportion can probably be explained by a combination of the strong increase in deposit appraisal activities on diamond exploration properties in the new Northwest Territories and lower gold and base-metal prices, rather than by a decrease in interest in Nunavut. Even with these lower predicted 1999 exploration and deposit appraisal expenditures, Nunavut would still rank sixth in Canada in terms of total exploration and deposit appraisal spending, just ahead of Saskatchewan, Manitoba and Alberta.

2. Drilling

2.1 INTRODUCTION

Drilling activities are an essential component of the mineral development cycle from the anomaly investigation stage to the deposit delineation and deposit definition stages. As such, drilling statistics constitute a valuable indicator of recent levels of Canadian mineral exploration and deposit appraisal 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. The quarterly drilling statistics compiled by the CDA are depicted in **Figure 8**.

In addition, two other sets of drilling statistics are compared with the CDA data (**Figure 9**). They consist of: total Canadian contract drilling, as reported annually to Natural Resources Canada by drilling contractors and published in Statistics Canada's catalogue no. 26-201; and data from the federal-provincial survey of mining and exploration companies, which include all metres drilled and expenditures reported by companies for their "own account" (drilling they did themselves) and for contracted drilling work. Exploration drilling and deposit appraisal drilling have been aggregated with mine development drilling 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.

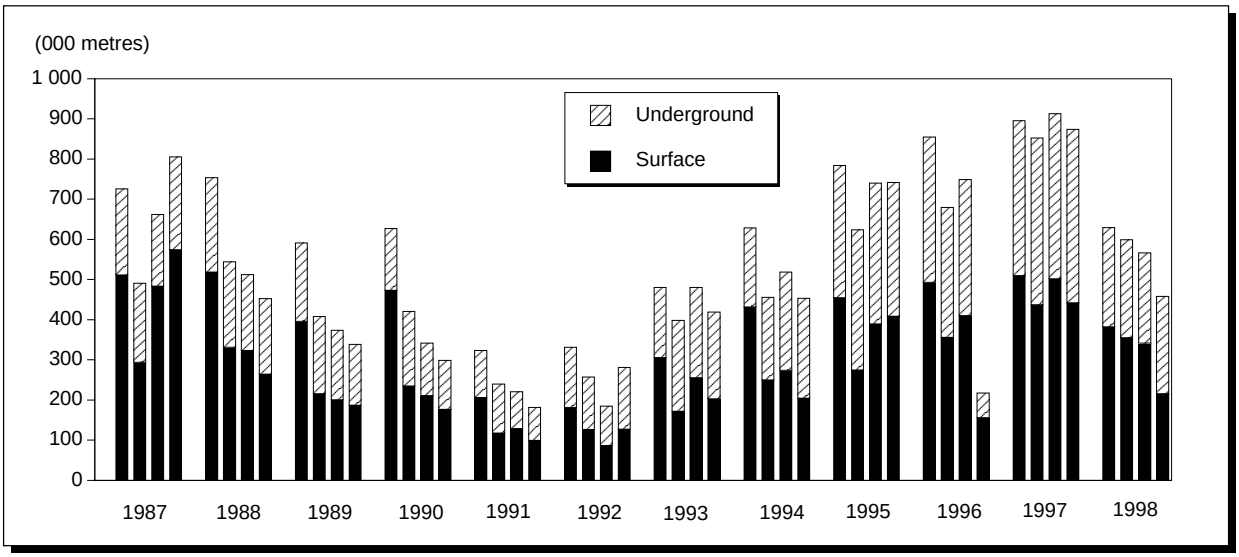
Although these three sources of statistics provide different annual results, the same overall trends are observable in the three surveys over the period 1989-97.

2.2.2 Canadian Drilling Association Results

As can be seen from **Figure 8**, each of the four years (1988, 1989, 1990 and 1991) exhibited a similar pattern of diminishing diamond drilling throughout the year, with metres drilled in the first quarter of each year higher than 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.

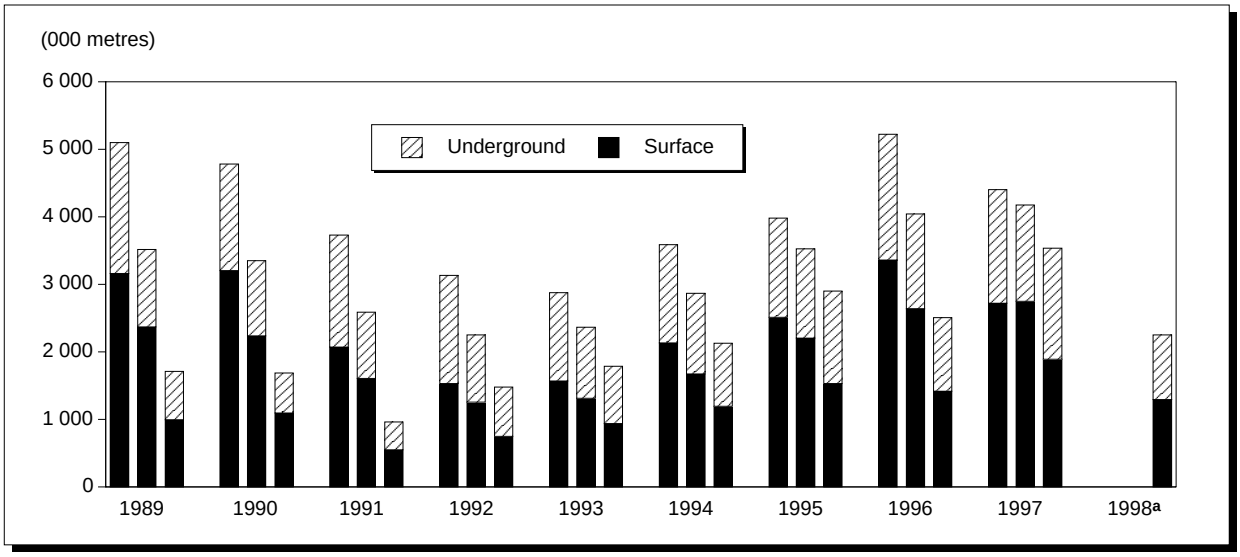
From 1988 to 1996, drilling peaked consistently during the first quarter of the year. The explanation is twofold: first, in each of those years, flow-through share funds from the previous year were carried over into January and February; and second, much of the drilling must be done during the winter months on frozen lakes and on areas of muskeg that are generally inaccessible to drilling equipment at other times of the year. The former has now become less relevant

Figure 8
Surface and Underground Drilling in Canada, by Quarter, 1987-98



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 for that year was never completed.

Figure 9
Comparison of Three Surveys of Canadian Diamond Drilling, 1989-98



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 1998.
Note: All data include exploration, deposit appraisal and mine development drilling.

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 quarterly statistics for 1997 and 1998 show that the number of metres drilled for these two years is more balanced throughout the year than it was prior to the change in the look-back period.

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 8**). The metres drilled during 1997 were 22% higher than the metres reported in 1995 (a comparison with 1996 is not possible since the survey was not completed for that year). Consistent with other indicators of exploration activity, such as spending, the total amount of metres drilled in 1998 was down from the 1997 level by a substantial 36%.

2.2.3 Exploration, Deposit Appraisal and Mine Development Drilling

According to the federal-provincial survey of mining and exploration companies, a total of 3 800 000 m of surface and underground drilling (including diamond drilling and other methods) was carried out for exploration and deposit appraisal purposes in Canada in 1997, compared to 4 067 000 m in 1996 (**Figure 10, Table 6**). Of this, 3 404 000 m were accounted for by diamond drilling, down by 13% from the 3 898 000 m drilled in 1996. Diamond drilling aimed at mine development reached 999 000 m in 1997, also down from the 1 327 000-m level of 1996.

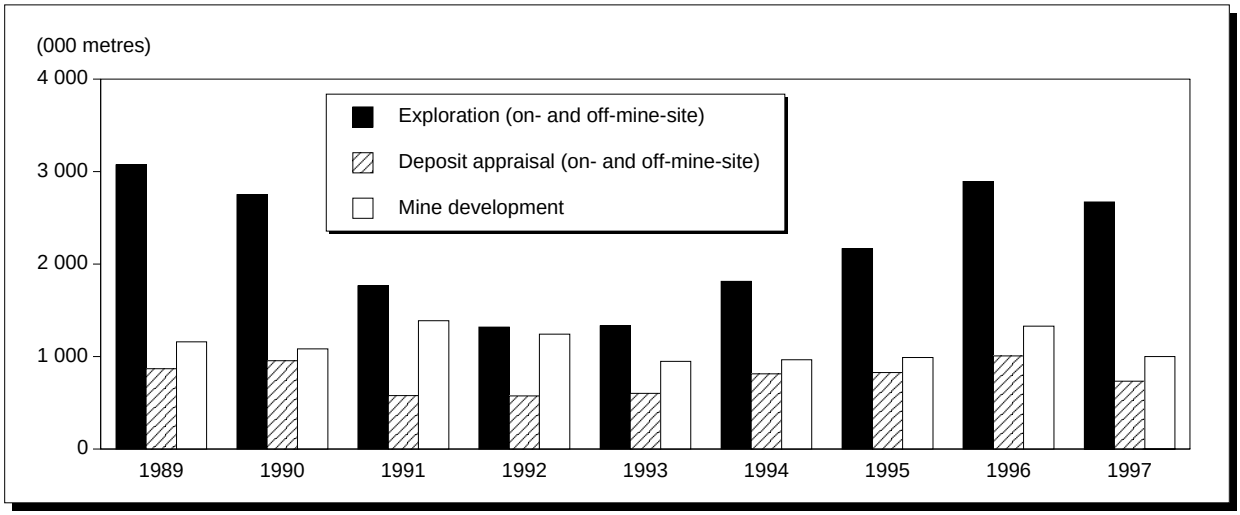
Ontario, Québec, the Northwest Territories and British Columbia, in decreasing order of importance, were the busiest provinces and territories jointly accounting for 77% of total surface and underground exploration and deposit appraisal diamond drilling activity in 1997 (**Figure 11**). In terms of surface exploration and deposit appraisal diamond drilling only, the same four jurisdictions accounted for 73% of the Canadian total.

Surface and underground exploration and deposit appraisal diamond drilling activities (totaling respectively 2 577 000 m and 827 000 m) were aimed primarily at the discovery of precious and base metals. In fact, 52% of surface diamond drilling activities was for the search for precious metals and 36% for base metals. For underground exploration and deposit appraisal diamond drilling, the percentages were 57% for precious metals and 34% for base metals. These surface and underground diamond drilling activities were mostly conducted by producers (seniors) and junior companies. Both types of companies accounted for roughly equal proportions of surface diamond drilling, while the producers were clearly the most active underground.

When adding other types of drilling to diamond drilling, underground exploration and deposit appraisal drilling totaled 931 000 m in 1997 while surface drilling totaled 2 869 000 m (**Table 7**). Ontario (582 000 m), Québec (190 000 m), the Northwest Territories (41 000 m) and Manitoba (40 000 m) together accounted for 91% of total underground exploration and deposit appraisal drilling for that year. Similarly, Ontario (787 000 m), Québec (520 000 m), British Columbia (369 000 m) and the Northwest Territories (309 000 m) accounted for 69% of all surface drilling in Canada.

As shown in **Figure 10**, some 60% of the total diamond drilling activity in 1997 was dedicated to exploration, while approximately 17% was dedicated to deposit appraisal activities. The remaining metres were reported under the mine development category.

Figure 10
Surface and Underground Diamond Drilling in Canada, by Type of Work, 1989-97



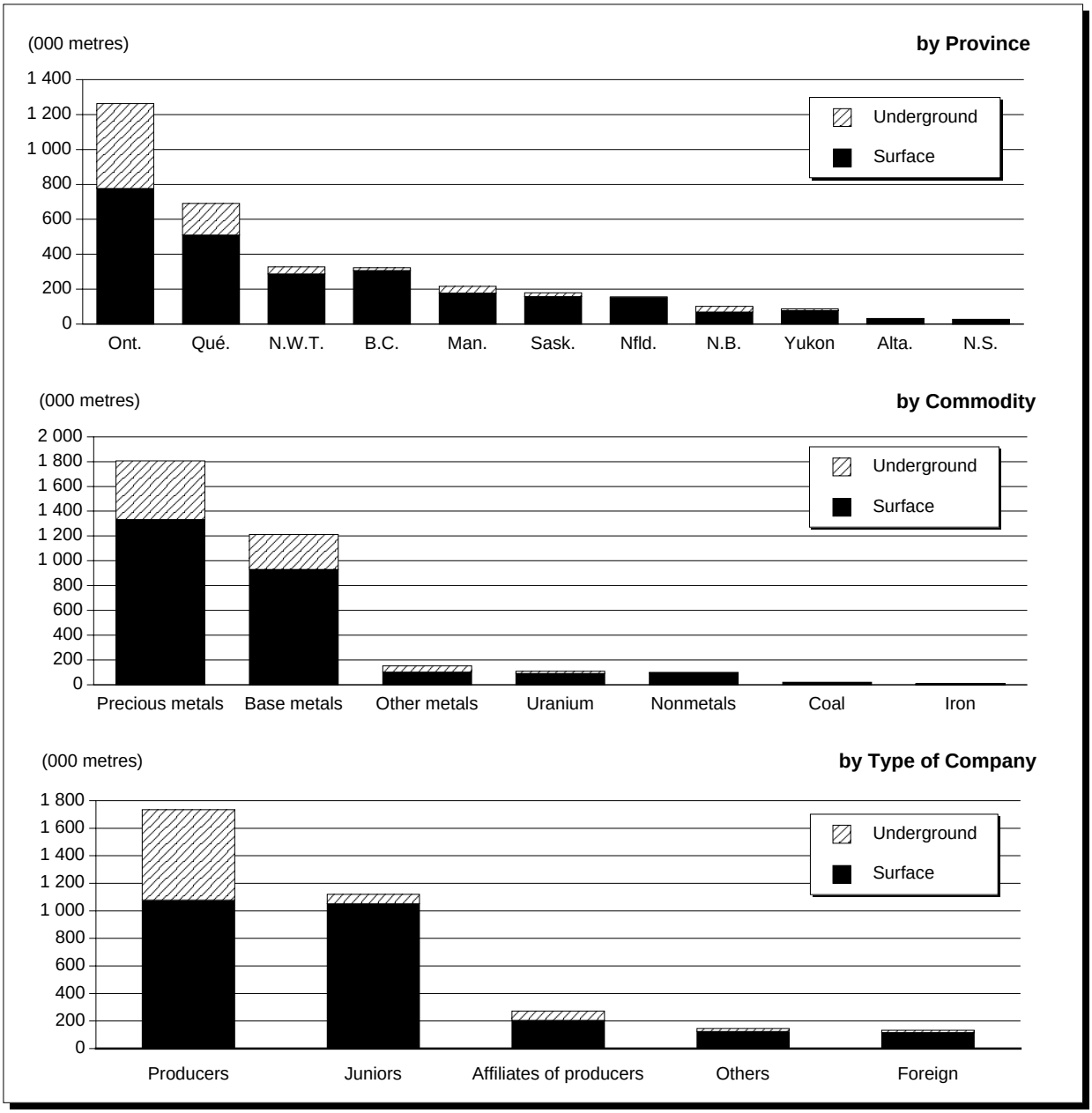
Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.

TABLE 6. SURFACE AND UNDERGROUND EXPLORATION AND DEPOSIT APPRAISAL DRILLING IN CANADA, 1985-97

Year	Diamond Drilling Metres Drilled	Other Drilling[1] Metres Drilled
	(000)	(000)
1985	2 531	270
1986	3 616	55
1987	6 221	262
1988	6 206	211
1989	3 940	297
1990	3 702	241
1991	2 341	234
1992	1 889	139
1993	1 932	282
1994	2 626	213
1995	2 993	280
1996	3 898	169
1997	3 404	396

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
[1] Other drilling methods include rotary and percussion.

Figure 11
Surface and Underground Exploration and Deposit Appraisal Diamond Drilling in Canada, 1997



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

TABLE 7. SURFACE AND UNDERGROUND EXPLORATION AND DEPOSIT APPRAISAL DRILLING,[1] BY PROVINCE AND TERRITORY, 1997

Province/Territory	Surface Drilling	Underground Driling	Total Drilling
		(000 m)	
Newfoundland	154.3	1.5	155.9
Nova Scotia	28.5	0.1	28.6
New Brunswick	72.4	31.1	103.5
Québec	519.7	190.0	709.7
Ontario	786.5	581.7	1 368.2
Manitoba	177.8	39.7	217.6
Saskatchewan	160.1	20.5	180.6
Alberta	189.1	1.3	190.4
British Columbia	368.8	16.3	385.0
Yukon	102.0	8.7	110.7
Northwest Territories	309.4	40.5	349.9
Total	2 868.6	931.4	3 800.0

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
[1] Includes diamond drilling and other drilling methods such as rotary and percussion.

3. Claim Staking

3.1 INTRODUCTION

The area of new mineral claims staked in Canada in 1998 (**Table 8**) totaled some 7.9 million hectares (Mha), which represents a dramatic drop from the 44 Mha that were staked in 1997. The area staked in 1997 was the largest area of new mineral claims ever recorded in this country and was largely the result of a staking rush that followed the discovery of diamonds in the Buffalo Head Hills area of Alberta. The largest yearly totals of new mineral claims areas recorded before 1997 had been 33 Mha in 1992 and 27 Mha in 1993. The 7.9 Mha recorded in 1998 is still somewhat higher than the levels recorded prior to 1992, that is, prior to the major exploration efforts that were triggered by the discovery of diamonds in the Northwest Territories and, later, base metals in Labrador.

3.2 NEW CLAIMS STAKED AND CLAIMS IN GOOD STANDING

The area of new mineral claims staked in 1998 was down in every province/territory except Manitoba and Newfoundland and Labrador. In terms of percentages, the declines in new mineral claims staked in 1998 were more evident in Alberta (-91%), the Yukon (-71%), Nova Scotia (-64%) and the Northwest Territories (-58%). In terms of hectares, Alberta experienced the largest decrease (-33.71 Mha) followed by the Northwest Territories (-1.13 Mha), the Yukon (-0.33 Mha) and Québec (-0.32 Mha).

In Alberta, the decline in new mineral claims staked can be explained by a relative slowdown in the diamond-staking rush (as companies concentrated on exploring their newly staked properties) and the ensuing reduction in the availability of prospective diamond exploration territory. Elsewhere in Canada, provincial and territorial mining recorders have reported that the decrease in new mineral claims staked in 1998 is probably due to depressed gold and base-metal prices. In Saskatchewan, the decrease in new claims is also explained by lower staking activity for uranium and diamonds as companies opted to further explore and develop claims that they had staked in previous years.

The total area occupied by claims in good standing amounted to approximately 7.1% of Canada's total land mass in 1998, compared to 5.6% in 1997 (**Table 9**). This increase is mostly attributable to the Alberta diamond-staking rush. Almost 65% of the area of that province was occupied by claims in good standing in 1998. While this percentage is bound to decrease in time as companies evaluate their properties and shift their focus to the most promising sites, positive exploration developments in Alberta continue to generate interest for diamonds in that province.

Newfoundland and Labrador, Saskatchewan, New Brunswick and British Columbia are the other Canadian jurisdictions that had the largest proportion of their land mass occupied by claims in good standing in 1998, although the Northwest Territories stood out in terms of the number of hectares covered by such claims. Nova Scotia, the Yukon, and Newfoundland and Labrador experienced the largest decreases in the percentage of their area covered by claims in good standing from 1997 to 1998. In terms of the actual number of hectares covered by such claims, the largest declines occured in the Northwest Territories, the Yukon, and Newfoundland and Labrador.

TABLE 8. AREA OF NEW MINERAL CLAIMS[1] STAKED IN CANADA, 1997 AND 1998

Province/Territory	1997		1998	
	(hectares)	(%)	(hectares)	(%)
Newfoundland	334 075	0.8	361 900	4.6
Nova Scotia	208 191	0.5	74 180	0.9
New Brunswick	53 760	0.1	40 000	0.5
Québec	1 050 629	2.4	728 142	9.3
Ontario	855 584	1.9	577 632	7.3
Manitoba	386 243	0.9	475 634	6.1
Saskatchewan	950 253	2.1	680 048	8.7
Alberta	37 200 000	84.1	3 490 000	44.4
British Columbia	765 257	1.7	474 296	6.0
Yukon	459 507	1.0	131 221	1.7
Northwest Territories	1 953 191	4.4	827 615	10.5
Total	44 216 690	100.0	7 860 668	100.0

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

TABLE 9. AREA OCCUPIED BY CLAIMS IN GOOD STANDING IN CANADA, 1997 AND 1998

Province/Territory	Total Area	Area of Claims in Good Standing	Area of Claims/ Total Area
	(hectares)		(%)
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	1 739 448	2.7
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	55 929 573	5.6
1998			
Newfoundland	40 572 000	2 097 375	5.2
Nova Scotia	5 549 000	141 556	2.6
New Brunswick	7 344 000	285 456	3.9
Québec	154 068 000	3 785 647	2.5
Ontario	106 858 000	2 793 472	2.6
Manitoba	64 995 000	1 833 200	2.8
Saskatchewan	65 233 000	3 116 228	4.8
Alberta	66 119 000	42 754 000	64.7
British Columbia	94 931 000	3 718 050	3.9
Yukon	48 345 000	1 530 296	3.2
Northwest Territories	342 632 000	8 383 926	2.4
Total Canada	996 646 000	70 439 206	7.1

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

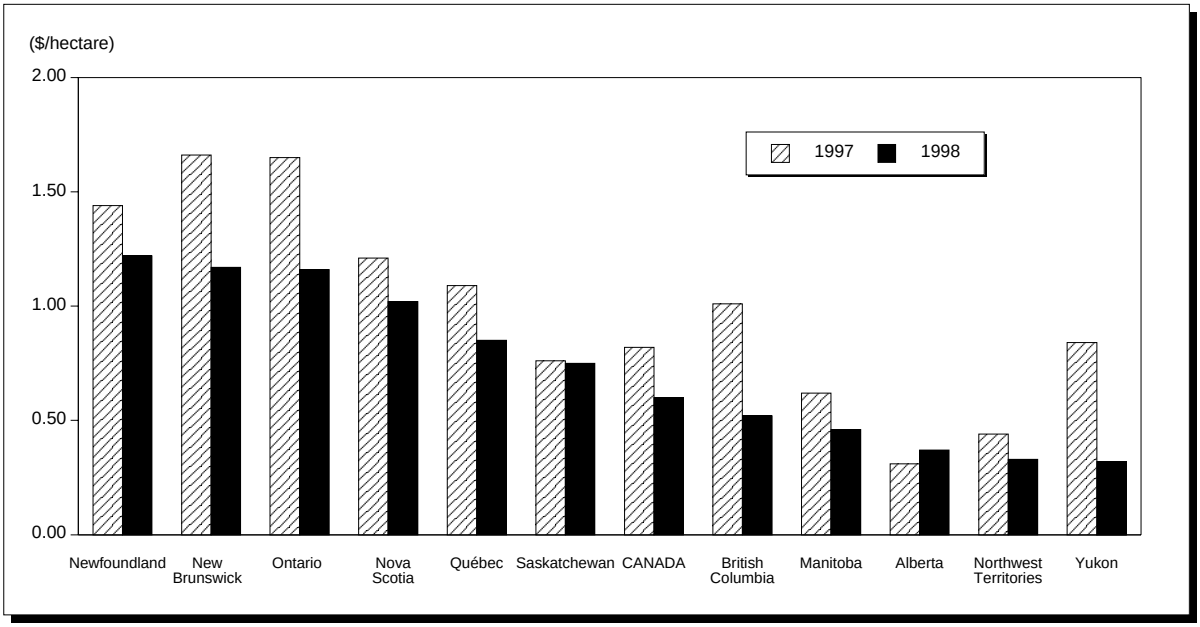
3.3 EXPLORATION AND DEPOSIT APPRAISAL INTENSITY

There is considerable variation in the level of mineral exploration and deposit appraisal expenditures across Canada's provinces and territories. For example, 1998 exploration and deposit appraisal expenditures amounted to $132 million (preliminary) in Québec, 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, covered 3 426 320 km^2 prior to the creation of Nunavut, more than one third the area of Canada. Because of these varying areas, it can be misleading to compare provinces and territories on the basis of exploration and deposit appraisal expenditures alone.

A more complete measure of exploration and deposit appraisal intensity can be obtained by looking at expenditures per unit of area. These statistics reveal that Newfoundland and Labrador, New Brunswick and Ontario have consistently recorded the greatest expenditures per hectare (**Figure 12**) over at least the four-year period 1995-98. However, all three of these jurisdictions, as well as British Columbia and the Yukon, experienced significant decreases in 1998 when compared with 1997 levels. Alberta, which had received the lowest spending per hectare from at least 1995 to 1997 inclusive, moved ahead of the Northwest Territories and the Yukon in 1998.

Although not all exploration and deposit appraisal expenditures in any jurisdiction are spent on existing mineral claims (some expenditures are incurred on unclaimed land, exploration permits or mining leases), off-mine-site expenditures per unit of area of mineral claims in good standing constitute another useful measure of exploration and deposit appraisal intensity. The

Figure 12
Exploration and Deposit Appraisal Expenditures Per Hectare, by Province and Territory, 1997 and 1998

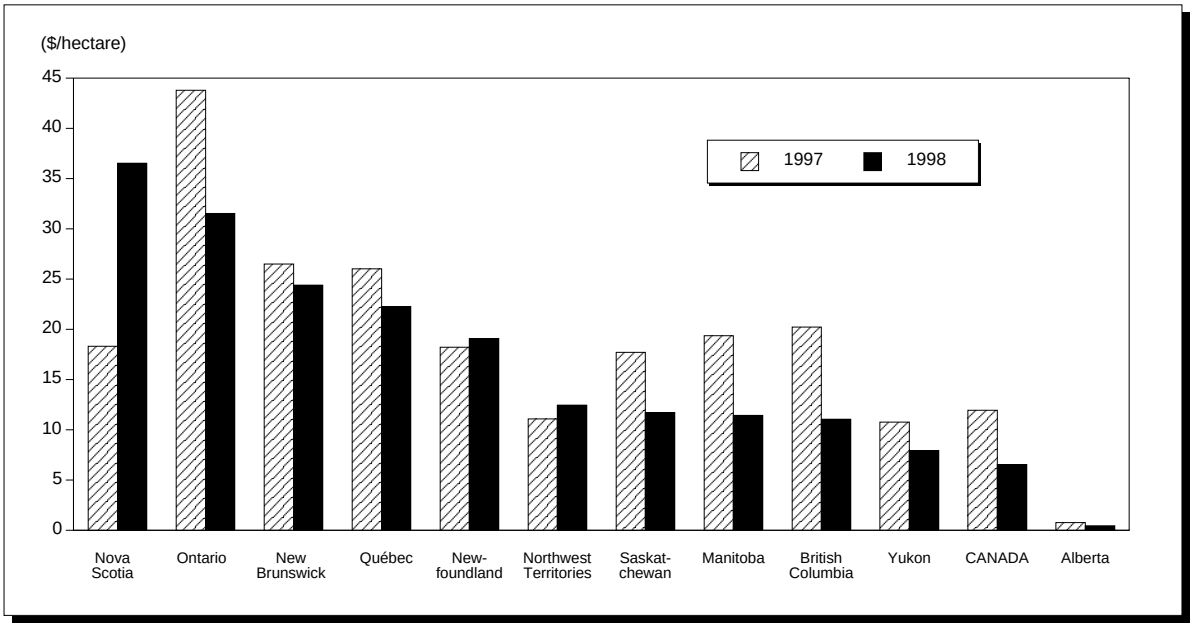


Sources: Federal-provincial survey of mining and exploration companies; provincial/territorial mining recorders offices.
Notes: Includes only field and overhead expenditures. Data for 1998 are preliminary.

data for 1997 (**Figure 13**) show that Ontario, New Brunswick and Québec enjoyed the highest levels of off-mine-site exploration and deposit appraisal expenditures per hectare of claims in good standing. For 1998, Nova Scotia took over first place, ahead of Ontario and New Brunswick. The increase in Nova Scotia's ranking can be explained by an important reduction in the area covered by claims in good standing in that province coupled with a relatively stable level of off-mine-site expenditures. Ontario, British Columbia and Manitoba suffered the most important decreases compared to 1997. While the decreases in Ontario and Manitoba can be mainly explained by the respective decreases in off-mine-site exploration and deposit appraisal spending in these two provinces, the decrease in British Columbia is the result of significant reductions in both spending and the number of claims in good standing. Once again, Alberta was at the lower end of the spectrum, a situation that can be explained by the huge area covered by claims in good standing in that province and for which increasing off-mine-site exploration and deposit appraisal expenditures could not compensate for.

For Canada as a whole, exploration and deposit appraisal spending per hectare of claims in good standing decreased once again in 1998, dropping to about $7/ha from $12/ha in 1997 and $21/ha in 1996. While the increase in the area occupied by claims in good standing in Alberta was the predominant factor in explaining the 1997 decrease in spending per hectare, declining exploration and deposit appraisal expenditures took on more importance in explaining the 1998 decrease.

Figure 13
Off-Mine-Site Exploration and Deposit Appraisal Expenditures Per Hectare of Claims in Good Standing, by Province and Territory, 1997 and 1998



Sources: Federal-provincial survey of mining and exploration companies; provincial/territorial mining recorders offices.
Notes: "Claims in good standing" excludes mining leases. Includes only field and overhead expenditures. Data for 1998 are preliminary.

4. The Search for Diamonds in Canada[1]

4.1 DIAMOND EXPLORATION AND DEPOSIT APPRAISAL HIGHLIGHTS

In April 1999, there were some 378 diamond exploration and deposit appraisal properties distributed across Canada (**Figure 14**). Although this number is considerably lower than the approximately 600 diamond properties that were recorded each year from 1993 to 1998, the apparent decline has probably resulted from a change in the databases used to compute this figure rather than from a marked decline in the number of active diamond properties between April 1998 and April 1999.

The most notable Canadian diamond exploration event in 1998 appears to have been the discovery of a gently dipping diamond-bearing dike on a peninsula in Snap Lake in the Camsell Lake area of the Northwest Territories. The discovery occured on a property owned by Winspear Resources Ltd. and Aber Resources Limited. This deposit does not appear to be large (a few million tonnes in size) but, on the basis of a small bulk sample of 200 t, has yielded the highest per-carat and per-tonne diamond values known in any Canadian diamond deposit.

4.2 STATISTICAL SUMMARY

Expenditures dedicated to exploration and deposit appraisal for diamonds in Canada by senior and junior companies since 1989 are shown in **Figure 15**. Over the seven-year period 1993-99 inclusive, a total of $772 million will have been spent on the search for diamonds in Canada, representing approximately 17% of all exploration and deposit appraisal expenditures (field and overhead) incurred in Canada over that period. Company spending intentions for diamond exploration and deposit appraisal in Canada for 1999 are about $77 million, an amount similar to that spent in 1998 (**Figures 15** and **16**).

In 1998, 48 companies (42 juniors and 6 seniors) were operators of diamond exploration and deposit appraisal projects, down from the 53 operators (41 juniors and 12 seniors) reported in 1997 (**Figure 17**). These project operators spent a total of $77 million in 1998, down from the $92 million spent in the previous year. Junior companies accounted for 40% of total Canadian diamond exploration and deposit appraisal expenditures in 1998 (up from 23% in 1997). In 1999, they are expected to account for 30% of all such expenditures in Canada.

In 1998, the Northwest Territories was once again the leading Canadian jurisdiction in terms of diamond exploration and deposit appraisal expenditures with about $54 million (**Figure 16**). Although that amount is lower than the $75 million recorded in 1997 and even more so than the amounts recorded for the years 1994, 1995 and 1996 (which averaged $129 million), it is still considerable. That is especially true given the fact that the recent construction of the

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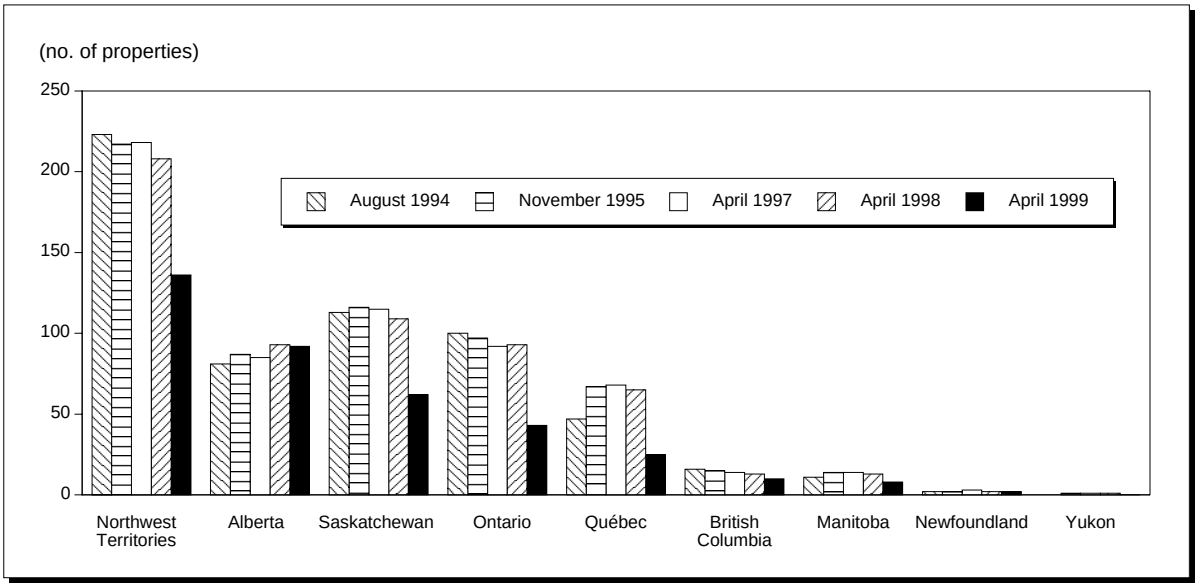
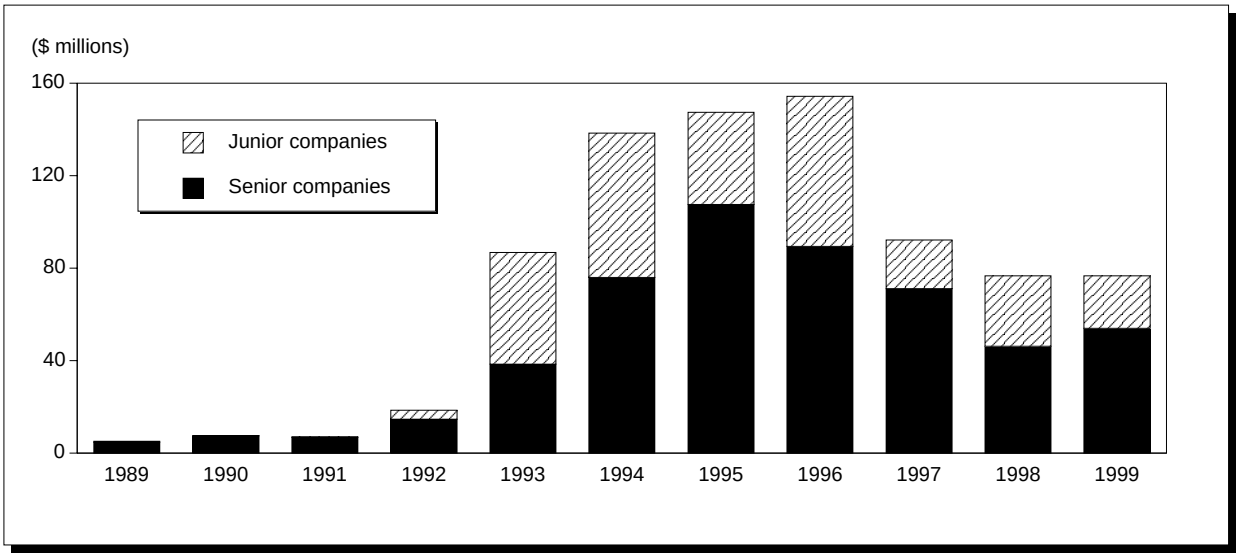
[1]The information provided in this chapter was current as of September 1, 1999. Since then, companies may have updated their data or released new information. The reader is also cautioned that reported grades may be based on samples that are not necessarily representative of the entire deposit.

Figure 14
Regional Distribution of Diamond Exploration and Deposit Appraisal Properties, 1994-99



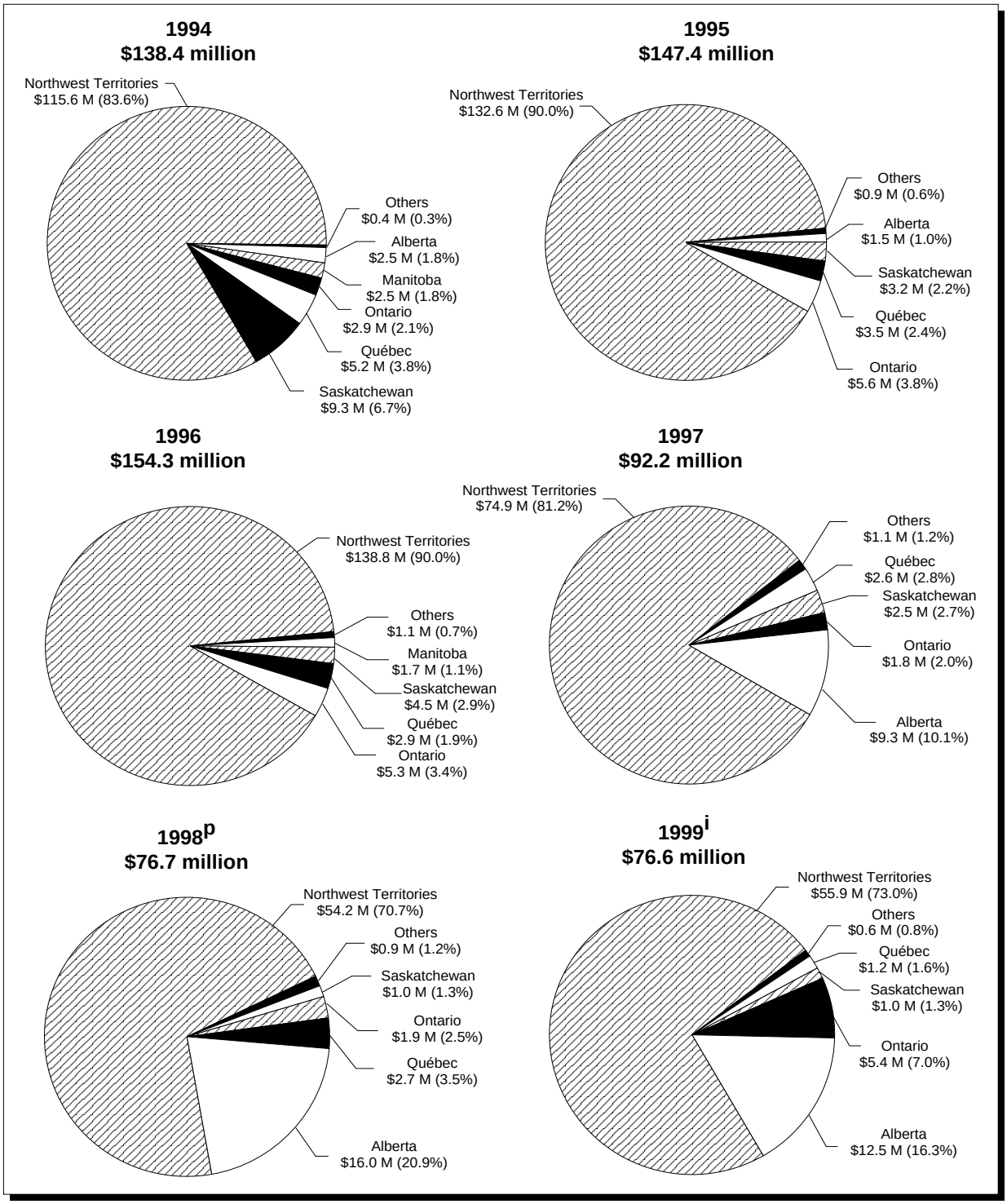
Source: Natural Resources Canada, based on *MIN-MET CANADA* database for 1994-98 and *Info-Mine* database for 1999, ROBERTSON INFO-DATA Inc., Vancouver, British Columbia and used under licence.

Figure 15
Diamond Exploration and Deposit Appraisal Expenditures in Canada, by Junior and Senior Project Operators, 1989-99



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: Data for 1998 are preliminary estimates; 1999 data are company spending intentions as compiled in January 1999. For comparison with pre-1997 years, the data include only field and overhead expenditures.

Figure 16
Diamond Exploration and Deposit Appraisal Expenditures in Canada, by Province and Territory, 1994-99

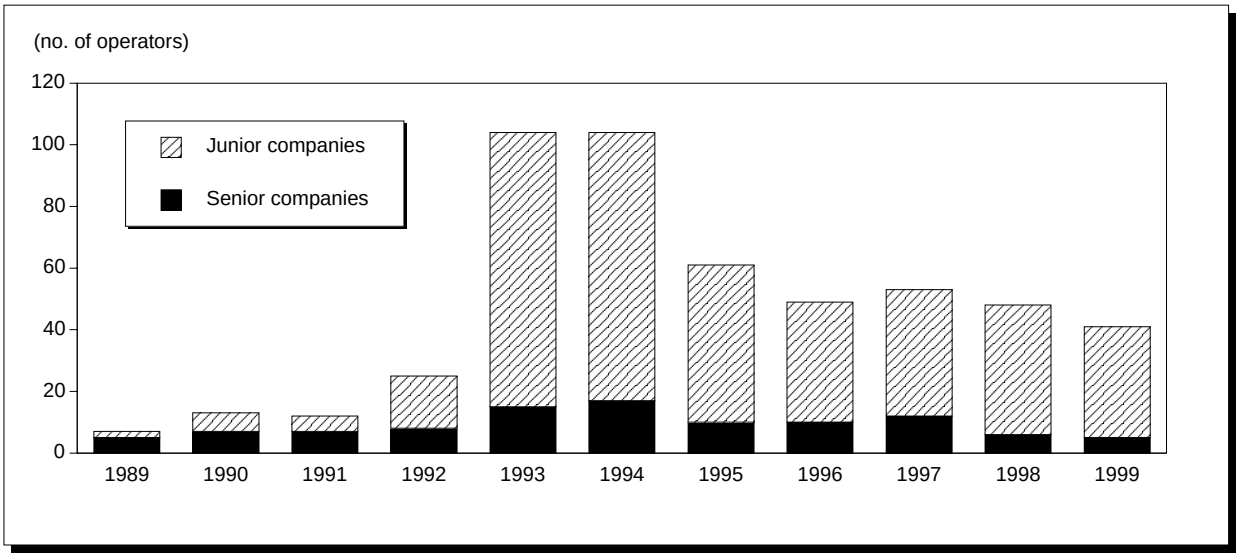


Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.

[i] Company spending intentions as compiled in January 1999; [p]Preliminary estimate.

Notes: "Others" includes Newfoundland and either British Columbia or Manitoba. For comparison with pre-1997 years, the data include only field and overhead expenditures.

Figure 17
Junior and Senior Project Operators Active in Diamond Exploration and Deposit Appraisal in Canada, 1989-99



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Note: Data for 1998 data are preliminary; 1999 data are based on company spending intentions as compiled in January 1999.

Ekati mine and the advancement of the Diavik project have resulted in the shifting of considerable financial resources away from exploration and deposit appraisal. Company spending intentions for 1999 reveal that a further $56 million is expected to be spent on diamond exploration and deposit appraisal in the Northwest Territories.

Alberta is the other Canadian jurisdiction where the search for diamonds has blossomed in recent years. In 1998, $16 million was spent on diamond exploration and deposit appraisal in that province compared to $9 million in 1997. Companies intend to spend another $13 million in 1999 as the northern part of the province continues to attract interest in diamonds. There is also interest for diamonds in other parts of the country, notably Ontario, where company spending intentions amount to more than $5 million for 1999, compared to $2 million in 1998.

4.3 EMERGING CANADIAN DIAMOND MINING INDUSTRY

4.3.1 Ekati Diamond Mine

The production of diamonds from the Ekati project in the Northwest Territories began in October 1998. Three of the five diamond pipes currently scheduled for mining at Ekati (Panda, Koala and Fox) are near the processing plant. The Sable pipe is 17 km to the north and the Misery pipe is 29 km to the southeast. A total of 78 Mt of ore and 508 Mt of waste rock is scheduled to be mined over the initial 17-year life of the project. The total project life is expected to be 25 years or longer, depending on future exploration results.

To the end of 1998, a total of 107 kimberlite pipes had been discovered (up from 100 pipes a year earlier) on the core block of the Ekati property (owned by BHP Diamonds Inc., 51%; Dia Met Minerals Ltd., 29%; Charles Fipke, 10%; and Stewart Blusson, 10%) or on the adjacent Buffer zone claims block (owned by BHP Diamonds, 51%; Archon Minerals Limited, 31.2%; Charles Fipke, 10%; and Dia Met Minerals, 7.8%). Eighty-one of the 107 kimberlites lie on the core block of claims and the remaining 26 are on the Buffer zone claims. Five diamondiferous

kimberlite intrusions were discovered in 1998 on the Ekati property and Buffer zone claims (**Table 10**). Bulk samples will be taken to better establish diamond contents and diamond values for these kimberlites. In May 1999, the discovery of two additional pipes on the Buffer zone claims was announced for a total of 109 kimberlites, 28 of which are on the Buffer zone.

The Jay pipe, on the Buffer zone claims, is reported to be 7.7 ha in size with an estimated resource of 38.5 Mt. A 238-t sample, collected from the pipe in 1996, had an average grade of 2.01 ct/t valued at US$22.50/ct. At the end of 1998, a total of 36 potential kimberlite targets remained to be tested on the core block/Buffer zone property.

4.3.2 Diavik Project

The Diavik project in the Northwest Territories is operated by Diavik Diamond Mines Inc., which owns a 60% interest. This company is a wholly owned subsidiary of Rio Tinto Plc of London, England. The remaining 40% is held by Aber Resources Ltd. of Vancouver, British Columbia. Aber has put up 40% of the project costs and retains the right to market its 40% share of diamond production. In the summer of 1999, Tiffany & Co., of New York, acquired a 14.9% equity interest in Aber for $104 million and agreed to purchase a minimum of US$50 million of Diavik diamonds annually.

To the end of 1998, a total of 53 kimberlite pipes had been discovered on the Diavik property, 24 of which are known to be diamondiferous. Four pipes (A-154 South, A-154 North, A-418 and A-21) currently appear to have the greatest promise (**Table 10**). A final feasibility study is scheduled to be completed for the Diavik property in 1999, at which time estimated capital and operating costs and a revised mining plan for the project are to be available.

A draft report by the federal government was released early in the summer of 1999 for a 30-day public review period. After the report and any public comments are considered, the federal Minister of Indian Affairs and Northern Development will issue a decision on whether or not the project will proceed to the permitting stage. Completion of the feasibility study has been delayed until that decision is made public as the partners hope to have a better understanding of the project's permitting, regulatory and fiscal requirements before completing the study. Provided results are favourable and all permits are issued, construction could start in January 2000 with production start-up, which was previously anticipated in mid-2002, now planned for 2003 because of a longer dike construction period.

The proposed mine development plan includes the construction of dikes in Lac de Gras around the A-154 North, A-154 South and A-418 kimberlites (which lie under the waters of Lac de Gras, adjacent to East Island) to permit open-pit mining of these deposits. Provided all necessary approvals, permits and licences are received in time, the construction of project infrastructure could begin in the year 2000, the construction of water retention dikes could be carried out in 2001 and 2002, dewatering and overburden removal could take place in the second half of 2002, and diamond production could commence in the first half of 2003.

Based on a 1.5-Mt/y mine, the feasibility study estimates capital costs for development of the Diavik diamonds project of $1.28 billion (±15%). Full open-pit production after ramp-up will be 6.3 million to 7.0 million ct/y. The capital cost to construct the Diavik diamond mine includes site facilities, the main processing plant, a diamond sorting facility, mine development and dike construction, camp facilities, logistics and mobilization, and manager's costs, including engineering and construction management.

The initial capital estimate does not include the construction of the A-418 ($115 million) and A-21 ($148 million) dikes starting in 2006 or underground mining capital ($45 million) or reclamation costs.

TABLE 10. 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)
EKATI MINE AND BUFFER ZONE 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	680	233	0.33	89	29
Pigeon (original sample)	154	60	0.39	51	20
Pigeon (1998 sample)	540	..	..	..	..
Upper crater zone	213.6	113.89	0.53	71	38
Lower hypabyssal zone	351.2	137.42	0.39	39	15
Jay	237.6	476.8	2.01	22.50	45
Sable	1 096	1 070	0.98	64	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	..	..
98-A	0.1949	0.112	0.57	..	..
98-B	0.0733	0.057	0.78	..	..
Phoenix (98-C)	0.2395	0.338	1.41	..	..
Shark	..	..	1.32	..	..
Gazelle	0.4834	..	0.87	..	..
Glory	0.2438	..	1.32	..	..
Wallaby	0.1208	..	0.57	..	..
Piranha (=A841) (straddles boundary of Buffer claims and Diavik property)	0.057	..	5.51	..	..
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	7.6	0.26	..	..
JERICHO PROPERTY					
JD/OD-1	9 400	10 539	1.12	70[b]	78[b]
JD/OD-3 (first sample)	10.53	7.34	0.697[a]	..	..
JD/OD-3 (second sample)	35.9	10.41	0.29	..	..
AK PROPERTY					
5034	573	980	1.71	51[c]	82[c]
Hearne	469	846	1.80	44[c]	103[c]
Tuzo	..	..	2.2	68	150
Tesla	..	..	0.37	96	36
SNAP LAKE PROPERTY					
Snap Lake Dike (Pits 1 and 2)	199.7	226.7	1.14	301	344
Snap Lake Dike (Pits 3 and 4)	5 985.7	10 708.1	1.789	105	188

Source: Natural Resources Canada, based on company data.
.. Not available.
a Includes a single 3.6-ct stone; if this stone is excluded, the grade is 0.25 ct/t. **b** Values have been revised to include stones larger than 10.8 ct that had been omitted in previously published values. **c** Values are based on previous smaller samples. Values of bulk samples listed are not yet available.

Initial open-pit mining of the A-154 South and A-154 North kimberlite pipes will begin in 2003. The A-418 pipe would be open-pit mined in approximately 2010 and the A-21 pipe would be open-pit mined beginning in approximately 2013. Underground mining of the A-154 South and A-418 pipes would occur in the latter part of the mine plan.

After a two-year ramp-up period, operating costs over the first 10 years of operation are estimated to be $85/t of ore processed. Mineable diluted reserves are estimated at 101.5 Mct of diamonds in 25.6 Mt of ore grading 3.96 ct/t. These reserves include only measured and indicated resources above the 420-m level below surface that are deemed to be economic by a specific mining method and mine plan. Inferred resources amounting to another 29.8 Mct (12.5 Mt at 2.38 ct/t) are excluded from reserves and have not been included in the feasibility study or mine plan.

A 29-t mini-bulk sample, taken in 1998 from the A-11 pipe (10 km east of the proposed Diavik development site), yielded 7.6 ct of diamonds including a 3.01-ct, gem-quality stone, for an average grade of 0.262 ct/t. Work on the Diavik property is continuing, including the additional drilling of two other diamondiferous kimberlite pipes.

4.3.3 Jericho Property

Tahera Corporation, a company formed on February 28, 1999, by the merger of Lytton Minerals Limited and New Indigo Resources Inc., has found three diamondiferous kimberlites (JD/OD-1, JD/OD-3 and Contwoyto-1) on its Jericho property in Nunavut (**Table 10**). A prefeasibility study concluded that the economics of the proposed JD/OD-1 project are marginal based on the established JD/OD-1 kimberlite resource alone, but could be considerably improved with the discovery of additional kimberlite resource tonnage. The 17.8 ct of diamonds recovered from the JD/OD-3 pipe included two diamonds weighing 1.18 ct and 0.75 ct. The joint-venture partners have no plans to evaluate the JD/OD-3 pipe further at this time due to its relatively low grade. Exploration for additional diamondiferous kimberlites continues in the immediate vicinity.

Tahera plans to take a 35-to-50-t mini-bulk sample from the approximately 3-Mt Contwoyto-1 kimberlite that was discovered in the fall of 1998.

The 10 539 ct of diamonds that were recovered from a 9400-t bulk sample from the JD/OD-1 pipe were originally valued at about US$60/ct, excluding stones larger than 10.8 ct. In 1998, further valuation using the Adtec valuation system (including stones larger than 10.8 ct), and based on April 1998 diamond prices, indicated a value of US$69.95/ct for the entire parcel of 10 500 ct. Tahera Corporation has filed a project proposal for the Jericho diamond project that marks the formal commencement of the environmental assessment and regulatory approval process. The project proposal is for an open-pit diamond mine on the land-based JD/OD-1 kimberlite pipe near the northwest end of Contwoyto Lake, approximately 27 km northwest of the Lupin gold mine. Ore would be transported by an ice road (mid-January to mid-May) from the mine to a year-round processing plant (using conventional diamond-processing techniques) at the Lupin site. Current kimberlite resources indicate that the Jericho diamond mining project could have a mine life in excess of 10 years. Production scheduling of the mining operations would enable the higher-grade phase of the pipe to be mined at an early stage to maximize project economics. The capital expenditure required will be determined during a feasibility study that began in May 1999. Commercial diamond production could be achieved by late 2001, subject to the permitting and environmental assessment processes.

4.4 ADVANCED PROJECTS

4.4.1 AK

Four diamond deposits have now been discovered on the AK property, located some 150 km southeast of Lac de Gras in the Northwest Territories. The property was owned by Mountain Province Mining Inc., 90%, and Camphor Ventures Inc., 10%. These companies discovered the AK-5034 kimberlite pipe in 1996. The property has been optioned to Monopros Limited, the Canadian subsidiary of De Beers Consolidated Mines Limited. Monopros can earn a 60% interest in the property by spending at least $18 million on bulk sampling, completing a bankable feasibility study, and advancing the project to commercial production.

In addition to the original AK-5034 pipe discovered by Mountain Province-Camphor Ventures, Monopros has discovered three additional diamond kimberlite deposits: the Hearne, Tuzo and Tesla pipes (**Table 10**). Early in 1999, Monopros used 12-inch drills to take four bulk samples totaling 1666 t, comprising 575 t from the AK-5034 pipe, 454 t from the Hearne pipe, 460 t from the Tuzo pipe, and 177 t from the Tesla pipe. The results were expected in the summer of 1999. It was estimated that approximately 1000 ct of diamonds would be recovered from each of the AK-5034, Hearne and Tuzo pipes, sufficient to model grades and values per tonne for each of these pipes. The sample from the Tesla pipe is expected to yield approximately 65 ct of diamonds that, together with previously recovered diamonds from this pipe, will allow an improved estimate of the pipe's potential.

At the time of revision of this text, in early September 1999, it had been announced that 980 ct of diamonds had been recovered from the processing of 573 t of kimberlite from the AK-5034 pipe, for a grade of 1.71 ct/t, better than the previously modelled grade of 1.6 ct/t. The three largest diamonds recovered were 10.0 ct, 4.90 ct and 4.85 ct. In total, there were 3 diamonds greater than 3 ct, 42 diamonds greater than 1 ct, 113 diamonds between 0.5 and 1 ct, and 606 diamonds between 0.2 and 0.5 ct. The diamonds have been sent to Kimberley, South Africa, for valuation.

From the Hearne pipe, 469 t of kimberlite yielded 846 ct of diamonds for a sample grade of 1.80 ct/t. The two largest diamonds were 3.37 ct and 3.16 ct. In total, there were 9 diamonds greater than 2 ct, 40 diamonds greater than 1 ct, 90 diamonds between 0.5 and 1 ct, and 599 diamonds between 0.2 and 0.5 ct. The diamonds will also be valued in Kimberley after undergoing acid cleaning.

Bulk sample results from the Tuzo and Tesla pipes remain to be released.

Over the 1998/99 winter, a delineation program consisting of 16 diamond drill holes was carried out to better delineate the contacts of the kimberlites at depth to enable improved resource tonnage estimates to be calculated for the four pipes. Additional drilling during the same winter to test promising exploration targets resulted in the discovery by Monopros of a new pipe 12 km northeast of the above cluster of four pipes. At the time of writing this chapter, no information was available on whether or not this pipe contains diamonds.

Three more diamondiferous kimberlites have also been discovered: the Wallace and 5034 South pipes were discovered nearby on the property, and the Faraday pipe was discovered 12 km to the northeast. Counts of macrodiamond contents of an 80-kg sample of the 5034 South pipe and 40-kg samples from the Wallace and Faraday pipes have all yielded interesting results and are very similar to macrodiamond counts that were obtained in October 1997 for the Hearne and Tuzo pipes.

4.4.2 Ice Claims

Tahera Corporation reports that the Ranch Lake kimberlite pipe on the company's Ice claims in the Northwest Territories contains an estimated 57 Mt of kimberlite, to a depth of 300 m, with an average diamond content that is between 0.30 and 0.35 ct/t. The company states that the exploration philosophy of a joint-venture agreement with Kennecott Canada Exploration Inc. is to explore for higher-grade pipes that would improve the economics of the Ranch Lake property.

4.4.3 Snap Lake

A shallow-dipping, diamond-bearing dike discovered at Snap Lake, in the Camsell Lake area of the Northwest Territories, on a property owned by Winspear Resources Limited (67.7%) and Aber Resources Ltd. (32.24%) has been yielding encouraging exploration results (**Table 10**). Two 100-t bulk samples taken from surface yielded 226.72 ct (or 1.14 ct/t) of diamonds valued at US$301/ct (US$343/t). This is an exceptionally high value per carat. The 226.72 ct of diamonds include 25 stones that each weigh more than one carat with the three largest diamonds, which weigh 10.82 ct, 8.42 ct and 6.04 ct, accounting for 75% of the value. The dike, which has an average thickness of 2.4 m over an identified strike length of 1350 m, has been encountered in limited, widely spaced drilling as far as 2200 m to the east of its surface exposure and has been intersected by drilling over a distance of 2000 m in a north-south strike length. A scoping study has indicated that the portion of the dike underlying the peninsula contains a resource of 1.3 Mt, of which 667 000 t are mineable by open-pit methods.

Winspear is attempting to identify a minimum of 3.5-5 Mt of kimberlite resources for a feasibility study, plus an equal tonnage of possible resources. Winspear has also discovered three other shallowly dipping kimberlite dikes in the lake that are similar in appearance to the above-noted diamond-bearing dike, but there is no information available to confirm whether or not these dikes are diamondiferous.

Two bulk samples, each about 3000 t in size, were taken from surface pits in the winter of 1999. A 3003.9 dry tonnes sample from Pit no. 4 yielded 5542.27 ct of diamonds for a grade of 1.845 ct/t. These diamonds were valued at US$98.42/ct, yielding a value of US$181.58/t. Six stones exceed 10.8 ct in weight and have been classified by all seven independent valuers as "specials." A total of 88 stones in the parcel exceed 3 ct in weight. The largest diamond recovered weighs 14.3 ct.

The second of these bulk samples (2981.8 dry tonnes from Pit no. 3) yielded 5165.81 ct, for a grade of 1.732 ct/t valued at US$111.98/ct. This amounts to US$193.95/t. Three stones from Pit no. 3 exceed 10.8 ct in weight and have been classified by the seven independent valuers as "specials."

A total of 103 stones in the parcel are classified as "specials." The largest diamond recovered weighs 14.07 ct. Of all kimberlite bulk samples taken in Canada, the per tonne values for these two bulk samples are surpassed only by the US$296/t that has been obtained from the A-154 pipe on the Diavik property.

Based on 180 drill hole intersections, the total *in situ* global tonnage for the Northwest Snap Lake kimberlite dike has been estimated by MRDI Canada, a division of H.A. Simmons Ltd., at 23.4 Mt with an average vertical thickness of 2.44 m. Over large areas of the dike, the true thickness is estimated to be at least 90% of the vertical thickness. Some 8.9 Mt of this, based on 132 drill holes, has an average vertical thickness of 3.0 m and has been defined with sufficient confidence for feasibility study purposes. Exploration of the Snap Lake dike continues.

In March 1999, a dispute arose between Winspear and Aber concerning their ownership shares of the Snap Lake project and it had not been resolved by early September 1999.

4.4.4 Buffalo Hills

Ashton Mining of Canada Inc., with a 42.5% share, is the operator of a diamond exploration project in the Buffalo Hills of northwestern Alberta, about 250 km north-northwest of Edmonton. The other partners are Alberta Energy Company Ltd. (42.5%) and Pure Gold Resources Inc. (15%). Since early 1997, a total of 31 kimberlite intrusions have been discovered on this property, of which at least 19 contain diamonds.

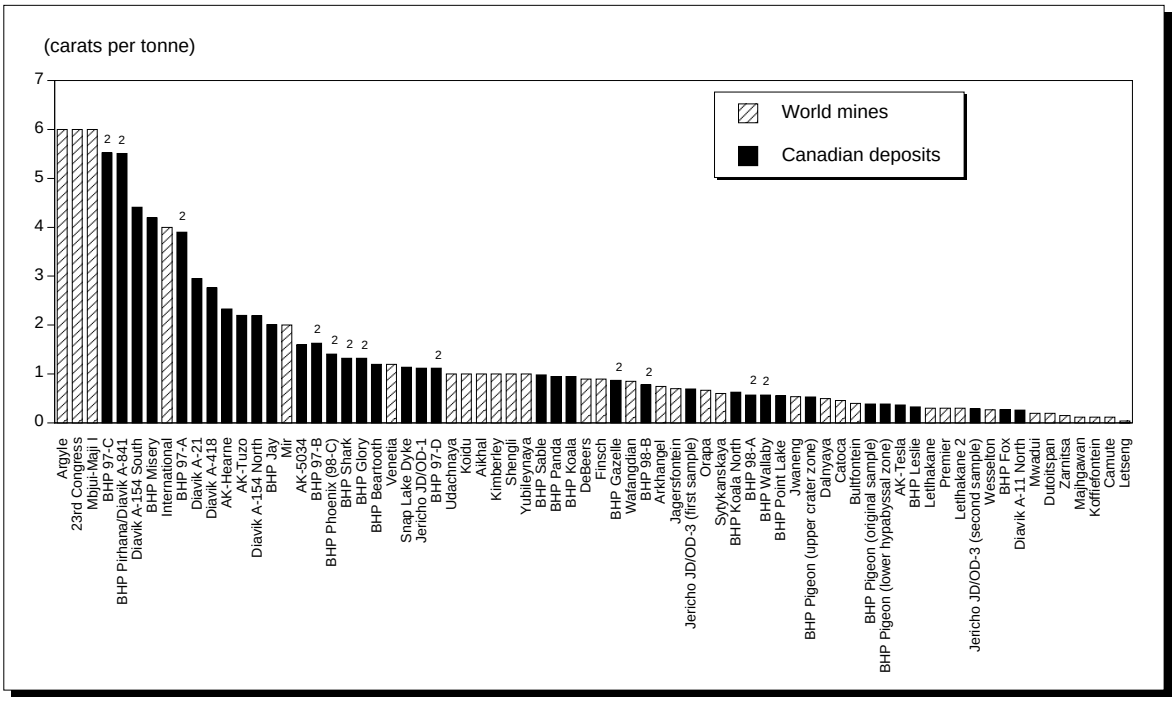
A 479-t bulk sample of the K-14 kimberlite taken in March 1998 yielded 56.45 ct of diamonds at a grade of 0.118 ct/t. The two largest diamonds recovered weigh 0.90 ct and 0.88 ct, respectively. The company considers the grade of 0.118 ct/t to be disappointing and is of the opinion that kimberlite K-14 would be unlikely to support a viable mining operation.

A mini-bulk sample of 18.68 t of kimberlite from the K-11 kimberlite yielded 0.82 ct, or 0.0441 ct/t, which is insufficient to be of economic interest. The company has not yet found any kimberlites of economic interest, but is continuing its exploration of the Buffalo Hills property.

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

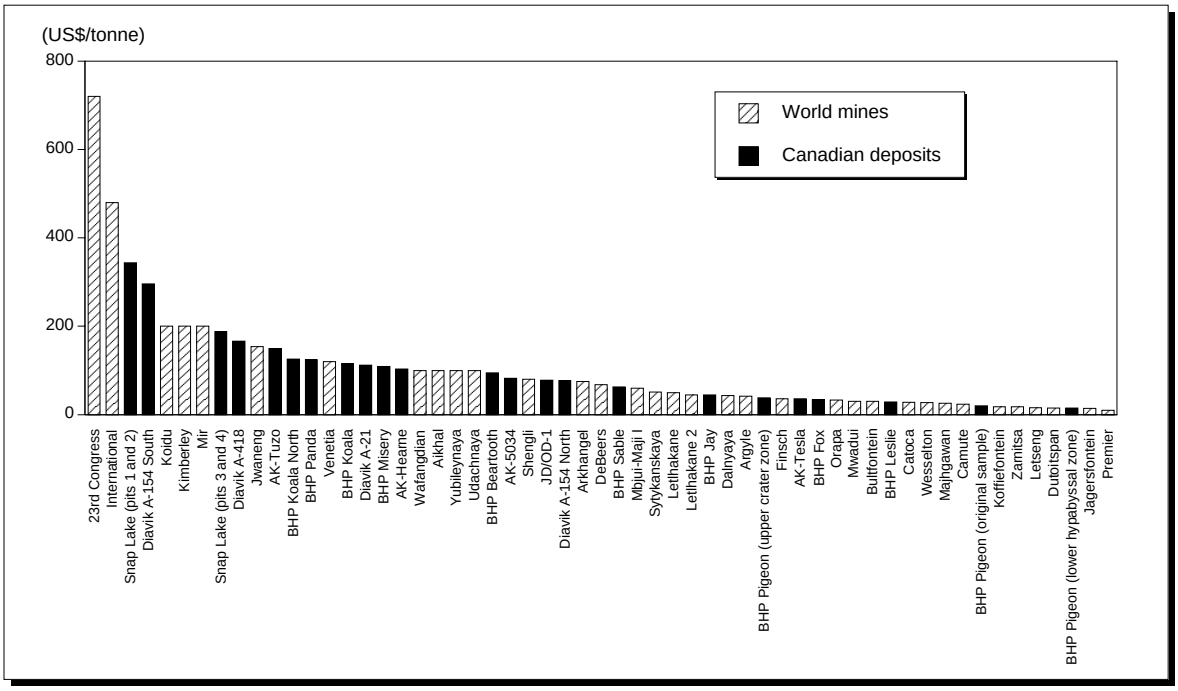
Recoverable diamond grades for the 38 Canadian diamond-bearing kimberlites for which unequivocal recoverable diamond content is publicly available appear to fall toward the higher-grade range of world diamond mines (**Figure 18**). On the other hand, most, if not all, of the currently known Canadian 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 be in the higher value range for world diamond mines (**Figure 19**). However, it is important to recognize that the sample sizes used for determination of diamond contents of many of the Canadian kimberlites are small (**Figure 20**). 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 18
Recoverable Diamond Grades From World Diamond Mines[1] and Canadian Diamond Deposits



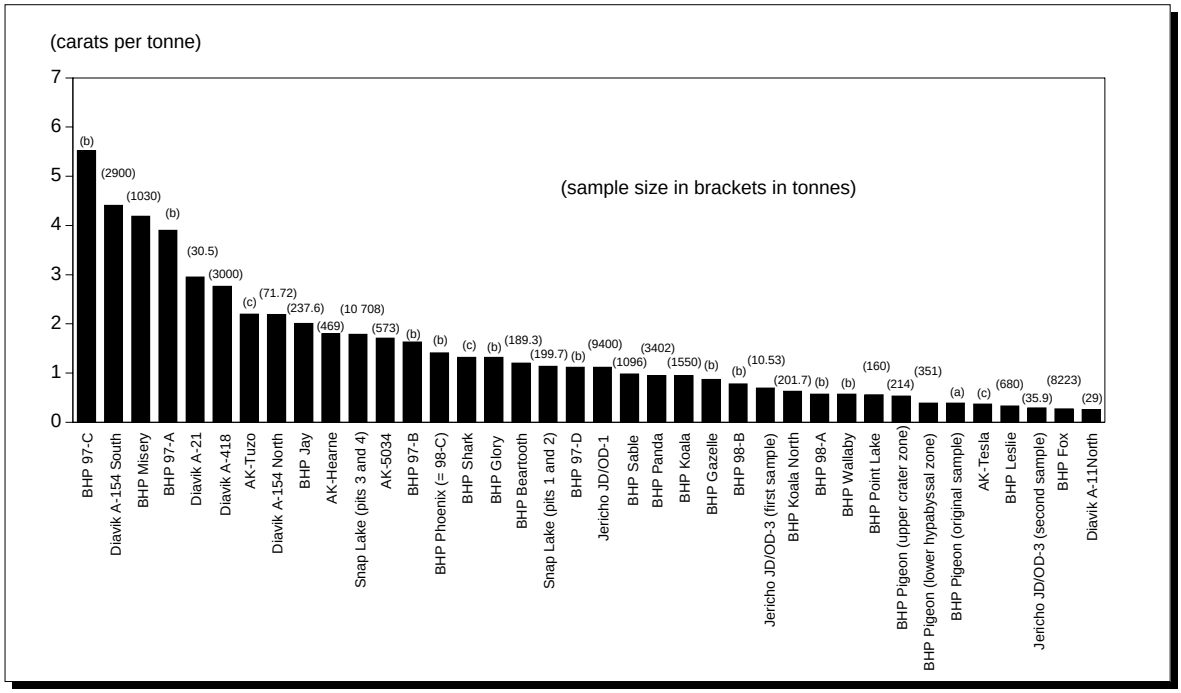
Source: Natural Resources Canada, based on published data.
[1] Grades of world diamond mines are based on data from the early 1990s. [2] Based on a sample weight of less than 0.5 tonnes.

Figure 19
Recoverable Diamond Values for World Diamond Mines[1] and Canadian Diamond Deposits



Source: Natural Resources Canada, based on published data.
[1] Values for world diamond mines are based on data from the early 1990s.

Figure 20
Grades of Selected Canadian Diamond Deposits



Source: Natural Resources Canada, based on published data.
(a) Pigeon 1998 sample totaled 540 tonnes. Weights of the upper crater zone and lower hypabyssal zone portions of this sample were not published.
(b) Based on a sample weight of less than 0.5 tonnes. (c) Sample size not available.

5. Regional Outlook

5.1 INTRODUCTION

This section presents comments from provincial and territorial officials on recent exploration and deposit appraisal activities in their respective jurisdictions and gives an indication of what they expect for 1999. The reader should note that many provinces/territories, in their respective review of activities, use the term "exploration" in its broad sense; that is, it includes both exploration (grass-roots) and deposit appraisal (advanced) components. Therefore, most of the expenditures and other data reported in this chapter include both the exploration and deposit appraisal phases of the mineral development cycle as defined in the new survey (please refer to Section 1.2 and the Appendix for further explanations).

It should also be noted that some of the 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 Ministry of Natural Resources that are excluded from all NRCan published totals and the junior/senior analysis for that province is based on different criteria. The totals reported for Saskatchewan are not based on the same set of definitions used for the national survey.

As indicated in Section 1 of this report, the new territory of Nunavut was officially created in April 1999 by dividing the former Northwest Territories into two territories: Nunavut and the Northwest Territories. Since the data presented herein were collected prior to this event, Nunavut does not have its own section in this chapter. However, the Northwest Territories section, which reviews exploration and deposit appraisal activities in what was the former Northwest Territories, contains some information that is clearly identified as pertaining to Nunavut.

5.2 NEWFOUNDLAND AND LABRADOR

Overview

Expenditures on mineral exploration in Newfoundland and Labrador in 1998 were almost $51 million, reflecting a continuing decrease from the Voisey's Bay spurred peak of 1996 (**Table 11**).

In 1998, base metals were the primary exploration target followed by industrial minerals and gold. Exploration for base metals comprised over 90% of the total expenditures and was concentrated in Labrador, whereas much of the gold and other precious metals and industrial minerals activity took place in insular Newfoundland.

Although overall numbers are down due to retrenching by many companies in Labrador and low metal prices, exploration expenditures on the island have increased significantly over the $7.4 million spent in 1997. To date, these trends have continued into 1999 with base-metal exploration, in particular, showing a resurgence of activity on the island where the 1999 estimate for exploration expenditures stands at $14 million.

TABLE 11. NEWFOUNDLAND AND LABRADOR EXPLORATION STATISTICS, 1993-99

	1993	1994	1995	1996	1997	1998p	1999f
				(dollars)			
Exploration expenditures	8 905 864	12 396 462	71 100 000	92 546 708	71 752 000	50 868 000	38 002 000
				(number)			
Claim staking							
Claims staked	6 955	22 256	248 707	15 299	13 363	14 476	10 000
In good standing	22 910	37 084	280 750	168 815	126 766	86 955	55 000
				(dollars)			
Exploration field expenditures							
Base metals	3 719 325	5 216 623	64 226 300	83 737 940	61 420 000	47 349 401	. .
Precious metals (gold)	1 867 878	3 613 526	5 371 500	6 395 873	5 228 072	1 500 000	. .
Other	1 192 896	884 000	1 241 000	2 412 895	2 336 828	2 018 599	. .
				(metres)			
Diamond drilling[1]							
Production/development	16 982	7 260	8 107	9 424	13 318	4 967	. .
Exploration	29 528	42 225	120 803	226 208	141 320	90 428	. .
Total diamond drilling	46 510	49 485	128 910	235 632	154 638	95 395	80 000

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

The number of claims staked in 1998 shows a small increase over 1997 levels, but it decreased in 1999 to around 9600. Both the claims held in good standing at the end of the year (86 955) and the amount of diamond drilling (95 395 m) declined in 1998; however, most indicators range from similar to very healthy when compared with pre-Voisey's Bay levels (1993-94).

New Mines

Shabogamo Mining & Exploration Limited has purchased processing equipment and constructed a railway and washing plant. The company has a rail car lease agreement in principle with the Iron Ore Company of Canada for transporting the ore to Sept-Îles. By the end of the year, it hopes to have shipped 75 000 t of quartzite to SKW Canada Limited at Bécancour, Québec, for smelting into silicon metal. A drilling program tested the silica potential of the surrounding claims in the fall of 1999.

Pennecon Limited started mining its barite-celestite deposit, located at Boswarlos on the Port au Port Peninsula, in October 1999. A total of 57 000 t was mined.

Galen Gypsum Mines Ltd. has taken out mining leases on two west coast gypsum properties, one at Flat Bay and the other at Coal Brook. The latter should start supplying the wallboard factory in Corner Brook this summer.

Development Stage Projects

WMC International (Australia) was awarded the Deer Cove talc-gold Ming's Bight property on the Baie Verte Peninsula following a call for proposals by the Department of Mines and Energy. The deposit was discovered and delineated by Noranda Inc. during the 1980s; Noranda's claims in the area lapsed in November 1998. WMC started with test mining and a prefeasibility study on the talc.

Burin Minerals Ltd.'s parent company, Burin Fluorspar Ltd. of Alberta, is involved in a proposed merger with Blue Desert Mining Inc. of Vancouver, British Columbia, which would greatly enhance its ability to raise capital for development and reactivation of the St. Lawrence operation and give it better market access for any subsequent fluorspar production. In July 1999, Burin Minerals Ltd. commenced a detailed drilling delineation program of the Blue Beach

North and Tarefare veins. Previous studies have indicated the veins have the potential to yield over two million tons of 97.5% CaF_2. Meanwhile, Burin Minerals Ltd. and its partner, Lawrencian Ventures Incorporated, through a subsidiary company (St. Lawrence Minerals Products), are planning to develop fluorspar and other local stone from the St. Lawrence area for dimension stone and ornamental uses as a complement to their proposed fluorite mining operation.

Expansions and Other Potentially Significant Developments

The Iron Ore Company of Canada is to spend $1.1 billion on expansions and improvements, a considerable investment given the market conditions for steel in North America and elsewhere.

In December 1997, Voisey's Bay Nickel Company Limited submitted its first environmental assessment on the impacts, and mitigation of same, of the proposed mine and mill development at Voisey's Bay. The panel appointed to review this assessment identified a number of deficiencies and areas needing clarification and subsequently received the completed assessment in June 1998. After extensive input from the public and government, the panel conducted public hearings in the fall of 1998 and then, at the end of March 1999, released a report containing 107 recommendations that addressed a wide range of environmental and sociological issues. The provincial government and its co-signatories (the federal government, the Labrador Inuit Association and the Innu Nation) to the Memorandum of Understanding that established the panel review process have studied the report and, in August 1999, released the project from further requirements under the *Canadian Environmental Assessment Act*. Voisey's Bay Nickel Company Limited may now proceed with advanced underground exploration and assessment of the mineral deposits. The company's next steps toward development include Impact and Benefit Agreements with the Aboriginal groups and issuance of a mining lease by the provincial government.

The negotiating team for the Labrador Inuit Association took a land claims "Agreement in Principle" with the federal and provincial governments back to their membership for ratification on July 26, 1999; this agreement was supported by over 80% of those that voted. This is a very significant step in one of two Aboriginal land claims for Labrador.

Atlantic Minerals Limited has begun a major expansion of its limestone-dolomite quarrying operation on the Port au Port Peninsula in western Newfoundland.

Exploration

A healthy level of diverse grass-roots exploration activity is being carried out by the junior mining sector and local prospectors. Many of the junior exploration companies are able to complete preliminary evaluation and first-round drilling of their properties. More sizeable and/or advanced exploration projects are being conducted by some dozen major companies, commonly in joint ventures with the junior companies and prospectors.

Voisey's Bay Nickel Company Limited completed a $20 million geophysical and exploration drilling program in 1998 at Voisey's Bay in northern Labrador. The company announced two significant discoveries this past year: a new zone of mineralization north of the Eastern Deeps, and the intersection of copper, nickel and cobalt mineralization below the Discovery Hill zone. In 1999, Voisey's Bay Nickel Company Limited continued exploration on the Voisey's Bay deposits and field work, including diamond drilling, was also undertaken on its claims in the Kiglapait Mountains. The company spent over $16 million in Labrador during 1999 on a program that included 56 holes incorporating over 50 000 m of diamond drilling.

Also active in Labrador during 1998 was Donner Minerals Ltd., which spent around $12 million that year in a search for another Voisey's Bay. The 1999 program of new geophysical and diamond drilling exploration, which is expected to generate up to $2.75 million in expenditures, was placed on hold pending the results of discussions with the Innu nation.

Gallery Resources Ltd. conducted diamond drilling and geophysical surveys on its Okak Property in northern Labrador, geophysics at its Harp Lake Property in north-central Labrador, and, with joint-venture partner International Silver Ridge Resources, worked on a 256-claim property at Cabot Lake west of Voisey's Bay.

Freeport Resources Inc. tested its garnet sands in northern Labrador for garnet and TiO_2 content, and is also exploring for diamonds.

During 1998, Billiton Exploration Canada Ltd. signed separate joint-venture agreements with Buchans River Ltd. and associated companies, Celtic Minerals Ltd. and Altius Resources Inc., on a substantial land package in the Buchans-Red Indian Lake area of central Newfoundland. A deep penetrating airborne geophysical survey was completed in late 1998. The survey also covered ground belonging to GT Exploration Ltd., Newfoundland Mining & Exploration Ltd., Vinland Resources Limited, Phelps Dodge Corporation of Canada, Ltd. and First Labrador Acquistions Inc. Interpretation of the airborne survey has been completed. A follow-up program of mapping, geochemical sampling, ground geophysics (particularly induced polarization surveys) and diamond drilling commenced in mid-May 1999 to test some of the anomalies identified by the survey and has been ongoing on many of these properties throughout the year. Buchans River Ltd. also completed a geochemical program at Duck Pond, southeast of Buchans, and investigated an electromagnetic (EM) anomaly at Burnt Pond, while Celtic Minerals Ltd. expanded its central Newfoundland properties in a quest for stratabound copper and, in December 1999, acquired, from Noranda Inc., the Great Burnt Lake copper deposit adjacent to its South Pond area and the Victoria mine base-metal prospect adjacent to its Hungry Hill project.

On March 2, 1999, Thundermin Resources Inc. announced that a definitive agreement had been reached with Noranda Inc. giving Thundermin Resources Inc. the right to acquire a 100% interest in Noranda's Duck Pond-Tally Pond base-metal deposits 30 km southeast of Buchans. Thundermin Resources Inc. has completed compilation work and an infill drilling program on the Duck Pond deposit and delineation drilling on the Boundary deposit. Exploration is designed to aid in putting the deposit into commercial production by March 31, 2006. Geological reserves stand at 6.35 Mt grading 3.29% copper, 1% lead, 6.3% zinc, 63.05 g/t silver and 0.82 g/t gold. On May 6, 1999, Thundermin further announced that the company had agreed to enter into a joint venture with Queenston Mining Inc. whereby Queenston can earn 50% of Thundermin's interest in the Duck Pond-Tally Pond deposits. Geophysical exploration continues at the North and South Moose Pond properties.

During 1998, Altius Resources Inc. signed agreements with Exploration Sulliden and Teck Exploration on separate properties in its Botwood Basin epithermal gold project. Diamond drilling programs have been completed on the Rolling Pond, Mustang and Moosehead properties. Values between 0.1 and 4.31 g/t gold over 0.3 and 17.1 m from the Mustang property have been released. Teck Exploration completed a diamond drilling program on the Moosehead property in the Bishops Falls area of central Newfoundland. In addition, Altius Resources Inc. acquired over 400 claims covering gold potential in the general Northwest Gander River area in early 1999, where exploration took place in mid-1999, and in August added 1255 claims in the Silver Mountain area of the Northern Peninsula where nickel is the main target on its Taylor Brook property (now 1415 claims). Billiton Exploration Canada Ltd. is in a joint venture with Altius Resources Inc. on this property. Preliminary exploration was also completed on the Point Leamington property in north-central Newfoundland.

Mountain Lake Resources Inc. continued exploring the Valentine Lake gold property. The property, located about 60 km southwest of Buchans, is under option from Noranda Inc. The work included geological surveys, trenching and diamond drilling. Values of up to 28.7 g/t gold averaged over 2 m were reported by Mountain Lake from one of its earlier 1999 diamond drill holes.

On March 4, 1999, Cornerstone Resources Inc. announced that it had negotiated an exploration option, share purchase and operating joint-venture agreement with Phelps Dodge Corporation

of Canada, Ltd. on its Princess base-metal (possibly red-bed copper) property in the Musgravetown area of eastern Newfoundland. A program of mapping and ground geophysics was undertaken. Phelps Dodge Corporation of Canada, Ltd. has elected not to proceed to the second year of option. As well, Cornerstone Resources Inc. completed mapping and ground geophysics on the adjacent West Princess property and continued prospecting its nearby South Princess and other properties, together with its Paul's Pond gold property in central Newfoundland.

On April 8, 1999, United Carina Resources Corp. optioned the Linear Group gold property, located near Gander in northeast central Newfoundland, from the KriASK Syndicate, a Newfoundland-based prospecting group. The property contains quartz veins with considerable visible gold. A program of prospecting, trenching, geochemistry and geophysics was conducted, along with a follow-up program of diamond drilling. Metallic assay checking confirmed, and in some cases improved, fire assay results for gold. United Carina and its partner, Consolidated Pine Channel Gold Corp., subsequently expanded holdings along strike of the "linear" group of properties through options with several prospectors (August and September 1999), with Battle Mountain Canada Ltd. (September 1999), with Noront Resources Ltd. for its Duder Lake and Mt. Peyton properties, respectively, northeast and southwest of the linear group (November 1999), and with another consortium of prospectors for 46 claims at Glenwood (December 1999), adjacent to the original play. The results of the drilling program were reported throughout the fall including, on November 9, a spectacular intersection of 304.8 g/t gold over 0.6 m.

Noranda Inc. converted approximately 70 000 ha of the A.N.D. Charter in central Newfoundland to claims and surrendered about 10 000 ha of it to the Crown in late 1998. The surrendered lands came open for staking in mid-March. Separate exploration agreements on some of the converted claims have been signed with Kelmet Resources Ltd., Alto Minerals Inc., Tulks Resources Ltd., Mountain Lake Resources Inc., Buchans River Ltd. and Phelps Dodge Corporation of Canada, Ltd. The claims cover both base-metal and gold potential.

Rubicon Minerals Corporation has signed joint-venture agreements with Billiton Exploration Canada Ltd. to fund and, in part, operate an exploration program on its properties around Point Leamington, 30 km north of Bishops Falls. Deep penetrating airborne EM/magnetic surveys, sampling and some diamond drilling were undertaken in 1999. Billiton Exploration Canada Ltd. also has the option to earn a 70% interest in either the Point Leamington deposit or the nearby Lewis Lake project. Rubicon Minerals Corporation is in the process of developing a digital database and completing an in-depth review of all data relating to the Point Leamington deposit where reserves stand at 13.8 Mt grading 0.48% copper, 1.92% zinc, 18.1 g/t silver and 0.9 g/t gold.

Boliden Westmin (Canada) Limited has staked 213 claims in five packages with zinc potential between Deer Lake and St. Anthony, including 129 claims around the area of the old Daniel's Harbour zinc mine.

Copper Hill Resources confirmed the presence of kimberlite dikes in northern Labrador in November 1999.

Major General Resources Ltd. completed a diamond drilling, trenching and bulk sampling program on the Hammerdown and Rumbullion gold deposits in the Springdale area and, on November 3, 1999, announced the sale of the property to Abiting Inc. of Québec. To date, Abiting Inc. has completed a due diligence evaluation program that included 4426 m of diamond drilling in 47 holes. Current resource estimates by Major General Resources Ltd. indicate approximately 356 000 oz of gold in 614 400 t grading 18.01 g/t gold.

Good gold and/or base-metal values over variable, but generally narrow, thickness intersections have also been reported by Copper Hill Resources Inc. at Powderhorn Lake (nickel-copper-cobalt) and North Powderhorn (volcanic massive sulphides), by Mutapa Copper & Cobalt Inc. at Little Deer (copper-gold), and by Fort Knox Gold Resources Inc. at both Wing's Point and Diversion Lake (epithermal gold).

Government Incentives

The Government of Newfoundland and Labrador has committed $6 million over a three-year period in funding assistance to the mineral exploration industry. This money is distributed among three ongoing or new incentives, namely: $250 000 per annum to the Prospectors Assistance Program (up from $100 000 per annum previously); $250 000 per annum to the Dimension Stone Incentive Program (new); and $1 500 000 per annum to the Junior Company Exploration Assistance Program (new). An agreement is in place with industry to match these funds. In addition, the Government continues to put $150 000 to $250 000 per annum into a Promotion Program.

A significant number of the exploration activities noted in the previous section have been generated by prospectors (who received assistance from the Prospectors Assistance Program) discovering and optioning-on properties for further development.

The Government has new map-staking regulations and procedures in place for areas that have reverted to the Crown. Prior to the change, parties interested in an area coming open for staking waited in a line-up for days, and on occasion weeks, at the Mines and Energy offices in St. John's in order to be first on the appointed date to submit an application for the area. This line-up procedure has been replaced by a random draw of applications that can be mailed or delivered during the notice period for areas coming open for staking.

Legislative Changes

A revised *Quarry Materials Act* was proclaimed in January 1999 that redefined quarry materials to exclude dimension stone. Dimension stone is now defined as a mineral and is administered and regulated under the *Mineral Act*. The change in the definition was not applied to Labrador because of potential implications for outstanding native land claims in the area.

Amendments to the *Mineral Act*, enacted in December 1998:

1. required plans for exploration work on licence areas to be submitted prior to starting the work, and activities capable of ground disturbance, water quality impairments or disruption to wildlife or wildlife habitat to require an “exploration approval”;

2. allowed applications for mineral exploration licences (mineral claims applications) to be made by mail or in person;

3. provided for a computer-generated draw to decide the successful applicant where multiple applications had been received for ground that had reverted to the Crown;

4. confirmed the authority to split licences;

5. included in the section on mining leases requirements that primary production be completed within the province, including a definition of primary production and when exemptions might be permitted, and that utilization of any resource be of “significant” benefit to the people or economy of this province or region; and

6. increased the maximum fine for offences under the act.

Regulations concerning the procedures relating to the computerized draw, the recording and prioritizing of map-staked claims, and details to do with security deposit refunds were added early in 1999.

5.3 NOVA SCOTIA

Overview

In 1998, exploration expenditures in Nova Scotia were estimated at $5.7 million, down from $6.7 million in 1997 and $6.9 million in 1996 (**Table 12**), but still substantially higher than levels recorded from 1992 to 1995. The trend of decreasing exploration expenditures is anticipated to continue with current forecast expenditures of $5.5 million for 1999.

Nearly half of the monies spent on exploration in 1998 focused on the potential for Cretaceous kaolin for use as fillers and coaters in the paper industry. The remainder was mostly spent on exploration for other industrial mineral commodities, particularly zeolites, gypsum, barite and titanium-bearing heavy mineral sands. Minor amounts were spent exploring for base metals and precious metals.

A preliminary estimate of the total number of claims staked, including new and re-issued claims, was 8744 at the end of 1998. This is a substantial reduction from the 34 265 claims staked in 1996 and 26 403 in 1997. The decrease reflects a reduction in larger ground holdings by several companies and low overall levels of exploration activity resulting, at least in part, from low commodity prices.

In contrast to this overall trend, staking activity for salt and potash increased significantly from 5600 acres in 1997 to 29 840 acres in 1998. A salt and potash licence is a prerequisite for obtaining an underground gas storage licence, and this staking activity is interpreted as a resurgence in interest resulting from the Sable offshore energy project.

Exploration drilling decreased significantly in 1998 with a preliminary estimate of 12 500 m drilled, compared with 24 500 m in 1997. Drilling activity focused on exploration for kaolin with lesser amounts for gold and base-metal exploration.

New Mines

In June 1999, Berichan Resources Limited began mining activities at its surface coal mine (reserves of 100 000 t) at Cottam Settlement in the Debert Coalfield. The mine is expected to operate for two years. Coal will be shipped to Nova Scotia Power's electrical generating station in Trenton, Pictou County.

Lynx Minerals Corporation commenced mining activities at its Scotsville open-pit barite mine (reserves of 200 000 t) on Cape Breton Island in June 1999. Lynx plans to produce mud-grade barite for use in offshore petroleum drilling in eastern Canada.

TABLE 12. NOVA SCOTIA MINERAL EXPLORATION STATISTICS, 1992-99

	1992	1993	1994	1995	1996	1997	1998p	1999f
Exploration expenditures (field + overhead, general + mine-site) ($)	3 258 000	1 797 000	1 714 000	2 843 000	6 892 000	6 726 000	5 654 000	5 479 000
Claim staking (new and reissued) (general + special licences) (no. of claims)	12 229	10 759	14 614	16 407	34 265	26 403	8 744	. .
Exploration diamond drilling (metres)	12 710	6 221	7 725	8 000	15 600	24 500	12 500	. .

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

Development Stage Projects

C_2C Mining Corporation has completed a 15-t bulk sampling and test processing program at its Stronach Mountain zeolite prospect located on the North Mountain in southwestern Nova Scotia. The company has announced that it will build a processing facility in the Annapolis Valley in late 1999 or early 2000. Zeolites occur in amygdaloidal basalt flows and constitute up to 20 weight percent of the rock in zones up to 10 m thick. The company is evaluating the potential for making several products for use in the agricultural, construction and manufacturing industries.

Georgia Pacific Corp. has obtained conditional approval from the Environmental Assessment process, and has submitted an application for a mining permit for its proposed surface gypsum mine at Melford, Inverness County. The deposit has a combined proven and probable mineable reserve of 20 Mt of gypsum. Georgia Pacific plans to bring the new quarry into operation while phasing out its existing mine at Sugar Camp near Port Hawkesbury.

Pasminco Limited purchased all the assets of Savage Resources Ltd., including the Gays River lead-zinc mine in central Nova Scotia. Pasminco continued with the Environmental Assessment process to obtain the necessary permits for developing an open pit at the site of the former underground mine.

Thorburn Mining Limited was released from the Environmental Assessment process for its proposed surface coal mine at Coalburn, Pictou County. The company subsequently applied for a Special Mining Lease and Mining Permit.

Brogan Mining submitted applications for a Special Mining Lease and Mining Permit for its proposed surface coal mine at Little Pond, Cape Breton Island.

Exploration

Industrial Minerals

Lynx Minerals Corp. 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. in 1998. Lynx will evaluate the viability of the deposit for various uses, including mud-grade barite for the offshore oil and gas industry, fluorite by-products, calcium carbonate, and pharmaceutical-grade barite.

Kaoclay Resources Ltd. is conducting a $20 million exploration program to define the quality and extent of kaolin clay and silica sand deposits in the Musquodoboit and Shubenacadie valleys of central Nova Scotia. The company has completed bulk sampling, regional drilling, shallow seismic surveying, research and development work, and process testing in its pilot plant in Georgia. Kaoclay is currently conducting a feasibility study for the project.

Black Bull Resources Inc. has completed an initial exploration program for its Flintstone Rock kaolinite project in southwestern Nova Scotia. The property is situated along the Tobeatic fault zone, at the southern margin of the South Mountain batholith. Work included trenching, diamond drilling and geophysical surveys. Initial analytical test work on drill core indicated favourable kaolin quality for producing paper-grade fillers. Additional work is planned to establish kaolinite grade, tonnage and overall quality.

Hibernia Resources completed a limited drilling program for kaolin in the West Paradise area of the Annapolis Valley.

NAR Resources Ltd. signed a joint-venture agreement with Titanium Corporation of Canada Ltd. for its titanium project in the Shubenacadie River in central Nova Scotia. The joint-venture

partners conducted a close-spaced drilling project for titanium-bearing mineral sands to follow up on encouraging drill results from 1998.

Maritime Mica Inc. conducted a limited drilling program to assess the andalusite deposits in the Doughboy Point area, Guysborough County.

Gold

Newfoundland Goldbar Resources Inc. purchased the former Dufferin gold mine (reported reserves of 121 729 t grading 12.5 g/t gold) from Dufferin Resources Inc. in December 1998. Newfoundland Goldbar conducted a diamond drilling project in 1999 to test the eastern extension of the mineralized zone.

Ameridex Minerals Corp. signed a letter of intent for a joint-venture agreement with Globex Mining Enterprises Inc. for the Mooseland Gold Project (Acadia Mineral Ventures estimated 2 020 000 tons grading 0.39 oz/ton gold; Hecla estimated 640 070 tons grading 0.47 oz/ton gold). Ameridex is reviewing a diamond drilling program that would increase Hecla's reported "drill indicated mineral inventory" along strike and at depth.

Regal Goldfields signed an agreement to earn a 75.5% interest in the Touquoy gold project with Moose River Resources Inc. in October 1998. An independent evaluation of the project by Watts, Griffis and McOuat in October 1997 estimated that the Touquoy deposit has a mineral resource of 5.74 Mt of ore grading 2.2 g/t gold, containing 405 000 oz of gold based on a 1-g/t gold cut-off grade.

Base Metals

Phelps Dodge Corporation of Canada Ltd. completed an exploration program consisting of geophysical surveys and diamond drilling to assess the potential for volcanogenic massive sulphides in the Stirling Belt of southeastern Cape Breton Island.

Sikaman Gold Resources Ltd. began an exploration program for volcanogenic massive sulphides at, and near, the former Stirling (Mindamar) base-metal mine in Richmond County.

Regal Goldfields Limited completed a diamond drilling program in the Faribault Brook area near Cheticamp, Inverness County. Regal continued to evaluate the potential for precious- and base-metal deposits in this area.

Mount Cameron Minerals Inc. completed a diamond drilling program for skarn-hosted base metals at its Boisdale Hills property on Cape Breton Island and continued to evaluate its Frenchvale and Leitches Creek properties.

Savage Resources Canada Ltd. conducted a diamond drilling project near the Jubilee zinc-lead deposit in Victoria County.

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 supports the continuing education of prospectors through seminars, workshops and field trips. Basic training courses were conducted in the fall of 1998 and spring of 1999, and advanced training was provided in the spring of 1999.

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

- The third component is marketing assistance. This component provides funding assistance to prospectors to market their mineral properties to junior and senior mining companies in local, national and international trade show venues. Funding is available for 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. In 1999, four prospectors received funding to attend the Cordilleran Roundup in Vancouver and thirteen prospectors obtained financial assistance to attend the Prospectors and Developers Association of Canada conference in Toronto.

Public Awareness Initiatives

The Department of Natural Resources and the Nova Scotia mineral industry have several new initiatives to help improve the public's perception of mining.

The Department of Natural Resources re-focused the annual Review of Activities conference in 1998. The conference was re-named *Mining Matters for Nova Scotia: Opportunities for Economic Development*. The aim of the conference was to highlight opportunities for mineral-related economic development, with an emphasis on developing new linkages and partnerships with non-traditional client groups. The ultimate goal was to increase awareness of the importance of mining to the economy of Nova Scotia and to garner support for future mineral development projects. Several agencies involved in economic development in Nova Scotia, including the Department of Economic Development and Tourism and regional development agencies, helped organize and also attended the conference.

As a consequence of the conference, the Department of Natural Resources has become involved in several cooperative initiatives to assess the viability of mineral-related development projects with regional development agencies throughout the province.

The Chamber of Mineral Resources of Nova Scotia has started a *Mining Works for Nova Scotia* fund-raising campaign. This project will generate funds for specific public relations initiatives.

5.4 NEW BRUNSWICK

Mineral Industry Highlights

The preliminary value of New Brunswick's mineral production for 1998 is $852 217 726, a decrease of 10.5% from the final value for 1997. Lower metal prices and reduced potash production in the nonmetals sector accounted for most of this decrease. Despite this lower production, New Brunswick continued to maintain its place in the Canadian mineral sector by ranking first among the provinces and territories in the production of zinc, lead, bismuth and peat, and second in silver, antimony and potash.

Metals accounted for 71% ($602 521 024) of the total value of production. Of these, zinc, lead, silver and copper made the largest contributions. Noranda Mining Inc. operated the No. 12

mine, the Heath Steele mine, and the Belledune smelter. In September 1998, operations at the Caribou and Restigouche mines were suspended because of low metal prices and lower-than-planned mill recoveries. Operations continue to be suspended at the Mount Pleasant mine (ADEX Mining Corporation), Murray Brook mine (Murray Brook Resources Inc.) and the Lake George antimony mine (APOCAN Inc.).

Nonmetallic minerals contributed 22% ($186 457 073) of the total value of production. The main commodities were potash, peat, salt, and sulphur in smelter gas. Early in 1998, the Potacan Mining Company sold its Cassidy Lake property to the Potash Corporation of Saskatchewan Inc. (PCS). The mine was closed in 1997 because of water infiltration underground. PCS will use the existing mill and related infrastructure to upgrade standard-grade potash product imported from western Canada. Four limestone quarries were active in Saint John (Brookville Manufacturing), Havelock (Havelock Lime, and Lafarge Canada Inc.) and Sormany (Elmtree Resources Ltd.). Upper Kent Lime Works Ltd. produced marl near Woodstock. Atlantic Silica Inc. and Chaleur Silica Ltd. produced silica from the Cassidy Lake and Bass River areas, respectively. Seventeen companies produced peat valued at $53 816 737 from 31 bogs in New Brunswick.

Coal production was valued at $23 090 000. N.B. Coal Limited has continued to reclaim lands disturbed by mining.

Structural materials such as lime, stone, and sand and gravel contributed about 5% ($40 149 629) of the value of production. Nelson Monuments Ltd. (Sussex), Smith Cut Stone & Quarries Ltd. (Shediac), Maritime Stoneworks Inc. (Dieppe), Brunswick Monuments Ltd. (Grand Falls), and Bastarache Stone Quarry (Notre-Dame) produced dimension stone in the province.

Exploration Industry Highlights

Introduction

The year 1998 was not a favourable one for the New Brunswick exploration industry. Reduced exploration budgets, market conditions that affected the raising of capital, and refocusing of exploration projects to other jurisdictions resulted in a 29.5% decrease in expenditures from 1997. Preliminary estimates indicate that approximately $8.6 million ($12.2 million in 1997) was spent in New Brunswick on exploration projects (**Table 13**). This trend was also reflected in the number of claims recorded in 1998, 2500 versus 3360 in 1997, a 26% decrease. One encouraging exploration indicator was the relatively constant number of claim renewals from year to year. Total claim equivalents in effect for 1998 was 24 319.

TABLE 13. NEW BRUNSWICK MINERAL EXPLORATION STATISTICS, 1990-98

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Exploration expenditures (general plus mine-site) ($ millions)[1]	16.5	15.8	12.2	11.1	10.0	12.7	14.7	12.4	8.6[a]
Mineral claims recorded (no.)	4 361	4 571	3 444	2 351	3 980	3 779	5 860	3 360	2 500
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	24 319

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

Metallic Minerals

Northern New Brunswick

Statistics from the database of the province's mining recorder indicate that the number of new claims recorded in northern New Brunswick during 1998 was 1336 and the number of claims in effect on December 31 was 14 230.

As usual, most of the exploration activity in northern New Brunswick was focused on base metals in the Bathurst mining camp. The active major companies were Breakwater Resources Ltd., Noranda Inc. and Teck Exploration Ltd. The active junior mining companies were Black Bull Resources Inc., Chapleau Resources Limited, Cimarron Minerals Limited, Eastmain Resources Inc., Fancamp Resources Ltd., Major General Resources Limited, Mountain Lake Resources Inc., Northeast Exploration Services Limited, NovaGold Resources Inc., Slam Exploration Ltd., and Stratabound Minerals Corp. All but two of these companies, Chapleau and NovaGold, received funding under the New Brunswick Exploration Assistance Program (NBEAP) for junior mining firms.

Noranda Inc. accounted for a large proportion of exploration expenditures in northern New Brunswick. In 1998, Noranda spent approximately $4 880 000 within the Bathurst mining camp, down $1 240 000 from 1997 and $2 790 000 from the year before; Noranda (including the Brunswick mine) has spent, on average, about $6 million annually on exploration throughout this decade. From east to west, Noranda's land holdings are concentrated in six belts: the Key Anacon-Lawson Brook belt, the Brunswick-Portage River belt, the Wedge-Indian Lake belt, the Heath Steele-Mountain Brook belt, the Halfmile Lake-TV Tower belt, and the Kagoot Brook belt. Notably, Noranda has dropped or will be dropping a large number of claims this year, but has added 116 claims to the Key Anacon-Lawson Brook belt.

Teck Exploration Ltd. has properties in the Little River, South Tetagouche, Chester, Kenny Lake and Murray Brook areas, but only conducted exploration on the South Tetagouche property, which is referred to as the North Rim property. A number of new targets were identified from a gravity survey carried out during the summer and five holes, totaling 2200 m, were drilled in the fall. No results were reported by year-end. In the fall, Teck staked 30 claims in the vicinity of California Lake.

Breakwater Resources Ltd. and its wholly owned subsidiary, CanZinco Ltd., conducted extensive exploration in two areas in 1998, namely, the Caribou-McMaster belt and the Armstrong-Middle River belt. A new massive sulphide zone was discovered on the Caribou mine lease, 2.2 km east of the mine site.

The Caribou mine and Restigouche open pit have been shut down since September 1998 because of historically low metal prices and lower-than-expected zinc recoveries. The feasibility study for Caribou predicted an 83% zinc recovery and a 70% lead recovery. At the time of closure, the lead recovery was more or less on target but zinc recovery was about 18% lower than predicted in the study and 10% lower than the mine's revised target of 75%.

In 1998, NovaGold Resources Inc. was the biggest spender among the junior companies with expenditures of $850 000, excluding funds provided by the New Brunswick Exploration Assistance program. Most of the company's effort was focused on its Murray Brook deposit where 14 holes were completed and a UTEM electromagnetic survey was conducted. The objective of the drilling was to test the down-plunge extent of the known copper zone in the open pit and to determine if the deposit also has a significant lead-zinc zone. Modelling of the previous vertical drill holes data showed that the deposit was virtually untested toward the northwest.

Eastmain Resources Inc. finalized its deal with BHP Minerals Canada Ltd. in late December 1997, which gave Eastmain the rights to all of BHP's claims in, and their database for, the

Bathurst mining camp. Early in the year, Eastmain focused on drill targets on its previously held Rocky Lake-Otter Brook property on which it has a joint venture with McBroom Resources. Three holes, totaling about 600 m, were drilled near Nepisiguit River, another three totaling 550 m near Half Moon Lake, and two more totaling about 400 m between Grants Lake and Caribou Lake. Two new prospects were found as a result of this drilling.

During the winter, Stratabound Minerals Corp. drilled 24 holes totaling 2960 m on its Nepisiguit Brook and Tomogonops River groups. Several narrow sulphide zones were discovered on the Nepisiguit Brook claim group, including a zone intersected in one hole that is considered to be equivalent to the "Brunswick Horizon" and another one in another hole that is considered to be equivalent to the "Heath Steele Horizon." An additional 23 claims were added to the Tomogonops River group to cover possible extensions to magnetic and alteration trends.

Southern New Brunswick

During 1998, exploration continued for various metallic mineral commodities including base-metal sulphides, nickel-cobalt-copper and gold. Exploration was also very active for industrial minerals and energy-related resources. The provincial mining recorder's database indicates that the number of claims recorded in 1998 was 1164 and the number of claims in effect at year-end was 3611.

A property in the Eel River area of western New Brunswick is being assessed for volcanogenic massive sulphide deposits by Phelps Dodge Corporation of Canada Ltd. The potential for these deposits was demonstrated in previous drilling by BHP Minerals Canada Ltd.

After completing geophysical and geochemical surveys, Noranda Mining and Exploration Inc. conducted a drilling program to investigate an Ordovician copper-gold porphyry system near Woodstock.

Cobrun Mining Corporation staked additional claims on its St. Stephen nickel-cobalt-copper deposit. The company completed a three-hole drilling program and was successful in extending one of the main mineralized zones (the Rogers' Farm zone) to the south and at depth. It also redrilled the E zone, which is immediately east of the Rogers' Farm zone, and intersected about 10 m of good-grade, massive mineralization.

Exploration activity for gold in southern New Brunswick continued to be strong, especially in the Canterbury area west of Fredericton where the work of Freewest Resources Canada Inc. has generated a significant staking rush. Last year, numerous high-grade gold occurrences were discovered on the company's Golden Ridge property. Geological interpretation of this property is in its infancy, but preliminary work has demonstrated that gold is associated with a large (km-scale), intensely altered felsic to intermediate volcanic complex of possible Ordovician age. The highest-grade mineralized zones appear to occur along faults and shears associated with the Woodstock fault, which is one of the major terrane-bounding structures in this region. In following up on these observations, on airborne and ground geophysical surveys, and on geochemical anomalies, an extensive stripping and detailed sampling program has been initiated.

Other companies that hold large claim groups in the area include Maple Mark International Inc., Black Bull Resources Ltd., Noront Resources Ltd., Fancamp Resources Ltd. and Sparton Resources Inc. Most of this ground was staked to follow up on geochemical anomalies and/or to cover other major terrane-scale faults in the region. Preliminary results from some of these companies are encouraging.

Reginald Cox, a local Fredericton prospector, has found a previously unrecognized and potentially very significant style of mineralization in the Rollingdam area in metasedimentary rocks along the contact granitoid rocks of the Saint George batholith. Preliminary work has revealed

an extensive mineralized zone that yielded samples with high-grade gold (more than 34 g/t) associated, in part, with massive antimony mineralization.

Pro-Max Resources Inc. conducted extensive prospecting on its Armstrong Brook property along strike of the Cape Spencer gold deposit south of Saint John. The company has relocated an old high-grade gold showing related to thrust fault zones that host gold throughout the area. Numerous other gold showings were also found in quartz-carbonate vein systems in the vicinity of the old showing.

Nonmetallic Minerals

In 1998, exploration for industrial rocks and minerals in New Brunswick was centred on granular and bedrock aggregate materials, high-calcium limestone, gypsum and anhydrite, and titanium.

Limestone deposits of the Carboniferous Windsor group were the target of several exploration programs in 1997/98. Havelock Lime, a division of Goldcorp Inc., has explored three southern New Brunswick properties with excellent potential as sources of high-calcium limestone (>95% $CaCO_3$).

Lafarge Canada Inc., also situated near Havelock, undertook some additional definition drilling on its Springhill property, 7 km southwest of the company's cement distribution terminal. Almost 16 Mt of probable reserves of high-calcium limestone are estimated for the property.

Ken Whaley of Mactaquac Mining Ltd. undertook a detailed diamond drilling program this year on his Hillsborough and Demoiselle anhydrite-gypsum properties, 20 and 25 km south of Moncton, respectively. Interest in anhydrite originates from a planned research project investigating the production of high-grade calcium and sulphur products through a process that consists of combining anhydrite and high-sulphur coal.

Southwest of Sackville, Maritime Stoneworks Inc., a company specializing in dimension stone products, has been evaluating the establishment of a new quarry site southeast of Moncton.

In northwestern New Brunswick, the Plaster Rock Gypsum and Manufacturing Company continued working toward the establishment of agricultural gypsum and lime operations. In an effort to further delineate limestone resources in the region, an air track drilling program was conducted near Wapske, just south of the village of Plaster Rock.

Development Highlights

Metallic Minerals

Noranda Inc. reported that, in 1998, the Brunswick mine continued to meet its revised production target of 9000 t/d. In 1996, the company had reduced its production target to 9000 t/d from the previous target of 10 500 t/d because of a marked increase in seismic activity, which resulted in some areas becoming unavailable for mining. Zinc accounts for approximately 70% of the value of the company's production. Lead, copper and silver represent the remaining 30%. Both the mine and smelter ran uninterrupted throughout the year. There were no shut-downs for inventory correction or lack of feed. The plunge in metal prices forced an urgent review by the company of its operating costs. The result was the announcement, in October 1998, that the work force would be reduced by 200 by the year 2000.

In 1998, Noranda Inc. announced that operations at the Heath Steele mine would cease on September 30, 1999, when all the recoverable ore will be depleted.

The Caribou Mine Division of CanZinco Ltd., 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. Operations were suspended in September 1998 because of low metal prices and difficulties in achieving targeted mill recoveries. The company is conducting metallurgical studies and re-evaluating its operating plan with a view to re-opening when metal prices improve.

Under the impact of a substantially lower copper price, Murray Brook Resources Inc. (a wholly owned subsidiary of NovaGold Resources Inc.) decided in 1998 not to proceed with further mining at Murray Brook despite some initially encouraging results from exploration drilling at the mine site. Some reclamation work was done during the year, including the placement of the remaining stockpiled copper ore into the pit.

Nonmetallic Minerals

The importance and high level of activity surrounding industrial minerals development in New Brunswick is reflected in a multi-million-dollar industry generating substantial revenue and providing a valuable product to its people.

Recently, several interesting developments have affected the industrial rock and minerals industry in New Brunswick. They include: (a) a demand for higher-quality aggregate materials to supply a major province-wide highway construction and related infrastructure project; (b) a rejuvenation of the province's building stone industry; (c) the utilization and marketing of industrial by-product and waste materials; (d) more research into value-added opportunities and production efficiencies; and (e) a general increase in exploration activity for industrial mineral resources.

In 1998, the development of industrial minerals in New Brunswick revolved around ten commodities, including dimension stone (e.g., sandstone and granite), mineral aggregates (e.g., sand and gravel, and bedrock), gypsum-anhydrite, limestone-dolomite, potash, salt and silica, as well as industrial minerals by-products such as sulphur and flue-gas desulphurization gypsum. Most of these find their way into world markets.

Mineral Aggregates

The production of mineral aggregates from bedrock and granular deposits (sand and gravel) is fairly widespread throughout much of New Brunswick. Although demand for bedrock material is satisfied from 10-15 quarries, most of which are strategically situated near centres of high demand in the southern part of the province, there are many smaller operations that have been established recently, functioning more or less on demand.

The 1990s have seen an unprecedented amount of highway and related infrastructure construction under way in New Brunswick. The present focus on upgrading the province's major highway systems has led to considerable interest in locating and developing sources of high-performance mineral aggregates.

Apart from meeting the needs of increased domestic consumption, the export of mineral aggregates from tidewater locations began in the mid-1990s from the southwestern part of the province. Initially this exercise involved shipments of Charlotte County sand through the port at Bayside into the New York area. In 1998, aggregates shipments were subsequently expanded by Charlotte County Ports Limited to include crushed bedrock material that is quarried and processed at an industrial park immediately adjacent to the port facility.

Limestone and Dolomite

Production at New Brunswick's operations reflects a steady upward trend in this sector over the last few years. The industry manufactures a range of chemical and pulverized products featuring agricultural and calcined/hydrated lime, flue-gas desulphurization limestone and

aggregates. Some of the major players in this market are Brookville Manufacturing, Havelock Lime (a Division of Goldcorp Inc.), Lafarge Canada Inc. and Elmtree Resources Ltd.

Gypsum and Anhydrite

The 1990s have witnessed several interesting developments in gypsum-related activities in the province. Gypsum as a soil amendment is gaining acceptance among the local farming community. This has led to some small shipments of agricultural material by Mactaquac Mining Ltd. from a former quarry site near Albert Mines in southeastern New Brunswick to various destinations throughout Canada's maritime provinces.

Besides naturally occurring gypsum, New Brunswick has also seen developments in the production of synthetic gypsum as a by-product of the combustion of fossil-fuel-fired power plants in northern New Brunswick. Montréal-based Canadian Gypsum Company Inc. (CGC) utilizes gypsum produced by the spraying of limestone (locally sourced) and water through hundreds of shower heads into sulphur-laden flue gases resulting from the combustion of coal and orimulsion$_{TM}$ fuels.

Dimension Stone

Recent architectural trends and preferences, combined with improved stone-processing techniques, construction practices and an increased public awareness and perception of natural stone as an alternative building material, suggest that future expansion of this industry in New Brunswick is possible. In 1998, Brunswick Monuments Ltd., Nelson Monuments Ltd., Smith Cut Stone & Quarries Ltd., Maritime Stoneworks Inc., and Bastarache Stone Quarry continued to develop and process granite and sandstone resources in the province for a host of applications ranging from curbing and related construction (new and restoration) purposes to monuments and customized stone carving assignments.

Potash and Salt

Production at the New Brunswick Division of PCS in 1998 was close to full capacity with potash markets remaining relatively stable. New Brunswick's second potash operation, located near Cassidy Lake, approximately 25 km southwest of Sussex, and previously owned by the Potacan Mining Company, was purchased by PCS in early 1998. The company utilizes the existing processing facility, now called Potash Corporation of Saskatchewan Inc. (Cassidy Lake Division), and related infrastructure to upgrade standard-grade potash product imported from company operations in western Canada. The result is a higher-value granular product supplied to markets in eastern Canada and the United States.

More than 500 000 t of salt are produced in New Brunswick each year by PCS (New Brunswick Division) in conjunction with its potash operation near Sussex. Some salt is consumed within the region; however, most is trucked to and exported from the port of Saint John.

Silica

New Brunswick supports two silica operations, one in northern New Brunswick, Chaleur Silica Ltd., and the second, Atlantic Silica Inc., in the southern part of the province. The latter produces a wide range of specialty silica products from a rather unique deposit of quartzose sand and gravel. Atlantic Silica undertook a major site development program during 1998 to expand the size of its excavation area. Production at the facility is expected to be bolstered next year as the company will be a major raw material supplier for a new agglomerated tile plant that was officially opened in Sussex late in 1998.

Peat

New Brunswick is the principal peat-producing area of Canada with about 35% of the national output. Nineteen companies were active in the province in 1998; most of the development is concentrated in northeastern New Brunswick. Peat production in 1998 totaled 10 725 000 bales, a slight increase compared to the preceding year, which was characterized by unfavourable weather conditions. During 1998, the industry continued to modernize its processing plants by adding automatic bagging systems and bulk balers. Palletizing has become the standard method of shipping peat to the markets.

Exploration Incentive Programs

Mineral Exploration Stimulation Program (MESP)

In 1998, 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 years in existence, the program has provided approximately $270 000 to assist prospectors in conducting grass-roots exploration on their claim groups. In 1998, 35 grants were provided for a total of $50 000; similar funding will be available for 1999.

New Brunswick Exploration Assistance Program (NBEAP)

The NBEAP (New Brunswick Exploration Assistance Program) continues to be extensively utilized by the junior mining sector to assist in their exploration activities in the province. An internal review of the NBEAP in 1997/98 indicated that the main objectives and goals of this incentive program continue to be achieved. To date, approximately $6.7 million of direct industry investment in the New Brunswick exploration sector has been attributed to the NBEAP. The Province of New Brunswick will continue the NBEAP in 1999 with available funding in the $350 000 range.

EXTECH II (EXploration and TECHnology) Program

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). It was initiated in 1994 in the Bathurst mining camp and will be concluded in 1999. The impact of EXTECH-II is still being assessed; however, some of the successes attributed to the program include the direct discovery of a new base-metal deposit (Camel Back), increased exploration expenditures in the Bathurst mining camp, and the development of several new and improved methods of exploration.

Restigouche Initiative: Airborne Geophysical and Geochemical Survey

In 1997, a multi-parameter airborne geophysical and multi-element geochemical survey was conducted in the northwestern part of the province. This $540 000 survey, covering part of the Restigouche geological zone, represented Phase I of a program whose objective is to provide much-sought-after geoscience products that will help stimulate exploration in this area while at the same time assist the private sector in evaluating the potential of northwestern New Brunswick. The results of Phase I were released to the public in 1998; the evaluation of these results, including follow-up geological mapping, constituted Phase II, which was concluded in late 1998. Continuation of the Restigouche initiative will result in Phase III of the program beginning during the third quarter of 1999. This latest phase will include additional airborne geophysical and geochemical surveys west of the Phase I area.

5.5 QUÉBEC

Overview

Preliminary data for 1998 show that exploration and deposit appraisal expenditures in Québec totaled $175.5 million, which represents an 8% decrease relative to the $190.1 million spent in 1997.

This decrease in total exploration and development expenditures in 1998 followed a relatively steady increase since 1992 when expenditures totaled $101.5 million.

In the past two years, over 80% of exploration and development expenditures were once again incurred in the Abitibi-Témiscamingue and Northern Québec regions, while the North Shore region accounted for 5-10% of such expenditures. It has also been noted that exploration and development expenditures in the precious metals category have increased considerably in the past several years. For example, from 1993 to 1998, the relative share of precious metals rose from 43.9% to 61.8%.

Off-mine-site exploration and deposit appraisal expenditures totaled $108.5 million in 1998, compared to $124.9 million in 1997. This decrease was brought about primarily by the declining involvement of senior companies, whose expenditures dropped from $64.0 million in 1994 to $36.8 million in 1998. Part of this decrease has been compensated for by an increase on the part of junior companies (from $36.2 million in 1994 to $44.0 million in 1998). However, the current situation is a subject of concern because the low level of public funding that was raised in 1998 could lead to a further decrease in expenditures by junior companies.

Exploration Highlights in 1998

In 1998 (1997 figures in brackets), 12 538 new claims were recorded (27 274) and 26 833 claims were renewed (43 510), while the number of active claims at the end of the year was 116 890 (116 148). The decline in exploration activity was further evidenced by a 20% decrease in the number of metres drilled in Québec, which dropped from 1 041 589 m in 1997 to 832 088 m in 1998. The number of exploration licences recorded rose from 360 in 1997 to 562 in 1998, while the number of active exploration licences at the end of the last two years rose from 870 to 1214. This significant increase in the number of exploration licences (available north of 52° latitude) seems to suggest a growing interest for the Northern Québec region, despite the more difficult situation in 1998.

The Abitibi belt remains a favourite target in the search for base-metal deposits. Drilling by Cancor Mines intersected 8.8 m grading 12.29% zinc and 0.19% copper, in addition to 208 g/t silver and 1.15 g/t gold, between the Normétal and Casa-Berardi areas. West of Matagami, Southern Africa Minerals and Noranda began a pre-feasibility study on the zinc-rich Caber deposit. North of Rouyn-Noranda, Globex Mining Enterprises intersected, at great depth, massive sulphide mineralization grading up to 3.62% copper, 2.94% zinc and 159 g/t silver over 2.6 m, as well as 2.04% zinc and 15.8 g/t silver over 11.27 m. East of the Louvicourt mine, Moss Resources acquired an option on a property belonging to two prospectors who had previously obtained grades of 1.47% copper, 0.4 g/t gold and 13.7 g/t silver in a 5.35-m-long channel sample.

Among the main gold exploration projects in the Abitibi region, Aurizon Mines has begun a $10 million investment program to define sufficient new reserves to reactivate the Casa Berardi mine. East of the former Casa Berardi West mine, the company has intersected a mineralized zone at depth, covering a lateral distance of over 400 m, with gold values of up to 18.5 g/t gold over a thickness of 18.5 m and 6.5 g/t gold over a thickness of 37.6 m.

Western Quebec Mines has begun a $4.5 million investment program on the site of its Wesdome project near Val-d'Or where previous exploration had identified 12 zones of gold mineralization. A 2.8-Mt mineral resource grading 4.4 g/t gold had been estimated on the basis of 4 of these 12 gold-bearing zones.

In the James Bay region, Virginia Gold Mines has discovered the Veine zone in the La Grande belt, with values of up to 14.67 g/t gold over 4 m. This new gold zone is located 200 m north of zone 32 where a mineral resource of 195 428 oz of gold was previously defined. Near La Grande 4, Sirios Resources has obtained gold values ranging from 1.3 to 25.4 g/t gold along a 7-km felsic horizon. South of La Grande 3, channel sampling by Virginia Gold Mines and Boreal Exploration returned values of up to 21.57 g/t gold over 5 m and 67.35 g/t gold over 1 m. Virginia Gold Mines and its partner, Silver Century Explorations, obtained 14.3 g/t gold over 2 m from channel samples.

In the Eastmain belt, Eastmain Resources and Barrick Gold intersected 0.36 g/t gold over more than 41 m in an intensely sericitized rhyolite horizon. Channel sampling by Virginia Gold Mines and Silver Century Explorations returned 7.94 g/t gold over more than 4 m. SOQUEM and Eastmain Resources intersected gold values of between 11.21 and 21.2 g/t gold in the Eau-Claire deposit, which enabled them to increase their geological resources to close to 1 Mt grading 10.9 g/t gold. In the Frotet-Evans belt, Nuinsco Resources has estimated a geological resource of 3 Mt grading 0.5% nickel and 0.2% copper.

A great deal of exploration interest has remained focussed on the search for precious and base metals, as well as for diamonds, in the Far North region located north of 55° latitude.

The best gold intersections to date have been obtained in iron formations of the Minto sub-province, including grades of 6 g/t gold over 3 m and 2.2 g/t gold over more than 27.85 m in the Kogaluc belt, and 4.6 g/t gold over more than 8.4 m in the Payne belt.

Selected samples returned grades of up to 6.4 g/t gold in the Dupire belt while values of 34.3 g/t gold and 7.4% zinc, as well as 1.9% copper and 1.7 g/t gold, were obtained in the Duquette belt. Channel samples by Makamikex L.G. in the Far North region returned grades of 13.8% copper, 1 g/t gold and 8.3 g/t silver over 6 m.

In the Ungava region, the Société Minière Raglan (Falconbridge) spent $9 million to increase mining reserves at and around the Raglan mine. Further east, Ossisko Exploration discovered five mineralized outcrops where samples returned grades of up to 6.5% nickel, 0.95% copper and 0.34% cobalt, as well as 1.0 g/t platinum and 2.4 g/t palladium.

Exploration activities in Québec have also been diversified with important projects being carried out in the Grenville Province and in the Appalachians.

In the Grenville Province, Exploration Matamec and SOQUEM continued to explore their Nipissis project where iron-copper-rare earths-fluorine mineralizations are associated with levels of magnetite, skarn and paragneiss that are close to the types of mineralization found in the world-class Olympic Dam and Kiruna deposits. The best results obtained in 1998 were 0.46% copper over 8.1 m and 0.5% copper over 21 m. SOQUEM and Norsk Hydro also continued to study the Sept-Îles apatite deposit, which is estimated to contain a mineral resource of 107 Mt grading 6% P_2O_5 and 8.4% TiO_2.

In the Appalachians, Ressources Appalaches continued work to define the Transfiguration copper-silver-zinc-lead mineralized zone, located in the Lower St. Lawrence region, which shows the characteristics of a "red beds" deposit. Trenching and drilling to date have intersected mineralization along a lateral distance of 9 km with grades of up to 0.4% copper and 5.3 g/t silver over 14 m.

Public Financing for the Québec Mining Industry

The mining sector raised funds of $43.2 million in the Québec capital market in 1998, representing a 61% decrease from the $110.1 million raised in 1997. In three years, mine financing in Québec has dropped from $160.0 million to $43.2 million. Flow-through share issues brought in $12.3 million in 1998, compared to $22.9 million in 1997 (**Table 14**).

Various factors account for the decrease in the number of share issues (whether flow-through, common or other) by mining companies in recent years. The main causes are the collapse in metal prices (particularly the drop in the price of gold) and the corresponding decline in the returns offered by mining company shares.

In addition, the confidence of investors in the mining industry has been tested in recent years. Accordingly, in the summer of 1997, a committee of industry stakeholders (the Québec Prospectors Association, the Québec Mining Association, the Professional Association of Geologists and Geophysicists of Québec, and the Montréal Exchange) was set up in collaboration with the Québec Ministry of Natural Resources to undertake actions deemed necessary to regain public confidence. After a comprehensive review of the practices and procedures of the mining industry, the committee issued several recommendations aimed at improving the framework under which mining activities take place. The committee's final report was made public in early February 1999.

The committee's recommendations are aimed at improving the quality and reliability of information conveyed to investors, and are directed toward the industry and mining companies as well as at financial sector stakeholders and regulatory agencies.

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

	1994	1995	1996	1997	1998p
			($ millions)		
Value of flow-through share issues	18.4	26.4	27.4	22.9	12.3
Exploration and deposit appraisal expenditures	136.6	131.6	148.2	190.1	175.5
Off-property	113.5	105.8	124.5	124.9	108.5
On-property	23.1	25.8	23.6	65.2	67.0

Source: Service de la recherche en économie minérale, Ministère des Ressources naturelles du Québec.
p Preliminary data.

Tax Measures in Support of Mineral Exploration

The tax deductions provided under the flow-through share regime allow an individual to receive 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 $457 for each $1000 invested in flow-through shares.

In the budget speech of March 31, 1998, the Québec Minister of Finance announced new fiscal measures to stimulate exploration in northern Québec. An additional deduction of 25% was allocated to the mining tax system for exploration work carried out in the Near North and Far North regions. This measure brings the exploration deduction to 175%. The *Taxation Act* was also amended to increase the income tax deduction for exploration expenses by an amount equal to 25% of expenses incurred in the Near North and Far North regions.

Other Measures in Support of Mineral Exploration

The Québec Ministry of Natural Resources offers various financial assistance programs for exploration such as:

1. The Programme d'assistance financière à l'exploration minière du Québec (Québec Mineral Exploration Assistance Program), which helps independent prospectors and companies involved in prospecting and mineral exploration in Québec - funding may reach $15 000 in the case of prospectors and $50 000 for companies;

2. The Programme d'exploration minière du Moyen-Nord (Near North Mining Exploration Program), which was established in 1995;

3. The Programme de développement de l'entreprenariat minier autochtone (Native Mining Entrepeneurship Development Program) in the Near North and Far North regions; and

4. The Programme d'assistance pour la région de la ceinture volcanique de l'Abitibi (Deep Drilling in the Abitibi Sub-Province Program), which helps stimulate subsurface exploration in the Abitibi volcanic belt.

During the 1998/99 fiscal year, the Québec Ministry of Natural Resources allocated some $6 million to the implementation of these various programs.

5.6 ONTARIO

Overview

Ontario remains one of the premier mining and exploration jurisdictions in the world. Preliminary figures for 1998 estimate that the total value of Ontario's mineral production remained stable at $5.1 billion. Also according to preliminary figures, 1998 exploration expenditures in Ontario amounted to $127.6 million.

Contradicting the national trend, Ontario's junior exploration sector saw a slight increase in spending for 1998. Activity in the junior sector is a good indicator of the overall health of the industry. It indicates a confidence by investors in the overall potential of the province to produce profitable mineral deposits. The junior sector has always played an important role in Ontario and represented 45% of its total exploration expenditures in 1998, up from 33% in 1997.

At the end of 1998, there were over 174 000 active claim units with a reported $55.7 million in exploration work recorded for assessment credits, up from $53.7 million in 1997. At the beginning of 1999, Ontario listed 64 operating mines: 20 base-metal mines (nickel, copper, zinc), 20 gold mines, 18 industrial mineral mines, 3 platinum group metal (PGM) mines, 1 iron ore mine, 1 magnetite mine and 1 other (magnesium, calcium and strontium) mine. Currently, there are 6646 active prospectors in Ontario.

Exploration Highlights

Barrick Gold Corporation announced that the Holt-McDermott mine shaft will be deepened from 941 m to 1196 m with production levels established at the 925-m and 1075-m levels. The project will take three years to complete at a capital cost of $18 million.

Capital expenditures in 1998 at the Holloway mine, owned by Battle Mountain Gold and Teddy Bear Valley Mines Limited, amounted to $6.2 million. In 1999, the companies plan to spend

more than $1.8 million on underground exploration and $400 000 on surface exploration. The latest total resource estimate on the Taylor property of St. Andrew Goldfields Ltd., audited by Roscoe Postle Associates, is 3.47 million tons averaging 0.30 oz/ton gold, or 1.03 million oz of contained gold, using a 0.075 oz/ton gold cut-off grade. The Stock mine is the site of ongoing underground exploration by St. Andrew Goldfields and the on-site mill is operated as a custom gold mill by the company. The mine and mill are located in Stock Township, 45 km east of Timmins. The mine has reserves of 142 600 tons grading 0.20 oz/ton gold.

Agrium Inc. is developing a new open-pit mine southwest of Kapuskasing that will begin production of phosphate in July 1999.

Falconbridge Limited has completed a pre-feasibility study on the "D" mine, between the 6800- and 8400-foot levels, indicating an additional 9.9 million tons of ore is deemed mineable. Mining of the D mine would extend the Kidd Creek mine life to the year 2015.

Canabrava Diamond Corporation (a subsidiary of Southwestern Gold Corporation) and joint-venture partner Paramount Ventures and Finance Inc. have recently signed an agreement with Kennecott Canada Exploration Inc. to acquire a 60% interest in the Whitefish Lake, Rocky Island Lake and KAP diamond projects by spending $25 million within the next seven years. Kennecott has a firm commitment to spend $1.5 million within the first 18 months. The company has recognized the importance of the initial work done by the Ontario Geological Survey in highlighting the diamond potential of the Wawa and Kapuskasing areas.

During 1998, the Eagle River mine, owned by River Gold Mines Ltd., initiated a program to expand the former Magnacon mill from its current 650 ton-per-day (t/d) capacity to 800 t/d. River Gold announced the purchase of the Mishi Lake gold deposit from MacMillan Gold Corp. and Mishibishu Gold Corporation. The Mishi Deposit contains reserves of 1.4 Mt, grading 4.26 g/t gold, more than half of which is considered amenable to low-cost, open-pit mining.

Teck Exploration and joint-venture partner Corona Gold Corporation initiated an advanced exploration program at the Thunder Lake gold project in July 1998. In early 1998, the joint-venture partners announced a revised resource calculation of 3.78 Mt grading 7.02 g/t gold (0.205 oz/ton gold).

In early 1998, Avalon Ventures Ltd. announced a preliminary resource calculation for the petalite zone of the "Big Whooper" pegmatite. A total of 7.1 Mt grading 1.285% Li_2O and 0.346% Rb_2O was calculated over a strike length of 600 m and to a maximum depth of 250 m.

Freewest Resources Canada Incorporated, Mustang Gold Corporation and Pacific Northwest Capital Corporation had aggressive exploration programs in the Sudbury area focusing on both old and new platinum group elements (PGE) discoveries.

The Hemlo project of Franco-Nevada Mining Corporation Limited is adjacent to the Williams gold mine. Previous surface diamond drilling on very wide spacings had inferred a resource of 1.75 million oz of gold on that property. On completion of this program in early 1999, Franco-Nevada will have tested the upper portion of the Hemlo horizon along the full 2500-foot strike length across its property. The cost of this program is budgeted at $2.2 million.

Lac des Îles Mines Ltd. conducted a $1.1 million exploration program in 1998. The company produced 84 220 oz of palladium, 5535 oz of platinum and 5079 oz of gold, as well as copper and nickel, from the open-pit mine in 1998. North American Palladium, through its wholly owned subsidiary Lac des Îles Mines Ltd., operates Canada's only primary platinum group metals (PGM) mine.

Three major mining companies, Noranda Mining and Exploration Inc., Placer Dome North America and Goldcorp Inc., continued long-standing exploration programs close to Red Lake.

Noranda explored for volcanogenic copper-zinc deposits in the greenstone belt extension between the Red Lake belt and the Birch-Confederation-Uchi lakes belt. Placer Dome and Goldcorp independently explored for gold on various properties in the Red Lake greenstone belt. Early in the year, Goldcorp acquired the assets of Wilanour Resources Ltd., including the past-producing Cochenour-Willans gold mine, also in Balmer Township, which produced over 1 million oz of gold between 1939 and 1971. Goldcorp began a two-year, $5 million exploration program on the newly acquired properties.

In southeastern Ontario, feldspar, vermiculite, silica, mica, soapstone, wollastonite, dimension stone and a number of specialty aggregates prospects were explored using a variety of commodity-specific techniques including x-ray fluorescence (XRF) analysis, thin sections, and beneficiation using high-intensity magnetic separation, exfoliation tests, lithogeochemical surveys, bulk sampling, and market research.

Ministry of Northern Development and Mines (MNDM) and the Internet

Mining entrepreneurs, explorationists and prospectors can now take advantage of the convenience and speed of the internet to obtain claim maps for all regions of Ontario. These maps are available on the ministry's web site at the following address:

- www.gov.on.ca/MNDM/MINES/LANDS/mlsmnpge.htm

MNDM's use of the internet provides instant access to anyone interested in reviewing a claim map or viewing the current status of an unpatented mining claim. Information on the web site is updated within 24 hours of documents being processed in a provincial recording office.

There are about 3500 claim maps in Ontario that show the Crown lands and mineral rights available for claim staking. The maps also show the mineral rights that have been granted by the Crown on any particular piece of land. The ministry also provides toll-free phone connections at the following numbers:

- Mining lands products and hard copy claim maps: 1-888-415-9845;
- Mining claim inquiries: 1-888-415-9844;
- Assessment work inquiries at the Geoscience Assessment Office: 1-888-415-9846; and
- Publication sales of the Ontario Geological Survey (OGS): 1-888-415-9847.

The Earth Resource and Minerals Exploration Web Site (ERMES) project will provide internet access to the data currently available on the Ministry's Earth Resources and Land Information System (ERLIS). The project includes:

- the conversion of digital data to a format more suited to internet access;
- the conversion of ERLIS modules to an ERMES data acquisition site;
- the development of a geospatial and attributes internet server;
- the development of an Assessment Files Research Imaging (AFRI) and OGS publications internet images server; and
- the development of a generic order process module, including e-commerce in the longer term.

This project is expected to be operational by the end of 1999.

Operation Treasure Hunt

There will be an increase in mineral exploration in Ontario thanks to a $19 million program announced by Mr. Chris Hodgson, former Minister of Northern Development and Mines. The two-year program, labeled "Operation Treasure Hunt," will include state-of-the-art geophysical

and geochemical procedures to pinpoint "buried treasure." The studies will uncover specific locations for prospectors and exploration companies to focus their activities in their search for new mines.

The areas to be surveyed and the best techniques to use will be determined by the OGS in cooperation with the Ontario Geological Survey Advisory Board. The advisory board, made up of industry-related experts, helps ensure that the OGS's mapping priorities reflect changing industry and scientific requirements.

5.7 MANITOBA

Overview

Mineral exploration expenditures during 1998 are estimated at $30.0 million compared to $40.3 million in 1997. Surface diamond drilling in 1998 is estimated at 107 000 m compared to 358 000 m in 1997. The total area of claims, exploration permits and special exploration permits recorded in 1998 was 475 634 ha (386 243 ha in 1997 and 325 181 ha in 1996). The total area of mineral dispositions and leases in good standing at the end of 1998 was 1 987 400 ha compared to 1 893 514 ha at the end of 1997.

Setbacks to resource-based sectors of the global economy directly affected exploration and development activity levels in Manitoba in 1998. Some events, however, such as Harmony Gold (Canada) Inc.'s acquisition of the Bissett gold mine, and development project approvals by Hudson Bay Mining and Smelting Co., Limited (HBMS), are encouraging signs of a more stable future for Manitoba's mining and exploration community.

In September 1999, HBMS received approval from parent company Anglo American to go ahead with project 2016, which involves total capital expenditures estimated at $360 million. This long-term project comprises various individual projects including development of the Triple 7 mine with a new shaft and development of the Chisel North deposit. When its discovery was announced in May 1998, the Triple 7 deposit was reported to contain 13.3 Mt grading 3.32% copper, 5.78% zinc and precious metal values. Reserves at the Chisel North deposit are estimated at 2.4 Mt grading 10.8% zinc.

Difficult times in the nickel mining business forced Inco Limited to cut costs by reducing the size of its Manitoba Division work force and suspending the deepening of the Birchtree mine shaft. On the exploration front, the company embarked on an extensive geophysical survey over a large area south of Thompson. The program is designed to outline untested conductors below a depth of 300 m.

Falconbridge Limited continued an aggressive exploration effort in the William Lake area on the southern extension of the Thompson nickel belt. The company also acquired a large exploration permit over the Fox River belt, located 200 km northeast of Thompson. Nickel, copper, cobalt and PGEs are the targets on this property, underlain by the Fox River sill, a stratiform ultramafic-mafic complex.

Foran Mining expanded its presence in Manitoba by acquiring the former copper-zinc Dickstone mine and completing a short program of mapping, geophysics and diamond drilling.

Gold exploration fell in 1998 as a result of low gold prices and investor apathy, which plagued junior companies' financing capabilities.

At Snow Lake, 50-50 partners TVX Gold and High River Gold Mines obtained encouraging results from the deep exploration drilling at the New Britannia gold mine.

Harmony Gold of South Africa purchased the Bissett gold mine out of receivership in June 1998. The operation was closed in December 1997 when Rea Gold filed for bankruptcy shortly after bringing the former producer back into production. Since taking over, Harmony has invested $10 million in additional development, equipment and infrastructure and has now brought the mine back into production.

Incentive Programs

In November 1998, the Government of Manitoba announced over $9 million in funding for mineral incentive programs to further encourage exploration and mining investment in the province.

Mineral Exploration Assistance Program (MEAP)

Established in 1995, the program has been extended over the next three years. It offers $8.25 million to help stimulate non-fuel mineral exploration that ultimately could lead to new mine development in Manitoba. Commencing in the spring of 1999, $8.25 million will be allocated through two offerings per year, corresponding with the typical spring/summer and fall/winter exploration phases. As of April 1, 1999, 60 companies have participated under MEAP representing 160 projects. Thirty of the 60 companies are recorded as new to Manitoba.

Manitoba Prospectors Assistance Program (MPAP)

Introduced in 1992, this program has also been extended over the next three years. It offers $125 000 per year to encourage mineral exploration by experienced prospectors. Grants are available for 50% of eligible costs to a maximum of $7500 upon completion of the field project and submission of an acceptable technical report.

In fiscal year 1998/99, 36 applications were received, of which 32 were approved. Twenty-two projects were completed, resulting in the payment of $92 813 in provincial funding.

Specialty Minerals Incentive Program (SMIP)

Beginning in the spring of 1999, this new program offers $500 000 over the next two years to help companies evaluate the economic potential of existing non-fuel specialty mineral deposits and market those resources more effectively.

Land Use

In 1998, program activities for land use were targeted towards implementing the Network of Special Places action plan. A comprehensive site selection process was partnered with the mining industry through the Mineral Exploration Liaison Committee (MELC). Industry support was achieved on many candidate sites and, once again, security of tenure for mining dispositions was achieved as no valid mineral dispositions were affected.

Also in 1998, the assessment of provincial Wildlife Management Areas for inclusion in the protected areas program continued.

A new sustainable development web site for mining was established as part of the Department of Energy and Mines homepage.

5.8 SASKATCHEWAN

Overview

In 1998, Saskatchewan experienced a decline in total exploration activity. At the same time, however, two major uranium projects and one base-metal project were in advanced stages of development; all are expected to commence production in 1999.

The annual survey of mineral exploration expenditures carried out by Saskatchewan's resident geologists indicated that mineral exploration expenditures in 1998 were $30 million, a decrease of $13 million (30%) over those for 1997 (**Table 15**). Expenditures shrank in all sectors including an 18% decrease for uranium (U), a 25% decrease for gold, and a 56% decrease for base metals. In 1999, total exploration expenditures are forecast to decrease further to $28.7 million. These estimates indicate that a significant increase in expenditures is planned for base metals and modest increases are predicted in diamond and other industrial minerals activity; expenditures for uranium and precious metals exploration are expected to decline. These figures exclude uranium, base-metal and gold test mining, and underground exploration costs of $262 million in 1998 and estimated expenditures of $222 million in 1999.

The total number of metallic mineral dispositions in good standing at the end of calendar year 1998 decreased to 3979 (covering 3.3 Mha) compared to 4014 (covering 3.0 Mha) at the end of 1997. In 1998, 654 new dispositions were recorded, marking a significant decrease in the number of new dispositions issued. The number of dispositions for industrial minerals (potash, coal, quarrying and alkali minerals) has remained fairly constant compared to previous years and

TABLE 15. SASKATCHEWAN EXPLORATION EXPENDITURES, 1988-99

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999e
	($ millions)											
Precious metals	42	20	11	5	6	2	4	8	7	4	3	2
Base metals	6	7	7	6	4	4	4	4	5	9	4	7
Uranium	20	21	12	10	8	7	11	13	17	27	22	16
Other	–	2	2	3	4	11	10	4	6	3	1	4
Total	68	50	32	24	22	24	29	29	35	43	30	29

Source: Resident Geologists' Survey, Saskatchewan Department of Energy and Mines.
– Nil; e Estimated.
Notes: "Other" includes some industrial mineral activity, but predominantly diamond exploration. All figures are rounded to the nearest million dollars.

covers an additional 354 121 ha, primarily in central and southeastern Saskatchewan.

Uranium

Saskatchewan's mines yield approximately 32% of the world's annual uranium production and the province remains the focus of uranium exploration activity in Canada. In 1998, expenditures on uranium exploration decreased, marking the first break in an upward trend that began in 1993 (**Table 15**). This decrease reflected not only a major consolidation in the industry, but also a significant weakening of the spot market price for uranium, which had dropped by 27% at the end of the year. Over a dozen operators, comprising single companies or joint-venture consortiums, continue to explore for uranium in the Athabasca Basin. While discovery potential remains high, no significant new finds were reported.

A transition in uranium mining occurred in 1998. This was marked by the development of a new generation of mines in the Athabasca Basin as reserves of historical producers were depleted and some of those sites were prepared for decommissioning. Second-generation

deposits include the super high-grade, large-tonnage orebodies at McArthur River and Cigar Lake. On the corporate front, a major development was the takeover of Uranerz Exploration and Mining Limited and Uranerz U.S.A. Inc. by Cameco Corporation, consolidating the latter's position as the largest uranium producer in the world. In 1999, Cameco Corporation sold selected uranium assets to COGEMA Resources Inc.

At Key Lake (83.33% Cameco Corp., 16.66% COGEMA Resources Inc.), production was 5385 tU (14 million lb U_3O_8), maintaining its status as the largest uranium operation in the world. The Key Lake mill is scheduled for an extended shut-down during the summer of 1999 so it can be retrofitted to handle higher-grade McArthur River ore.

At Rabbit Lake (100% Cameco Corp.), production was 4500 tU (11.7 million lb U_3O_8), a slight decrease from the 4616 tU (12 million lb U_3O_8) produced in 1997. Cameco Corp. announced in 1999 that it would suspend mining at Rabbit Lake and operate the mill at half capacity. These measures were not only in response to market conditions, but also to allow for a smooth transition to the point when Cigar Lake ore can be processed at the Rabbit Lake mill. The latter reflects a decision by the owners of the Cigar Lake deposit to process the majority of that ore at the Rabbit Lake mill. This strategy is subject to regulatory approval.

In 1998, production at Cluff Lake (100% COGEMA Resources Inc.) was 1040 tU (2.7 million lb U_3O_8). Ore was from the Dominique-Peter and West Dominique-Janine underground mines and the DJ extension open-pit stockpile. COGEMA announced that operations at Cluff Lake would be suspended indefinitely as of December 31, 2000. In announcing its decision, the company noted that, in current market conditions, the mine is only marginally economic and does not have the reserves to support the investment to create a new tailings management facility, which will be required after the year 2000. The decision to suspend operations could be re-evaluated if favourable results are obtained from an aggressive exploration program in the Cluff Lake region.

Construction at McArthur River (69.80% Cameco Corp., 30.20% COGEMA Resources Inc.), the world's largest high-grade uranium deposit, proceeded on schedule towards a fourth-quarter 1999 start-up that is contingent upon obtaining all of the necessary operating licences. As a result of additional underground exploration drilling, reserves at McArthur River have increased to 98 160 tU (255.2 million lb U_3O_8) at an average grade of 14.7% U (17.33% U_3O_8); the resource remained at 87 600 tU (227.8 million lb U_3O_8) at an average grade of 10.19% (12.02% U_3O_8).

At McClean Lake (70% COGEMA Resources Inc, 22.5% Denison Mines, 7.5% OURD Canada), the construction of most surface facilities was completed. The final approval of operating licences, however, was delayed due to problems with construction of the rock fill drain system in the JEB pit tailings management facility. These problems were addressed in the spring of 1999 and production began in late June 1999. Initial ore is from the mined-out JEB pit; subsequent ore will come from the SUE pit currently under development.

At Cigar Lake (50.025% Cameco Corp., 37.100% COGEMA Resources Inc., 7.875% Idemitsu, 5% TEPCO), the second largest high-grade uranium deposit in the world, conditional approval for development was received from both federal and provincial governments. If construction proceeds as planned and regulatory and licensing requirements are met, it is anticipated that production will begin in late 2001 or early 2002. Current reserves at Cigar Lake are 13 578 tU (353.3 million lb U_3O_8) at an average grade of 11.53%U (13.60% U_3O_8). Cigar Lake ore is to be processed at both the Rabbit Lake and McClean Lake mills.

Gold

Although the potential for the discovery of new gold orebodies in Saskatchewan is high, the current depressed price for gold has had a severe effect on gold exploration. Nine companies con-

ducted exploration programs with most of these efforts in the La Ronge, Glennie, and Flin Flon domains.
Claude Resources Inc.'s Seabee mine produced a record 60 200 oz of gold in 1998. Since its opening in November 1991 to the end of December 1998, the Seabee gold mine has produced more than 368 000 oz of gold. The average head grade processed during the year was 9.27 g/t gold. Mill throughput totaled 224 600 t for an average of 615 t/d. This was a 6% increase over 1997. In a March 1999 report to the company, A.C.A. Howe International estimated reserves in the proven and probable categories of 560 000 t at an average grade of 8.29 g/t (0.29 oz/ton) gold.

Production from the Contact Lake mine (100% Cameco Corp.) was about 29 000 oz of gold. Mining ended in April 1998 after reserves were depleted, and milling ended in June of the same year. The site is in the process of being decommissioned.

In January 1999, Greater Lenora Resources Corporation announced the preliminary details of a small-scale, low-production rate plan for the Box mine, which is part of its Goldfields project near Uranium City.

Base Metals

Base-metal exploration programs, carried out by nine companies, continued in Shield and sub-Phanerozoic terranes mostly west and southwest of Flin Flon. Exploration expenditures decreased from $9.4 million in 1997 to $3.6 million in 1998.

On a positive note, Hudson Bay Mining and Smelting Co. Ltd. announced the decision to proceed with the final phase of development of the Konuto Lake copper project at an estimated cost of $27.5 million. Geological resources for the deposit were estimated at 1.41 Mt grading 5.27% copper, 1.44% zinc, 10.47 g/t silver and 2.1 g/t gold. Full production will not be achieved until the summer of 1999; during 1998 there was limited production of 45 531 t grading 3.91% copper, 1.20% zinc, 8.6 g/t silver and 1.78 g/t gold.

Most 1998 production from Hudson Bay's Callinan mine came from the North and East zones in Manitoba. Mining of the Saskatchewan side of the North zone did begin this year, contributing 51 183 t grading 1.49% copper, 2.8% zinc, 19.9 g/t silver and 1.5 g/t gold.

Leader Mining International Inc. continued its evaluation of the Knife Lake deposit. Previously, Leader defined a geological resource of 79 Mt grading 0.69% copper, 0.017% cobalt, 0.16 g/t gold and 3.00 g/t silver. Follow-up work during 1998 included ground geophysics and diamond drilling, and resulted in the discovery of new copper, silver and gold prospects in close proximity to the Knife Lake deposit.

Foran Mining entered into an agreement with Cameco Corporation and Billiton Metals Canada Inc. to purchase a 100% interest in the McIlvenna Bay copper-zinc deposit near Hanson Lake. During the summer, the company did a reassessment of previous work and released an upward revised resource figure of 27 225 000 t grading 3.27% zinc, 0.90% copper, 0.37 g/t gold and 16.63 g/t silver. In December, Foran began the first phase of a large diamond drilling program designed to define probable reserves and expand the known geological resource.

Uravan Minerals Inc. initiated a new nickel-platinum exploration program in the Rottenstone domain along strike of the closed Rottenstone mine, a past producer of nickel-copper-platinum.

Diamonds

At the end of 1998, the amount of land under disposition for diamonds was approximately 420 000 ha. Diamond exploration expenditures declined to just over $1 million. Most activity is in an area running across the province between latitudes 53° and 55° that includes: Fort à la

Corne; the Pasquia Hills; the Molanosa Arch; and Candle, Sturgeon, Smoothstone and Wapawekka lakes. There is also new activity in the Wood Mountain area in the southern part of the province. Ground held by the Fort à la Corne joint venture (Cameco Corp., Monopros Ltd., and Kensington Resources Ltd.) contains over 70 magnetically defined pyroclastic crater facies kimberlite bodies comprising one of the largest kimberlite fields in the world. Micro- and macro-diamonds have been recovered from several of the kimberlites and exploration and evaluation are ongoing. Shore Gold Inc. has also obtained positive results from its exploration program at the south end of the Fort à la Corne kimberlite trend.

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 continued to be reviewed this year, including *The Quarrying 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 early next year following additional consultation with industry.

Disposition maps for minerals regulated under *The Mineral Disposition Regulations, 1986*, have been completely digitized. A test project of integrating the digitized maps with disposition databases for a complete Geographic Information Systems (GIS) package was initiated in the second quarter of 1999. Test products have been circulated to various industry representatives for comments. A product for the public is expected to be available by year-end. The digitization of industrial mineral dispositions is currently under way with a final product also expected 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. A review of mapped provincial parklands in Saskatchewan was initiated and completed last year to ensure disposition maps accurately reflect gazetted parklands as identified in *The Parks Act*. The Department is also working with NRCan to establish a one-window approach to collecting mineral statistics.

The Treaty Land Selection process is continuing smoothly. Crown Reserves initially created through Treaty Land Selections identified under the Treaty Land Entitlement process will continue to be reviewed by the department. Those no longer required will be re-opened for mineral dispositions.

Mineral Resource Assessment

Saskatchewan Energy and Mines is providing mineral resource assessment for land-use planning projects initiated by sister department Saskatchewan Environment and Resource Management. A total of 17 separate plans are currently under way. Mineral assessments of the areas are undertaken prior to land-use designation. To date, Energy and Mines has been successful in working cooperatively with industry, the public, and other government departments to ensure that “representative areas,” which are to act as ecological benchmarks for the future, are designated in areas identified as generally having low-to-moderate mineral potential.

Changes to Royalty Structure

The March 1999 provincial budget contained royalty changes for gold and base metals aimed at increasing mineral development in northern Saskatchewan. A key provision allows for new mine development expenses to be claimed at 150% of their actual cost. Another change lowers the royalty rate from 12.5% of profits to an incremental structure that is initially set at 5% of profits and increased to 10% of profits when metal production reaches certain levels.

5.9 ALBERTA

Exploration Review

The mineral sector continued to show strength in Alberta, led by exploration for diamonds in the northern portion of the province. The amount of land under metallic and industrial permits sits at near record numbers with 4825 permits in good standing covering almost 42 Mha. There were 420 new permit applications on 3.7 Mha during 1998.

A major focus of diamond exploration in the province continues to be the Buffalo Head Hills area, 400 km north of Edmonton. Ashton Mining of Canada and its partners Alberta Energy Company and Pure Gold Minerals Inc. began exploring in this area in late 1996. By the spring of 1999 Ashton was reporting that it had discovered a total of 32 kimberlites since exploration began. Work has included heavy mineral sampling, ground and airborne geophysics, and drilling. No results have been released for many of the kimberlites drilled in the winter of 1998/99, but Ashton announced that 16 of the first 23 kimberlites were found to contain diamonds. Bulk and mini-bulk samples were taken from a number of kimberlites and, while diamonds of commercial size and quality have been found, no kimberlite has demonstrated the overall grade to be economically mined. Pipe K-14 produced 56.45 ct from a sample of 479 t, an effective grade of 11.78 carats per 100 tonnes (ct/100 t), while pipe K-11 gave indicated grades of 4.41 ct/100 t and 4.53 ct/100 t in two separate samples. Work continues this summer on a number of previously discovered pipes and geophysical anomalies.

Kennecott Canada Exploration Inc. conducted diamond exploration on 600 000 ha of land held under permit by Montello Resources Ltd. in the Birch Mountains area of northeastern Alberta. The work consisted of extensive geophysics and the subsequent drilling of a number of magnetic anomalies in a winter program. The drilling program identified seven kimberlites, at least one of which was diamondiferous. The results for the other kimberlites have yet to be announced. A number of targets remain to be drilled in a program scheduled for this summer. The Kennecott finds are important because they extend the kimberlite field beyond the Ashton properties.

New Claymore Resources conducted airborne geophysical surveys on 280 000 ha of its permit lands in northeastern Alberta. Three holes were drilled into their Panny River prospect, which lies on trend between the kimberlites of Ashton and Kennecott. The holes were drilled between 145 and 175 m in depth but all of the holes bottomed in overburden. On the Cox prospect, located south of Lesser Slave Lake, the company drilled three holes into the largest of six magnetic anomalies. Overburden on these holes was thin and samples of interfingered volcanics were recovered. Analysis is under way to determine the source of the materials. The company also conducted airborne surveys on its Kimberly/Manon prospect, which surrounds the Mountain Lake kimberlite discovered by Monopros and drilled and reported on by the Alberta Geological Survey and the Geological Survey of Canada.

Monopros Limited conducted exploration on 419 000 ha of permits optioned from Troymin Resources Ltd., located on lands adjacent to Ashton Mining of Canada's Buffalo Head Hills prospect. The Monopros program entailed aeromagnetic surveys, sediment sampling, ground geophysics and drilling. Monopros drilled three of four planned targets and failed to encounter kimberlite in any of the holes. Due to the results of the program, Monopros elected to terminate the option agreement with Troymin. Troymin continues to hold 250 000 ha and is searching for new partners.

Marum Resources Inc. conducted a helicopter-supported geological reconnaissance and sampling program to investigate aeromagnetic cluster anomalies in the Chinchaga area of northwestern Alberta. Marum holds 200 000 ha under permits in the area. Samples were taken from the anomaly locations and are currently being analyzed. Marum is currently reviewing

seismic data in the areas of priority aeromagnetic targets as an aid to identifying intrusions. Tintina Mines Limited continued to work on its permits in northeastern Alberta near Fort McKay. The properties host laterally extensive metal enrichment zones in near-surface sulphidic unconsolidated black shales. The company's efforts in 1998/99 were concentrated on process metallurgy and re-assaying of drill core to check gold grades. The assay work confirmed that the shale zones host low-grade, gold-bearing sections in addition to the previously identified base metals: cobalt, nickel, zinc, molybdenum and vanadium. Tintina also examined the diamond potential of its properties through an analysis of indicator minerals and the results were encouraging. The company will pursue further work this year.

Birch Mountain Resources Ltd. conducted a drilling program on its properties at Fort McKay in late 1998, drilling five holes for a total of 560 m of core. The holes were drilled near a 1995 hole that returned 2.21-4.94 g/t platinum and 0.19-0.21 g/t gold over a 1.6-m interval. Assay work on these recent holes has not yet been reported. The company also conducted an airborne magnetic survey of its Birch Mountain block, an area of 83 000 ha lying to the north of the Kennecott/Montello kimberlite discovery property. A number of targets have been identified and follow-up work is planned.

5.10 BRITISH COLUMBIA

Summary and Outlook

Mineral commodity prices, particularly copper and gold, decreased substantially and exploration spending in British Columbia dropped by almost 50% in 1998. In spite of this drop, over 150 companies were actively exploring in the province and this number will be exceeded in 1999. These companies are exploring in a diversity of terranes, for a variety of deposit types, covering a range of different minerals.

Table 16 shows British Columbia's drop in exploration spending from roughly $100 million in 1997 to the preliminary estimate of about $50 million in 1998, and the same amount again in the forecast intentions for 1999.

The three sets of figures shown in **Table 16** measure different things for different purposes. This report focuses on the figures in the second row. The additional dollar expenditures

TABLE 16. EXPLORATION SPENDING IN BRITISH COLUMBIA

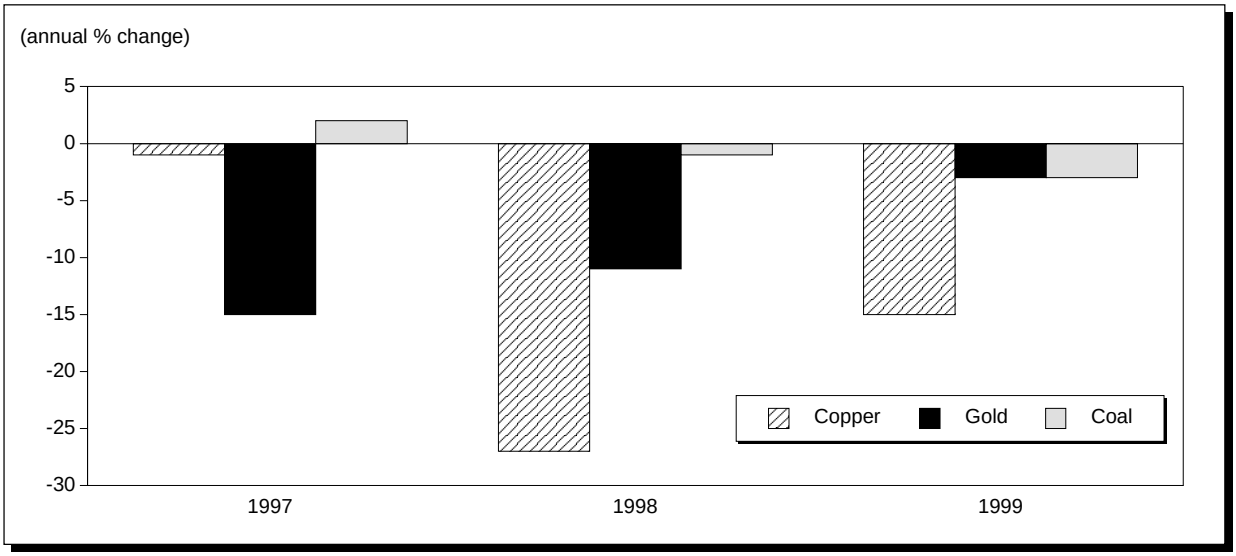
	1997	1998p	1999f	Main Use for Statistics
		($ millions)		
Field work and overhead	95.8	50.0	50.6	Official federal/provincial statistics, national accounts' computations
Comprehensive	115.2	58.2	59.3	Comprehensive analyses (this report)
Field work	90.3	43.5	46.2	Geoscientific industry benchmark

Source: British Columbia's Ministry of Energy and Mines.
f forecast of intentions; p preliminary.
Notes: All figures include exploration and deposit appraisal expenditures (and exclude mine complex development expenditures). "Field work and overhead" are comparable with previous years' published exploration time series. "Comprehensive" statistics include engineering, economic and feasibility studies, environmental and land access spending (i.e., dollars that must be spent as part of the exploration effort). They are the baseline for analyses in this chapter. "Field work" statistics from the survey are comparable with "best-guess" ongoing industry estimates by Ministry of Energy and Mines' geologists. Their estimates are based on published company information (public and private), field visits and other personal contacts.

included in the "comprehensive" category (i.e., engineering, economic and feasibility studies, environmental compliance and land access costs) reflect a necessary part of the exploration/ mine finding process, thus providing more complete information on these activities and the probabilities for developing viable mining operations from exploration projects.

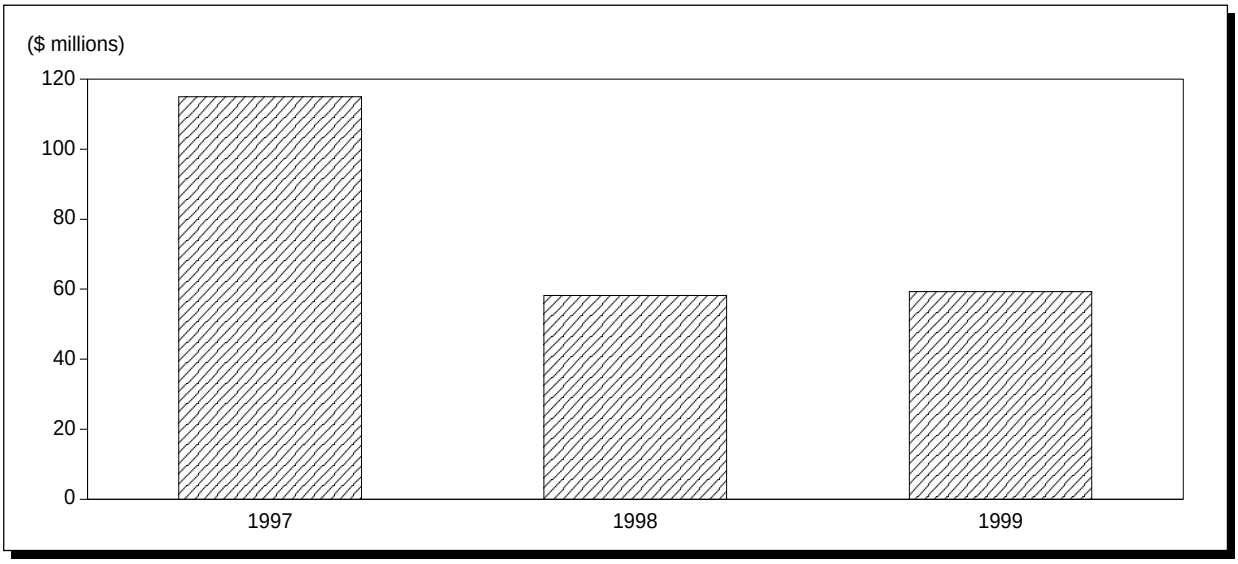
The following sequence of charts (**Figures 21, 22, 23** and **24**) explains the large drop in exploration between 1997 and 1998. The charts also indicate that the exploration and mining indus-

Figure 21
Mineral Commodity Price Changes



Source: British Columbia's Ministry of Energy and Mines.

Figure 22
Exploration Spending in British Columbia, 1997-99

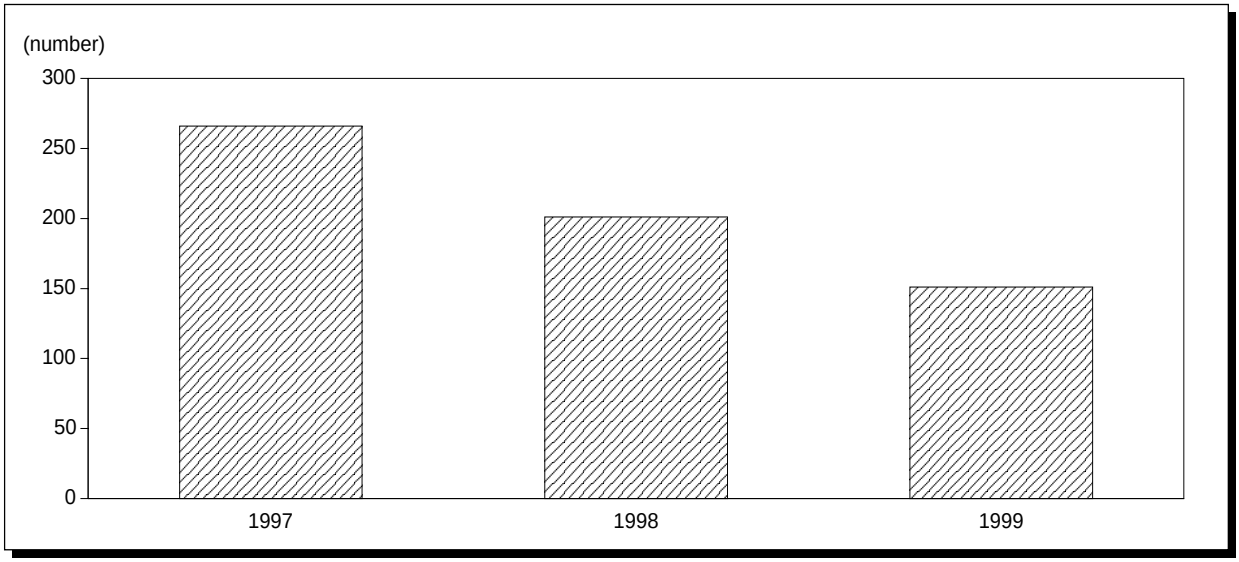


Source: British Columbia's Ministry of Energy and Mines.

try itself should remain strong, not necessarily now, but at least in the longer term. As shown in **Figure 21**, mineral commodity prices have dropped significantly over the past two and a half years, which has made it difficult for exploration companies to raise risk financing. This, in turn, led to the large drop in exploration expenditures (**Figure 22**) and brought about a decrease in the number of companies actively exploring in British Columbia (**Figure 23**).

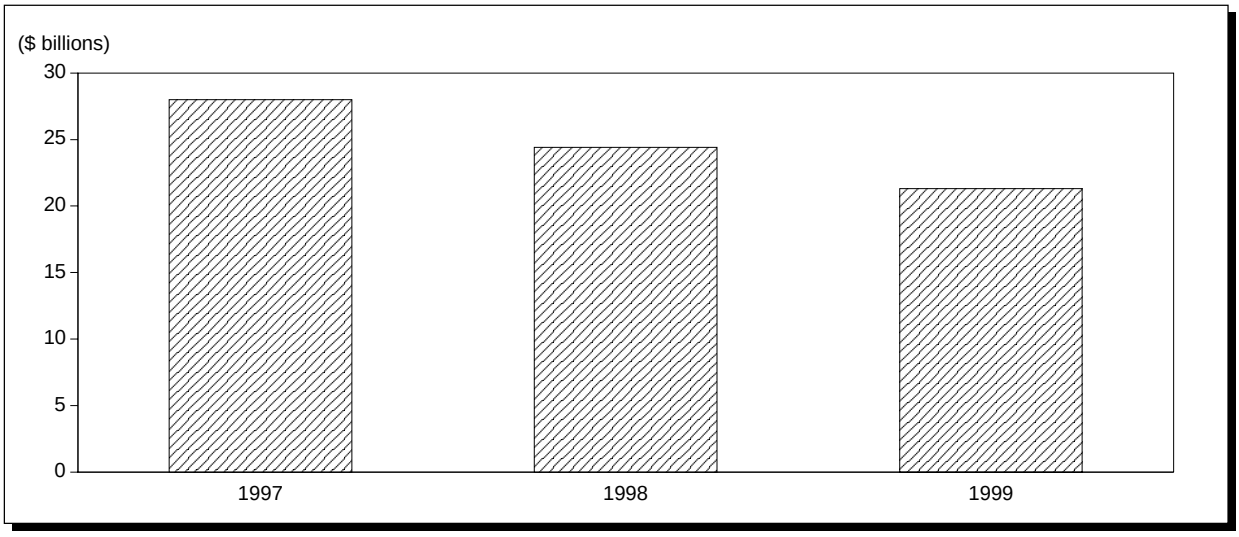
Two mine openings took place in 1997 and two more in 1998. At current low mineral prices, the possibility of another mine opening in 1999 seems remote. **Figure 24** indicates that the inven-

Figure 23
Active Exploration Companies in British Columbia, 1997-99



Source: British Columbia's Ministry of Energy and Mines.

Figure 24
In-Ground Value of Advanced Exploration Projects in British Columbia, 1997-99



Source: British Columbia's Ministry of Energy and Mines.

tory of "in-ground values" from advanced exploration projects has been reduced by these four new mines and the value of remaining inventory has been reduced by lower commodity prices. However, in-ground inventories still total over $20 billion.

Recognizing the challenges that face the mining industry in British Columbia, the provincial government has implemented or continued the following mining initiatives with the aim of ensuring that the exploration and mining sectors remain vital and healthy:

- The *Mining Rights Amendment Act* provides the industry with the right to mine in all non-protected areas of the province, assures access to mineral tenures, provides fair compensation in the event tenures are expropriated for the creation of parks, and ensures timely approvals for projects in any phase of the mine development process.

- The Mineral Exploration Code provides a one-agency approach for permit approvals and applies environmental protection standards designed specifically for exploration.

- The Mining Exploration Tax Credit Program, which came into effect on August 1, 1998, allows eligible individuals and corporations to qualify for a 20% refundable tax credit. In 1998/99 this program is worth approximately $7 million and this will rise to $9 million in 1999/2000 and in future years.

- The New Mine Allowance, extended to 2008, provides for a one third gross-up of the capital costs of new, re-opened or expanded mines for the purposes of calculating the mineral tax.

- Changes to the *Environmental Assessment Act* have streamlined the criteria for determining which projects require a full environmental assessment review. The new thresholds are 250 000 tonnes per year (t/y) for coal mines (from 100 000 t/y) and 75 000 t/y for mineral mines (from 25 000 t/y).

- The Prospectors Assistance Grant Program continues to promote grass-roots prospecting for minerals. Fifty-two prospectors were awarded grants in 1998 ranging from $5000 to $10 000 each. In addition to individual grants, the ministry also provided $40 000 to seven organizations throughout the province to enable them to deliver prospector training programs. To date, both discoveries and mine development potentials attest to the success of this program.

- Mr. Michael Farnsworth was appointed the province's first Mining Advocate. With his extensive background in the mining industry, Mr. Farnsworth will work closely with stakeholders to address concerns and opportunities in the mining sector.

- The Job Protection Commission has been instrumental and successful in negotiating economic relief packages for B.C. mines facing financial difficulties, either due to low commodity prices or the Asian economic crisis. Three mines would have closed had an economic risk-sharing plan, facilitated by the Job Protection Commission, not been negotiated. Essentially, the negotiated risk-sharing package, which involves all stakeholders, enables mines to remain economic at lower mineral prices.

- The Power for Jobs Program allows the government to set flexible power rates for new and existing enterprises, for example, rates can be tied to the price of commodities.

Statistical Trends in the British Columbia Mining Industry

The following general trends are indicated by the 1997 and 1998 exploration survey results and the 1999 forecast of intentions.

Figure 25 shows that declining trends in the number of claim units staked, free miner certificates and notices of work recorded all coincide with decreased exploration spending. These three indicators were down by 42%, 13% and 20%, respectively, from 1997 to 1998.

A new trend away from exploration for porphyry and vein deposits and toward massive sulphide deposits is reflected in **Figure 26**. Over $35 million of exploration spending on porphyry and vein deposits has been dropped. Some of it has been re-targeted at massive sulphide deposits, which have replaced porphyries as the number one mineral deposit target. One rationale for this change is that explorers are seeking high unit value targets knowing that it is the low-unit-cost, high-margin producers that remain in business the longest when prices drop and lower price levels persist. Another possible explanation is that major mining companies looking for giant world-class deposits have scaled down their search and/or are currently focusing their efforts in other jurisdictions. The increased spending on massive sulphide targets reflects the fact that zinc prices have remained firm compared with copper and gold. It also reflects the good discovery potential in the region surrounding the world-class Sullivan mine (only a few years from closing).

Figure 27 provides a break-down of three years of data that were collected using the new exploration survey form, which groups spending into three phases: exploration, deposit appraisal, and mine complex development. Each phase is further segmented to highlight the amount of spending by functional categories:

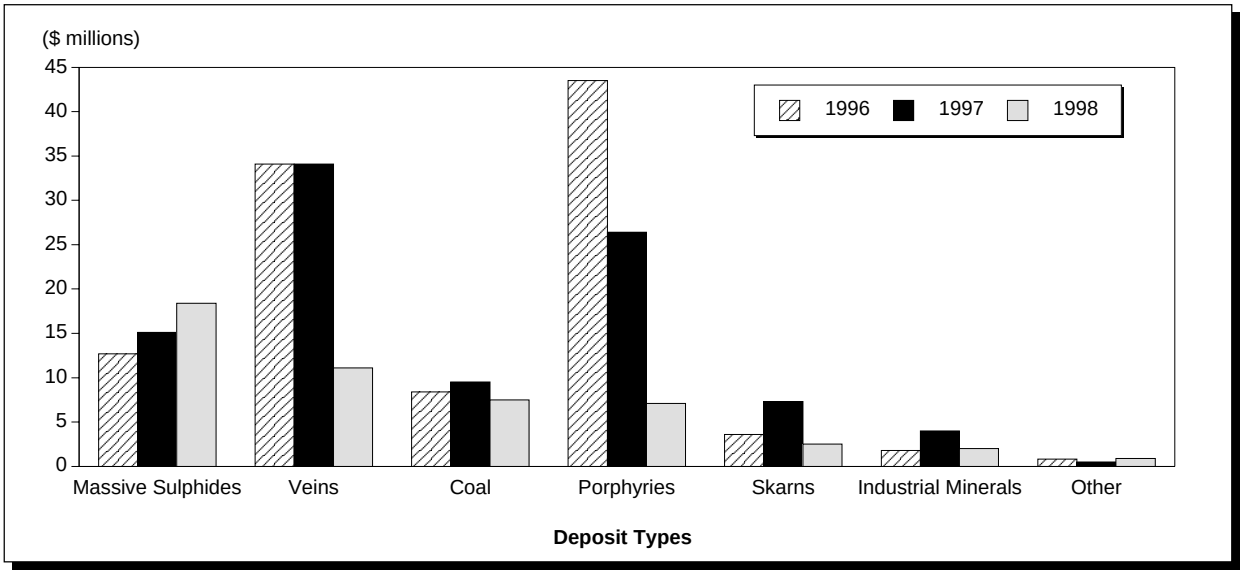
- field work and overhead costs;
- engineering, economic and feasibility studies;
- environmental work; and
- land access costs.

As shown in **Figure 27**, the major drop in exploration spending is reflected only in the exploration and deposit appraisal phases. This sustained drop in spending is not reflected in the mine complex development phase in which spending is anticipated to increase by $10 million in

Figure 25
Exploration Activity in British Columbia as Indicated by Claim Units, Free Miner Certificates and Notices of Work, 1995-98

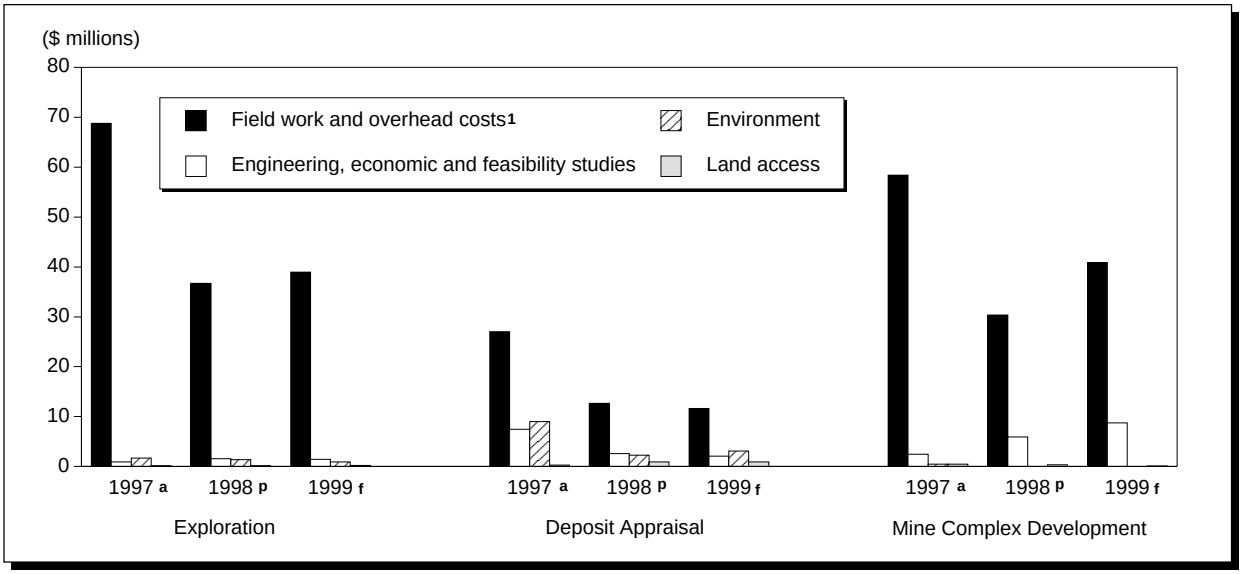
Source: British Columbia's Ministry of Energy and Mines.

Figure 26
Exploration Spending in British Columbia, by Deposit Type, 1996-98



Source: British Columbia's Ministry of Energy and Mines.

Figure 27
Exploration Spending in British Columbia, by Phase (Exploration, Deposit Appraisal, Mine Complex Development) and by Function (Field, Engineering, Environmental and Access Costs), 1997-99



Source: British Columbia's Ministry of Energy and Mines.
a actual; p preliminary; f forecast.
1 Exploration plus deposit appraisal total can be compared to some extent with previous exploration expenditure series.

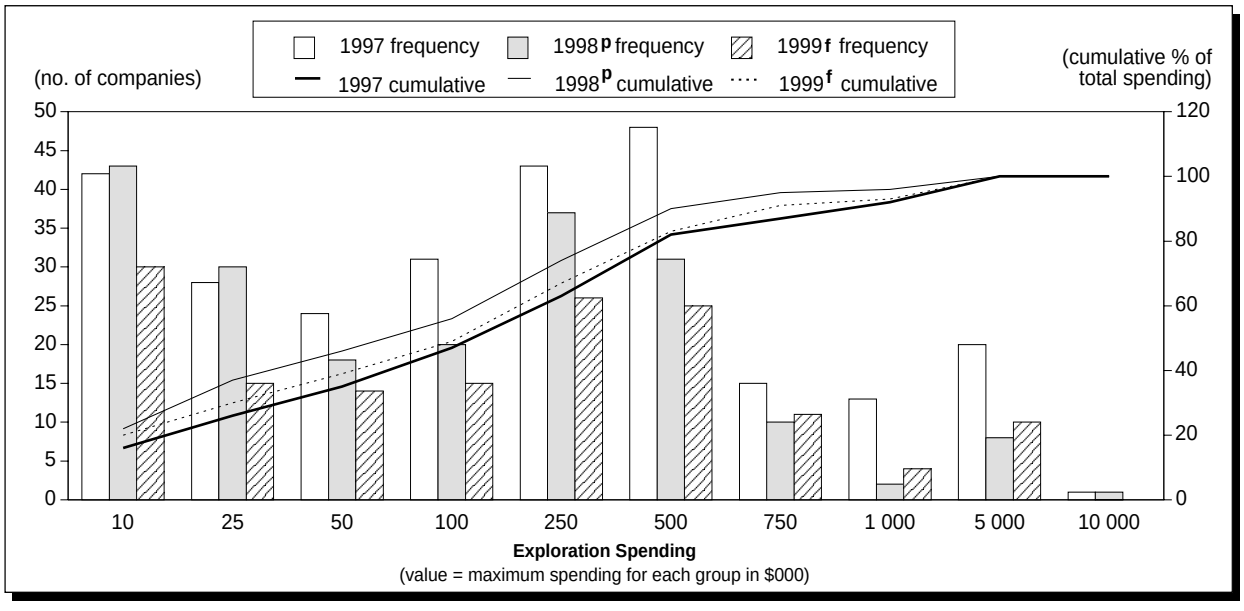
1999. Exploration and deposit appraisal (the latter is often termed advanced exploration) are key activities of the exploration sector where the focus is on finding new mines. Mine complex development spending, on the other hand, tends to fit more closely with the mineral production sector where the focus is on extending the life of an operating mine. Mine complex development is not included in estimates of total exploration spending (such as those in **Table 16**).

The inclusion of spending on other functions besides field work and overhead, namely engineering, economic and feasibility studies, environmental concerns and land access, is important in relation to both the magnitude of dollars spent and their configuration. These "other-functions" costs must be incurred as part of the overall exploration process, and typically account for 10% of total costs in the exploration phase, 40% in the deposit appraisal phase and 20% in the mine complex development phase. In deposit appraisal, these costs are split between feasibility studies and environmental costs. In mine complex development, they comprise mainly engineering, economic and feasibility studies (i.e., environmental compliance tends to be accounted for as a mine operating cost). Finally, although land access costs are a real concern for some specific projects, their total has never exceeded 2% of exploration spending in any one year.

The next two charts indicate a consistent pattern in year-on-year spending by individual companies. The first chart (**Figure 28**) shows the distribution by value of companies' spending on exploration and deposit appraisal. The data include, on average, over 200 companies per year for the three years and are presented in a standard size-frequency histogram and cumulative percent curve.

All three years show a coincident, tri-modal distribution, where company spending tends to group into three semi-discrete ranges, i.e., $1 to $25 000, $100 000 to $500 000, and $1 million to $5 million. The interpretation is that there are a cluster of "big spenders" who are considerably more advanced in their phase of exploration than the "medium-range" spenders and a cluster of "smaller spenders" (such as prospectors and companies in preliminary phases of exploration) who are well behind the "medium spenders" in terms of expenditures.

Figure 28
Exploration Companies in British Columbia Grouped by Level of Spending, 1997-99



Source: British Columbia's Ministry of Energy and Mines.
f Forecast; p Preliminary.

Also significant is the break in the "cumulative percent" curves in all three years at the $500 000 level. This shows that, in all three years, 10-20% of the companies consistently spent more than $500 000.

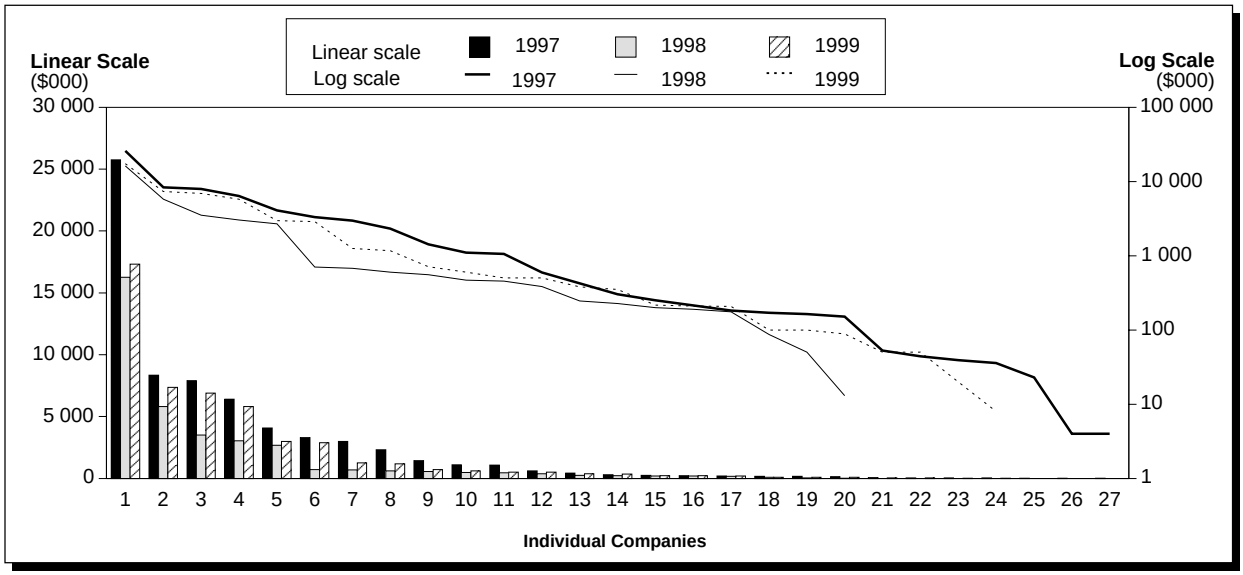
The consistency of these two relationships over a three-year period, which includes well over 600 company survey returns, suggests that even though exploration spending has dropped by 50%, the structural focus on different phases of exploration necessary for new mine development has not been compromised. Stated another way, the magnitude of spending has dropped but the remaining activity reflects a diversified "business as usual" mode.

Similar conclusions can be drawn from **Figure 29**, which shows the distribution of the companies that made mine complex development expenditures over the same three-year period. For clarification, the same data are plotted two different ways. The bars show the actual distribution of expenditures by each company and the lines are log linear plots that enable one to read the magnitude of expenditure of the "smaller spenders." Except for the upper and lower tails of the largest and smallest two to three companies, all three years show a reasonably consistent log linear plot. Similar to the distribution of exploration and deposit appraisal spending above, these coincident linear plots also indicate a "business as usual" situation for mine complex development over the same three years. In conclusion, even at lower mineral commodity prices, no disturbing distortions appear in the exploration sector, which might suggest the occurrence of adverse structural changes.

The main reason for the 50% drop in exploration spending is the drop in mineral commodity prices. In British Columbia, price declines in copper, gold and coal in particular have directly affected the ability of the mining and exploration companies to raise risk capital to finance exploration programs.

At higher mineral commodity price levels, companies are able to raise funds more easily and spending goes up. The reverse is true as witnessed by the major drop in spending between 1997 and 1998. Previous calculations bear this out, showing significant correlation between

Figure 29
Distribution of Mine Complex Development Spending in British Columbia, By Company, 1997-99



Source: British Columbia's Ministry of Energy and Mines.

British Columbia's exploration spending and the prices of copper and gold in particular. **Figure 30** also illustrates the relationship between commodity price levels and exploration spending over a 17-year period. In this figure, the year-on-year percent change in British Columbia's minerals price index shows a high degree of correlation with exploration spending.

British Columbia's assurance of continued exploration efforts and mining successes is supported by a number of factors. The Cordillera crust provides highly favourable terrane for hosting mineable deposits. Within these rocks is a diversity of mineral commodities that ensures a broad spectrum of alternative exploration targets and, therefore, exploration attractiveness or "staying power" during periods of adverse mineral commodity price swings. There is a track record of over 150 years of continuous mining in the province and proof that future potential exists.

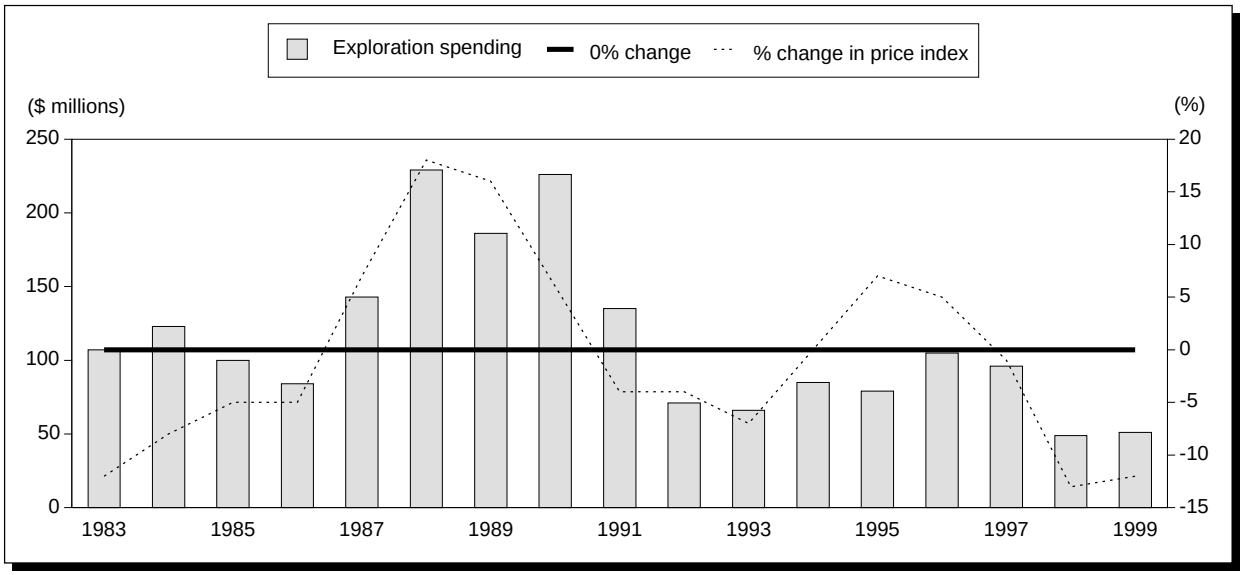
More immediate future potential is verified by the "in-ground values" (tonnes x grade x current price) of advanced exploration projects. **Figure 31** indicates the in-ground values of advanced metal and coal projects. Also illustrated on this graph are the different deposit types and minerals associated with these projects. Prices used to calculate values were: $259.00/oz gold, $5.00/oz of silver, $0.649/lb of copper, $2.77/lb of molybdenum, $0.225/lb of lead, $0.463/lb of zinc; $37.50/t of metallurgical coal, and $29.00/t for thermal coal.

The current mineral inventory, which totals over $20 billion, represents only currently active projects at the advanced exploration stage. British Columbia also hosts a substantial additional inventory in less-advanced exploration projects, inactive delineated deposits, industrial mineral projects, and other known resources. The implication is that there is an extensive mineral inventory with reasonable mining potential that will continue to attract and retain globally oriented exploration companies.

Mining Highlights

There were two metal mine openings in 1998 (Kemess South and Blackdome) and one metal mine closure (Quesnel River). Full production from the Huckleberry and Mount Polley por-

Figure 30
Annual Exploration Spending Related to Changes in British Columbia's Mineral Price Index, 1983-99

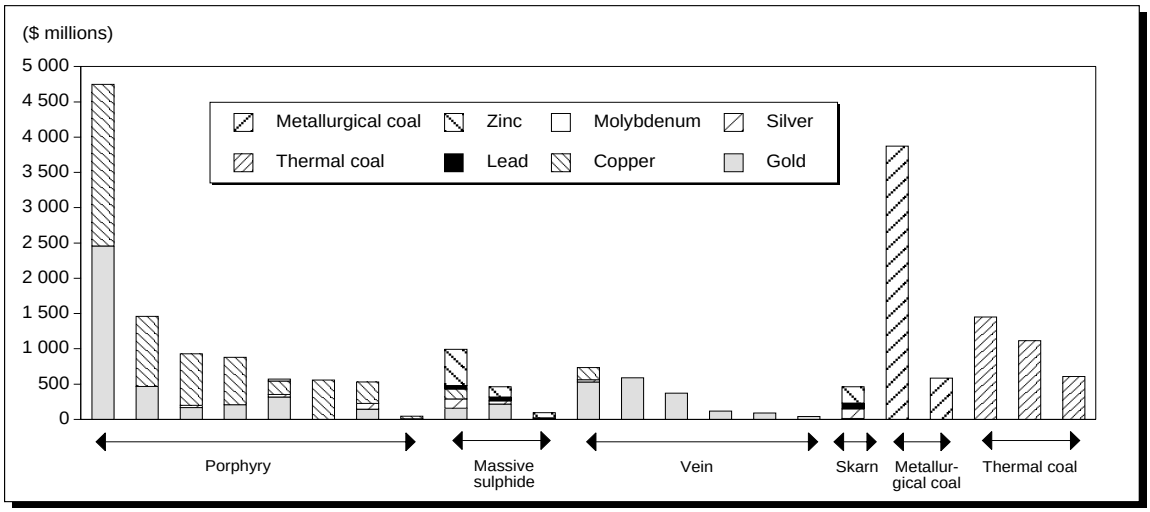


Source: British Columbia's Ministry of Energy and Mines.

phyry copper mines, which opened in late 1997, together with the opening of the Kemess South porphyry gold-copper mine in the spring of 1998, was partly responsible for an increase in the value of copper production. Significant increases in silver and gold production from the Eskay Creek mine contributed to an increase in the value of silver production and helped offset the loss from the closure of the Quesnel River mine in March 1998.

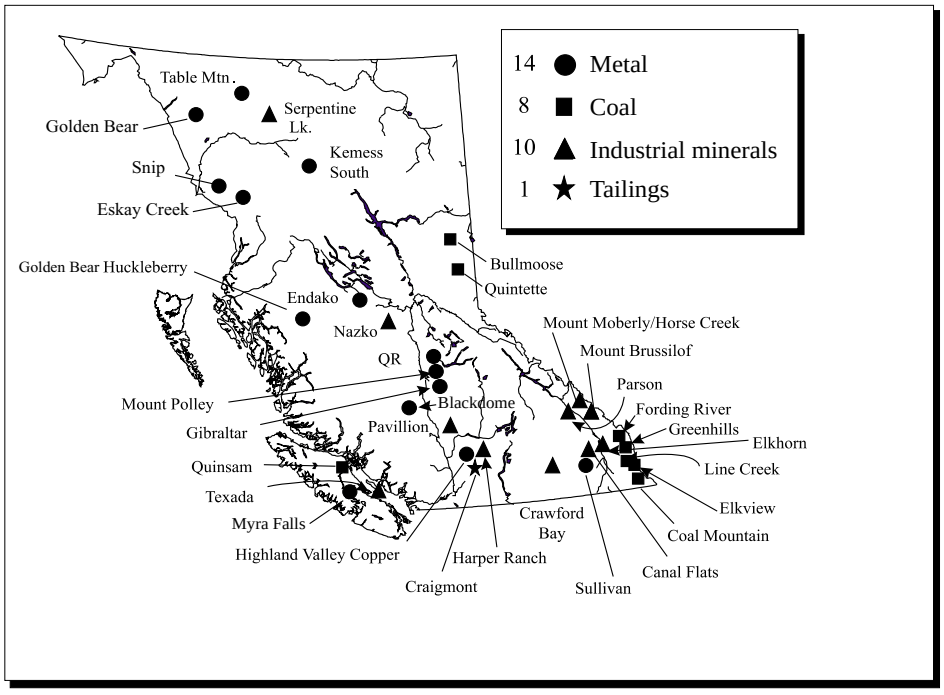
Figure 32 shows the location of 1998 mining operations in British Columbia.

Figure 31
In-Ground Value of British Columbia's Advanced Exploration Projects At June 1999 Prices



Source: British Columbia's Ministry of Energy and Mines.

Figure 32
Operating Mines in British Columbia, 1998



Source: British Columbia's Ministry of Energy and Mines, Information Circular 1999-1.

Exploration Highlights

As indicated by **Figures 28** and **29**, British Columbia is the focus of a wide diversity of exploration efforts from grass-roots projects through to operating mines with significant exploration programs. Detailed descriptions of the important exploration projects conducted in 1998 are documented in *British Columbia's Mineral Exploration Review 1998*, Information Circular 1999-1, Ministry of Energy and Mines, Energy and Minerals Division. The following three maps (**Figures 33, 34** and **35**) show the minerals, deposit types and locations of both regular and advanced exploration projects.

Metal Exploration

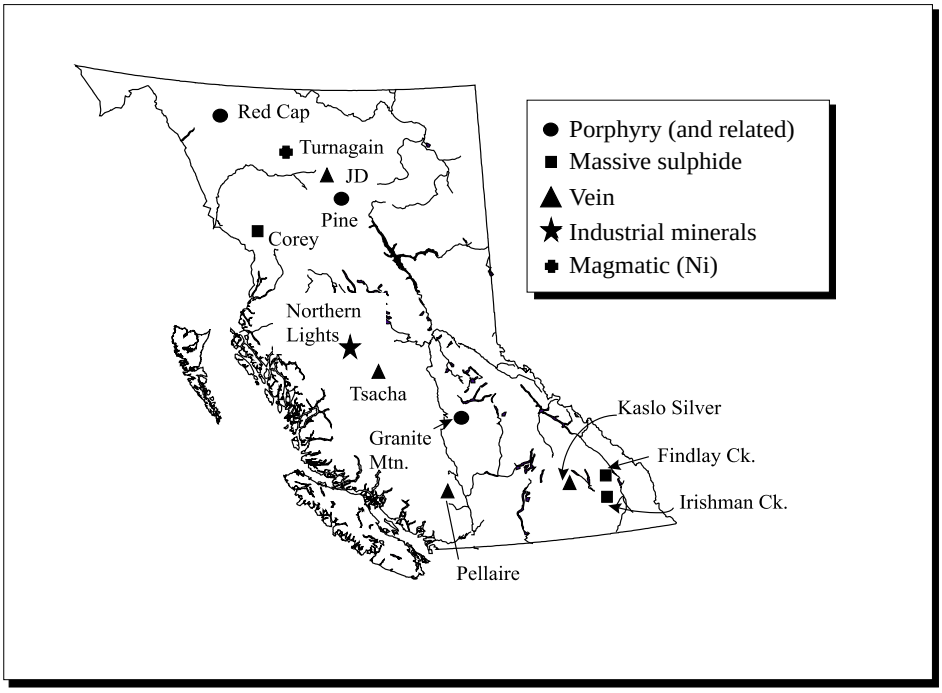
In 1998, the Bronson Slope, Red Chris, Red Mountain, Silvertip (Midway), Telkwa, Prosperity and Getty North projects submitted applications for provincial approval under the Environmental Assessment process. Several other advanced projects are close to submitting applications (Cariboo Gold Quartz, Giant Copper, Specogna, Hearne Hill/Morrison, Isk, J&L, Bull River and Polaris-Taku).

The most active exploration area in the province was the southeast where numerous companies and prospectors explored for massive sulphide deposits. In the rest of British Columbia, many programs were focused near existing mines and several new, low-budget regional programs were initiated.

MASSIVE SULPHIDE DEPOSITS

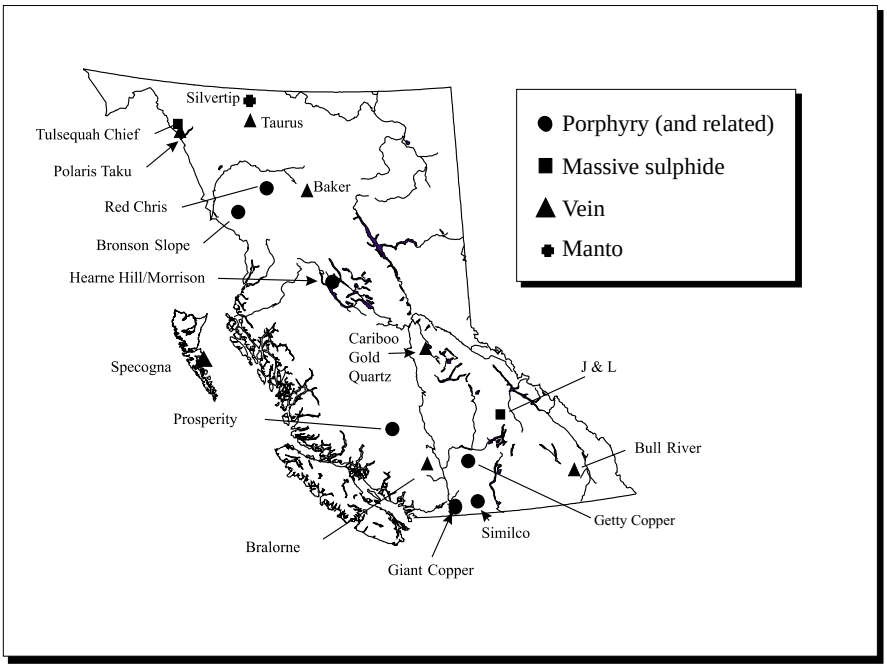
Base- and precious-metal exploration comprised an important part of the 1998 exploration

Figure 33
Major Exploration Projects in British Columbia, 1998



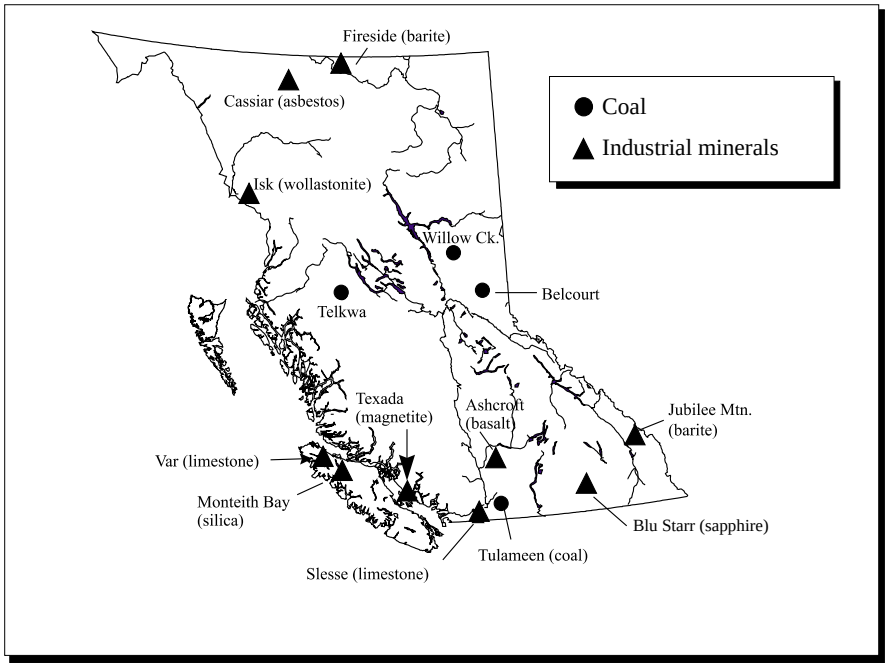
Source: British Columbia's Ministry of Energy and Mines, Information Circular 1999-1.

Figure 34
Advanced Metals Exploration Projects in British Columbia, 1998



Source: British Columbia's Ministry of Energy and Mines, Information Circular 1999-1.

Figure 35
Advanced Coal and Industrial Minerals Exploration Projects in British Columbia, 1998



Source: British Columbia's Ministry of Energy and Mines, Information Circular 1999-1.

effort. Successes at Myra Falls, Tulsequah Chief and Eskay Creek testify to the excellent potential for these deposit types. Other properties of significance are J&L (McKinnon Creek), the Sullivan-type deposit, Findlay Creek, Greenland Creek, Irishman Creek and the Corey property.

PORPHYRY AND RELATED DEPOSITS

A number of porphyry deposits that companies have been exploring over several years are in advanced stages of exploration. These include the Prosperity, Red Chris, Bronson Slope, Getty North, Hearne Hill, Morrison, Giant Copper, Pine, Similco, Granite Mountain and Red Cap properties.

PRECIOUS-METAL-BEARING VEINS AND BULK-MINEABLE DEPOSITS

Epithermal and mesothermal vein deposits offer potential for both large-tonnage, low-grade operations and lower-tonnage, high-grade deposits. Some of the more advanced projects of this type are Specogna, Polaris-Taku, Bralorne, Pellaire, Cariboo Gold Quartz, Tsacha and Kaslo Silver.

SKARN/MANTO DEPOSITS

The Silvertip property is representative of this type of deposit. It is a high-grade precious-metal and base-metal configuration near the British Columbia-Yukon border.

MAGMATIC NICKEL

Turnagain is an ultramafic-hosted, disseminated nickel-cobalt showing east of Dease Lake. Laboratory tests are focused on finding an economic method for processing concentrate production using pressure-leaching and solvent extraction.

Coal Exploration

During 1998, off-lease coal exploration was undertaken at Telkwa, Willow Creek, Belcourt, Tulameen, McGillivray Creek and Middle Mountain. These projects represent a diversity of coal deposits in different sedimentary basins targeting both metallurgical and thermal product.

Industrial Minerals Exploration

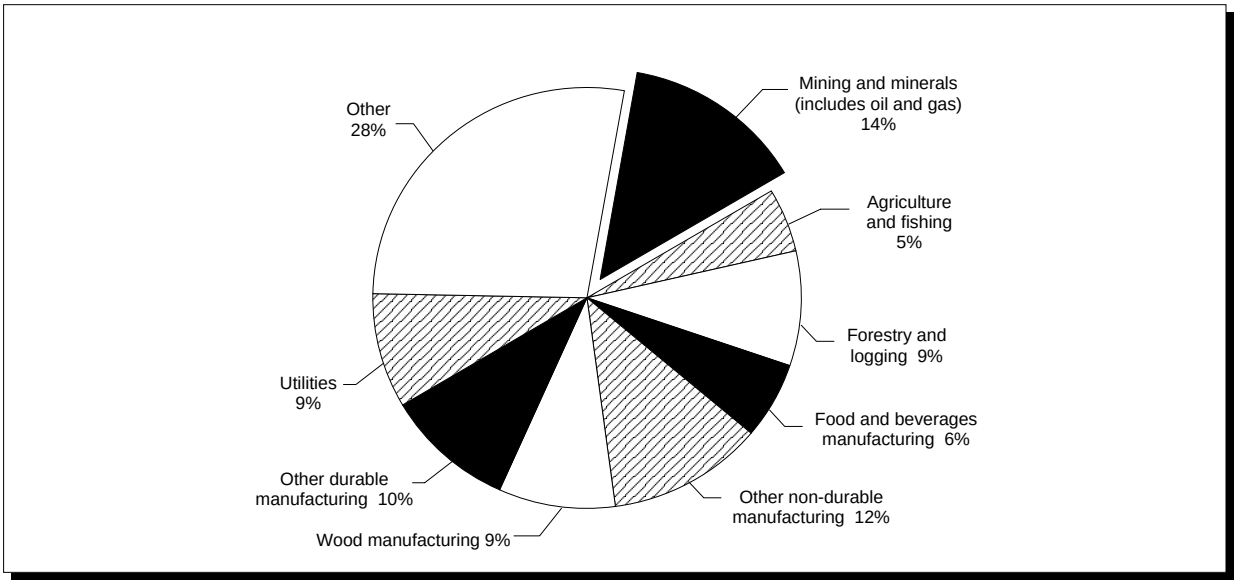
In 1998, exploration varying from grass-roots to trial processing was completed. Some key projects included Cassiar Mining's work on asbestos tailings, the Bril wollastonite project, Black Crystal graphite, Blu Starr sapphire, Texada Island magnetite, and other projects involving dimension stone, chemical-grade limestone, and volcanic ash.

Conclusion

Sustained low mineral commodity prices have had an impact on the mining and exploration sectors of British Columbia. However, mining and minerals contribute 14% of British Columbia's gross domestic product for the goods-producing sector, of which two-thirds is minerals production and one third is oil and gas production (**Figure 36**). As a result, the government is committed to new and continuing initiatives focused on enhancing these two sectors.

The internationally recognized rich mineral endowment of the Cordilleran terrane, the extensive and well-documented knowledge base of more than 11 000 mineral occurrences in British Columbia, and the in-ground inventory of advanced exploration projects are expected to continue to attract a significant number of exploration companies as the diversified provincial deposit base has allowed many explorationists to shift focus from porphyry deposits to massive

Figure 36
Goods-Producing Sector Gross Domestic Product (GDP) in British Columbia, 1997



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

sulphide and other deposit types.

5.11 NORTHWEST TERRITORIES

Introduction

On April 1, 1999, the territory of Nunavut came into existence, along with a new Northwest Territories. Separate reports for the two territories will be included in the next version of this publication but, for 1998 results, they are considered together since they were a single jurisdiction in 1998. For clarity, exploration and mining information are separated into Northwest Territories and Nunavut sections.

1998 Mineral Production Summary

The suspension of operations at the Lupin mine, Nunavut, and a labour dispute at the Con mine in Yellowknife took their toll on gold production in 1998. The Northwest Territories' gold production slipped to 2% of total 1998 Canadian production (it ranked fifth among the seven gold-producing provinces/territories) from 8% in 1996 and 1997. As a consequence of lower gold production, the total value of metal shipments from the Northwest Territories dropped to 3.4% of the value of Canadian production, despite increases in base-metal production (zinc and lead). The Northwest Territories produced 18% of Canada's zinc, 19% of its lead and 1.4% of its silver.

The value of total metal shipments from the Northwest Territories dropped to $349 million in 1998 from $544 million in 1997. Decreased gold production and lower metal prices were the major reasons for the lower figure. Zinc remains the most valuable metal commodity export from the Northwest Territories, with gold second.

The 1998 gold production of the Northwest Territories was valued at $53 million, representing 15% of its total value of metal production, down from 37% in 1997. Zinc increased its dominance of the Northwest Territories' metal mining industry, representing 77% of the total value of metal shipments, at $268 million. The Northwest Territories ranked second in Canada for

zinc production in 1998. Lead shipments in 1998 held steady at $23 million, and silver remained a minor commodity at $4.2 million. Diamond shipments from the Northwest Territories began late in 1998 with a value of $53 million.

Producing Mines

At the beginning of 1998, there were five producing mines in the Northwest Territories. Three continued operating throughout the year. The Lupin mine was placed on care and maintenance in the first quarter due to low gold prices. In the second quarter, a labour dispute caused a production stoppage at the Con mine.

The first diamond production from the Northwest Territories was recorded in 1998 as the Ekati mine of BHP Diamonds Inc. and Dia Met Minerals Ltd. officially opened in October. Diamond production in 1998 was 278 000 ct.

In Yellowknife, Royal Oak Mines Inc.'s Giant mine produced 88 038 oz of gold in 1998, from 346 918 tons of ore, at an average grade of 0.293 oz/ton. Miramar's Con mine produced 23 447 oz of gold before the onset of a labour dispute in May.

In Nunavut, Breakwater Resources' Nanisivik mine produced 96 346 t of zinc concentrate containing 55 244 t of zinc metal plus 511 945 oz of silver. Cominco's Polaris mine produced 225 900 t of zinc concentrate at an average grade of 62% zinc and 48 000 t of lead concentrate at an average grade of 78.2% lead.

1998 Exploration Summary

There was a further decrease in exploration spending in the Northwest Territories in 1998 when expenditures dropped to $113 million, the second decrease since the record high of $195 million in 1996. The Northwest Territories ranked third in Canada, behind Québec and Ontario.

A total of 990 claims covering 0.7 Mha were staked in 1998. On December 31, 1998, there were 10 164 claims in good standing covering 8.3 Mha, a net decrease of 5387 claims. A total of 111 new mining leases were issued, up from 97 new leases in 1997, for a total of 1072 mining leases in good standing at the end of 1998. Overall, this reflects the increasing maturity of diamond exploration in the Northwest Territories following the staking rush of the early 1990s. Eighty-seven claims were taken to lease in 1998.

In 1998, 14 prospecting permits were issued for a total of 371 such permits in good standing covering 8.1 Mha at December 31, 1998.

Northwest Territories – Western Arctic: Diamonds

Diavik Diamond Mines Inc. and Aber Resources Limited continued an $80 million pre-feasibility study on the Diavik project, concurrent with an environmental review. Attention on the project is focussed on four pipes: A-154N, A-154S, A-418 and A-21. Proven and probable reserves quoted in the pre-feasibility study are listed in **Table 17**. Total diluted reserves for the four pipes, including both open-pit and underground mineable reserves, are quoted as 27.7 Mt at an average grade of 3.7 ct/t.

BHP Diamonds Inc. and Dia Met Minerals Ltd. conducted exploration work on the Ekati property, resulting in the discovery of seven new pipes. Sample results were released for the Koala North and Beartooth pipes (**Table 18**).

Monopros collected mini-bulk samples from the Hearne, Tesla, Tuzo and 5034 kimberlite pipes, located on the AK and CJ claim blocks, collectively known as the Kennady Lake project. Sample results are shown in **Table 19**. The bottom cut-off for micro-diamonds was 1.5 mm. Varia-

TABLE 17. PROVEN AND PROBABLE RESERVES OF THE DIAVIK DIAMOND PROJECT

Pipe	Resource	Carats	Grade	Value
	(million tonnes)	(millions)	(ct/t)	(US$/ct)
A-154N	2.8	8.0	2.84	35
A-154S	11.3	51.8	4.58	63
A-418	8.7	33.2	3.80	56
A-21	3.9	11.0	2.84	38

Source: N.W.T. Department of Resources, Wildlife and Economic Development, based on company prefeasibility data.

TABLE 18. SAMPLE RESULTS FOR THE KOALA NORTH AND BEARTOOTH PIPES, EKATI PROPERTY

Pipe	Tonnes Sampled	Carats	Grade	Value
		(>1 mm)	(ct/t)	(US$/ct)
Koala North	201.7	126.58	0.63	200
Beartooth	189.3	227.09	1.20	79

Source: N.W.T. Department of Resources, Wildlife and Economic Development, based on company data.

TABLE 19. SAMPLE RESULTS FOR THE KENNADY LAKE PROJECT

Pipe	Grade	Value	Value
	(ct/t)	(US$/ct)	(US$/t)
Tuzo	2.20	51-108	112-238
Hearne	2.33	25-50	58-117
Tesla	0.37	56-112	21-441
5034	1.60	26-58	42-93

Source: N.W.T. Department of Resources, Wildlife and Economic Development, based on company data.

tions in value reflect scatter in data and uncertainty due to the small size of the mini-bulk samples. Further bulk sampling is planned for 1999. The largest diamonds recovered were 2.34 ct for the Tuzo pipe, 1.87 ct for Hearne, just under 1 ct for Tesla, and 1.90 ct for 5034. As project operator, Monopros has the right to earn a 60% interest from Glenmore Highlands Inc., Mountain Province Mining Inc. and Camphor Ventures Inc.

Winspear Resources Ltd. and Aber Resources Ltd. undertook till sampling, diamond drilling and mini-bulk sampling at the Snap Lake project located on the Camsell Lake property. A 200-t mini-bulk sample taken from the northwest peninsula kimberlite dike produced a total of 228.9 ct at an average grade of 1.14 ct/t (cut-off screen of 1.2 mm) and an average value of US$301/ct. Three large diamonds, weighing respectively 10.83, 8.43 and 6.03 ct, were recovered. Further drilling was conducted around Snap Lake and elsewhere on the Camsell Lake property. Bulk sampling is planned for the winter of 1999.

Other diamond exploration work was performed by GMD Resource Corp. on the Royce claims, by Gerle Gold Ltd. on the Doyle Lake property, by Kennecott Canada Exploration Inc. on the DHK claim block, and by SouthernEra Resources Ltd. on the Mackay Lake/Back Lake property.

Northwest Territories – Western Arctic: Gold

Placer Dome Exploration completed three phases of drilling on the Tundra (FAT) gold deposit at the Courageous Lake project, 230 km northeast of Yellowknife. Battle Mountain has part ownership in the Courageous Lake project. Previous work in 1988/89 by Hemlo Gold and joint-venture partners Noranda Minerals and Total Energold included sinking a shaft to 476 m and 2000 m of drifting. In 1988, a drill-indicated calculation outlined a resource of 3.6 Mt grading 13.7 g/t gold using a 9.94 g/t gold cut-off grade. Exploration was concentrated on three closely spaced zones ranging in width from under 5 m to over 30 m true thickness within a 1-km strike length. The zones trend north-northeast and dip steeply to the west. Besides drilling, the company also completed regional and detailed mapping, geochemical and geophysical surveys, and structural studies.

Royal Oak Mines Inc. completed 5565 m of underground exploration drilling on the 1500 level and lower LAW zone of the Giant mine. On the 1500 level, significant widths of altered volcanic rocks containing sections of quartz veins and pyrite-arsenopyrite mineralization were encountered. The 1500-level drift will be extended 1200 feet to the south to allow widely spaced drilling of these structures in 1999. Drilling from an extension of the main access ramp for the LAW, at the minus 950 elevation, was used to test for a down-plunge extension of the zone from section 4800 to 5000 North. Sub-economic mineralization was intersected.

Northwest Territories – Western Arctic: Base Metals

Aber Resources Ltd. (operators) conducted a seven-hole (1543 m) diamond drill and down-hole electromagnetic survey on its Sunrise Lake joint venture with Hemisphere Development Corp. Sunrise is a volcanogenic massive sulphide deposit containing zinc, lead, copper and silver. A new reserve calculation incorporating results from the 1998 drilling of the main zone and the lower-grade stringer type mineralization above the minus 150-m elevation was performed to evaluate the open-pit potential of the deposit. The 1998 calculations are based on a specific gravity of 3.67, lower than the previous specific gravity of 4.0 used in 1989 calculations. The 1998 re-evaluation of the main zone gave an indicated and inferred resource of 3.180 Mt grading 0.09% copper, 6.32% zinc, 2.52% lead, 244.71 g/t silver and 0.7 g/t gold to a depth of 650 m. Inferred stringer ore calculations of 1.593 Mt grading 0.05% copper, 2.25% zinc, 0.82% lead, 22.15 g/t silver and 0.22 g/t gold were added to the main zone to give a total of 4.87 Mt grading 0.08% copper, 5.0% zinc, 1.96% lead, 171.96 g/t silver and 0.54 g/t gold.

Highwood Resources Ltd. re-logged and sampled core not previously submitted for analyses from its Thor Lake beryllium-rare metals deposit (beryllium-zircon-tantalum-rare earth

elements-niobium-gallium). The deposit is hosted by the Blatchford Lake intrusive complex of Aphebian age that intrudes Archean plutonic and metasedimentary rocks of the Slave province. Mineralization occurs within part of the Thor Lake syenite core and the surrounding Grace Lake granite. Highwood's work is concentrated on the T zone, which has the most economic beryllium potential including a measured reserve of 462 662 t grading 1.11% BeO.

Fortune Minerals Ltd. undertook diamond drilling on the Sue-Dianne polymetallic deposit. The company is earning a 50% interest in the Noranda-owned property. Drilling extended the known deposit strike length from 300 to 500 m. An independent resource estimate based on recent drilling indicates that the deposit now contains a measured and indicated resource totaling 14.9 Mt averaging 0.78% copper, 3.22 g/t silver and 0.023 g/t gold, using a minimum 0.25% copper cut-off grade. Using a minimum 0.50% copper cut-off grade, a higher-grade measured and indicated resource totaling 9.7 Mt averaging 1.01% copper, 3.44 g/t silver and 0.022 g/t gold is obtained.

Preliminary flotation test results by Lakefield Research on mineralization from the Sue-Dianne deposit were released in July. Composite samples of chalcopyrite mineralization and of gold- and silver-enriched chalcopyrite-bornite mineralization, respectively, produced a copper recovery of 90% in a 28-30% copper concentrate, and recoveries of 93% copper, 81% gold and 77% silver in a concentrate grading 44-47% copper, 15-17 g/t gold and 220-240 g/t silver. Further tests have been carried out to determine if the concentrate can be leached at atmospheric conditions or blended with concentrates from the nearby Bowl zone deposit for autoclave treatment to produce saleable metal products at the site.

Fortune Minerals Ltd. also drilled on the Nico project area, 30 km south of the Sue-Dianne deposit. Drilling was concentrated in the Bowl zone, which is composed of several closely stacked stratabound magnetite-rich lenses containing disseminated cobaltian arsenopyrite and chalcopyrite. These lenses are each up to 70 m in thickness and are concentrated at the base of a felsic volcaniclastic sequence that unconformably overlies metasedimentary rocks. The Bowl zone is up to 700 m in width, and 1998 drilling extended its strike length by 600 m to 1.9 km. The deposit remains open in all directions.

One hole intersected a new copper zone located 1.1 km northeast of the Bowl zone in the vicinity of a large positive gravity anomaly with surface mineralization and peripheral cordierite alteration.

New independent resource estimates for the Bowl zone deposit, based on the 82 drill holes drilled up to the end of 1997, were released in June 1998 and included the following:

1) A measured and indicated mineral resource of 41.6 Mt grading 1.025 g/t gold, 0.124% cobalt, 0.133% bismuth, and 0.053% copper at a cut-off value of $40/t, which includes:

2) A measured and indicated mineral resource of 33.4 Mt grading 1.167 g/t gold, 0.140% cobalt, 0.154% bismuth and 0.052% copper at a cut-off value of $50/t.

Metallurgical testing by Lakefield Research indicated that the economic metals are contained within the 5 to 10 weight percent sulphide fraction and can be recovered by flotation, followed by 180°C acid pressure oxidation hydrometallurgical methods and cyanidation. The process is based on known technology used in existing mining operations to produce high-value metal products at the mining site. Tests indicate net recoveries of over 90% for cobalt, 83-85% each for gold and copper, and 55% for bismuth. Leach tests on the residue produced after pressure oxidation and cyanidation indicate that the waste product can be disposed of as a registerable non-hazardous waste.

Geotechnical engineering studies were performed on both the Nico and Sue-Dianne projects. Data generated from this work will be used to assess pit-slope stability for open-pit mining scoping and pre-feasibility studies. In addition, a survey of heritage sites plus aquatic and

terrestrial biology baseline studies were carried out on both projects.
Aber Resources Ltd. in partnership with Victoria Exploration & Mining Ltd. continued to explore Victoria Island for copper-nickel-PGEs and diamond mineralization on the Kuujjua project. They carried out property-wide mapping and diamond drilling. Drill targets were selected on the basis of previous mapping, prospecting and geophysical work. Rock and drill core samples were collected for analyses. Minor copper and insignificant nickel mineralization was intersected at one target. Results are pending for diamond indicator samples.

Nunavut – Eastern Arctic: Diamonds

Tahera Corporation (formerly Lytton Minerals Ltd. and New Indigo Resources Inc.) continued work on its Jericho property northwest of Contwoyto Lake. Drilling in late September intersected kimberlite on the Contwoyto-1 target, southeast of Jericho. A kimberlite boulder train was also discovered in the vicinity. Results were released for the JD-3 kimberlite. A 35.9-t sample returned a total of 10.41 ct for an overall grade of 0.29 ct/t (1 mm bottom cut-off).

Major General Resources and Ascot Resources Ltd. announced that five kimberlites had been discovered during drilling by joint-venture operator Monopros on their Victoria Island property. Micro-diamond results from bulk samples of each pipe are as follows: Snowy Owl, 75 diamonds in 80 kg; Golden Plover, 39 diamonds in 160 kg; Longspur, 9 diamonds in 80 kg; Phalerope, 6 diamonds in 160 kg; and Whimbrel, 1 diamond in 160 kg. Following this discovery, the partners embarked on a program of additional staking, detailed helicopter-borne geophysics, till sampling, glacial mapping, and visual site inspections of the target areas.

Nunavut – Eastern Arctic: Gold and Base Metals

Echo Bay Mines Ltd. conducted diamond drilling on the Lupin mine property. Lupin has been on care and maintenance since early 1998.

WMC International Inc. (56%), Cumberland Resources Ltd. (22%) and Comaplex Minerals Corp. (22%) released preliminary diluted gold resource estimates on the Tiriruniak and F-zone deposits of their Meliadine West gold joint venture. The Tiriruniak zone is estimated to contain 8.0 million tons grading 0.324 oz/ton (11.1 g/t) for 2.9 million oz of gold. The F-zone resource is estimated at 1.8 million tons grading 0.228 oz/ton (7.8 g/t) for 0.40 million oz of contained gold. The resource estimate is based on drill intercepts obtained to the end of 1997. Exploration in 1998 was designed to upgrade the drill-indicated resource on the Tiriruniak zone from 100 m to 50 m intercept spacing, and to increase gold resources in other showings on the property. Drilling was completed on the Tiriruniak, Fox, Wolf, F and Pump zones. In-fill and deeper drilling on the Tiriruniak zone confirmed the previous resource estimate and indicated that the zone remains open at depth. Twenty-eight drill holes on the F zone in 1998 demonstrated continuity of grade between previous drill intercepts, and expanded the depth of the deposit by approximately 100 m. The F zone has been delineated over a 300-m strike length and is open at depth. A new resource estimate will be completed on the Wolf zone.

On the Meliadine East project, Cumberland Resources (50%) and Comaplex Minerals (50%) collected rock and till samples, and carried out mapping and magnetometer surveys. The program found a new area of sheared felsic volcanics with anomalous gold values.

Cumberland Resources continued advanced exploration on its wholly owned Meadowbank property, including diamond drilling and surface sampling and prospecting. Cumberland also completed a ground-based magnetic survey. In a scoping study for a potential mine, Cumberland engaged in fish studies, water and soil baseline testing, weather monitoring, and community consultation workshops. Geotechnical studies included analyzing site suitability for tailings disposal and geotechnical rock quality analysis for pit engineering.

BHP Minerals' gold and base-metal exploration drill program in the Hope Bay volcanic belt con-

sisted of drilling on the BOSTON claims, the MADRID claims, the KOIG claims, the KAMIK claims, the AMAROK claims, and the PJ claims, plus overburden reverse circulation drill holes. BHP mapped the BOSTON and PJ claims and conducted an airborne magnetic survey over the Hope Bay belt.

Cominco Ltd. was active on Little Cornwallis, Bathurst, Baffin and Somerset islands searching for lead-zinc mineralization. Diamond drilling was undertaken north of the Polaris mine and on the Eclipse deposit.

1999 Government Programs

EXTECH III is a collaborative project involving earth scientists from the Geological Survey of Canada, the Government of the Northwest Territories, the federal Department of Indian Affairs and Northern Development, private industry and academic institutions.

Like the previous two EXTECH projects, EXTECH III is designed to address problems of declining metal reserves in the Yellowknife gold camp over a three-to-five-year period. Preliminary research was undertaken in 1998, and a number of new projects are planned for 1999 covering a variety of geoscience topics.

The Northwest Territories' Prospector Grubstake program is designed to provide financial assistance to residents of the new Northwest Territories to conduct grass-roots exploration. This Government of the Northwest Territories program provides funds to a number of prospectors every year to undertake projects within the Northwest Territories. Prospector training programs are also available to regions upon request.

5.12 YUKON

Overview

Exploration expenditures in 1998, at $15.4 million, were down from the $35 million spent in 1997. A large number of reconnaissance-style exploration projects were directed at the gold potential of the mid-Cretaceous Tombstone suite intrusive belt, as well as that of other Yukon Cretaceous intrusive suites. Gold exploration accounted for more than 60% of exploration expenditures.

The decrease in exploration expenditures is reflected in the number of advanced exploration projects involving drilling. The approximately 20 000 m of diamond drilling in 1998 was down 80% from the 1997 total. The number of quartz claims staked in 1998 was 5148, down from 9692 claims staked in 1997.

Mine development expenditures were approximately $6 million, which is lower than the $23 million incurred in 1997. Development expenditures were incurred at the Brewery Creek gold mine and the Mt. Nansen gold-silver mine. Development also took place at the Yukon's next mine, the Minto copper-gold-silver project.

Production from the Faro lead-zinc-silver mine was suspended in January 1998 when Anvil Range Mining Corporation filed for court protection. An interim receiver has sold most of the mine's assets, except for a few key components. The Mt. Nansen gold-silver mine operated in 1998, but closed in 1999.

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 using 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 79 396 oz was produced in 1998 compared to a total of 72 387 oz of gold in 1997. A total of 11.8 Mt grading 1.13 g/t gold of mineable reserves remained as of May 1999. The eight low-grade oxide gold deposits at Brewery Creek are distributed over a 7-km-long linear trend underlain by Cretaceous Tombstone suite quartz-monzonite sills and Devono-Mississippian greywacke of the Earn group.

Mount Nansen Mine

In 1998, B.Y.G. Natural Resources produced and processed 136 095 t of ore at the Mount Nansen mine at an average head grade of 5.03 g/t gold and 43.25 g/t silver. The mine opened in November 1996.

A water balance problem in the tailings pond at the beginning of the year resulted in a shutdown and a reduced milling rate; consequently, milling for the year has been at 50% capacity. Installation and commissioning of a water treatment plant rectified the water balance problem and milling continued at full capacity from June 1998. Production continued until early 1999 when mining operations shut down and the mine went into receivership.

Grum Mine

Anvil Range Mining Corporation shut down production from its Grum open-pit lead-zinc-silver mine near Faro 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. Production resumed and lead and zinc concentrates were shipped starting in November 1997, until the mine ceased operations in January 1998. The mine's assets, except for the key assets such as the mill, are being sold by an interim receiver.

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.

Tea Barite Mine

The Tea barite mine is located near Macmillan Pass northeast of Ross River. Approximately 3000 t of barite were mined in 1998 and then processed and shipped to Alaska for use as drilling mud in oil exploration on the North Slope.

Mine Development

Mine development expenditures were incurred mainly at the Minto copper-gold-silver porphyry deposit where mill footings, a tailings dam grout curtain and the installation of a permanent camp were completed in preparation for construction. The current mine design calls for an open pit containing 6.51 Mt grading 2.13% copper, 0.62 g/t gold and 9.3 g/t silver at a stripping ratio of 4.9:1.0. The mill is designed for a throughput of 477 000 t of ore per year, resulting in an initial mine life of 13 years.

Cominco's Sa Dena Hes zinc-lead-silver mine and the Keno Hill silver-lead-zinc mine of United Keno Hill Mines Ltd. remained on care and maintenance during 1998 awaiting an increase in metal prices.

Three projects remained in the permitting process in 1998. New Millennium Mining Ltd. continued with the comprehensive review of the Dublin Gulch gold deposit under the *Canadian Environmental Assessment Act*. Dublin Gulch, an intrusive-hosted gold deposit, contains

open-pit mineable reserves of 50.4 Mt grading 0.93 g/t gold. The Carmacks copper deposit is an oxidized copper-gold porphyry deposit containing 14.1 Mt grading 1.01% copper and 0.51 g/t gold. In 1998, Western Copper Holdings Limited continued its review of the Carmacks copper project under the Environmental Assessment and Review Process. The Kudz Ze Kayah deposit of Cominco awaits final signature on its Class A Yukon water licence. No production decision has been made on the volcanogenic massive sulphide (VMS) deposit, which 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.

Placer Mining Industry

Low gold prices in 1998 resulted in a decrease in both production and employment at the Yukon's placer mines. A total of 161 mines operated with approximately 600 people directly employed in the industry. This represents a 6% drop in the number of mines and a 20% drop in employment from 1997. Over 80% of the placer gold was produced from unglaciated regions of the Yukon including Klondike, Indian River, west Yukon (Fortymile, Sixtymile, Moosehorn) and lower Stewart River. The remaining gold came from glaciated regions including Clear Creek, Mayo, Dawson Range, Kluane and Livingstone.

Placer gold production in 1998 totaled 90 288 crude oz, compared to 116 383 crude oz in 1997. This represents a 22% drop in production. The gold is worth approximately $31.4 million, which is $12 million lower than the value of gold produced in 1997.

Mining land use regulations are scheduled to take effect on placer claims in 1999 and the current standards of effluent discharge set out in the Yukon Placer Authorization will be reviewed in 2001. These are some of the issues that face the industry, along with the lowest placer gold production in 16 years.

Precious-Metal Exploration

For the first time in many years, exploration expenditures for gold surpassed expenditures for base metals in the Yukon. Recent exploration successes in Alaska related to mid-Cretaceous intrusive rocks, namely the Fort Knox and more recently the Pogo gold deposit, have boosted exploration in Yukon areas hosting similar geology to the Alaskan discoveries. The potential in the Yukon for similar plutonic-related deposits to these Alaska discoveries has long been known and was illustrated by the discovery in 1991 of the Dublin Gulch gold deposit near Mayo, the closest known match to the Fort Knox model. The pluton-related, low-cost, heap-leach Brewery Creek gold mine near Dawson has proven that these types of deposits can be economically exploited in the Yukon. Several senior mining companies conducted reconnaissance exploration programs in the mid-Cretaceous Tombstone belt, which resulted in the staking of several new properties. Other properties staked in previous years in this belt had exploration programs ranging from prospecting to diamond drilling.

Base-Metal Exploration

Since 1994, base-metal exploration has been dominated by the search for VMS deposits in the Finlayson Lake district. In 1998, exploration for base metals covered most areas of the Yukon; companies were seeking a wide range of commodities and deposit types. Although there were several active exploration projects in the Finlayson district, the level of exploration has declined dramatically from previous years. Expatriate Resources acquired Boliden Westmin's 60% share of the Wolverine deposit (6.2 Mt grading 12.7% zinc, 1.3% copper, 1.5% lead, 371 g/t silver and 1.76 g/t gold). Expatriate and joint-venture partner Atna Resources chose not to work on the Wolverine deposit in 1998. Exploration for VMS deposits continued in other areas of the Yukon-Tanana terrane apart from the Finlayson Lake district.

In 1998, additional exploration work was carried out by Atna Resources on the Wolf lead-zinc-

silver VMS deposit, where an additional 30 holes were drilled. Expatriate Resources announced a resource calculation for the Ice deposit containing 4 561 863 t grading 1.48% copper with minor gold, silver and cobalt.

Exploration and Development Forecast for 1998

The Yukon Chamber of Mines conducted a survey of exploration companies doing work in the Yukon during 1999. A total of 23 companies responded with expenditure forecasts. Total forecast expenditures are $7 872 000 for exploration and development. These estimates are usually 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 offered three programs in 1998 to encourage the development of the Yukon's mineral and energy resources. These programs are: the Yukon Mining Incentives Program (YMIP), the Yukon Industrial Support Policy (YISP), and the Energy Infrastructure Loans for Resource Development Program. In addition, the Yukon government worked with Revenue Canada in developing a Yukon Mineral Exploration Tax Credit to come into effect in 1999. The tax credit will come into effect for two years starting on April 1, 1999, and will provide a 22% refundable tax credit for individuals and companies carrying out mineral exploration in the Yukon.

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. Grass-roots 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 grass-roots 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 1998.

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 1998.

6. Historical Review

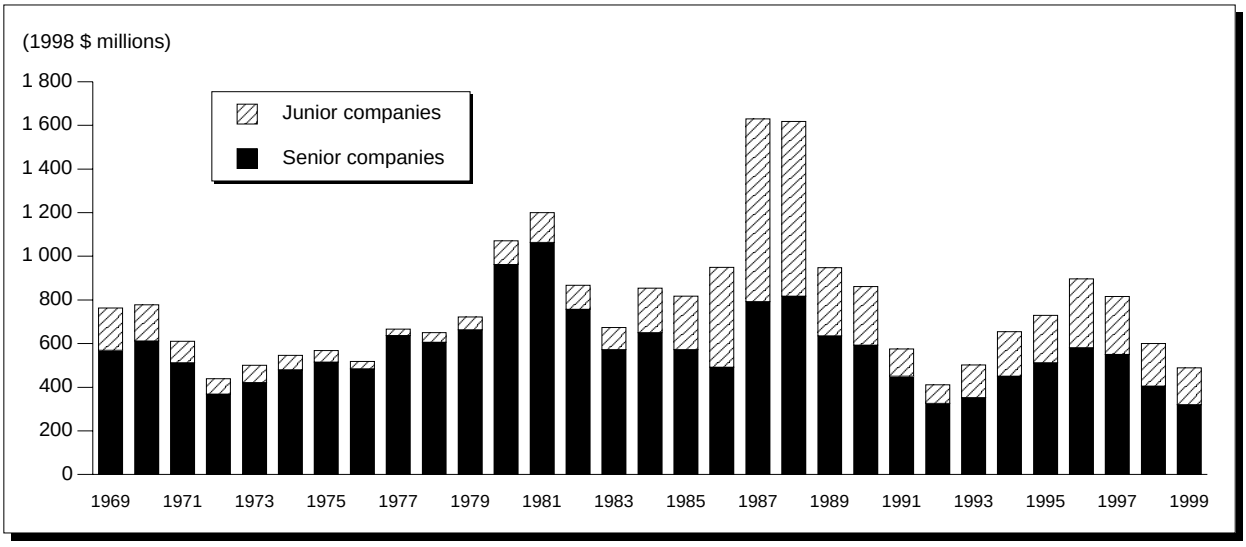
6.1 INTRODUCTION

This section presents an historical review of patterns of exploration and deposit appraisal spending based on results from the federal-provincial survey of mining and exploration companies. As explained in Chapter 1, only field and overhead costs are considered in order to allow comparisons between data from the old and new surveys.

6.2 HISTORICAL SUMMARY

Figure 37 depicts Canadian exploration and deposit appraisal expenditures (in constant 1998 dollars) over the period 1969 to 1999. Above-normal expenditures in the 1980-82 period resulted from high prices for gold, silver and copper over much of that period. Spending 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, expenditures had reached unprecedented high levels because of MEDA and the high gold prices that had existed until the end of 1987. However, spending fell dramatically after 1988 and decreased until 1992, when it reached its lowest inflation-adjusted level since 1967.

Figure 37
Exploration and Deposit Appraisal Expenditures in Canada by Junior and Senior Companies, 1969-99



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: Total 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. Data for 1998 are preliminary; 1999 data are company spending intentions as compiled in January 1999. For comparison with pre-1997 years, the data include only field and overhead expenditures.

Activity picked up in the 1993-96 period. Expenditures increased by 118% from 1992 to 1996 and the 1996 level of $896 million (1998 dollars) was the highest since 1989. Although exploration and deposit appraisal spending declined somewhat to $816 million (1998 dollars) in 1997, it still remained relatively strong by historical standards. However, spending dropped significantly in 1998 to $601 million (1998 dollars), a decline of 26% from 1997. The forecast for 1999, based on company spending intentions, calls for yet another major decline with expenditures expected to drop to $489 million (1998 dollars), 19% lower than the 1998 level. After reaching a peak in 1996, exploration and deposit appraisal spending in Canada will have dropped by 45% in the three-year period 1997-99.

The relatively higher expenditures since 1992 have been driven to a great extent by important discoveries of diamond deposits, leading some companies to invest in advanced exploration or deposit appraisal projects and, recently, in mine development activities. As indicated in Section 4 of this report, a total of $772 million will have been spent on the search for diamonds in Canada over the period 1993-99. Canada's first diamond mine, the Ekati mine at Lac de Gras in the Northwest Territories, began producing in October 1998. The Diavik project, also in the Northwest Territories, could enter the construction stage in 2003 and the search for diamonds continues to attract interest, principally in the Northwest Territories and Alberta.

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 and deposit appraisal activity in the area had a strong impact on expenditures, particularly in 1995 and 1996.

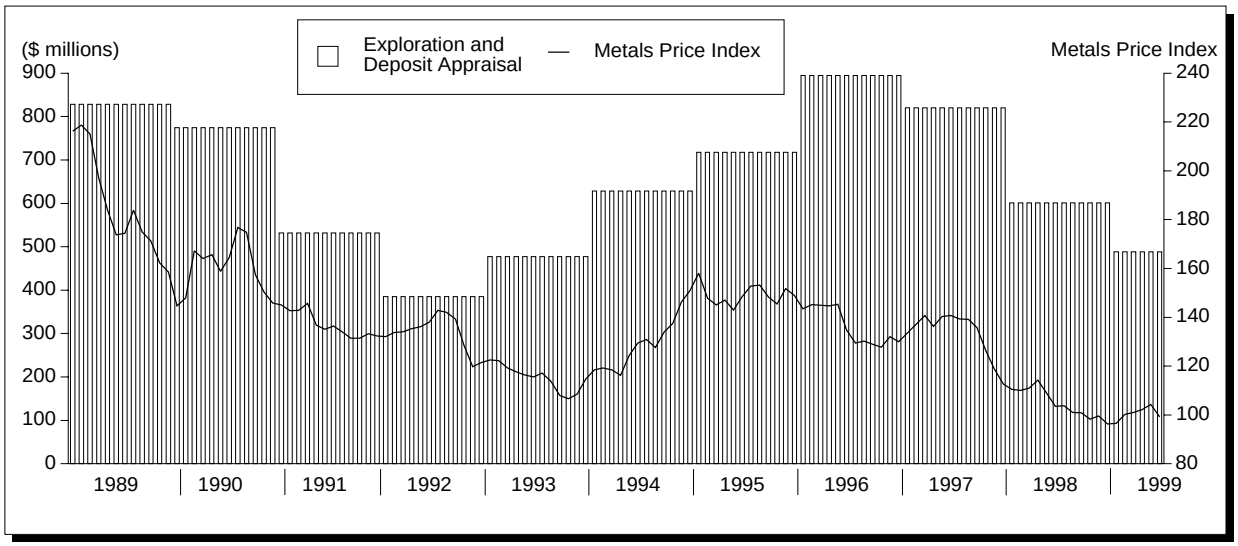
6.3 METAL PRICES AND EXPLORATION AND DEPOSIT APPRAISAL LEVELS

In Chapter 1 of this report, metal prices were shown to be an important factor in determining the level of exploration and deposit appraisal activity (**Figure 6**). 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 and deposit appraisal 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 38**). After peaking in January 1995, the index began a generally decreasing trend and had fallen by 39% by December 1998, when it reached its lowest level since at least January 1989. In June 1999, the Monthly Metals Price Index was still 37% below its value of January 1995.

As mentioned above, expenditures peaked in 1996, started declining in 1997, fell even more in 1998, and are expected to decline further in 1999. A comparison of the prices of certain important metals between June 1997 and June 1999 provides further evidence of the link between metal prices and exploration and deposit appraisal expenditure levels. In June 1997, copper was selling at an average price of US$1.18/lb whereas it averaged only US$0.65/lb in June 1999. The price of nickel stood at US$3.20/lb in June 1997. For June 1999, it averaged US$2.36/lb. As for zinc, its price was US$0.61/lb in June 1997 and averaged US$0.45/lb in June 1999. Similarly, gold, which sold at US$340.83/oz in June 1997, was selling for an average price of US$261.40/oz in June 1999.

This prolonged price weakness generally reflects world production in excess of world demand and was worsened by the fallout from the Asian crisis, which dramatically cut demand for primary materials in Asian countries. The price of gold was further affected by expectations of additional sales of the precious metal by central banks and the International Monetary Fund.

Figure 38
Exploration and Deposit Appraisal Expenditures and Natural Resources Canada's Monthly Metals Price Index, 1989-99



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Note : Exploration and deposit appraisal data for 1998 are preliminary; 1999 data are company spending intentions as compiled in January 1999. For comparison with pre-1997 years, the data include only field and overhead expenditures.

6.4 EXPLORATION AND DEPOSIT APPRAISAL AS PART OF TOTAL MINING INVESTMENT

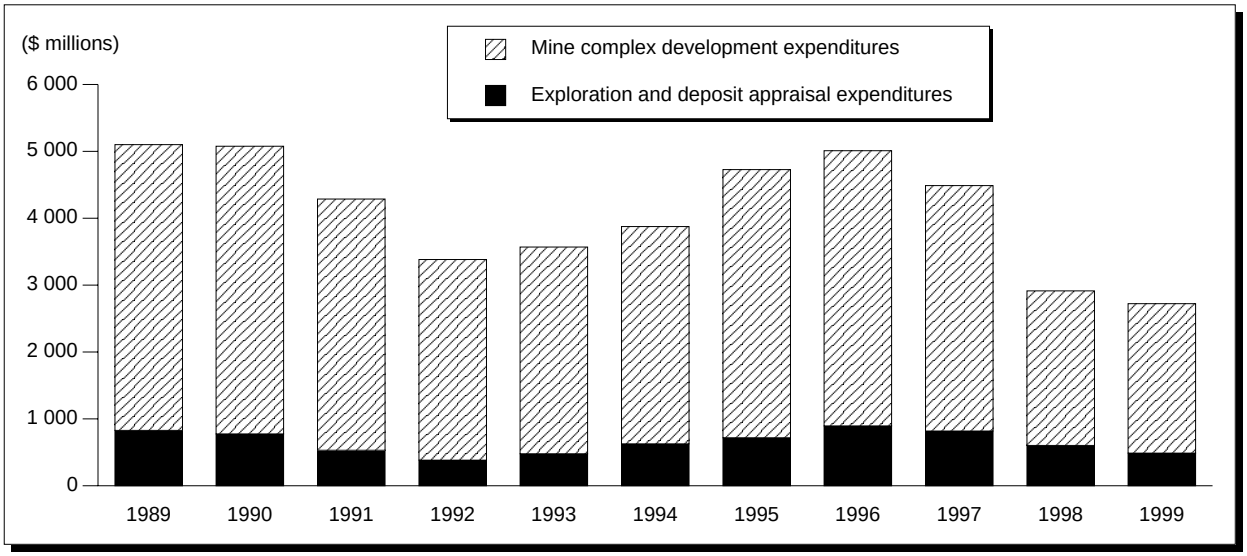
A measure of total mining investment can be arrived at by adding expenditures incurred for exploration, deposit appraisal and mine complex development. As shown in **Figure 39**, total mining investment peaked in 1996, when it reached $5 billion, after increasing by almost 50% over the period 1992-96. In 1997, total mining investment declined to $4.5 billion. In 1998, there was a further and more significant decline to $2.9 billion and total mining investment is expected to continue decreasing in 1999 to reach a level of $2.7 billion. As for the total exploration and deposit appraisal expenditure component (off- and on-mine-site) of total mining investment, it has generally represented between 15% and 20% of total mining investment. In 1998, it accounted for 21% of total mining investment and is expected to account for 18% in 1999.

6.5 EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES BY PROVINCE AND TERRITORY

Table 20 shows current dollar expenditures on mineral exploration and deposit appraisal in Canada by province and territory for the period 1987-99. **Table 21** reports the same information, but in constant 1998 dollars. **Table 22** presents these data as percentages.

From 1987 to 1992, Québec, Ontario and British Columbia were the most actively explored provinces/territories. In 1993, for the first time since 1982, spending in Ontario and Québec combined fell below 40% of the Canadian total, having peaked at 56% 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 expenditures of $194.5 million, compared to $194.9 million for Ontario. The high levels of diamond exploration and deposit appraisal expenditures helped maintain the Northwest Territories' contribution to over 20% of the Canadian total from 1993 to 1996, and at around 18% thereafter.

Figure 39
Total Exploration and Deposit Appraisal Expenditures Relative to Total Mining Investment, 1989-99



Sources: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: Data for 1998 are preliminary estimates; 1999 data are company spending intentions as compiled in January 1999. For comparison with pre-1997 years, the exploration and deposit appraisal data include only on- and off-mine-site field and overhead expenditures. "Mine complex development expenditures" includes expenditures on mine development, structures, machinery, equipment and repairs.

The case of Ontario provides a good indication of the deterioration that has occured in terms of exploration and deposit appraisal spending in Canada in recent years. In 1993 and 1994, Ontario was in third place behind the Northwest Territories and Québec. Its ranking then improved until 1996, when it led the nation with spending of $194.9 million. In 1999, Ontario should come very close to being ranked first again with only $0.3 million behind Québec. However, this time its exploration and deposit appraisal total is forecast, in constant 1998 dollars, at $105.4 million, or 46% less than what it was in 1996.

British Columbia is also a striking example of the weakening Canadian mineral exploration sector. Over the period 1993-97, exploration and deposit appraisal activity in that province had also resumed strongly with an increase in spending of 37% in constant 1998 dollars. Over the next year, British Columbia then experienced a 48% drop to reach a level of $49.4 million, the lowest level since at least 1986. The forecast for 1999 calls for approximately the same level of spending as in 1998 in that province. The Yukon, much like British Columbia, also experienced a dramatic reduction in exploration and deposit appraisal spending starting in 1998.

As for Newfoundland and Labrador, which had experienced tremendous increases in spending in 1995 and 1996 following the discovery of the Voisey's Bay base-metal deposit, its exploration and deposit appraisal expenditure levels have been steadily declining, but are still much higher than the levels recorded in the 1990-94 period. In fact, about the only Canadian jurisdiction that can boast of maintaining spending close to its 1998 peak of $24.8 million is Alberta. The search for diamonds in that province has meant that expenditures will have exceeded the $20 million level for three years in a row (1997, 1998 and 1999).

TABLE 20. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES IN CANADA, BY PROVINCE AND TERRITORY, 1987-99 (CURRENT DOLLARS)

Province/Territory	Field Work Only		Total Exploration and Deposit Appraisal[1]										
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998p	1999f
	($ millions)												
Newfoundland	27.7	37.7	36.2	23.3	12.1	11.1	8.9	12.4	71.1	92.5	58.4	49.7	36.2
Nova Scotia	41.6	46.7	21.4	11.0	4.5	3.3	1.8	1.7	2.8	6.9	6.7	5.7	5.5
New Brunswick	9.1	13.8	13.6	16.5	15.8	12.2	11.1	10.0	12.7	14.8	12.2	8.6	7.4
Québec	415.5	328.2	185.0	196.4	138.1	94.1	106.1	130.3	123.4	137.2	168.6	131.6	105.7
Ontario	308.1	343.6	217.8	152.6	109.7	77.4	75.6	113.0	129.7	194.9	176.5	124.3	105.4
Manitoba	40.0	30.0	37.0	41.2	29.7	32.0	27.4	40.5	32.6	41.2	40.3	30.0	28.3
Saskatchewan	63.5	61.1	63.3	42.2	31.5	25.9	53.1	50.6	43.8	50.6	49.9	48.9	28.7
Alberta	2.5	4.3	6.2	10.7	6.6	5.4	7.3	9.4	10.6	10.8	20.5	24.8	22.0
British Columbia	142.6	196.8	186.6	226.5	135.7	71.6	66.0	85.0	79.4	104.9	95.8	49.4	50.6
Yukon	29.0	38.6	15.1	18.4	16.5	9.7	19.2	25.7	39.3	46.4	40.6	15.5	12.6
Northwest Territories	59.0	66.5	45.7	36.0	31.6	42.7	100.7	149.5	172.2	194.5	150.7	112.9	86.3
Total field work (excluding overhead)	1 138.6	1 167.3	703.5	660.3	439.2	323.5	410.1	540.5	608.1	776.9	753.4	547.7	449.3
Total exploration and deposit appraisal[2] (including overhead)	1 300.0	1 350.0	827.9	774.7	531.8	385.3	477.3	628.1	717.6	894.8	820.2	601.1	488.6

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
f Forecast; **p** Preliminary estimate.
1 For comparison with pre-1997 years, the data include only field and overhead expenditures. They do not include other related expenditures such as those for engineering, environment and land access. **2** For 1987 and 1988, 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. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES IN CANADA, BY PROVINCE AND TERRITORY, 1987-99 (1998 DOLLARS)

Province/Territory	Field Work Only		Total Exploration and Deposit Appraisal[1]										
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998[p]	1999[f]
							($ millions)						
Newfoundland	34.7	45.2	41.5	25.9	13.1	11.9	9.4	12.9	72.3	92.7	58.2	49.7	36.2
Nova Scotia	52.1	56.0	24.5	12.2	4.9	3.5	1.9	1.8	2.9	6.9	6.7	5.7	5.5
New Brunswick	11.4	16.5	15.6	18.4	17.1	13.0	11.7	10.4	12.9	14.8	12.1	8.6	7.4
Québec	520.7	393.3	212.0	218.5	149.6	100.6	111.7	135.8	125.5	137.4	167.8	131.6	105.7
Ontario	386.1	411.8	249.5	169.7	118.8	82.8	79.6	117.7	131.9	195.3	175.6	124.3	105.4
Manitoba	50.1	36.0	42.4	45.8	32.2	34.2	28.9	42.2	33.2	41.3	40.1	30.0	28.3
Saskatchewan	79.6	73.2	72.5	46.9	34.1	27.7	56.0	52.7	44.6	50.7	49.7	48.9	28.7
Alberta	3.1	5.2	7.1	11.9	7.1	5.7	7.7	9.8	10.8	10.9	20.4	24.8	22.0
British Columbia	178.7	235.9	213.8	251.9	147.0	76.5	69.5	88.5	80.7	105.1	95.4	49.4	50.6
Yukon	36.3	46.3	17.3	20.5	17.9	10.3	20.2	26.8	40.0	46.4	40.4	15.5	12.6
Northwest Territories	73.9	79.7	52.4	40.0	34.2	45.7	106.1	155.8	175.1	194.9	150.0	112.9	86.3
Total field work (excluding overhead)	1 427.0	1 399.0	806.0	734.5	475.7	345.8	431.9	563.1	618.5	778.4	749.9	547.7	449.3
Total exploration and deposit appraisal[2] (including overhead)	1 629.3	1 617.9	948.6	861.7	576.0	411.9	502.6	654.4	729.9	896.5	816.3	601.1	488.6

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
f Forecast; **p** Preliminary estimate.
1 For comparison with pre-1997 years, the data include only field and overhead expenditures. They do not include other related expenditures such as those for engineering, environment and land access. **2** For the years 1987 and 1988, 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 22. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES IN CANADA, BY PROVINCE AND TERRITORY, 1987-99 (PERCENT DISTRIBUTION)

Province/Territory	Field Work Only		Total Exploration and Deposit Appraisal[1]										
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998p	1999f
							(%)						
Newfoundland	2.4	3.2	4.4	3.0	2.3	2.9	1.9	2.0	9.9	10.3	7.1	8.3	7.4
Nova Scotia	3.7	4.0	2.6	1.4	0.8	0.8	0.4	0.3	0.4	0.8	0.8	0.9	1.1
New Brunswick	0.8	1.2	1.6	2.1	3.0	3.2	2.3	1.6	1.8	1.7	1.5	1.4	1.5
Québec	36.5	28.1	22.3	25.4	26.0	24.4	22.2	20.7	17.2	15.3	20.6	21.9	21.6
Ontario	27.1	29.4	26.3	19.7	20.6	20.1	15.8	18.0	18.1	21.8	21.5	20.7	21.6
Manitoba	3.5	2.6	4.5	5.3	5.6	8.3	5.7	6.5	4.5	4.6	4.9	5.0	5.8
Saskatchewan	5.6	5.2	7.6	5.4	5.9	6.7	11.1	8.1	6.1	5.7	6.1	8.1	5.9
Alberta	0.2	0.4	0.7	1.4	1.2	1.4	1.5	1.5	1.5	1.2	2.5	4.1	4.5
British Columbia	12.5	16.9	22.5	29.2	25.5	18.6	13.8	13.5	11.1	11.7	11.7	8.2	10.4
Yukon	2.5	3.3	1.8	2.4	3.1	2.5	4.0	4.1	5.5	5.2	4.9	2.6	2.6
Northwest Territories	5.2	5.7	5.5	4.6	5.9	11.1	21.1	23.8	24.0	21.7	18.4	18.8	17.7
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

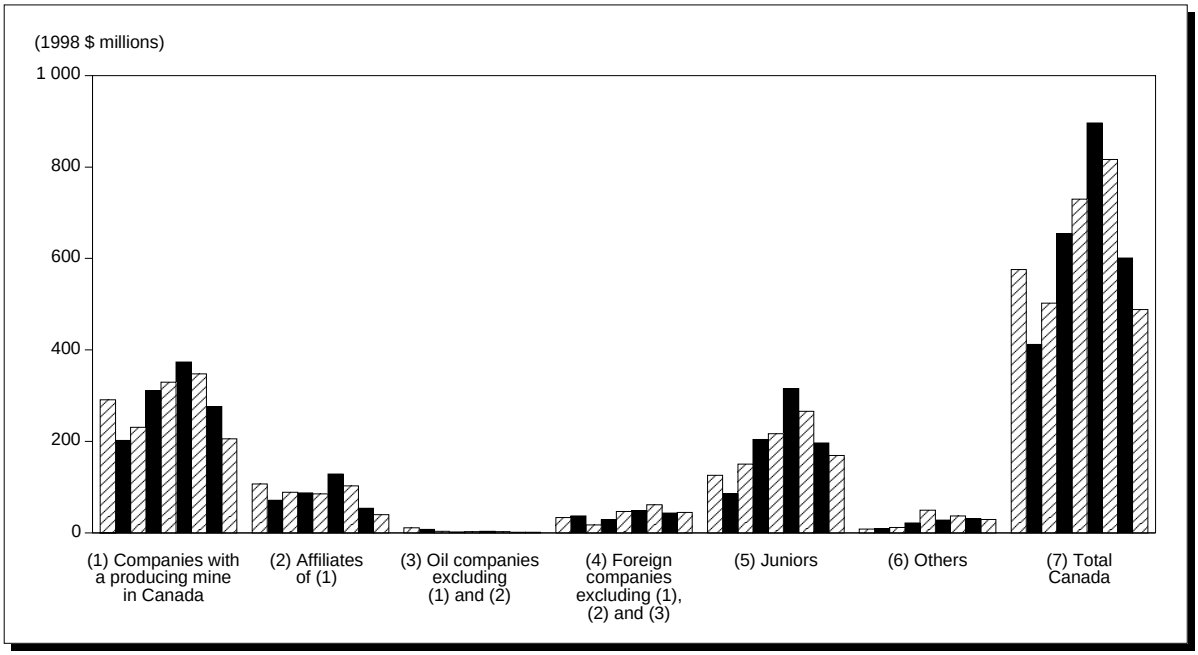
Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
f Forecast; **p** Preliminary estimate.
1 For comparison with pre-1997 years, the data include only field and overhead expenditures. They do not include other related expenditures such as those for engineering, environment and land access.
Notes: The percentages from 1987 and 1988 are calculated on field work only, but those from 1989-99 are based on total expenditures, which include related overhead.
Numbers may not add to totals due to rounding.

6.6 EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES BY TYPE OF COMPANY

Figure 40 depicts exploration and deposit appraisal expenditures (field work plus overhead) by type of company for 1991 to 1998 (preliminary) and 1999 (intentions). Producers and their affiliates usually represent about 80% of the total senior companies category. In constant 1998 dollar terms, exploration and deposit appraisal by producing companies and their affiliates peaked in 1987 and 1988, declined until 1992, and then increased again until 1996. In reality, the 1988-92 period of decline may not be as large as it appears because of the considerable contributions that 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 and their affiliates have been steadily declining since peaking at $502 million in 1996 and are expected to decline further in 1999. The level of $245 million that is forecast for 1999 is 51% lower than the level achieved in 1996.

Exploration and deposit appraisal expenditures by junior companies followed the same pattern as those by senior companies (**Figures 37** and **40**), peaking in 1987 and 1988, and then decreasing until 1992 (the lowest expenditures since 1980). Junior company expenditures then rose until 1996 when they peaked at $315 million. Much like the senior companies, spending by the juniors declined steadily starting in 1997 and is expected to drop to $169 million in 1999 (a 46% decline from the 1996 level). The change in exploration trends by junior companies is attributable to a variety of factors, including the positive impact of the discovery of diamonds in the Northwest Territories and of base metals in Labrador, and, lately, the negative effects of low metal prices, the Asian crisis and difficulties in raising financing.

Figure 40
Exploration and Deposit Appraisal Expenditures in Canada, by Type of Company, 1991-99



Source: Compiled by Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies.
Notes: The years 1991 to 1999 are represented in each group. The left bar represents 1991; the right bar represents 1999. Data for 1998 are preliminary estimates; 1999 data are company spending intentions as compiled in January 1999. For comparison with pre-1997 years, the data include only field and overhead expenditures. The company classification system is explained in the Appendix.

In 1983, junior companies accounted for about 15% of total Canadian exploration and deposit appraisal 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 and deposit appraisal expenditures in 1992; around 30% in 1993, 1994 and 1995; 35% in 1996; around 33% in 1997 and 1998; and are likely to account for 35% of total spending in 1999.

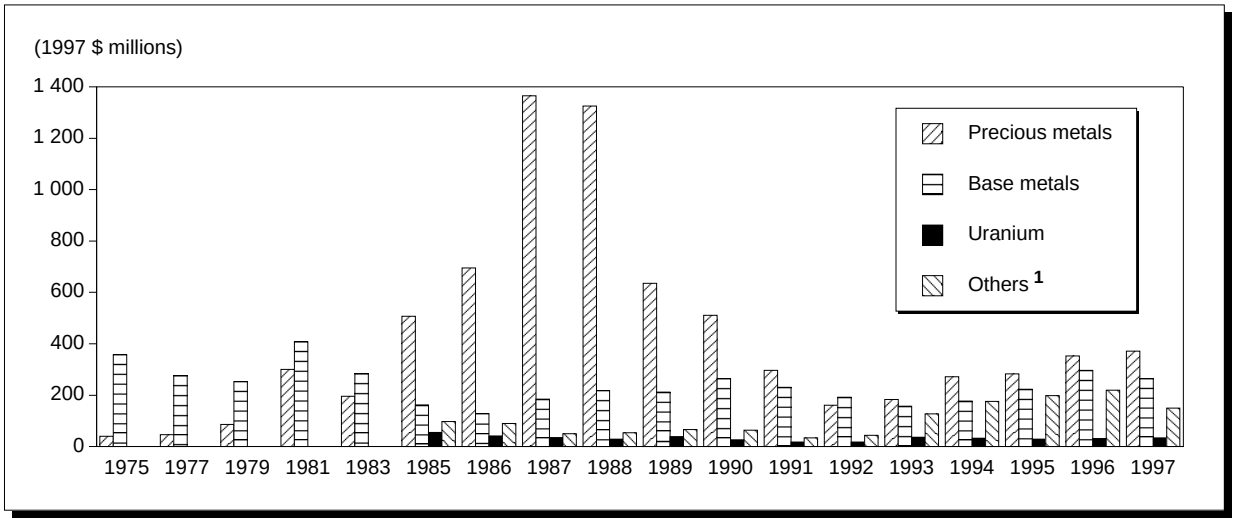
6.7 EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES BY TYPE OF COMMODITY SOUGHT

Exploration and deposit appraisal expenditures for precious metals (95% of which was for gold) peaked in 1987 (**Figure 41**) and subsequently declined as the availability of flow-through share capital decreased and as the gold price declined after the end of 1987. After reaching a low in 1992, expenditures for the search for precious metals rose steadily from 1993 to 1997, reflecting higher prices for gold during most of that period.

After reaching a low in 1986, exploration and deposit appraisal expenditures for base metals increased until 1990. They declined again in 1991 through 1993. During 1992, the decrease in precious-metal spending was much more severe than that in base metals. Consequently, total expenditures for base-metal exploration and deposit appraisal 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 an 88% increase in base-metal expenditures over the period 1993-96. The 11% decline registered in base-metal exploration and deposit appraisal spending in 1997 marked the beginning of another downward trend caused by declining metal prices.

In 1987 and 1988, expenditures for the search for all non-petroleum mineral commodities (excluding uranium) other than base and precious metals (**Figure 41**) accounted for only about 3% of total Canadian exploration and deposit appraisal expenditures. In 1989 and 1990, expenditures directed at these other mineral commodities (excluding uranium) more than doubled in

Figure 41
Exploration and Deposit Appraisal Expenditures in Canada, by Commodity Sought, 1975-97



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: Includes field and overhead expenditures only. 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.

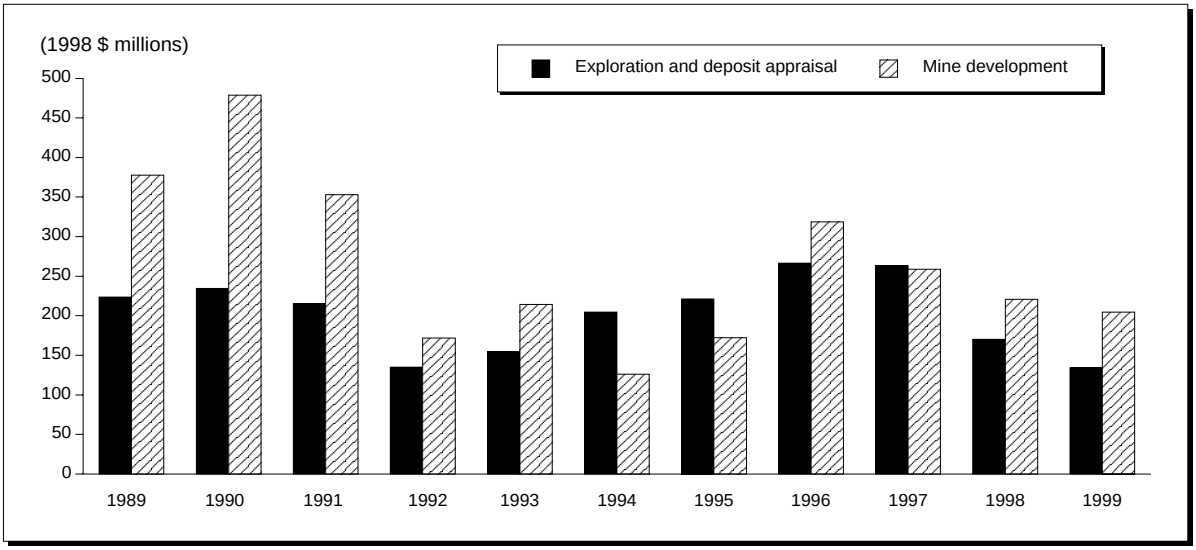
percentage terms, but did not actually increase significantly in constant dollar terms. In 1991, expenditures for "other" (excluding uranium) reached a low in both percentage and constant dollar terms. They started increasing again in 1992, both in percentage and in constant dollar terms, and they increased substantially in 1993 to reach between 24% 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 these higher expenditures in the "other" minerals and metals category. In 1997, spending targeted at the "other" category declined to $150 million. As opposed to the decline in base- and precious-metals exploration, which is due to lower prices, the lower exploration spending on this "other" category can be explained by a shifting of funds away from exploration and deposit appraisal to mine development and construction in the diamonds sector.

6.8 EXPLORATION, DEPOSIT APPRAISAL AND MINE DEVELOPMENT EXPENDITURES BY FOREIGN-CONTROLLED FIRMS

Foreign companies (see Appendix for definition) have long recognized Canada's mineral potential and have been contributing significantly to exploration, deposit appraisal and mine 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 25% of spending on exploration and deposit appraisal in Canada and for a similar proportion of mine development expenditures.

In 1998, foreign firms spent some $170 million (**Figure 42**) on exploration and deposit appraisal in Canada, some $92 million less than they did in 1997. This decrease can be explained by a number of factors, including the shifting of diamond exploration and deposit appraisal expenditures to mine development and construction activities (for example, the Ekati diamond mine has a large Australian ownership component), lower metal prices, and the return

Figure 42
Exploration, Deposit Appraisal and Mine Development Expenditures in Canada by Foreign-Controlled Firms, 1989-99



Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies, and on Statistics Canada's Intercorporate Ownership.
Notes: Data for 1998 are preliminary; 1999 data are based on company spending intentions as compiled in January 1999. For comparison with pre-1997 years, the data include only off- and on-mine-site field and overhead exploration and deposit appraisal expenditures. "Mine development expenditures" include expenditures on a property that is in production or committed to production to outline, block out and gain access to the ore and prepare it for production. They also include drilling and rock work to extend known mineral deposits already in production or committed to production.

of Falconbridge Limited to Canadian control. Much like exploration and deposit appraisal spending by Canadian firms, exploration and deposit appraisal expenditures by foreign-controlled companies in Canada are expected to continue their decline in 1999 with a forecast level of $134 million. In terms of mine development expenditures, spending by foreign firms reached $221 million in 1998 and is forecast to decline to $204 million in 1999, a decrease of 7%.

Actual amounts spent by foreign firms on exploration, deposit appraisal and mine 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.

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, Natural Resources Canada (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 both non-producing and 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*. Statistics from this survey include detailed information on feasibility studies and other more technically related costs that were previously excluded. The redesigned survey also provides a clearer distinction between the primary exploration and deposit appraisal phases, and additional information on associated environmental costs.

SURVEY PROCESS

Two questionnaires are distributed each year. For example, for the survey period 1998/99, the *preliminary* survey was conducted during the last quarter of 1998 and January 1999, while the more detailed *final* survey questionnaires were distributed in early 1999. The results of this *final* survey will be compiled during the course of 1999. The *preliminary* survey provides preliminary results on 1998 exploration activity and a forecast for 1999 that is based on company spending intentions. The *final* survey provides a wealth of project-specific information, including specific commodities explored for, the type of field work undertaken, related overhead expenditures, the type of company involved, joint-venture partners, and other details.

A total of 1829 questionnaires (preliminary survey) were distributed in October 1998. 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 projects. Companies are now asked to report expenditures for the calendar year surveyed.

The survey is a full census of all the companies involved in mineral exploration, deposit appraisal and mine complex development 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 expenditures 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 1998 and January 1999 and the final survey for 1998 conducted throughout 1999 may give rise to discrepancies between the two surveys.

Spending intentions, which are also compiled in the preliminary survey, may often be modified by events that can limit the availability of funds for conducting exploration, deposit appraisal and mine complex development 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 23**, the results of this survey of spending intentions should not be interpreted as always being an accurate reflection of the work that will ultimately be performed in 1999.

Table 23 shows intentions, as well as preliminary and actual expenditures, when available, for off-mine-site and on-mine-site exploration and deposit appraisal for the years 1986-99. 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 1996-97, this pattern was reversed. A possible explanation for the 1986-88 period could be that more flow-through share 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, funding was probably more readily available than originally expected as a result of the interest generated by the discovery of diamonds in Canada's North and of nickel-copper-cobalt at Voisey's Bay in Labrador. Actual expenditures were less than intentions in 1996 and 1997 as lower metal prices began to set in, activity began to diminish around the Voisey's Bay deposit, and some junior companies had to revise their financing objectives down. Since the 1997, 1998 and 1999 data on 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, 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.

TABLE 23. CANADA, COMPARISON OF INTENTIONS, PRELIMINARY AND ACTUAL EXPLORATION EXPENDITURES, 1986-98

Exploration Expenditures	Intentions	Preliminary	Actual	Actual/Intentions
		($ millions)		(%)
1986				
On-mine-site	87.5	110.2	108.6	
Off-mine-site	431.2	483.6	589.3	
Total	518.7	593.8	697.9	+35
1987				
On-mine-site	122.6	121.5	161.0	
Off-mine-site	583.2	849.6	1 139.0	
Total	705.8	971.1	1 300.0	+84
1988				
On-mine-site	154.7	138.7	143.0	
Off-mine-site	891.0	1 107.9	1 207.0	
Total	1 045.7	1 246.6	1 350.0	+29
1989				
On-mine-site	111.7	160.0	115.3	
Off-mine-site	832.2	766.7	712.5	
Total	943.9	926.7	827.8	–12
1990				
On-mine-site	150.0	107.7	112.4	
Off-mine-site	633.0	643.5	662.3	
Total	783.0	751.2	774.7	–1
1991				
On-mine-site	97.9	80.4	67.3	
Off-mine-site	548.3	514.4	464.4	
Total	646.2	594.8	531.7	–18
1992				
On-mine-site	71.2	75.4	59.4	
Off-mine-site	426.3	344.2	325.9	
Total	497.5	419.6	385.3	–23
1993				
On-mine-site	70.1	78.1	64.0	
Off-mine-site	364.5	404.9	413.2	
Total	434.6	483.0	477.2	+10
1994				
On-mine-site	66.0	68.3	72.3	
Off-mine-site	470.9	561.8	555.8	
Total	536.9	630.1	628.1	+17
1995				
On-mine-site	67.9	76.9	86.4	
Off-mine-site	586.8	686.6	631.2	
Total	654.7	763.5	717.6	+10
1996				
On-mine-site	79.4	98.3	99.6	
Off-mine-site	865.8	774.2	795.2	
Total	945.2	872.5	894.8	–5
1997				
On-mine-site	104.8	152.6	153.1	
Off-mine-site	771.2	651.6	667.1	
Total	876.0	804.2	820.2	-6
1998				
On-mine-site	121.5	142.0		
Off-mine-site	645.9	459.1		
Total	767.4	601.1	. .	. .
1999				
On-mine-site	106.3			
Off-mine-site	382.3			
Total	488.6	. .	. .	. .

Source: Natural Resources Canada, based on the federal-provincial survey of mining and exploration companies. For comparison with pre-1997 years, the data include only off- and on-mine-site field and overhead expenditures
. . Not available.

Deposit appraisal expenditures represent all activities, 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 carried out on a property that is in production or committed to production to outline, block out, and gain access to the ore and 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 and capital expenditures applied to exploration or deposit appraisal for an additional mineral deposit separate from the current mine reserves strictly on an existing mine site in production or committed to production.

Off-mine-site expenditures represent all activities 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 temporarily or permanently closed mines and advanced projects not yet committed to production.

A *mine site* is an area that can be assessed 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, economics 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 of 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 and 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 construction, machinery and equipment include expenditures by the company for work performed by contractors or by the company from 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-related 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 and deposit appraisal 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 and deposit appraisal projects. Junior companies, on the other hand, usually have no regular source of income and must finance their exploration and deposit appraisal activities through the issuance of treasury shares.

7. Canadian Exploration Activity Around the World

7.1 INTRODUCTION

This section provides an overview of Canadian exploration[1] activity abroad. It also highlights the domestic and foreign components of the larger-company exploration market in Canada. The information in this review[2] was current as at March 1999.

7.2 GLOBAL MARKET FOR MINERAL EXPLORATION

Although it became considerably more difficult to raise risk capital during 1997 than during the previous year, exploration programs around the world for precious metals, base metals and diamonds were, in total, remarkably close to budget. In 1998, however, global exploration activity by companies of all sizes fell to an estimated $5.0 billion (US$3.5 billion) from $7.0 billion (US$5.1 billion) the previous year, or down by roughly 30%. Programs were reduced in most countries, but were postponed or abandoned entirely in some developing countries.

Global trends in worldwide mineral exploration are based largely on data for the world's larger companies, defined here as those with annual exploration budgets greater than $4 million (US$3 million). In 1998, 182 companies planned to spend more than $4 million on exploration, down from a record 279 in 1997. During 1998, the world's larger companies were expected to undertake programs with a combined value of $4.0 billion (US$2.8 billion), which represents over 80% of the global market for mineral exploration.

7.3 LARGER CANADIAN-BASED COMPANIES

In 1996, mining companies listed on Canadian stock exchanges raised a record amount of capital.[3] As a result, the number of Canadian-based companies that planned to spend more than $4 million on exploration around the world grew to a record 141 during 1997, up from 94 in 1996 and only 55 in 1995.

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[1] Most of the information on the larger-company mineral exploration market worldwide is based on *Corporate Exploration Strategies: A Worldwide Analysis*, published annually by the Metals Economics Group (MEG), Halifax, Nova Scotia. MEG counts, as exploration, work from the earliest stage through perimeter drilling, reconnaissance and evaluative forays as well as work to further quantify and define an identified orebody once the target outline stage has been completed. It also counts as exploration all feasibility work up to the point of a production decision.

[2] Chapter 7 is based on an article from the 1998 *Canadian Minerals Yearbook* published by Natural Resources Canada.

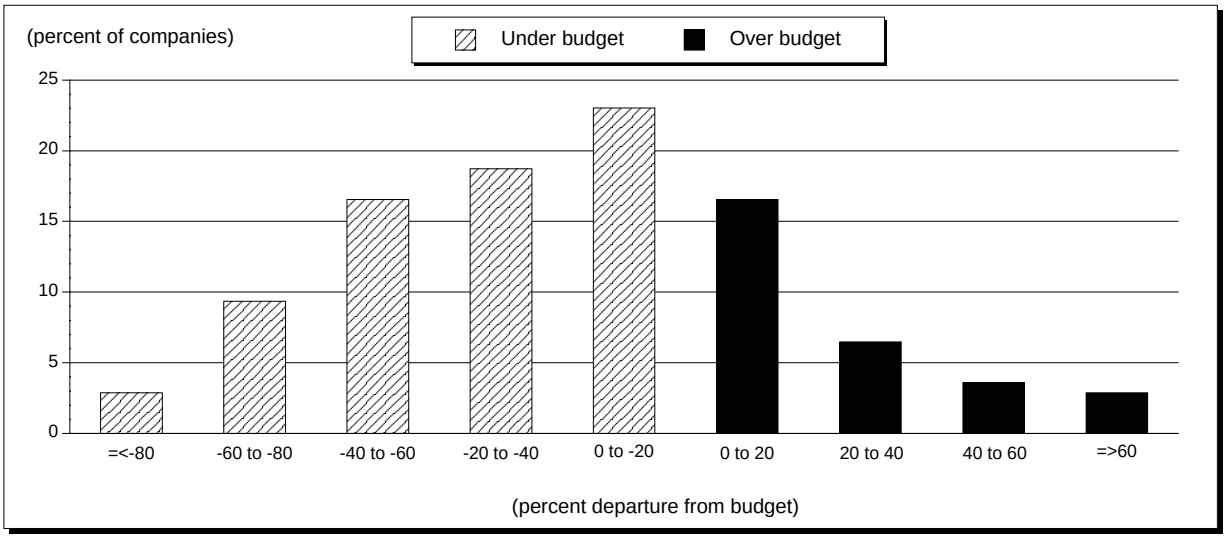
[3] Keith J. Brewer and André Lemieux, *Canada's Global Position in Mining - Canadian Financing of the International Mining Industry*, Metals Finance 4th International Conference, Toronto, May 7-9, 1997, Natural Resources Canada, Ottawa, 53 pp.

Nonetheless, during 1997, the larger Canadian-based companies underspent their exploration budgets, in aggregate, by $160 million, or by about 8% less than they had planned (**Figure 43**). One third of them (94 companies) spent less than budgeted, while a little more than one quarter (37 companies) spent more than budgeted. Individual company departures from 1997 plans ranged from $25 million under budget to $34 million over budget. In general, companies that exceeded their program budgets during 1997 did so in response to new discoveries or other opportunities that arose during the year.

Many of the larger Canadian-based companies derive little or no substantial revenues from mineral production and, therefore, rely almost entirely on the stock market to finance their exploration programs. Because of investor uncertainty during 1997 and 1998, the number of Canadian-based companies that planned to spend more than $4 million on exploration in 1998 decreased to 83. The total amount that these companies planned to spend on mineral exploration in both Canada and elsewhere around the world fell to $1.3 billion in 1998 (**Figure 44**) from $1.9 billion the previous year, or down by 34%. Nonetheless, during 1998, Canadian-based companies planned to undertake more than 30%, and the dominant share by far, of all the larger-company exploration programs around the world. In 1997, Canadian programs accounted for a record 35% of all worldwide mineral exploration activity.

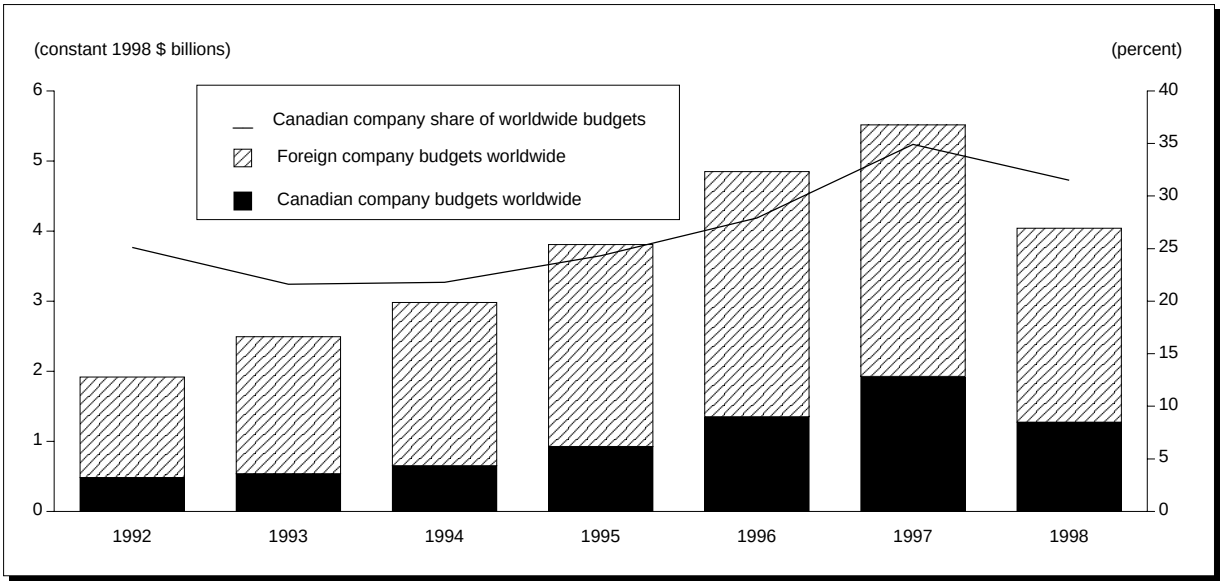
Relatively fewer of the many companies that budgeted only somewhat more than $4 million in 1997 were able to raise a similar amount for exploration in 1998. As a result, the average company budget for 1998 increased. In the case of the larger Canadian-based companies, the mean budget for 1998 increased to $15.4 million and the median to $7.1 million, up from $13.7 million and $6.4 million respectively the previous year.

Figure 43
Departure of Global Exploration Expenditures from Budgets, 1997
Canadian-Based Companies with 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.
Note: During 1997, the aggregate expenditures of 139 larger Canadian-based companies were more than $160 million or 8% under budget.

Figure 44
Exploration Budgets of the World's Larger Companies, by Origin, 1992-98
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: The worldwide exploration budgets of companies that intended to spend less than $4 million (US$3 million) annually are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

At the end of 1998, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of more than 6800 exploration or producing properties (**Figure 45**) located in Canada or in more than 100 countries around the world.[4] Most of this portfolio is at the exploration stage.

7.4 LARGER-COMPANY EXPLORATION MARKET IN CANADA

In 1998, the larger-company mineral exploration market in Canada was valued at $440 million (**Figure 46**). The balance of the Canadian market is held mainly by smaller companies, the activities of which are not addressed specifically here. At the end of 1998, there were more than 3500 mineral properties with recent exploration activity in this country.[5]

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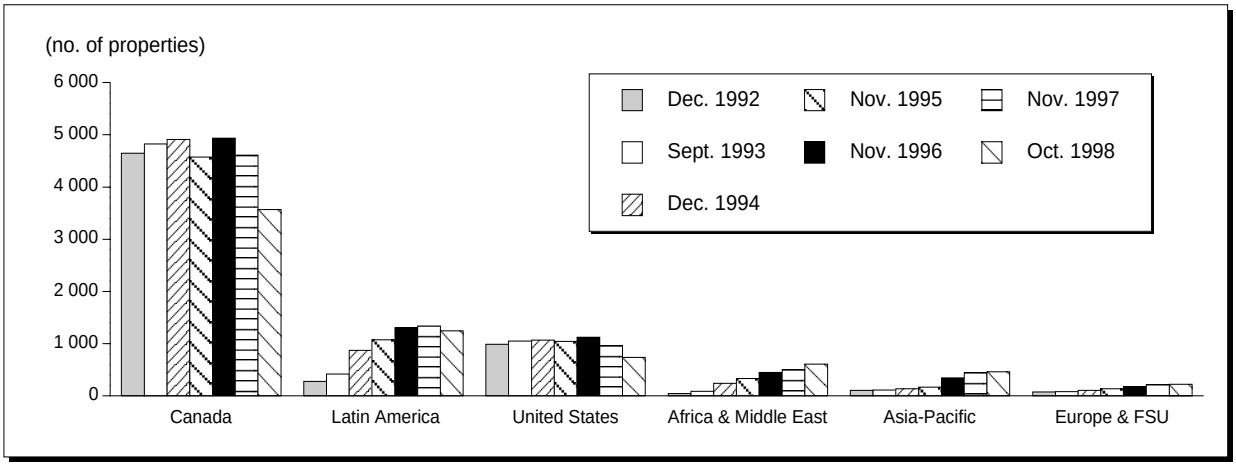
[4] Most of the information for 1991 through 1997 on the mineral property portfolio of companies of all sizes listed on Canadian stock exchanges is derived from the *Min-Met Canada* database; for 1998, it is derived from the *Info-Mine* database. These are both products of Robertson Info-Data Inc., Vancouver, British Columbia.

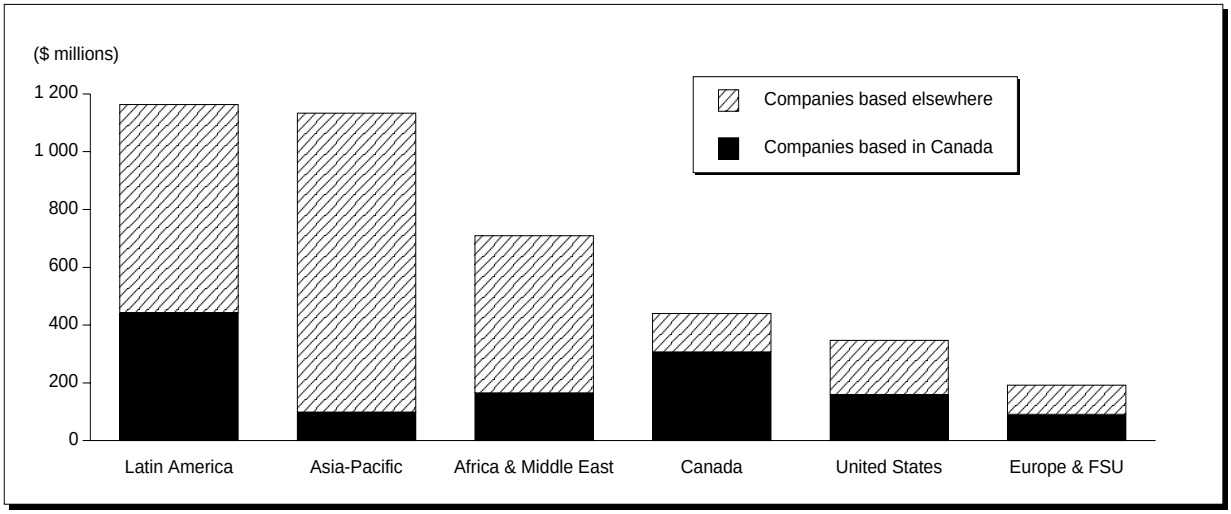
[5] For trends in mineral deposit appraisal activity in Canada over the interval 1982-97, and for a list of projects at the deposit appraisal stage in early 1997, see André Lemieux, "Canada's Global Mining Presence," in the 1996 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa,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

Figure 45
Canadian Mineral Property Portfolio Worldwide, by Region, 1992-98
Companies of All Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* database for 1992-97 and *Info-Mine* database for 1998, ROBERTSON INFO-DATA Inc., Vancouver, British Columbia, and used under licence.

Figure 46
Exploration Budgets of the World's Larger Companies for Selected Regions of the World, 1998
Companies with Worldwide Budgets of at Least $4 Million (US$3 Million)
for Precious-Metal, Base-Metal or Diamond Exploration



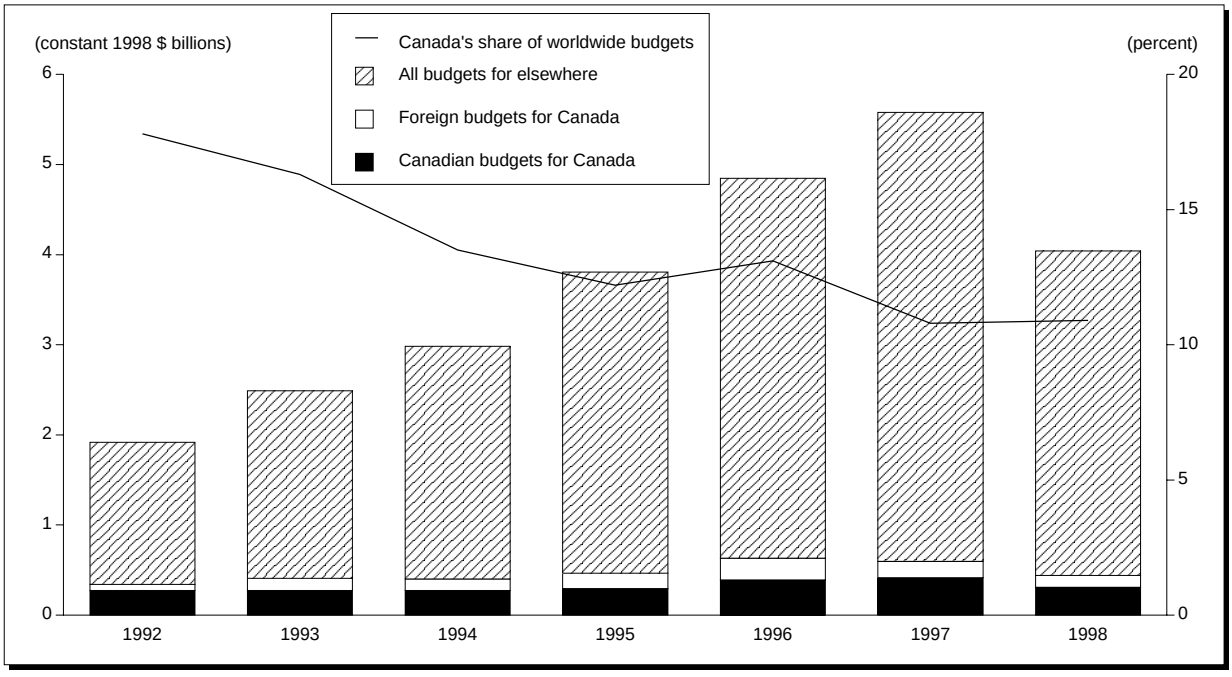
Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: The worldwide exploration budgets of companies that intended to spend less than $4 million (US$3 million) annually are excluded. The worldwide exploration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

In 1998, 66 of the world's larger domestic-based or foreign-based companies allocated budgets for exploration in Canada. Their aggregate budgets for 1998 for this country were down by $155 million, or by more than 25%, compared with those for 1997. Nonetheless, almost 11% of the exploration programs of all the world's larger companies were destined for Canada (**Figure 47**), slightly more than in 1997. However, Canada's share of worldwide exploration activity has fallen gradually from about 18% in 1992 because of the mammoth increase in exploration activity that occurred in Latin America, Asia and Africa starting in the early 1990s.

In 1998, 49 of the larger Canadian-based companies allocated over $300 million for exploration in Canada. This represents a reduction of almost $110 million, or 26%, from the $417 million budgeted in 1997. Canadian-based companies control 70% of the larger-company market in Canada. Australia is the only other country where domestic companies control as large a share of their domestic larger-company market for mineral exploration. In 1992, Canadian-based companies controlled 80% of the larger-company market in Canada but, with increasing globalization, their share has fallen gradually as foreign-based companies have increased their investment 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. Still, Canada remains the country where Canadian companies spend the most, by far, on mineral exploration (**Figure 48**).

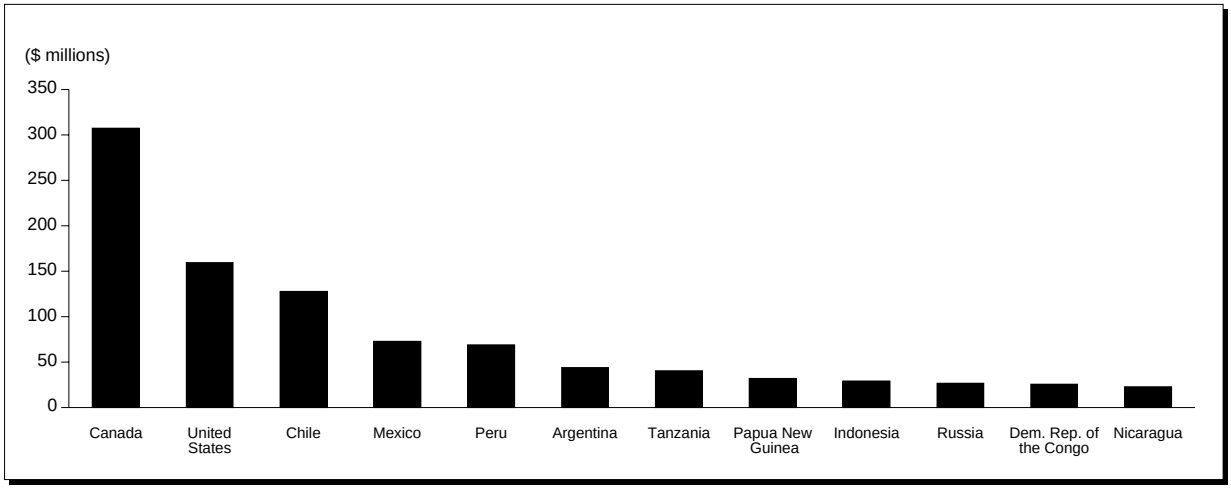
During 1998, the larger foreign-based multinationals planned to spend over $130 million on mineral exploration in Canada (**Figure 47**), or 30% of all exploration programs planned for this country. Compared with 1997, their budgets decreased by about one quarter. Nonetheless, their budgets are still considerably larger than the $70 million budgeted in 1992, which represented less than 20% of all exploration programs then planned for Canada.

Figure 47
Exploration Budgets of the World's Larger Companies for Canada and Elsewhere, 1992-98
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: The worldwide exploration budgets of companies that intended to spend less than $4 million (US$3 million) annually are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

Figure 48
Exploration Budgets of the Larger Canadian-Based Companies, 1998 – Countries Accounting for 80% of Canadian 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: The worldwide exploration budgets of companies that intended to spend less than $4 million (US$3 million) annually are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

The larger foreign-based companies active in Canada include the Ashton Group, BHP Minerals Pty Ltd., QNI Ltd. and WMC Limited, all based in Australia; Battle Mountain Gold Company, Cyprus Amax Minerals Company, Echo Bay Mines Ltd., Freeport-McMoRan Copper & Gold, the Homestake Group, Newmont Gold Company and Phelps Dodge Corporation, all based in the United States; Billiton Plc., the Minorco Group, the Outokumpu Group and the Rio Tinto Group, all based in Europe; the De Beers Group, based in South Africa; and Korea Zinc Co. Ltd.

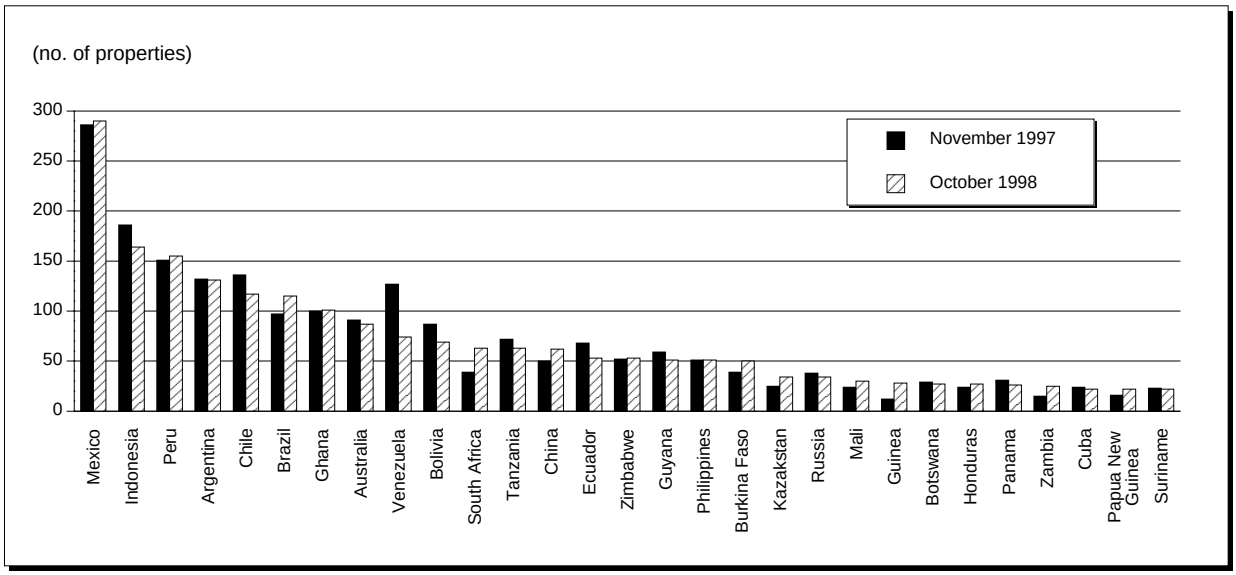
7.5 LARGER CANADIAN-BASED COMPANIES ABROAD

In 1998, the larger Canadian-based companies planned to spend $967 million on mineral exploration outside Canada (**Figure 46**). The proportion of their budgets allocated to foreign programs was almost 76% in 1998. That proportion peaked at over 78% in 1997, up from only 43% in 1992.

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 mid-1991, that ratio was 0.84 for Europe and the former Soviet Union (FSU), 0.80 for Latin America, 0.77 for Africa, and 0.67 for Asia-Pacific. By late 1998 it had increased to over 0.93 for Latin America and to 0.90 for both Africa and Asia-Pacific. In comparison, the ratio of exploration properties to the total number of properties held in Canada remained roughly constant at 0.96 between 1991 and 1997. In late 1998 it was 0.95.

At the end of 1998, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of almost 3300 mineral properties located abroad (**Figure 45**). Foreign properties now represent almost half of the total mineral property portfolio held by these companies, up from

Figure 49
Canadian Mineral Property Portfolio Abroad, 1997 and 1998 – Countries Accounting for 80% of Canadian Holdings Located Outside the United States in 1998
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* database for 1992-97 and Info-Mine database for 1998, ROBERTSON INFO-DATA Inc., Vancouver, British Columbia, and used under licence.

about 25% in 1992.[6] Between 1992 and 1998, their holdings of foreign mineral properties grew at an average annual compound rate of almost 14%. Apart from the United States, where companies of all sizes listed on Canadian stock exchanges have a substantial mining presence, roughly two dozen other nations, spread across the globe, account for 80% of the balance of their mineral property portfolio held abroad (**Figure 49**).

7.5.1 United States

In 1998, the larger-company mineral exploration market in the United States was valued at $350 million (**Figure 46**), or about 9% of the $4.0 billion larger-company market worldwide. In spite of global retrenchment, over 30 of the larger Canadian-based companies planned to spend a total of about $160 million in the United States, about the same as in 1997. Because companies based in other countries considerably reduced their exploration programs for the United States during 1998, Canadian-based companies increased their share of the larger-company exploration market in that country to 46%, up from 32% in 1997. The United States ranks second in the world as the country where Canadian companies are the most active.

Canadian companies planned to spend almost $40 million more than U.S. companies in the United States during 1998. As a result, they became the leading explorationists in that country. 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 11% since the early 1990s.

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6 For a discussion of social issues related to Canadian investment in the mineral industry of developing countries, see Moira Hutchinson, "Beyond Best Practice - The Mining Sector," Chapter 4 in *The Canadian Development Report 1998 - Canadian Corporations and Social Responsibility,* The North-South Institute, 1998, Ottawa, pp. 74-90.

In late 1998, companies of all sizes listed on Canadian stock exchanges held over 700 mineral properties in the United States (**Figure 45**). They had projects in 31 states, but mainly in the western part of the country in Nevada, California, Alaska, Arizona, Idaho, Montana, Washington, Utah, Wyoming, Colorado, New Mexico and South Dakota. Nevada alone accounted for almost 300 of their mineral properties, or about 40% of the Canadian portfolio in the United States.

Although Canadian companies have expanded their activities considerably in 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 1998, the United States accounted for over 20% of all properties held abroad by these companies.

Of all the Canadian-based companies, Teck Corporation, Placer Dome Inc. and Barrick Gold Corporation planned the largest exploration programs in the United States during 1998. Together they planned to spend almost $80 million there. Teck planned to spend much of its $35 million budget for the United States on the Pogo (Stone Boy) gold deposit in Alaska. Placer Dome planned to spend much of its almost $23 million budget for the United States on the Donlin Creek gold project in Alaska and on the Pipeline and South Pipeline gold projects located on the Battle Mountain-Eureka gold trend in Nevada. Barrick planned to spend over $20 million, much of it on further exploration at the Betze-Post, Dee, Meikle and Pinson mines in Nevada.

7.5.2 Latin America and the Caribbean

In 1998, the larger-company mineral exploration market in Latin America and the Caribbean was valued at $1.2 billion (**Figure 46**), or almost 29% of the $4.0 billion larger-company market worldwide. Latin America accounts for the largest concentration of Canadian mineral exploration activity. During 1998, the larger Canadian-based companies planned to spend over $440 million there. However, this amount represents a decrease of more than $250 million, or over 36%, compared with 1997.

In spite of significant decreases since 1997, 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 30% between 1992 and 1998. In 1998, these companies held more than 38% of the larger-company market in the region, by far the largest share. In addition, they held the dominant share of the exploration activity in several countries in the region.

At the end of 1998, companies of all sizes listed on Canadian stock exchanges held interests in over 1200 mineral properties in the region. Since 1996, the total number of mineral properties held by Canadian companies in Latin America and the Caribbean has exceeded the number held in the United States (**Figure 45**).

7.5.2.1 Mexico

In 1998, the larger-company mineral exploration market in Mexico was valued at over $180 million, or 4.5% of the $4.0 billion larger-company market worldwide. Twenty of the larger Canadian-based companies planned to spend, in total, more than $70 million in that country, equivalent to 40% of the market, and the dominant share. Mexico ranks second as the country of Latin America and the fourth in the world where Canadian companies are the most active (**Figure 48**).

During 1994, there was a significant increase in the average size of the mineral property portfolio held in Mexico by companies of all sizes listed on Canadian stock exchanges.[7] At the end of 1998, these companies held interests in projects in 18 of the country's 31 states.

Cambior Inc. planned the largest Canadian exploration program in Mexico during 1998. The company planned to spend over $15 million there, most of it on its Cerro San Pedro gold-silver project.

7.5.2.2 South America

In 1998, the larger-company mineral exploration market in South America was valued at $850 million, or over 20% of the $4.0 billion larger-company market worldwide. Thirty of the larger Canadian-based companies planned to spend about $300 million in total in the region, equivalent to almost 35% of the market there. Canadian companies held the dominant share of the market in Argentina, Bolivia, Chile, Colombia, Guyana and Peru.

Chile is the country of South America where Canadian-based companies conduct the largest portion of their exploration programs (**Figure 48**). Chile also ranks third in the world as the country where Canadian companies are the most active. Placer Dome planned to spend a large part of its almost $39 million budget for Chile on the Cerro Casale (Aldebaran) gold-copper project, while Barrick planned to spend about $30 million on the Pascua gold project. Elsewhere in South America, Orvana Minerals Corporation planned to spend almost $8 million on the Don-Mario gold-copper deposit in Bolivia, Greystar Resources Ltd. planned to spend almost $6 million in Colombia, and Cambior planned to spend over $2 million at the Omai gold mine and the Hicks gold deposit in Guyana.

At the end of 1998, companies of all sizes listed on Canadian stock exchanges held more than 800 mineral properties throughout South America. They held more than 150 properties in Peru and more than 100 in each of Argentina, Chile and Brazil.

7.5.2.3 Central America

In 1998, the larger-company mineral exploration market in Central America was valued at about $40 million, or 1% of the $4.0 billion larger-company market worldwide. One dozen of the larger Canadian-based companies planned to spend almost all of that amount. They held the dominant share of the market in Costa Rica, Salvador, Honduras, Nicaragua and Panama.

In 1998, four Canadian-based companies planned the largest exploration programs in five countries of Central America: Placer Dome planned to spend almost $8 million in Costa Rica; Kinross Gold Corporation planned to spend about $0.7 million on the El Dorado and the Potonico gold projects in Salvador; Greenstone Resources Ltd. planned to spend over $7 million at the San Andres gold mine in Honduras, and also planned to spend nearly $11 million at the La Libertad gold mine and almost another $4 million at the Bonanza gold mine, both in Nicaragua; and Teck planned to spend over $1 million at the Petaquilla copper-gold project in Panama.

At the end of 1998, companies of all sizes listed on Canadian stock exchanges held about 100 mineral properties throughout Central America. They held 20 or more in each of Honduras and Panama.

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[7] 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. 23-34.

7.5.2.4 Caribbean

In 1998, the larger-company mineral exploration market in the Caribbean was valued at over $15 million. The larger Canadian-based companies planned to spend $1 million there, equivalent to roughly 7% of the market.

At the end of 1998, companies of all sizes listed on Canadian stock exchanges held about 40 mineral properties in the Caribbean, about half of them in Cuba.

7.5.3 Europe and the Former Soviet Union

In 1998, the larger-company mineral exploration market in Europe and the former Soviet Union (FSU) was valued at over $190 million (**Figure 46**), or roughly 5% of the $4.0 billion larger-company market worldwide. The larger Canadian-based companies planned to spend over $90 million there, equivalent to almost half the market. At the end of 1998, companies of all sizes listed on Canadian stock exchanges held about 225 mineral properties in the region (**Figure 45**).

7.5.3.1 Western Europe

In 1998, the larger-company mineral exploration market in western Europe was valued at almost $70 million, or roughly 2% of the $4.0 billion larger-company market worldwide. The larger Canadian-based companies planned to spend $25 million there, equivalent to about 37% of the market. They held the dominant share in Greenland and Sweden.

During 1998, three Canadian-based companies planned the largest programs in three countries of western Europe: Dia Met Minerals Ltd. planned to spend almost $2 million on exploration for diamonds in Greenland; Noranda Inc. planned to spend over $2.5 million on grass-roots exploration for zinc-lead deposits in Ireland; and Boliden Limited planned to spend two thirds of its $15 million budget for Europe at, or around, its mining leases in Sweden.

At the end of 1998, 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 Sweden, Portugal, Finland and Greenland.

7.5.3.2 Eastern Europe

In 1998, the larger-company mineral exploration market in eastern Europe was valued at $38 million, or roughly 1% of the $4.0 billion larger-company market worldwide. The larger Canadian-based companies planned to spend about $27 million there, equivalent to almost 70% of the market.

Canadian-based companies held the dominant share of the market and planned the largest programs in four countries of eastern Europe: TVX Gold Inc., alone, planned to spend almost $10 million in Greece, mainly on its Olympias and Skouries deposits; Nebex Resources Ltd. planned to spend $7 million in Albania; Gabriel Resources Limited planned to spend over $4 million in Romania; and Cominco Ltd. planned to spend over $2 million searching for gold in Turkey.

At the end of 1998, companies of all sizes listed on Canadian stock exchanges held about 50 mineral properties in eastern Europe. They held one dozen or more in each of Turkey and Slovakia.

7.5.3.3 Former Soviet Union

In 1998, the larger-company mineral exploration market in the FSU was valued at over $70 million, or roughly 2% of the $4.0 billion larger-company market worldwide. The larger Canadian-based companies planned to spend over $35 million in these countries.

Since the early 1990s, there has been growing Canadian interest in participating in mineral opportunities in the FSU. At the end of 1998, companies of all sizes listed on Canadian stock exchanges held interests in over 80 mineral properties in seven countries of the FSU.

Russia is by far the country of the FSU where Canadian companies are the most active. In 1998, a dozen of these companies planned to spend almost $27 million in total on exploration there, about the same amount as in 1997 and the dominant share of the market. The number of properties held in Russia by companies of all sizes listed on Canadian stock exchanges increased significantly starting in 1996 and now stands at over 30. Archangel Diamond Corporation, with the largest exploration budget for Russia, planned to spend over $13 million exploring for diamonds in the Verkhotina licence area.

Kazakstan also has become increasingly attractive to Canadian companies. During 1998, the portfolio of mineral properties held in that country by companies of all sizes listed on Canadian stock exchanges increased to over 30.

7.5.4 Africa and the Middle East

In 1998, the larger-company mineral exploration market in Africa and the Middle East was valued at almost $710 million (**Figure 46**), or almost 18% of the $4.0 billion larger-company market worldwide. The larger Canadian-based companies planned to spend $165 million in Africa,[8] equivalent to over 23% of the market on that continent.[9] In addition, they planned to spend about $0.6 million in the Middle East.

During 1998, nine of the larger Canadian-based companies planned the largest mineral exploration programs in eight countries of Africa: Sutton Resources Ltd. planned to spend over $30 million in Tanzania; SouthernEra Resources Limited planned to spend over $17 million exploring for diamonds in Angola; Tenke Mining Corp. planned to spend $14 million and Banro Resource Corporation planned to spend $11 million in the Democratic Republic of the Congo; High River Gold Mines Ltd. planned to spend $7 million on its Taparko gold project in Burkina Faso; Samax Gold Inc. planned to spend $0.7 million in the Congo; Messina Diamond Corporation planned to spend $7 million in Lesotho; Etruscan Resources Inc. planned to spend almost $6 million in Niger; and DiamondWorks Ltd. planned to spend $0.4 million in Sierra Leone.

Between 1992 and 1998, 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 over 50%. As a result, at the end of 1998, these companies held interests in over 600 mineral properties in 34 countries there. They held interests in about 100 properties in Ghana, in about 60 in each of South Africa and Tanzania, and in about 50 in each of Zimbabwe and Burkina Faso.

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[8] For a review of certain economic, political and social aspects of mineral investment in Africa, see Bonnie Campbell, "Liberalisation, deregulation, state promoted investment - Canadian mining interests in Africa," *Journal of Mineral Policy, Business and Environment, Raw Materials Report*, Volume 13, No. 4, 1998, pp.14-34.

[9] For details on Canadian mineral exploration activity in Africa, see "La ruée vers l'Afrique" and "Les grands projets miniers" in *Stratégies - Le magazine des gens d'affaires du Canada, de l'Afrique et de la francophonie*, mai-juin 1998, Les Publications du Scorpion, Montréal, pp. 16-23.

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. Some of the commodities of interest to Canadians on that continent are not currently produced in Canada or there is not much exploration for them in this country.

7.5.5 Asia-Pacific

In 1998, the larger-company exploration market in Asia-Pacific was valued at over $1.1 billion (**Figure 46**), or roughly 28% of the $4.0 billion larger-company market worldwide. The market in Asia-Pacific has become almost as large as the one in Latin America. The larger Canadian-based companies planned to spend about $100 million in the region, equivalent to roughly 9% of the market there. At the end of 1998, companies of all sizes listed on Canadian stock exchanges held interests in over 450 mineral properties in the region (**Figure 45**).

7.5.5.1 Southeast Asia

In 1998, the larger-company mineral exploration market in Southeast Asia was valued at over $360 million, or 9% of the $4.0 billion larger-company market worldwide. The larger Canadian-based companies planned to spend over $70 million in Southeast Asia, equivalent to almost 20% of the market there. They held the dominant share of the market in each of Myanmar, Papua New Guinea and Thailand.

In Indonesia, eight of the larger Canadian-based companies planned to spend $30 million in total, equivalent to 15% of the more than $190 million exploration market in that country. Inco Limited alone planned to spend almost $8 million on grass-roots exploration there.

At the end of 1998, companies of all sizes listed on Canadian stock exchanges held almost 270 mineral properties in Southeast Asia. They held over 160 in Indonesia and about 50 in the Philippines.

7.5.5.2 East Asia

In 1998, the larger-company mineral exploration market in east Asia, which includes China, Japan, Mongolia, Taiwan and South Korea, was valued at about $37 million, or 1% of the $4.0 billion larger-company market worldwide. The larger Canadian-based companies planned to spend over $7 million there, equivalent to about 20% of the market.

Over the past four years, China has become increasingly attractive to Canadian mining companies. In late 1998, companies of all sizes listed on Canadian stock exchanges held interests in over 60 mineral properties in that country.

7.5.5.3 South Pacific

In 1998, the larger-company mineral exploration market in the South Pacific was valued at over $710 million, or 18% of the $4.0 billion larger-company market worldwide. Australia accounted for almost all of that market.

The larger Canadian-based companies planned to spend about $20 million in the region in 1998, all of it in Australia. The larger Canadian-based companies held about 3% of the market in that country.

At the end of 1998, companies of all sizes listed on Canadian stock exchanges held over 100 properties in the South Pacific, of which almost 80% were in Australia.

7.6 OUTLOOK

During 1996, a record amount of equity financing was raised in Canada for exploration companies listed on Canadian stock exchanges. As a result, these companies had the capital to conduct, during 1997, more mineral exploration programs worldwide than those of any other nation. In spite of the subsequent uncertainty in capital markets, worldwide exploration expenditures were remarkably close to budgets during 1997.

In 1997 and 1998, it became progressively more difficult to raise risk capital. As a result, worldwide exploration programs in 1998 were curtailed by about one third compared with those of 1997. In 1998, in spite of continuing uncertainty in global markets, the proportion of exploration budgets allocated to Canada stood at almost 11%, slightly larger than in 1997. In addition, Canadian-based companies conducted almost one third of the world's mineral exploration programs, more than any other nation.

Canadian companies consolidated their position in the Americas during 1998. For the first time, they became the dominant explorationists in the United States, accounting for almost half of the activity there. Furthermore, they continued to conduct the largest share of exploration programs, not only in Canada, but also in Mexico, South America, Central America and Europe. Although Canadian companies have diversified their portfolio of mineral projects to well over 100 countries, Canada remains the country where they are, by far, the most active.

Investor uncertainty continues to depress exploration finance markets, and a return to the record levels of financing raised in Canada in 1996 for exploration worldwide is not yet in sight. A number of multi-nationals have announced sizeable reductions in exploration programs for 1999. The level of junior company exploration activity around the world will continue to decline until the demand for mineral commodities rises, their prices increase in response, and investor confidence is restored. In the meantime, Canadian companies are likely to continue to dominate mineral exploration, especially in the Americas.