Overview of Trends in Canadian mineral exploration

Canadian Intergovernmental Working Group on the Mineral Industry

2000

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

Unless indicated otherwise, the data contained in this report are current as of June 2000 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.

The report can be accessed via the Minerals and Metals Sector's home page on the Internet at http://www.nrcan.gc.ca/mms/efab/invest/exploration.

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Executive Summary

According to the federal-provincial/territorial *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures*, all-inclusive exploration and deposit appraisal expenditures in Canada have declined significantly since 1997, when they amounted to $921 million. Most of that decline occurred in 1998 when spending dropped by $265 million (29%) to $656 million. In 1999, the downward trend continued with a further 24% year-on-year decrease to $501 million. Company spending intentions (compiled in January 2000) predict total expenditures of $502 million for 2000. This level of spending is so similar to that of 1999 that it is difficult to ascertain whether this marks the beginning of a stabilization period, the initial phase of an upward trend, or simply a pause in advance of further drops in exploration and deposit appraisal levels.

The uncertainty around the short-term direction of spending levels is further compounded by an apparent weakening of Canada's grass-roots exploration capacity, as reflected by: a drop of 50% in expenditures incurred for the exploration work phase between 1997 and 2000; a similar decline in off-mine-site exploration spending; and an important reduction in the number of companies (particularly juniors) conducting exploration work in Canada during the same period. These factors and the fact that core exploration spending (field and overhead costs only) remains on a downward trend point to a Canadian exploration and deposit appraisal sector that continues to suffer from low commodity prices, project financing difficulties and international competition for mineral investment.

Despite a number of success stories, such as the search for diamonds in Canada's North and other projects described in the Regional Outlook section of this report, the situation described above can, to different degrees, be applied to all regions of Canada. In 1999, exploration and deposit appraisal spending decreases were recorded in all Canadian provinces and territories. Company spending intentions for 2000 point to increases in expenditures in Ontario, the Northwest Territories, Saskatchewan, Nunavut and Nova Scotia. However, decreases forecast in Québec and Newfoundland and Labrador are expected to nullify these gains on a national scale.

Although the number of junior exploration companies has declined considerably in recent years, junior spending remains an important component of total expenditures. In 1999, it accounted for 27% ($137 million) of total spending compared to the $364 million spent by senior companies. In 2000, junior company spending is forecast to be $165 million (33% of the predicted total of $502 million). While base metals and precious metals continue to attract a major share of exploration and deposit appraisal spending in Canada, their overall importance has declined in recent years. In 2000, for the first time ever, diamonds are expected to be the most-sought-after commodity in Canada.

Globally, Canada remains one of the world's top mineral exploration targets, garnering almost 11% of the exploration budgets of the world's larger exploration and mining companies in 1999. With over 3000 foreign mineral properties (most of them at the exploration stage) in more than 100 countries, Canadian companies are very active abroad. In 1999, they planned to undertake almost 30% of all the larger-company programs around the world. They not only dominate the Canadian exploration market, but also the markets of the United States, South America, Central America and Europe.

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ABBREVIATIONS

The reader should note that a number of abbreviations for common units of measurement appear in the text:

cm	centimetres
ct	carats
ct/t	carats per tonne
ct/y	carats per year
ft	feet
g	grams
g/t	grams per tonne
ha	hectares
kg	kilograms
km	kilometres
km2	square kilometres
lb	pounds
m	metres
Mct	million carats
Mha	million hectares
Mt	million tonnes
Mt/y	million tonnes per year
oz	ounces or troy ounces
t	tonnes (metric)
t/d	tonnes per day
t/y	tonnes per year
tU	tonnes of uranium

Note: Unless specified otherwise, all dollar figures are in Canadian dollars.

1. Indicators of Mineral Exploration and Deposit Appraisal Activity in Canada

1.1 INTRODUCTION

The first chapter of this report presents data and analysis on indicators of mineral exploration and deposit appraisal activity in Canada. The most important of these indicators is spending and, accordingly, most of the analysis focuses on expenditure trends and patterns. Chapter 1 also provides analysis on two other indicators of exploration and deposit appraisal activity: drilling and claim staking. These two activities were covered under separate sections in previous editions of this report.

The *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures* was redesigned in 1997 to provide a more comprehensive breakdown of the mineral development cycle in Canada. This chapter is primarily based on the statistics compiled by this survey. In the last two editions of this report (1998 and 1999), special attention was given to the fact that two different sets of data were available, one for the pre-1997 period and one for the period starting with the new survey format. To ensure a smooth transition, and because it would have been difficult to draw inferences from only a few years of data, the analysis contained references to both periods. In this edition of the report, the move to the latter set of statistics is more evident.

With four years of available data, it is now possible to put more emphasis on the analytical options offered by the more comprehensive data series. While the pre-1997 data will continue to be used to show historical trends, the analysis will, unless otherwise mentioned, be based on the new set of definitions.[1] For a better understanding of the redesigned survey and its definitions, the reader is invited to read the following paragraphs and Appendix 2.

1.2 SUMMARY OF SURVEY DEFINITIONS

In the redesigned *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures*, often referred to as the federal-provincial/territorial survey of mining and exploration companies, 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, on the other hand, includes the work carried out to bring a delineated deposit to the stage of detailed knowledge required for a production feasibility study.

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 engineering, economic and feasibility studies, environment and land access were not previously accounted for. For example, the new expenditures, now collected in addition to the traditional “field work and overhead costs,” represent about 15% and 21%, respectively, of the total exploration and deposit appraisal expenditures for the years 1999 and 2000.

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[1] A different set of definitions is used in Chapter 3 for international exploration. It is based on data from the Metals Economics Group.

The Survey also collects data on capital and repair costs for construction, machinery and equipment for each of the work phases (exploration, deposit appraisal and mine complex development), but these costs will seldom be referred to in this review. The comprehensive coverage offered by all these categories of expenditures provides a more complete picture of the total investment required to bring projects to the production decision stage.

1.3 EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES

Over the years, levels of exploration and deposit appraisal expenditures have been relied upon to determine the health of Canada's mineral exploration sector and to provide an insight into the future of the country's minerals and metals production capacity. This section focuses on analyzing expenditure data for 1999 (preliminary estimates) and 2000 (company spending intentions), both compiled in January 2000. It also provides some coverage of the four-year period 1997-2000, which represents the first four years of data for the redesigned survey.

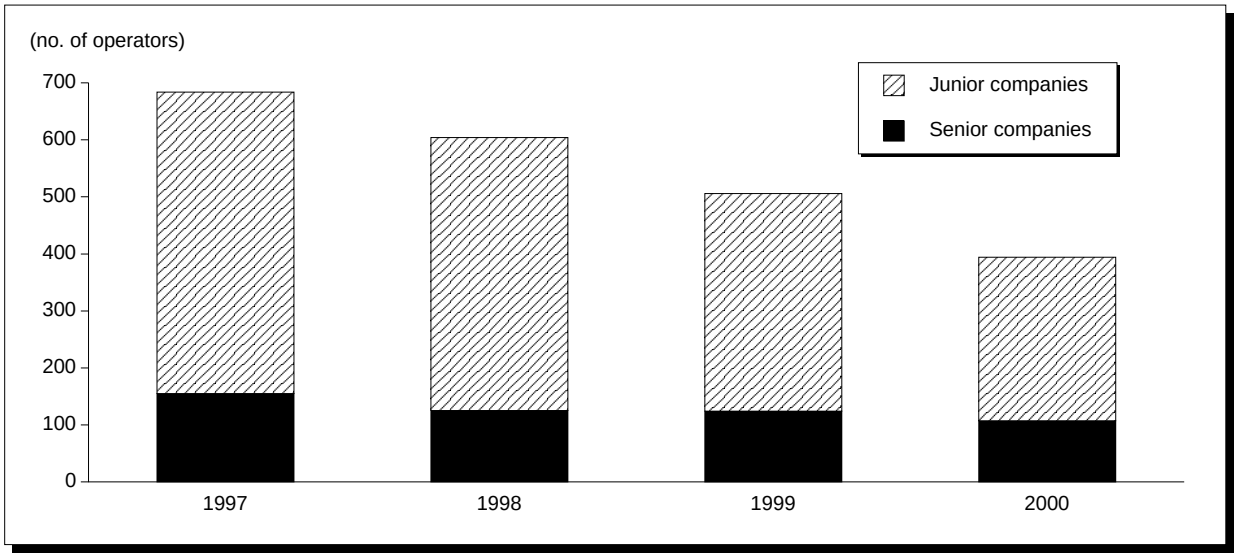
1.3.1 1999 Exploration and Deposit Appraisal Expenditures

1.3.1.1 Statistical Summary

In 1999, 506 companies (project operators) and some prospectors spent $501 million on mineral exploration and deposit appraisal in Canada (**Figure 1**). That number of companies represented a decrease of 16% from the 1998 total of 604 companies (expenditures of $656 million). A total of 77 companies (compared to 91 in 1998) spent more than $1 million each (**Table 1**); these companies' expenditures accounted for 84% of the total expenditures for 1999.

Compared to 1998, spending decreases totaling $155 million were recorded in all provinces and territories (**Figure 2** and **Table 2**). Major declines occurred in Saskatchewan (22% of the $155 million total decrease) and Ontario (19% of the $155 million). The Northwest Territories and Nunavut also experienced a major decrease in their combined total, losing some $21 million compared to 1998 and accounting for about 14% of the total $155 million decline.

Figure 1
Project Operators Active in Exploration and Deposit Appraisal in Canada, 1997-2000



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
Notes: Data exclude prospectors. Data for 1999 are preliminary; 2000 data are based on company spending intentions as compiled in January 2000.

TABLE 1. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES BY RANGE OF EXPENDITURES[1] AND BY TYPE OF COMPANY, 1999 AND 2000

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)	(%)
1999									
>10 million	1	15 623	11.4	11	198 052	54.5	12	213 675	42.6
5 million-10 million	1	5 100	3.7	12	88 419	24.3	13	93 519	18.7
1 million-5 million	25	52 038	37.9	27	61 216	16.8	52	113 255	22.6
500 000-1 million	24	16 868	12.3	11	8 169	2.2	35	25 036	5.0
200 000-500 000	85	28 581	20.8	15	5 032	1.4	100	33 613	6.7
100 000-200 000	48	7 440	5.4	11	1 553	0.4	59	8 993	1.8
50 000-100 000	51	4 020	2.9	8	617	0.2	59	4 637	0.9
0-50 000	147	2 709	2.0	29	586	0.2	176	3 295	0.7
Subtotal	382	132 379	96.3	124	363 645	100.0	506	496 024	99.0
Prospectors[2]	38	5 070	3.7	–	–	–	38	5 070	1.0
Total 1999	420	137 449	100.0	124	363 645	100.0	544	501 094	100.0
2000									
>10 million	2	24 995	15.1	9	195 165	57.9	11	220 160	43.8
5 million-10 million	3	18 967	11.5	10	72 538	21.5	13	91 505	18.2
1 million-5 million	29	59 158	35.8	25	55 618	16.5	54	114 776	22.9
500 000-1 million	35	24 759	15.0	9	6 336	1.9	44	31 095	6.2
200 000-500 000	70	25 608	15.5	15	4 308	1.3	85	29 916	6.0
100 000-200 000	39	6 057	3.7	10	1 651	0.5	49	7 708	1.5
50 000-100 000	38	2 974	1.8	9	756	0.2	47	3 730	0.7
0-50 000	71	1 199	0.7	20	464	0.1	91	1 662	0.3
Subtotal	287	163 718	99.1	107	336 835	100.0	394	500 553	99.7
Prospectors[2]	22	1 555	0.9	–	–	–	22	1 555	0.3
Total 2000	309	165 273	100.0	107	336 835	100.0	416	502 108	100.0

Source: Natural Resources Canada.
– Nil.
[1] On-mine-site plus off-mine-site; includes field work and overhead costs plus engineering, economic and feasibility studies, environment and land access costs. [2] Data for prospectors are incomplete.
Notes: Data for 1999 are preliminary estimates; 2000 data are based on company spending intentions as compiled in January 2000. Numbers may not add to totals due to rounding.

The largest year-to-year decreases in expenditures (in terms of percentages) were experienced by Saskatchewan (-54%), Alberta and Nova Scotia (-35% each), the Yukon (-34%), and Newfoundland and Labrador (-33%). In decreasing order of amounts spent on exploration and deposit appraisal, Québec, the Northwest Territories and Ontario accounted for 59% of all such expenditures in Canada in 1999.

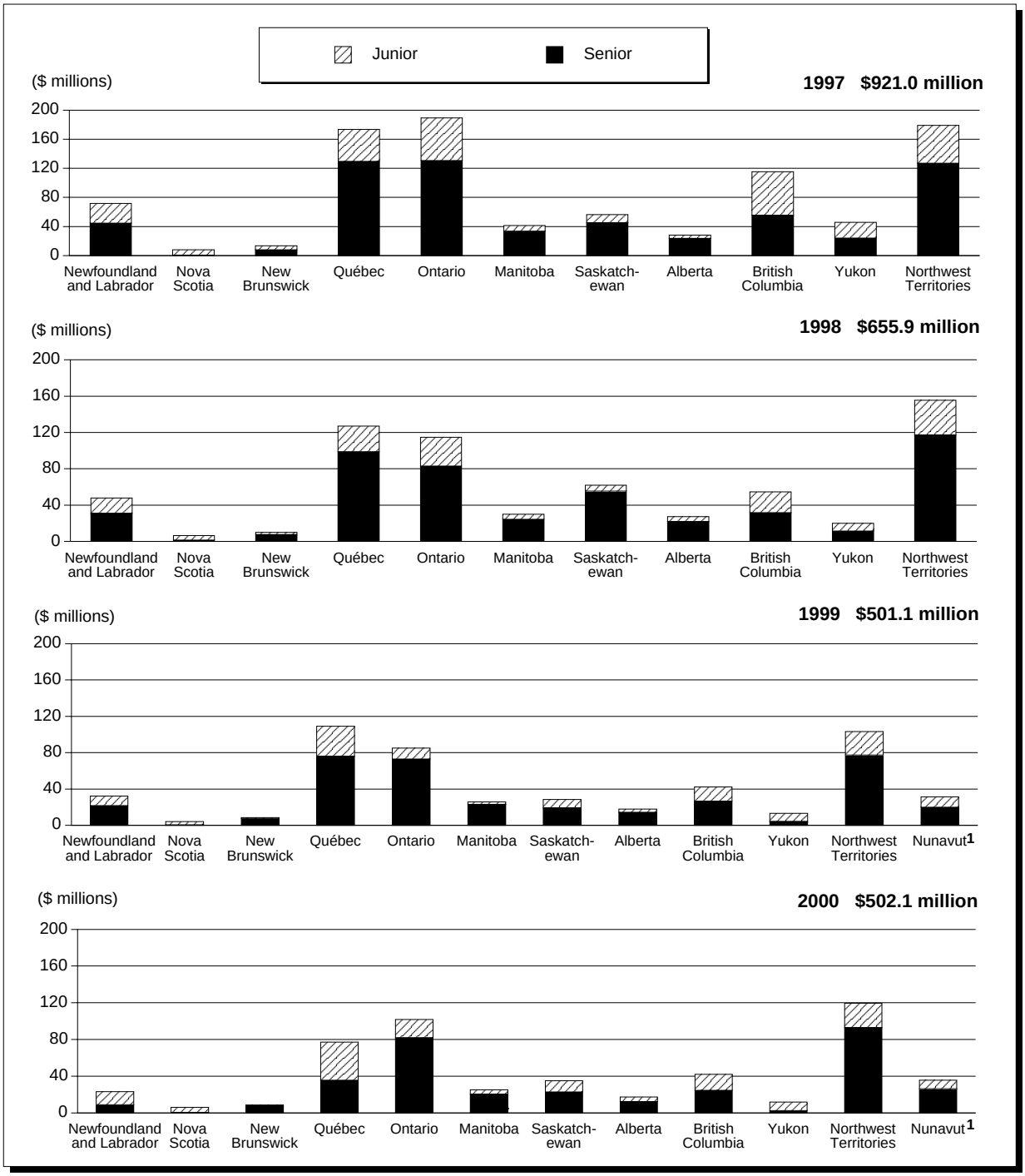
Expenditures for off-mine-site exploration and deposit appraisal activity decreased by 23% from the 1998 level of $527 million (**Figure 3**). Overall, $408 million, or 81% of all exploration and deposit appraisal expenditures in 1999, was for off-mine-site activity. The Northwest Territories ranked first in off-mine-site spending with 23% of the total for that category, followed by Québec and Ontario with 19% and 13%, respectively (**Figure 4**).

On-mine-site exploration and deposit appraisal expenditures decreased by about 28% to $93 million in 1999 from the 1998 level of $129 million. They accounted for more than 25% of the respective exploration and deposit appraisal totals recorded for Ontario, Québec, Manitoba and New Brunswick. The highest proportion was recorded in Ontario where 40% of total expenditures in that province was dedicated to on-mine-site activities. The $34 million spent for on-mine-site exploration and deposit appraisal activities in that province represented 36% of the Canadian total for that category of expenditure.

1.3.1.1.1 SPENDING BY WORK PHASE

Because of the redesigned survey, it is now possible to follow separately and compare the trends between the exploration phase and the deposit appraisal phase (**Figure 5**).

Figure 2
Exploration and Deposit Appraisal Expenditures in Canada by Junior and Senior Companies, by Province and Territory, 1997-2000



Sources: Natural Resources Canada and Statistics Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.

[1]The territory of Nunavut was created in April 1999 by dividing the former Northwest Territories into two distinct territories: Nunavut and the Northwest Territories.

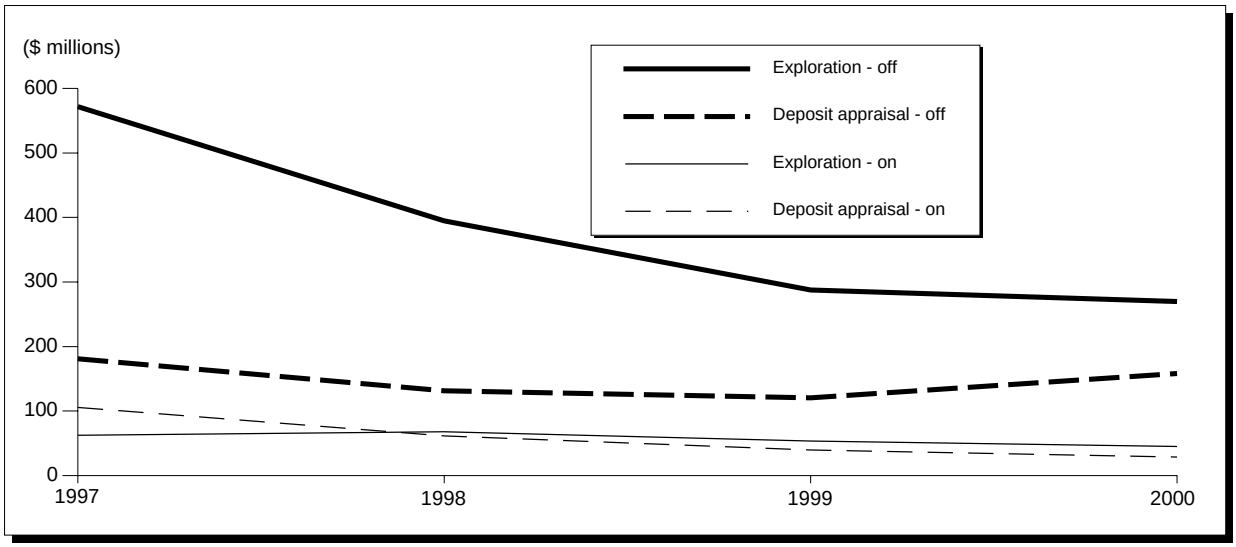
Notes: Exploration and deposit appraisal activities include only the search for and appraisal of new deposits; they do not include work for extensions of deposits already being mined or committed to production. Exploration and deposit appraisal activities include off-mine-site and on-mine-site costs incurred for field work and overhead plus engineering, economic and feasibility studies, environment and land access costs. Data for 1999 are preliminary estimates; 2000 data are company spending intentions as compiled in January 2000.

TABLE 2. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES IN CANADA, BY PROVINCE AND TERRITORY, 1997-2000

Province/Territory	1997		1998		1999p		2000f	
	Expenditures	Percentage of Canadian Total	Expenditures	Percentage of Canadian Total	Expenditures	Percentage of Canadian Total	Expenditures	Percentage of Canadian Total
	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)
Newfoundland and Labrador	71 751.8	7.8	47 855.2	7.3	32 325.7	6.5	23 023.1	4.6
Nova Scotia	7 855.0	0.9	6 471.2	1.0	4 191.7	0.8	5 861.7	1.2
New Brunswick	13 367.9	1.5	10 111.4	1.5	8 552.1	1.7	8 454.5	1.7
Québec	173 303.1	18.8	127 072.2	19.4	109 076.0	21.8	77 111.0	15.4
Ontario	189 288.6	20.6	114 820.4	17.5	84 991.5	17.0	101 630.5	20.2
Manitoba	41 365.1	4.5	29 852.2	4.6	25 760.3	5.1	24 990.0	5.0
Saskatchewan	56 149.3	6.1	62 071.0	9.5	28 466.8	5.7	34 981.0	7.0
Alberta	28 008.8	3.0	27 465.5	4.2	17 751.8	3.5	17 362.9	3.5
British Columbia	115 217.4	12.5	54 515.1	8.3	42 188.1	8.4	41 912.1	8.3
Yukon	45 608.4	5.0	20 075.1	3.1	13 165.0	2.6	11 812.5	2.4
Northwest Territories	179 054.1	19.4	155 621.6	23.7	103 206.8	20.6	119 314.0	23.8
Nunavut[1]	. .	. .	. .	. .	31 417.9	6.3	35 654.7	7.1
Total	920 969.5	100.0	655 931.0	100.0	501 093.7	100.0	502 108.1	100.0

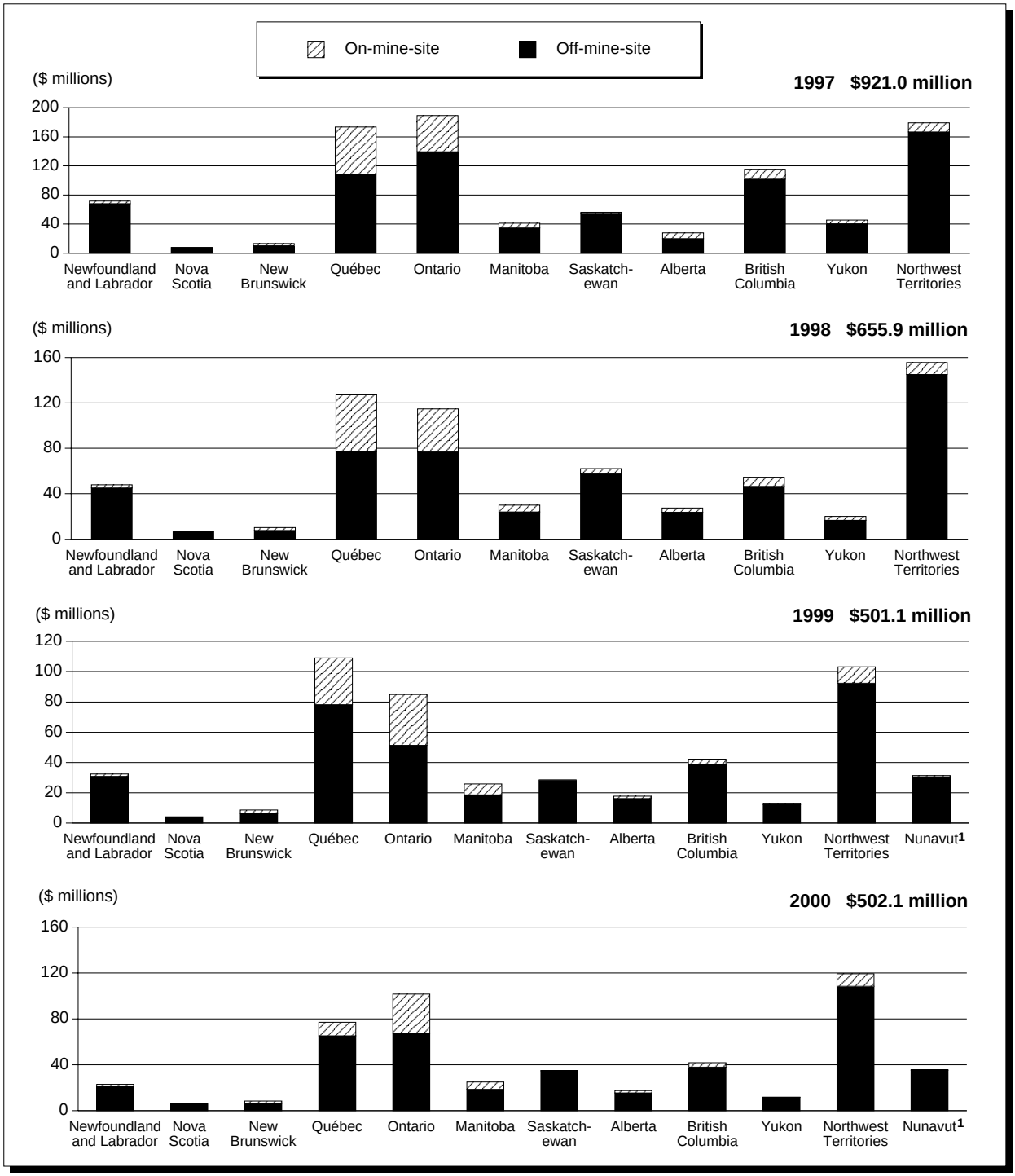
Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
. . Not available; p Preliminary; f Forecast.
1 The territory of Nunavut was created in April 1999 by dividing the former Northwest Territories into two distinct territories: Nunavut and the Northwest Territories.
Notes: Data for 1999 are preliminary estimates; 2000 data are spending intentions as compiled in January 2000. Exploration and deposit appraisal expenditures include off-mine-site and on-mine-site costs incurred for field work and overhead plus engineering, economic and feasibility studies, environment and land access costs. Numbers may not add to totals due to rounding.

Figure 3
On-Mine-Site and Off-Mine-Site Exploration and Deposit Appraisal Expenditures[1] in Canada, 1997-2000



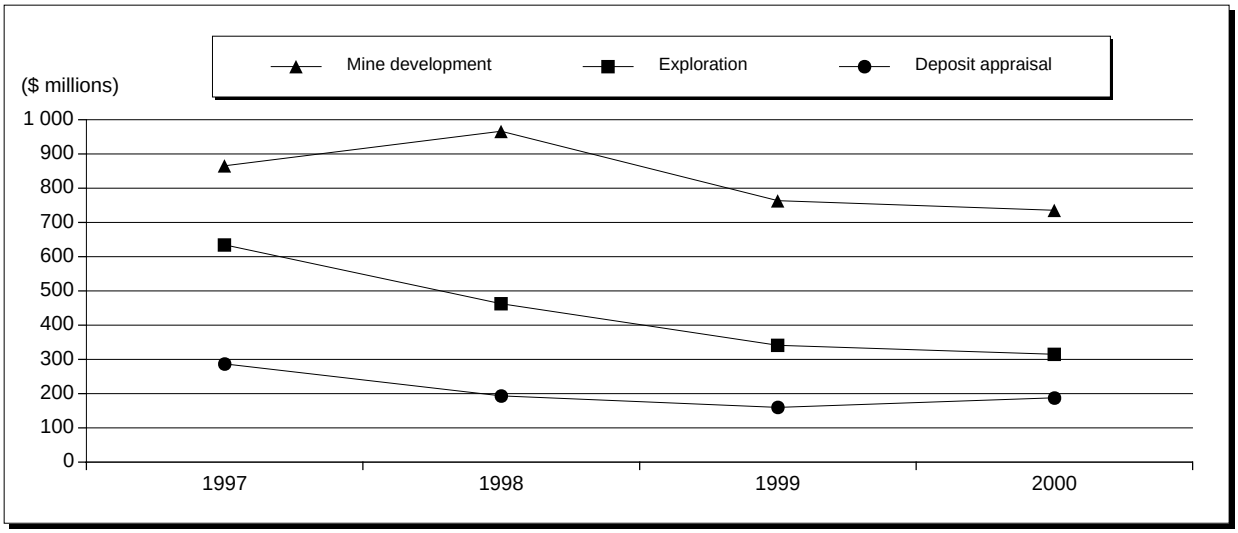
Source: Natural Resources Canada, from the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
1 On-mine site and off-mine-site exploration and deposit appraisal expenditures include field work and overhead costs plus engineering, economic and feasibility studies, environment and land access costs.
Note: Data for 1999 are preliminary; 2000 data are company spending intentions as compiled in January 2000.

Figure 4
On-Mine-Site and Off-Mine-Site Exploration and Deposit Appraisal Expenditures, by Province and Territory, 1997-2000



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
1 The territory of Nunavut was created in April 1999 by dividing the former Northwest Territories into two distinct territories: Nunavut and the Northwest Territories.
Notes: Exploration and deposit appraisal activities include only the search for and appraisal of new deposits; they do not include work for extensions of deposits already being mined or committed to production. Exploration and deposit appraisal activities include off-mine-site and on-mine-site costs incurred for field work and overhead plus engineering, economic and feasibility studies, environment and land access costs. Data for 1999 are preliminary; 2000 data are company spending intentions as compiled in January 2000.

Figure 5
Mineral Exploration, Deposit Appraisal and Mine Development Expenditures in Canada, 1997-2000



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
Notes: Exploration and deposit appraisal activities include only the search for and appraisal of new deposits; they do not include work for extensions of deposits already being mined or committed to production. Exploration and deposit appraisal activities include off-mine-site and on-mine-site costs incurred for field work and overhead plus engineering, economic and feasibility studies, environment and land access costs. Mine development activities include work to gain access to ore or to increase ore reserves at properties in production or already committed to production. It does not include investments for structures, machinery and equipment. Data for 1999 are preliminary; 2000 data are company spending intentions as compiled in January 2000.

In 1999, exploration expenditures amounted to $341 million (68% of total exploration and deposit appraisal spending) and deposit appraisal stood at $160 million (32% of total spending). Both numbers represented decreases compared to the 1998 totals of $463 million for the exploration phase and $193 million for the deposit appraisal phase.

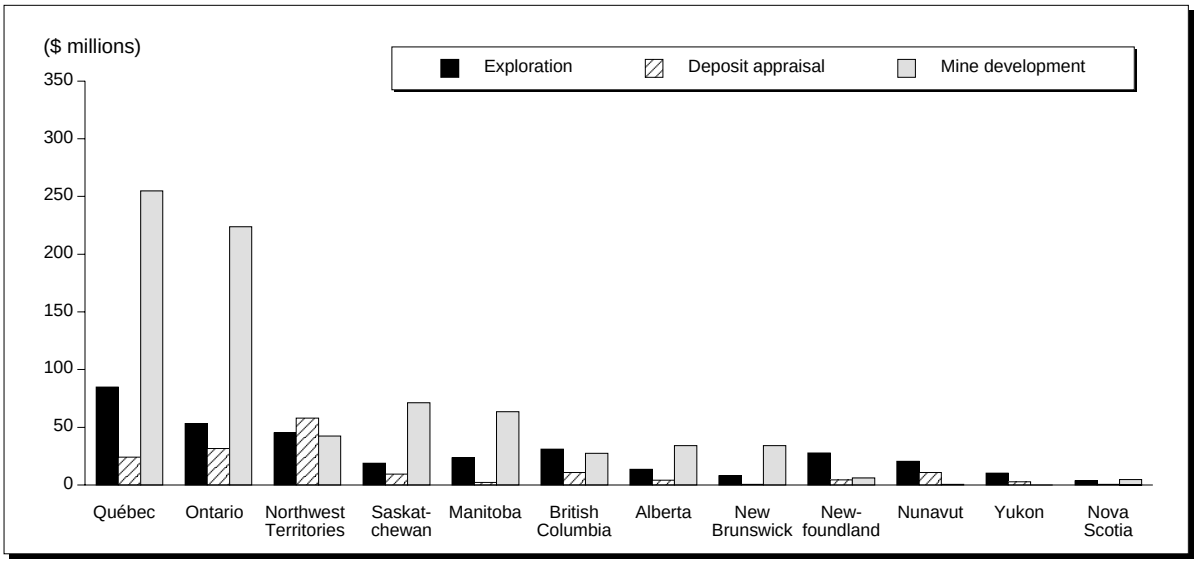
Off-mine-site spending of $288 million represented 84% of spending in the exploration phase in 1999, which amounts to about the same proportion as in 1998 when $395 million was spent for off-mine-site exploration. Combined off-mine-site and on-mine-site exploration activities for that year had amounted to $463 million (**Figure 3**). In terms of deposit appraisal expenditures, approximately 75% of the $160 million recorded for off- and on-mine-site deposit appraisal activities in 1999 was reported as off-mine-site spending.

A provincial/territorial breakdown of exploration and deposit appraisal expenditures reveals that more than 90% of total 1999 spending in New Brunswick and Manitoba was reported as exploration work (**Figure 6**). That proportion fell to 86% in Newfoundland and Labrador, and to between 78% and 63% in the Yukon, Québec, Alberta, Nova Scotia, British Columbia, Saskatchewan, Nunavut and Ontario (in decreasing order).

The advanced stage of some diamond projects in the Northwest Territories is reflected by the fact that 56% ($58 million) of total exploration and deposit appraisal expenditures of $103 million in that territory in 1999 was directed at deposit appraisal activities. Of this $58 million, slightly more than half (55%) was aimed at off-mine-site deposit appraisal activities.

In terms of ranking by total exploration expenditures, Québec placed first followed by Ontario and the Northwest Territories. For deposit appraisal spending, the Northwest Territories ranked first followed by Ontario and Québec.

Figure 6
Exploration, Deposit Appraisal and Mine Development Expenditures, by Province and Territory, Preliminary 1999



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
Notes: Exploration and deposit appraisal activities include only the search for and appraisal of new deposits; they do not include work for extensions of deposits already being mined or committed to production. Exploration and deposit appraisal activities include off-mine-site and on-mine-site costs incurred for field work and overhead plus engineering, economic and feasibility studies, environment and land access costs. Mine development activities include work to gain access to ore or to increase ore reserves at properties in production or already committed to production. It does not include investments for structures, machinery and equipment. Data for 1999 are preliminary.

1.3.1.1.2 SPENDING CATEGORIES OTHER THAN FIELD AND OVERHEAD

An interesting feature of the redesigned survey is its ability to track exploration and deposit appraisal expenditures that are dedicated to categories of spending other than the traditional field work and overhead ones. As such, it is now possible to follow the spending evolution of various cost components, including environment-related items such as characterization, permits, protection and restoration.

In 1998, a total of $32 million was recorded as environment-related expenditures, or 5% of all exploration and deposit appraisal expenditures for that year (**Tables 3a** and **4**). This percentage declined to 4% in 1999 when $18 million, out of total exploration and deposit appraisal expenditures of $501 million, was spent on environment-related items (**Table 3b**). Thus, in dollar terms, environment-related spending dropped by $13 million (42%) between 1998 and 1999. Most of that decrease is attributable to a drop in environment-related spending in off-mine-site deposit appraisal activities.

Land access costs only account for a small fraction of total exploration and deposit appraisal expenditures (0.6% in 1998 and 1.1% in 1999). However, expenditures for economic, engineering and feasibility studies are more significant. In aggregate, these costs represented 10% ($51 million) of total exploration and deposit appraisal expenditures in 1999 compared to 7% ($45 million) in 1998. The gain registered in 1999, in the midst of downward trending expenditures, can be attributed to a few targeted projects and to a strong performance in the off-mine-site deposit appraisal category, which registered a 16% increase over 1998.

TABLE 3a. EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT EXPENDITURES,[1] 1997 AND 1998

Expenditure Category	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal		Mine Complex Development		Grand Total	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
					($000)					
Field work and overhead[2]	599 336	445 055	220 839	130 865	820 175	575 920	834 040	932 290	1 654 215	1 508 209
Engineering economic and pre- or production feasibility studies	8 976	4 851	38 936	39 773	47 912	44 624	17 020	19 031	64 932	63 655
Environment	21 560	11 294	25 726	20 373	47 286	31 667	12 193	9 958	59 479	41 625
Land access	4 538	1 605	1 058	2 115	5 596	3 720	2 288	4 783	7 885	8 503
Subtotal	634 410	462 805	286 560	193 126	920 970	655 931	865 542	966 061	1 786 511	1 621 992
Off-mine-site[3]	572 027	394 929	180 951	131 591	752 979	526 520	n.a.	n.a.	752 979	526 520
On-mine-site[3]	62 383	67 875	105 608	61 535	167 991	129 411	865 542	966 061	1 033 532	1 095 472
Capital[4]	25 716	9 697	147 435	25 103	173 151	34 800	2 089 640	1 226 347	2 262 792	1 261 147
$ for environmental protection and restoration[5]	81	157	126	144	207	301	27 034	23 783	27 241	24 084
Total	660 126	472 501	433 995	218 230	1 094 121	690 731	2 955 182	2 192 409	4 049 303	2 883 139
Repair and maintenance[4]	5 071	4 838	50 831	17 995	55 902	22 832	1 578 291	1 671 588	1 634 193	1 694 420
$ for environmental protection and restoration[5]	5	390	98	1 120	102	1 510	28 392	103 765	28 494	105 276
Grand total	665 197	477 339	484 826	236 224	1 150 023	713 563	4 533 473	3 863 997	5 683 496	4 577 560
Total environment	21 646	11 841	25 949	21 638	47 595	33 479	67 619	137 506	115 214	170 985
Environment as a percentage of grand total	3.3	2.5	5.4	9.2	4.1	4.7	1.5	3.6	2.0	3.7

Sources: Natural Resources Canada and Statistics Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
n.a. Not applicable.
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.

TABLE 3b. EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT EXPENDITURES,[1] 1999 AND 2000

Expenditure Category	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal		Mine Complex Development		Grand Total	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
					($000)					
Field work and overhead[2]	327 446	298 996	98 475	95 892	425 921	394 888	724 819	700 527	1 150 740	1 095 415
Engineering economic and pre- or production feasibility studies	5 010	6 665	46 146	76 559	51 156	83 224	20 891	17 210	72 046	100 434
Environment	7 479	7 683	10 984	11 187	18 463	18 870	9 267	9 989	27 729	28 859
Land access	1 292	1 555	4 262	3 571	5 554	5 126	8 274	7 727	13 828	12 853
Subtotal	341 226	314 899	159 867	187 209	501 094	502 108	763 250	735 453	1 264 344	1 237 562
Off-mine-site[3]	287 502	269 692	120 436	158 361	407 937	428 053	n.a.	n.a.	407 937	428 053
On-mine-site[3]	53 725	45 207	39 431	28 848	93 156	74 055	763 250	735 453	856 407	809 508
Capital[4]	3 227	607	26 978	41 376	30 205	41 983	813 649	886 188	843 854	928 171
$ for environmental protection and restoration[5]	–	13	102	178	102	191	25 742	43 351	25 844	43 542
Repair and maintenance[4]	4 105	1 337	28 971	37 247	33 076	38 584	1 217 103	1 134 538	1 250 179	1 173 122
$ for environmental protection and restoration[5]	–	–	493	150	493	150	59 757	60 265	60 250	60 415
Subtotal	7 332	1 944	55 949	78 623	63 281	80 567	2 030 753	2 020 726	2 094 034	2 101 292
Grand total	348 558	316 843	215 816	265 832	564 375	582 675	2 794 003	2 756 179	3 358 377	3 338 854
Total environment	7 479	7 696	11 579	11 515	19 058	19 211	94 765	113 605	113 823	132 816
Environment as a percentage of grand total	2.1	2.4	5.4	4.3	3.4	3.3	3.4	4.1	3.4	4.0

Sources: Natural Resources Canada and Statistics Canada, from the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Expenditures.
– Nil; n.a. Not applicable.
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.
Notes: Numbers may not add to totals due to rounding. Data for 1999 are preliminary estimates; 2000 data are based on company spending intentions as compiled in January 2000.

TABLE 4. SUMMARY OF EXPENDITURES NOT PREVIOUSLY RECORDED, 1997-2000

Expenditure Category	1997	1998	1999	2000
		($ millions)		
EXPLORATION PLUS DEPOSIT APPRAISAL				
Environment	47.3	31.7	18.5	18.9
Engineering, economic and pre- or production feasibility studies	47.9	44.6	51.2	83.2
Land access	5.6	3.7	5.6	5.1
Subtotal	100.8	80.0	75.2	107.2
Capital	173.2	34.8	30.2	42.0
Repair and maintenance	55.9	22.8	33.1	38.6
Total	329.9	137.6	138.5	187.8
MINE COMPLEX DEVELOPMENT				
Environment	12.2	10.0	9.3	10.0
Engineering, economic and pre- or production feasibility studies	17.0	19.0	20.9	17.2
Land access	2.3	4.8	8.3	7.7
Total	31.5	33.8	38.4	34.9
Grand total	361.3	171.4	176.9	222.7
% of total investment	6.4	3.7	5.3	6.7

Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
Notes: Numbers may not add to totals due to rounding. Data for 1999 are preliminary estimates; data for 2000 are company spending intentions as compiled in January 2000.

1.3.1.1.3 TOTAL MINERAL DEVELOPMENT INVESTMENT

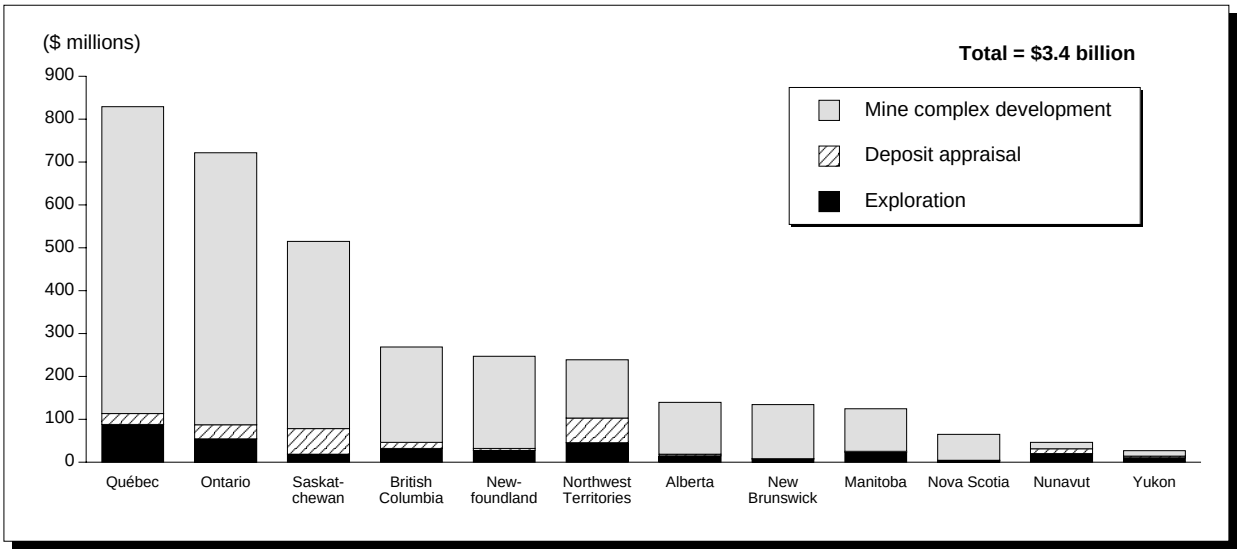
The total mineral development cycle, as defined by the *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures*, consists of the exploration and deposit appraisal phases plus mine development and mine complex development activities. Mine development activities include work to outline, block out and gain access to ore or to increase ore reserves at properties in production or committed to production. These activities are a subset of mine complex development expenditures, which also include investments for structures, machinery and equipment, at a mine in production or committed to production.

Mine development spending totaled $763 million in 1999 and most of these expenditures (63%) occurred in Québec and Ontario (**Figure 6**). When adding all project work phases (exploration, deposit appraisal and mine development), and including all capital and repair costs associated with these three phases and with construction, machinery and equipment for mine complex development, mineral development investment totaled $3.4 billion in 1999 (**Figure 7**), down significantly from the $4.6 billion recorded in 1998. In decreasing order of expenditures, Québec, Ontario and Saskatchewan were responsible for 61% of all mineral development investment in Canada for 1999.

1.3.1.2 Spending by Type of Company

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.

Figure 7
Total Investment for Exploration, Deposit Appraisal and Mine Complex Development Expenditures, by Province and Territory, Preliminary 1999



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
Notes: Exploration, deposit appraisal and mine complex development expenditures include costs incurred off- and on-mine-site for field work; engineering, economic and feasibility studies; overhead; the environment; land access; structures, machinery and equipment, and repairs. Data for 1999 are preliminary.

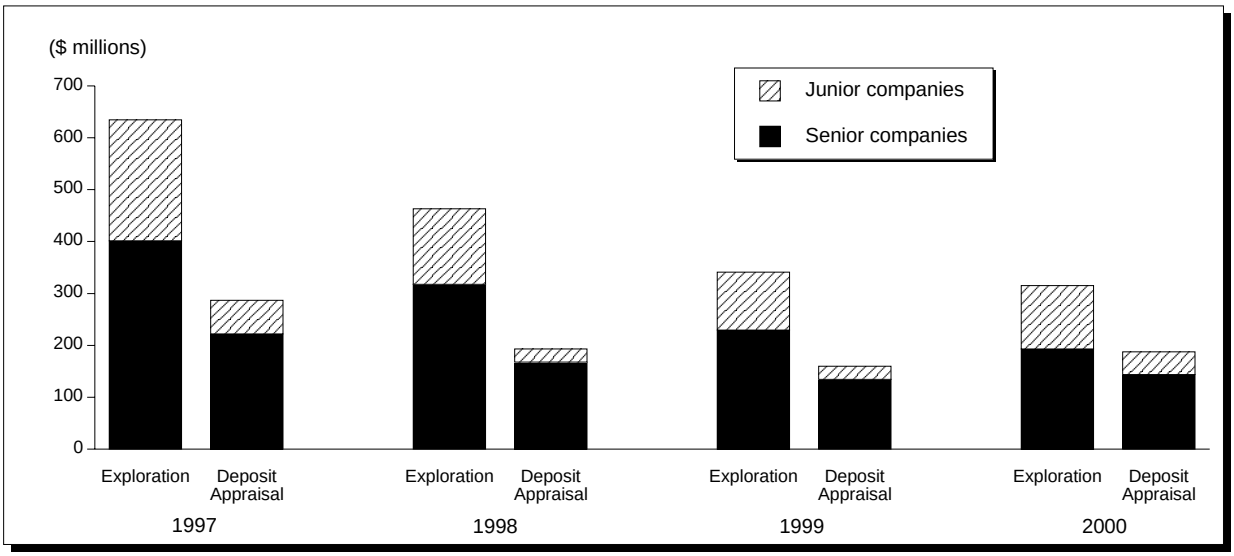
In 1999, 124 senior project operators accounted for 73% ($364 million) of all exploration and deposit appraisal expenditures (**Figures 1** and **2**). About 63% of total senior spending was allocated to exploration activities with the remaining 37% going to deposit appraisal work (**Figure 8**). The number of senior project operators and their proportion of total spending were virtually the same in 1998 when 125 senior project operators reported 74% ($485 million) of total spending. The lower spending in 1999 by a constant number of senior project operators is primarily explained by the drop in the number of operators spending more than $10 million. In 1998, 15 senior companies spent $10 million or more for a total of $298 million. In 1999, only 11 senior operators spent more than $10 million and their total spending amounted to $198 million (**Table 1**).

About 62% ($226 million) of the expenditures reported by senior firms in 1999 were incurred in the Northwest Territories, Québec and Ontario (in decreasing order). Although senior companies decreased their spending in 1999 in all provinces and territories, they remained the main contributors to exploration and deposit appraisal expenditures in every Canadian jurisdiction except Nova Scotia and the Yukon. Senior company expenditures exceeded 70% of total expenditures in each of Manitoba, Ontario, New Brunswick, Alberta, the Northwest Territories and Québec (in decreasing order).

The number of junior project operators dropped to 382 in 1999, down by 20% from the 479 recorded in 1998 (**Figure 1**). Prospectors are not counted in this total because only aggregated prospectors' expenditures are provided by provincial/territorial survey partners and because some provinces/territories do not survey prospectors. It is estimated that prospectors account for, at most, about 2% of total Canadian exploration and deposit appraisal expenditures.

Altogether, junior companies and prospectors spent $137 million on exploration and deposit appraisal in 1999, a decrease of 19% over 1998. However, this decrease is less important than the 25% decrease in expenditures recorded for senior companies. Decreases in expenditures by juniors were recorded in all provinces and territories except Québec, Saskatchewan and the

Figure 8
Exploration and Deposit Appraisal Expenditures, by Type of Company, 1997-2000



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
Notes: Exploration and deposit appraisal expenditures include off- and on-mine site field and overhead expenditures plus engineering, economic and feasibility studies, environment and land access costs. Data for 1999 are preliminary; 2000 data are company spending intentions as compiled in January 2000.

Yukon (**Figure 2**). The Northwest Territories and Nunavut, when taken together, also experienced a small increase in junior spending. Going back to 1997, British Columbia suffered the most severe decrease with only $16 million in junior spending in 1999 compared to $60 million in 1997. In decreasing order of expenditures, Québec, the Northwest Territories, British Columbia, Ontario and Nunavut accounted for 71% of all junior expenditures in 1999.

With the exception of the large number of junior companies spending less than $50 000, junior company spending in 1999 most frequently fell in the $200 000-$500 000 interval (**Table 1**). As for senior companies, the most commonly reported range of exploration and deposit appraisal expenditures was also less than $50 000, followed closely by the $1 million-$5 million range.

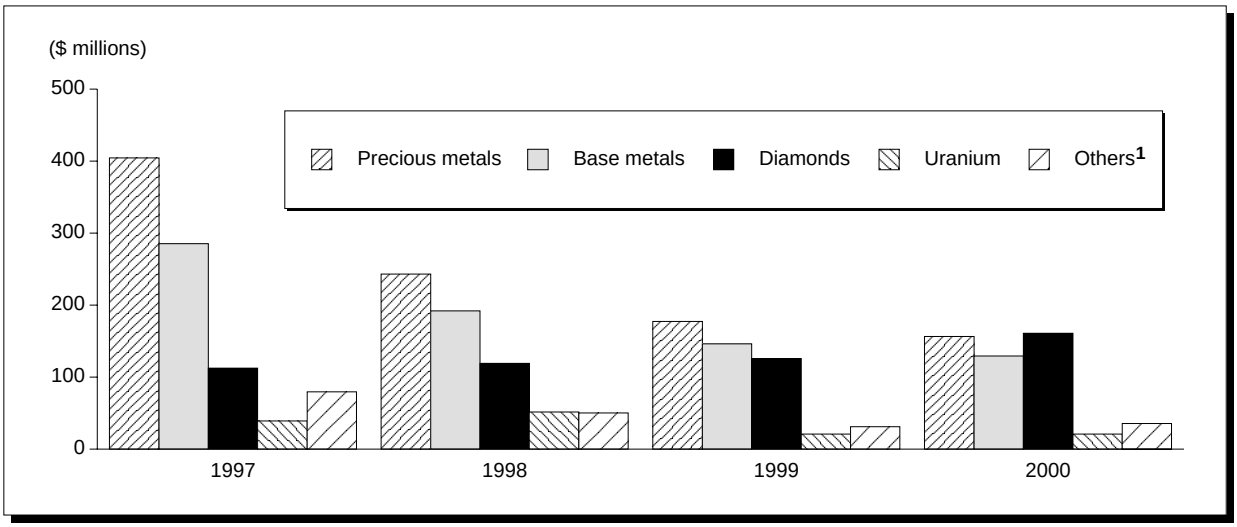
1.3.1.3 Spending by Type of Commodity Sought

The redesigned survey provides a breakdown of exploration and deposit appraisal spending statistics by type of commodity sought. **Figure 9** shows such a breakdown for the groups of commodities or individual commodities most explored for in Canada: precious metals, base metals, diamonds, uranium and "others."

Exploration and deposit appraisal spending for the two main commodity groups, precious metals (mostly gold) and base metals, declined significantly between 1997 and 1999. Precious-metal spending dropped from $405 million in 1997 to $177 million in 1999 while base-metal spending decreased from $286 million to $146 million over the same period. Factors such as low metal prices, the Asian crisis and central bank gold sales can be cited to explain this downturn in precious-metal and base-metal exploration and deposit appraisal activity.

Spending on the search for uranium and others commodities (e.g., nonferrous metals, other metals, nonmetals and coal) also declined significantly in 1999. A weak spot market price and consolidation within the industry help explain the reduction in expenditures for uranium.

Figure 9
Exploration and Deposit Appraisal Expenditures in Canada, by Commodity Sought, 1997-2000



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
[1] Includes ferrous metals, other metals, nonmetals (including coal), and "not specified."
Note: Exploration and deposit appraisal expenditures include field and overhead expenditures plus engineering, economic and feasibility studies, environment and land access costs.

The search for diamonds in Canada continued to draw strong interest in 1999, especially with the October 1998 opening of the Ekati mine in the Northwest Territories, the advancement of a number of projects, and the discovery of new prospects. Diamond exploration and deposit appraisal activities took place across Canada in 1999 with 378 properties being held for diamond exploration purposes, according to an April 1999 compilation (**Figure 10**).

In terms of expenditures, considerable sums (close to $1 billion since 1994) have been invested in diamond exploration and deposit appraisal activities in Canada. The total amount spent in 1999 was $126 million, a 6% increase over 1998 (**Figure 11**). During that year, the Northwest Territories was once again the recipient of most of the expenditures for the search for diamonds as $98 million was spent in that territory. An additional $10 million was spent in Nunavut, resulting in a 13% increase from the 1998 level for the two territories combined. Alberta ($11 million) and Ontario ($6 million) were the other two most popular Canadian jurisdictions for diamond exploration and deposit appraisal.

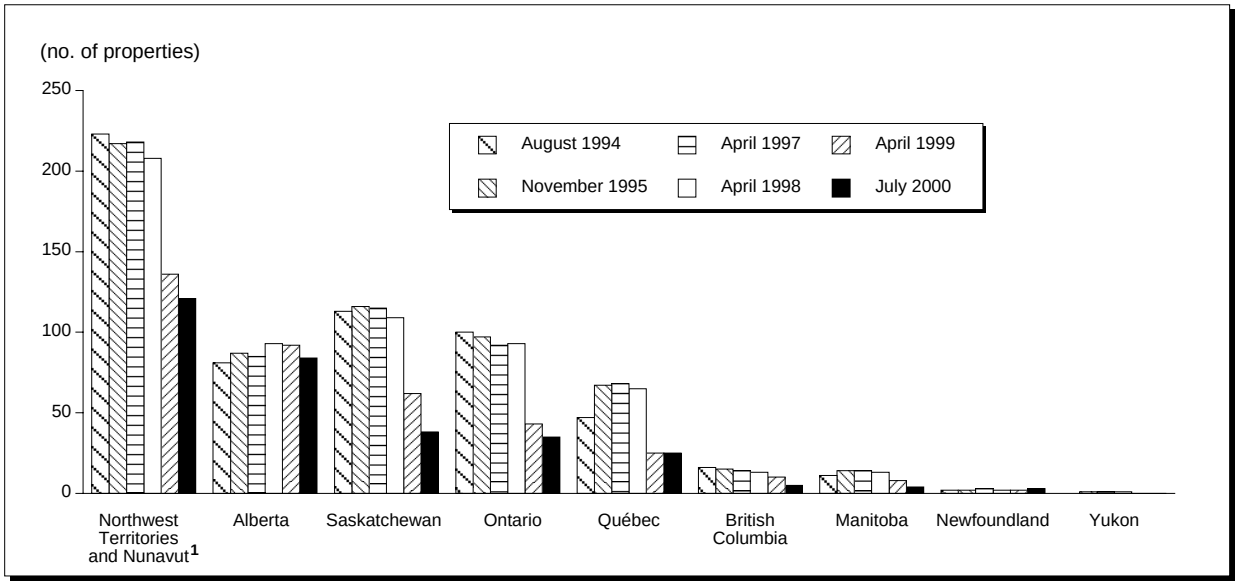
1.3.2 2000 Exploration and Deposit Appraisal Expenditures

1.3.2.1 Statistical Summary

Company spending intentions, compiled in January 2000, reveal that 394 companies (project operators) and some prospectors intended to spend some $502 million in 2000 on exploration and deposit appraisal in Canada (**Figures 1** and **2**). That number of companies represents a sizeable 22% decrease from the 1999 total of 506 companies (expenditures of $501 million). A total of 78 companies (77 in 1999) each intended to spend more than $1 million (**Table 1**). These 78 companies expected to spend a total of $426 million, or 85% of total intended expenditures for 2000.

An analysis of the distribution of companies according to how much they intended to spend tends to support the hypothesis that many small junior companies became inactive in 2000 due mainly to the ongoing weakness in metal prices and difficulty in raising exploration funds. The

Figure 10
Regional Distribution of Diamond Exploration and Deposit Appraisal Properties, 1994-2000



Source: Natural Resources Canada, based on *MIN-MET CANADA* database for 1994-98 and InfoMine db for 1999-2000, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.
1 In July 2000, there were 112 diamond exploration properties in the Northwest Territories and 9 in Nunavut, for a total of 121 properties for the two territories.

difference between the 506 companies that reported their intention to spend in 1999 and the 394 companies that did so in 2000 is explained mostly by the drop of 107 companies in the last three spending intervals (85 companies in the $0-$50 000 range, 12 in the $50 000-$100 000 range and 10 in the $100 000-$200 000 range). While the combined loss, in dollar terms, was largely compensated for by an increased number of companies (44 versus 35) in the $500 000-$1 000 000 spending interval, these statistics imply that some of Canada's pure grass-roots exploration capacity has either disappeared, moved to other countries, or is on hold pending better market conditions.

Based solely on spending levels, the fact that the 2000 forecast of $502 million is just a bit higher than the $501 million total recorded in 1999 could indicate that the downward trend in exploration and deposit appraisal expenditures that had started in 1997 has come to an end or has at least tapered off. However, as mentioned above, the 2000 forecast is based on company spending intentions compiled in January 2000 and companies may well have altered their spending plans since then. Nevertheless, the declining trend has certainly slowed significantly. It remains to be seen whether spending will increase, remain flat or resume the downward trend in the near future.

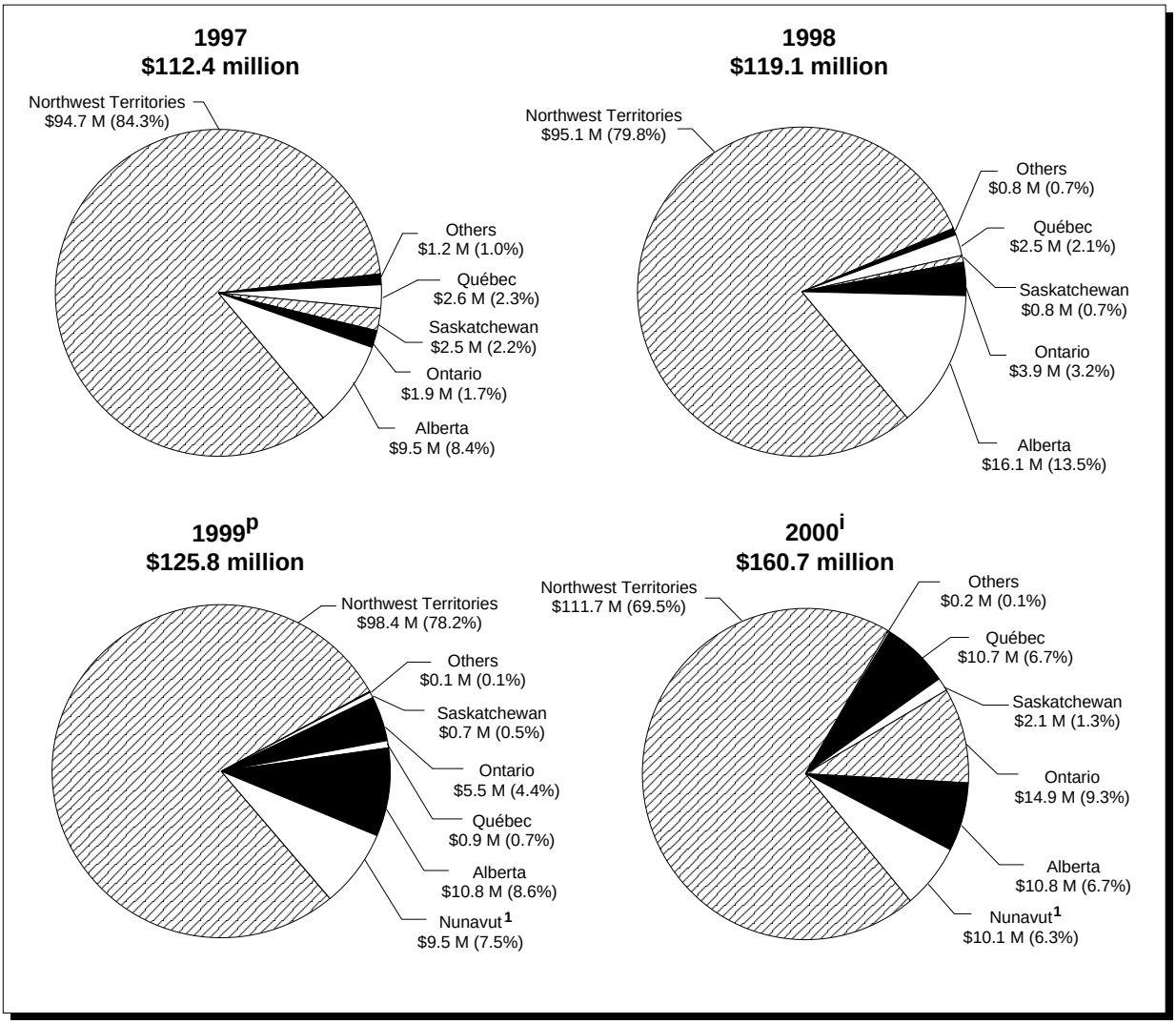
While all-inclusive spending appears to have stabilized, the former survey measure of field plus overhead costs provides further indication that traditional exploration and deposit appraisal activities remain fragile. As shown in **Figure 44** (in Appendix 1), exploration and deposit appraisal spending (when considering only field and overhead costs) declined by 9% ($39 million) from 1999 to 2000. This drop followed even stronger declines of 27% between 1998 and 1999 and 29% between 1997 and 1998. Therefore, core spending in exploration and deposit appraisal remains on a downward trend.

The cost categories of engineering, economic and feasibility studies are offsetting this decline when the all-inclusive cost measure called for by the new survey format is taken into account.

These cost categories counteract the decline in field and overhead costs with a 63% ($32 million) increase in 2000. These engineering, economic and feasibility expenditures were mostly intended for deposit appraisal work.

About 60% of the total intended exploration and deposit appraisal expenditures for 2000 were reported, in decreasing order, by the Northwest Territories, Ontario and Québec (**Figure 2** and **Table 2**). After the declines recorded in all provinces and territories in 1999, increases in expenditures are expected in Ontario, the Northwest Territories, Saskatchewan, Nunavut and Nova Scotia. The largest increases in exploration and deposit appraisal expenditures compared to 1999 are expected to occur in Ontario and in the Northwest Territories with an increase of

Figure 11
Diamond Exploration and Deposit Appraisal Expenditures in Canada, by Province and Territory, 1997-2000



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
[i] Company spending intentions as compiled in January 2000; [p] Preliminary estimate.
[1] The territory of Nunavut was created in April 1999 by dividing the former Northwest Territories into two distinct territories: Nunavut and the Northwest Territories.
Notes: Exploration and deposit appraisal expenditures include field and overhead expenditures plus engineering, economic and feasibility studies, environment and land access costs. "Others" includes Newfoundland, British Columbia and Manitoba. Numbers may not add to totals due to rounding.

about $16 million each. Altogether, these two jurisdictions will account for 73% of the total $45 million increase. As for those provinces/territories that will experience spending decreases (totaling $44 million) in 2000, Québec will lead the way with a $32 million decline. In percentage terms, this 29% decrease puts Québec on an equal footing with Newfoundland and Labrador where spending will decline by $9 million.

Although company spending intentions for 2000 were compiled in January 2000, an informal survey of provinces/territories conducted in August 2000 tends to confirm the indicated trends. For instance, it appears that, in Nova Scotia, the level of spending will be lower than expected and, in the Yukon, the expected decline will be more severe than anticipated.

Company spending intentions indicate that off-mine-site exploration and deposit appraisal expenditures are expected to increase by 5% from $408 million in 1999 to $428 million in 2000 (**Figure 3**). However, in each of New Brunswick, Alberta, the Yukon and British Columbia, off-mine-site spending is expected to decrease slightly (**Figure 4**). Québec and Newfoundland and Labrador will experience more significant decreases of $13 million and $10 million, respectively. Increases of approximately $16 million are expected in each of the Northwest Territories and Ontario. Overall, off-mine-site spending should account for 85% of total exploration and deposit appraisal expenditures in 2000. The Northwest Territories is expected to again rank first in off-mine-site exploration and deposit appraisal activity with 25% ($108 million) of the total spending intentions for that category. Ontario (16%) and Québec (15%) are forecast to rank second and third.

Unlike off-mine-site expenditures, on-mine-site exploration and deposit appraisal spending is expected to continue its downward trend with a further drop of 21% to reach $74 million in 2000. While this downward trend might raise questions about diminishing prospects for outlining and discovering additional reserves at existing mines, it is more likely the result of mining companies curtailing their exploration and deposit appraisal activities in times of lower metal prices and, thus, times of lower revenues and earnings.

The highest proportions of on-mine-site spending out of total exploration and deposit appraisal expenditures are expected to be recorded in Ontario, New Brunswick and Manitoba, and should range between 25% and 34%. In dollar terms, the largest decrease in on-mine-site spending is expected to occur in Québec with a $19 million decline. Smaller decreases are forecast for the Yukon, Manitoba and Nunavut.

1.3.2.1.1 SPENDING BY WORK PHASE

For 2000, company spending intentions reveal a further drop in expenditures dedicated to exploration activities. After reaching $634 million in 1997, these expenditures should amount to $315 million in 2000, a decrease of 50% since 1997 (**Figure 5**). Exploration spending amounted to $463 million in 1998 and $341 million in 1999. The $315 million to be spent on exploration in 2000 represents 63% of total forecast exploration and deposit appraisal expenditures for that year. Of this $315 million total, $270 million (86%) will be incurred off mine sites (**Figure 3**). That single component explains most of the drop in total exploration and deposit appraisal expenditures since 1997 when off-mine-site exploration expenditures amounted to $572 million.

Deposit appraisal spending is expected to amount to $187 million in 2000. This amount represents a 17% improvement over 1999 and approaches the level of $193 million reached in 1998. At 85% of total deposit appraisal spending, the proportion of off-mine-site deposit appraisal spending is expected to be very similar to that of off-mine-site exploration spending in relation to total exploration spending.

On a provincial/territorial basis, exploration expenditures are expected to constitute more than 90% of the combined 2000 exploration and deposit appraisal expenditures in New Brunswick

(**Figure 12**). The proportion of exploration work, out of total exploration and deposit appraisal spending, in other provinces/territories is expected to range between 90% and 80% in Manitoba, Québec, the Yukon, Alberta, Newfoundland and Labrador, and British Columbia, and between 75% and 60% in Nova Scotia, Saskatchewan and Nunavut. As in 1999, most of the spending (75%) in the Northwest Territories in 2000 will likely go to deposit appraisal activities with the majority of these expenditures expected to be incurred off mine sites.

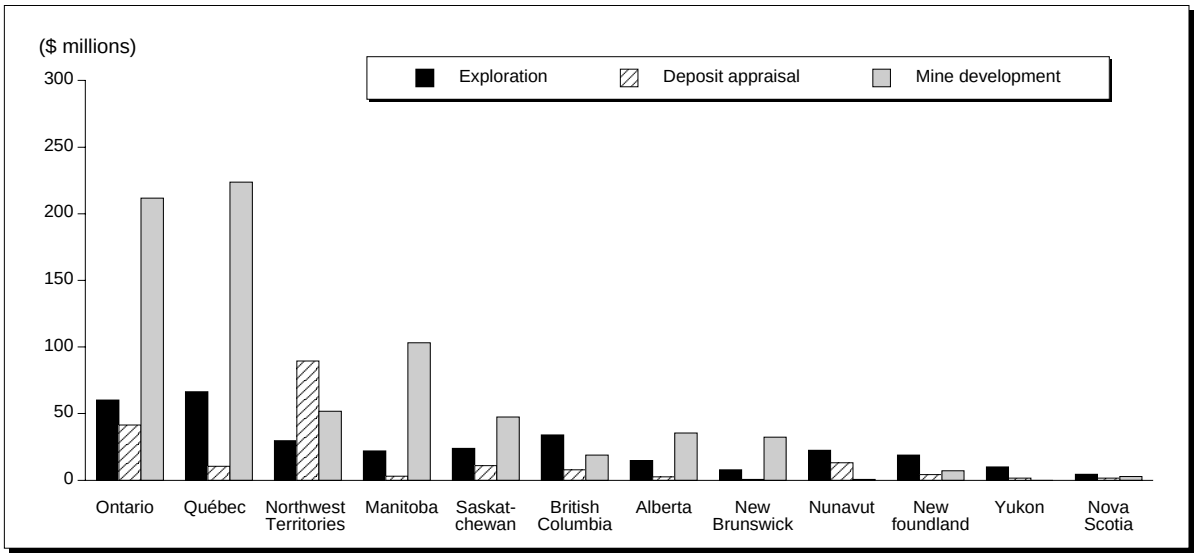
In terms of ranking by total exploration expenditures, Québec is expected to once again rank first but, after experiencing a 22% decline over 1999, will be followed more closely by Ontario. Together, these two provinces should contribute about 40% of total Canadian exploration expenditures.

The Northwest Territories will continue to dominate in terms of deposit appraisal expenditures in 2000. The $90 million that is expected to be spent on deposit appraisal activities in that territory constitutes 48% of the Canadian total for that type of expenditure. Ontario is the only other province/territory that should experience considerable deposit appraisal spending with forecast expenditures of $41 million.

1.3.2.1.2 SPENDING CATEGORIES OTHER THAN FIELD AND OVERHEAD

According to company spending intentions for 2000, exploration and deposit appraisal expenditures related to the environment and land access will be similar to the levels recorded in 1999 (**Tables 3b** and **4**). While the $18.9 million anticipated to be spent on environment-related items in 2000 will almost match the $18.5 million spent in 1999, it will be much lower than the levels recorded in 1998 and 1997. At $5.1 million, land access expenditures, on the other hand, continue to be quite stable over the 1997-2000 period.

Figure 12
Exploration, Deposit Appraisal and Mine Development Expenditures, by Province and Territory, Forecast 2000



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
Notes: Exploration and deposit appraisal activities include only the search for and appraisal of new deposits; they do not include work for extensions of deposits already being mined or committed to production. Exploration and deposit appraisal activities include off-mine-site and on-mine-site costs incurred for field work and overhead plus engineering, economic and feasibility studies, environment and land access costs. Mine development activities include work to gain access to ore or to increase ore reserves at properties in production or already committed to production. It does not include investments for structures, machinery and equipment. Data for 2000 are company spending intentions as compiled in January 2000.

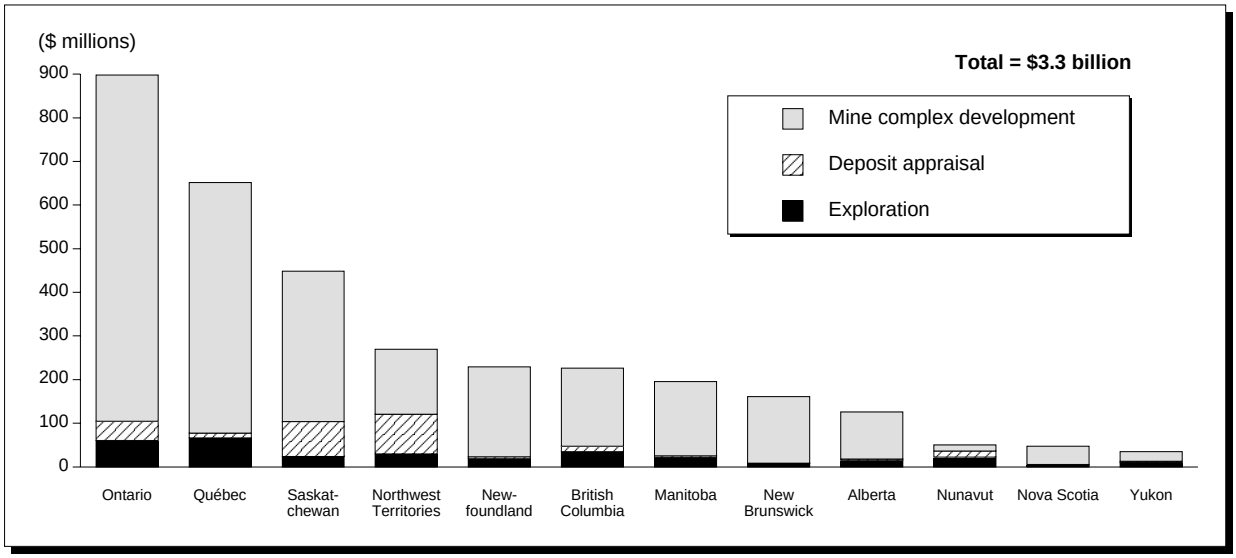
As mentioned earlier, costs incurred for engineering, economic and feasibility studies represent a larger portion of total exploration and deposit appraisal expenditures than do expenditures related to the environment and land access. For the second year in a row, these costs are expected to increase, going from $51 million in 1999 to $83 million in 2000. They are expected to represent almost 17% of all exploration and deposit appraisal expenditures in Canada. Deposit appraisal activities will account for most (92%) of this $83 million total and these activities will occur primarily off mine sites. The increase in this category of spending can probably be explained by feasibility studies at advanced projects.

1.3.2.1.3 TOTAL MINERAL DEVELOPMENT INVESTMENT

With a 2000 forecast of $736 million (**Figure 12**), mine development spending is expected to be slightly lower than in 1999 when this type of spending reached $763 million. Québec, Ontario and Manitoba are expected to account for 73% of mine development spending in 2000. Manitoba will benefit from the largest increase with an additional $40 million to be spent on mine development while Québec and Saskatchewan will experience decreases of $31 million and $24 million, respectively.

When adding all project work phases (exploration, deposit appraisal and mine development), and including all capital and repair costs associated with these three phases and with construction, machinery and equipment for mine complex development, the total mineral development investment is forecast at $3.3 billion in 2000 (**Figure 13**), compared to $3.4 billion in 1999. Rounding causes the difference between the 1999 and 2000 totals to be larger than it really is. In fact, total mineral development investment for 2000 is expected to be only about $20 million less than the level recorded in 1999. In decreasing order of expenditures, Ontario, Québec, Saskatchewan and the Northwest Territories should account for 68% of all mineral development investment in Canada in 2000.

Figure 13
Total Investment for Exploration, Deposit Appraisal and Mine Complex Development Expenditures, by Province and Territory, Forecast 2000



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
Notes: Exploration, deposit appraisal and mine complex development expenditures include costs incurred off- and on-mine-site for field work; engineering, economic and feasibility studies; overhead; the environment; land access; structures, machinery and equipment, and repairs. Data for 2000 are based on company spending intentions as compiled in January 2000.

1.3.2.2 Spending by Type of Company

Based on company spending intentions compiled in January 2000, a total of 107 senior project operators expected to spend $337 million in 2000, accounting for 67% of all exploration and deposit appraisal expenditures for that year (**Figures 1** and **2**). About 57% of total spending by seniors was expected to be allocated to exploration activities and the balance to deposit appraisal activities **(Figure 8)**.

In 1999, 124 senior project operators had reported 73% ($364 million) of total exploration and deposit appraisal expenditures in Canada. The 14% decline in the number of active senior companies in 2000 was accompanied by a 7% decline in expenditures for that category of companies. The decline in terms of total expenditures by senior companies is more noticeable in the $5 million-$10 million range of company spending where approximately $16 million less was spent in 2000 (**Table 1**). At $195 million, the amount spent in the +$10 million range is about the same as in 1999.

Almost two thirds of the expenditures reported by senior firms in 2000 will be incurred in the Northwest Territories, Ontario, and Québec (in decreasing order). Senior firms are expected to decrease their expenditures in 2000 in seven provinces/territories. The most severe decrease is forecast to occur in Québec where senior spending is predicted to fall from $76 million in 1999 to $36 million in 2000. Spending increases are anticipated in the Northwest Territories, Ontario, Nunavut, Saskatchewan and New Brunswick (in decreasing order). Senior companies should be the main contributors to exploration and deposit appraisal spending in all Canadian jurisdictions in 2000 with the exception of Newfoundland and Labrador, Nova Scotia, Québec and the Yukon.

The number of junior project operators (excluding prospectors) is expected to drop again in 2000 to 287, a 25% decrease from the 382 recorded in 1999 (**Figure 1**). However, junior spending is expected to increase by 20% to $165 million and almost return to the 1998 level of $171 million (**Figure 2**). This increase in junior spending should compensate for the anticipated senior spending decrease and help sustain exploration and deposit appraisal expenditures at around the $500 million level.

The paradox of having fewer junior firms spending more can be explained primarily by the increased number of juniors planning to spend in excess of $500 000 in 2000 (**Table 1**). Altogether, a total of 69 junior companies are expected to spend more than that sum, compared to 51 in 1999. As well, most of the companies that did not plan to explore in 2000 were situated in lower spending intervals in 1999; the overall effect of their withdrawal from active exploration projects will not, therefore, have a significant effect on the 2000 spending level.

Increases in expenditures by juniors are expected in all provinces/territories except New Brunswick and Nunavut, where the combined decrease will be less than $3 million. In decreasing order of expenditures, Québec, the Northwest Territories, Ontario and British Columbia, as a group, are expected to account for 63% of all junior expenditures in 2000.

1.3.2.3 Spending by Type of Commodity Sought

Company spending intentions reveal that exploration and deposit appraisal expenditures for precious metals and base metals will decline once again in 2000 (**Figure 9**). However, the declines are not predicted to be as severe as those in 1998 and 1999 when precious-metal spending dropped by 40% and 27%, respectively, and base-metal spending dropped by 33% and 24% for the same two years.

Exploration and deposit appraisal expenditures for precious metals in 2000 are expected to reach $156 million. While the price of gold remains a concern and continues to seriously affect overall spending, there has been increasing interest in exploring for platinum group metals (PGM) in Canada.

At $129 million, base-metal spending is expected to be 11% lower than in 1999. However, there has been a relative strengthening in base-metal prices (at least up to August 2000). The price of nickel, for example, reached US$4.67/lb in March 2000 and, despite having fallen to US$3.63/lb in August 2000, was still much stronger than in early 1999 when it was trading at less than US$2/lb.

Spending on the search for uranium and other commodities (nonferrous metals, other metals, nonmetals and coal) is expected to remain fairly constant in 2000 with predicted expenditures of $21 million for uranium and $31 million for the "other" category.

Diamonds remain the brightest spot of the Canadian exploration and deposit appraisal sector as expenditures dedicated to their search are predicted to increase by 28% in 2000 to $161 million (**Figure 11**). This increased spending will take place on a smaller number of properties (315 versus 378 in 1999) across Canada (**Figure 10**). The steadily declining number of diamond exploration properties reflects a consolidation in the industry as companies focus their efforts on their most promising prospects and move away from those with less potential. As a result, in areas of earlier discoveries, spending is more concentrated on deposit appraisal activities at advanced projects. There is still, however, strong interest in exploration for diamonds as evidenced by the flurry of activity that results whenever new areas with diamonds potential are identified. The strong increase in exploration and deposit appraisal expenditures for diamonds in Québec ($11 million in 2000 versus $1 million in 2000) is a good example.

Overall, the Northwest Territories should record the highest diamond exploration and deposit appraisal expenditures in 2000 with $112 million in company spending intentions. Ontario ($15 million), Alberta ($11 million), Québec ($11 million) and Nunavut ($10 million) are also expected to host significant diamond exploration and deposit appraisal activities in 2000.

1.3.2.4 Statistical Estimation of Exploration and Deposit Appraisal Spending (Based on Field and Overhead Costs Only)

1.3.2.4.1 METHODOLOGY

In this section, an attempt is made to predict the level of exploration and deposit appraisal spending for 2000 using standard statistical estimation techniques. Expenditures are estimated by linking historical exploration and deposit appraisal spending (field and overhead expenditures only) 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.

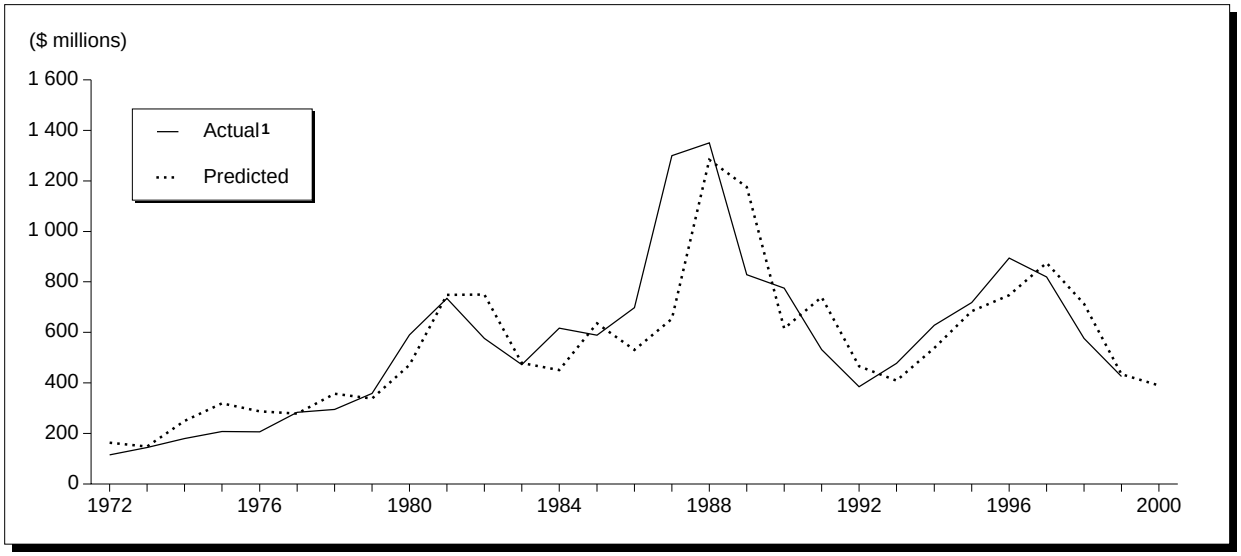
Mineral exploration and deposit appraisal is a multi-stage process (see Appendix 2) that usually proceeds over a relatively long period of time as information is gathered from geological mapping, geophysical and geochemical surveying, diamond drilling and so on. At various stages, this information is 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, and to launch a feasibility study, 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.

1.3.2.4.2 RESULTS

It is important to remember that the following results are based on an analysis of expenditures that include only field and overhead costs. The new categories of expenditures such as environment, land access, economic, engineering and feasibility studies were excluded for the years for which they are available (1997, 1998 and 1999) in order to establish a valid comparison. It is also important to remember that diamonds are not included in NRCan's metals price index and that they have accounted for much exploration and deposit appraisal spending in recent years.

Therefore, notwithstanding these caveats and using data for the years 1971-99, the statistical equation predicts that senior companies will spend about $288 million on mineral exploration and deposit appraisal in 2000. For junior companies, the equation predicts expenditures of about $112 million. For all companies, expenditures of about $390 million are predicted (**Figure 14**). This estimation compares with the $395 million in field and overhead costs that were reported as company spending intentions for 2000 in the *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures*.

Figure 14
Actual and Predicted Exploration and Deposit Appraisal Expenditures in Canada, 1972-2000



Source: Natural Resources Canada.
1 For 1999, preliminary expenditures are shown because actual expenditures were not available.
Note: For comparison with pre-1997 years, the data include only off- and on-mine-site field and overhead expenditures.

1.4 DRILLING

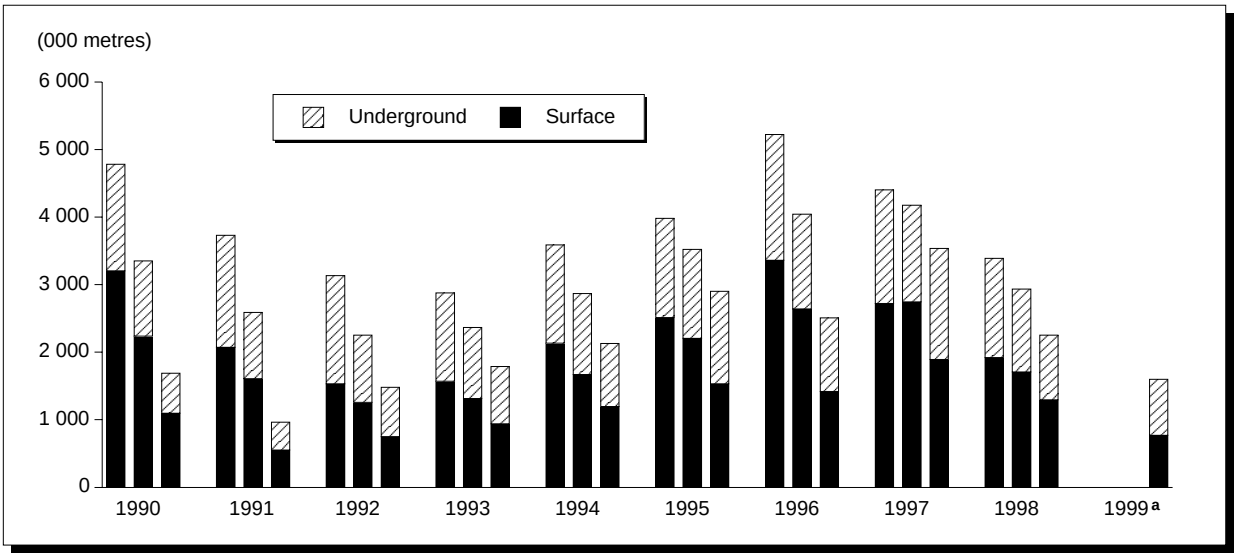
Drilling activities are an essential component of the mineral development cycle from the anomaly investigation stage to the deposit delineation and deposit definition stages. As such, drilling statistics constitute a valuable indicator of recent levels of Canadian mineral exploration and deposit appraisal activity.

1.4.1 Statistical Sources

Diamond drilling is the most widely used drilling method for determining the existence, location, extent, grade and tonnage of a mineral deposit. Canada harbours an important diamond drilling industry and many of its companies are represented by the Canadian Drilling Association (CDA). The CDA gathers diamond drilling statistics from its members, which cover about 50-60% of total Canadian contract diamond drilling activity. Although incomplete, these data provide a reasonable and the most up-to-date indication of recent national mineral exploration and deposit appraisal trends.

The yearly drilling statistics compiled by the CDA are depicted in **Figure 15** along with two other sets of diamond drilling statistics. These are: total Canadian contract diamond drilling, as reported annually to Natural Resources Canada by drilling contractors and published in Statistics Canada's catalogue no. 26-201; and diamond drilling data from the *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures*, which include all metres (m) drilled and expenditures reported by companies for their "own account" (drilling they did themselves) and for contracted drilling work. In this last set of data, exploration drilling and deposit appraisal drilling have been aggregated with mine development drilling to allow a valid comparison with the other two sets of statistics. Mine-site development drilling (mainly underground) consists of drilling aimed at extending ore reserves at producing mines.

Figure 15
Comparison of Three Surveys of Canadian Diamond Drilling, 1990-99



Sources: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures (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 1999.
Note: All data include exploration, deposit appraisal and mine development drilling.

1.4.1.1 Comparison of Drilling Statistics

Although the three sources of statistics mentioned above provide different annual results, the same overall trends are observable in the three surveys over the period 1990-98.

On an annual basis, the CDA diamond drilling statistics confirm the trends observed in exploration and deposit appraisal expenditures in recent years. **Figure 15** shows that, after peaking in 1997, the drilling reported to the CDA declined by 36% in 1998 and by a further 29% between 1998 and 1999. Although official CDA statistics for 2000 were not available at the time of preparing this report, preliminary data provided by the CDA for the first five months of the year point to a further decline. The other two sets of statistics portrayed on that figure also show the same trend except for the fact that, in the statistics provided by the *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures*, drilling peaked in 1996 instead of 1997.

1.4.1.2 Drilling by Work Phase

According to the last-mentioned survey, a total of 2 597 744 m of surface and underground drilling (including diamond drilling and other drilling methods) was carried out for exploration and deposit appraisal purposes in Canada in 1998, compared to 3 800 000 m in 1997 (**Tables 5** and **6**). Of this, 2 457 832 m were accounted for by diamond drilling, down by 28% from the 3 404 000 m drilled in 1997. Diamond drilling aimed at mine development reached 932 655 m in 1998 (**Table 7**), also down from the 999 000-m level of 1997. When adding diamond drilling metres for the three work phases, total diamond drilling amounts to 3 390 487 m, down from the 4 402 666 m reported in 1997.

The more specific contract diamond drilling survey reveals that 2 936 791 m were drilled by contractors in 1998, which represents 87% of the total amount of diamond drilling when this total is applied against the total reported above for the three work phases by the *Survey of Mineral Exploration, Deposit Appraisal, and Mine Complex Development Expenditures.* The remaining 13% of diamond drilling was done by companies on their own account (drilling they did by themselves).

Some 60% (2 024 000 m) of the total diamond drilling activity in 1998 was dedicated to the exploration phase while approximately 13% (433 000 m) was dedicated to deposit appraisal work (**Table 7**). As mentioned above, the remaining 27% (933 000 m) was reported under the mine development category.

TABLE 5. SURFACE AND UNDERGROUND EXPLORATION AND DEPOSIT APPRAISAL DRILLING,[1] BY PROVINCE AND TERRITORY, 1998

	Surface Drilling			Underground Driling			Total Drilling		
Province/Territory	Exploration	Deposit Appraisal	Total	Exploration	Deposit Appraisal	Total	Exploration	Deposit Appraisal	Total
					(000 m)				
Newfoundland	71.1	29.9	101.0	2.6	–	2.6	73.7	29.9	103.6
Nova Scotia	20.4	1.5	21.8	–	–	–	20.4	1.5	21.8
New Brunswick	44.0	2.0	46.0	0.9	16.1	16.9	44.8	18.1	62.9
Québec	381.1	45.7	426.8	129.0	109.7	238.7	510.1	155.3	665.4
Ontario	463.5	8.3	471.8	336.3	62.1	398.4	799.8	70.4	870.2
Manitoba	109.8	6.1	115.9	11.0	31.2	42.2	120.8	37.3	158.1
Saskatchewan	118.8	7.4	126.2	–	14.0	14.0	118.8	21.4	140.2
Alberta	38.8	69.4	108.2	–	–	–	38.8	69.4	108.2
British Columbia	114.0	22.2	136.2	11.2	6.5	17.7	125.3	28.7	154.0
Yukon	23.4	7.8	31.2	–	–	–	23.4	7.8	31.2
Northwest Territories	205.4	75.4	280.8	1.2	–	1.2	206.6	75.4	282.0
Total	1 590.1	275.8	1 865.9	492.3	239.6	731.9	2 082.4	515.4	2 597.7

Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
– Nil.
1 Includes diamond drilling and other drilling methods such as rotary and percussion.

TABLE 6. SURFACE AND UNDERGROUND EXPLORATION AND DEPOSIT APPRAISAL DRILLING IN CANADA, 1985-98

Year	Diamond Drilling			Other Drilling[1]		
	Metres Drilled			Metres Drilled		
	Exploration	Deposit Appraisal	Total	Exploration	Deposit Appraisal	Total
			(000 m)			
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[a]	2 670	734	3 404	157	239	396
1998	2 024	433	2 458	58	82	140

Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
. . Not available.
a The exploration and deposit appraisal phases were adopted as part of the survey redesign in 1997.
1 Other drilling methods include rotary and percussion.

TABLE 7. SURFACE AND UNDERGROUND EXPLORATION, DEPOSIT APPRAISAL AND MINE DEVELOPMENT DRILLING IN CANADA, 1998

Work Phase	Diamond Drilling	Other Drilling[1]	Total by Work Phase
		(000 m)	
Exploration	2 024	58	2 082
Deposit appraisal	433	82	515
Mine development	933	1 433	2 366
Total	3 390	1 573	4 963

Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
1 Other drilling methods include rotary and percussion.

1.4.2 Drilling by Type of Company

Senior companies accounted for 89% (4 401 100 m) of all surface and underground drilling (including diamond drilling and other drilling methods) aimed at the three work phases of exploration, deposit appraisal and mine development in 1998 (**Table 8**). They accounted for all of the 2 365 800 m drilled for mine development in Canada for that year. In terms of exploration and deposit appraisal, drilling by senior companies represented 78% (2 035 300 m) of the total drilling for these two work phases. Junior companies accounted for 23% (485 800 m) of total exploration drilling and for 15% (76 700 m) of total deposit appraisal drilling.

In terms of surface and underground drilling, senior companies, by virtue of their mine-site development drilling activities, accounted for almost 98% of all underground drilling for the three work phases. When restricting this measure to only exploration and deposit appraisal work, senior companies still recorded 96% of total underground drilling activity. Surface drilling activity was somewhat less concentrated as seniors accounted for 82% (2 492 600 m) of total surface drilling compared to 18% (531 400 m) for junior companies.

Exploration drilling by senior companies was mostly conducted from the surface while their deposit appraisal activities were almost evenly divided between surface and underground work. Their mine development drilling was also almost equally split between surface and underground activities. As can be expected, junior companies were more focused on surface exploration and deposit appraisal with 96% (464 800 m) of their exploration drilling conducted from surface and 87% (66 600 m) of their deposit appraisal drilling also originating above ground.

1.4.3 Drilling by Type of Commodity Sought

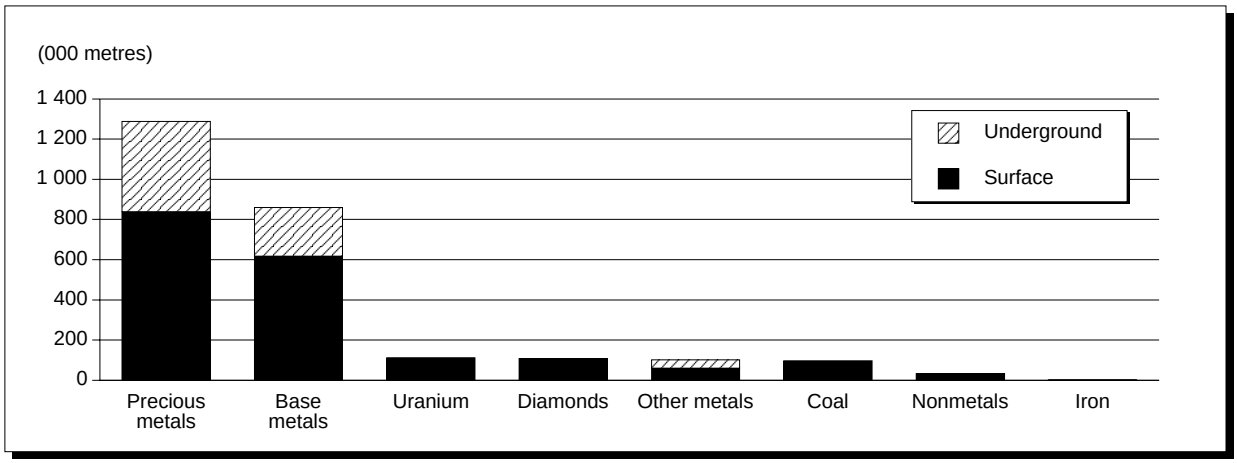
In terms of total surface and underground drilling (including diamond drilling and other drilling methods) by type of commodity sought, **Figure 16** shows that exploration and deposit appraisal drilling activities in Canada in 1998 were primarily aimed at the discovery of precious and base metals. A total of 1 287 600 m was drilled in the search for precious metals, representing almost 50% of total exploration and deposit appraisal drilling. Of this total, 839 100 m (65%) were drilled from the surface. Drilling for base metals accounted for 33%

TABLE 8. SURFACE AND UNDERGROUND EXPLORATION, DEPOSIT APPRAISAL AND MINE DEVELOPMENT DRILLING[1] IN CANADA, BY TYPE OF COMPANY, 1998

Type of Company	Exploration Drilling	Deposit Appraisal Drilling	Mine Development Drilling	Total by Type of Company
		(000 m)		
Junior companies				
Surface	464.8	66.6	–	531.4
Underground	21.0	10.1	–	31.1
Subtotal	485.8	76.7	–	562.5
Senior companies				
Surface	1 125.3	209.1	1 158.2	2 492.6
Underground	471.3	229.6	1 207.6	1 908.5
Subtotal	1 596.6	438.7	2 365.8	4 401.1
Total	2 082.4	515.4	2 365.8	4 963.6

Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
– Nil.
1 Includes diamond drilling and other drilling methods such as rotary and percussion.

Figure 16
Surface and Underground Exploration and Deposit Appraisal Drilling[1] in Canada, by Commodity, 1998



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
[1] Includes diamond drilling and other drilling methods such as rotary and percussion.

(859 600 m) of total exploration and deposit appraisal drilling and, once again, surface drilling was more prevalent with 72% (617 800 m) of the drilling aimed at this commodity group.

Surface drilling also accounted for most of the exploration and deposit appraisal drilling activity aimed at discovering commodities other than precious and base metals. In fact, it represented all of the drilling conducted, within these two phases of activity, for the search for diamonds, coal, nonmetals and iron, and it accounted for almost all (99%) drilling aimed at discovering uranium.

1.5 CLAIM STAKING

Claim staking is another useful indicator of exploration activity. It is particularly efficient at rapidly highlighting emerging trends, such as the mid- and late-1990s exploration rush for diamonds, and at pinpointing areas of interest. Since claim staking usually happens at a relatively early stage of the exploration and deposit appraisal process, it also provides a good measure of current grass-roots-type activities and a good insight into where future advanced (deposit appraisal) work could be focused.

1.5.1 Statistical Summary

The area of new mineral claims staked in Canada in 1999 (**Table 9**) totaled some 5.2 million hectares (Mha), which represents a continued decrease from the 7.9 Mha staked in 1998 and the 44.2 Mha staked in 1997. The area staked in 1997 was the largest area of new mineral claims ever recorded in Canada and was largely the result of a staking rush that followed the discovery of diamonds in the Buffalo Head Hills 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 5.2 Mha recorded in 1999 is somewhat similar to the levels recorded prior to 1992, that is, prior to the major exploration and deposit appraisal efforts that were triggered by the discovery of diamonds in the Northwest Territories and, later, base metals in Labrador.

TABLE 9. AREA OF NEW MINERAL CLAIMS[1] STAKED IN CANADA, 1998 AND 1999

Province/Territory	1998		1999	
	(hectares)	(%)	(hectares)	(%)
Newfoundland	361 900	4.6	241 075	4.6
Nova Scotia	74 180	0.9	157 394	3.0
New Brunswick	40 000	0.5	28 336	0.5
Québec	728 142	9.3	754 102	14.5
Ontario	577 632	7.3	604 096	11.6
Manitoba	475 634	6.1	566 571	10.9
Saskatchewan	680 048	8.7	107 083	2.1
Alberta	3 490 000	44.4	1 026 000	19.8
British Columbia	474 296	6.0	478 740	9.2
Yukon	131 221	1.7	152 731	2.9
Northwest Territories	827 615	10.5	354 755	6.8
Nunavut	. .	. .	718 186	13.8
Total	7 860 668	100.0	5 189 069	100.0

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

1.5.2 New Claims Staked and Claims in Good Standing

As mentioned above, the total area of new mineral claims staked decreased by 2.7 Mha in 1999, a drop of 34% compared to 1998. Decreases occurred in Saskatchewan (-84%), Alberta (-71%), Newfoundland and Labrador (-33%) and New Brunswick (-29%). In terms of hectares, Alberta experienced the largest decreases (-2.46 Mha) followed by Saskatchewan (-0.57 Mha), Newfoundland and Labrador (-0.12 Mha), and New Brunswick (-0.01 Mha).

In Alberta, the number of new mineral claims staked continued to decline from the phenomenal level of 37.2 Mha that was recorded in 1997 during the height of the diamond-staking rush in that province. While Alberta continues to lead the country in terms of new claims staked, it appears that companies in that province have now consolidated their land holdings and are mostly focusing their efforts on those properties deemed to offer the best prospects in terms of finding diamonds.

Elsewhere in Canada, provincial and territorial mining recorders have reported that the decrease in new mineral claims staked in 1999 may be attributed to the concentration of activity on actual holdings in Saskatchewan, to reduced staking activity in Labrador (Voisey's Bay and vicinity), and to a consolidation of holdings by Noranda in New Brunswick.

Nova Scotia recorded the largest year-over-year improvement in its area of new claims staked with a 112% increase. The province's mining recorder explains this increase by the fact that a number of junior companies had acquired the rights to large areas of land in their search for heavy minerals and titanium, but have since dropped many of these claims.

Of the other Canadian jurisdictions that registered an increase in their area occupied by new claims, the cases of Nunavut and the Northwest Territories are interesting in that Nunavut accounted for two thirds of the 1.1 Mha claimed during 1999 in these two territories combined. While advanced exploration and deposit appraisal projects for diamonds were mostly taking place in the Northwest Territories, Nunavut was the site of much grass-roots work for diamonds and gold in 1999.

The total area occupied by claims in good standing amounted to approximately 6.3% of Canada's total landmass in 1999, compared to 7.1% in 1998 (**Table 10**). This decrease is mostly attributable to the slowdown in Alberta diamond-staking activity and to a 27% reduction in the area occupied by claims in good standing in the combined landmasses of the Northwest Territories and Nunavut, which is most likely a reflection of the consolidation of diamond properties and the conversion of claims into mining leases. In Alberta, almost 60% of the area of the province was still occupied by claims in good standing in 1999 compared to 65% in 1998. While this large proportion is bound to decrease in time as companies evaluate their properties and shift their focus to the most promising sites, exploration developments in Alberta continue to generate interest for diamonds in that province.

Newfoundland and Labrador and Québec also experienced large decreases in their respective areas covered by claims in good standing from 1998 to 1999 with decreases of 720 000 ha and 710 000 ha, respectively. Only Manitoba (+110 000 ha) and Nova Scotia (+70 000 ha) registered increases.

1.5.3 Exploration and Deposit Appraisal Intensity

There is considerable variation in levels of mineral exploration and deposit appraisal expenditures across Canada's provinces and territories. For example, 1999 spending amounted to $109 million (preliminary) in Québec but was only $4 million in Nova Scotia. There is also great variation in the land areas of individual provinces and territories where mineral exploration and deposit appraisal activities are taking place. Nova Scotia is the smallest province where exploration activity is reported. It has an area of 55 490 km^2 compared to the

TABLE 10. AREA OCCUPIED BY CLAIMS IN GOOD STANDING IN CANADA, 1998 AND 1999

Province/Territory	Total Area	Area of Claims in Good Standing	Area of Claims/ Total Area
	(hectares)		(%)
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
1999			
Newfoundland	40 572 000	1 377 275	3.4
Nova Scotia	5 549 000	210 182	3.8
New Brunswick	7 344 000	238 144	3.2
Québec	154 068 000	3 073 123	2.0
Ontario	106 858 000	2 500 800	2.3
Manitoba	64 995 000	1 943 403	3.0
Saskatchewan	65 233 000	2 704 363	4.1
Alberta	66 119 000	39 348 014	59.5
British Columbia	94 931 000	3 425 000	3.6
Yukon	48 345 000	1 511 021	3.1
Northwest Territories	143 232 000	3 651 262	2.5
Nunavut	199 400 000	2 491 451	1.2
Total Canada	996 646 000	62 474 038	6.3

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

1 999 400 km^2 of Canada's largest jurisdiction, the territory of Nunavut. Because of these varying areas, it can be misleading to compare provinces and territories on the basis of exploration and deposit appraisal spending alone.

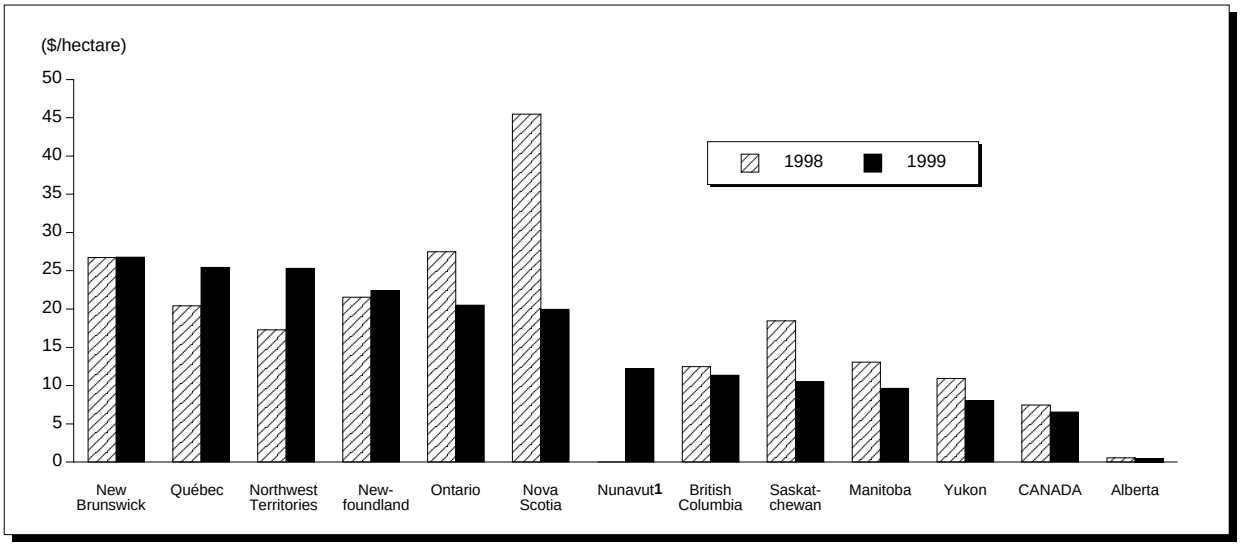
Although not all exploration and deposit appraisal expenditures in any jurisdiction are spent on existing mineral claims (some expenditures are incurred on unclaimed land, exploration permits or mining leases), off-mine-site expenditures per unit of area of mineral claims in good standing constitute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

As shown in **Figure 17**, Nova Scotia, Ontario and New Brunswick enjoyed the highest levels of off-mine-site exploration and deposit appraisal expenditures per hectare of claims in good standing in 1998. For 1999, New Brunswick took first place followed by Québec and the Northwest Territories.

The decrease in Nova Scotia's ranking can be explained by an important growth in the area covered by claims in good standing in that province coupled with a small reduction in off-mine-site expenditures. Other jurisdictions such as Saskatchewan, Ontario and Manitoba suffered important decreases compared to 1998. The decreases in these three provinces can be mainly explained by lower off-mine-site exploration and deposit appraisal spending and also, for Manitoba, by an increase in the area covered by such claims. Once again, Alberta was at the lower end of the spectrum, a situation that can also be explained by the huge area covered by claims in good standing in that province and by decreasing off-mine-site exploration and deposit appraisal expenditures.

Increases in the cost per hectare in Québec, the Northwest Territories/Nunavut and Newfoundland and Labrador were primarily a consequence of the reduction in their respective areas covered by claims in good standing.

Figure 17
Off-Mine-Site Exploration and Deposit Appraisal Expenditures Per Hectare of Claims in Good Standing, by Province and Territory, 1998 and 1999



Sources: Natural Resources Canada, based on the Survey of Mineral Exploration Deposit Appraisal and Mine Complex Development Expenditures; provincial/territorial mining recorders offices.
1 The territory of Nunavut was created in April 1999 by dividing the former Northwest Territories into two distinct territories: Nunavut and the Northwest Territories.
Notes: Off-mine-site exploration and deposit appraisal expenditures include costs incurred off-mine-site for field work and overhead plus engineering, economic and feasibility studies, environment and land access costs. "Claims in good standing" excludes mining leases. Data for 1999 are preliminary.

For Canada as a whole, exploration and deposit appraisal off-mine-site spending per hectare of claims in good standing decreased once again in 1999, dropping to $6.53/ha from $7.47/ha in 1998 and about $12/ha in 1997. While the increase in the area occupied by claims in good standing in Alberta was the predominant factor in explaining the 1998 decrease in spending per hectare, declining exploration and deposit appraisal expenditures took on more importance in explaining the 1999 decrease. The lower off-mine-site spending per hectare of claims in good standing in Canada provides further evidence that overall exploration and deposit appraisal activity was on a downward trend in 1999, adding to the tendency identified by other exploration and deposit appraisal indicators.

1.6 SHORT-TERM OUTLOOK FOR EXPLORATION AND DEPOSIT APPRAISAL SPENDING IN CANADA

The three indicators (spending, drilling and claim staking) of exploration and deposit appraisal activity analyzed in this chapter confirm that the downward trend that began in 1997 continued unabated into 1999. For 2000, company spending intentions point to a possible stabilization of exploration and deposit appraisal spending, with a forecast of $502 million in 2000 versus expenditures of $501 million in 1999.

While this tapering off of the downward trend is welcome news, it remains too early to predict whether this will be the start of an upward trend or if it represents merely a pause in advance of further drops in exploration and deposit appraisal activity. Many factors justify a certain caution when predicting future levels of exploration and deposit appraisal in Canada.

Despite some recent improvements, metal prices, an important driver of exploration, remain at levels that are not very conducive to an increased commitment by companies and investors. International competition for mineral investment also has a role to play as a great number of countries now welcome foreign investment into their respective mining industries. As indicated in Chapter 3, Canadian companies are at the forefront of this globalization movement, creating many opportunities abroad for Canadian suppliers of mining-related goods and services.

In terms of this chapter's analysis, there appears to be a weakening of Canada's exploration (grass-roots) capacity. Spending on the exploration work phase dropped by 50% from 1997 to 2000. Off-mine-site exploration spending also dropped by about the same percentage over the same period. Furthermore, core exploration spending (field work plus overhead) is still on a downward trend. Coupled with the continuing decrease in the number of companies (particularly juniors) conducting exploration and deposit appraisal work in Canada, these observations point to a Canadian exploration and deposit appraisal sector that remains quite fragile.

In recognition of this situation, many provincial and territorial governments have improved their incentives and programs to encourage exploration and deposit appraisal activity. Some of these recently introduced measures are described in the provincial/territorial reviews found in Chapter 2.

In October 2000, the federal government announced a national mineral exploration tax credit of 15% that will be available for a period of three years to individual investors incurring certain surface exploration expenses for most mineral commodities, except coal, bituminous sands and some industrial minerals, in any region of Canada. The federal government also announced a reduction from 66% to 50% of the capital gains inclusion rate for purposes of computing taxable income.

Industry associations and Canadian governments are hoping that the combined effects of these federal-provincial/territorial measures will help stimulate interest in the activities of the Canadian junior mining sector and prevent further deterioration of this important component of the Canadian mining industry.

2. Regional Outlook

2.1 INTRODUCTION

This section presents comments from provincial and territorial officials on recent exploration and deposit appraisal activities in their respective jurisdictions and indicates their expectations for 2000 and, in some cases, 2001.

The reader should note that some 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. Some also consider only field and overhead costs and do not account for other available cost data such as those for environment, economic and feasibility studies, and land access.

The expenditure data mentioned by the different provincial and territorial authorities may also differ from those reported in Chapter 1 of this report (official federal-provincial/territorial figures released by NRCan) for other reasons. For example, the figures reported by Québec include expenditures by the Québec Ministry of Natural Resources that are excluded from the NRCan published totals, and the junior/senior analysis for that province is based on different criteria. As well, the totals reported for Saskatchewan are not based on the same set of definitions used in the national survey.

The territory of Nunavut was created in April 1999 by dividing the former Northwest Territories into two territories: Nunavut and the Northwest Territories. The Nunavut review of activities that appears in this chapter is the first ever to be published in this annual report.

2.2 NEWFOUNDLAND AND LABRADOR

Overview

Expenditures on mineral exploration in Newfoundland and Labrador in 1999 were $32.35 million (**Table 11**). Base metals were the primary exploration target followed by gold and industrial minerals. 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, exploration expenditures in insular Newfoundland have increased slightly.

In 1999, both the number of claims staked (9643) and the number of claims held in good standing at the end of the year (57 431) show an approximate 30% reduction from 1998 levels, reflecting a continued decrease in nickel exploration in Labrador. The final figure (116 263 m) for diamond drilling, however, reflects a healthy 20% increase over 1998.

TABLE 11. NEWFOUNDLAND AND LABRADOR EXPLORATION STATISTICS, 1994-2000

	1994	1995	1996	1997	1998	1999p	2000f
				(dollars)			
Exploration expenditures	12 396 462	71 100 000	92 546 708	71 752 000	50 868 000	32 353 000	23 319 000
				(number)			
Claim staking							
Claims staked	22 256	248 707	15 299	13 363	14 476	9 643	10 000
In good standing	37 084	280 750	168 815	126 766	86 955	57 431	40 000
				(dollars)			
Exploration field expenditures							
Base metals	5 216 623	64 226 300	83 737 940	61 420 000	35 289 730	25 000 000	15 714 000
Precious metals (gold)	3 613 526	5 371 500	6 395 873	5 228 072	3 213 618	4 767 000	2 785 000
Other	884 000	1 241 000	2 412 895	2 336 828	12 366 652	2 586 000	4 820 000
				(metres)			
Diamond drilling[1]							
Production/development	7 260	8 107	9 424	13 318	4 967	4 168	. .
Exploration	42 225	120 803	226 208	141 320	90 428	112 095	. .
Total diamond drilling	49 485	128 910	235 632	154 638	95 395	116 263	80 000

Source: Newfoundland and Labrador Department of Mines and Energy, December 2000.
. . Not available; f Forecast; p Preliminary.
1 Based on a special diamond drilling survey.

Mining

Sixteen mining leases were issued in 1999, primarily for industrial minerals production (dimension stone, barite, gypsum, etc.).

In February 2000, Shabogamo Mining and Exploration Limited shipped its first quartzite from Labrador City to Bécancour in Québec where SKW Canada Limited will refine the high-purity product into silicon metal.

Galen Gypsum Mines Limited supplied the North Star Cement wallboard factory in Corner Brook with its first shipments of gypsum in 1999. The company also shipped a 25 000-tonne (t) test sample to Blue Circle Cement Company in Ontario.

United Bolero Development Corporation was issued a mining lease for barite production from a tailings processing operation at Buchans, in central Newfoundland, in September 1999.

In 1999, International Granite Corporation was issued three mining leases and Classic Stone Inc. was issued two mining leases in the Mt. Peyton area of central Newfoundland to develop new sources for the fabrication plant, operated by subsidiary Cabot Granite Fabricators Inc., at Jumpers Brook near Grand Falls, central Newfoundland. The company produces “black granite” monuments from this area.

Mining leases for dimension stone were also issued to Kenny’s Marble Works for quarries near Goobies and Terrenceville in southeastern Newfoundland, to Dimension Stone Inc. for the Goobies and Mt. Peyton areas, to Tim Gushue near Corner Brook, to BBK Quarry Limited at Gambo in eastern Newfoundland, and to Bookend Resources Inc. at St. Anthony on the Great Northern Peninsula.

The Torngait Ujaganniavingit Corp., a subsidiary of the Labrador Inuit Development Corp. (LIDC), is to open a second quarry for labradorite dimension stone near Nain, Labrador, in 2000. LIDC will also complete a stone plant at Hopedale, 150 km farther south, to process offcuts and waste from the Nain operation into speciality products such as jewellery and monuments.

Development-Stage Projects

A feasibility study for Thundermin Resources Inc. and Queenston Mining Inc. is being undertaken by MRDI Canada on the Duck Pond base-metal project southwest of Buchans in central Newfoundland. MRDI Canada issued a new resource estimate of 6.2 million tonnes (Mt) grading 3.5% copper, 6.3% zinc, 1.1% lead, 63 g/t silver and 0.9 g/t gold, and have moved on to consider mining method options. Thundermin Resources Inc. has announced reserves of 483 000 t grading 3.8% copper, 3.3% zinc, 0.4% lead, 26 g/t silver and 0.3 g/t gold for the nearby Boundary deposit.

In June 2000, Burin Minerals completed a diamond drilling program that had been recommended in a 1998 pre-feasibility study on its St. Lawrence fluorspar property on the Burin Peninsula.

In May 2000, Hurley Slate Works Company Inc. re-opened the slate quarry at Nut Cove, Trinity Bay, eastern Newfoundland.

Expansions and Other Potentially Significant Developments

Iron Ore Company of Canada, now owned by British giant Rio Tinto (via its subsidiary, the Australian company North Ltd.), began mining the new Luce deposit in western Labrador in February 1999. Although of lower grade, the ease of mining and processing of this large-tonnage deposit (proven and probable reserves of 1.6 billion t and indicated and inferred resources of 3.9 billion t) will contribute to an estimated 25% increase in production in 2000.

Better prices for iron ore products in 2000 will add to the profitability of both Iron Ore Company of Canada and Wabush Mines. The latter will also increase production following mill improvements in 1999.

Richmont Mines Inc. purchased the Hammerdown/Rumbullion gold deposit in March 2000 from Abiting Inc. of Québec. The property had been sold to Abiting Inc. by Major General Resources Ltd. in November 1999, and results of diamond drilling during a due diligence evaluation by Abiting Inc. gave a resource estimate of 614 400 t grading 18.01 g/t gold (356 000 oz). Richmont Mines Inc. completed processing of a 17 505-t bulk surface sample in November 2000, which yielded 15.8 g/t, and has initiated the work required to develop the underground mine. The ore will help extend the life of the mill at the Nugget Pond mine on the Baie Verte Peninsula until at least 2007. Richmont Mines Inc. won a Prospectors and Developers Association of Canada environmental award in March 1999 for its production, monitoring and rehabilitation programs at Nugget Pond.

In 1999, Atlantic Minerals completed a three-year capital expansion program at its limestone-dolomite quarrying operation on the Port au Port Peninsula in western Newfoundland.

Exploration - Labrador

Voisey's Bay Nickel Company Limited completed $16.6 million of diamond drilling and geophysical surveys during its 1999 exploration program in northern Labrador. The program included 48 009 m in 49 holes at Voisey's Bay (Main Block), 30 kilometres (km) southeast of Nain, and 2239 m in 7 holes on its Kiglapait property, 60 km north of Nain. A total of 30 000 m of exploratory and delineation drilling on the Main Block, further geophysical surveys and mapping in the Kiglapait area are planned for 2000. Voisey's Bay resources (all categories) stand at 136.7 Mt grading 1.59% nickel, 0.85% copper and 0.09% cobalt. Inco Limited also staked 1001 claims around the Notakwanon River, 40 km south of Voisey's Bay, in August 2000.

Iron Ore Company of Canada staked 4212 claims around its Labrador City mining leases on October 31, 2000, and conducted an airborne geophysical survey over all of its western Labrador holdings late in 2000.

Société Minière Mazarin Inc. staked 90 claims with graphite potential near the border with Québec to the southwest of Labrador City in April and May 2000. Near Fermont, Québec, Société Minière Mazarin Inc. is in a joint venture with Ucar Graph-Tech to develop the Lac Knife graphite deposit, which has reserves of 5.5 Mt grading 17.1% carbon.

Gallery Resources Ltd. conducted a program of prospecting, geological mapping, geochemical analysis, diamond drilling and geophysical surveys with joint-venture partner International Silver Ridge Resources on the Cabot Lake South base-metal property west of Voisey's Bay. In July 2000, Gallery Resources Limited staked a further 432 claims in this area.

In July 2000, Major General Resources Inc. announced an agreement with the Innu Nation enabling it to conduct exploration on its Sarah Lake and Satellite properties, 120 km south and 130 km south-southwest of Nain, respectively. The exploration programs include mapping, ground geophysics, diamond drilling and geochemistry, and the search is for Voisey's Bay-type nickel, copper and cobalt mineralization.

Hathor Exploration Ltd. completed ground geophysical surveys on its Point property in the Red Wine Mountains, about 100 km east of Churchill Falls, where nickel-copper sulphides are the primary target.

Exploration - Newfoundland

In late March and early April 2000, British Canadian Mines Ltd. staked 504 claims in the La Poile area of southwestern Newfoundland. The ground includes the Strickland base-metal deposit.

New Island Resources Inc. staked 239 additional claims adjacent to its Glover Island property in June 2000. The property now comprises 336 claims with a gold resource of 4 Mt grading 2.0 g/t gold. New Island Resources Inc. concentrated its recent exploration effort (ground geophysics and diamond drilling) around the Clyde showing, a pyrite-pyrrhotite-chalcopyrite showing that has yielded 2.0% copper, 0.26% nickel, 0.39 g/t palladium and 0.16 g/t platinum from a 2-m channel sample. An airborne survey of the Glover Island property was completed in November 2000 and soil geochemistry over a zone of anomalies delineated by the airborne survey has identified a number of diamond drilling targets.

Near Corner Brook in western Newfoundland, Pacific North West Capital Corp. staked 294 claims with chromite and platinum group metals (PGM) potential, mostly close to Serpentine Lake, 30 km west-southwest of the city. David Barbour and associates are investigating similar rocks and mineral potential on 94 claims, 45 km north of Corner Brook.

Corner Brook Pulp and Paper completed mapping, trenching, geochemistry and ground geophysics for zinc on its fee simple mining grant, northeast of Corner Brook.

Altius Resources Inc., in joint venture with Billiton Exploration Canada Ltd., has completed ground geophysical surveys and a trenching program at Taylor Brook, a property with nickel-copper-PGM potential, 100 km northeast of Corner Brook.

Noveder Inc. (on the Cabot property) and New Island Resources Inc. (at Pine Cove) both completed diamond drilling programs on their Baie Verte Peninsula gold and base-metal properties.

Major General Resources Ltd. optioned its 600-claim Green Bay base-metal properties, west of Springdale in north-central Newfoundland, to Hudson Bay Exploration & Development Company Ltd.

Altius Resources Inc. completed a 2700-m diamond drilling program on its Lockport property, 60 km north of Grand Falls in central Newfoundland, and has reported semi-massive sulphides with grades of up to 21.5% zinc over 28 cm. Altius Resources Inc. also staked ground near Pilley's Island and Robert's Arm, 20 km east of Springdale in north-central Newfoundland. The latter areas contain known gold and base-metal mineralization and are within the highly prospective Buchans-Robert's Arm belt.

Gallery Resources Limited completed a ground geophysical survey and a diamond drilling program on the Gullbridge base-metal property, 50 km northwest of Grand Falls, in central Newfoundland.

Billiton Exploration Canada Ltd. has undertaken follow-up programs in the Red Indian Lake region of central Newfoundland on base-metal targets on which it is in a joint venture with Buchans River Ltd., Celtic Minerals Ltd. and Altius Resources Inc. This work included geophysical and geological interpretations of the initial airborne GEOTEM survey data, anomaly checking and ground geophysics (induced polarization surveys). Mapping, diamond drilling and geochemical studies were also conducted on these areas (e.g., by Buchans River Ltd. at Buchans, by Celtic Minerals Ltd. at Skull Hill/Lake Bond and Hungry Hill, and by Altius Resources Inc. at Victoria River). Buchans River Ltd. also completed a geochemical program at Duck Pond and Celtic Minerals Ltd. conducted an induced polarization study on its ground near Great Burnt Lake, 35 km and 75 km southeast of Buchans, respectively.

Also in the Red Indian Lake region of central Newfoundland, around 25 km east of Buchans, Vinland Resources Limited completed a ground geophysics and diamond drilling program on its Buchans Junction base-metal project and Phelps Dodge Corporation of Canada, Limited conducted geochemical studies, diamond drilling and downhole geophysics on its Mary March base-metal project. Twenty kilometres south of Buchans, Kelmet Resources Ltd. completed ground geophysics, diamond drilling and geochemistry on the Tulks North base-metal property and, in August 2000, reported Buchans-grade assays of 37.2% and 38.0% zinc from a 6-centimetre (cm) layer.

Tulks Resources Limited has reported assay values of up to 1.1% copper, 5.7% zinc and 0.36 g/t gold over 4.15 m from a diamond drilling program on the Tulks South Property approximately 50 km south-southwest of Buchans and, in December 2000, Buchans River Ltd. acquired the 720 000-t Tulks Hill deposit, which grades 5.6% zinc, 2.0% lead, 1.3% copper, 0.4 g/t gold and 41 g/t silver.

Mountain Lake Resources Inc. confirmed widespread mineralization at its Valentine Lake gold property. The property, located about 60 km southwest of Buchans, is under option from Noranda Inc. Reported grades ranged from 10.19 to 1.01 g/t over intervals of 0.6 to 5.7 m.

At Long Lake, 40 km south of Buchans, Island-Arc Resources Corporation has optioned a 150 km^2 area from Noranda Inc. Resource estimates include a 1.0-Mt lens grading 10.9% zinc, 1.7% copper, 1.3% lead, 33 g/t silver and 0.8 g/t gold. Diamond drilling will be ongoing throughout the winter of 2000/01. Twenty kilometres further east, Altius Resources Inc. optioned the 190-claim South Tally Pond base-metal property, also from Noranda Inc.

Gallery Resources Ltd. staked 573 claims surrounding the Katie prospect, which it has optioned from Black Bart Prospecting. Angular float from the property, which is located about 65 km south of Grand Falls in central Newfoundland, has yielded assay results that include 32.74% and 25.6% zinc and up to 3.5% lead, 1.66% copper, 150 g/t silver and 3.77 g/t gold. Induced polarization (IP) surveys were completed in November 2000 and a 2500-m diamond drilling program commenced in December 2000.

Rubicon Minerals Corporation reported 8.22 m grading 9.07% zinc and 2.71 g/t gold from its Point Leamington joint venture with Billiton Exploration Canada Ltd., 40 km north of Grand Falls, in central Newfoundland. On the surrounding ground, Altius Resources Inc. is conducting exploration on its Point Leamington base-metal property under an earn-in/joint-venture agreement with Inmet Mining Corporation.

In 1999 and early 2000, United Carina Resources Corp. conducted a program of trenching, geochemistry, ground geophysics and diamond drilling on the Linear Group and associated gold properties, located near Gander in northeastern central Newfoundland. On November 9, 1999, United Carina Resources Corp. reported a spectacular intersection from the property of 304.8 g/t gold over 0.6 m.

Sandy and Robert Stares and associates staked 102 claims for gold exploration between Gambo and Benton, 20 km east-southeast of Gander in northeastern Newfoundland.

Cornerstone Resources Inc. continued with programs of mapping, trenching, geochemistry and ground geophysics on its copper exploration holdings in eastern Newfoundland and, in August 2000, completed an airborne geophysics and radiometry survey. Widespread copper and silver mineralization with a magnetic and/or structural correlation is indicated. In addition, Cornerstone Resources Inc. staked a further 302 claims in the area (Red Cliff property). During 1999, in central Newfoundland, Cornerstone Resources Inc. also prospected its Paul's Pond gold property and staked 106 claims at Noel Paul's Brook on a base-metal target.

On the Avalon Peninsula, Vinland Resources Limited completed diamond drilling at its Triangle Pond gold property. Also, Phelps Dodge Corporation of Canada, Limited is exploring for copper on a 362-claim property on the isthmus to the peninsula, staked in June and August 2000, and for base metals on a 126-claim property 30 km south of St. John's.

Government Incentives

In May, 2000, the Government of Newfoundland and Labrador increased its annual contribution to the Junior Company Exploration Assistance Program from $1.5 million to $1.75 million per year. Together with the Prospectors Assistance Program ($250 000 per year), the Dimension Stone Incentive Program ($250 000 per year) and matching funds from the industry, there is now $18 million over four years available for industry assistance, up from $12 million over three years.

Recent changes to the Junior Exploration Company Assistance Program include acceptance of proposals to complete diamond drilling on some geophysical and/or geochemical targets.

As of August, over 100 prospectors had received assistance from the Prospectors Assistance Program in 2000.

Legislative Changes

A *Mining Act* and Regulations were proclaimed in June 2000. This Act applies to producing mines. The Act requires the submission of a development plan and a closure and rehabilitation plan, and that progressive rehabilitation be undertaken wherever possible. Furthermore, financial assurance against the completion of the rehabilitation and closure must be posted.

At the same time, the jurisdiction of the Mineral Rights Adjudication Board, established under the *Mineral Act*, was expanded to include disputes within the *Mining Act*. *The Mineral Act* was also amended to allow the holders of ground-staked licences the option of converting to the more easily maintained map-staked licences.

2.3 NOVA SCOTIA

Overview

In 1999, exploration expenditures in Nova Scotia were estimated at $3.4 million (field and overhead), down from $4.8 million in 1998, $6.7 million in 1997 and $6.9 million in 1996 (**Table 12**). Including engineering, economic and feasibility studies, as well as environmental and land access costs, exploration expenditures for 1999 totaled $4.2 million. Exploration expenditures in Nova Scotia for 2000 are forecast to be similar to 1999 levels.

Nearly half of the amount spent on exploration (field and overhead costs) in 1999, approximately $1.7 million, focused on the potential for various types of kaolin, including: Cretaceous sedimentary kaolin in central Nova Scotia, Devonian granite-hosted primary kaolin in southwestern Nova Scotia, and kaolin of uncertain age in Devonian granite unconformably overlain by Triassic sedimentary rocks in the Annapolis Valley. Kaolin from the first two locations is currently being evaluated for use as a filler and coater in the paper industry and in other industrial applications. Preliminary estimates indicate that approximately $750 000 was spent on gold and base-metal exploration, while the remaining expenditures were incurred on exploration for other industrial mineral commodities such as silica, salt and titanium-bearing heavy mineral sands.

A preliminary estimate of the total number of claims staked as of December 1999, including new and re-issued claims, was 12 984 claims. This level continued in June 2000, when this provincial review was prepared, representing a significant increase over the 8744 claims in effect in December 1998. However, the number of claims in late 1999 and early 2000 was much lower than the 34 265 claims staked in 1996 and the 26 403 claims staked in 1997. This overall decline reflects low country-wide levels of exploration activity resulting, at least in part, from low commodity prices and difficulties in raising venture capital.

Staking activity for salt and potash remained high in 1999 with approximately 23 000 acres (9308 ha) under licence. This is down slightly from 29 840 acres (12 076 ha) in 1998, but remains significantly above the 5600 acres (2266 ha) under licence in 1997. A salt and potash licence is a prerequisite for obtaining an underground gas storage licence in Nova Scotia, and this staking activity reflects a resurgence in interest resulting from the Sable Offshore Energy Project.

Exploration drilling in 1999 totaled approximately 17 000 m, down from the 1997 and 1998 totals of 26 487 m and 20 297 m, respectively. The 1999 level of drilling, however, was more than double the amount drilled annually from 1993 to 1995. Approximately 60% of the drilling activity in 1999 focused on exploration for kaolin, 30% was for gold and base metals, and the remainder was for various industrial mineral commodities.

TABLE 12. NOVA SCOTIA MINERAL EXPLORATION STATISTICS, 1993-2000

	1993	1994	1995	1996	1997	1998	1999p	2000f
Exploration expenditures (field + overhead, general + mine-site) ($)	1 797 000	1 714 000	2 843 000	6 892 000	6 726 000	4 835 112	3 400 000	3 500 000
Claim staking (new and reissued) (general + special licences) (no. of claims)	10 759	14 614	16 407	34 265	26 403	9 440	12 984	. .
Exploration diamond drilling (metres)	6 221	7 725	8 000	15 600	26 487	20 297	17 000	. .

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

New Mines

Georgia-Pacific Canada Inc. obtained a mining permit for its proposed surface gypsum mine at Melford, Inverness County, on March 13, 2000. 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.

Thorburn Mining Limited has been issued a Special Lease and Mining Permit for its proposed surface coal mine at Coalburn in Pictou County. The company began mining coal at the site on May 8, 2000, and is currently nearing completion of construction and final testing of its highwall miner. Thorburn plans to begin using the highwall miner during the summer of 2000 and is investigating using this equipment at its Thorburn surface coal mine. The company expects that this technology will extend the mine life and increase production at its surface coal operations.

Brogan Mining Company Limited received a Special Lease and Mining Permit on December 24, 1999, to carry out surface coal mining activities at its property in Little Pond, Cape Breton County.

Lynx Minerals Inc. commenced mining activities at its Scotsville open-pit barite mine on Cape Breton Island in June 1999. Lynx plans to supply mud-grade barite for use in offshore petroleum drilling in eastern Canada. The company recently completed a 12-hole drilling program at the site to further evaluate the deposit.

Development-Stage Projects

C_2C Mining Corporation continued evaluation of the zeolite potential of amygdaloidal basalts along the North Mountain in western Nova Scotia. Zeolites reportedly constitute up to 20 weight percent of basalt flows in zones up to 10 m thick. The company has completed geological mapping, diamond drilling and analytical work on several zeolite properties, and has recently completed a bulk sampling and test processing program at its Stronach Mountain zeolite prospect. In addition, C_2C has conducted research and product development work on its other zeolite properties. The company has announced that it plans to build a processing facility in the Annapolis Valley.

Pasminco Limited continued with the Environmental Assessment process to obtain the necessary permits for developing an open pit at the site of the former underground zinc-lead mine at Gays River, Halifax County.

Fundy Gypsum Company completed the construction of and commissioned its new crushing facility at the Miller Creek mine, near Windsor, in early 2000. The $20 million crushing facility will enable the company to increase production and also provide custom products for its end-use customers.

Exploration

Industrial Minerals

Lynx Minerals Inc. plans to evaluate the viability of the Lake Ainslie barite-fluorite deposit (1.7 Mt $BaSO_4$, 0.86 Mt CaF_2) in western Cape Breton Island. Potential end uses for the deposit include mud-grade barite for the offshore oil and gas industry, fluorite by-products, calcium carbonate, and pharmaceutical-grade barite.

Kaoclay Resources Inc. continued its exploration program to define the quality and extent of kaolinitic clay and silica sand deposits in the Musquodoboit and Shubenacadie valleys of central Nova Scotia. The company has completed bulk sampling, regional-scale and detailed grid

drilling, and shallow seismic surveying. At the time this report was prepared, Kaoclay was conducting analytical work at its laboratory in Milford, Nova Scotia, and at its pilot plant in Georgia.

Black Bull Resources Inc., under an option agreement with CAG Enterprises Ltd., completed an initial exploration program for the Flintstone Rock kaolin-quartz project in southwestern Nova Scotia. The property is situated along the Tobeatic Fault Zone at the southern margin of the South Mountain Batholith. Work to date includes trenching, geophysical surveys (IP), diamond drilling and sample testing. The company completed 29 drill holes and reported that the target alteration zone varies from 100 to 200 m in width, exceeds 100 m in depth, and exceeds 1200 m in strike length. Two large trenches were excavated in early 2000 and the company has applied for permits to collect bulk samples of both the kaolin and quartz zones within the deposit to evaluate the various industrial applications for these minerals.

NAR Resources Ltd., under an option agreement with Titanium Corporation of Canada Ltd., continued exploration of titanium-bearing sands in the Shubenacadie River in central Nova Scotia. The company completed a total of 395 shallow vibra-core drillholes on sand bars exposed at low tide during the summer of 1999. The holes were cored in the Shubenacadie River on a 100-m x 100-m spacing, and in Cobequid Bay on a 300-m x 300-m spacing. Samples collected from the core holes contained heavy mineral concentrations from 2% to 20%. "Qualitative mineralogical test work" revealed that the heavy mineral sands contain 34% ilmenite, 2% leucoxene, 7.5% rutile, 19% zircon, 5% garnet, 20% magnetite and 12.5% "others."

LaFarge Canada Inc. carried out an exploration drilling program for limestone in the Hardwoodlands area of Hants County and in the Brentwood area of Colchester County.

Kelly Rock Ltd. completed additional work, consisting of trenching and rock sampling, on the Glendale limestone deposit in Inverness County.

In addition to the above-mentioned companies, there was considerable activity by two international gypsum companies that have expressed interest in developing new gypsum mines in Nova Scotia. Activity in 1999 included regional resource evaluation, land agreements and drilling.

Gold

Earth Search Sciences Inc. staked 1600 claims covering approximately 70 000 acres (28 329 ha), comprising 26 licences for 10 gold and copper prospects throughout mainland Nova Scotia and Cape Breton Island. The company plans to combine its "Probe 1 Hyperspectral" remote sensing technology with the extensive on-line database from the Nova Scotia Department of Natural Resources, using desktop GIS technology, to focus its follow-up exploration activities.

Newfoundland Goldbar Resources Inc. drilled a deep exploration hole at the former Dufferin gold mine at Dufferin Mines, Halifax County, in 1999. The company reported that 10 new saddle reef quartz veins were encountered in a 396-m drill hole at the site.

Base Metals

NAR Resources Ltd. signed an option agreement with Titanium Corporation of Canada to acquire a 50% interest in the Lochaber Lake base-metal project in Antigonish County. The company initiated an exploration plan in the summer of 2000 consisting of geochemical surveying and airborne and ground geophysical surveying.

Mount Cameron Minerals Inc. completed a six-hole drill program for zinc skarns hosted by Precambrian carbonates in the Boisedale Hills area of Cape Breton Island. Only low-grade zinc

was encountered in the drillholes; however, exploration activities led to the discovery of occurrences of "flake" graphite and nickel-copper-platinum-palladium mineralization related to gabbroic intrusions in the area.

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. The program is designed to give assistance to prospectors and has three components:

- A training component that provides funding for basic and advanced prospecting courses. Courses are held at locations throughout the province as demand warrants. In addition, this component supports the continuing education of prospectors through seminars, workshops, field trips and web-site development. Basic and advanced training courses were conducted in the fall of 1999 and spring of 2000.

- A prospector assistance component, the most popular part of PAP, that provides funding to help prospectors in their search for minerals. Individual prospectors, or a prospector's company, are eligible for up to a $5000 contribution from PAP, provided that the prospector also contributes a minimum of 30% additional funding to the project. Projects from grass-roots exploration to diamond drilling are eligible for support.

- A marketing assistance component that provides funding to prospectors to market their properties to junior and senior mining companies at local, national and international trade shows. Funding is available for individual prospectors to travel to trade shows and display information about their properties. In addition, the PAP will assist with the cost of renting display hardware and space. In 2000, four prospectors received assistance to attend the Cordilleran Round-Up in Vancouver and twelve prospectors obtained funds to attend the Mining Millennium 2000 conference in Toronto.

2.4 NEW BRUNSWICK

Exploration Highlights

The year 1999 proved to be another challenging one for the New Brunswick exploration industry. As has been the case in the past few years, it appears that reduced exploration budgets, market conditions that affect the raising of capital, and a refocusing of exploration projects to other jurisdictions have affected not only New Brunswick, but most of the other Canadian provinces and territories as well. Exploration expenditure surveys conducted for New Brunswick in 1999 point to a 15% decrease from 1998. Preliminary estimates indicate that approximately $8.5 million ($10 million in 1998) was spent in New Brunswick on exploration projects.

This downward trend was more pronounced in the number of claims recorded in 1999; 1771 were recorded versus 2500 in 1998, a 29% decrease. The total number of claim equivalents in effect for 1999 was 21 362. The number of new claims recorded in northern New Brunswick during 1999 was 1343 and the number of claims in effect at year-end was 12 368. For southern New Brunswick, the number of claims recorded in 1999 was 428 and the number of claims in effect at year-end was 2516.

Metallic Minerals

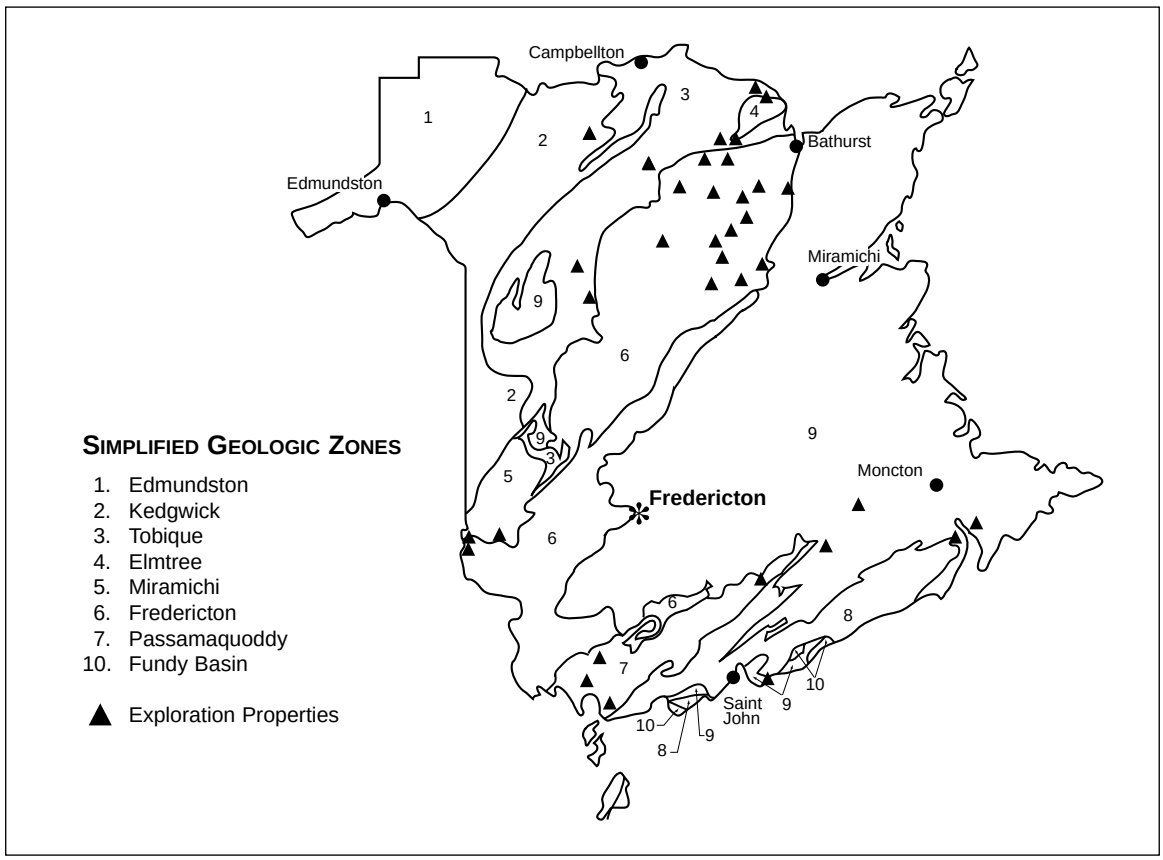
As in past years, most of the exploration activity in northern New Brunswick (**Figure 18**) was focused on base metals in the Bathurst Mining Camp.

MAJOR COMPANIES

The active major companies in 1999 were Noranda Inc. and Breakwater Resources Ltd., which together spent about $6 500 000. Noranda Inc. accounted for most of the exploration expenditures in northern New Brunswick, spending $6 470 000 within the Bathurst Mining Camp (up $1 600 000 over 1998). Approximately $1 000 000 of this total was spent on two-dimensional seismic surveys in the Brunswick belt. Noranda's land holdings are in the Key Anacon-Lawson Brook belt, Brunswick-Portage River belt, Heath Steele-Mountain Brook belt, Camel Back-Wedge belt and Upsalquitch-Half Mile Lakes belt. Breakwater Resources Ltd. conducted limited exploration (totaling approximately $50 000) on the Wildcat and Caribou North properties.

Teck Exploration Ltd., which was active in 1998, closed its office in Bathurst at the first of August.

Figure 18
Exploration Activity in New Brunswick, 1999



Source: New Brunswick Department of Natural Resources and Energy.

JUNIOR COMPANIES

The active juniors in 1999 were Black Bull Resources Inc., Chapleau Resources Limited, Eastmain Resources Inc., Fancamp Resources Ltd., Lewis Brook Resources Ltd., Northeast Exploration Services Limited, Omni Mines Ltd., PGE Resource Corporation, and Slam Exploration Ltd., which collectively spent approximately $500 000. Eastmain Resources Inc., which spent approximately $230 000 during that year, focused on its Tingley Brook and Sandburn Brook properties. Bubbee Ventures Inc., in partnership with Eastmain, contributed $150 000 towards the exploration program. Eastmain also explored its wholly owned Railroad property.

In mid-September, Eastmain Resources Inc. announced an agreement in principle with Stratabound Minerals Corp. regarding mining of the Captain North Extension (CNE) deposit. Eastmain considers the remaining open-pit reserve (i.e., approximately 75 300 t of 7.3% zinc, 2.6% lead and 89.1 g/t silver) to be understated because the grade of the mill feed in the early 1990s was higher (i.e., 11.1% zinc, 4.7% lead and 150.86 g/t silver). With the closure of Heath Steele in 1999, future custom milling will be done at Brunswick No. 12.

Outside the Bathurst Mining Camp, Chapleau Resources Ltd., Lewis Brook Resources Ltd., Slam Exploration Ltd. and Fancamp Resources Ltd. carried out work, or expected to carry out work, in 1999.

Exploration in southern New Brunswick (**Figure 18**) was targeted mainly on precious metals and base-metal sulphides with emphasis on gold. Exploration continued to be active for industrial minerals and energy-related resources. Exploration expenditures in southern New Brunswick are estimated to be $740 000 for 1999.

The high potential for economic gold deposits, which have been associated with a variety of geological environments in the southern part of the province, is becoming widely recognized. One of the most important is the recent discovery of impressive gold mineralization associated with certain Late Paleozoic granitoid rocks in a contact metasomatic environment. In a regional context, many of the gold-bearing vein, skarn and porphyry systems in this area appear to be associated directly or indirectly with broadly similar intrusions indicating the presence of an extensive, genetically related gold district. Other significant new gold discoveries associated with Hercynian fold-thrust belts that affect Neoproterozoic and/or Carboniferous rocks along the south coast of the province have also been located, highlighting the potential for gold in these environments as well.

Over the past year, Freewest Resources Canada Inc. has conducted exploration on two promising gold properties: Golden Ridge and Clarence Stream. On the Golden Ridge property in the Canterbury area, gold sourced in high-level, intermediate intrusions and enriched along a major fault zone occurs within an Ordovician felsic to intermediate volcanic pile. The company completed a 10-hole diamond drilling program, following up on three main targets outlined by soil geochemistry and trenching.

Freewest also acquired the Clarence Stream gold property that was found by Reginald Cox in 1998 after following up government detailed mapping and regional stream-sediment sampling surveys. There, gold with arsenopyrite and stibnite occurs along the northwestern contact of the Saint George Batholith for at least 4 km. Gold is present as disseminations in altered granodioritic rocks of the batholith, and in deformed sedimentary and gabbroic rocks within the contact aureole.

Some exploration for base-metal sulphides was conducted in the southern part of the province. Government personnel involved in a 1:10 000-scale bedrock geological mapping survey have succeeded in outlining the potential productive horizon for volcanogenic massive sulphide deposits near Canterbury.

Other active companies in southern New Brunswick include PGE Resource Corporation and Phelps Dodge Corporation of Canada Ltd. PGE continued to work on the Albright Brook property in the Annidale area, which has high potential for economic gold and base-metal sulphide deposits. Phelps Dodge staked claims in the Jordan Mountain area, which also has potential for these commodities.

In addition to the major and junior companies, approximately 35 prospectors actively explored various areas in New Brunswick in 1999.

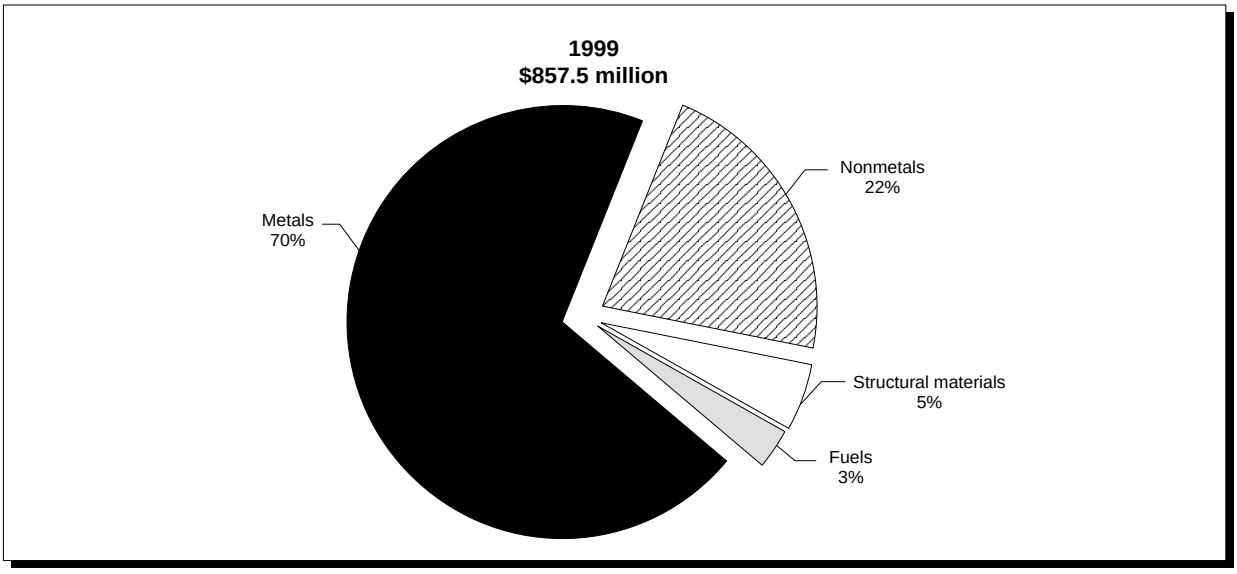
Nonmetallic Minerals

In 1999, exploration was centred on high-calcium limestone, diatomaceous earth and silica. Limestone deposits of the Carboniferous Windsor Group in southern New Brunswick continued to be the target of exploration. Havelock Lime, a division of Goldcorp Inc., evaluated a limestone property a few kilometres north of its Havelock processing facility in conjunction with the development of a new specialty lime product. In 1998, the company acquired a 20 000-t bulk sample from a small test quarry on the property and subsequently undertook a 2800-m diamond-drilling program in the fall of 1999 to verify long-term reserves. If successful, calcined lime production at Havelock could increase by several tens of thousands of tonnes annually and result in a capital investment of $3 000 000-$4 000 000. A number of mineral claims were established northwest of St. George where McMinn Pit Ltd. is investigating fine-grained silica and diatomaceous earth found on the floor of a few eutrophic lakes and adjacent bogs.

Mining Highlights

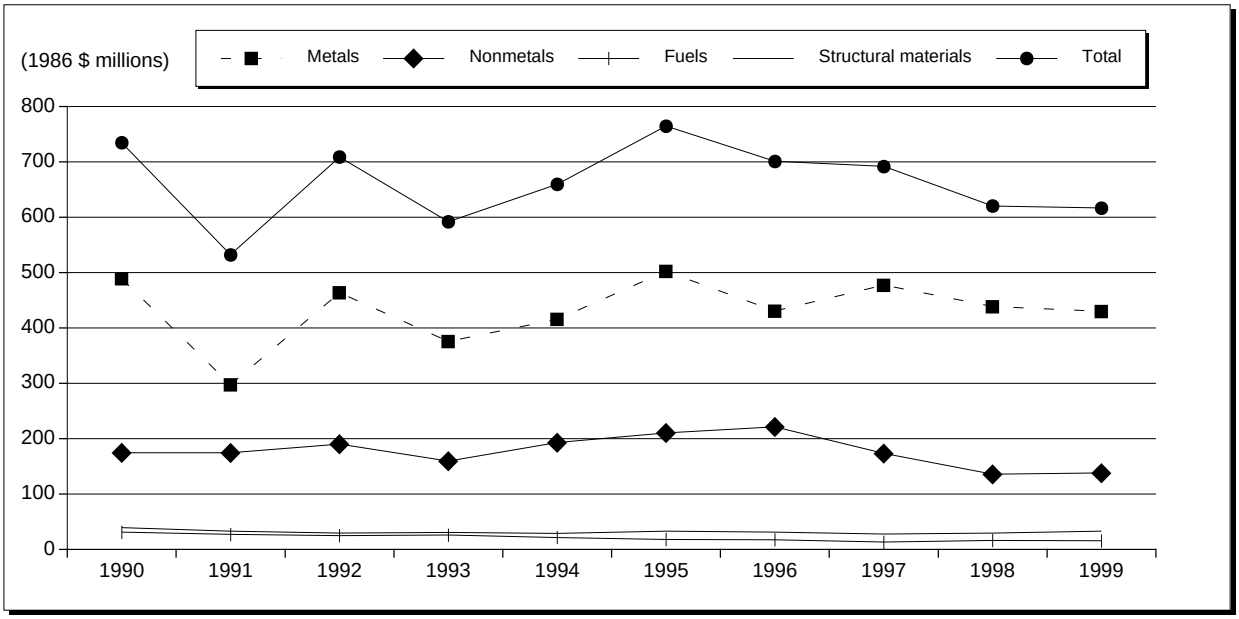
The preliminary value of New Brunswick's mineral production for 1999 is $857 516 900 (**Figures 19** and **20**), a decrease of 0.6% from the final value of $862 992 354 for 1998. The loss of production from the closure of the Heath Steele mine was almost offset by a slightly higher average zinc price and a slightly lower Canadian dollar. In 1999, there were two metal producers and 41 nonmetallic producers (includes industrial minerals, peat and aggregates) in New Brunswick (**Figure 21**).

Figure 19
New Brunswick Mineral Production Value, 1999



Source: New Brunswick Department of Natural Resources and Energy.

Figure 20
New Brunswick Mineral Production Values, 1990-99



Source: New Brunswick Department of Natural Resources and Energy.

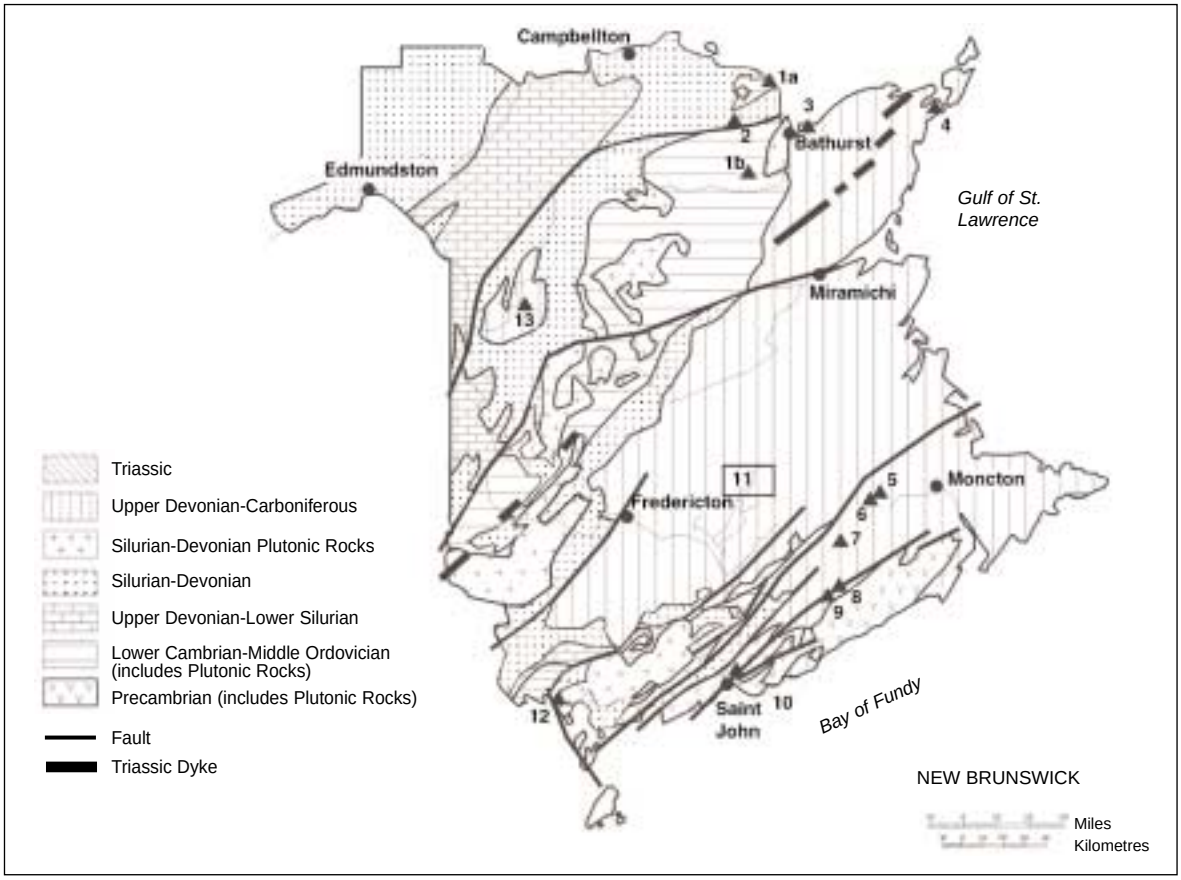
Metals accounted for 70% ($597 933 574) of the total value of production. Of these, zinc, lead, silver and copper made the largest contribution. Noranda Mining Inc. operated the Brunswick No. 12 mine, the Heath Steele mine and the Belledune lead smelter. The No. 12 mine and the smelter ran uninterrupted throughout the year; the Heath Steele mine closed. Operations continue to be suspended at the Caribou and Restigouche mines (Caribou Mine Division of CanZinco Ltd.), Mount Pleasant mine (ADEX Mining Corporation), Murray Brook mine (Murray Brook Resources Inc.), and Lake George antimony mine (APOCAN Inc.).

Nonmetallic minerals contributed 22% ($191 993 876) to the value of production. The main commodities are potash, peat, salt and sulphur in smelter gas. Progress had been made in reducing a small brine inflow detected by the Potash Corporation of Saskatchewan Inc. (New Brunswick Division) in its mine near Sussex in 1998. The inflow had not affected production. The company utilized its Cassidy Lake Division processing facility to upgrade standard-grade potash imported from Saskatchewan. Four limestone quarries were active: Saint John (Brookville Manufacturing), Havelock (Havelock Lime; 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. Eighteen companies produced peat valued at $57 557 627 from 33 bogs in New Brunswick.

Coal production was valued at $21 600 000. 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% ($45 989 450) to 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 Quarrie (Notre-Dame) produced dimension stone in the province.

Figure 21
Mines and Quarries in New Brunswick, 1999



1a. Belledune smelter (Noranda Inc.)
1b. Brunswick No. 12 (Noranda Inc.)
2. Sormany quarry (Elmtree Resources Ltd.) – limestone
3. Bass River area deposit (Chaleur Silica Ltd.) – silica
4. Shippagan (Jiffy Products NB Ltd.) – peat
5. Havelock area quarry (Lafarge Canada Inc.) – limestone
6. Havelock area quarries (Havelock Lime) – limestone
7. Sussex area mine (PCS (NB Division)) – potash, salt
8. Cassidy Lake deposit (Atlantic Silica Inc.) – silica
9. Cassidy Lake processing facility (PCS (Cassidy Lake Division)) – potash, salt
10. Brookville quarry (Brookville Manufacturing) – limestone, dolomite, gypsum
11. Minto-Chipman coalfield (N.B. Coal Limited) – coal
12. Lake Dideguash area/Bayside (McCormack Materials/Charlotte County Ports Limited) – sand/aggregate
13. Plaster Rock area (D.F. Merrithew) – gypsum, limestone

Source: New Brunswick Department of Natural Resources and Energy.

Incentive Programs and Special Projects

Mineral Exploration Stimulation Program (MESP)

In 1998, the Province of New Brunswick continued its support for this popular prospector incentive program. In 1999, 33 grants were provided for a total of $40 000.

New Brunswick Exploration Assistance Program (NBEAP)

This program continues to be extensively utilized by the junior mining sector to assist in their exploration activities in the province. Funding levels for 1999 provided assistance to 10 recipients totaling $350 000.

Value-Added/Mineral Processing Program (VAMP)

The VAMP, launched in 1996 in accordance with New Brunswick's Mineral Policy, is designed to provide funding on a shared basis for projects that could enhance the value of New Brunswick's minerals either by processing them to a higher level or by improving the recovery of present products. In 1999, the program funded two studies: one on an oxidation process for recovering metals and another on the production of chemicals from industrial minerals.

Restigouche 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 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 by assisting the private sector in evaluating its potential. Phase II (evaluation of the results of Phase I) supported the continuation of this initiative; consequently, Phase III resulted in another 11 400 line km being flown over the adjacent area and additional geochemical surveys being conducted in 1999. Results are to be made available to the public in the second quarter of 2000.

For More Information

To obtain a more in-depth review of the New Brunswick mineral industry, please visit the Minerals & Energy Division's web site at http://www.gnb.ca/0078/minerals/index.htm, or consult the report entitled *New Brunswick's Mineral Industry 1999*, which can be downloaded from ftp://ftp.gnb.ca/dnre-mrne/minerals/pubs/ (the file name is Mineral Resource Report 2000-3.pdf).

2.5 QUÉBEC

Overview[1]

Preliminary data for 1999 show that exploration and deposit appraisal expenditures amounted to $129.3 million (**Table 13**), which represents a 19% decrease relative to 1998 and is the third lowest total on record in the last 10 years. It is also lower than the $145.9 million average for the past 10 years.

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1 Source: *L'industrie minière du Québec*, 1999 Edition, Ministère des Ressources naturelles, Service de la recherche en économie minérale, May 2000.

TABLE 13. QUÉBEC, FLOW-THROUGH SHARE FINANCING AND EXPLORATION EXPENDITURES, 1995-99

	1995	1996	1997	1998	1999p
			($ millions)		
Value of flow-through share issues	26.4	27.4	22.9	12.3	5.9
Exploration and deposit appraisal expenditures	131.6	148.2	190.1	170.3	129.3
Off-property	105.8	124.5	124.9	100.5	98.4
On-property	25.8	23.6	65.2	69.8	30.9

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

The difficulties in mineral exploration reflected by the drop in exploration and deposit appraisal expenditures are also confirmed by the decrease in the number of metres drilled reported by drilling companies. In fact, the number of metres drilled has been falling steadily since 1996. Since that year, the number of metres drilled has dropped significantly, going from 1 089 619 m in 1996 to 757 724 m in 1999, a decline of 331 895 m (30%).

Preliminary data show that the decrease in total exploration and deposit appraisal expenditures observed in Québec in 1999 can be explained primarily by a significant decrease in on-mine-site expenditures. While the $30.9 million recorded in 1999 is close to the $33.5 million average for this activity between 1990 and 1999, it is lower than the $65.2 million and $69.8 million totals achieved in 1997 and 1998, respectively. These larger sums were associated with some large-scale projects in the townships of Bousquet and Cadillac in the Abitibi-Témiscamingue region.

Off-mine-site exploration and deposit appraisal expenditures totaled $98.4 million in 1999, which is roughly equivalent to the 1998 total of $100.5 million.

Exploration Highlights in 1999[2]

The number of active claims in Québec in 1999 was 95 981. This was lower than the average for the past 10 years (approximately 114 100) and was also below the symbolic threshold of 100 000 active claims for the first time since 1990. The situation could actually worsen in the future given that the number of claims recorded in 1998 (12 538) and 1999 (16 825) is lower, in each case, than the average number recorded for the past 10 years (18 714). A total of 57 exploration licences (available north of 52° latitude) were recorded in 1999, down from the 103 recorded in 1998, but close to the 62 recorded in 1997. However, the number of active exploration licences remained relatively constant at year-end through 1997 (189), 1998 (239) and 1999 (201).

The Abitibi greenstone belt remains a favourite target in the search for base and precious metals. East of Rouyn-Noranda, exploration work at the LaRonde mine of Agnico-Eagle Mines increased the mineral resource to 39.8 Mt grading 4.28% zinc, 0.36% copper, 66.9 g/t silver and 4.3 g/t gold. North of La Sarre, Aurizon Mines spent over $10 million on an exploration and development campaign on its Casa Berardi property, defining a mineral resource of 6.9 Mt grading 7.41 g/t gold. In December 1999, Corporation Copper Rand announced a $22 million investment to increase the depth of shaft No. 4 and drive a ramp to a depth of 1390 m in order to resume production at the Copper Rand mine in Chibougamau. On the Brosman property,

[2] For further details, consult the *Report on Mineral Exploration Activities in Québec*, 1999, DV 2000-01, Ministère des Ressources naturelles, Géologie Québec.

north of Chibougamau, SOQUEM Inc. reported the discovery of a 58-m mineralized zone grading 1 g/t gold. In Matagami, Noranda invested $113 million in its Bell Allard mine, which went into production in the summer of 1999. Work by Cancor Mines on the B zone of the Gemini property, discovered in 1998, confirmed the zone's potential. Drilling returned grades of 6.6% zinc, 0.29% copper, 177.5 g/t silver and 1.33 g/t gold over 10.7 m. Major General Resources and Cameco Gold continued work on the Despinassy property located 75 km north of Val-d'Or. Drill hole 99-17 intersected 3.1 m grading 26 g/t gold. On the Windfall Lake property located about 100 km southwest of Chibougamau, Inlet Mining Corporation, Alto Minerals and Noront Resources have discovered several mineralized zones. The best results obtained were 65.22 g/t gold over 0.6 m and 41.62 g/t gold over 1.1 m. The numerous recent discoveries clearly demonstrate the mineral potential of the Abitibi region and the ever-present possibility of new discoveries at so-called traditional mining camps.

In the James Bay region, Nuinsco Resources announced in January 1999 that hole 99-1 had intersected 3.2 m grading 10.8% nickel. A major drilling campaign by Nuinsco Resources did not significantly extend the original mineralized zone. Nevertheless, several companies are still interested in the numerous geophysical anomalies, and the exposure of new favourable settings should mean that the work will continue in 2000. In the Eastmain river area, work by SOQUEM Inc. and Eastmain Resources on the Clearwater property has led to the discovery of three new veins, which should substantially increase the geological resources. In the La Grande region, Cambior joined forces with Virginia Gold Mines to continue work on the La Grande Sud property, where geological resources are estimated at 4 525 000 t grading 2.13 g/t gold (March 1999). Discoveries of gold mineralization in iron formations or associated with major deformation zones, porphyry mineralizations and massive sulphides in the James Bay region should maintain interest in this area.

In November 1999, Virginia Gold Mines announced the discovery of several nickel-copper-platinum-palladium-cobalt showings on the Gayot project, about 100 km north of the Fontanges airport and the Trans-Taïga road in Québec's Far North. The best results obtained were 2.17% nickel, 0.05% cobalt, 0.42% copper and 2.46 g/t platinum-palladium over 4.85 m. In the fall of 1999, Twin Gold announced that it had found 112 diamonds in the Torngat 1 dyke (sample of 212 kg). As a result of this announcement, several mineral exploration licences were issued for the region. Also in the Far North, 1:250 000-scale geological mapping initiated by Géologie Québec in the summer of 1998 led to the discovery of new exploration targets in this relatively unknown area.

Falconbridge and Dumont Nickel have been actively exploring in the Ungava Trough. These two companies are looking for nickel-copper-PGE deposits in peridotite horizons similar to those at the Raglan mine.

Several interesting metal showings have been found in the Grenville Province (Mont Laurier, Lac Saint-Jean and North Shore areas) and in the Appalachians.

With regard to magnesium, the main activity involved Noranda's Magnola project near the town of Asbestos in the Eastern Townships. The company invested $730 million in the construction of a 68 000-t/y capacity magnesium plant (originally designed at 63 000 t/y) that went into production in June 2000.

In the industrial minerals sector, three other projects continued in 1999. In the Thetford Mines region, Allican Resources completed a pre-feasibility study on bringing chromium deposits into production. At the Lac-Des-Deux Montagnes Seignory near Montréal, Niocan continues to develop its niobium deposit in the Oka Hill carbonatite complex. SOQUEM and Norsk Hydro are still investigating the possibility of bringing the Sept-Îles apatite-ilmenite deposit into production. Finally, there is heightened interest in industrial minerals exploration, particularly by regional mining exploration funds. Prospecting, sampling and, in some cases, drilling have been carried out for over 10 different types of materials.

Public Financing for the Québec Mining Industry

Preliminary data show that the mining sector raised funds of $28.7 million in the Québec capital market in 1999, representing a 34% decrease from the $43.2 million raised in 1998. In four years, mine financings in the Québec capital market have dropped from $160.0 million to $28.7 million. However, the proportion of these funds invested in projects in the province rose from 30% in 1996 ($47.9 million) to 58% in 1999 ($16.3 million).

During 1999, flow-through share issues raised $7.2 million for mineral exploration investments, compared to $12.3 million in 1998, representing a decrease of 42%. Of this $7.2 million, 82%, or $5.9 million, is earmarked for exploration projects in Québec (**Table 13**).

In 1999, $21.5 million was raised through other sources of public funding (common shares and debentures) for projects in Québec and elsewhere, representing a 31% decrease from the $31 million raised in 1998.

Measures in Support of Funding and Mineral Exploration Activities

Tax Measures in Support of Mineral Exploration

In the budget speech of March 25, 1997, the Québec Minister of Finance announced that individuals could continue to receive the additional deductions provided under the flow-through share arrangement for the 1999 and 2000 taxation years. When the proceeds of a flow-through share issue are invested in surface exploration in Québec, the tax deduction can be up to 175% of the original investment.

Sodémex and Sodémex II

The objective of the Sodémex and Sodémex II limited partnerships is to participate in the development of the Québec mining industry by making equity investments in junior exploration companies and mining producers in Québec.

Sodémex was established in late 1996 with funds contributed by limited partners SOQUEM and Capital d'Amérique CDPQ Inc. (a subsidiary of the Caisse de dépôt et placement du Québec). The capital subscribed by the limited partners totals $17 million, with $7 million invested at the time Sodémex was created and the rest to be paid over a five-year period until 2001 at the rate of $2 million per year. The Sodémex portfolio consists of shares in about 50 mineral exploration companies and mining producers active in Québec whose capitalization is less than $125 million.

Sodémex II was created in August 1997 by Capital d'Amérique CDPQ, which is the only limited partner in this second limited partnership. Sodémex II has subscribed capital of $15 million that it can invest in the Québec mining sector and, at the same time, improve the international prospects of Québec junior mining companies.

Gestion Sodémex Inc. is the general partner of the two limited partners and, as such, is responsible for managing their investments. As general partner, Gestion Sodémex has the authority and the responsibility for managing the activities of Sodémex and Sodémex II.

In 1999, the two limited partners invested about $3.8 million, of which $1.5 million was invested in the primary market (new share issues) and $2.3 million in the secondary market (existing securities). Approximately 75% of investments by Sodémex and Sodémex II went into exploration companies while the remaining 25% was invested in mining producers.

Equity investments were made in the following junior exploration companies: Birim Goldfields Inc., Cambiex Exploration Inc., Exploration minières du Nord Ltd., Sulliden Exploration Inc.,

Minerais Buisseau Inc., Ressources Appalaches Inc., Freewest Resources Canada Inc., Metco Resources Inc., and Sirios Resources Inc. At December 31, 1999, the market value of the mining portfolios of Sodémex and Sodémex II amounted to approximately $13 million.

Mining Investment Portfolio of the Québec Federation of Labour (QFL) Solidarity Fund

In 1996, the Solidarity Fund established a mining portfolio with initial capital of $32.5 million. At the beginning of 1998, the value of the portfolio was increased to $67.5 million, which represents approximately 1.2% of all Solidarity Fund investments.

Originally, about 90% of the investments were earmarked for bringing new deposits into production or for the growth of Québec mining producers. Thus, the Fund made equity investments in McWatters Mining Inc., Mazarin Corporation Inc., Orleans Resources Inc. and Carrières Glendyne. In addition, about 10% of the funding was allocated to improving the working capital of mineral exploration companies. Today, the Fund still distributes its assets in the same way, dividing them between mining production and exploration companies.

The Fund was particularly active during the 1998/99 fiscal year and has remained active since the beginning of the 1999/2000 fiscal year. As of December 31, 1999, two thirds of the $67.5 million envelope reserved for the mining sector was already invested in or committed to companies active in Québec.

For example, the Fund invested over $3.5 million in the common shares of Granite Bussière Inc. to participate in the acquisition of Granilac Inc., which owns a quarry of black gabbroic anorthosite (Cambrian Black) and Grani-Décor Tiles. In addition, the Fund joined with other investors in a $9 million funding commitment, $2 million of which was to cover the cost of expanding the Sigma mill owned by McWatters Mining. The Fund also maintained its support of Orleans Resources Inc., approving an outlay of $750 000 to fund the re-opening of its mining operations. The Caisse de dépôt et placement du Québec, SOQUEM, the Québec Ministry of Natural Resources and other investors are also involved in this project. Carrières Glendyne also received an equity investment of $300 000 from the Fund for a project to expand its slate roofing shingle plant in Saint-Marc-du-Lac-Long. The Fonds régional de solidarité du Bas-Saint-Laurent also contributed $125 000 to this project.

Investments of over $1.5 million were made in debentures and shares primarily to increase the working capital of eight Québec junior companies: Boreal Exploration Inc., Maude Lake Exploration Ltd., Altavista Mines Inc., Niocan Inc., Osisko Exploration Inc., Allican Resources Inc., Majescor Resources Inc., and Radisson Mining Resources Inc.

Finally, the Solidarity Fund made a number of investments on the secondary market, purchasing shares in mineral exploration companies and small producers.

Regional Solidarity Funds

The Fonds régional de solidarité Nord-du-Québec and the Fonds régional de solidarité Abitibi-Témiscamingue were established by the Solidarity Fund QFL, which provided them with initial capital funds of $6 million to assist businesses in their respective regions. Mining companies have been among the businesses targeted by these agencies to benefit from equity investments in recent years.

In 1999, the Fonds de solidarité Abitibi-Témiscamingue committed $450 000 to the mining sector in its region, investing in Dynacor Mines Inc., Azimut Exploration Inc. and McWatters Mining Inc. Also in 1999, the Fonds de solidarité Nord-du-Québec made an equity investment of $100 000 in Metco Resources Inc.

Financial Assistance Programs for Exploration

In order to provide support for mineral exploration activities in the province, the Québec Ministry of Natural Resources (MRN) offers various financial assistance programs for prospectors, regional exploration funds, companies, and Aboriginal communities in the Near North and Far North regions.

- The Programme d'assistance à l'exploration minière du Québec (Québec Mineral Exploration Assistance Program) helps independent prospectors and companies involved in prospecting and mineral exploration in Québec. Independent prospectors can obtain up to $4000 for a basic prospecting project (off claim) and up to $15 000 for an advanced prospecting project ($50 000 in the case of companies). In addition, certain regions of Québec are covered by regional funds. Under an agreement, the MRN has given the various regional exploration funds responsibility for managing the Program for their respective regions. The MRN's contribution to these regional funds totals $1 000 000. In addition, the Nunavik Mineral Exploration Fund, which focuses on the development of Aboriginal mining entrepreneurship, received $300 000 in financial assistance in 1999. During the summer, the Fund carried out a number of prospecting projects in the areas of Puvirnituk, Akulivik and east of Kangiqsualujjuaq. About 10 Inuit prospectors took part in various exploration projects carried out by mining companies in the Nunavik Territory.

- The Programme d'exploration minière du Moyen-Nord québécois (Near North Mining Exploration Program) was established in 1995 to stimulate exploration in this relatively unexplored region of promising mineral potential with funding of up to $100 000 per project.

- The intent of the Abitibi Subprovince Deep Drilling Program is to stimulate exploration work at depth in this region where only 6% of drilling is below 200 m but where the most recent discoveries have been made below the 200-m level. Funding may reach $50 000 per project.

During the 1999/2000 fiscal year, the MRN allocated some $7 million to the implementation of these various programs.

2.6 ONTARIO

Ontario Rated as Canada's Best Mining Jurisdiction

The Fraser Institute has once again rated Ontario as Canada's most attractive province for mining and exploration and the third most attractive jurisdiction in the world. The recent results of the Fraser Institute's *Annual Survey of Mining Companies 2000/2001*, released on December 19, 2000, assesses mining jurisdictions in Canada, the United States and other countries on their mineral exploration investment attractiveness. Ontario was rated Canada's best mining jurisdiction in terms of mineral potential (scoring 100 out of a possible 100 points) and number one in overall investment attractiveness. For full details, the report is available on the Institute's web site at http://www.fraserinstitute.ca/publication/surveys/2000mining/.

Industry View of the Provincial Budget

The Ontario government continues to reaffirm its commitment to a healthy and vibrant mining industry in the province by creating an investment climate that will ensure and enhance its status as one of the world's most important mining jurisdictions. It continues to recognize the importance of the mineral sector to its present and future prosperity by supporting policies and programs that focus on creating conditions favourable to growth and investment in the mining industry.

In the May 2000 Ontario budget, Finance Minister Ernie Eves announced several new policy and investment commitments in support of Ontario's mineral exploration and mining sectors, which include:

AT A GLANCE

2000 Ontario budget initiatives that stimulate and support mineral investment include:

- Cutting the mining tax rate by 50%.
- Providing a 10-year tax holiday and reduced tax rates for new remote mines.
- Enhanced tax incentives for investors in flow-through shares.
- Reduced corporate income tax rates for resource companies.
- $10 million additional funding for field work and mapping under *Operation Treasure Hunt*.
- $8 million in funding over four years to develop and test innovative mineral exploration technologies.

The budget referenced major new reductions in mining and corporate taxes for mine operators, including a 50% reduction in the mining tax rate over five years, as well as a 10-year mining tax exemption for new remote mines and preferential tax rates thereafter. When fully implemented, Ontario will have the lowest mining tax rate in Canada. Minister Eves also announced enhancements to flow-through share investment incentives, the acquisition of new geoscience information, and research and development support for advanced mineral exploration techniques.

Overview

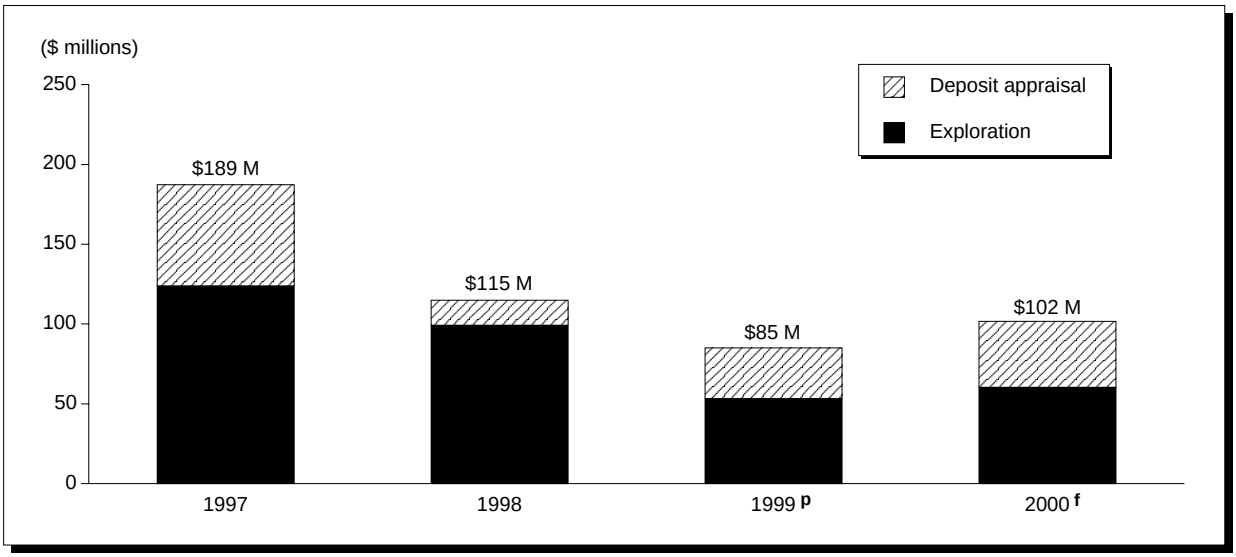
Ontario has been one of the world's leading mineral producers for more than a century. Today, over $5 billion worth of minerals a year, from barite to zinc, are produced in the province. Commodity price declines faced by Ontario and world mineral producers in the later part of the decade are now showing strong recovery and should reflect positively on producer revenues into the new millennium.

Ontario is one of the premier mining and exploration jurisdictions in the world and indications are that its share of Canadian exploration expenditures will continue to increase. Early indications point to a reversal in trends towards reduced exploration expenditures in 2000 (**Figure 22**). Forecasts for exploration and deposit appraisal expenditures are estimated at $101.6 million, up 20% from 1999. Spending by Ontario's senior and junior sectors are expected to increase by 12.6% and 62%, respectively, from 1999. Ontario's senior sector accounts for over 80% of all exploration and deposit appraisal expenditures in the province.

At the end of 1999, active claim units in Ontario exceeded 156 000. The Ministry of Northern Development and Mines (MNDM) recorded more than $36 million of assessment work on those units, with much of the exploration activity taking place in traditional mining camps such as Red Lake, Timmins, Kirkland Lake and Sudbury.

The Ontario Geological Survey (OGS) continues to play a vital role in stimulating Ontario's exploration sector. In keeping with this philosophy, a two-year, $19 million program labeled *Operation Treasure Hunt* was established in 1999 to apply state-of-the-art geophysical and geochemical procedures to pinpoint new "buried or blind" mineral deposits in Ontario. The studies will uncover specific locations for prospectors and exploration companies to focus their activi-

Figure 22
Exploration and Deposit Appraisal Expenditures in Ontario, 1997-2000



Sources: Ontario's Ministry of Northern Development and Mines; Natural Resources Canada.
[f] Forecast; [p] Preliminary.

ties on in their search for new mines. With an additional funding allocation of $10 million announced in its May 2000 budget, the MNDM is extending its successful *Operation Treasure Hunt* geological program to a third year.

The areas to be surveyed and the best techniques to use are being determined by the MNDM's OGS in cooperation with the Ontario Geological Survey Advisory Board (OGSAB). The advisory board, whose membership comprises industry experts, helps ensure that the OGS's mapping priorities reflect changing industry and scientific requirements.

The generation of new geoscientific data promotes Ontario's standing as one of the world's best jurisdictions for mineral exploration investment. Investing in new exploration technologies and methods will also reinforce this standing. On September 11, 2000, the Ministry announced a new four-year, $8 million Ontario Mineral Exploration Technologies (OMET) program designed to stimulate the development of new technologies for mineral exploration. This program will focus on technologies and methods with the potential to enhance the efficiency of exploration programs in high-potential geological areas of Ontario. The expectation is that it will also lead to exciting new discoveries in the province. As well, if these technologies are proven effective, they can be exported around the world.

Exploration and Development Highlights

New Mines

Canada Brick is completing the development of a new $51 million shale quarry and adjacent brick plant (150 million brick units per year) at Aldershot within the city of Burlington. The plant will be in operation by late 2000.

Mine Expansions

The Kidd Creek mine, owned by Falconbridge Limited, underwent evaluation for a major deepening project below the 2100-m level to the 3100-m level to access deep copper, zinc and silver

mineralization. The feasibility study was completed in June 2000 and the company announced, in July 2000, that it had approved the development of Mine D (Deep) at a cost of $640 million. When completed, the mine will extend to 3100 m, making the Kidd Creek mine the deepest base-metal mine in the world. Production from the D mine is scheduled to begin in 2004 and will contribute 2 Mt of ore per year to mine production. The project will extend the current mine life beyond the year 2015.

Placer Dome Inc. continued gold production at its Campbell mine in Balmertown and reached the 10 million oz (311 035 kg) cumulative production milestone in April 2000. Production for the year 2000 was 262 000 oz (8149 kg) of gold. An option/joint-venture agreement with Claude Resources Inc. with respect to Claude's past producing Madsen gold mine and adjacent exploration property in Red Lake adds 10 500 acres (4249 ha) of prime exploration ground to Placer Dome's portfolio.

In late 1999, Brampton Brick Limited began a $30 million-$33 million expansion of its Brampton plant that will increase capacity by 50% to about 200 million brick units per year. The increased brick production will result in accelerated mining of shale from the company's Cheltenham quarry in 2000.

OMYA Canada Incorporated has completed the fourth year of a five-year plant expansion program near Perth. The company produces a variety of calcium carbonate products from a calcitic marble extracted from the nearby Tatlock Quarry in Darling Township. Annual production is 250 000 tons (226 796 t) with reserves of more than 5 million tons (4.54 million t).

Capital expenditures by Battle Mountain Gold and Teddy Bear Valley Mines Limited on the Holloway mine property for 1999 amounted to $6.2 million. The companies plan to spend more than $1.8 million on underground exploration and $400 000 on surface exploration near the mine property.

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.

Mine Development

Goldcorp Incorporated settled the strike at its Red Lake mine in April 2000. In March 2000, Goldcorp Inc. announced "The Challenge," an Internet-based exploration contest. The company made all the data on the Red Lake mine available over the Internet to any interested party and invited exploration proposals to find additional gold reserves at the mine. Although Goldcorp currently awaits the last votes from the judges, a list of semi-finalists can be viewed on the company's web site. The new Red Lake mine poured its first gold on August 1, 2000. Commercial production with a target rate of 600 tons/day (544 t/d) of ore was achieved at the beginning of the first quarter of 2001. Total production for 2000 was 85 116 oz (2467 kg). The year-end estimated High Grade zone (HGZ) gold reserves and resources at the new Red Lake mine have increased by 30%. The HGZ reserves now stand at 3.02 million oz (93 932 kg) of gold with a diluted cut-off grade of 1.68 oz/ton (57.60 g/t) of gold.

North American Palladium Limited has increased its reserves at the Lac des Iles mine near Thunder Bay to 94.1 Mt grading 1.66 g/t palladium, 0.18 g/t platinum, 0.14 g/t gold, 0.062% copper and 0.053% nickel. The company received a positive detailed feasibility study on a proposed US$126 million expansion of the operation to 15 000 tonnes per day (t/d) from the current 2400 t/d and began construction in 2000.

Falconbridge Limited continued development of its Thayer Lindsley mine, shifting from a high-grade, low-tonnage nickel-copper operation to a lower-grade, higher-tonnage operation. This has increased the mineable reserves to 5 Mt.

Inco Limited continued a US$125 million development project at its Creighton mine. A total of 6 Mt of high-grade ore between the 7400-ft (2256-m) and 7699-ft (2346-m) levels will be brought into production in two phases beginning in 2001. The project should continue until 2013.

Highwood Resources acquired the Canada Talc property near Madoc in December 1998. During 1999, the company completed substantial upgrading to the plant and milling facilities. Development of recently identified talc reserves at the mine site is scheduled. The company has also expressed a strong interest in investigating other industrial mineral deposits in southeastern Ontario.

At the Eagle River mine, River Gold Mines Ltd. is sinking its main shaft to a first-phase target depth of 550 m. Ongoing development of the high-grade No. 6 zone will be tied to the shaft infrastructure. River Gold Mines Ltd. has also made an agreement to acquire a 75% interest in the Magnacon mine properties in the Mishibishu Lake area from the Windarra group of companies. The company will spend $2 million on exploration of the gold property over the next four years.

Advanced Exploration

Emerald Fields Resource Corporation continued work on its Big Mack petalite (lithium silicate) property, north of Kenora. The access road to the site was completed in February 2000. Results from an earlier 5-t sample removed from a 30-m trench registered a lithium oxide value of 4.85%. In December 1999, the company submitted an amended closure plan to permit it to install a 50-t/d pilot mill. Wabaseemoong Independant Nations and Emerald Fields Resource Corporation signed a memorandum of understanding in 1999.

Avalon Ventures Limited has updated the prefeasibility study of its Big Whopper petalite (lithium silicate) deposit north of Kenora. Geological mapping and diamond drilling have defined a total petalite resource of 11.6 Mt grading 1.34% lithium oxide and 0.30% rubidium oxide within the Big Whopper pegmatite system. A 15 000-t bulk sample has identified the principal commodities as petalite, tantalum and rubidium-rich potassium feldspar. Avalon Ventures completed compilation of regional and property scale data of lithogeochemical, ground and airborne magnetic surveys. Following a 1999 pre-feasibility study, Avalon Ventures plans a full feasibility study, including a 5000-t bulk sample.

Canmine Resources Corporation has reached an agreement to acquire a hydrometallurgical cobalt extraction plant and refinery, formerly owned by Cobatec Inc., for $6.1 million. This facility, located in Cobalt, will enable Canmine to upgrade cobalt concentrates produced by the company's Werner Lake cobalt project into cobalt carbonate.

An exploration objective to replace mined reserves of gold was satisfied at Placer Dome's Musselwhite mine via surface and underground drilling. Over the past year, some 55 200 m of exploration and delineation drilling were completed. A ground magnetic survey was also conducted in 2000.

Cantera Mining Limited, through a contract with Wolfden Resources, completed a 406-t bulk sample in December 1999 at the Pickle Crow property, northeast of Pickle Lake. Positive results from this project prompted Cantera to proceed with a Phase 2 advanced exploration project. A Certified Closure Plan was filed with the MNDM in October 2000 and a Phase 2 bulk sample was initiated. Approximately 9000 t of ore is currently being excavated. Milling of the ore will be done at Battle Mountain Gold's Hemlo facility.

Shaft dewatering and rehabilitation work continued at Claude Resources Inc.'s Madsen mine project in Red Lake. Drill stations are planned on the 16th level and are designed to drill off the No.8 zone between the 22nd and 16th levels. An $8.2 million, three-year option/joint-venture deal was signed with Placer Dome Ltd. in the fourth quarter of 2000 with respect to

the Madsen mine project and Claude's 10 500 contiguous acres (4249 ha) in the Red Lake camp. Placer Dome has announced plans for a drill program on the Madsen mine property in the first quarter of 2001.

Falconbridge Limited continues to outline newly discovered orebodies at the Onaping Deep, Craig Deep, and Southeast zones, all of which are in the north range of the Sudbury Igneous Complex. Work also continued on the Norman West zone on the east range of the Sudbury structure.

Regis Resources acquired the Goshawk property in 1997 and has outlined a new zone of vermiculite to the west of Highway 507 in Cavendish Township. In 1999, the company staked additional claims over adjacent areas thought to have high potential. Diamond drilling to confirm the depth extent of the weathered material was completed.

Monopros Limited (now De Beers Canada Inc.) extracted a 9400-t bulk sample from the Victor kimberlite pipe near Attawapiskat for diamond evaluation. In the winter of 2000/01, the company returned to the area to do more exploration both on the Victor pipe and several other kimberlite pipes. To date, De Beers has discovered 16 kimberlite pipes in the area, of which 15 are diamond-bearing.

Major Exploration Projects

Franco-Nevada Mining Corporation Limited reported that previous surface diamond drilling on its Hemlo property adjacent to the Williams mine had defined an inferred resource of 1.75 million oz (54 431 kg) of gold. In 1999, the company tested the upper portion of the Hemlo horizon across 765 m of strike length on its property.

Kinross Gold Corporation and United Tex-Sol Mines Incorporated are exploring the Clavos gold deposit east of Timmins. A 20 000-m diamond-drilling program has been completed and has encountered encouraging gold mineralization. The purpose of the diamond-drilling program was to further delineate and outline high-grade shoots, while increasing confidence in grade continuity and overall geometry of the deposit. The program has changed focus to test the east and west boundaries of the shoots in order to extend them laterally and to possibly connect various shoots together. The companies indicated the program has been a success in establishing grade continuity, indicated by the presence of visible gold mineralization within the HW and FW zones.

Canabrava Diamond Corporation, Paramount Ventures and Finance Incorporated, and Kennecott Canada Exploration Incorporated have a major exploration program under way that extends from Wawa to Kapuskasing. The companies are searching for diamonds with a $25 million exploration budget.

Ontex Resources Limited is conducting a major drilling and airborne geophysical program on the Brookbank and Cherbourg gold properties in Irwin Township (Beardmore area). The Brookbank deposit contains an inferred mineral resource of 1.38 million tons (1.25 Mt) of ore grading 0.263 oz/ton (9.02 g/t) gold, as identified in previous drilling.

The Lilypad Lakes tantalum-cesium project is located 150 km northeast of Pickle Lake. Avalon Ventures Ltd. completed an initial diamond-drilling program in December 2000. Economically significant tantalum mineralization ranging in grade from 0.023% to 0.158% Ta_2O_5 over estimated true widths of 0.5 to 28.0 m was intersected in all eight holes.

Houston Lake Mining Incorporated continued field-based and laboratory work on its Pakeagama Lake rare metals property north of Red Lake. Believed to be the second-largest complex-type petalite sub-type pegmatite discovered in Ontario, channel sampling of the north

wall returned 344 g/t tantalum oxide, 0.90% rubidium oxide, 1776 g/t cesium oxide, 68.9 g/t tin, 131.9 g/t niobium oxide, 1.34% lithium oxide, 25.9 g/t thallium and 42.2 g/t gallium over 11 m.

Wolfden Resources and Jonpol Explorations Ltd. acquired the Birch Lake Intrusive property in the Birch Lake belt, east of Red Lake. The property hosts a known gold deposit of 893 508 tons (810 590 t) grading 0.14 oz/ton (4.80 g/t) gold and a PGE zone in a mafic intrusion that previously assayed 5.8 g/t gold, 4.4 g/t platinum, 3.4 g/t palladium, 9.4 g/t silver, 0.8% nickel and 0.9% copper across 1.5 m. They carried out a two-hole diamond drill program in June 2000 and plan to carry out more diamond drilling on this project in the first quarter of 2001. The partners have two properties that straddle the Ontario-Manitoba border (Little Stull Lake and Monument Bay properties) and have acquired a potential PGE property at Borthwick Lake as well as several claim blocks covering airborne geophysical anomalies that may have diamond potential.

Exploration on Goldcorp Inc.'s Trout Bay property 25 km west of the Red Lake mine returned surface grab samples assaying as high as 7.07 g/t palladium and 7.08% nickel. Intensive surface work in the summer and fall of 2000 included stripping, channel sampling and diamond drilling. Goldcorp is also exploring several other properties in the Red Lake camp by carrying out several diamond-drilling programs on various properties. Geological mapping and sampling in addition to detailed airborne geophysical surveys, as well as Mobile Metal Ion sampling, were included in exploration programs on most of Goldcorp's Red Lake properties.

Nuinsco Resources Ltd. conducted a time domain airborne geophysical survey over its gold-nickel-platinum-palladium Rainy River property located west of Fort Frances. The purpose of the survey was to locate the extension of the No. 34 base-metal zone from which selected core samples average 2.26% nickel, 1.99% copper, 0.084% cobalt, 2.58 g/t platinum, 6.35 g/t palladium, 1.80 g/t gold and 25.77 g/t silver. Nuinsco also carried out base-metal exploration at properties in the Confederation Lake area. Diamond drilling intersected several zones anomalous in zinc with selected assay returns of 1.81% zinc over 4.15 m and 4.21% zinc over 0.45 m.

Ansil Resources Ltd. continued surface exploration on its Ranger Township property and retained but did not work on other properties in the Red Lake camp.

Cypress Development Corp. carried out diamond drilling on its Baird Township gold property and geological mapping, a ground magnetic survey and sampling on its McKenzie Island gold property in Dome Township.

Rubicon Minerals Corporation signed a $3 million, five-year deal with Anglo Gold North America with respect to Rubicon's Red Lake gold project. Detailed mapping, assaying and lithogeochemical sampling programs were carried out on Rubicon's extensive landholdings in the camp. Rubicon also reported 1.15 g/t palladium, 0.17 g/t platinum and 0.25 g/t gold over 0.21 m from preliminary, limited sampling of drill core from its Peterson project, 6 km east of the Red Lake and Campbell mines. Rubicon acquired 370 claim units covering highly prospective PGE and gold occurrences at the west end of Red Lake adjacent to the Goldcorp Inc. Trout Bay PGE property.

Royal Roads Corp. carried out ground magnetometer and very low frequency electromagnetic (VLF-EM) surveys, a Quantec Real Time induced polarization (IP) survey, geological mapping and diamond drilling on its Adams Lake property under option from Rubicon Minerals Corp.

Band-Ore Resources Limited started a drilling program on its Nym Lake PGE property near Atikokan. Four holes totaling 2000 ft (610 m) are planned. Magnetic and induced polarization anomalies associated with a pyroxenite intrusion have returned grab samples up to 3.3 g/t palladium and platinum combined, 0.45% copper, 0.8% nickel and 2.9 g/t silver.

Inco Limited continued to expand new nickel-copper discoveries immediately north and south of the Copper Cliff South mine. The company also commenced an aggressive exploration project at the former Totten nickel-copper mine on the Worthington orebody.

Mustang Minerals Limited, Pacific North West Capital Corporation and Aquiline Resources Incorporated worked extensively on the River Valley mafic intrusion east of Sudbury. Programs of linecutting, ground geophysical surveys, geological mapping, soil and lithogeochemical sampling, and diamond drilling were undertaken. The second area of exploration for PGEs was in the East Bull Lake and Agnew Lake area west of Sudbury. Mustang Minerals Limited and New Millennium Metals Corporation completed similar work to that undertaken at River Valley.

Diamond Lake Minerals Incorporated has defined a significant new graphite deposit in Bedford Township. Work done to date has included stripping, trenching, sampling, air-track drilling, bulk sampling, bench testing, reserve calculations and market research. Additional definition diamond drilling to confirm the reserves and acquisition of the necessary permits are planned.

Early in 1999, Millstream Mines Limited began another deep drill program at the Potter mine property in Munro Township. New drilling returned up to 7.82 m of sulphide mineralization grading 1.96% copper, 3.18% zinc, 0.085% cobalt and 0.53 oz/ton (18.17 g/t) silver. The mineralization is approximately 914 m vertically below surface and 579 m below the former mine bottom working level. An induced polarization anomaly east of the mine shaft is currently being tested with deep diamond drilling.

Cross Lake Minerals Ltd. began a 700-m drill program on its Sheraton Township property. The company is investigating a 500-m-long electromagnetic anomaly northeast of the Cross Lake zone.

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

The MNDM provides the information that companies and investors need on Ontario's mineral deposits, geology, exploration assessment work, and geochemical and geophysical projects.

The MNDM's Mines Library, Ontario Geological Survey offices, Mining Lands offices, and Mines and Minerals Information Centre house nearly 400 000 reports, maps and records.

The Earth Resources and Land Information System (ERLIS) allows fast, easy access to most of the Ministry's information at MNDM offices across Ontario. ERLIS contains over 1.5 million pages of documents and approximately 120 000 maps. Computer workstations provide fast retrieval and high visual resolution. ERLIS thematic data sets include:

- topographic bases at various scales for reference to other subjects of digital data;
- digital bedrock geology and tectonic assemblages maps;
- mineral exploration assessment files and reports of exploration work;
- mineral deposit and occurrence records;
- summary drill hole records compiled from reports in the assessment files; and
- geochemical analyses from samples collected by Ontario Geological Survey staff.

In addition to continuously adding data, the Ministry is preparing to make the information available on the Internet in 2000 through the Earth Resources Mineral Exploration web site (ERMES). This project will provide worldwide access 24 hours a day to the MNDM geoscience database from the convenience of the client's office.

In 1998, the MNDM launched "Mining Claim Maps" (CLAIMaps I), an Internet product to provide clients with a real-time 24-hour access tool to mining claim maps in the province of Ontario. This site provides scanned images of the paper copies of maps that were edited to reflect their current status.

In 2001, the Ministry will launch the second phase of this highly successful application. The CLAIMaps II project will build on the success of CLAIMaps I and will improve the product in a number of areas. The CLAIMaps II application will move to a seamless 1:20 000 Ontario base map (OBM) base where available in the province. This will provide a consistent scale, legend and topographic features. All features on the base will be sharp and clear to the user and will include information on claims, leases and patents.

The Ministry will be looking for further input from its client groups to ensure the end result is a product that suits client needs in years to come.

For further information concerning mining and exploration activity in Ontario, please visit the web site at http://www.mndm.gov.on.ca.

2.7 MANITOBA

Overview

As foreign competition continues to lure exploration dollars out of North America, Manitoba remains an attractive jurisdiction where mining companies can conduct business. The level of new mining development being undertaken in the province is testimony to Manitoba's attractiveness as a destination for mineral investment. Topping the list is the $360 million expenditure by Hudson Bay Mining and Smelting (HBM&S) to expand and upgrade its Flin Flon and Snow Lake operations. HBM&S also has plans to spend an additional $600 million in capital replacement costs. These expenditures will extend the life of its operations to at least 2016. In Thompson, Inco Limited will go ahead with a $70 million capital expansion program that will deepen the Birchtree mine. The deepening will allow mine production to nearly double from the current daily rate of 1635 t to 3175 t by the year 2004 and will extend the life of the mine to 2016. The project will add an estimated 13.6 Mt of ore grading 1.8% nickel to current reserves. In southeastern Manitoba, Harmony Gold's expansion of the Bissett mine to boost production and decrease costs is positive news for that area.

Partnerships between the minerals industry and northern and Aboriginal communities have become increasingly important in terms of certainty of land access and tenure for mineral exploration and development. A new initiative to develop a process for relationship-building between the stakeholders was launched in 1998. By 2000, a set of guiding principles to facilitate relationship-building between those involved in or affected by mineral activity in the province was developed. This work has been captured in a document entitled *The Manitoba Minerals Guideline: Building Relationships and Creating Opportunities – Guiding Principles for Success between the First Nations, Metis Nation, Northern Community Councils, the Minerals Industry and the Province of Manitoba,* and is a positive step towards certainty of land access and tenure for the industry and a more certain future for northern and Aboriginal communities.

The total area of mining claims, exploration permits and special exploration permits issued in 1999 was 801 550 ha, a significant increase from 475 634 ha in 1998 and 386 243 ha in 1997. The total area of mineral dispositions and leases in good standing at the end of 1999 was 1 943 442 ha compared to 1 987 400 ha at the end of 1998. Mineral exploration expenditures during 1999 are estimated at $25.8 million compared to $29.9 million in 1998. Surface exploration diamond drilling in 1999 is estimated at 83 000 m compared to 107 000 m in 1998.

Base Metals

FLIN FLON–SNOW LAKE REGION

Hudson Bay Exploration and Development (Hudbay) continued to test SPECTREM airborne anomalies with ground geophysics and diamond drilling. The company continued flying the

SPECTREM survey on untested areas and also on some previously flown properties. The system apparently has been upgraded with improved technologies that allow for deeper penetration and improved noise filtering capabilities.

Callinan Mines obtained encouraging drilling results on an optioned parcel of land containing known deposits in the Chisel Lake area. They included: at the Pot zone, an 8.4-m intersection grading 3.4% copper, 3% zinc and 2 g/t gold and, at the Pen zone, 9.2 m grading 8.4% zinc and 0.8% copper. Additional airborne and ground geophysics were conducted late in 1999 and follow-up drilling commenced in January 2000.

Aur Resources and partners Thundermin Resources and Consolidated Abitibi Resources conducted drilling at the Lew property east of Flin Flon and at the Norris Lake property west of Snow Lake.

Berland Resources and Fort Knox Gold Resources recently entered into an agreement to acquire a 100% interest in Hudbay's Watts River property 50 km east-southeast of Snow Lake. Previous drilling by Hudbay tested a mineralized zone over a 1600-m strike length. After completing a drilling program this winter, the two junior partners announced the discovery of a new zone that returned an intersection of 7.0 m grading 3.1% copper.

Other companies conducting exploration in the area included Foran Mining, M'Ore Exploration, Bell Resources and Marksmen Resources.

THOMPSON NICKEL BELT AND EXTENSION

In early March 2000, Nuinsco Resources reported preliminary results from its drilling program on the Mel option north of Thompson. Highlights included intersections of 10.2 m grading 2.43% nickel and 11.7 m grading 2.60% nickel. The purpose of the program is to delineate an economic mineable tonnage. Earlier work by Inco on the Mel deposit had outlined a resource of 6.3 Mt grading 1.25% nickel. Geophysical surveys on the adjacent Mel claims completed over the winter identified a number of targets in the vicinity of known nickel mineralization. These were to be followed up with drilling and results are pending. Inco Exploration is acting as operator on behalf of Nuinsco.

At Wabowden, Nuinsco announced encouraging results from its delineation drill program at the Bucko deposit optioned from Falconbridge. Intersections of up to 5.59% nickel over 5.88 m and 6.94% nickel over 3.39 m are part of longer intercepts (10 to 22 m) grading between 2 and 3% nickel. This drill program was successful in outlining a high-grade nickel resource over mineable widths. Nuinsco recently announced plans to dewater the Bucko shaft in preparation for underground drilling and bulk sampling.

Falconbridge and partner Hudson Bay Exploration completed a 10-to-12-hole drill program in the William Lake area.

Hudbay also conducted diamond drilling in the Minago River-Huzyk Creek area and Falconbridge carried out ground geophysics on its Strong Lake property north of Thompson.

NORTHEASTERN REGION

Falconbridge conducted an extensive program of mapping, prospecting, ground geophysics and diamond drilling on its large permit area along the Fox River sill. A grab sample collected from a sulphide horizon during the prospecting program returned 3.9 g/t palladium, 2.27% copper and 1.13% nickel.

WMC Exploration (a subsidiary of WMC Limited of Australia) recently acquired an exploration permit in the Hudson Bay lowlands east-northeast of Shamattawa. Phanerozoic rocks in the area overlie known or interpreted ultramafic/mafic intrusions.

LYNN LAKE-LEAF RAPIDS REGION

Hudbay drill tested SPECTREM targets in the area east of the Rat River.

SOUTHERN REGION

Canmine Resources continued with feasibility studies and environmental assessments for the Maskwa nickel project near Bird River. Canmine has upgraded the resource figure for the main deposit to 2.66 Mt grading 1.27% nickel and 0.21% copper, plus cobalt and PGE values. Other mineralized zones in the vicinity could upgrade the value of the project.

Near Arborg, Tulsa Resources conducted extensive sampling in search of Mississippi Valley-type lead-zinc deposits.

Precious Metals

At the New Britannia gold mine in Snow Lake, partners TVX Gold and High River Gold Mines reported another banner year for production in 1999. Total production for the year was 100 911 oz (3139 kg) at a total cash cost averaging US$216/oz. This compares to 1998 production figures of 97 603 oz (3036 kg) at a total cash cost of US$238/oz. The production plan for 2000 is 100 000 oz (3110 kg) at a total cash cost of US$210/oz. For the fourth consecutive year, underground exploration at New Britannia has more than replaced production with additional reserves.

Pioneer Metals completed a drill program on the Nokomis Lake property, 70 km northeast of Flin Flon. The drilling was intended to increase the tonnage and grade of a known small sub-economic gold deposit.

In the northern Superior Province, Wolfden Resources conducted a program of mapping, sampling and diamond drilling at the Monument Bay property near the Ontario border. Wolfden is attempting to earn a 100% interest in the property from Battle Mountain Gold. The property has remained dormant since the early 1990s after Noranda outlined a drill-indicated resource of 639 272 oz of gold in three zones. The company reports that drilling consistently intersected two parallel gold-bearing horizons over a minimum strike length of 430 m. Some of the better intersections include 29.97 g/t gold over 4.2 m and 16.55 g/t gold over 4.8 m.

Torch River Mines completed a short drilling program on a property at Island Lake.

The Rice Lake camp continued to show signs of encouragement in 1999. Since acquiring the Bissett gold mine in 1998, Harmony Gold has successfully driven production costs down. With confidence in the operation, Harmony decided to spend $6 million to boost production to 1000 t/d and reduce cash costs further to US$220/oz.

Junior companies continued to explore for new deposits and to further upgrade reserve figures on known gold deposits in the Bissett area. At the San Norm project, San Gold Resources conducted infill drilling to test the down-dip portion of the deposit. Golden Pocket Resources carried out drilling to further extend the strike extension of the Nevada zone. Diamond drilling was also carried out by Tudale Exploration at Wallace Lake. Early in 2000, San Gold Resources and Tudale Exploration reached an agreement with the Hunter Dickinson Group allowing the latter to complete a program of airborne geophysics and basal till sampling over the two junior companies' ground.

A small drilling program was carried out by Falcon Crest Resources on the Manigotagan property.

Diamonds

A number of exploration permits for diamond exploration were recently acquired in the Superior Province and Fox River area by De Beers Canada Limited, Kennecott Canada/Montello Resources, BHP Minerals, Indicator Explorations and a variety of other junior companies. Over 50 exploration permits covering an area of approximately 20 000 km^2 have been taken out in the past year.

Pegmatites

In southeastern Manitoba, small exploration programs were carried out for pegmatitic minerals by Avalon Ventures near Falcon Lake and by Tantalum Mining Corporation near the Bernic Lake mine.

More information on exploration and development in Manitoba is available on the Internet at http://www.gov.mb.ca/em.

Incentives

The Government of Manitoba has made more than $9 million in funding available over a three-year period beginning in April 1999 to further encourage exploration and mining investment in the province. The funding is obtainable through the following mineral incentive programs:

Mineral Exploration Assistance Program (MEAP)

MEAP provides financial assistance to companies or individuals undertaking mineral exploration in Manitoba. The program, established in the fall of 1995, aims to increase exploration and stimulate activities that may lead to the development of new mines. Companies or individuals may qualify for up to 35% of eligible exploration expenditures to a maximum of $400 000 per recipient per fiscal year, depending on the area of exploration.

MEAP announced its first offering of $1 million in October 1995 and allocated $3 million per fiscal year for three years beginning on January 2, 1996, and ending on March 31, 1999. A continuation of the program was approved in June 1998 with $8.25 million of assistance allocated over a three-year period beginning April 1, 1999. In response to difficult times brought on by the downturn of the minerals industry, MEAP was expanded to provide a higher percentage of assistance on eligible expenditures for projects in the Lynn Lake-Leaf Rapids and other northern areas. The number of offerings per fiscal year was also changed from one to two to coincide with the spring/summer and fall/winter exploration phases.

PROGRAM HIGHLIGHTS FROM OCTOBER 1995 TO MARCH 31, 2000

- 69 companies have participated under MEAP representing 186 exploration projects.
- 37 of the 69 companies are considered new to Manitoba, including six joint-venture participants. Of the 69 companies, 11 are major exploration companies and 58 are junior companies (a company is considered a major exploration company if its market capitalization is greater than $100 million).
- $8.3 million in assistance has been issued to 186 completed projects.
- $37.9 million in exploration expenses has been reported.
- Reported exploration expenditures under the program indicate that every $1 million in assistance paid generates $4.6 million in exploration expenditures.

Specialty Minerals Incentive Program (SMIP)

The Specialty Minerals Incentive Program commenced on August 3, 1999, with $250 000 available for each of two fiscal years ending March 31, 2001. The program is designed to assist spe-

cialty mineral companies in evaluating the economic potential of existing non-fuel speciality mineral deposits and to market those resources more effectively.

The SMIP provides financial assistance towards eligible expenses as they pertain to these resources. These may include consultant contract fees for the preparation of marketing studies, process flow sheets or business plans, definition drilling, geochemical analysis, bulk testing, metallurgical studies related to the testing of the commodity, and certain administrative costs.

It is anticipated that this program will assist both local specialty mineral producers and new producers to the province who are attempting to establish themselves in Manitoba. In 1999, six proposals were received and two were approved for funding.

Manitoba Prospectors Assistance Program (MPAP)

Since its inception in 1992, MPAP has offered $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 report.

In fiscal year 1999/2000, 30 applications were received, of which 24 were approved. Twenty projects were completed, resulting in the payment of $87 079 in provincial funding.

Assay Credit Program

For the 2000/01 fiscal year, the province has allocated $20 000 towards this program. A prospector can earn assay coupons for eligible expenditures on exploration work. Coupons can be redeemed for assays for certain metals as specified in Manitoba Regulation 64/92.

In fiscal year 1999/2000, a total of 9154 credits were issued to 12 prospectors and 11 101 credits were redeemed by 17 prospectors.

Additional information on Manitoba's mineral exploration and development incentives is available on the Internet at http://www.gov.mb.ca/em/minerals/exp-incentives/ei-index.html.

Land Use

Priorities regarding land-use management in 1999 focused on the ongoing implementation of the Network of Protected Areas Action Plan. Technical support to the stakeholder assessment/consultation process was provided by documenting mineral tenure and withdrawing Crown mining rights. Manitoba has created a successful partnership with the Mining Association of Manitoba and the World Wildlife Fund Canada, and has found a sustainable balance between environmental preservation and economic development. Special attention was given to Wildlife Management Areas and the northern areas of special interest.

Other significant land-use activities included progress towards meeting provincial obligations for Treaty Land Entitlement, Northern Flood Agreement and the ongoing implementation of sustainable development as required by *The Mines and Minerals Act*.

Additional information on land access and sustainable development in Manitoba is available on the Internet at http://www.gov.mb.ca/em/minerals/sustain/s-index.html.

2.8 SASKATCHEWAN

Overview

The year 1999 was a banner one for the mining sector in Saskatchewan as two new uranium mines began production and a base-metal mine was officially opened.

The annual survey of mineral exploration expenditures carried out by the resident geologists indicated that mineral exploration expenditures in 1999 were $23.75 million, a decrease of $6.25 million (20.9%) over those for 1998 (**Table 14**). Expenditures shrank in all sectors, including a 17% decrease for uranium (U), a 23% decrease for gold and a 62% decrease for base metals. In 2000, total exploration expenditures are forecast to return to a level slightly above 1998 at about $32.0 million. These estimates reveal that a substantial increase in expenditures is planned in the search for platinum group metals and diamonds, with modest increases in uranium activity. Significantly, for the first time in many years, more than half of the planned expenditures will be undertaken by junior companies. These figures exclude uranium and gold test mining and underground exploration costs of $230 million in 1999 and estimated expenditures of $106 million in 2000.

The total number of metallic mineral dispositions in good standing at the end of the 1999 calendar year decreased to 3633 (covering 2.9 Mha) compared to 3979 (covering 3.3 Mha) at the end of 1998. In 1999, 182 new dispositions were recorded, marking a significant decrease in the number of new dispositions issued.

The number of dispositions for industrial minerals (potash, quarrying and alkali minerals) and coal has remained fairly constant compared to previous years covering an additional 350 861 ha, primarily in central and southeastern Saskatchewan.

Uranium

Saskatchewan continued its pre-eminence in uranium production, accounting for 100% of Canadian output and approximately 32% of world output. The province remains the focus of uranium exploration activity in Canada. In 1999, expenditures on uranium exploration decreased from those in 1998, marking the second year of a downward trend preceded by several years of increasing activity (**Table 14**). This decrease in part reflected a major consolidation in the industry in 1998, but also reflected a continued weak spot market price for uranium, which has declined from a high of US$16.60/lb of U_3O_8 in 1996 to US$9.60/lb of U_3O_8 at the end of 1999.

Eleven operators, comprising single companies or joint-venture consortiums, continue to explore for uranium in the Athabasca Basin. Discovery potential remains high. In early October 1999, Cameco Corporation announced that drilling completed in the winter and summer of 1999, on the La Rocque Lake claims, intersected significant uranium mineralization at depths of about 280 m in three holes: DDH 34 – 6.95% U (8.2% U_3O_8) over 3.6 m; DDH 40 – 25.36% U (29.9% U_3O_8) over 7.0 m; and DDH 42 – 16.2% U (19.1% U_3O_8) over 2.5 m. The mineralized zone was reported to have a length of at least 200 m. The La Rocque Lake claims are part of the Dawn Lake joint venture owned 57.466% by Cameco Corporation, 23.086% by COGEMA Resources Inc. and 19.448% by PNC Exploration (Canada) Co. Ltd.

On the mining front, two new uranium mines, McClean Lake and McArthur River, entered production as some historical deposits were mined out.

At McClean Lake (70% COGEMA Resources Inc., 22.5% Denison Mines, and 7.5% OURD Canada), production[3] began in June after receipt of final approvals from the Atomic Energy Control Board (AECB) and Saskatchewan Environment and Resource Management. The AECB approval provided for an amendment to the McClean Lake operating licence allowing operation of the JEB mill and a Tailings Management Facility in the 120-m-deep, mined-out Jeb pit. Production in 1999, from ore stockpiled from the Jeb orebody, was 577 tU (1.5 million lb U_3O_8). In November, the AECB announced that it had issued a licence that permits open-pit

[3] All production figures for Saskatchewan mines are derived from public domain reports of individual companies or from the Saskatchewan Mining Association.

TABLE 14. SASKATCHEWAN EXPLORATION EXPENDITURES, 1988-2000

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000e
	($ millions)												
Precious metals	42	20	11	5	6	2	4	8	7	4	3	1	1
Base metals	6	7	7	6	4	4	4	4	5	9	4	6	5
Uranium	20	21	12	10	8	7	11	13	17	27	22	14	15
PGM[1]												1	5
Other	–	2	2	3	4	11	10	4	6	3	1	2	6
Total	68	50	32	24	22	24	29	29	35	43	30	24	32

Source: Resident Geologists' Survey, Saskatchewan Department of Energy and Mines.
[1] Exploration for platinum group metals (PGM) was not reported separately prior to 1999.
– Nil; e Estimated.
Notes: "Other" includes some industrial mineral activity, but predominantly diamond exploration. All figures are rounded to the nearest million dollars.

mining of the SUE orebodies. Previously, the SUE C pit had been developed to a depth of 80 m, which is immediately above the ore. The SUE C and SUE A deposits will be mined from the same pit; the SUE B deposits will be mined from a separate pit. The SUE deposits will be mined out by 2003. Subsequently, and subject to the necessary approvals, ore will be derived from the McLean orebody and from the Cigar Lake and Midwest projects.

At Key Lake (69.805% Cameco Corporation and 30.195% COGEMA Resources Inc.), production was 3731 tU (9.7 million lb U_3O_8). This production, from a stockpile of ore from the mined-out Key Lake deposits, maintained the operation's status as the largest uranium operation in the world. The Key Lake mill was shut down during the summer of 1999 and retrofitted to handle higher-grade McArthur River ore. The mill now has the capacity to process 6924 tU (18 million lb of U_3O_8) annually, maintaining its status as the largest in the world. The AECB renewed the mill's operating licence in November.

In October the AECB approved an operating licence for McArthur River (69.805% Cameco Corporation and 30.195% COGEMA Resources Inc.) and mining began there just before year-end. The Key Lake mill processed the first McArthur ore in January 2000. Reserves at McArthur River are 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 is 87 600 tU (227.8 million lb U_3O_8) at an average grade of 10.19% U (12.02% U_3O_8). This is the world's largest high-grade uranium deposit.

In early 1999, at Rabbit Lake (100% Cameco Corporation), operations at the Eagle Point underground mine were suspended and the mill was reduced to operating at half capacity. As a consequence, production was 2693 tU (7.0 million lb U_3O_8), a significant decrease from the 4500 tU (11.7 million lb U_3O_8) produced in 1998. These measures were not only a 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 aspect reflects a decision of 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; the environmental impact statement (EIS) document will be submitted to regulatory authorities in 2000. An extension to the temporary shut-down of operations was announced in 2000 and will result in an approximate one-year shut-down of the mill beginning in the first quarter of 2001.

In 1999, production at Cluff Lake (100% COGEMA Resources Inc.) was 1230 tU (3.2 million lb U_3O_8). Ore was from the Dominique-Peter, Dominique-Janine, and West Dominique-Janine underground mines plus the Dominique-Janine extension open pit. Significant resources still remain in the West Dominique-Janine area. Economic Dominique-Peter reserves were mined out by October 1999. Initially announced in 1998, current plans are to close the Cluff Lake mine at the end of 2001 once the tailings facility capacity is reached. The basis for this decision

is 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.

At Cigar Lake (50.525% Cameco Corporation, 37.1% COGEMA Resources Inc., 7.875% Idemitsu, and 5% TEPCO), the second-largest high-grade uranium deposit in the world, conditional approval for development has been received from both the federal and provincial governments. During 1999, testing of the jet boring mining system was undertaken. It is expected that production will begin in 2003. Current reserves at Cigar Lake are 142 320 tU (370 million lb U_3O_8) at an average grade of 11.53% U (13.60% U_3O_8). Subject to regulatory approval, the Cigar Lake ore is to be processed at both the Rabbit Lake and McLean Lake mills.

Gold

Although the potential for the discovery of new gold deposits is high, the current depressed price for gold has had a severe effect on gold exploration. Nine companies conducted exploration programs in the province with most of these efforts in the La Ronge, Glennie and Flin Flon domains.

In 1999, Claude Resources Inc.'s Seabee mine produced 54 100 oz (1683 kg) of gold. Ore was from the Seabee property and the surrounding 100%-owned Currie Rose property for which there is a 30% net profit interest payable to Currie Rose Inc. after payout of exploration and development expenditures. The Currie Rose project was incorporated with the Seabee mine in early 1999. Since its opening in November 1991 to the end of December 1999, the Seabee gold mine has produced more that 450 000 oz (12 757 kg) of gold at an average grade of 8.86 g/t gold. The average head grade processed during the year was 7.34 g/t gold compared to an average grade of the overall mine reserve base of 8.56 g/t gold. Mill throughput totaled a record 245 300 t for an average of 672 t/d. The company attributed the reduction in grade to the timing of ore development and extraction, which is a reflection of its policy not to high-grade the deposit. In a March 2000 report to the company, A.C.A. Howe International estimated reserves at 853 000 t at an average grade of 8.56 g/t (0.29 oz/ton) gold with 507 000 t in the proven and probable categories. The report also indicated a resource potential of 1.5 Mt.

In January 1999, Greater Lenora Resources Corporation announced the preliminary details of a small-scale, low-production-rate plan for the Box mine, part of its Goldfields project, near Uranium City. During 1999, the company investigated financing arrangements and contracting of mine services, and worked towards obtaining the necessary permits.

Base Metals

Base-metal exploration, involving 14 companies, continued in Shield and sub-Phanerozoic programs mostly west and southwest of Flin Flon. Exploration expenditures in 1999 increased to $5.72 million from $3.6 million in 1998. Expenditures in 2000 are forecast to be similar to those in 1999.

This was the first full year of production for Hudson Bay Mining and Smelting Co. Ltd.'s Konuto Lake mine, a volcanogenic massive sulphide (VMS) deposit just east of Flin Flon. In the first eight months of 1999, the mine produced 125 708 t of ore grading 4.49% copper, 1.0% zinc, 1.61 g/t gold and 10.15 g/t silver. Production for the rest of the year was estimated to be approximately 93 000 t of ore. As of January 1, 1999, the deposit's mineable resources were listed at 1 550 159 t grading 1.84 g/t gold, 8.35 g/t silver, 4.00% copper and 1.20% zinc.

Most 1999 production from Hudson Bay's Callinan mine came from the North and East zones in Manitoba, although there was some mining of the Saskatchewan side of the North zone. In the first eight months of 1999, 11 968 t of ore grading 1.61 g/t gold, 15.39 g/t silver, 1.40% copper and 3.04% zinc came from north zone lenses in Saskatchewan. Production from the Saskatchewan side for the remainder of the year was projected to be approximately 28 000 t of ore.

Leader Mining International Inc. (Leader) encountered exceptionally high-grade silver values in its 1999 drill program at the Knife Lake base- and precious-metals project in the Scimitar Lake area of the Glennie Domain, 110 km northwest of Flin Flon. Previously, Leader had defined a geological resource of 79 Mt grading 0.69% copper, 0.017% cobalt, 0.16 g/t gold and 0.39 g/t silver. In November 1999, Leader announced that it had signed a Memorandum of Understanding with Korea Resources Corporation (Kores) to further explore and develop the Knife Lake project. Under the terms of the agreement, Kores has the right to earn up to a 50% working interest in the Knife Lake project by making an investment of $5.2 million, including cash payments of $1.2 million to Leader and funding $4.0 million of exploration and development work.

Foran Mining Corporation (Foran) continued to evaluate the McIlvenna Bay zinc-copper deposit located in the Hanson Lake area of the Flin Flon Domain, west of Flin Flon. This work comprised a two-phase diamond drill program totaling 15 000 m to define probable reserves and expand the known geological resource.

On November 4, 1999, Foran released the results of an independently audited revised resource estimate for the McIlvenna deposit. Total combined indicated and inferred resources for the Lens 2 massive sulphide and the newly discovered Upper West zone are now 11.4 Mt grading 6.08% zinc, 0.94% copper, 0.45% lead, 0.45 g/t gold and 24.40 g/t silver. For the copper stringer zone underlying the Lens 2 massive sulphide and the upper West zone, the total indicated and inferred resource is 11.7 Mt with a grade of 1.79% copper, 0.48% zinc, 0.57 g/t gold and 11.96 g/t silver.

Platinum Group Elements

For 2000, the most significant jump in exploration activity is forecast to be in the search for platinum group metals (PGM) with $4.5 million in expenditures planned versus actual expenditures of $0.91 million in 1999. This activity will be widespread, ranging from the border with the Northwest Territories to beneath Phanerozoic cover southeast of La Ronge.

The most advanced project is that of Uravan Minerals Inc. who continued a major PGM-nickel exploration program in the Rottenstone Domain along strike of the closed Rottenstone mine, a past producer of nickel-copper-platinum. A multiparameter airborne geophysical survey and a helicopter-conducted airborne biogeochemical sampling were followed up by diamond drilling that has extended the known distribution of sulphide-bearing ultramafic rocks in the vicinity of the Rottenstone mine.

Diamonds

The amount of land under disposition for diamonds at the end of 1999 was approximately 673 500 ha. Diamond exploration expenditures were $1.43 million and are predicted to rise to $2.56 million in 2000. 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 Molonosa Arch, and Candle, Sturgeon, Smoothstone and Wapawekka lakes. Ground held by the Fort à la Corne joint venture (Cameco Corporation, 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 macrodiamonds have been recovered from several of the kimberlites and exploration and evaluation are ongoing. Shore Gold Inc. continued to obtain positive results from its exploration program that focused on the Star kimberlite 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 to ensure relevant regulations are in place to address evolving exploration trends and technology, a number of

regulations continued to be reviewed and modified in 1999, including *The Mineral Disposition Regulations 1986*. Consultation with industry remains a critical part of all regulatory reviews. Revisions to *The Mineral Disposition Regulations 1986* are expected in 2000 following legal drafting and final consultation with industry.

The conversion of metallic mineral disposition maps and data files into digital GIS compatible format was completed in fiscal year 1999. Industrial mineral dispositions for coal, potash, alkali and quarriable materials have been mapped. Conversion of the coal disposition database directly to a map product was also initiated in fiscal year 1999.

To assist clients in applying for mineral dispositions in Saskatchewan, downloadable forms and guidelines pertinent to the acquisition and administration of various Crown minerals were posted on the department's web site at http://www.gov.sk.ca/enermine.

The Treaty Land Selection process continued in 1999. Twenty-two Crown Reserves, which withdraw lands from having dispositions issued on them, were established in fiscal year 1999 and over 500 reviews and mapping of Treaty Land Selections were completed.

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 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. A review of the uranium royalty structure will be initiated in 2000.

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.

2.9 ALBERTA

Staking and Exploration Activity

During 1999, slightly more than 1 million hectares (Mha) were staked in Alberta, and another 620 000 ha were expected to have been staked by the end of May 2000. The new staking brought the total land under mineral permits to 29.5 Mha, representing approximately 60% of available provincial Crown lands. The total land under permit has dropped some 30% from the 42 Mha reported last year.

Exploration continued to be steady in the province with $24.75 million filed for assessment in 1999 and another $14.5 million filed to May 2000. Most of these expenditures are being directed at exploration for diamondiferous or precious/base-metal deposits associated with Phanerozoic strata in northern Alberta.

Exploration Highlights

In general, exploration for diamondiferous kimberlites was the primary focus. In the Buffalo Head Hills region of north-central Alberta, the Ashton Mining of Canada Ltd.-Alberta Energy Corp.-Pure Gold Resources Inc. joint venture, with Ashton as the operator, is reported to have discovered six new kimberlite bodies during 1999. Approximately 60% of the Ashton kimberlites are diamondiferous, and Ashton continues to actively explore for other kimberlite bodies. In 1999, the joint venture spent in excess of $5 million on exploration and mini-bulk sampling. Exploration in early 2000 included drill testing selected targets and the mini-bulk sampling of the BH225 kimberlite pipe in the K14 project area, where approximately 1 t of drill core was collected for processing at the company's dense media separation plant to establish the macro and microdiamond counts. Ashton announced, in March 2000, the discovery of three new kimberlites (K8, buried under 38 m of overburden; K160, buried under 40 m of overburden; and K252, buried under 67 m of overburden). This brings to 35 the total number of kimberlites that Ashton has discovered in the Buffalo Head Hills region.

In the Caribou Mountains of northern Alberta, Ashton is reported to have found hundreds of favourable diamond indicator minerals, including one diamond, and several interesting aeromagnetic targets, at least two of which warranted drill testing. Ashton drilled the CM1 anomaly and intersected an "iron-rich rock," presumably in Cretaceous strata. Ashton advised that it was not a kimberlite, but it may have some geological similarities to the titanium-iron ilmenite-magnetite zone that New Blue Ribbon intersected north of Calling Lake. Ashton is also reported to be exploring in the Birch Mountains in northeastern Alberta and in the Grande Prairie-Peace River area of northwestern Alberta.

Elsewhere in Alberta, Buffalo Diamonds Ltd. has been actively exploring its large Calling Lake property, east of Lesser Slave Lake, and its Hanna property in southeast-central Alberta, spending about $1.5 million during the past year. At Calling Lake, Buffalo Diamonds has collected over 500 samples and identified thousands of diamond indicator mineral grains with excellent chemistries, including at least 66 Guerney G10 pyrope garnets. During 1999, Buffalo Diamonds performed a high-resolution aeromagnetic survey at the Calling Lake area and identified at least 30 prospective aeromagnetic anomalies, including 8 high-quality targets it plans to drill. The company received the necessary permits for drilling at Calling Lake in late winter, but an early breakup precluded drilling.

At the Legend property in the Birch Mountains in northeastern Alberta, the Kennecott Canada Exploration Inc.-Montello Resources Ltd.-Redwood Resources Inc. joint venture discovered eight kimberlites in 1998 and one kimberlite in 1999. Unfortunately, to date, only one of the kimberlites is reported to be diamondiferous and it was recently reported that Kennecott has withdrawn from the joint venture. However, New Blue Ribbon Resources Ltd. has taken an interest in the Legend property and plans to drill-test several untested aeromagnetic targets during 2000.

Several other companies and individuals continued to actively explore their properties in Alberta for diamondiferous kimberlites. It is noteworthy that, near Cold Lake in east-central Alberta, prospectors are reported to have discovered G10 pyrope garnets but, as of yet, there is little information available.

With respect to gold-PGE-base-metal targets in the Paleozoic and Cretaceous units of northeastern Alberta, Birch Mountain Resources Ltd. continues to be active and recently purchased a 100% interest in the leases formerly held by Tintina Mines Limited-NSR Resources Inc. in the Fort Mackay area. Birch Mountain's primary target is apparently precious metals, particularly in the Devonian, at or near the Devonian-Cretaceous contact, based on Dr. H. Abercrombie's "Prairie Gold Model." Controversy continues (e.g., see February 7-13, 2000, edition of *The Northern Miner*) over the difficulties in assaying for the precious metals, particularly gold, with past results reported to range up to 6 g/t gold, 11 g/t platinum and 1.9 g/t palladium. Recently,

Birch Mountain has been working on a number of analytical and process procedures in order to provide more consistent, accurate assays of the in-ground, potentially recoverable precious-metal grades; the company has announced that it expects its research testing on bulk samples to soon lead to a process patent. Birch Mountain recently raised about $2.7 million and plans to continue evaluating assay techniques, and then to resume actively exploring its large property holdings in northern Alberta during 2000.

In the Chinchaga region of northwestern Alberta, Marum Resources Inc. has been actively exploring its large property for diamondiferous kimberlites and precious metals. In late 1999, it reported the discovery of numerous gold grains in stream sediments, and anomalous gold concentrations ranging from 0.1 to about 1.0 g/t gold in stream sediments and rock samples. The rock samples are from possible volcanic rocks in a unit approximately stratigraphically equivalent to the Late Cretaceous Badheart Formation. The Badheart Formation, further to the south, hosts the huge Peace River oolitic iron deposit. It has been proposed that this deposit may have been genetically related to subsea hydrothermal venting. Marum reports that it is considering drill testing selected prospective horizons in the Chinchaga Hills area during 2000. Marum drilled several holes north of the Clear Hills this spring in two separate locales and announced some narrow massive sulphide (mainly pyrite) intersections. It is of definite interest that, stratigraphically, the sulphidic zone is approximately correlative with the Peace River iron oolitic bed, raising the question of whether there may be other facies of metals present (i.e., the classic iron formation to VMS basinal model) in some places, particularly if, as recent work shows, the source of the iron and silica in the Peace River iron is derived from hydrothermal venting along structures. This was suggested in the Alberta Metallogenic Study that R. Olson and M. Dufresne authored for the Alberta Geological Survey (AGS) in 1994.

New Claymore Ltd. drilled three holes ranging from 825 to 1270 ft (252 to 387 m) on three selected magnetic targets at the Steen River structure in the northwesternmost part of Alberta. This structure has been reported as being due to a meteorite impact and is also along or near the Great Slave Lake shear zone. Two of the three aeromagnetic targets that were drilled are satellite anomalies proximal to the Steen River structure. New Claymore is investigating if some of the local magnetic highs might be due to kimberlite emplacement. The AGS is examining the petrography of the core, with a report on this due out in fall 2000. New Claymore's target is apparently diamondiferous kimberlites, but also includes the potential for metalliferous deposits spatially or genetically associated with inferred intrusives that are the possible cause of the shallow-seated magnetic anomalies.

Lastly, in northeast-central Alberta in the Pelican Mountains north of Calling Lake, New Blue Ribbon Resources has recently discovered a paleoplacer titanium-iron resource in Late Cretaceous strata. Aeromagnetic surveys and a few drill holes indicate the paleoplacer may represent a "linear" beachfront deposit. Assays are up to 35.18% Fe_2O_3, 9.94% TiO_2, and 0.61% ZrO_2 over a thickness of up to 2.42 m. The iron-titanium mineral is uncertain at present, but is believed to be either rutile or ilmenite, and associated orthopyroxenes are also reported. Currently, the only other significant paleoplacer iron resources in Cretaceous strata in Alberta are in the southwestern part of the province near Burmis and Dungarvan. The Pelican Mountain paleoplacer deposit is significant because it may indicate the iron-titanium minerals and orthopyroxenes are derived from intrabasinal volcanism, possibly kimberlitic activity, and are not far from the British Columbia Intermontane or Cordillera belts to the west.

Industrial Minerals

United Industrial Services Ltd. has completed construction of a silica sand processing plant 10 km north of the town of Peace River. Supplies of silica are obtained on site from an open-pit operation in the Lower Cretaceous Paddy Member sandstone. The silica is being marketed for uses such as foundry and well-fracturing sand.

Assessment Report Submissions for 1999

Table 15 shows statistics that were recorded from Assessment Report submissions during 1999.

TABLE 15. ASSESSMENT REPORT SUBMISSIONS IN ALBERTA, 1999

Summary	
Number of permits worked on	760
Hectares worked	6 510 353
Work expenditures	$24 756 862
Geophysical Work	
Airborne geophysics line km	252 178
Airborne geophysics expenditures	$3 398 749
Ground geophysics line km	3 912
Ground geophysics expenditures	$1 902 367
Drilling	
Meters drilled	15 769
Number of drill holes	147
Drilling expenditures	$6 821 083

Source: Alberta Department of Resource Development.

2.10 BRITISH COLUMBIA

Summary and Outlook

During the last four years, exploration spending in British Columbia has been decreasing. The rate of decrease is slowing and the province may even show a slight increase in 2000 expenditures over those of 1999. The decreases in mineral commodity prices over the same time period are largely responsible for the lower levels of exploration spending. While uncertainties associated with resolving land-use planning processes and First Nations treaty negotiations exist, government initiatives have been and are being implemented to help offset any additional risks. Exploration activity has received an additional boost from both new discoveries and the presence of major companies that have renewed or established exploration programs in the province.

Table 16 shows three years of exploration spending and the forecast of intended spending for 2000. **Figure 23** shows the price changes for copper, gold, zinc and metallurgical coal during the same period (2000 prices equal the first six-months' average). These four minerals account for over 80% of British Columbia's mineral production and exploration. A strong correlation between price levels and exploration spending is apparent from a comparison of **Table 16** and **Figure 23**. In 1998, all mineral commodity prices declined significantly. With the exception of zinc, there were further declines in 1999. Fortunately, after two years of price declines, the first six months of 2000 have shown slight increases in price, with the exception of coal. Exploration spending has shown a strong correlation with prices, having dropped over 50% between 1997 and 1998, a further 20% between 1998 and 1999, and is now expected to hold at 1999 levels or to increase slightly in 2000. (**Table 16** shows a 1% decline for the "Official-Comprehensive" forecast and a 9% increase for "Field work and Overhead.")

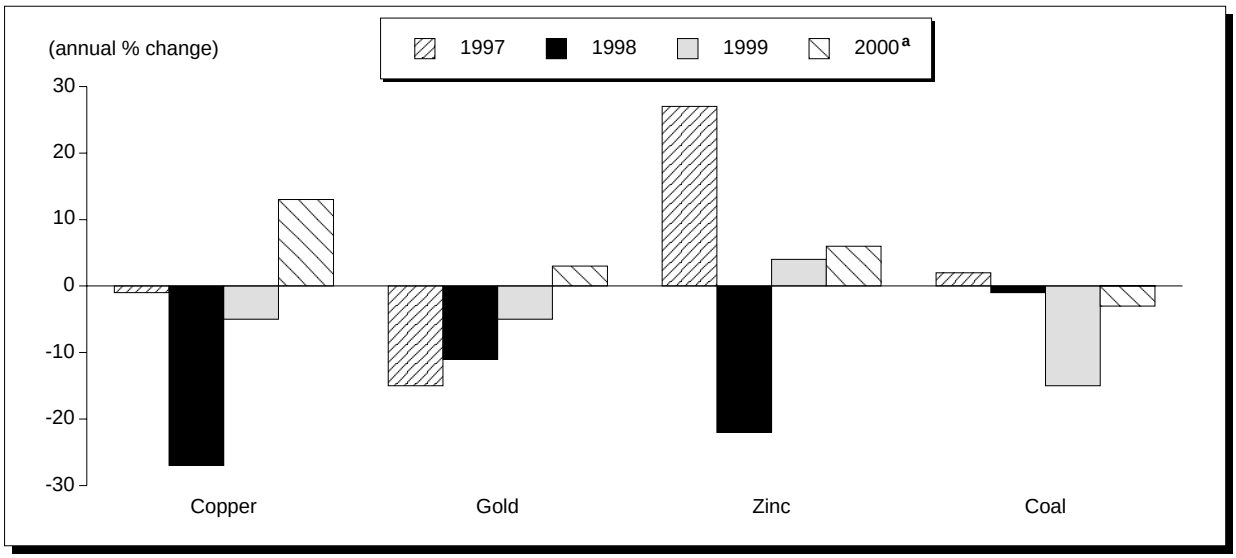
The impact of the down-trending commodity prices on other aspects of exploration is highlighted in **Figure 24**. Over the four-year period (1997-99, and 2000 as forecast), exploration

TABLE 16. EXPLORATION SPENDING IN BRITISH COLUMBIA, 1997-2000

	1997	1998	1999[p]	2000[f]
		($ millions)		
Official and comprehensive	115.2	54.5	42.2	41.9
Percent change	. .	-53%	-23%	-1%
Field work and overhead	95.8	44.3	31.8	34.7
Percent change	-9%	-54%	-28%	9%

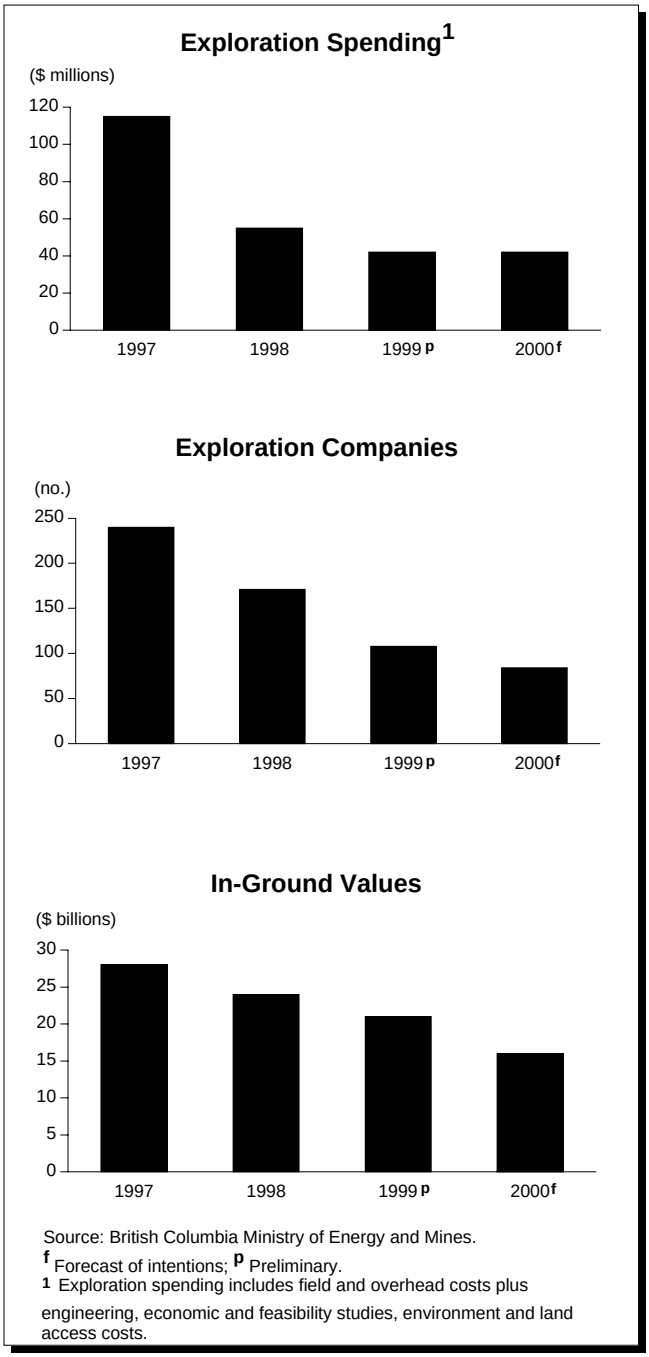
Source: British Columbia Ministry of Energy and Mines.
. . Not available; [f] Forecast of intentions; [p] Preliminary.
Notes: All figures include exploration and deposit appraisal (and exclude mine complex development). In addition to field work and overhead expenditures, "official and comprehensive" 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) and are used for analyses in this chapter. These statistics are the official federal/provincial numbers. "Field work and overhead" compare with pre-1998 published exploration-spending statistics. In British Columbia, these statistics are used as a geoscientific benchmark.

Figure 23
Mineral Commodity Price Changes, 1997-2000



Source: British Columbia Ministry of Energy and Mines.
[a] Prices for 2000 equal the first six months' average.

Figure 24
Comparison of Exploration Spending, Number of Exploration Companies, and In-Ground Values of Advanced Exploration Projects, 1997-2000



Source: British Columbia Ministry of Energy and Mines.
f Forecast of intentions; p Preliminary.
1 Exploration spending includes field and overhead costs plus engineering, economic and feasibility studies, environment and land access costs.

spending decreased from $115 million to $42 million, the number of companies actively exploring declined from 240 to 82, and the in-ground value of deposits being explored in advanced exploration projects dropped from $28 billion to $16 billion. The upward trending prices in the first six months of 2000 and the lower rates of decline in exploration spending suggest that British Columbia is about to come out of this economic trough of lower exploration activity.

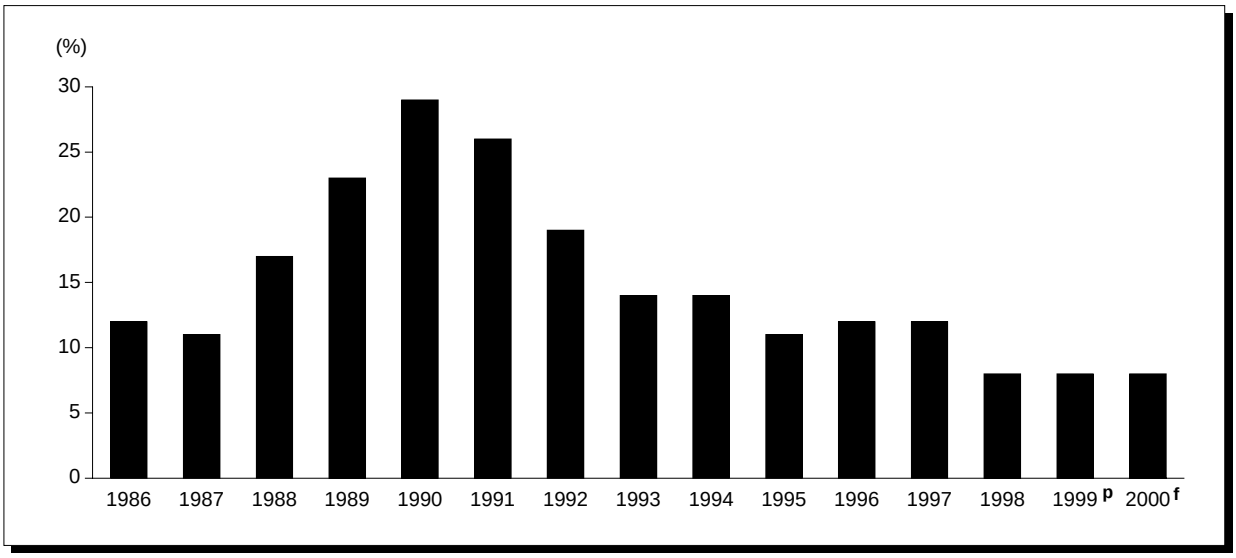
Although British Columbia has experienced declines in recent years, it is holding its own relative to Canadian exploration as a whole. **Figure 25** plots British Columbia's exploration spending as a percentage of Canada's total. The province's share rose to a peak of almost 30% in 1990 and has been more or less declining ever since. Fortunately, this decline has flattened out in the past two years (1998 and 1999), and the expectation for 2000 is that the province's share will hold at the 8% level.

Government Initiatives

The British Columbia government is aware of and concerned about the uncertainties affecting exploration spending that are associated with First Nations treaty negotiations and other land-use planning initiatives. Recognizing the challenges that face the mining industry, the provincial government has implemented a wide variety of initiatives over the last few years with the goal of ensuring the health of the exploration and mining sectors.

- 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.

Figure 25
British Columbia Exploration Expenditures as a Percent of Canada's Total, 1986-2000



Source: British Columbia Ministry of Energy and Mines.
[f] Forecast of intentions; [p] Preliminary.

- 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. This program is worth $9 million in 1999/2000 and in future years.
- New Mine Allowance - Extended to 2010, the allowance provides for a one-third gross-up of the capital costs of new, re-opened or expanded mines for the purposes of calculating 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 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 Program continues to promote grass-roots prospecting for minerals. Fifty prospectors were awarded grants in 1999 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.
- The Job Protection Commission has been instrumental and successful in negotiating economic relief packages for British Columbia 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.
- Regional Geochemical Survey samples for the Quesnel Lake area were re-analyzed for gold and 25 other metals and results were released in June by the B.C. Geological Survey Branch. This was part of the ongoing program of enhancing previously released survey results.
- The Geological Survey Branch field programs continued to develop the geoscience database. The potential for massive sulphide deposits along the Ancient Pacific Margin (e.g., Dorsey Terrane, Big Salmon Complex, Kootenay Terrane and Ingenika area) will be examined over

the next five years as part of a new multidisciplinary project with the Geological Survey of Canada and the Yukon Geology Program.

- The potential for Pogo-type, Carlin-type gold and iron oxide copper-gold-rare earth elements deposits in British Columbia was investigated, and mineral deposit models and geochemical models are being developed. The Ecstall and Robb Lake massive sulphide deposit settings were also examined. Several smaller-scale projects were carried out on coal and industrial minerals. A number of projects are in the write-up stage (e.g., Toodoggone, Nechako NATMAP and Eagle Bay). Results of these programs are expected to encourage exploration.
- The ARIS (assessment reports), MINFILE and MapPlace databases continue to be upgraded and made more easily accessible to clients on the Ministry's web site. The MapPlace database can be accessed at http://www.em.gov.bc.ca/geology.
- Three areas along the central coast were studied, funded under the government's Corporate Resource Inventory Initiative (CRII), as part of the Ministry's contribution to the Central Coast Land and Coastal Resource Management (CCLCRMP) planning process. In each area (Khutze River, Cape Caution and Bella Coola), regional geochemical surveys were conducted and the mineral potential was examined. Limited CRII-funded work was also carried out on the Queen Charlotte Islands.

Statistical Trends in the British Columbia Mining Industry

This section highlights exploration factors and trends as interpreted from federal/provincial survey results and data available from British Columbia's Ministry of Energy and Mines.

In general, exploration data, as illustrated by **Figures 26-32**, indicate: (1) a strengthening trend for exploration in British Columbia; (2) balanced spending, where exploration dollars are spent on projects covering all phases of exploration (including reconnaissance and first-stage exploration, deposit appraisal and mine complex development); and (3) that companies are taking advantage of an attractive diversity of the different deposit and mineral types that occur in the province.

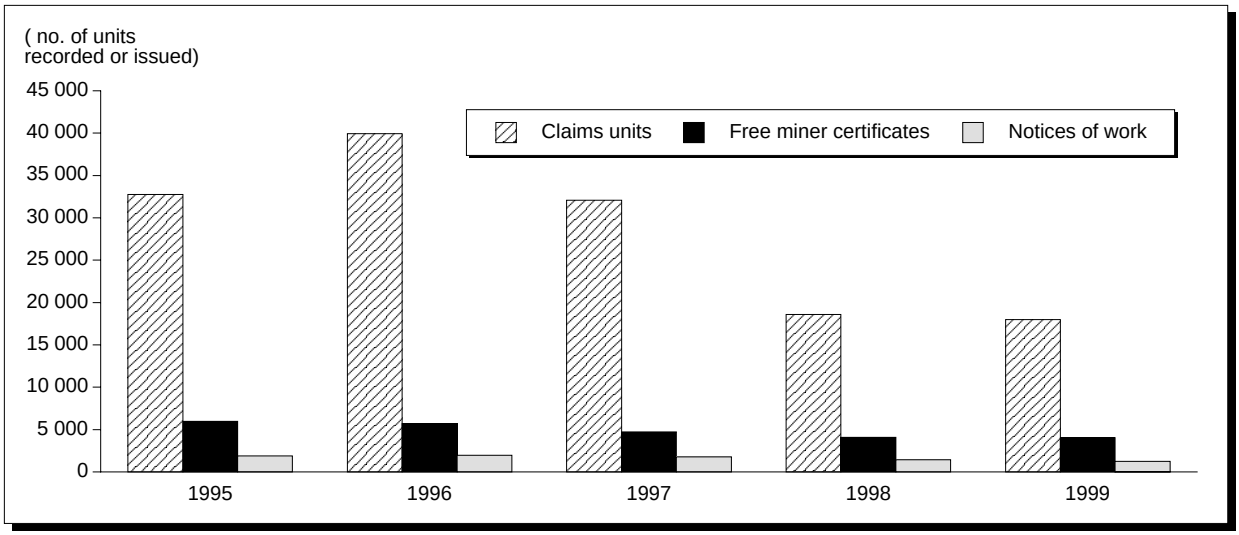
Beginning with **Figures 26** and **27**, these plots illustrate and support the idea that we are beginning to see a strengthening trend in exploration in British Columbia. **Figure 26** shows year-on-year claim-staking activity as well as the number of notices of work recorded and the number of Free Miner Certificates issued. All three series attained similar levels in 1999 as they did in 1998 and claim staking, in the first eight months of 2000, is well ahead of staking in 1999. Much of the additional claim staking is a direct result of new gold discovered in the Cariboo region.

In **Figure 27**, twenty years of exploration spending ("field work and overhead" costs) is plotted as a bar chart. Superimposed on this bar chart is a B.C. mineral price index (using copper, lead, zinc, gold, silver and coal prices), which shows a high degree of correlation between mineral commodity prices and exploration spending. Corresponding to the increased claim-staking activity, both the price index and exploration spending show increases in 2000 over 1999. As a footnote, an analysis of these two time series suggests that exploration spending is 60-80% explained by mineral commodity price levels/expectations and 20-40% explained by provincial policy and other factors. The large bars that penetrate above the price index in the middle of the chart are partly explained by flow-through share incentives. The gap between the "bar tops" and the price index line in recent years is partially explained by reduced exploration due to uncertainties from land-use planning and Aboriginal treaty negotiations.

Figures 28, **29** and **30** indicate that spending is balanced amongst different phases of exploration activity; this is a desirable quality since the province wants projects, in all phases of exploration, advancing simultaneously to ensure a continuous stream of future mines.

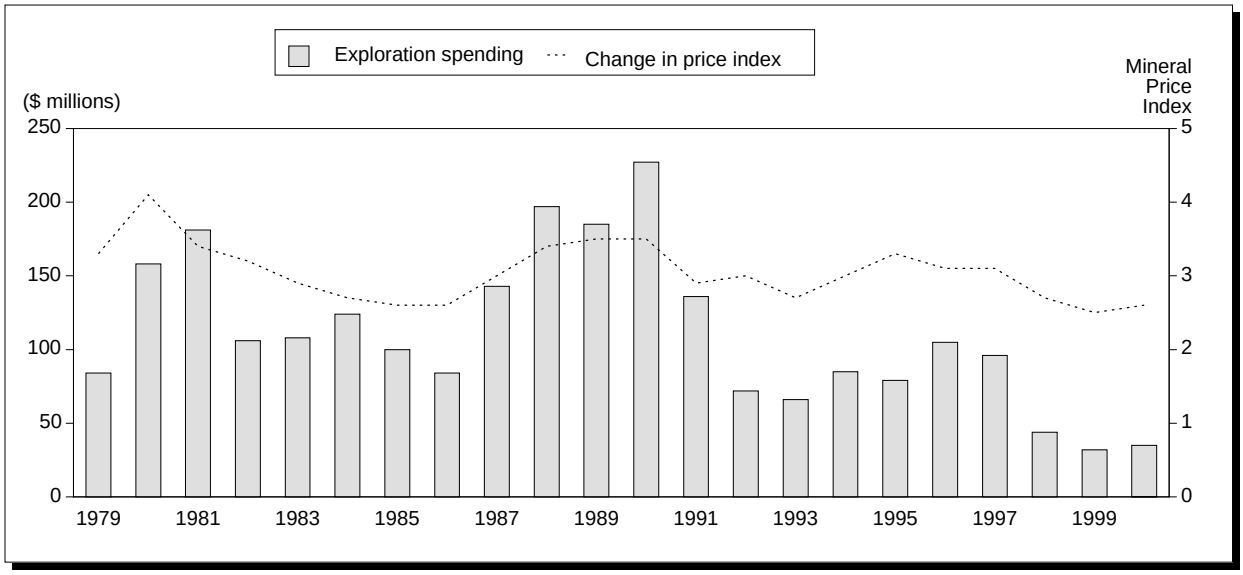
Figure 28 is a histogram (and cumulative frequency plot to show inflections) of exploration companies, grouped by various amounts of spending. Three discrete groups are present in each

Figure 26
Exploration Activity in British Columbia as Indicated by Claim Units, Free Miner Certificates and Notices of Work, 1995-99



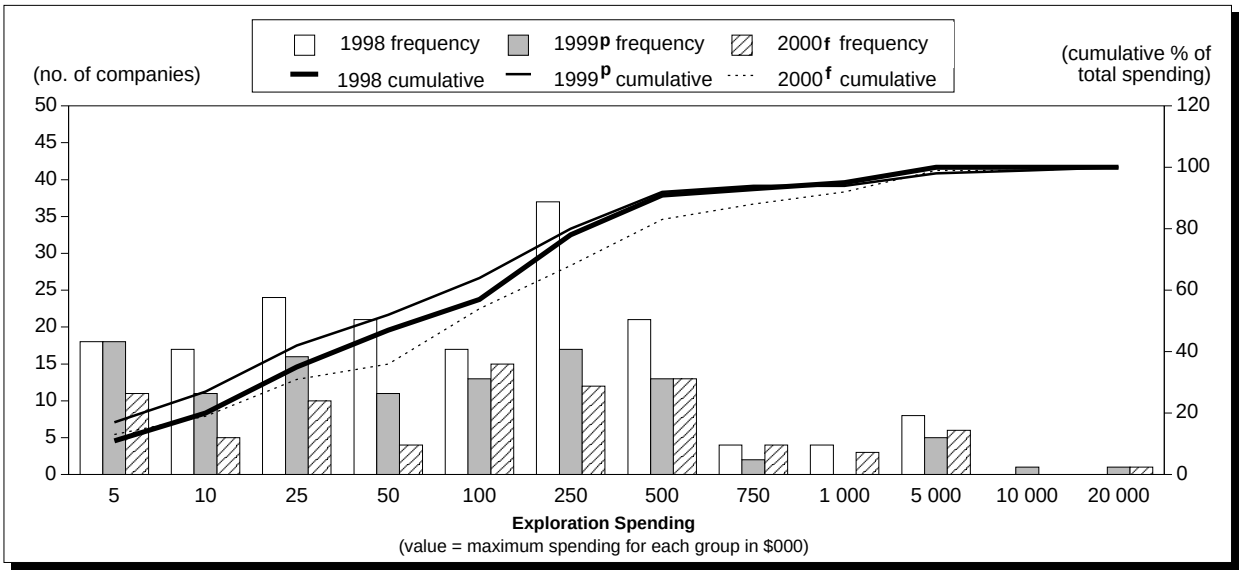
Source: British Columbia Ministry of Energy and Mines.

Figure 27
Annual Exploration Spending Related to Changes in British Columbia's Mineral Price Index, 1979-2000



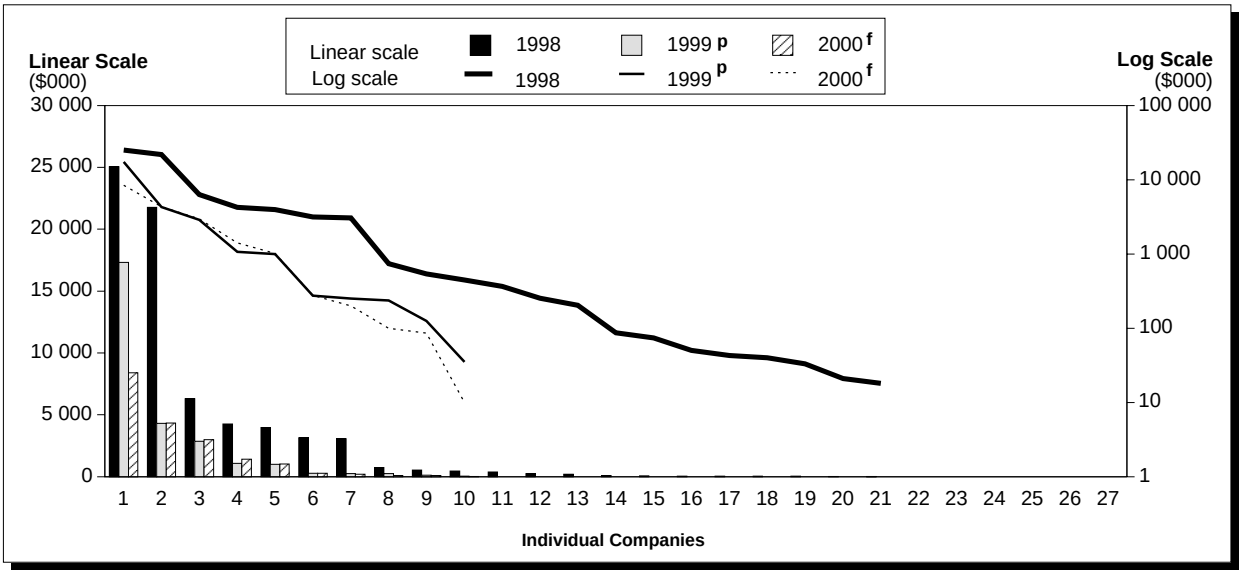
Source: British Columbia Ministry of Energy and Mines.
Note: Exploration expenditures for 2000 are based on a forecast of intentions; 1999 expenditures are preliminary.

Figure 28
Exploration Companies in British Columbia Grouped by Level of Spending, 1998-2000



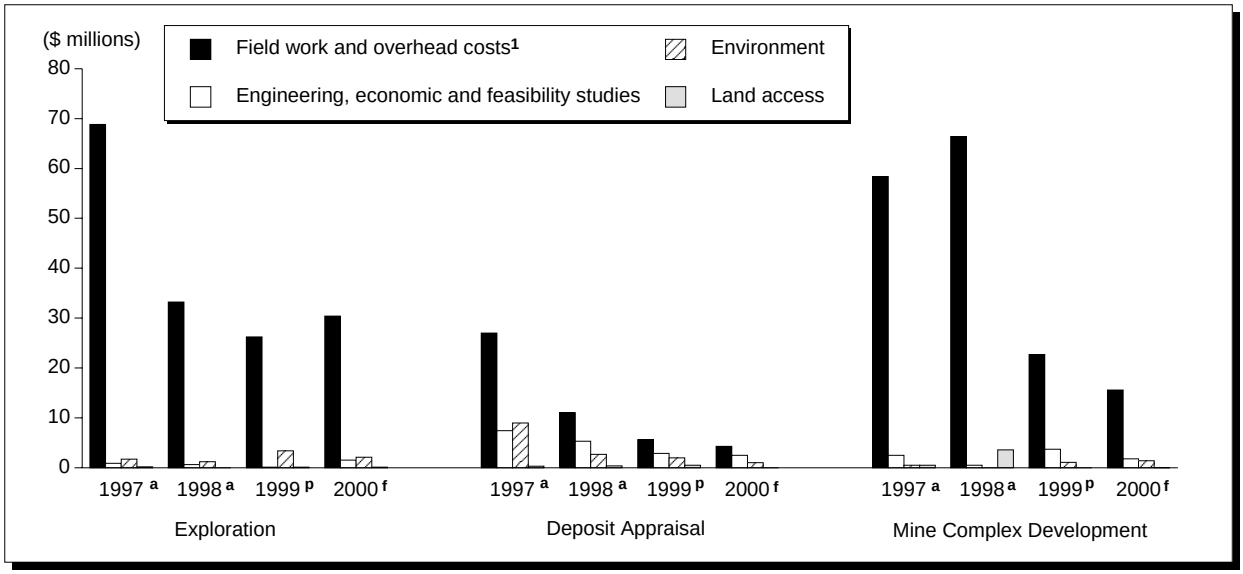
Source: British Columbia Ministry of Energy and Mines.
f Forecast; p Preliminary.

Figure 29
Distribution of Mine Complex Development Spending in British Columbia, by Company, 1998-2000



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

Figure 30
Exploration Spending in British Columbia, by Phase (Exploration, Deposit Appraisal, Mine Complex Development) and by Function (Field, Engineering, Environmental and Land Access Costs), 1997-2000



Source: British Columbia Ministry of Energy and Mines.
[a] Actual; [p] Preliminary; [f] Forecast.
[1] Exploration plus deposit appraisal comprises official figure for "Total Exploration Spending."

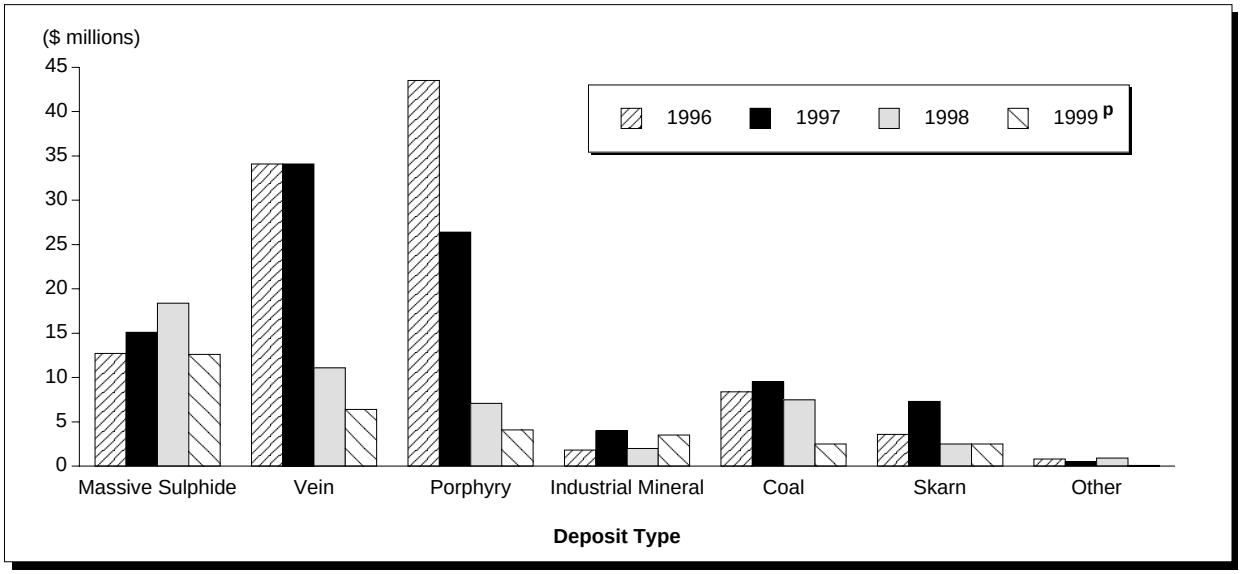
of the three years: those spending $5000 to $25 000, those at $100 000 to $500 000, and those above $750 000. These three clusters reflect a healthy exploration balance of "smaller spenders" focused on prospecting and first-stage exploration, "medium-range" spenders targeting a successful deposit appraisal or possibly completing a large-scale reconnaissance program, and "big spenders" who might be focused on a mine production or major mine expansion decision.

Similarly, **Figure 29** shows the distribution of expenditures (including a log scale plot for clarity) for companies involved in mine complex development. One interpretation is that there are a number of companies in all three years working on a diversity of mine complex development projects at varying levels of expenditure. While there is a drop in the number of companies involved from 1998 (21 companies) to 1999 and 2000 (10 companies each year), this may reflect the heavier expenditures in 1998 required to move Kemess, Huckleberry and Mt. Polley from development to production mode and for the mill expansion at Eskay Creek.

Figure 30 shows spending by work phase and by function over the four-year period 1997-2000. It also shows consistent expenditures, year on year, within the exploration and deposit appraisal phases, on engineering, economic and feasibility studies, environmental work and land access costs. Over the four-year period, the bulk of these latter "non-geoscience" exploration costs is spent in the deposit appraisal stage, which consistently averages 40-50% of total deposit appraisal costs.

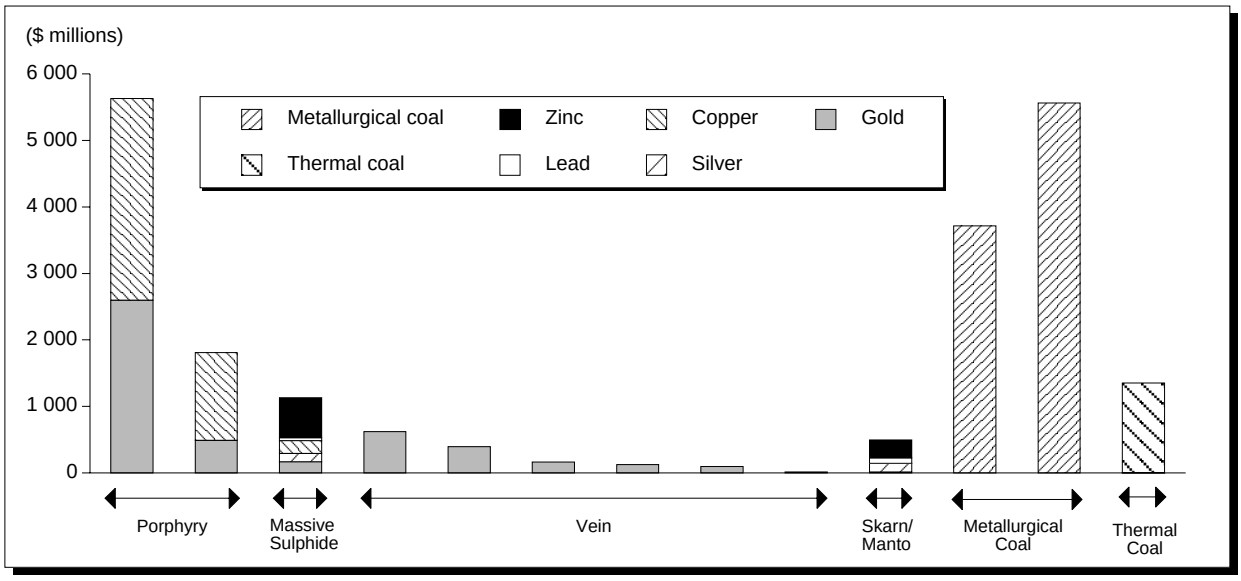
As indicated in **Figures 31** and **32**, British Columbia is well-endowed with an attractive diversity of a broad range of different deposit and mineral types. This is a strong advantage for exploration companies and prospectors who may wish to switch their focus to other minerals as commodity prices move up or down, or who may want to re-focus on finding other deposit types when new theories are developed or supply/demand, technology and/or other circumstances

Figure 31
Exploration Spending in British Columbia, by Deposit Type, 1996-99



Source: British Columbia Ministry of Energy and Mines.
p Preliminary.

Figure 32
In-Ground Value of British Columbia's Advanced Exploration Projects At August 2000 Prices



Source: British Columbia Ministry of Energy and Mines.

change. The flexibility of British Columbia as a host jurisdiction for exploration is shown in **Figure 31**. Here it is seen that massive sulphide deposits were attracting more spending in 1999 than were vein and porphyry deposits (where expenditures were greater in 1996 and 1997). Similarly, in the forecast for 2000, there is an anticipated switch in spending levels with that for industrial minerals increasing and that for coal decreasing.

Additional evidence of the appeal of deposit and mineral diversity is shown in **Figure 32**. Here six different deposit types are currently attracting advanced exploration expenditures. In-ground values of these deposits, while declining in recent years, still add up to a substantial $16 billion (i.e., value = [grade x tonnage x price] based on August 2000 mineral commodity prices).

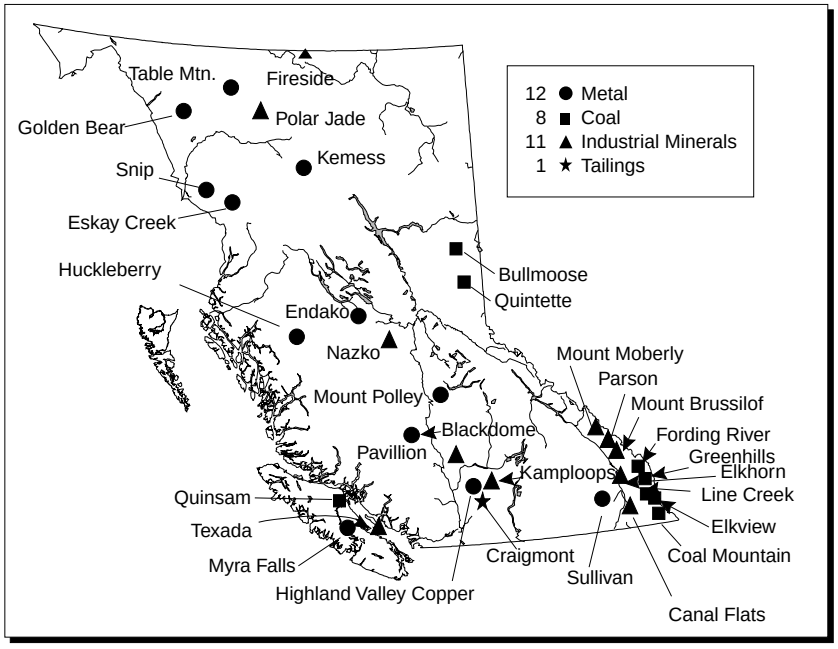
Mining and Exploration Highlights

The major mining and exploration activities for 1999 are highlighted on the three map figures that follow. **Figure 33** shows the location of operating mines in British Columbia. **Figures 34** and **35** give the location of major exploration and advanced exploration projects. These maps further illustrate the diversity of exploration targets available in the province, both geographically and in terms of mineral and deposit types.

Detailed descriptions of the important exploration projects conducted in 1999 are documented in *British Columbia's Mineral Exploration Review 1999*, Information Circular 2000-1.

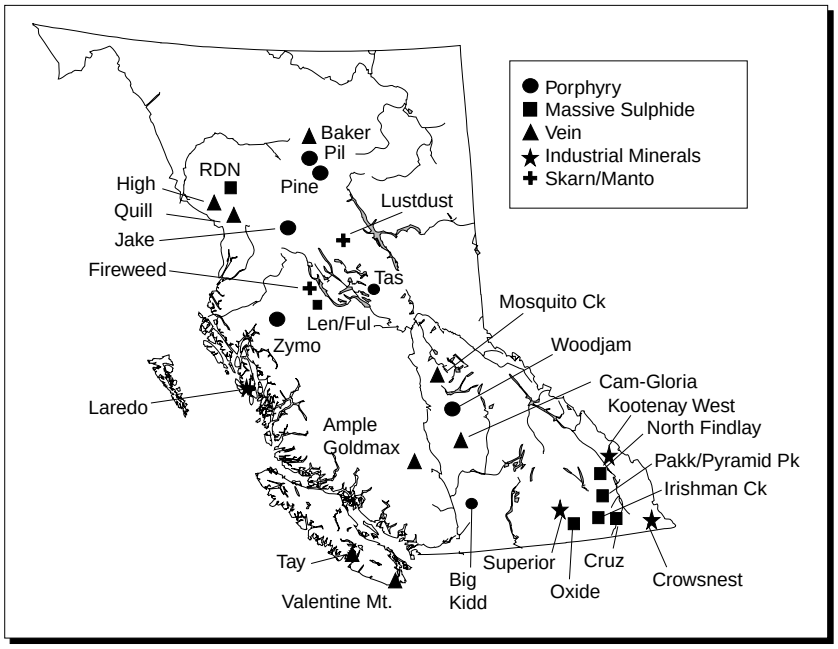
A positive development in the exploration sector has come from major companies who have renewed or established an exploration presence in the province. Hudson Bay Exploration and Development Co. Ltd. drilled a number of properties in the Babine area to test airborne geophysical anomalies identified in 1997. Homestake Canada Inc. carried out both detailed and

Figure 33
Operating Mines in British Columbia, 1999



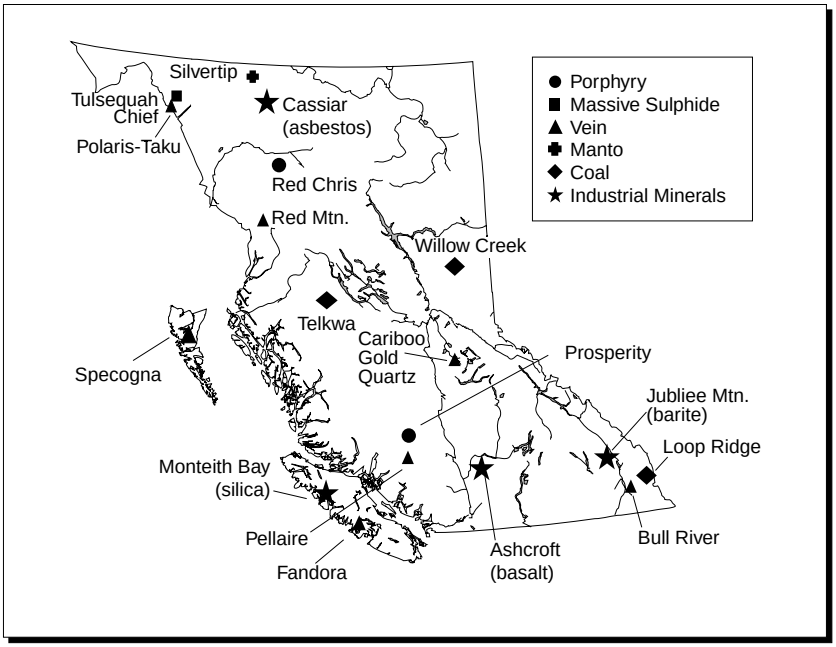
Source: British Columbia Ministry of Energy and Mines.

Figure 34
Major Exploration Projects in British Columbia, 1999



Source: British Columbia Ministry of Energy and Mines.

Figure 35
Advanced Projects in British Columbia, 1999



Source: British Columbia Ministry of Energy and Mines.

regional exploration programs around the Eskay Creek mine. It also examined other areas in the northwest for Eskay Creek-style mineralization. Freeport Copper Ltd. (a subsidiary of Freeport-McMoRan of the United States) optioned the Zymo porphyry target west of Smithers and drilled six short holes. Billiton Metals Canada Inc. opened an office in Vancouver and took an interest in the Sullivan camp. Phelps Dodge Corporation of Canada established an office in Vancouver and started fieldwork in 1999. BHP Minerals also re-established one of its three major, worldwide offices in Vancouver. By Letter of Intent dated September 30, 1999, Doublestar Resources Ltd. has agreed to acquire substantially all of Falconbridge Limited's mineral property interests in British Columbia. These include a number of significant resources, including Sustut, Catface, Ruddock Creek, Robb Lake, Scotia, Hiller and Baldwin/McVicar. Exploration programs were carried out on the Sustut and Ruddock Creek projects in 2000.

Metals

The exploration highlight for 1999 was the continued interest, by major and junior mining companies, in base-metal potential, particularly for Proterozoic and Paleozoic stratiform zinc-lead-silver deposits and Paleozoic-Mesozoic precious-metal-enriched massive sulphide deposits. For example, Rio Algom Ltd., Kennecott Canada Inc. and Billiton Metals Canada Inc., together with a number of junior companies, have sustained diligent efforts towards locating the elusive successor to the world-class Sullivan zinc-lead-silver orebody in southeastern British Columbia. Three aggressive drilling programs have identified new sulphide-rich hydrothermal vents, and exploration on several other prospects has defined new drilling targets (e.g., Pakk, North Findlay, South Findlay, Greenland Creek, Irishman Creek, Pyramid Peak, Yahk, Car, Cruz and Smoker). This was the most active exploration area in 1999.

In another discovery, an outstanding drill intersection was completed by Peruvian Gold Ltd. and Imperial Metals Corp. on the Silvertip silver-lead-zinc manto prospect in northern British Columbia.

In the more advanced deposit appraisal stage, several bulk-sampling projects were carried out (e.g., Jubilee Mountain, Mountain Boy, Pellaire, Fandora and Cassiar). A number of advanced projects are in the Environmental Assessment process (e.g., Silvertip [Midway], Red Mountain, Red Chris, Prosperity and Bronson Slope), and project certificates are in place for Mt. Milligan and Tulsequah Chief.

At the other end of the spectrum, some noteworthy first-stage (grass-roots) exploration programs took place in:

- the northwest area (Eskay Creek) for precious-metal-rich subaqueous hot-spring deposits;
- the Toodoggone (Kemess) area for porphyry gold-copper deposits;
- the area north of Wells for polymetallic massive sulphide deposits;
- the area north of Revelstoke for polymetallic massive sulphide deposits;
- the area northeast of Kamloops for intrusion-hosted (e.g., Fort Knox, Pogo) gold deposits; and
- numerous areas throughout the province in the search for industrial minerals.

Coal

Although coal exploration was modest during 1999, there was a lot of interest in coalbed methane in the province. Exploration is taking place in the southeast and a number of companies are interested in obtaining exploration rights for coal on Vancouver Island, especially in the area of the Quinsam coal mine. The interest reflects increased success in recovering coalbed methane in the United States, natural gas prices and favourable exchange rates. Also, the spectacular success in recovering economic quantities of methane from shallow low-rank

coals in the Powder River Basin in Wyoming has stimulated interest in exploration for coalbed methane in low-rank coal deposits in British Columbia.

Industrial Minerals

Industrial minerals spending was up in 1999 over 1998. Projects vary widely in terms of mineral type, geography and the nature and scope of process development. For example, an $8 million pilot plant was constructed by Cassiar Mining Inc., a fully owned subsidiary of Cassiar Mines & Metals Inc., to recover short-fibre asbestos from the Cassiar Asbestos tailings (17 Mt). A small shipment was made for market testing late in the year. The company is now rehabilitating a portion of the dry milling circuit in the old mill to process approximately 4 Mt of ore. Anticipated start-up of the operation is targeted at a milling rate of 720 t/d.

In another situation, IG Machine and Fibers Ltd. (a subsidiary of IKO Industries Ltd.) received a permit for a 250 000-t/y basalt quarry and processing plant at Ashcroft. The basalt will be crushed, sized and coloured to produce roofing granules for IKO plants in Sumas, Washington, and Calgary, Alberta. Plant construction is scheduled for next spring.

Conclusion

Even though British Columbia has seen large decreases in exploration spending in 1998 and 1999, spending in 2000 is forecast to at least reach 1999 levels and to possibly exceed them slightly. This is based on positive factors such as increasing commodity prices, the presence of strong mining companies in the province, and new discoveries.

The province maintains a stable exploration environment, as indicated from the analyses above. This stability is reflected in the strengthening trend for exploration, the balanced spending by companies covering all phases of exploration, and the attractiveness, to exploration companies and prospectors, of the highly diverse mineral deposit targets found in British Columbia's Cordilleran terranes. Many government initiatives are in place to help offset industry uncertainty over land-use and First Nations treaty negotiation issues.

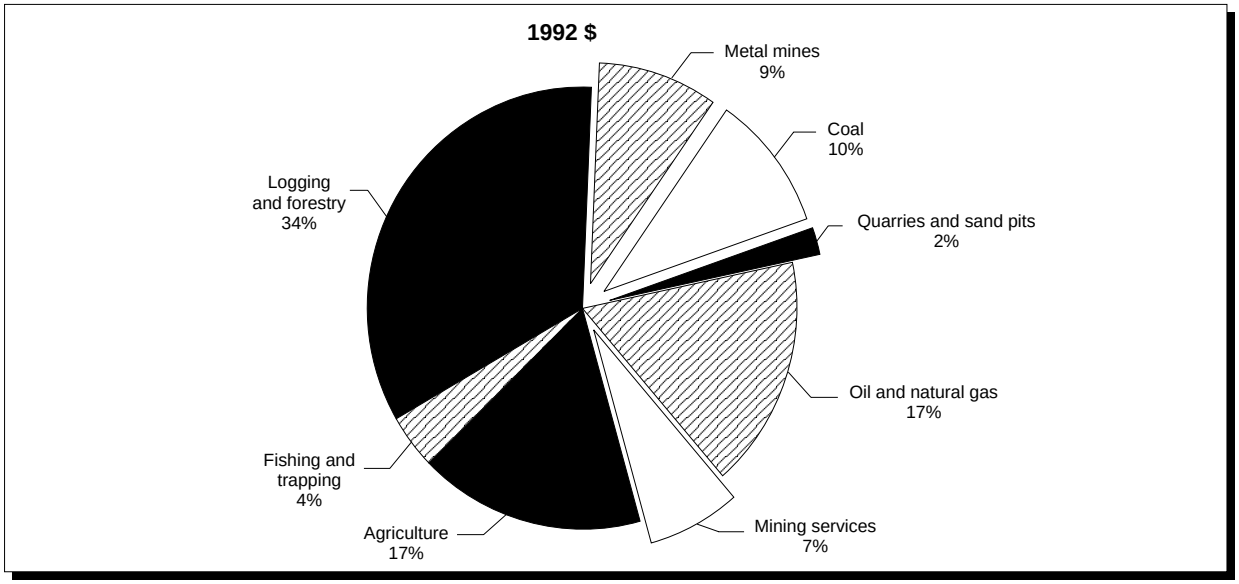
More specifically, project-oriented targets that hold strong appeal for continuing and expanded exploration programs are as follows:

- The economic significance of the Eskay Creek mine continues to attract province-wide attention to the potential for stratabound, precious-metal-enriched subaqueous hot-spring deposits.
- The search for zinc-rich sedex deposits in the southeastern part of the province is expected to intensify, with follow-up work at the North Findlay, South Findlay, Greenland Creek, Pakk, Pyramid Peak, McNeil and Irishman Creek properties.
- Exploration for Carlin-type gold mineralization is expected to increase throughout the province.
- Interest in the potential for the discovery of deposits similar to the Pogo deposit and the Fort Knox orebody, which is currently being exploited in Alaska, will continue in British Columbia, especially in the Kootenay Terrane and Shuswap Metamorphic Complex.
- Evaluation of recently discovered volcanogenic massive sulphide prospects in the Cariboo, hosted by Slide Mountain and Barkerville terrane rocks, is expected to revive regional exploration in those belts.
- Polymetallic volcanogenic and sedex massive sulphide deposits will also continue to be primary targets. There is good potential for the discovery of Broken Hill-type deposits in the Kootenay Terrane along a north-trending belt west of Revelstoke.
- GTN Copper Technology Ltd., a Sydney, Australia-based company, has proposed a $117 million copper processing plant at the former Island Copper mine site near Port Hardy to process copper concentrate from mines in western Canada, the United States and South America. Detailed marketing and engineering studies and an application for the necessary

environmental permits will be the next step. The presence of a copper processing plant on the west coast would have a significantly positive impact on the economic viability of many bulk-mineable copper (-gold) deposits in the province.
- The association of nickel and PGE with mafic to ultramafic rocks in British Columbia is expected to attract attention in 2000.

While British Columbia's mineral economy contracted slightly from 1998 to 1999 ($3.0 billion to $2.6 billion by revenue), mainly as a result of lower commodity prices, the province's mineral sector comprises a substantial part of the resource sector as shown in **Figure 36**. As a result, the government is committed to new and continuing initiatives focused on the future growth and development of the exploration and mining sector.

Figure 36
British Columbia, Percentage Distribution of Resources Industry's Gross Domestic Product (GDP), 1992 $, 1998



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

2.11 YUKON

Overview

Exploration expenditures in 1999, at $9.5 million, were down from the $15.4 million spent in 1998 and the $35 million spent in 1997. A large number of 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 75% of exploration expenditures.

The decrease in exploration expenditures is reflected in the number of advanced exploration projects involving drilling. A total of 10 579 m of diamond drilling took place in 1999, compared to 20 000 m in 1998. The number of quartz claims staked in 1999 was 7258, up from the 5148 claims staked in 1998. The number of quartz claims in good standing was 61 882 at the end of 1999. The number of placer claims staked in 1999 was 1002 and the number of placer claims in good standing at the end of 1999 was 16 671.

Mine development expenditures in 1999 were approximately $6.5 million, slightly higher than the $6.0 million incurred in 1998. The bulk of mine development expenditures ($6.2 million) was incurred at the Brewery Creek gold mine. A short construction program was completed at the Minto copper-gold-silver property. The Minto project is fully permitted and a production decision is anticipated in 2000.

Production Summary

Brewery Creek Mine

The Brewery Creek mine was opened by Viceroy Resource Corporation in November 1996. The mine successfully produced gold during its first winter of operation by utilizing heap leach technology in the extremes of a cold northern climate. Gold production during the first two months of operation, November and December 1996, totaled 316 kg (10 175 oz). A total of 2251 kg (72 387 oz) of gold were produced in 1997 compared to 2469 kg (79 396 oz) in 1998. During 1999, a total of 2.1 Mt of ore grading 1.43 g/t gold were mined, producing 1498 kg (48 164 oz) of gold at an operating cash cost of US$288/oz. Earlier forecasts had projected production of 2302 kg (74 000 oz) of gold, but longer leach cycles for sediment-hosted ore and lower recoveries resulted in a shortfall. The leach pad loading system at the Brewery Creek mine will be modified in 2000 and will operate under a revised operating schedule. 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.

Mt. Nansen Mine

The Mt. Nansen gold-silver mine owned by BYG Natural Resources shut down in February 1999. Production in 1999, to the end of February, was 15 500 t at a grade of 7.5 g/t gold and 50 g/t silver, or 3738 oz (116 kg) of gold and 24 917 oz (775 kg) of silver. The company subsequently went into receivership; the site is currently being maintained by the federal Department of Indian Affairs and Northern Development.

Mine Development

A total of $6.2 million was spent at the Brewery Creek gold mine to expand the heap leach pad and extend the haul road.

Two grinding mills owned by Minto Explorations Ltd. were moved from a temporary storage area to the Minto property. All mill components were cleaned, sandblasted and painted, and the two mills were assembled. In addition, some roadwork and preparations to allow construction to continue through the coming winter were also completed. 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.

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 throughout 1999 awaiting an increase in metal prices.

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. In 1999, Western Copper Holdings Limited continued its review of the Carmacks Copper project under the Environmental Assessment and Review Process. The Carmacks Copper deposit is an oxidized copper-gold porphyry deposit containing 14.1 Mt grading 0.99% copper and 0.51 g/t gold.

Expatriate Resources and Atna Resources conducted metallurgical studies in 1999 for the treatment of selenium in mineralization from the Wolverine volcanogenic massive sulphide deposit. The Wolverine deposit contains reserves of 6.2 Mt grading 12.66% zinc, 1.33% copper, 1.55% lead, 370.9 g/t silver and 1.76 g/t gold.

No production decision was made in 1999 on Cominco's adjacent Kudz Ze Kayah volcanogenic massive sulphide deposit, which hosts open-pit mineable reserves of 11.3 Mt grading 5.9% zinc, 0.9% copper, 1.5% lead, 133 g/t silver and 1.3 g/t gold. In 1999, Cominco released an inferred reserve on a small satellite deposit discovered in 1998 on the Kudz Ze Kayah property. The deposit hosts reserves of 1.5 Mt grading 6.4% zinc, 3.1% lead, 0.1% copper, 90 g/t silver and 2.0 g/t gold.

In 2000, Expatriate Resources announced it was purchasing the Kudz Ze Kayah deposit from Cominco and consolidating exploration and pre-feasibility studies for both deposits.

Placer Mining Industry

A total of 171 placer gold mines operated in 1999, with approximately 600 people directly employed in the industry, which represents a 6% increase in the number of mines from 1998. Placer gold production for 1999 totaled 89 573 crude oz, slightly higher than the 87 488 crude oz produced in 1998. Despite the small increase in production, the total value of gold production in 1999 dropped to $29.6 million (due to lower gold prices), short of the $30.6 million produced in 1998.

Over 80% of the placer gold was produced from unglaciated regions of the Yukon including Klondike, Indian River, west Yukon (Fortymile, Sixtymile, Moosehorn), and the lower Stewart River. The remaining gold came from glaciated regions including Clear Creek, Mayo, Dawson Range, Kluane and Livingstone.

Mining Land Use regulations took 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.

Precious-Metal Exploration

Most gold exploration targets are within the Tintina gold belt, an arcuate sequence of intrusive-related gold occurrences and deposits in the Yukon and Alaska. The Yukon experienced extensive plutonism in the mid-Cretaceous, and the Tintina gold belt encompasses several of these mid-Cretaceous intrusive suites. Several exploration projects such as Scheelite Dome, Clear Creek, Dragon Lake and Hit, which are related to the Tombstone and Tungsten intrusive suites, had drill programs in 1999. The Tombstone and Tungsten suites have received several years of exploration for intrusive-related gold targets, and several areas are generating drill targets and new discoveries. The Dawson Range intrusive belt in west-central Yukon experienced a large amount of claim staking on targets generated by research and reconnaissance using a Pogo model (Alaskan intrusive-related gold deposit). Most projects in the Dawson Range were subjected to first-pass exploration in 1999, and the positive results generated could lead to more advanced projects and discoveries. The Longline project within the Dawson Range is the most advanced project in this intrusive belt; positive drill results will continue to advance this project and anchor expanded exploration in this area.

Base-Metal Exploration

Base-metal exploration in 1999 focused on a variety of deposit types. Exploration for volcanogenic massive sulphide deposits continued in the Finlayson Lake district, and equivalent Yukon-Tanana Terrane rocks in southern Yukon and the Dawson area. In addition, the Rancheria silver-lead district was investigated for high-grade silver vein and carbonate replacement deposits. Only a small amount of exploration was conducted in southwestern Yukon on

copper-nickel-PGE targets; this area has, in recent years, produced some of Canada's most spectacular PGE numbers. Results reported in 1997 from Inco Limited's Klu property returned values from grab samples of up to 3.1% nickel, 10.4% copper, 0.19% cobalt, 75.8 g/t platinum, 20.6 g/t palladium and 7.0 g/t gold. Most exploration for base metals was directed at refining drill targets on existing properties and several drill programs are anticipated in 2000.

Exploration and Development Forecast for 2000

The Yukon Chamber of Mines conducted a survey of exploration companies doing work in the Yukon during 2000. A total of 15 companies responded with expenditure forecasts. Total forecast expenditures are $7.4 million for exploration and development in 2000.

Yukon Government Programs

The Yukon government offered three programs in 1999 to encourage development of the Yukon's mineral and energy resources: the Yukon Mining Incentives Program (YMIP), the Yukon Industrial Support Policy (YISP), and the Energy Infrastructure Loans for Resource Development Program. In addition, the Yukon government offers a refundable mineral exploration tax credit of 22% for eligible individuals and companies carrying out exploration in the Yukon. The tax credit is in effect from April 1, 1999, to March 31, 2001. It will then be increased to 25% for the period ending March 31, 2002.

Yukon Mining Incentives Program (YMIP)

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 1999 was $476 600. A total of 20 contributions were approved in the Grass-Roots Program and a total of 16 contributions were approved in the Target Evaluation Program.

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 1999.

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 1999.

2.12 NORTHWEST TERRITORIES

Introduction

On April 1, 1999, the territory of Nunavut came into existence, along with a new Northwest Territories.

1999 Mineral Production Summary

The value of total metal shipments from the Northwest Territories dropped to $41.6 million in 1999 from $349 million in 1998. Decreased gold production, depressed commodity prices and the division of the territories were the major reasons for the decline. There is no base-metal production from the current Northwest Territories. As a consequence, the total value of metal shipments from the Northwest Territories in 1999 dropped to 0.4% of Canadian production. Gold production from the Northwest Territories continues, as it did in 1998, to account for 2% of total 1999 Canadian production. This is a decrease from 8% in 1997. The 1999 gold production of the Northwest Territories was valued at $41.6 million, representing 99.6% of its total value of metal production. A small amount of silver with an attributed value of $158 000 was produced in the Northwest Territories. The year 1999 was the first complete year of diamond production in the Northwest Territories. A total of 2 400 000 carats (ct) was produced from the Ekati™ diamond mine with an estimated value of $581 million.

Producing Mines

The year 1999 was a year of change in the mining industry in the Northwest Territories. After Nunavut was created in April 1999, there were two producing mines in the Northwest Territories: the Ekati™ diamond mine and the Miramar Con gold mine. The Ekati™ diamond mine operated continuously throughout 1999, whereas the Con mine remained shut down for the early part of the year due to a labour dispute. The Giant mine was on care and maintenance at year-end.

Full production at the Miramar Con mine resumed in July 1999 and, by year-end, the mine had produced 38 678 oz (1203 kg) of gold at an average cash cost of US$272/oz. In February 1999, the owner of the Giant mine, Royal Oak Mines Inc., filed for bankruptcy. Operation of the company was turned over to a receiver and, in December, the assets of the Giant mine were sold to Miramar Mining Inc., the owner of the Con mine. The federal Department of Indian Affairs and Northern Development and the Government of the Northwest Territories assumed the environmental liability for the property. The Giant mine was shut down in November and remained shut down at December 31, 1999. Miramar Mining Inc. intended to bring the operation back into production, at reduced levels, early in 2000. During 1999, the Giant mine produced 70 299 oz (2187 kg) of gold.

Production from the Ekati™ diamond mine, located 300 km northeast of Yellowknife near Lac de Gras, totaled 2 400 000 ct at an average value of US$168.05/ct. The operation is owned by BHP Diamonds Inc. (51%), Dia Met Minerals Ltd. (29%), Charles Fipke (10%) and Stewart Blusson (10%). The realized price per carat was 29% higher than the US$130/ct price upon which the 1997 Ekati™ feasibility study was based.

1999 Exploration and Mine Development Summary

There was a further decrease in exploration spending in the Northwest Territories in 1999 when expenditures dropped to $103 million, down from the 1998 total of $113 million. About half of this total is attributed to deposit appraisal expenditures (i.e., engineering, economic and feasibility studies). The Northwest Territories ranked second in Canada behind Québec.

A total of 1032 claims covering 0.94 Mha were staked from April 1 to December 31, 1999. At year-end, there were 7294 claims in good standing. A total of 78 new mining leases were issued. Overall, this reflects the maturity of diamond exploration, a disinterest in mining stocks by the investment community, and depressed commodity prices.

Diamonds[4]

Diavik Diamond Mines Inc.™ continued to undergo the environmental review for its project. Four pipes (i.e., A-154N, A-154S, A-418 and A-21) are within the scope of the environmental review. In March 1998, Diavik submitted a project description to the federal government, triggering the Environmental Assessment process. In September 1998, the Environmental Assessment Report was submitted. At year-end 1999, approval for operating permits and licences was still pending. Construction was expected to commence in the first quarter of 2000. The Diavik diamonds project resources are estimated, to a depth of 420 m, at 37 Mt containing 138 million ct, for an average resource grade of 3.7 ct/t. Four exploration holes were drilled into the A-180 kimberlite pipe located 25 km to the northeast of the Diavik camp. A total of seven delineation holes and two mini-bulk sample holes were drilled into the A-841 pipe, also named the Piranha pipe. This pipe straddles the BHP-Diavik claim boundary.

BHP Diamonds Inc. and Dia Met Minerals Ltd. conducted exploration work on the Ekati property, resulting in the discovery of seven new pipes.

At the Kennady Lake project, results of bulk sampling and diamond-drilling programs were released. The project is operated by Monopros on behalf of Mountain Province Mining. A total of 533 ct were recovered from 523 t of kimberlite from the Tuzo pipe. Grades range from 0.34 to 3.07 ct/t. The resource for the Tuzo pipe is currently estimated at 15 Mt to a depth of 360 m. Bulk samples from the Hearne pipe returned 846 ct from 469 t of material. Three additional pipes, named the Wallace, 5034-South and Faraday pipes, were discovered on the Kennady Lake property.

At the Snap Lake project, the operator, Winspear Resources Ltd., undertook a diamond-drilling program to identify sufficient kimberlite resource for a feasibility study and also a 6000-t bulk sample to test diamond grade. A total of 10 708 ct of diamonds were recovered from the sample, giving an undiluted grade of 1.78 ct/t at an average value of US$105/ct. A resource of 7.96 Mt has been outlined with sufficient certainty to conduct a feasibility study. Further study, including a pre-feasibility study, was planned for 2000. The pre-feasibility study was to include test mining of a 20 000-t underground bulk sample.

In addition, exploration for diamondiferous kimberlite was carried out by:

- Aber on the GEM and CRYSTAL properties;
- Monopros, as operator on behalf of GMD, on the Royce claims;
- Gerle Gold on the Gerle property;
- Noront Resources Ltd. and Ateba Mines Inc. on the Walmsley Lake property, located to the east of Kennady Lake;
- SouthernEra Resources Ltd. on the Munn Lake and Yamba Lake properties;
- Kennecott Canada Exploration, as operator on behalf of Intertech Minerals Corp., on the Alfridi Lake property, about 60 km east-southeast of Diavik; and
- Kennecott Canada Exploration, as operator on behalf of Diavik on the DHK property, about 15 km west of Diavik.

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4 Note from the editor: There have been a number of developments related to the search for and production of diamonds in the Northwest Territories since this review of activities was written. These developments include the beginning of construction at the Diavik mine, which should start producing in 2003; the acquisition by De Beers Canada Corporation of the Snap Lake project, where it plans to develop an underground mine; and plans by De Beers for further bulk sampling at the Kennady Lake project.

Gold

Royal Oak Mines Inc., funded by the Department of Indian Affairs and Northern Development, completed 2500 m of surface diamond drilling at the Giant mine. Development drifting and diamond drilling continued on three underground targets (i.e., the 1500 level, and the 370 and 750 levels). This work was funded by the Government of the Northwest Territories, but was suspended when Royal Oak filed for bankruptcy.

Geological mapping, geophysical surveys and diamond drilling were conducted at the Walsh Lake property by Inmet Mining Corp.

Base Metals

Work was conducted on the Sunrise massive sulphide deposit, the Hart massive sulphide property, the Prairie Creek lead-zinc deposit, the Darnley Bay gravity anomaly, and the NICO polymetallic project.

Aber Resources and Hemisphere Development Corp. conducted mapping and sampling programs at the Sunrise VMS deposit, about 115 km northeast of Yellowknife. Solid Resources Ltd. and Tri-star Syndicate conducted a review of existing geological and geophysical data on the Hart VMS property, located immediately northwest of the Sunrise deposit. Canadian Zinc Corporation, formerly San Andreas Resources, acquired additional claims in the area of its Prairie Creek deposit. Darnley Bay Resources completed geophysical surveys and prospecting over the Thrasher zone, targeting nickel-copper-PGE deposits. Till samples were collected over 22 discrete geophysical anomalies with possible kimberlite signatures.

Fortune Minerals Ltd. continued diamond drilling and ground magnetic surveys at the NICO polymetallic project. SNC Lavalin completed a comprehensive resource audit and recalculation of the NICO resources and prepared a geological audit and resource estimate report for the Bowl zone. Using an average price of US$15/lb and a cobalt equivalent cut-off value of 0.08%, the Bowl zone is estimated to contain a measured and indicated mineral resource of 27.1 Mt grading 0.097% cobalt, 0.037% copper, 0.110% bismuth and 0.506 g/t gold.

1999 Government Programs

The Department of Indian Affairs and Northern Development (Northwest Territories Geology Division) and the Government of the Northwest Territories' Department of Resources, Wildlife and Economic Development began merging their geoscience programs in 1997. In 1999, staff from both governments involved in the collection of new geoscience data moved into shared facilities, the C.S. Lord Northern Geoscience Centre located in Yellowknife. The Centre is supported by the Department of Indian Affairs and Northern Development, the Government of the Northwest Territories, and the Geological Survey of Canada.

In 1999, two major geoscience projects were carried out under the auspices of the C.S. Lord Northern Geoscience Centre. The second year of a four-year program of bedrock mapping on a scale of 1:50 000 was carried out in the Snare River area. This project is integrated with structural, geochemical, pressure-temperature (P-T), geochronological and isotopic studies through a partnership with Memorial University of Newfoundland. The 1999/2000 fiscal year was the first fully funded year of the Yellowknife EXTECH (EXTECH-III). 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. In 1999, a total of $195 000 was available for EXTECH III. Sixteen projects were funded, representing a total research investment of $1.07 million.

Work continued on populating the NORMIN database with data. NORMIN is a database of mineral showings and geological/exploration references. Efforts in the Northwest Territories focussed on the EXTECH area. The KIDD (Kimberlite Indicator and Diamond Database) database was launched in 1999. It is a compilation of results from till samples collected over diamond exploration properties in the Slave Province.

2.13 NUNAVUT

Introduction

The formation of Nunavut on April 1, 1999, is the result of the largest Aboriginal land settlement in Canada, covering approximately 2 000 000 km^2 that formerly comprised the eastern and northern portions of the Northwest Territories.

Mineral Production Summary, 1999 to Present

The total recorded value of metal shipments for 1999 in Nunavut was approximately $350 million, representing 3.6% of Canada's total metal production.

A large proportion of Nunavut's total metal production was from zinc (approximately 196 million kg valued at $313 million). According to Natural Resources Canada, this equates to 90% of the total value of metal production in Nunavut. The remaining $37 million consisted of lead ($32 million from sales of 43 million kg) and silver ($4.04 million from sales of 14 000 kg). Gold production was curtailed due to the general decline of the price of gold on world markets.

Nunavut ranked second in Canada in both zinc and lead sales, accounting for 20.4% of Canada's zinc and 27.6% of its lead. The region also contributed 1.4% of Canada's total silver sales.

In 1999, all production in Nunavut arose from two producing mines: the Polaris mine, operated by majority owner Cominco Ltd. (77.5%, with Teck Corporation holding 22.5%) and the Nanisivik mine, wholly owned by Breakwater Resources.

Production in 1999 at the Polaris mine was 238 300 t of zinc concentrate (142 851 t of zinc metal) and 49 300 t of lead concentrate (35 423 t of lead metal), an increase of 5.5% and 2.7%, respectively. As of November 30, 1999, total remaining reserves were given as 2.1 Mt grading 13.2% zinc and 3.5% lead. As of October 24, 2000, shipments for 2000 were expected to total 210 000 t of zinc concentrate and 42 000 t of lead concentrate. Based on reserve estimates, the mine, currently employing roughly 240 people, is scheduled to cease production in July 2002.

Production in 1999 at Nanisivik totaled 101 313 t of zinc concentrate (58 326 t of zinc metal) and 520 092 oz (16 177 kg) of silver from the milling of 802 806 t of ore grading 7.5% zinc and 27 g/t silver. Production in 2000 to June 30 was 30 547 t of zinc metal and 284 068 oz (8836 kg) of silver. Projected production for all of 2000 is estimated at 60 000 t of zinc metal and 558 000 oz (17 356 kg) of silver. Current mineable reserves, in the proven and probable categories, total 3 222 000 t grading 7.4% zinc, 0.4% lead and 31 g/t silver. Mine-site exploration in 1999 resulted in an increase in reserves from 1998 figures of roughly 500 000 t.

In November 1999, Echo Bay Mines Ltd. announced it would re-open the Lupin gold mine. Production had been suspended since early 1998 due to low gold prices. The first gold-pour occurred in mid-April 2000, and the company is on track towards its target production of 105 000 oz (3266 kg). Proven reserves currently stand at 518 000 oz (16 112 kg) of gold with a further resource of 268 000 oz (8336 kg), sufficient for a predicted annual production of 150 000 oz (4666 kg) through 2004. Echo Bay's Ulu deposit, located 160 km north of Lupin, contains resources of 565 000 oz (17 573 kg) of gold, representing potential additional ore feed for the Lupin milling facility.

Exploration Summary, 1999 to Present

Diamonds

Tahera Corporation has initiated the regulatory process for the development and mining of its Jericho diamond deposit located in western Nunavut, near the Lupin mine. As of June 2000, resource calculations from the Jericho pipe indicate 2.5 Mt of ore grading 1.19 ct/t, or 3 million ct of diamonds. Mineable resources stand at 1.9 Mt valued at approximately $200 million. This is recoverable by open-pit mining and will carry an eight-year mine life. A proposed deal with Echo Bay Mines to utilize a portion of the Lupin facility fell through and Tahera is now planning to construct its own milling and infrastructure facilities.

At the Takajuak diamond exploration project, operator Kennecott Canada Exploration Inc., in a joint venture with Tahera Corporation, carried out surface geophysical surveys, geochemical surveys, sonic drilling and diamond-drilling programs throughout 1999, with similar exploration work planned for 2000. To date, two kimberlite pipes have been found by drilling this past winter and surface exploration indicates more kimberlite structures towards the property's north end.

In 1999, Tahera optioned the Hood River project to Kennecott. Conventional diamond exploration was carried out and the Tenacity kimberlite pipe was discovered. Sample results are pending.

Monopros Ltd. (now called De Beers Exploration Canada), a division of De Beers Consolidated Mines Ltd., has a number of ongoing diamond exploration projects. Exploration on the Rockinghorse diamond project has been of interest from 1994 to present. The company carried out a drilling project in 1999. Monopros also reported some diamonds from drill core of a kimberlite pipe discovered on the Epworth polymetallic base-metal property of Rhonda Mining Corporation. The company has commenced a till sampling program across a large land package between the Queen Maud Island Bird Sanctuary and the Thelon Bird Sanctuary.

Monopros has dropped its option on the Victoria project on Victoria Island after drilling several kimberlite pipes this past winter. Dia Met Minerals Ltd. has now picked up an option on portions of this ground from property owner Major General Resources. Dia Met is planning to drill on the Mariner and Home Run projects this year.

Gold

Gold exploration remains a major focus within Nunavut despite continued depressed gold prices. In the western portion of Nunavut, exploration and resource development of the Boston and Doris gold deposits of joint-venture partners Hope Bay Gold Ltd. and Miramar Mining Corporation continue to impress. In late 1999, BHP Minerals Canada Ltd. (BHP) relinquished its interest in a large property area covering most of the Hope Bay greenstone belt to Cambiex Inc. Miramar joined the project shortly thereafter. Cambiex changed its name to Hope Bay Gold Ltd. in June 2000.

Hope Bay Gold and Miramar are continuing with definition drilling on the Boston deposit, including 16 000 m of underground drilling. Delineated resources within the volcanic-hosted, gold-bearing quartz vein deposit currently stand at 2.3 million oz (71 538 kg) of gold. The companies are also continuing extensive exploration consisting of surface trenching and 20 000 m of diamond drilling on the nearby Doris deposit. Reserves are currently estimated at 1.2 million oz (37 324 kg) of gold. Plans for open-pit mining are being formulated. The Hope Bay Belt claim group also contains the promising Madrid, Koig, Kamik, Amarok and PJ gold prospects.

East of the Lupin mine, Wheaton River Minerals Ltd. and Kinross Gold Corporation have established an indicated resource at the George Lake iron formation-hosted gold project of

1.335 million oz (41 523 kg) of gold and an additional inferred resource of 692 000 oz (21 524 kg) of gold for a total resource of 2.220 million oz (69 050 kg) of gold. Wheaton River bought out the interest previously held by the now defunct Kit Resources Ltd. early in 2000. Kinross can earn a 70% interest by spending $20 million in exploration costs by 2004. Recent drilling at the Goose Lake deposit (part of the George Lake project) has yielded positive results; the drill program has been increased to 11 000 m.

The Qikiqtaaluk Corporation has recently obtained ownership of the Pistol Lake gold project. Resources currently stand at 580 000 tons (526 176 t) grading 0.406 oz/ton (13.92 g/t) gold, for 235 480 contained oz (7324 kg). Qikiqtaaluk was planning a 4000-m drill program for the summer of 2000.

Several major gold exploration projects are ongoing within the central part of the territory. The Meliadine West project, 56% held by Western Mining Corporation (WMC) and 22% held by each of Cumberland Resources Ltd. and Comaplex Minerals Corporation, hosts four major deposits: the Tiriganiaq, Wolf, Pump and F zones. Resource estimates currently stand at roughly 4.0 million oz (124 414 kg) of gold within the Tiriganiaq zone, 1.0 million oz (31 103 kg) of gold within the F zone, 750 000 oz (23 328 kg) of gold within the Wolf zone, and 500 000 oz (15 552 kg) of gold within the Pump zone, for a grand total resource of 6.25 million oz (194 397 kg) of gold. A drilling program of up to 10 000 m, designed to upgrade resource estimates to the reserve category on the Tiriganiaq zone, is anticipated later in 2000. Additionally, 5000 m of exploration diamond drilling through July 2000 tested numerous gold targets to the west.

A 2000-m diamond drill program across the adjoining Meliadine East property, held jointly by Cumberland and Comaplex, began in July 2000, focusing on the J2 zone. Resources at the Discovery deposit stand at approximately 400 000 oz (12 441 kg) of gold. The property contains numerous other promising prospects.

Cumberland Resources conducted a 3000-m exploration program at the company's wholly owned Meadowbank project. Recent pre-feasibility studies indicate a resource of 962 000 oz (29 921 kg) of gold from the Third Portage deposit, part of the roughly 2.0 million oz (62 207 kg) delineated in four zones across the property. The year 2000 drilling program focused on the Vault Lake area north of the Third Portage deposit.

Other significant gold exploration projects within this part of the territory are being conducted by Phelps-Dodge in the Nowyuk Lake area and by Comaplex Minerals in the Noomut River area.

Base Metals

In 1996, Inmet Mining Corporation delineated a resource of 16.5 Mt grading 11.4% zinc, 2.2% copper, 1.1% lead, and 60 g/t silver at the Izok Lake deposit. The deposit represents a significant resource for Nunavut with contained metal values of some $3 billion. Viability for mining the deposit rests on infrastructure development. Discussions at the industry, Inuit organization and Government of Nunavut levels about construction of deep port facilities at Bathurst Inlet and road access to Izok Lake are currently under way. Inmet also holds two other deposits in the vicinity of Izok Lake: the Hood River deposit, with resources of 1.8 Mt grading 4.5% zinc and 3.4% copper, and the Gondor deposit, hosting 7.3 Mt grading 4.8% zinc and 0.2% copper.

The Hackett River (volcanogenic massive sulphide or VMS) deposit, held jointly by Hackett River Resources Inc. (53%) and Cominco Ltd. (47%), currently contains a combined resource of 22 Mt grading 5.6% zinc, 0.56% copper, 0.7% lead, 136 g/t silver and 0.38 g/t gold in four mineralized zones. The setting of the deposit suggests favourable conditions for the discovery of similar VMS-style deposits in the area. The deposit would benefit from an access road leading from Izok Lake to Bathurst Inlet.

Cominco is carrying out regional reconnaissance exploration for base metals over Somerset Island and the Boothia Peninsula in the 2000 summer season. Noranda is also looking at Baffin Island.

The Epworth zinc-lead-silver-copper project held by Rhonda Mining Corporation is also promising due to its favourable zinc concentration. Rhonda Mining is currently seeking funding or a joint-venture partner to continue exploration.

Hornby Bay Explorations Limited completed a 9000-ft diamond drill program on the Rose Garden zinc-lead-copper project in 1999.

Nickel-Copper-Platinum Group Elements (PGE)

Muskox Minerals Corporation (49%) and the Kitikmeot Corporation (51%) hold a large land package on the Muskox Intrusion. The complex is one of the world's largest "layered intrusions" containing potential copper, nickel, chrome and PGE deposits. First explored in the 1950s for chromite, copper and nickel, the focus has shifted to exploration for platinum and palladium. Surface geochemical sampling and mapping, as well as diamond drilling, are ongoing. Results from drilling early in 2000 include values of 1.81 g/t combined platinum, palladium and gold, 2.00% copper and 0.84% nickel across 23.45 m. The Muskox Intrusion contains the widest variety of metallic minerals from a single project within Nunavut.

During the spring of 2000, West Coast Capital Inc. staked some claims adjoining the northern part of the Muskox Minerals group. The company was planning surface geophysics and geological mapping for PGE mineralization during the summer.

Starfield Resources Inc., claim holder of the Ferguson Lake project situated 200 km west of Rankin Inlet, received promising results from its 1999 drilling project. Consequently a 10 000-m diamond-drilling program was scheduled to commence in July 2000. Three main deposits have been delineated over a major mineralized horizon: the West zone/Main deposit, hosting a possible resource of 7.15 Mt grading 0.87% copper and 0.75% nickel; the East Zone I deposit, with 2.6 Mt of possible resources grading 0.94% copper and 0.72% nickel; and the East Zone II deposit, with a possible resource of 1.3 Mt grading 0.94% copper and 0.80% nickel.

With the recent rise in platinum and palladium prices on world markets, Starfield's exploration has recently shifted towards delineation of PGE mineralization. The main focus is on the extension of the West zone. Sampling has returned values of up to 4.55 g/t palladium. Geophysical survey results from early in 2000 indicate that this zone, which averages 10-12 m thick, is now traceable for a strike length of 3.2 km and, significantly, has been interpreted to lie close to its magmatic origin.

Government Programs in 2000

The Canada-Nunavut Geoscience Office (CNGO, a partnership between the Government of Nunavut, the Geological Survey of Canada (GSC), and the Department of Indian Affairs and Northern Development (DIAND), is conducting three major field projects in 2000. The Central Baffin project will focus on geological mapping and interpretation of sedimentary stratigraphy of the Early Proterozoic Foxe Fold Belt in central Baffin Island. The project will cover NTS map sheets 37A and 37D, and western areas of sheets 27B and 27C. The Committee Bay project will focus on the Prince Albert Group located southwest of Committee Bay. The area is part of an Archean greenstone belt considered to have high mineral potential. This survey will cover NTS Map Sheets 56J, 56K, 56O and 56P. The GSC will carry out airborne geophysical surveying of the Committee Bay region in 2000. Coverage consists of 85 000 line km at 400-m line spacing at a cost of $1 million.

The CNGO is also conducting its "Arctic Zinc" project, focusing on potential base-metal-bearing horizons in the Polaris mine area near Resolute. This is a collaborative effort between the CNGO, Noranda Exploration, and Cominco Ltd. The companies will provide technical and in-house geoscience data as well as representative rock samples from past activities. This project covers NTS Sheets 68F, 68G and 68H.

Privately funded exploration tends to be attracted to the vicinities of these government-sponsored projects due to upcoming releases of improved geoscientific information following the field programs. Both BHP and Cominco Ltd. are conducting regional exploration in the central Baffin area. Apex Geosciences and Committee Bay Resources are active in the Committee Bay area.

DIAND continues to regulate and monitor exploration and mining activities, and undertook site visits to major projects such as Meliadine East, Meliadine West, Meadowbank and Hope Bay, as well as the Lupin mine, in the summer of 2000. Detailed property visit reports will be available in late 2000 along with an information package highlighting the nickel-platinum showings and ultramafic occurrences in Nunavut due out in September 2000.

Work on both of DIAND's databases, KIDD (Kimberlite Indicator Diamond Database) and the Normin mineral showing database, will continue throughout 2000. Over 70 000 samples have been entered into the KIDD database with recent concentration on the northern Slave Province. The entering of data into the Normin mineral showing database in 2000 will focus on NTS 55/NW, the site of recent gold exploration and GSC mapping.

The DIAND Nunavut regional office began establishing its Mineral Resources section with the hiring of a manager in June 2000. Further staffing is to be completed by October-November 2000 and will be followed by the transfer of all Nunavut-related duties, files and geological data to the Iqaluit office by April 2001.

Prospector's Assistance Program

The Minerals, Oil and Gas Division (MOG) of the Department of Sustainable Development is continuing to promote and instruct Inuit people in the principles of general geology and prospecting methods. Prospectors can apply for a contribution of up to $5000 that can be used to prospect, stake claims and collect rock samples of a specified region or property. In 1999, several interesting mineral showings in all regions of Nunavut were reported. In 2000, a total of 50 prospectors received the contribution and will be working the land in the summer field season.

The prospector courses are very popular for both prospectors and people with a general interest in mineral deposits. Based on past experiences, MOG expects good results from the 2000 field work, possibly some significant mineral discoveries, and such work is seen as a key to help open the territory to more significant exploration activity.

Projected Exploration and Market Trends within Nunavut

Nunavut is increasingly being recognized by industry as an "under-explored" region with very high economic mineral potential. Nunavut is the target of numerous reconnaissance programs in 2000 including, among others, exploration by BHP, diamond exploration by Kennecott, base-metal exploration by Hudson Bay Exploration and Development and Cominco, and gold exploration by Comaplex. This is particularly encouraging given current depressed commodity prices for gold and some base metals. This activity reflects the recognition by major exploration and mining companies, as well as some of the investment community, that Nunavut, despite obvious climatic and infrastructure disadvantages, remains a sound place for mineral investment. Despite difficulties and disadvantages, mining can be profitable in Nunavut, as is

demonstrated by the Polaris and Nanisivik zinc mines and the Lupin gold mine. Diamonds are successfully mined at BHP's Ekati mine in the neighbouring Northwest Territories.

An increase in grass-roots-style gold exploration at current prices suggests a belief by industry that the "fundamentals" influencing prices are positive, and that prices will have increased substantially by the time a discovery from this exploration is developed into the production phase. Steadily increasing demand and anticipated eventual reduced production, together with reduced central bank sales of gold, should ultimately place strong upward pressure on the gold price. Gold also continues to be a leading commodity for expenditures incurred through advanced exploration of several large, possibly world-class, deposits in Nunavut (Boston-Doris and Meliadine).

In the past year, prices for PGE, particularly platinum and palladium, have surged to unprecedented levels, partly due to increased demand for pollution-control devices and partly because of uncertainty of the Russian supplies to world markets. Platinum demand for jewellery is also on the rise. Although prices may decline somewhat, they are expected to remain well above pre-1999 levels due to sustained demand. These elements commonly occur within copper-nickel-enriched magmatic sulphides; nickel has also enjoyed a considerable price increase within the past year. Thus, a renewed interest in copper-nickel-PGE deposits, such as the Muskox project and Ferguson Lake deposits, has been generated. Companies engaged in magmatic sulphides nickel-copper or PGE exploration, or both, are likely to increase exploration activities in Nunavut in the future. Already, grass-roots exploration by West Coast Capital is under way on the Muskox Intrusion.

A number of world-class zinc mines, including the two in Nunavut, are becoming depleted in resources. The demand for zinc is relatively high; therefore, zinc and related base-metal exploration is expected to intensify in Nunavut. Some grass-roots exploration for zinc is under way by Cominco, Noranda and Hudson Bay.

Diamond markets are still strong. Recent successes by Kennecott show that potential is very good in western Nunavut. Interesting structures that may host kimberlites are found on the Boothia Peninsula and Baffin Island.

3. Canadian Exploration Activity Around the World

3.1 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 June 2000.

3.2 GLOBAL MARKET FOR EXPLORATION

Although it continued to be difficult to raise risk capital during 1998, exploration programs around the world by companies of all sizes for precious metals, base metals and diamonds were, in total, only about 3% below budget. In 1999, global exploration activity by these companies fell to an estimated $4.0 billion (US$2.7 billion) from $5.0 billion (US$3.5 billion) the previous year, or down by over 20%. 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 1999, 132 companies planned to spend more than $4 million on exploration, down from a record 279 in 1997. During 1999, the world's larger companies were expected to undertake programs with a combined value of $3.2 billion (US$2.2 billion), which represents an estimated 80% of the global market for mineral exploration.

3.3 LARGER CANADIAN-BASED COMPANIES

During 1998, the larger Canadian-based companies underspent their exploration budgets, in aggregate, by almost $86 million, or by about 7% less than they had planned (**Figure 37**). Two thirds of them (51 companies) spent less than budgeted, while a little more than 30% (25 companies) spent more than budgeted. Individual company departures from 1998 plans ranged from $10 million under budget to $17 million over budget. In general, companies that exceeded their program budgets during 1998 did so in response to new discoveries or other opportunities that arose during the year.

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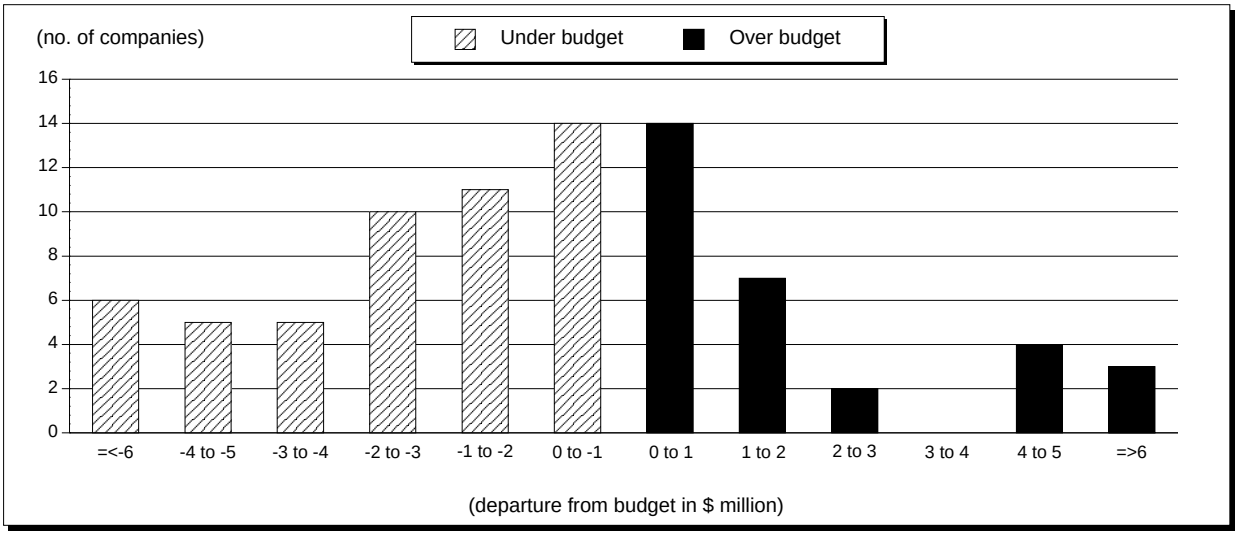
[1] Most of the information on the larger-company mineral exploration market worldwide is based on *Corporate Exploration Strategies: A Worldwide Analysis*, published annually by the Metals Economics Group (MEG), Halifax, Nova Scotia. MEG counts, as exploration, work from the earliest stage through perimeter 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 3 is based on an article from the 1999 *Canadian Minerals Yearbook* published by Natural Resources Canada.

Figure 37
Departure of Global Exploration Expenditures from Budgets, 1998
Canadian-Based Companies with Budgets of at Least $4 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 1998, the aggregate expenditures of Canadian-based companies were almost $86 million, or about 7% lower than previously budgeted.

Many exploration companies derive little or no substantial revenues from mineral production and, therefore, rely almost entirely on the stock market to finance their exploration programs. In 1996, mining companies listed on Canadian stock exchanges raised a record amount of capital.[3] As a result, a record 141 Canadian-based companies each planned to spend more than $4 million on exploration around the world during that year. Their aggregate exploration budgets, adjusted for inflation, stood at a record $1.9 billion. Because of investor uncertainty since 1997, the number of Canadian-based companies that planned to spend more than $4 million on exploration in 1999 decreased to 47. The total amount that these companies planned to spend on mineral exploration in both Canada and elsewhere around the world fell to $884 million in 1999 (**Figure 38**) from $1.3 billion the previous year, or down by 32%. Nonetheless, during 1999, Canadian-based companies planned to undertake almost 30% of all the larger-company exploration programs around the world, about the same amount as companies based in Australia. In 1997, Canadian programs accounted for a record 35%, which is the dominant share, by far, of all worldwide mineral exploration activity.

Relatively fewer of the many companies that budgeted only somewhat more than $4 million in 1998 were able to raise a similar amount for exploration in 1999. As a result, the average company budget for 1999 increased. In the case of the larger Canadian-based companies, the mean budget increased to $24.5 million and the median to $10.4 million, up from $15.4 million and $7.1 million, respectively, the previous year.

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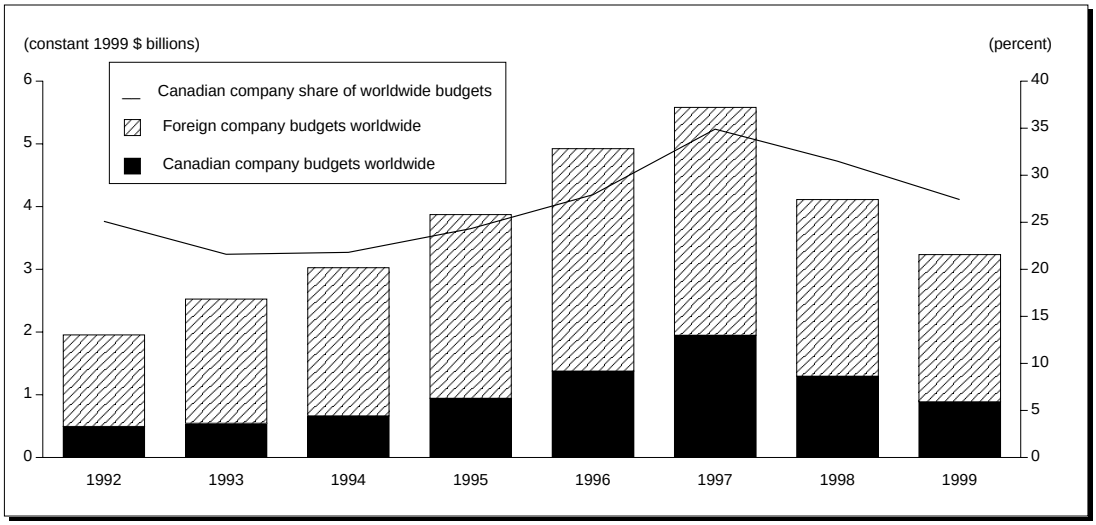
3 Keith Brewer and André Lemieux, *Canada's Global Position in Mining - Canadian Financing of the International Mining Industry*, Metals Finance 4th International Conference, Toronto, May 7-9, 1997, Natural Resources Canada, Ottawa, 53 pp.

At the end of 1999, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of more than 6300 properties (**Figure 39**) located in Canada or in more than 100 countries around the world.[4] Most of this portfolio is at the exploration stage.

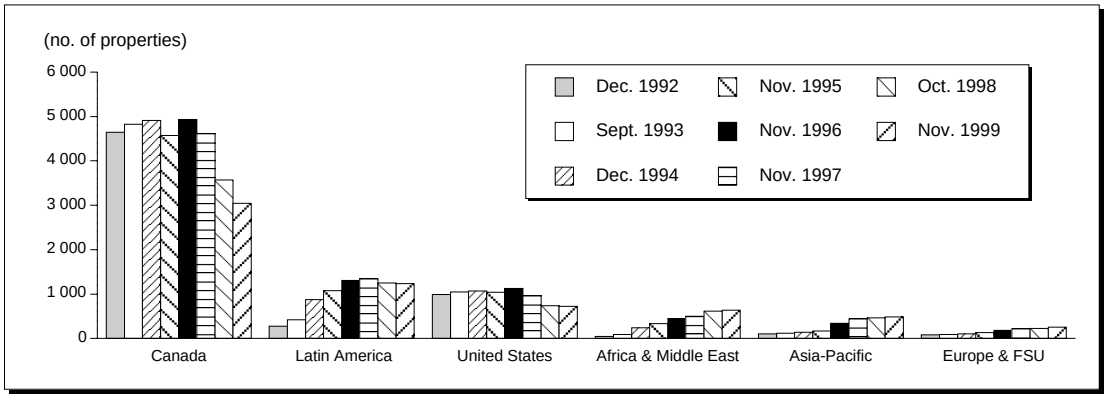
[4] Most of the information for 1991 through 1997 on the mineral property portfolio of companies of all sizes listed on Canadian stock exchanges is derived from MIN-MET CANADA; for 1998 and 1999, it is derived from InfoMine db. These databases are produced by Robertson Info-Data Inc., Vancouver, British Columbia.

Figure 38
Exploration Budgets of the World's Larger Companies, by Origin, 1992-99
Companies with Worldwide Budgets of at Least $4 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 39
Canadian Mineral Property Portfolio Worldwide, by Region, 1992-99
Companies of All Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1992-97 and InfoMine db for 1998 and 1999, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.
Note: The decrease in properties in Canada after 1997 is due mainly to the implementation of database features that make it possible to exclude many inactive properties.

3.4 LARGER-COMPANY EXPLORATION MARKET IN CANADA

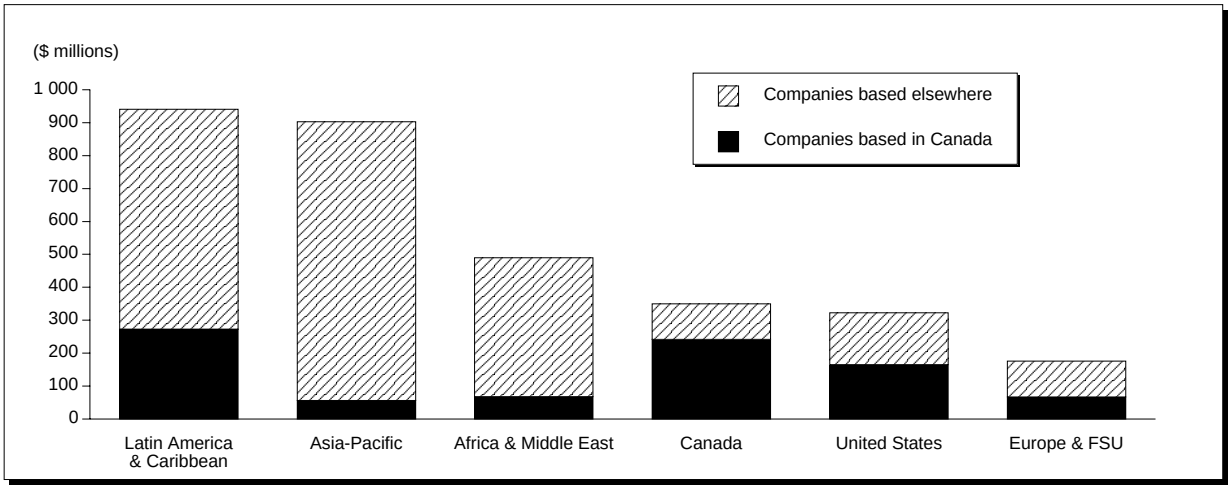
In 1999, the larger-company mineral exploration market in Canada was valued at about $350 million (**Figure 40**). The balance of the Canadian market is held mainly by smaller companies, the activities of which are not addressed specifically here.

During 1999, 48 of the world's larger domestic-based or foreign-based companies planned to explore for minerals in Canada. Their aggregate budgets were down by almost $100 million, or by almost 25%, compared with those of the previous year. Nonetheless, almost 11% of the exploration programs of all the world's larger companies were destined for Canada (**Figure 41**), nearly the same as in 1997 and 1998. However, the proportion of worldwide exploration activity taking place in Canada has fallen gradually each year from about 18% in 1992 because of the large increase in exploration activity that occurred in developing countries starting in the early 1990s. At the end of 1999, there were more than 3000 mineral properties with recent exploration activity in this country[5] (**Figure 39**).

In 1999, 34 of the larger Canadian-based companies allocated over $240 million for exploration in Canada. This represents a reduction of almost $71 million, or 23%, from the more than $310 million budgeted in 1998. Canadian-based companies control almost 70% of the larger-company market in Canada. Australia is the only other country where domestic companies control more than half of the 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

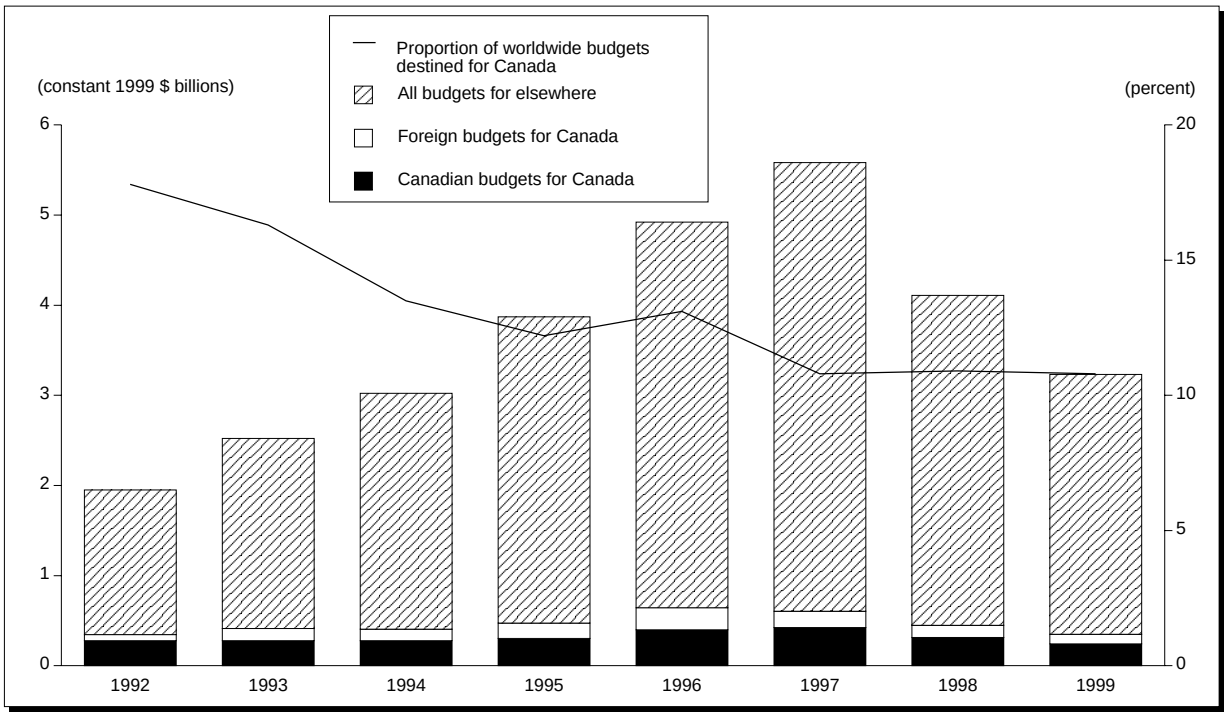
[5] For trends in mineral deposit appraisal activity in Canada over the interval 1982-97, and for a list of projects at the deposit appraisal stage in early 1997, see André Lemieux, "Canada's Global Mining Presence," in the 1996 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa,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

Figure 40
Exploration Budgets of the World's Larger Companies for Selected Regions of the World, 1999
Companies with Worldwide Budgets of at Least $4 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 41
Exploration Budgets of the World's Larger Companies for Canada and Elsewhere, 1992-99
Companies with Worldwide Budgets of at Least $4 Million for Precious-Metal, Base-Metal or Diamond Exploration



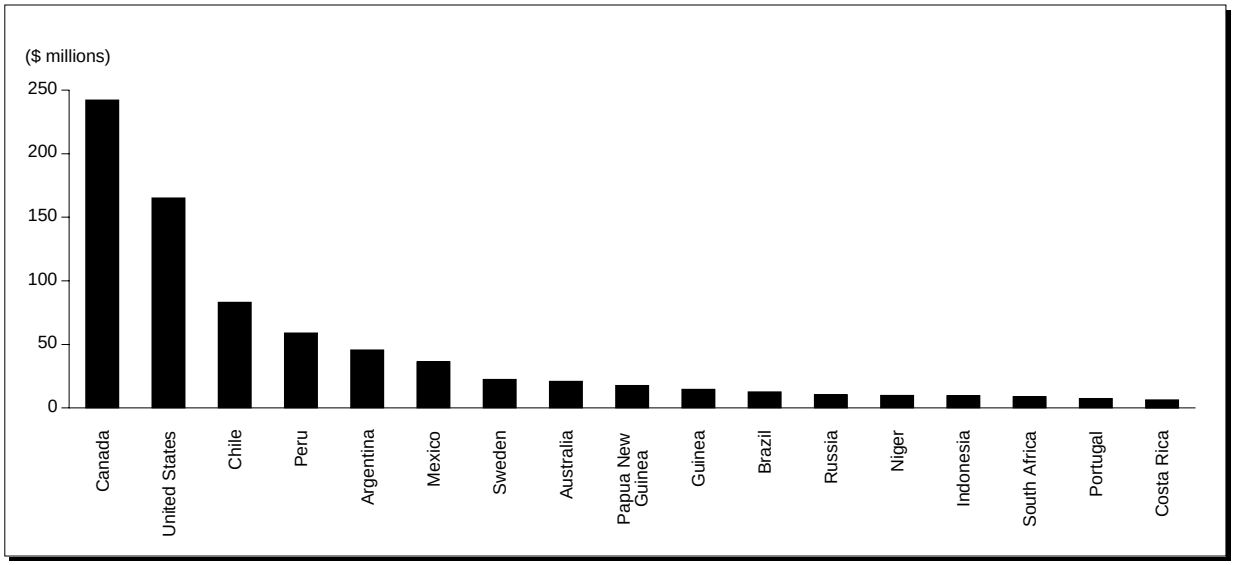
Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: The worldwide exploration budgets of companies that intended to spend less than $4 million (US$3 million) annually are excluded. The worldwide exploration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

the larger domestic firms has also fallen in the United States, Australia and Latin America. Still, Canada remains the country for which Canadian companies budget the most, by far, for mineral exploration programs (**Figure 42**).

During 1999, the larger foreign-based multinationals planned to spend over $100 million on mineral exploration in Canada (**Figure 41**), or more than 30% of all exploration programs planned for this country. Compared with 1998, their budgets decreased by almost $30 million, or by about one quarter.

The larger foreign-based companies active in Canada include: The Broken Hill Proprietary Company Limited (BHP) and WMC Limited, both based in Australia; Battle Mountain Gold Company, Echo Bay Mines Ltd., Freeport–McMoRan Copper & Gold Inc., Homestake Mining Company, Newmont Mining Corporation and Phelps Dodge Corporation, all based in the United States; Anglo American plc, Billiton plc, Outokumpu Oyj and Rio Tinto plc, all based in Europe; and Anglo American Platinum Corporation Limited and De Beers Consolidated Mines Limited, both based in South Africa.

Figure 42
Exploration Budgets of the Larger Canadian-Based Companies, 1999 – Countries Accounting for 90% of Canadian Budgets
Companies with Worldwide Budgets of at Least $4 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.

3.5 LARGER CANADIAN-BASED COMPANIES ABROAD

In 1999, the larger Canadian-based companies planned to spend more than $640 million on mineral exploration outside Canada (**Figure 40**). This represents a 35% decrease from the more than $980 million they planned to spend in 1998. The proportion of their total budgets allocated to foreign programs was almost 73% in 1999. That proportion peaked at over 78% in 1997; it was only 43% in 1992.

At the end of 1999, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of over 3300 mineral properties located abroad (**Figure 39**). Foreign properties now represent more than half of the total mineral property portfolio held by these companies, up from about 25% in 1992.[6] Between 1992 and 1999, their holdings of foreign mineral properties grew at an average annual compound rate of about 12%. Apart from the United States, where companies of all sizes listed on Canadian stock exchanges have a substantial mining presence, about 30 other nations, spread across the globe, account for 80% of the balance of their mineral property portfolio held abroad (**Figure 43**). Canadian companies have interests in 150 mines, smelters or refineries in over 40 foreign countries. Several of their other advanced projects in these countries and elsewhere are either under construction or awaiting the results of a final production feasibility study. Their other projects are at the exploration stage.

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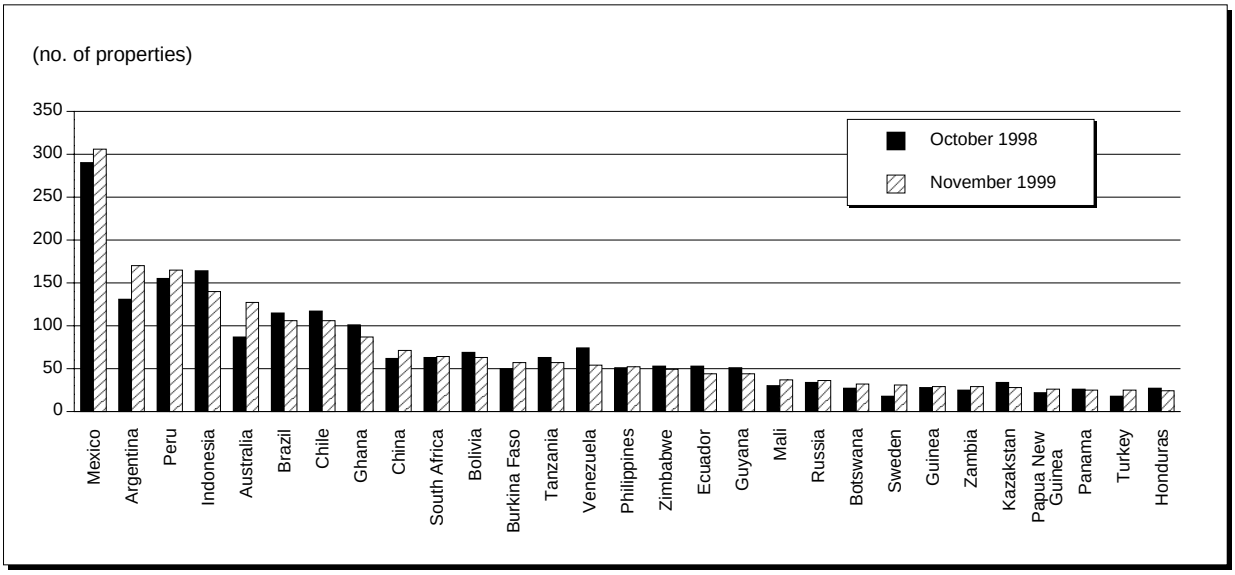
6 For a discussion of social issues related to Canadian investment in the mineral industry of developing countries, see Moira Hutchinson, "Beyond Best Practice - The Mining Sector," Chapter 4 in *The Canadian Development Report 1998 - Canadian Corporations and Social Responsibility*, The North-South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

Figure 43
Canadian Mineral Property Portfolio Abroad, 1998 and 1999 – Countries Accounting for 80% of Canadian Holdings Located Outside the United States in 1999
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on InfoMine db, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

3.5.1 United States

In 1999, the larger-company mineral exploration market in the United States was valued at over $320 million (**Figure 40**), or about 10% of the $3.2 billion larger-company market worldwide. In spite of global retrenchment, over 30 of the larger Canadian-based companies planned to spend about $165 million in total in the United States, slightly more than in 1998. Because companies based in most other countries considerably reduced their exploration programs for the United States during 1999, Canadian-based companies increased their share of the larger-company exploration market in that country to 51%. Canadian-based companies have increased their share of the exploration market in the United States each year since the early 1990s. The exploration budgets of the larger Canadian-based companies for the United States have grown at an average annual compound rate of about 10% since the early 1990s. The United States ranks second after Canada as the country where Canadian companies are the most active (**Figure 42**).

Canadian companies planned to spend over $70 million more than U.S. companies in the United States during 1999. American companies have budgeted decreasing amounts for exploration in the United States each year since the early 1990s. While they accounted for almost 60% of the exploration programs there in 1992, they accounted for only 29% in 1999.

In late 1999, companies of all sizes listed on Canadian stock exchanges held over 700 mineral properties in the United States (**Figure 39**). They had projects in 22 states, but mainly in the western part of the country in Nevada, Alaska, California, Arizona, Idaho, Montana, Utah, Wyoming, Colorado and South Dakota. Nevada alone accounted for almost 300 of their mineral properties, or about 40% of the total 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 1999, the United States accounted for over 20% of all properties held abroad by these companies.

Of all the Canadian-based companies, Placer Dome Inc., Barrick Gold Corporation, Teck Corporation and Cominco Ltd. planned the largest exploration programs in the United States during 1999. Together they planned to spend more than $120 million, or over 70% of Canadian budgets for that country. Teck planned to spend much of its $25 million budget for the United States at the Pogo gold deposit in Alaska. Placer Dome planned to spend about 80% of its $45 million budget for the United States at the Getchell gold mine in Nevada. Barrick planned to spend over $30 million, much of it on further exploration in and around its mining operations in Nevada. Cominco planned to spend a good portion of its $19 million budget for the United States at the Red Dog mine in Alaska.

3.5.2 Latin America and the Caribbean

In 1999, the larger-company mineral exploration market in Latin America and the Caribbean was valued at $940 million (**Figure 40**), or almost 29% of the $3.2 billion larger-company market worldwide. Latin America accounts for the largest concentration of Canadian mineral exploration activity around the world. During 1999, the larger Canadian-based companies planned to spend over $270 million there. However, this amount represents a decrease of more than $175 million, or over 39%, compared with 1998.

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 18% between 1992 and 1999. In 1999, these companies held more than 29% 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 1999, 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 39**).

3.5.2.1 Mexico

In 1999, the larger-company mineral exploration market in Mexico was valued at almost $140 million, or more than 4% of the $3.2 billion larger-company market worldwide. Fourteen of the larger Canadian-based companies planned to spend, in total, more than $36 million in that country, equivalent to 30% of the market. Mexico ranks fourth in Latin America and sixth in the world as the country where Canadian companies are the most active (**Figure 42**).

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. At the end of 1999, these companies held interests in more than 300 properties in 20 of the country's 31 states or district.

Cambior inc. planned the largest Canadian exploration program in Mexico during 1999. It planned to spend over $12 million there, 80% of that amount on the Cerro San Pedro gold-silver project.

3.5.2.2 South America

In 1999, the larger-company mineral exploration market in South America was valued at over $740 million, slightly more than 20% of the $3.2 billion larger-company market worldwide. Twenty-three of the larger Canadian-based companies planned to spend around $220 million in

total in the region, approximately 30% of the market there. Canadian companies held the dominant share of the market in Argentina, Chile, Colombia and Peru.

Chile is the country of South America where Canadian-based companies conduct the largest portion of their exploration programs (**Figure 42**). Chile also ranks third in the world as the country where Canadian companies are the most active in terms of spending. In 1999, Placer Dome and Barrick were expected to conduct about 25% of all the exploration programs planned for Chile. Placer Dome planned to spend most of its almost $29 million budget for Chile on the Cerro Casale (Aldebaran) gold-copper project. Barrick planned to spend most of its $25 million budget for Chile exploring the Pascua gold project. Elsewhere in South America, Barrick planned the largest exploration program in Argentina. It planned to spend most of its $31 million budget for that country on the extension of the Pascua deposit from Chile into Argentina. Greystar Resources Ltd. planned to spend more than $5 million in Colombia, and Cambior planned to spend over $2 million in proximity to the Omai gold mine in Guyana. Cambior also planned to spend almost $16 million in Peru, including over $9 million on the Huamachuco gold project (Virgen and La Arena properties) and more than $3 million on the La Granja copper-gold project.

At the end of 1999, companies of all sizes listed on Canadian stock exchanges held 800 mineral properties throughout South America. They held about 170 properties in each of Argentina and Peru, more than 100 in each of Brazil and Chile, and more than 50 in each of Bolivia and Venezuela.

3.5.2.3 Central America

In 1999, the larger-company mineral exploration market in Central America was valued at about $10 million, or less than 1% of the $3.2 billion larger-company market worldwide. Six of the larger Canadian-based companies planned to spend about 70% of that amount.

Canadian-based companies planned to conduct all of the exploration programs in three countries in the region: Lyon Lake Mines Ltd. planned to spend over $6 million at the Crucitas deposit in Costa Rica, Kinross Gold Corporation planned to spend over $0.4 million at the El Dorado gold project in Salvador, and Aur Resources Inc. planned to spend over $0.4 million at the Cerro Colorado copper deposit in Panama.

At the end of 1999, 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.

3.5.2.4 Caribbean

In 1999, the larger-company mineral exploration market in the Caribbean was valued at about $15 million. The larger Canadian-based companies reported no exploration programs for that region. At the end of 1999, companies of all sizes listed on Canadian stock exchanges held about 40 mineral properties in the Caribbean, most of them in the Dominican Republic and Cuba.

3.5.3 Europe and the Former Soviet Union

In 1999, the larger-company mineral exploration market in Europe and the Former Soviet Union (FSU) was valued at over $175 million (**Figure 40**), or roughly 5% of the $3.2 billion larger-company market worldwide. The larger Canadian-based companies planned to spend almost $70 million there, equivalent to 40% of the market. At the end of 1999, companies of all sizes listed on Canadian stock exchanges held about 250 mineral properties in the region (**Figure 39**).

3.5.3.1 Western Europe

In 1999, the larger-company mineral exploration market in western Europe was valued at over $75 million, or roughly 2% of the $3.2 billion larger-company market worldwide. The larger Canadian-based companies planned to spend $40 million there, equivalent to more than half of the market. They held the dominant share in Greenland, Portugal and Sweden.

During 1999, Canadian-based companies planned the largest programs in three countries of western Europe: Dia Met Minerals Ltd. planned to spend over $3 million on exploration for diamonds in Greenland, EuroZinc Mining Corporation planned to spend over $7 million on the Aljustrel zinc-lead-silver deposit in Portugal, and Boliden Limited planned to spend 80% of its more than $22 million budget for Europe mainly at the Renström, Petiknäs and Kristineberg mines in Sweden.

At the end of 1999, companies of all sizes listed on Canadian stock exchanges held more than 100 mineral properties in western Europe. They held more than 30 in Sweden and more than 10 in each of Portugal, Finland and Greenland.

3.5.3.2 Eastern Europe

In 1999, the larger-company mineral exploration market in eastern Europe was valued at about $20 million, or roughly 1% of the $3.2 billion larger-company market worldwide. The larger Canadian-based companies planned to spend about $9 million there, equivalent to almost half of the market.

Canadian-based companies held the dominant share of the market in two countries of eastern Europe. In Romania, Gabriel Resources Limited planned to spend over $5 million on the Rosia Montana gold-silver deposit; in Turkey, Cominco and Inco Limited each planned to spend over $0.75 million on grass-roots exploration for base metals and Inmet Mining Corporation planned to spend about 0.5 million on mine-site exploration for gold.

At the end of 1999, companies of all sizes listed on Canadian stock exchanges held 75 mineral properties in eastern Europe. They held 20 or more in each of Turkey and Slovakia.

3.5.3.3 Former Soviet Union

In 1999, the larger-company mineral exploration market in the countries of the Former Soviet Union was valued at about $70 million, or roughly 2% of the $3.2 billion larger-company market worldwide. The larger Canadian-based companies planned to spend about $15 million in these countries. At the end of 1999, companies of all sizes listed on Canadian stock exchanges held interests in almost 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 1999, seven of these companies planned to spend over $10 million in total on exploration there, equivalent to about half of the market. Kinross planned to spend more than $4 million, mainly at the Kubaka gold mine. Bema Gold Corporation planned to spend almost $4 million at the Julietta gold-silver deposit. The number of properties held in Russia by companies of all sizes listed on Canadian stock exchanges has increased significantly starting in 1996 and now stands at well over 30.

Kazakstan also is of interest to Canadian companies. At the end of 1999, the portfolio of mineral properties held in that country by companies of all sizes listed on Canadian stock exchanges stood at almost 30.

3.5.4 Africa and the Middle East

In 1999, the larger-company mineral exploration market in Africa and the Middle East was valued at almost $490 million (**Figure 40**), or more than 15% of the $3.2 billion larger-company market worldwide. The larger Canadian-based companies planned to spend almost $70 million in Africa, equivalent to 14% of the market on that continent.[7,8] They reported no exploration programs for the Middle East.

During 1999, Canadian-based companies planned the largest mineral exploration programs in five countries of Africa: SouthernEra Resources Limited planned to spend $4 million on the Camafuca-Camazambo diamond deposit in Angola; Trivalence Mining planned to spend $14 million on the Aredor Concession, which surrounds its alluvial diamond operation in Guinea; Dia Met Minerals Ltd. planned to spend $3 million exploring for diamonds in the Reguibat Archean Shield in Mauritania; Diamond Fields International Ltd. planned to spend more than $5 million on the Luderitz marine diamond concession in Namibia; and Etruscan Resources Inc. planned to spend $10 million on the Tiawa permit, which hosts the Samira Hill deposit and the adjacent Saoura gold permit.

Between 1992 and 1999, 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 40%. As a result, at the end of 1999, these companies held interests in almost 630 mineral properties in 39 countries on that continent. They held interests in almost 90 properties in Ghana, in over 60 in South Africa, and in 50 or more in each of Burkina Faso, Tanzania and Zimbabwe.

3.5.5 Asia-Pacific

In 1999, the larger-company mineral exploration market in Asia-Pacific was valued at over $900 million (**Figure 40**), or almost 28% of the $3.2 billion larger-company market worldwide. The exploration market in Asia-Pacific is almost as large as the one in Latin America. The larger Canadian-based companies planned to spend over $55 million in the region, equivalent to roughly 6% of the market there. At the end of 1999, companies of all sizes listed on Canadian stock exchanges held interests in almost 490 mineral properties in the region (**Figure 39**).

3.5.5.1 Southeast Asia

In 1999, the larger-company mineral exploration market in Southeast Asia was valued at over $235 million, or 7% of the $3.2 billion larger-company market worldwide. The larger Canadian-based companies planned to spend over $30 million in Southeast Asia, equivalent to about 7% of the market there. They held the dominant share of the market in four countries: Ivanhoe Mines Ltd. planned to spend $0.6 million on exploration for gold near its Monywa copper mine in Myanmar, Madison Enterprises Corp. planned to spend $14 million at the Mt. Kare gold-silver deposit in Papua New Guinea, Ivanhoe planned to spend more than $1 million on gold exploration in Thailand, and Falconbridge Limited planned to spend $0.9 million at the Ban Phuc nickel-copper deposit in Vietnam.

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[7] For details on Canadian 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.

[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, Vol. 13, No. 4, 1998, pp. 14-34.

In Indonesia, six of the larger Canadian-based companies planned to spend $10 million in total, equivalent to about 7% of the more than $140 million exploration market in that country. Placer Dome planned to spend more than $4 million evaluating the Awak Mas gold property, the largest Canadian program reported there in 1999.

At the end of 1999, companies of all sizes listed on Canadian stock exchanges held over 240 mineral properties in Southeast Asia. They held 140 in Indonesia and more than 50 in the Philippines.

3.5.5.2 East Asia

In 1999, the larger-company mineral exploration market in east Asia, which includes China, Japan, Mongolia, Taiwan and South Korea, was valued at about $40 million, or 1% of the $3.2 billion larger-company market worldwide. The larger Canadian-based companies planned to spend about $3 million there, equivalent to almost 15% of the market.

Since 1993, there has been considerable Canadian interest in the mineral potential of China. In 1999, Southwestern Gold Corporation planned to spend $0.4 million in China, the largest Canadian exploration project reported for that country. In late 1999, companies of all sizes listed on Canadian stock exchanges held interests in over 70 mineral properties in that country.

3.5.5.3 South Pacific

In 1999, the larger-company mineral exploration market in the South Pacific was valued at almost $615 million, or 19% of the $3.2 billion larger-company market worldwide. Australia accounted for almost all of that market.

The larger Canadian-based companies planned to spend over $20 million in the region, all of it in Australia. These companies hold about 3-4% of the market in that country. Noranda Inc. planned to spend a good portion of its more than $7 million budget for Australia on the Lady Loretta zinc-lead-silver deposit. Placer Dome planned to spend most of its almost $7 million budget for that country looking for copper at the Osborne mine site and for gold at the Kidston mine site.

At the end of 1999, companies of all sizes listed on Canadian stock exchanges held over 150 properties in the South Pacific, of which over 80% were in Australia.

3.6 SUMMARY AND OUTLOOK

During 1996, a record amount of equity capital was raised in Canada for mining companies listed on Canadian stock exchanges. As a result, these companies, many of which have no other source of funds because they have no income from production, had the financial resources to conduct, during 1997, more mineral exploration programs worldwide than those of any other nation. Since then, it has been difficult for many companies that only conduct exploration to raise capital. As a result, exploration programs worldwide were cut back significantly in 1998 and again in 1999. In spite of continuing uncertainty, especially for those companies that have no cashflow from production, almost 11% of the world's exploration programs were conducted in Canada in 1999, about the same as in the previous two years. In addition, Canadian-based companies conducted roughly 30% of all of the world's mineral exploration programs.

In 1999, Canadian companies increased their share of the exploration market in the United States to over 50%. Furthermore, they continued to conduct the largest share of exploration programs, not only in Canada, but also in 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.

Exploration finance markets remain depressed, and a return to the record levels of financing raised in Canada in 1996 for exploration worldwide is not in sight. Many of the smaller companies are inactive because of lack of funds, and mergers and acquisitions appear to be on the rise. For the foreseeable future, Canadian companies with cash flow from mineral production are likely to continue to dominate mineral exploration, especially in the Americas.

APPENDIX 1

Historical Exploration and Deposit Appraisal Statistics

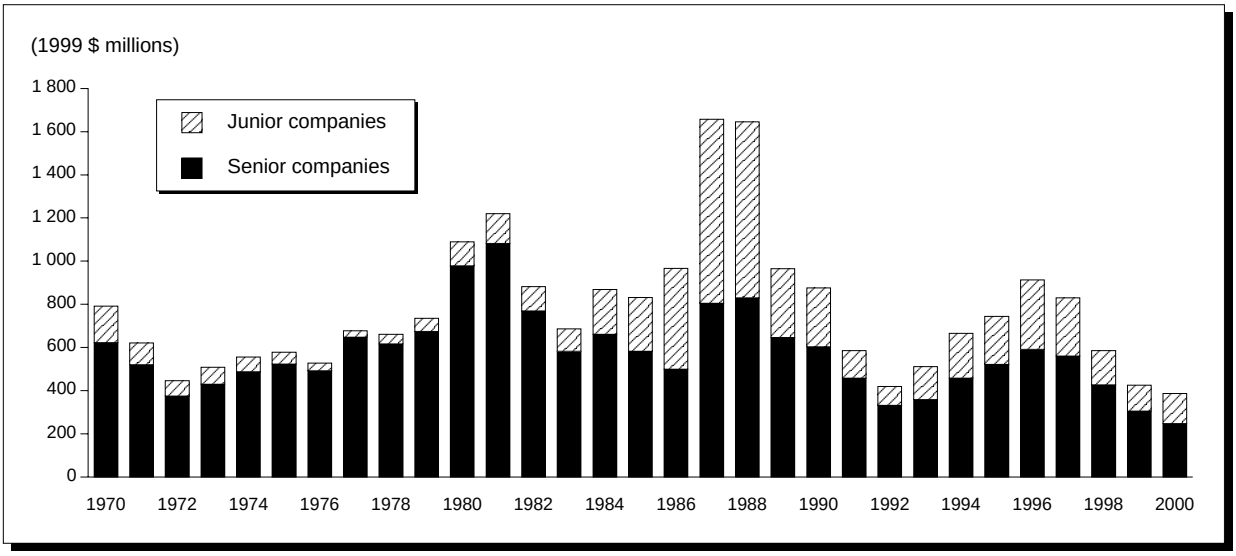
INTRODUCTION

Appendix 1 contains data and analysis that are based on the former survey definitions where only field and overhead costs are considered. While more restricted by this measure of exploration and deposit appraisal activity, the data are available over a much longer time series and provide a statistical basis for studying historical trends.

HISTORICAL SUMMARY

Figure 44 depicts Canadian exploration and deposit appraisal expenditures (field and overhead costs only) in constant 1999 dollars over the period 1970 to 2000. Above-normal expenditures in the 1980-82 period resulted from high prices for gold, silver and copper over much of

Figure 44
Exploration and Deposit Appraisal Expenditures [1] (Field Work and Overhead) in Canada by Junior and Senior Companies, 1970-2000



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
[1] Includes on-mine-site and off-mine-site activities.
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 1999 are preliminary; 2000 data are company spending intentions as compiled in January 2000. Expenditures for 1997 to 2000 include both exploration and deposit appraisal costs as per the new survey definitions; up to and including 1996, most of the expenditures now included in the deposit appraisal phase were reported under "exploration," broadly speaking.

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 prevailed until the end of 1987. However, spending fell dramatically after 1988 and decreased until 1992, when it reached its lowest inflation-adjusted level since 1966.

Activity picked up in the 1993-96 period. Expenditures increased by 118% from 1992 to 1996 and the 1996 level of $912 million (1999 dollars) was the highest since 1989. Although exploration and deposit appraisal spending declined somewhat to $829 million (1999 dollars) in 1997, it still remained relatively strong by historical standards. However, spending dropped significantly in 1998 to $585 million (1999 dollars), a decline of 29% from 1997. At $426 million, the preliminary estimate for 1999 represents a further drop of 27% from the 1998 level. Contrary to the all-inclusive spending measures discussed in Chapter 1, which amounted to almost the same total as in 1999, the 2000 level of field and overhead costs shows another, although less pronounced, decline of 9%. If accurate, the 2000 forecast of $387 million (1999 dollars) will replace the 1992 total as the worst exploration and deposit appraisal level since 1966. Therefore, after reaching a peak of $912 million (1999 dollars) in 1996, field and overhead exploration and deposit appraisal spending in Canada will have dropped by 58% over the period 1997-2000.

Returning to 1992, the relatively higher expenditure levels that were recorded in ensuing years resulted, to a great extent, from important discoveries of diamond deposits. These discoveries led companies to invest vast sums of money into advanced exploration or deposit appraisal projects and in mine development activities. As indicated in Chapter 1 of this report, close to $1 billion will have been spent on the search for diamonds over the period 1993-2000.

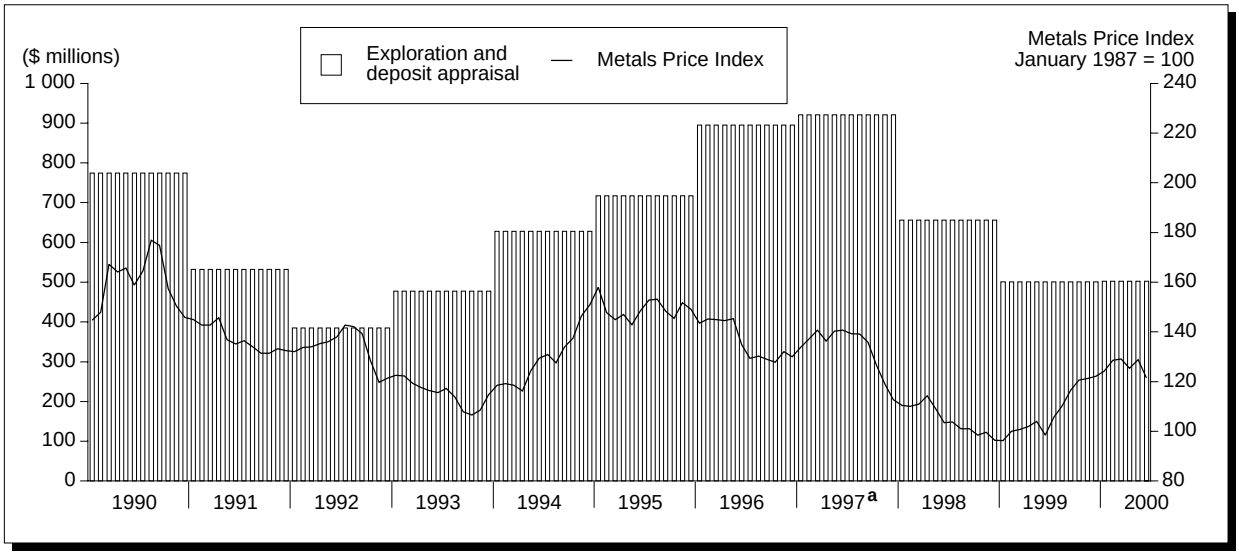
In late 1994, the nickel-copper-cobalt discovery at Voisey's Bay, Labrador, a result of exploration for diamonds in that area, attracted the attention of many mining companies, particularly junior exploration companies. The resulting flurry of exploration and deposit appraisal activity in the area also had a strong impact on expenditures, particularly in 1995 and 1996.

METAL PRICES AND EXPLORATION AND DEPOSIT APPRAISAL LEVELS

Metal prices are an important factor in determining the level of exploration and deposit appraisal activity. 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 period, exploration and deposit appraisal spending increased by over 40%. However, since early 1995, metal prices have generally been on a downward trend as reflected by Natural Resources Canada's monthly Metals Price Index (**Figure 45**). After peaking in January 1995, the index began a generally decreasing trend and had fallen by 39% by January 1999, when it reached its lowest level since at least January 1989. Since then, the index has generally increased. It peaked in March 2000 when it was about 34% above the level of January 1999. By August 2000, the index had weakened somewhat, but still remained about 26% above the low of early 1999. The relative strength of the index is due to stronger copper, nickel and zinc prices over the last year, although the low price of gold continues to have a negative effect on the index.

As outlined in Chapter 1, there is a relationship between the level of spending in a particular year and metal prices in earlier years. The decreasing trend in metal prices that began in 1995 was not reflected in spending levels before 1997, partly because of that relationship and partly because of the expenditures on the search for diamonds, which added an element of stability to exploration and deposit appraisal levels. Expenditures (field and overhead costs only) peaked in 1996, started declining in 1997, fell even more in 1998 and 1999 and, based on company spending intentions, are expected to reach an historical low in 2000. However, if the relation-

Figure 45
Exploration and Deposit Appraisal Expenditures and Natural Resources Canada's Monthly Metals Price Index, 1990-2000



Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.

[a] Starting in 1997, the data include field and overhead expenditures plus engineering, economic and feasibility studies, environment and land access costs.

Notes: Exploration and deposit appraisal data for 1999 are preliminary; 2000 data are company spending intentions as compiled in January 2000. For pre-1997 years, the data include only field and overhead expenditures.

ship established above holds true, there could be some deceleration in this downward trend in sight as the following comparison of metal prices between the end of 1998 and August 2000 indicates.

At the end of 1998 and through the first part of 1999, copper was trading in the US$0.62/lb-US$0.69/lb range. By August 2000, the price of copper had risen to about US$0.80/lb. Nickel, which was trading at less than US$2.00/lb in late 1998 and early 1999, rose steadily to US$4.67/lb in March 2000 before weakening somewhat to US$3.63/lb in August 2000. The price of zinc has also risen steadily over the same period, going from US$0.43/lb to about US$0.53/lb. As for the price of gold, it fluctuated between US$256/oz and US$310/oz. In August 2000, it averaged US$275/oz. While the prices of some important commodities are still too low to entice major incremental exploration and deposit appraisal efforts, and past prices are not the only determinant of future spending levels, there appears to be, at least, better price support than there was in recent years.

EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES BY JUNIOR COMPANIES

As shown in **Figure 44**, junior companies have traditionally played an important role in Canadian mineral exploration and deposit appraisal activity. However, their contribution really expanded in 1984, a year after the introduction of MEDA, when their spending accounted for almost 24% of total exploration and deposit appraisal expenditures. That proportion had more than doubled by 1987 when junior companies accounted for $852 million (1999 dollars) or 51% of the total of $1.67 billion spent during that year. Junior spending was also very important in 1988 with 50% ($814 million) of total expenditures. Their proportion of total spending then started to gradually decrease until it reached 21% in 1992.

The levels of spending recorded by junior companies in the 1986-88 period are even more impressive when taking into account the fact that, during that period, considerable contributions were made 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 that period.

Since 1993, junior spending has represented approximately 30% of total expenditures, following basically the same pattern as senior company spending. The discovery of diamonds in Canada's North and of nickel-copper-cobalt at Voisey's Bay were the two most important positive factors affecting junior spending between 1993 and 2000. Low metal prices, the Asian crisis and difficulties in raising financing are at the source of the recent decline in junior expenditures, which rose from $87 million (1999 dollars) in 1992 to $321 million in 1996 and then dropped to $121 million in 1999. They are expected to recover slightly in 2000 with forecast expenditures of $139 million.

EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES BY PROVINCE AND TERRITORY

Tables 17 and **18** show exploration and deposit appraisal expenditures (field and overhead costs only) by province and territory in terms of current dollars and 1999 constant dollars. Both tables cover the period 1988 to 2000, which includes the tail of the exploration boom that had started in 1986, the difficult period that led to the trough of 1992, the exciting discoveries of 1993 and 1994 and the ensuing increase in spending up to 1996, and finally, the latest downward trend that has brought exploration and deposit appraisal spending down to historical lows.

TABLE 17. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES (FIELD WORK AND OVERHEAD) IN CANADA, BY PROVINCE AND TERRITORY, 1988-2000 (CURRENT DOLLARS)

Province/Territory	Field Work Only	Total Exploration and Deposit Appraisal[1]											
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999p	2000f
	($ millions)												
Newfoundland	37.7	36.2	23.3	12.1	11.1	8.9	12.4	71.1	92.5	58.4	40.8	31.0	16.8
Nova Scotia	46.7	21.4	11.0	4.5	3.3	1.8	1.7	2.8	6.9	6.7	4.8	3.4	5.0
New Brunswick	13.8	13.6	16.5	15.8	12.2	11.1	10.0	12.7	14.8	12.2	10.0	8.5	8.4
Québec	328.2	185.0	196.4	138.1	94.1	106.1	130.3	123.4	137.2	168.6	123.5	103.0	67.8
Ontario	343.6	217.8	152.6	109.7	77.4	75.6	113.0	129.7	194.9	176.5	111.3	80.7	95.6
Manitoba	30.0	37.0	41.2	29.7	32.0	27.4	40.5	32.6	41.2	40.3	29.5	25.4	24.8
Saskatchewan	61.1	63.3	42.2	31.5	25.9	53.1	50.6	43.8	50.6	49.9	57.8	24.7	31.8
Alberta	4.3	6.2	10.7	6.6	5.4	7.3	9.4	10.6	10.8	20.5	21.6	14.4	16.3
British Columbia	196.8	186.6	226.5	135.7	71.6	66.0	85.0	79.4	104.9	95.8	44.3	31.8	34.7
Yukon	38.6	15.1	18.4	16.5	9.7	19.2	25.7	39.3	46.4	40.6	17.5	11.4	10.5
Northwest Territories	66.5	45.7	36.0	31.6	42.7	100.7	149.5	172.2	194.5	150.7	114.8	62.7	51.3
Nunavut	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	28.8	32.0
Total field work (excluding overhead)	1 167.3	703.5	660.3	439.2	323.5	410.1	540.5	608.1	835.9	749.5	522.4	385.4	359.6
Total exploration and deposit appraisal[2] (including overhead)	1 350.0	827.9	774.7	531.8	385.3	477.3	628.1	717.6	894.8	820.2	575.9	425.9	394.9

Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
. . Not available; **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, economic and feasibility studies, environment and land access. **2** For 1988, the total with overhead was 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 18. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES (FIELD WORK AND OVERHEAD) IN CANADA, BY PROVINCE AND TERRITORY, 1988-2000 (1999 DOLLARS)

Province/Territory	Field Work Only	Total Exploration and Deposit Appraisal[1]												
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999[p]	2000[f]
	($ millions)												
Newfoundland	46.0	42.2	26.4	13.3	12.1	9.5	13.1	73.8	94.4	59.0	41.4	31.0	16.5
Nova Scotia	57.0	25.0	12.5	5.0	3.5	1.9	1.8	2.9	7.0	6.8	4.9	3.4	4.9
New Brunswick	16.8	15.9	18.7	17.4	13.3	11.9	10.6	13.2	15.1	12.3	10.2	8.5	8.3
Québec	400.3	215.7	222.3	152.2	102.4	113.7	138.2	127.9	139.9	170.3	125.5	103.0	66.8
Ontario	419.1	254.0	172.8	120.9	84.3	81.0	119.8	134.5	198.8	178.3	113.0	80.7	94.1
Manitoba	36.6	43.1	46.6	32.7	34.8	29.4	43.0	33.8	42.1	40.7	29.9	25.4	24.4
Saskatchewan	74.5	73.8	47.8	34.7	28.2	57.0	53.6	45.4	51.6	50.4	58.7	24.7	31.3
Alberta	5.2	7.2	12.1	7.3	5.9	7.8	10.0	11.0	11.1	20.7	21.9	14.4	16.0
British Columbia	240.0	217.6	256.4	149.6	77.9	70.8	90.1	82.3	106.9	96.8	45.0	31.8	34.1
Yukon	47.1	17.6	20.8	18.2	10.5	20.6	27.3	40.7	47.3	41.0	17.8	11.4	10.4
Northwest Territories	81.1	53.3	40.8	34.8	46.5	108.0	158.5	178.6	198.4	152.2	116.7	62.7	50.5
Nunavut	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	28.8	31.5
Total field work (excluding overhead)	1 423.7	820.4	747.5	484.1	351.9	439.6	573.2	630.7	852.3	757.2	530.6	385.4	354.0
Total exploration and deposit appraisal[2] (including overhead)	1 646.5	965.5	877.1	586.2	419.2	511.6	666.1	744.2	912.4	828.5	585.0	425.9	388.7

Source: Natural Resources Canada, based on the Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures.
. . Not available; **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, economic and feasibility studies, environment and land access. **2** For 1988, the total with overhead was calculated by multiplying the field expenditures by the ratio total/field from Statistics Canada.
Note: Numbers may not add to totals due to rounding.

APPENDIX 2

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.

A review of survey definitions was carried out in the mid-1990s to improve the quality of the survey. This revision was undertaken by the Federal-Provincial Committee on Mineral Statistics, in consultation with industry, and completed in 1997. The resulting *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures* was designed to better describe the full mineral development cycle (**Table 19**) and to provide more comprehensive measures of investment in the Canadian minerals and metals industry. 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. Since 1997, NRCan has been fully responsible for the coordination of the federal-provincial/territorial preliminary and forecast survey, and partially responsible for the annual survey for both non-producing and producing firms.

SURVEY PROCESS

Two questionnaires are distributed each year. For example, for the survey period 1999/2000, the *preliminary* survey was conducted during the last quarter of 1999 and January 2000, while the more detailed *final* survey questionnaires were distributed in early 2000. The results of this *final* are being compiled during the course of 2000. The *preliminary* survey provides preliminary results on 1999 exploration and deposit appraisal activity and a forecast for 2000 that is based on company spending intentions. The *final* survey provides a wealth of project-specific information, including the type of commodities explored for, the type of field work undertaken, related overhead expenditures, the type of company involved, joint-venture partners, and other details.

TABLE 19. Generalized Model of the Mineral Resource Development and Mining Process

PHASE	MINERAL RESOURCE ASSESSMENT	MINERAL EXPLORATION					MINERAL DEPOSIT APPRAISAL				MINE COMPLEX DEVELOPMENT	MINE PRODUCTION	ENVIRON-MENTAL RESTORATION
		GRASSROOTS EXPLORATION											
	MRA	EX-1	EX-2	EX-3	EX-4	EX-5	DA-1	DA-2	DA-3	DA-4	MCD	MP	ER
STAGE	Various surveys, research and synthesis.	Exploration planning.	Regional reconnaissance and surveys.	Prospecting and ground surveys of anomalies.	Verification of anomalies and showings.	Discovery and delimitation of a mineral deposit.	Mineral deposit definition.	Project engineering.	Project economics.	Feasibility study, production decision.	Mine develop-ment, construc-tion of proces-sing plant and infrastructure.	Production, marketing and renewal of reserves.	Mine complex closure and decommission-ing, site restoration.
OBJECTIVES	Supply informa-tion and tools required to develop the mineral potential of the nation for economic bene-fit, in the perspective of sustainable development.	Select target commodities. Establish exploration objectives and strategies. Select target areas and sites. Acquire claims or permits if appropriate.	Seek anomalies of interest over wide areas by various survey methods. Select the more promising targets. Acquire claims or permits.	Confirm the presence, exact location and characteristics of anomalies. Acquire claims, leases and properties.	Investigate the cause of anomalies. Find mineral showings. Acquire additional claims, leases and properties.	Discover, delimit and interpret grade quality and tonnage of a new mineral deposit. Determine if it constitutes a mineral resource of "potential economic interest", to justify more intensive and detailed work.	Define the limits, controls and internal distri-bution of grades, mineralogy and mineral processing characteristics of the deposit. Acquire all data required for project engineering and cost estimation.	Determine, in an iterative fashion, the design, plans, schedules, capital cost and operating cost estimates for all aspects of the project. Establish technical feasibility and costs thoroughly and realistically.	Obtain all the information required and determine, based on corporate objectives, parameters for the economic, financial and social-political evaluation of the project.	Diligently validate and integrate project data, interpretations, estimations, plans and evaluations to achieve MCD and production objectives. Decide on whether to undertake the mining project. Obtain permits and financing.	Complete mine development and construction on schedule and within budgets and specifica-tions. Ensure efficient and timely mine complex start-up according to schedule, specifications and cash flow forecasts.	Achieve commercial production on schedule and meet cash flow forecasts and quantity and quality specifica-tions. Achieve mine profitability and company survival in the perspective of sustainable development.	Restore mine site, outside plant and infrastructure to environmentally acceptable condition. Ensure the future quality of the environment.
EVALUATION METHODS	Geoscientific, mineral and economic sur-veys, research, compilations and synthesis by governments, research institutes, universities and industry.	Metal and mineral market research. Review of geological and ore deposit information and of the legal, fiscal and socio-political context in various areas.	Remote sensing, aerial photography and airborne geophysics. Prospecting, geology and geochemistry. Appraisal, rating and selection of anomalies.	Ground, geological, geo-chemical and geophysical prospecting and surveys. Compilation, appraisal and selection of significant anomalies.	Geological mapping and other surveys. Trenching, drilling and sampling. Appraisal of results, recommenda-tions for further work, and selection of new targets.	Stripping, trench-ing, mapping, sampling, drilling and down-hole geophysics. Initial mineral processing tests. Environmental and site surveys. Mineral resource estimation and inventory.	Detailed map-ping, sampling and drilling on surface or from underground. Systematic mineralogy and mineral proces-sing tests. Detailed environ-mental and site surveys. Pre-feasibility studies.	Pilot tests, engineering design and planning. Capital and operating costs for mining, mineral processing, infrastructure, environmental protection and restoration. Technical risk analysis. Pre-feasibility studies.	Market, prices, product devel-opment and financial studies. Environmental, economic, financial, and socio-political risk analysis. Pre-feasibility studies.	Exhaustive due diligence review of all data, interpretations, plans and estimates. Evaluation of profitability, given the geological, technical, financial and qualitative risks, and the up-side factors.	Project manage-ment methods in a quality assurance perspective. Training program for personnel and detailed start-up plan to meet the requirements of this demanding period.	Production management methods to ensure continuous quality and efficiency improvements. Exploration, deposit appraisal and development of new zones or deposits on-mine-site and off-mine-site.	Mine closure and decommission-ing. Environ-mental restora-tion and monitoring.
RESULTS	Maps, data bases, tools and models.	Exploration projects.	Regional anomalies.	Local anomalies.	Mineral showings.	Mineral deposit.	Deposit appraisal project.			Mining project.	Mining complex.	Mineral production.	Restored site.
MINERAL INVENTORY	UNDISCOVERED MINERAL POTENTIAL			INFERRED RESOURCE	DELIMITED MINERAL RESOURCE			MINERAL RESERVE					
	SPECULATIVE		HYPOTHETICAL		INDICATED	INDICATED AND MEASURED		PROVEN AND PROBABLE					
ESTIMATION ERROR (targeted margin of error of tonnage/grade estimates at the 90% confidence level)				± 100%	± 50%	Indicated: ± 50 to 30% Measured: ± 20 to 10% (often several sample grid dimensions are used in each category)		Proven (feasibility: ± 10%; mining: ± 5%)					Full compliance
INVESTMENTS	Moderate	Low, but increasing multiple investments.				Larger and increasing multiple investments.				Very large industrial investment.			
RISK LEVEL	Low	Very high, but decreasing risk of failure and financial loss.				High, but decreasing risk of failure.				Moderate to low industrial risk.			

Sources: Modified by D.A. Cranstone, A. Lemieux and M. Vallée, February 25, 1994, from M. Vallée, 1992, *Guide to the Evaluation of Gold Deposits*, CIM Special Volume 45, p. 4, and *SOQUEM Annual Report*, 1976-77, pp. 4 and 5. Revised by M. Vallée, January 2001.

A total of 1653 questionnaires (preliminary survey) were distributed in October 1999. Some companies receive more than one questionnaire depending on the number of provinces/territories in which they are conducting activities. To avoid duplicate reporting, joint-venture participants who are not project operators do not report expenditures on such joint-venture projects. Companies are 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. To protect the confidential data provided by the respondents, only aggregate statistics are released. However, specific information can be added when such information has already entered the public domain.

DEFINITIONS USED IN THE 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. The following is a summary of the definitions most referred to in this report. For a more comprehensive list of definitions, along with more complete descriptions, the reader is invited to consult the Reporting Guide for the *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Expenditures*. This guide is available from Natural Resources Canada or from provincial/territorial survey partners.

Mineral Development Phases (Work Phases)

Exploration expenditures represent all field 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.

Deposit appraisal expenditures represent all field 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 justify and support a production decision and the investment required.

Mine complex development expenditures include all mine development, capital (construction, machinery and equipment), repair and maintenance 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 define, 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 current ore reserves.

Location of Activity

On-mine-site expenditures represent all field activities and capital, repair and maintenance expenditures applied to exploration or deposit appraisal for an additional mineral deposit separate from the current mine reserves and located strictly on an existing mine site in production or committed to production.

Off-mine-site expenditures represent all field activities and capital, repair and maintenance 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 than can be accessed and exploited from the current or committed installations; hence, the size of this area will vary depending on the commodity under consideration, attitude (horizontal vs. vertical), type and extent of the deposit(s), and the mining method(s) in use.

For a mine site to be *committed to production*, all of the following criteria must be met: (i) a production feasibility study has been completed; (ii) a formal production decision has been taken 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 and work 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, mineral processing, metallurgy, 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, product development, price studies, 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 for environmental assessment and for 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 requirements, 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 for its own account, such as salaries and wages, materials and supplies, and other charges such as engineering and consulting fees. Environment-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.