

Canadian Mineral Exploration and Discovery Analysis

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CANADA'S STANDING AS AN EXPLORATION TARGET

In 1997, exploration expenditures for non-petroleum minerals in Canada totaled \$820.2 million. Canada remained one of the world's top targets (second after Australia) in terms of mineral exploration expenditures that year. Company exploration spending intentions were \$767.4 million, gathered by a survey conducted early in 1998, but these were not met because of low gold and base-metal prices throughout most of 1998. The "preliminary" exploration total for 1998 (gathered early in 1999) is \$601.1 million. Despite this decline, the Metals Economics Group's (MEG) 1998 survey (data that were gathered later in 1998) indicate that, in 1998, Canada remained in second place after Australia in terms of mineral exploration expenditures, with the United States continuing in third position. The relative rankings of these three countries have remained unchanged since 1992 (Figure 1). The United States has been consistently in third place since 1980.

However, the MEG exploration rankings do not adequately account for exploration expenditures in countries such as China and the various countries that have resulted from the breakup of the former Soviet Union. This is because MEG covers only exploration expenditures by the Western companies exploring in these countries. The value of Chinese non-petroleum mineral output is roughly five to six times that of Canada, so it may well be that the magnitude of the Chinese mineral exploration effort exceeds that in Canada or Australia.

The MEG survey has a cut-off exploration budget level of US\$2.9 million; therefore, the survey has consistently and substantially underestimated the real levels of annual exploration spending in Canada and in Australia because both countries each have several

hundred active junior exploration companies with exploration expenditures that are below that US\$2.9 million cut-off. Aggregate exploration

Figure 1
Top Three Country Destinations of Mineral Exploration Capital from Worldwide Sources, 1973-98

Year	Rank		
	First	Second	Third
1998	Australia	Canada	United States
1997	Australia	Canada	United States
1996	Australia	Canada	United States
1995	Australia	Canada	United States
1994	Australia	Canada	United States
1993	Australia	Canada	United States
1992	Australia	Canada	United States
1991	Canada	Australia	United States
1990	Canada	Australia	United States
1989	Canada	Australia	United States
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1981	Canada	Australia	United States
1980	Australia	Canada	United States
1979	Australia	United States	Canada
1978	Australia	United States	Canada
1977	United States	Canada	Australia
1976	Canada	United States	Australia
1975	United States	Canada	Australia
1974	Canada	United States	Australia
1973	Australia	United States	Canada

Source: Natural Resources Canada, based on official Canadian and Australian statistics and the best available data for the United States.

Notes: Australian expenditures were 6.5% higher than those for Canada in 1983 and 3.3% higher in 1991; however, correcting the reported Australian totals for substantial mine development expenditures, which are not included in Canadian statistics, ranks Canada first in 1983 and 1991. Complete data are not available for the former Soviet Union and China.

expenditures directed at Canada or Australia by these companies are substantial, and most likely are considerably in excess of the expenditures of junior companies in other individual countries worldwide. For this reason, the MEG survey exploration expenditure totals for Australia and Canada almost undoubtedly understate the exploration expenditures actually being directed at these countries relative to such expenditures in other countries.

RECENT MINERAL EXPLORATION AND DISCOVERY ACTIVITY AND RESULTS

Lower market prices for most metals, together with increased difficulty being experienced by junior companies in raising exploration funds, have resulted in a significant decline in exploration spending in Canada to \$601 million (preliminary) in 1998, significantly lower than the \$820 million of such expenditures in 1997. A further decline is anticipated in 1999. Company exploration spending intentions for 1999 (gathered early in 1999) total only \$489 million.

Exploration for diamonds provided the most notable exploration successes in Canada in 1998 when at least eight new diamond deposits were discovered in the Northwest Territories. On the basis of small samples from these new deposits, it appears that they might be economically mineable, but larger bulk samples will be needed to more accurately measure diamond contents and diamond values.

DIAMOND EXPLORATION HIGHLIGHTS

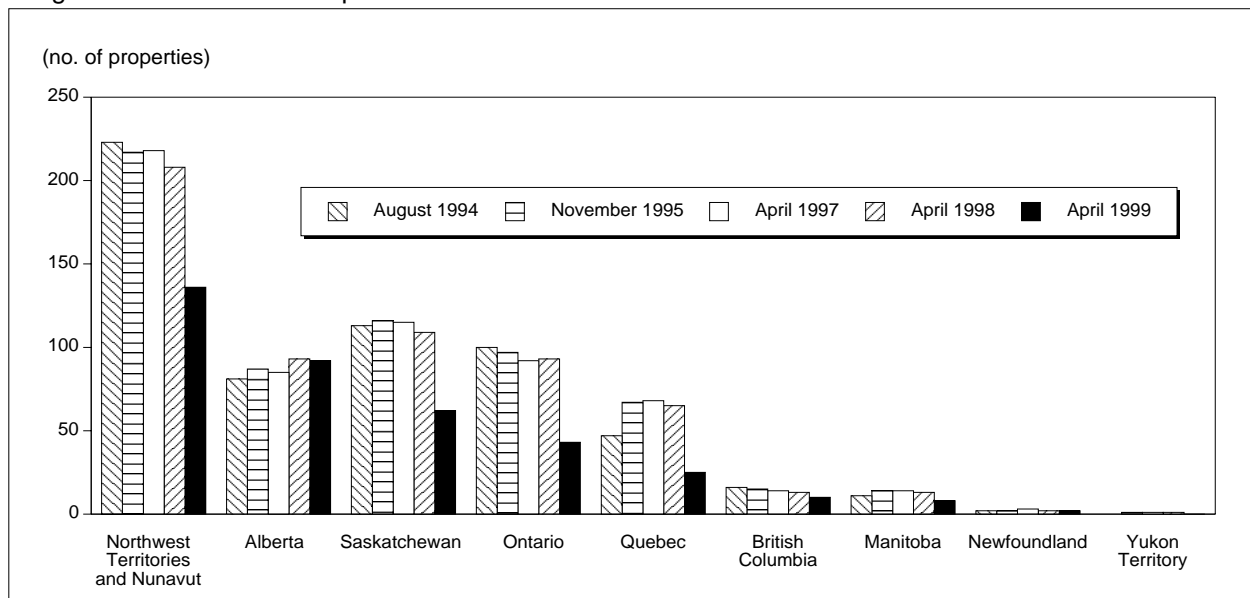
Introduction

In April 1999, there were some 378 diamond exploration properties in Canada (Figure 1). Although this number is considerably lower than the approximately 600 diamond exploration properties of each year from 1993 to 1998, the apparent decline has probably resulted from a change in the databases used to prepare the figure rather than from a marked decline in the number of diamond properties between April 1998 and April 1999. The most notable Canadian diamond exploration event in 1998 appears to have been the discovery of a gently dipping diamond-bearing dyke on a peninsula in Snap Lake in the Camsell Lake area of the Northwest Territories on a property owned by Winspear Resources Ltd. and Aber Resources Ltd. This deposit does not appear to be large (a few million tonnes in size) but, on the basis of a small bulk sample of 200 t, has yielded the highest per-carat and per-tonne diamond values known in any Canadian diamond deposit.

Ekati Diamond Mine

Production of diamonds from the Ekati mine property in the Northwest Territories began in October 1998. To the end of 1998, a total of 107 kimberlite pipes had been discovered (up from 100 pipes a year earlier) on the Core Block of the Ekati property

Figure 2
Exploration for Diamonds in Canada, 1994-99
Regional Distribution of Properties



Source: Natural Resources Canada, based on *MIN-MET CANADA* database for 1992-98 and *Info-Mine* database for 1999, ROBERTSON INFO-DATA Inc., Vancouver, British Columbia and used under licence.

(owned by BHP Diamonds Inc., 51%; Dia Met Minerals Ltd., 29%; Charles Fipke, 10%; and Stewart Blusson, 10%) or on the adjacent Buffer Zone claim block (owned by BHP Diamonds, 51%; Archon Minerals Limited, 31.2%; Charles Fipke, 10%; and Dia Met Minerals, 7.8%). Eighty-one of the 107 kimberlites lie on the Core Block of claims and the remaining 26 are on the Buffer Zone claims. Five diamondiferous kimberlite intrusions were discovered in 1998 on the Ekati property and Buffer Zone claims (Table 1). Bulk samples will be taken to better establish diamond contents and diamond values for these kimberlites.

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

Diavik Project

The Diavik project in the Northwest Territories is operated by Diavik Diamond Mines Inc., which owns a 60% interest. This company is a wholly owned subsidiary of Rio Tinto plc of London, England. The remaining 40% is held by Aber Resources Ltd. of Vancouver, British Columbia. Aber has put up 40% of the project costs and retains the right to market its 40% share of diamond production.

To the end of 1998, a total of 53 kimberlite pipes had been discovered on the Diavik property, 24 of which are known to be diamondiferous. Four pipes (A-154 South, A-154 North, A-418 and A-21) currently appear to have the greatest promise. A final feasibility study is scheduled to be completed for the Diavik property by mid-1999, at which time estimated capital and operating costs and a revised mining plan for the project are to be available. The proposed mine development plan includes the construction of dikes in Lac de Gras around the A-154 North and A-154 South kimberlites (which lie under the waters of Lac de Gras, adjacent to East Island) to permit open-pit mining of these deposits to begin in the second quarter of 2002. The A-418 dike is to be constructed in approximately 2007 and the A-21 pit is to be mined over a three-year period of approximately 2012-14. Underground mining of A-418 and A-154 South is to begin 12 to 14 years after start-up.

The feasibility study includes a range of production rates from 1.5 to 1.9 Mt/y, which would yield 6-8 Mct of diamonds annually during the period of maximum output from the open-pit mining phase.

The resource estimate total for the four pipes, to a depth of 400 metres, is 37.4 Mt containing 133 Mct of diamonds (Table 2). Estimated diluted mineable reserves from a prefeasibility study are 26 Mt containing 102 Mct at an average reserve grade of 3.9 ct/t. A 29-t mini-bulk sample, taken in 1998 from the A-11 pipe (10 km east of the proposed Diavik development site), yielded 7.6 ct of diamonds including a 3.01-ct, gem-quality stone, for an average grade of 0.262 ct/t. Exploration on the Diavik property is continuing, including additional drilling of two other diamondiferous kimberlite pipes.

AK-CJ Property

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

In addition to the original AK-5034 pipe discovered by Mountain Province-Camphor Ventures, Monopros has discovered three additional diamond kimberlite deposits: the Hearn, Tuzo and Tesla pipes (Table 3). Early in 1999, Monopros used 12-inch drills to take four bulk samples totaling 1666 t, comprising 575 t from the 5034 pipe, 454 t from the Hearne pipe, 460 t from the Tuzo pipe and 177 t from the Tesla pipe. The samples are currently being processed and the results are expected in the summer of 1999. It is estimated that approximately 1000 ct of diamonds will be recovered from each of the 5034, Hearne and Tuzo pipes, sufficient to model grades and values per tonne for each of these pipes. The sample from the Tesla pipe is expected to yield approximately 65 ct of diamonds which, together with previously recovered diamonds from this pipe, will allow an improved estimate of the potential of this pipe.

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

Jericho Project

Tahera Corporation, a company formed on February 28, 1999, by the merger of Lytton Minerals Limited and New Indigo Resources Inc., has found three diamondiferous kimberlites (JD/OD-1, JD/OD-3 and Contwoyto-1) on its Jericho Project property in Nunavut. A prefeasibility study concluded that the economics of the proposed JD/OD-1 project are marginal based on the established JD/OD-1 kimberlite resource alone, but could be considerably improved with the discovery of additional kimberlite resource tonnage. The 16.9 ct of diamonds recovered from the JD/OD-3 pipe included two diamonds weighing 1.18 ct and 0.75 ct. The joint-venture partners have no plans to evaluate the JD/OD-3 pipe further at this time due to its relatively low grade. Exploration for additional diamondiferous kimberlites continues in the immediate vicinity.

Ice Claims

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

Snap Lake Project

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

Winspear is attempting to identify a minimum of 3.5-5 Mt of kimberlite resource for a feasibility study, plus an equal tonnage of possible resources. A 6000-t

bulk sample is to be collected from three separate sample sites during 1999. Winspear has also discovered three other shallowly dipping kimberlite dykes in Snap Lake that are similar in appearance to the above-noted diamond-bearing dyke, but there is no information available concerning whether these dykes are diamondiferous.

In March 1999, a dispute arose between Winspear and Aber concerning their ownership shares of the Snap Lake project, and it had not been resolved when this article was written.

Buffalo Hills

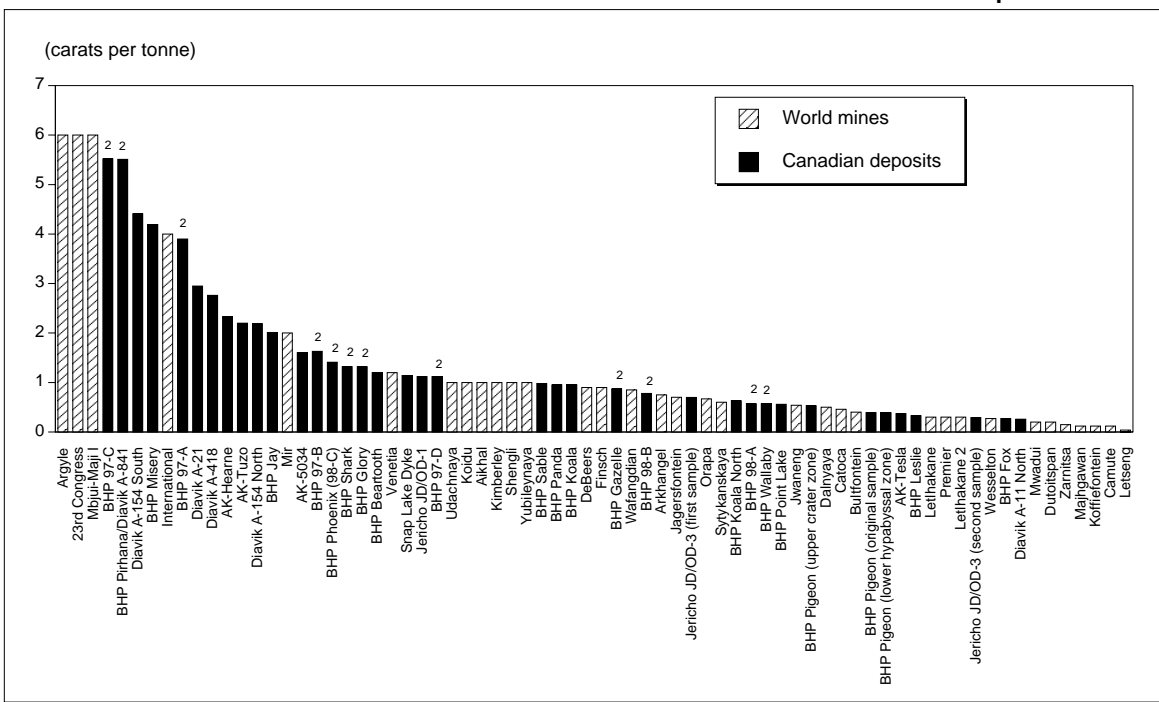
Ashton Mining of Canada Inc., with a 42.5% share, is the operator of a diamond exploration project in the Buffalo Hills of northwestern Alberta, about 250 km north-northwest of Edmonton. The other partners are Alberta Energy Company Ltd. (42.5%) and Pure Gold Resources Inc. (15%). Since early 1997, a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

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

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

Note: Information in this review was current as of April 30, 1999.

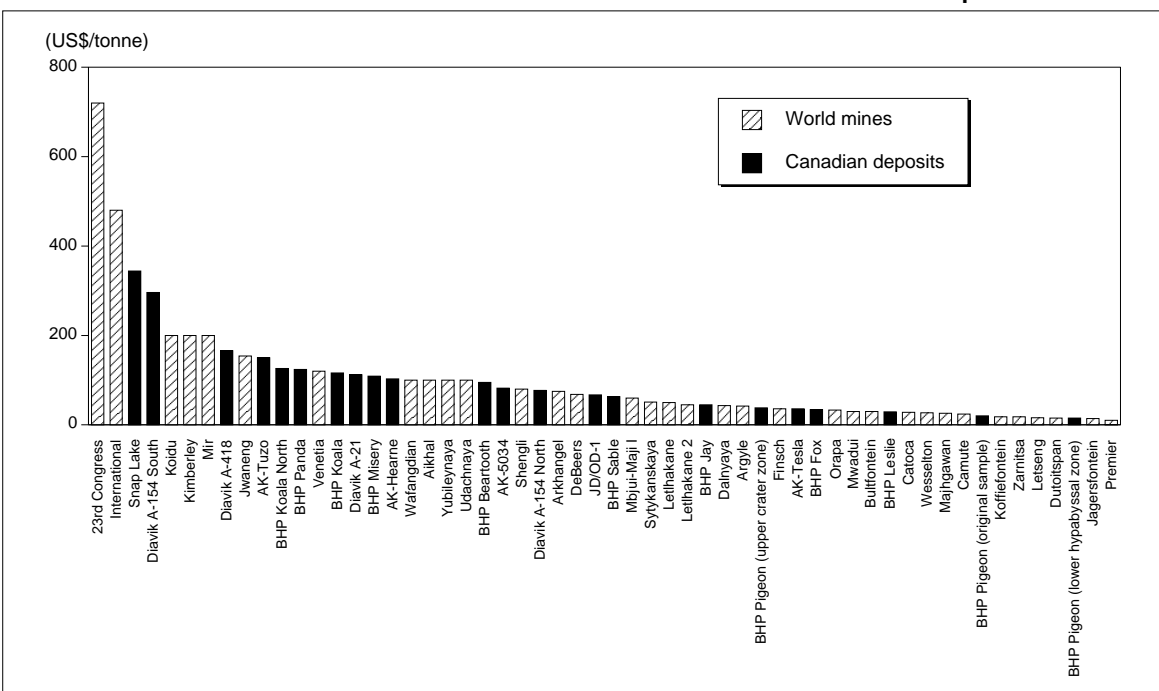
Figure 3
Recoverable Diamond Grades From World Diamond Mines¹ and Canadian Diamond Deposits



Source: Natural Resources Canada, based on published data.

¹ Grades of world diamond mines are based on data from the early 1990s. ² Based on a sample weight of less than 0.5 tonnes.

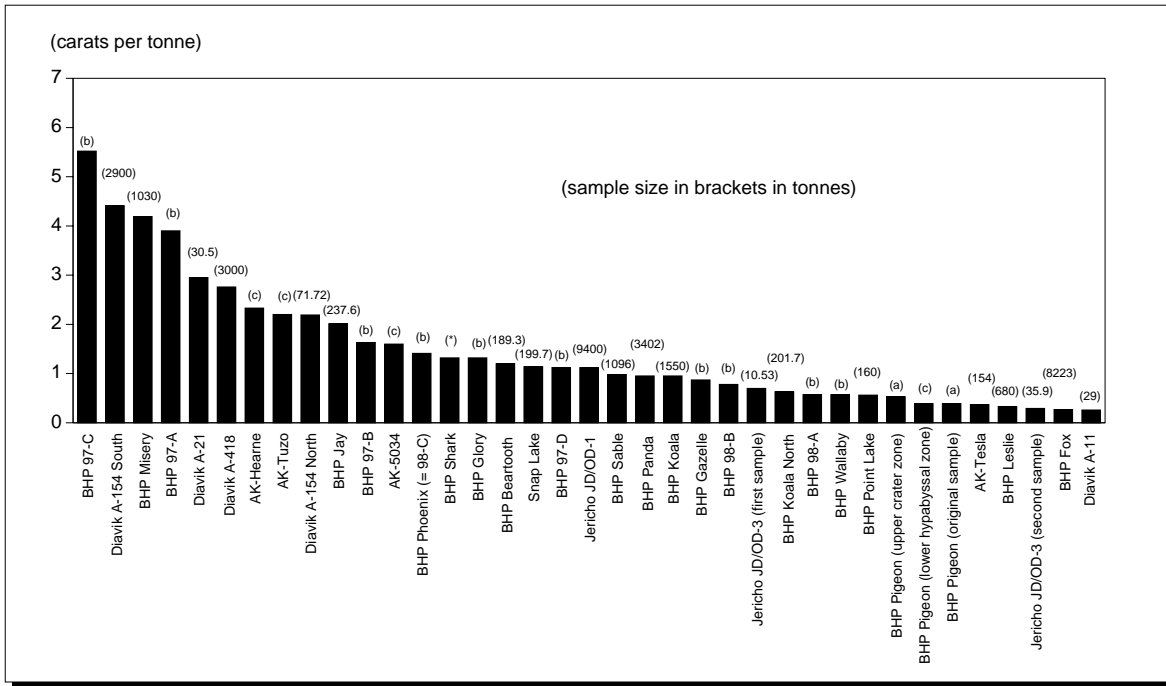
Figure 4
Recoverable Diamond Values for World Diamond Mines¹ and Canadian Diamond Deposits



Source: Natural Resources Canada, based on published data.

¹ Values for world diamond mines are based on data from the early 1990s.

Figure 5
Grades of Selected Canadian Diamond Deposits



Source: Natural Resources Canada, based on published data.

* Not available.

(a) Pigeon 1998 sample totalled 540 tonnes. Weights of the upper crater zone and lower hypabyssal zone portions of this sample were not published.

(b) Based on a sample weight of less than 0.5 tonnes. (c) Sample size not available.

TABLE 1. SELECTED DATA ON CANADA'S MOST PROMISING DIAMOND DEPOSITS

Pipe	Total Tonnes Sampled	Total Carats Recovered	Average Grade (carats/tonne)	Average Value (US\$/carat)	Average Value (US\$/tonne)
EKATI MINE AND BUFFER ZONE PROPERTIES					
Panda	3 402	3 244	0.95	130	124
Misery	1 030	4 313	4.19	26	109
Koala	1 550	1 465	0.95	122	116
Koala North	201.7	126.58	0.63	200	126
Fox	8 223	2 199	0.27	125	34
Leslie	680	233	0.33	89	29
Pigeon (original sample)	154	60	0.39	51	20
Pigeon (1998 sample)	540	..	..	..	..
Upper crater zone	213.6	113.89	0.53	71	38
Lower hypabysal zone	351.2	137.42	0.39	39	15
Jay	237.6	476.8	2.01	33	45
Sable	1 096	1 070	0.98	64	63
Beartooth	189.3	227.09	1.20	79	95
Point Lake	160	90+	0.56	..	..
97-A	0.0669	0.261	3.90	..	..
97-B	0.4070	0.662	1.63	..	..
97-C	0.0572	0.316	5.52	..	..
97-D	0.232	0.260	1.12	..	..
98-A	0.1949	0.112	0.57	..	..
98-B	0.0733	0.057	0.78	..	..
Phoenix (98-C)	0.2395	0.338	1.41	..	..
Shark	..	..	1.32	..	..
Gazelle	0.4834	..	0.87	..	..
Glory	0.2438	..	1.32	..	..
Wallaby	0.1208	..	0.57	..	..
Piranha (also known as Diavik A-841) (straddles boundary of Buffer Claims and Diavik Property)	0.057	..	5.51	..	..
DIAVIK PROPERTY					
A-154 South	2 900	12 800	4.41	67	296
A-154 North	71.72	156.81	2.19	35	77
A-418	3 000	8 275	2.76	56	166
A-21	30.5	90	2.95	38	112
A-11 North	29	7.6	0.26	..	..
JERICHO PROPERTY					
JD/OD-1	9 400	10 539	1.12	60	67
JD/OD-3 (first sample)	10.53	7.34	0.697 ^a	..	..
JD/OD-3 (second sample)	35.9	10.41	0.29	..	..
AK PROPERTY					
5034	..	..	1.6	51	82
Hearne	..	..	2.33	44	103
Tuzo	..	..	2.2	68	150
Tesla	..	..	0.37	96	36
SNAP LAKE PROPERTY					
Snap Lake Dyke	199.7	226.7	1.14	301	344

Source: Natural Resources Canada, based on company data.

.. Not available.

^a Includes a single 3.6-ct stone; if this stone is excluded, the grade is 0.25 ct/t.

TABLE 2. DIAVIK PROJECT RESOURCE ESTIMATES

Unit	A-418 Pipe	A-154 South Pipe	A-154 North Pipe	A-21 Pipe	Total/Average
Resources (million tonnes)	9.0	12.0	11.5	4.9	37.4
Grade (ct/t)	3.7	4.8	2.4	3.0	3.5
Total (millions of carats)	33	57	28	15	133

Source: Natural Resources Canada, based on company data.

TABLE 3. ESTIMATED RESOURCES OF AK PROPERTY DEPOSITS

Pipe	Tonnage	Average Grade	Value Per Carat	Value
	(million tonnes)	(carats/tonne)	(US\$)	(US\$/tonne)
5034	15	1.6	51	82
Hearne	8	2.33	44	103
Tuzo	9	2.2	68	150
Tesla	4	0.37	96	36

Source: Natural Resources Canada, based on company data.