Diamonds

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SUMMARY

Major events in the Canadian and international diamond industry during 1999 included the following:

- The Ekati diamond mine in the Northwest Territories completed its first full year of production. In 1999, the mine produced some 2.3 million carats (Mct) valued at US$376.8 million. This is the first major Canadian diamond mine.
- BHP contracted to sell 35% of the diamonds mined at the Ekati mine to De Beers.
- In June, the first diamond-cutting and polishing factory in the Northwest Territories began commercial production. Sirius Diamonds N.W.T. owns and operates the factory. Rough diamonds are purchased directly from BHP.
- The year 1999 was a record one for De Beers as it increased its rough diamond sales by 56% to US$5.24 billion from US$3.34 billion in 1998.
- The robust U.S. economy released pent-up demand for goods, augmented by a recovery in Asian economies after the poor year of 1998.
- De Beers extended its trade deal with Almazy Rossii-Sakha (Alrosa), the largest Russian diamond producer, through to the end of 2001. In the contract, De Beers (the Central Selling Organization (CSO)) will be guaranteed sales of at least US$550 million per year of rough stones from run-of-mine and the stockpile.
- In 1999, the United Nations declared a ban on trade with UNITA, the rebel forces in Angola's ongoing civil war. There is growing concern that the continued sale of illicit diamonds (often referred to as "conflict diamonds") will eventually have an adverse impact on the worldwide sale of diamonds that come from legitimate sources.

CANADIAN DEVELOPMENTS

Mine Developments

Ekati™ Diamond Mine

The Ekati™ diamond mine, located about 300 km northeast of Yellowknife near Lac de Gras in the Northwest Territories, completed its first full year of production. In the 12 months ending December 1999, the mine produced some 2.3 Mct of rough diamonds at an average price of about US$165/ct.

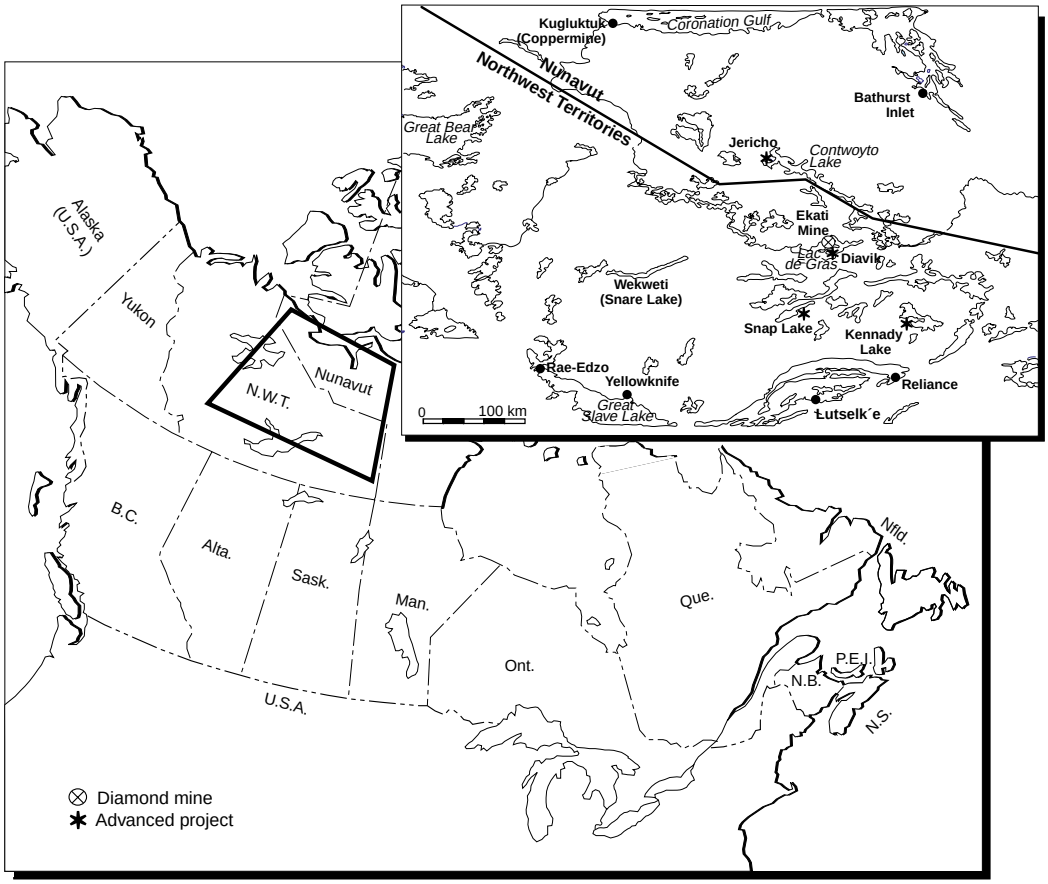
The Ekati™ mine is owned 51% by BHP Diamonds Inc., who is the operator, 29% by Dia Met Minerals Ltd. of Kelowna, British Columbia, and 10% each by Charles Fipke and Stewart Blusson, both of Canada. Under the joint-venture agreement, BHP will market all diamond production for the first five years.

BHP Diamonds Inc. has two primary marketing channels for the production from Ekati™. Thirty-five percent of the run-of-mine production is sold under contract to De Beers in London, United Kingdom. The remaining 65% is sold through its sales office in Antwerp, Belgium, where by far the majority of the world's rough diamond production is sold.

As well, BHP makes available some 7000 ct of rough diamonds of a specific range in size and grade for purchase by three northern diamond manufacturers in each five-week cycle.

During 1999, the Ekati™ diamond mine met and exceeded the targets prescribed in its Socio-Economic Agreement with the Government of the Northwest Territories (GNWT). The mine employs about 600 people, of which some 69.8% are Northerners (the target is 62%) and 33.2% are Aboriginals (the target is 31%). The total value of goods and services purchased during 1999 was $356.1 million, of which $280.3 million, or about 78%, was purchased from northern businesses.

Figure 1
Diamond Properties, Slave Province



Source: Indian and Northern Affairs Canada.

In November 1998, BHP submitted a project description to add three kimberlite pipes to its mine plan for future operation. The three pipes, named Sable, Pigeon and Beartooth, are within the BHP claim block. Together these pipes will extend the mine life by about three years, thereby providing additional employment and opportunity for the discovery of additional pipes.

At the present time there are about 120 known kimberlite occurrences on the BHP claim block. Exploration work is ongoing to determine the economic significance of these pipes.

Diavik Diamonds Project

The Diavik diamonds project is a joint venture between Aber Diamond Mines Ltd. (40%), a wholly owned subsidiary of Aber Resources Ltd. of Vancouver, B.C., and Diavik Diamond Mines Inc. (DDMI) (60%), a subsidiary of Rio Tinto plc of London, U.K. DDMI is the project manager.

The Diavik diamonds project is a proposal to mine four kimberlite pipes located just offshore of a 20-km^2 island in Lac de Gras, approximately 300 km northeast of Yellowknife and 30 km southeast of BHP's Ekati^{TM} diamond mine. The pipes are referred to as A-154 South, A-154 North, A-418 and A-21. Diamond grades and values are variable between the four pipes. As of December 1999, reserves from the four pipes stood at 101.5 Mct contained in 26 Mt of kimberlite with a diluted grade of 3.96 ct/t. There are also inferred resources of 12.5 Mt grading 2.38 ct/t, but these have not been included in the current mine plan.

A $30 million feasibility study, completed in August 1999, concluded that the capital cost for the project would be about $1.28 billion for the 1.5-Mt/y mine that is expected to produce about 6.5 Mct/y.

The project was submitted to the federal government for environmental assessment on March 8, 1998. In June 1999, after 12 months of environmental assessment work, a Comprehensive Study Report (CSR), prepared by the federal Regulatory Authorities, was submitted to the Minister of the Environment (MOE) for public comments. In November, after review and consideration of all comments received, the MOE approved the CSR and the project proceeded to the regulatory phase. In early December the Northwest Territories Water Board held public hearings to hear from interveners on specific technical issues with respect to the project. Given the complexity of the project, it is not known when the water licence for it will be issued.

In October 1999, a Socio-Economic Monitoring Agreement was signed by DDMI, Aber and the GNWT. The agreement formalizes the socio-economic commitments made by DDMI and the recommendations arising from the environmental assessment hearings held earlier in the year.

Canadian Government Diamond Valuator

In the Northwest Territories and Nunavut, the Canada Mining Regulations require that all diamonds produced in the territories be examined by a government valuator in order to establish a value for the diamonds for the purposes of calculating royalties owed to the Crown. The valuation must be done before the diamonds are sold or exported out of the territories.

In August 1998, the Canadian government signed a three-year contract with Diamonds International Canada (DICAN) Ltd. to carry out the functions of the government diamond valuator with respect to diamond production from the Ekati™ mine. DICAN is a Canadian incorporated company with headquarters in Yellowknife, Northwest Territories. The company is a partnership between Aboriginal Diamonds Group Ltd. (51%) and WWW International Diamond Consultants Ltd. (49%).

DICAN has a team of nine individuals with expertise in the valuation of rough diamonds and in statistical analysis of rough diamond production. As required by regulation, DICAN has provided the government with a value of diamond production from the Ekati™ mine for use in the calculation of royalties that BHP Diamonds Inc. will pay to the Crown.

DICAN is also committed to initiating a training program for rough diamond valuation. The program will initially be targeted at Aboriginals, then possibly at other Northerners, and finally at other Canadians.

Exploration Developments

In 1999, exploration for diamonds continued in several regions of Canada. Preliminary data indicate that diamond exploration expenditures increased from $119 million in 1998 to $126 million in 1999. It is expected that the amount for 2000 will see a further increase to about $161 million.

Exploration was focussed principally in the Northwest Territories and, to a lesser extent, in the new territory of Nunavut. As well, exploration companies were also active in British Columbia, Alberta, Ontario and Quebec.

In the Northwest Territories, Monopros, the Canadian exploration arm of De Beers Consolidated Mines, completed a $14 million bulk sampling program on the AK-CJ diamond property about 320 km northeast of Yellowknife. The bulk sample of the 5034, Hearne, Tuzo and Tesla pipes was started on January 11, 1999, and was completed on April 6, 1999. The kimberlite was initially processed at Monopros's dense media separation (DMS) plant at Grand Prairie, Alberta, and the resulting concentrates were shipped to Johannesburg, South Africa, where final diamond recovery was completed. For the Hearne pipe, 856 ct were recovered from 469 t of kimberlite; the average value was estimated at US$65/ct. For the 5034 pipe, a total of 1044 ct were recovered from 609 t of kimberlite with an estimated average value of US$51/ct. At year-end, results from the bulk samples taken from the Tuzo and Tesla pipes were still pending.

Monopros, through a joint-venture agreement signed in 1997 with Mountain Province Mining Inc., which owns 90% of the AK property, and Camphor Ventures, which owns the other 10%, can earn up to a 60% interest in the property.

Winspear Resources Ltd. continued the sampling program of the NW kimberlite dyke near Snap Lake on the Camsell lake property, located approximately 220 km northeast of Yellowknife. The property is controlled by the Camsell Lake joint venture, of which Winspear is the majority owner (67.7%) and operator. Aber Resources Ltd. owns the remaining 32.3% interest in the project.

The Camsell Lake property is the only property held by Winspear. Under the terms of a Plan of Arrangement that became effective on May 27, 1999, Winspear placed all of its other exploration properties into Diamondex Resources Ltd. (DSP), which is now a publicly traded company on the Canadian Venture Exchange.

During the spring/summer of 1999, Winspear drilled approximately 20 000 m in 108 holes to test the extension of the NW dyke under Snap Lake and under the north shore. From the results of the drill programs, MRDI Canada, a division of AGRA Simons Ltd., determined that the NW dyke appears to be a continuous body that is relatively uniform in thickness. Furthermore, MRDI calculated an indicated

resource with a minimum vertical thickness of 2 m to be 7.96 Mt. The average vertical thickness of the kimberlite within this resource is 2.76 m. This resource has been demonstrated to the level of accuracy necessary to support a feasibility study. An additional 8.06 Mt with a thickness averaging 2.75 m was outlined as an inferred resource in surrounding areas from a global tonnage estimated to be approximately 20.0 Mt.

The valuation of 10 708 ct of diamonds recovered from two 3000-t samples of kimberlite obtained from the NW peninsula established an undiluted grade of 1.78 ct/t at US$105/ct. This work indicates that the NW dyke represents a potentially significant diamond resource.

An advanced exploration program will begin in January 2000. In this program, a decline will be driven out under Snap Lake to about 600 m east of the bulk sample sites on the NW peninsula. From this position, a drive will be extended approximately 575 m in kimberlite. The purpose of this work is to test underground mining conditions under Snap Lake and to obtain a bulk sample of the kimberlite from that location. Winspear purchased a $2.3 million, 10-t/h diamond processing plant from Tahera Corporation for processing the underground bulk sample. During test mining, it is anticipated that 20 000 t of kimberlite may be extracted. Present plans are to process approximately 6000 t of this material to test for the recovered diamond grade and value from below Snap Lake. As part of the advanced exploration program, a 75-person camp and a 900-m airstrip will be constructed on the property, together with a containment area for processed kimberlite.

Preliminary development plans for the Snap Lake project include a small open pit with the bulk of the kimberlite being extracted by normal underground mining techniques.

Tahera Corporation continued work on the Jericho diamond project. The project, wholly owned by Tahera, is located in the new territory of Nunavut, approximately 420 km northeast of Yellowknife in the Northwest Territories and 170 km north of the Ekati^{TM} diamond mine.

A prefeasibility study for the Jericho project indicates that approximately 2.7 Mct could be produced over an eight-year mine life. The current plan consists of open-pit mining of the Jericho kimberlite and processing 300 000 t/y of kimberlite ore at the Echo Bay Lupin mine site. Tahera plans to complete a feasibility study by the second quarter of 2000. Subject to receiving regulatory approval and finalizing arrangements with Echo Bay, as well as completing financing arrangements, the project could possibly start commercial production by 2003.

Both the Northwest Territories and Nunavut will continue to see a large number of grassroots exploration projects under way during the next year. Many companies have reported kimberlite discoveries and have announced intentions to undertake further assessment work.

Diamond exploration companies were active in other parts of Canada.

In Alberta, joint-venture partners Ashton Mining of Canada Limited, Alberta Energy Company Ltd. and Pure Gold Minerals Inc. continued work on the Buffalo Hills property in the northern part of the province. The interests of the parties upon completion of currently approved programs are expected to be: Ashton, 45%; Alberta Energy, 45%; and Pure Gold, 10%. To further define drilling targets for the winter of 1999/2000, extensive heavy mineral sampling and geophysical surveys were carried out over a number of anomalous areas not related to any known kimberlite occurrences. Four new anomalies are scheduled for drilling next year. In addition, further drilling of BH225, discovered in February 1999, is also planned for this winter. The Buffalo Hills and Joint Venture Lands consist of five properties totaling 2.3 million ha (5.7 million acres). To date, 32 kimberlites have been discovered, most of which contain diamonds.

In Ontario, De Beers Canada announced the discovery of a number of diamondiferous kimberlites close to Attawapiskat in the James Bay Lowlands area. In early 2000, the company extracted a bulk sample from the large Victor kimberlite pipe, one of 16 kimberlite pipes identified by Monopros Limited in the area. A custom-built plant has been erected on site for the purpose of treating the sample in the summer of 2000.

In Quebec, Twin Gold Corporation announced the discovery of high-quality diamonds on its Torngat property east of Ungava Bay. The source material is a series of kimberlite dykes that Twin Gold expects to further evaluate during the next year.

CANADIAN DIAMOND MANUFACTURING INDUSTRY

Diamond Cutting and Polishing

Whan compared to other countries with cutting and polishing industries, the Canadian industry is relatively new and fairly small. However, the start of Canada's mine production of rough diamonds has created quite an interest in establishing new facilities in the country.

First, Canadian Diamond Cutting Works set up a new operation in Montréal, Quebec. The company brought experienced cutters from Belgium to act as forepersons and trainers to six local people interested in becoming diamond cutters and polishers. The company expects to have a crew of about 20 employees processing 3000 ct per month within about two years.

Sirius Diamond Ltd. opened the first cutting and polishing factory in the Northwest Territories in June 1999. The company has the first purchase agreement with BHP Diamonds Inc. to produce cut and polished Canadian diamonds. As part of its sales promotion, Sirius laser engraves a polar bear on each Canadian diamond that it polishes. Initial production is expected to be at a rate of 2000 ct per month, rising to about 5000 ct per month as efficiencies and skills increase.

In August, two additional northern diamond manufacturing companies signed contracts with BHP Diamonds Inc. for a supply of rough diamond from the Ekati™ mine. Both new companies are joint ventures between experienced diamond manufacturing companies and Aboriginal groups. Arslanian Cutting Works (N.W.T.) Ltd. is a joint venture between the Dogrib and the Arslanian family in Belgium, and Deton'cho Diamonds Inc. is a joint venture between Deton'cho Corporation, the economic development arm of the Yellowknives Dene, and Goldeos Limited of Calgary, Alberta. Construction and start-up of the two new factories are expected next year. At full capacity, both operations will employ about 30-40 people.

The supply contracts between the three northern manufacturers and BHP are the result of an agreement negotiated between BHP and the GNWT in 1997. The GNWT has negotiated a similar type of agreement with Diavik Diamond Mines Inc. that will come into force shortly after the Diavik project begins commercial operations.

Other manufacturers include Cohenor and Hope Diamond with small factories in Montréal, Quebec, and Polar Star with a factory in Edmonton, Alberta.

The General and Vocational College of Matane, Quebec (Collège d'enseignement général et professionnel (CÉGEP) de Matane), enrolled about 40 students in a course on diamond cutting and polishing for the 1998/99 winter term.

Aurora College in the Northwest Territories has also developed a diamond cutting and polishing course for northern students. As well, the college has introduced a new course at its Yellowknife facilities entitled "Introduction to Diamonds." The 16-week course has space for 20 students who, upon completion of the course, will be qualified to apply for cutting and polishing jobs.

Diamond Tools and Equipment Manufacturing

These products include drill bits, segments for circular blades, grinding wheels and specialty tools. The major manufacturing plants are: Fordia at Ville St-Laurent, Quebec; Diamond Production at Montréal, Quebec; North Star Abrasives at Montréal, Quebec; Diacan at Québec City, Quebec; Diamond Systems at Dorval, Quebec; Dimatec at Winnipeg, Manitoba; JKS Boyle, Longyear, JKS Lamage, and Pilot Diamond Tools, all in North Bay, Ontario; Diaset Products at Delta, British Columbia; and Hobic Bit Industry at Richmond, British Columbia.

Diamond Jewellery Manufacturing

There are approximately 20 major plants located mainly in the Toronto region with a few in Montréal. There are also several smaller plants in Montréal.

Synthetic Diamond Production

Crystalline Manufacturing Ltd. of Calgary, Alberta, produces synthetic diamond films using the Carbon Vapour Deposition (CVD) method.

WORLD PRODUCTION

World Rough Diamond Production

World production of rough diamonds was estimated by Terraconsult bvba of Belgium at 111 Mct in 1999 compared with 120 Mct in 1998. The main reason for the decline in production was the decrease in production from the Argyle mine in Australia.

In 1999, the major producing countries included Botswana, with 21.3 Mct valued at US$1.6 billion; Russia, with 16.2 Mct valued at US$1.5 billion; South Africa, with 9.7 Mct valued at US$984 million; Congo, with 22.2 Mct valued at US$725 million; Angola, with 3.6 Mct valued at US$543 million; Namibia, with 1.6 Mct valued at US$414 million; and Australia, with 29.8 Mct valued at US$436 million.

In Namibia, Namdeb (the Namibian government (50%) and De Beers (50%) joint venture) has installed a $40 million dredge that is expected to help reach a production capacity of 1.3 Mct/y.

In Angola, production at the Catoca mine produced 1.44 Mct valued at US$92 million in 1999. The mine is an international joint-venture operation owned 33% by Alrosa from Russia, 33% by the Angolan government company Endiama, 18% by the Brazilian company Odebrecht, and 16% by Leviev Company of Israel.

During the year, the Angolan Selling Corporation (Ascorp) was formed to market Angola's diamond production. Ascorp is a partnership between Endiama, Leviev and the Belgium diamond dealer Sylvain Goldberg.

In Angola, a significant part of the alluvial diamond-producing area is under the control of the UNITA rebel forces. UNITA uses the proceeds gained from the sale of these illicit diamonds to fund its civil war effort. In 1999, the United Nations declared a ban on trade with UNITA. There is growing concern that the continued sale of the illicit diamonds (often referred to as "conflict diamonds") will eventually have an adverse impact on the worldwide sale of diamonds that come from legitimate sources.

In Botswana, work aimed at doubling production at the Orapa mine was nearly completed by year-end. Production in 1999 increased to 9.1 Mct. The full production rate of 12 Mct/y is expected to be achieved by mid-2000.

In Australia, Ashton Mining Pty continued with development at the Merlin mine site in the Northern Territory, recovering some 84 000 ct. There are four small pipes from which the company hopes to recover about 150 000 ct/y.

In 1999, production from the Argyle mine was down to 29.7 Mct from over 40 Mct the previous year. The drop was expected as a result of the expansion program at the AK1 open-pit mine. Production is expected to drop a further 10-20% during the next two years as access to some of the higher-grade portions of the orebody will be restricted as the open pit is developed further. However, by 2002, production is expected to return to the 30-Mct/y level.

Factors Affecting Diamond Mining

Grade

Grade is the weight of diamonds expressed as carats per tonne (ct/t) of ore. It varies widely from one mine to another, but generally falls somewhere between 0.3 and 1.3 ct/t. The value of the ore per tonne equals the grade times the average value per carat of all the individual diamonds in the deposit.

Size (Weight) of Rough Diamonds in the Deposit

Individually, rough diamonds can range in size from micro-sized to stones weighing in excess of 1000 ct. A much more telling measure of a mine's production is the average size of its rough diamonds. Depending on the mine, the average size of rough diamonds recovered can vary from 0.01 ct (about 1 mm in size) to more than 0.7 ct. Many mines in the world average about 0.4-0.5 ct per stone. It is interesting to note that the number of stones larger than 1 ct (0.2 g) produced at mines is very small (about 400 000 stones per year) and, in terms of total carats produced, this represents only about 0.5% of world production.

Mine Production Costs

According to different sources, production costs (excluding depreciation and interest) for kimberlites and lamproites are approximately US$5-$6/t for large and easy-to-access diamond mines operating in good climatic conditions, and are about US$35-$38/t for small mines located in remote areas and operating under harsh climatic conditions. The total production costs for these mines are around US$15/t and US$40-$45/t, respectively.

World Synthetic Diamond Production

Synthetic diamonds that are manufactured using the high-pressure and high-temperature method compete with natural industrial diamonds as an abrasive mineral, and with silicon carbide (SiC), alumina (Al_2O_3), tungsten carbide (WC) and cubic boron nitride (CBN) as a manufactured abrasive material. The value of world synthetic diamond production is estimated at US$650 million-$800 million. Most marketed synthetic diamonds are 0.6-0.8 mm and smaller. A very popular type of synthetic diamonds is called "Synthetic Diamond Abrasives" (SDA). It is used for sawing, drilling or milling hard stones, concrete aggregate, refractory materials, masonry and asphalt.

Industry sources indicate that a plant producing synthetic diamonds using the high-pressure and high-temperature method with an annual capacity of 10 Mct requires about 60-70 employees, while a plant with an annual capacity of some 50 Mct requires 160-170 employees. One large press of 10 000 t produces about 5-6 Mct of synthetic diamonds.

To produce diamond grit with grain sizes up to about 1 mm, the following method is used. High-purity graphite powder, either natural or synthetic, is mixed with a metal (nickel, cobalt or iron) powder alloy that serves as a solvent catalyst. The pressure is applied and then the temperature is raised with an electric current. Liquid metal alloy starts to dissolve the graphite. When the metal alloy becomes saturated, small crystals begin to crystallize out in the form of stable carbon, which is diamond. Synthetic diamonds are allowed to grow to a certain size. Then the temperature is decreased and when the crystals have cooled somewhat, the pressure is removed. The masses of hard material removed from the presses go to a chemical cleaning section where they are crushed and boiled in various acid baths that dissolve non-diamond materials. The diamonds are then cleaned, dried and sent to a sorting department.

In 1999, synthetic diamonds that are manufactured using the high-pressure and high-temperature

method were produced in some 20 countries. The two leading producers are De Beers of South Africa and General Electric of the United States. Together these two companies control approximately 70% of world production, and both produce a full range of synthetic diamond products. The smaller producers specialize in certain sizes and types of products. De Beers has plants near Johannesburg in South Africa; at Robertsfors, Sweden; in Hamburg, Germany; on the Isle of Man, British Isles; and in Shannon, Ireland. General Electric has plants at Worthington, Ohio, and in Dublin, Ireland.

In many applications, synthetic diamonds are preferred to natural industrial diamonds because they can be tailored (size and shape) to the customer's needs.

In general, larger crystals are used for cutting softer materials and smaller crystals are used for the tougher materials.

WORLD DIAMOND-CUTTING AND POLISHING INDUSTRY

Natural diamonds are cut and polished in some 30-40 countries. The major diamond-cutting centres in the world are Kempen and Antwerp, Belgium; Ramat-Gan and Tel-Aviv, Israel; New York City; and Surat and Mumbai (formerly Bombay), India. With the exception of India, which is a very small producer of rough diamonds, none of these countries mine diamonds. Many other countries also cut diamonds, but their industries are small.

Canada's cutting industry is very small, but its potential is good as Canadian labour costs are in line with those in New York, Antwerp, Australia and Israel. In 1997, De Beers reported that labour costs at manufacturing centres (based on the assumption that 1995 figures were used) were as follows (in U.S. dollars per hour): the United States, $20; Belgium, $14; Israel, $12; South Africa, $4; and Moscow, $3.8. In Canada, average labour costs in U.S. dollars per hour were: Montréal, $7.5; Edmonton, $7.6; Vancouver, $8.5; and Toronto, $8.7. In rural regions such as the Gaspé, labour costs were $4.7 per hour.

De Beers' estimates of manufacturing costs at the major centres are as follows (in U.S. dollars): United States, $80/ct for +3-ct roughs; Belgium, $25-$40/ct for 0.5-1.0-ct roughs (although 1.0-2.5-ct roughs are more typical); Israel, $18-$30/ct for 0.2-1.0-ct roughs; and India, $10-$12/ct for 0.1-1.0-ct roughs. For the same size of roughs noted above, other sources indicate the manufacturing costs as: United States, $50-$100/ct; Belgium, $30-$60/ct; and Israel, $25-$50/ct.

Among the four major manufacturing centres, India, Israel and Belgium are net exporters of polished diamonds and the United States is a net importer of polished diamonds.

Belgium is the world's largest trading centre for rough and polished diamonds. Its total trade in 1996, the latest year for which statistics are available, was 260 Mct valued at close to US$23 billion. Trade in rough stones was US$7.1 billion in imports and US$6.3 billion in exports, while trade in polished stones was US$4.4 billion in imports and $5.2 billion in exports.

India cuts more carats of rough diamonds than any other country. In fiscal year 1996/97, India imported 98 Mct of rough stones valued at US$3.26 billion (US$33/ct) and exported 18 Mct of polished stones worth US$4.2 billion (US$233/ct). About 90% of Argyle's cuttable production is cut in India. Imports of rough stones in India have increased steadily from 38 Mct in 1990 to 98 Mct in 1997. During that period, import prices for rough stones have decreased steadily from a high of US$52/ct to US$33/ct. Exports of polished stones from India have increased steadily from 9 Mct in 1990 to 18 Mct in 1997; this growth rate is much higher than the growth rate for diamond jewellery sales. Therefore, as can be expected, export prices for polished stones decreased steadily from US$286/ct to US$233/ct during that same period.

Israel is the second largest exporting country of polished diamonds. In 1996, rough stones for local production of polished stones (net imports minus exports) amounted to 5.74 Mct valued at US$2.98 billion (US$520/ct), and net exports of polished stones were 3.8 Mct worth US$3.998 billion (US$1050/ct). Israel is also the leader in diamond-cutting and polishing technology, including in the use of lasers and robots that cut, shape and polish diamonds. Israel cuts a very wide range of diamonds and is renowned for its fancy cuts.

New York cuts the largest and best-quality rough diamonds. In 1996, U.S. manufacturers, most of which are in New York City, imported rough stones worth US$730 million and exported rough stones (not suitable for local production of polished stones) worth US$174 million, for a net value of US$558 million. In 1996, U.S. trade in polished stones was US$2.2 billion in exports and US$5.8 billion in imports.

In Russia, most production of rough diamonds comes from Yakutia. As Russia wants to maximize employment, more diamonds mined in Russia are now cut in Russia. In 1997, preliminary figures indicate that the production of polished stones in Russia was valued at US$650 million-$700 million. Most production is exported as domestic sales of diamond jewellery only account for about US$30 million.

Diamond cutting is relatively labour-intensive when compared to many other sectors. Automated cutting

and polishing techniques are increasingly being used to compete with low-wage operations. The types of automated equipment being acquired include automatic girdling machines (sometimes connected with stroboscopes), automatic blocking and faceting machines, lasers to shape the roughs, and computers that suggest an optimal cut based on the shape and dimensions of, and inclusions in, a rough stone.

The major diamond-cutting centres have a very wide range of indirect jobs associated with them such as brokers, wholesalers, suppliers of machinery and equipment for cutters, bourses, insurance companies, travel agencies, jewellery manufacturing, etc.

Because of high labour costs, factories in New York cut bigger and better-quality diamonds. Belgium and Israel are in the middle of the labour-cost spectrum and, as a result, are generally involved in cutting stones of intermediate size and quality. India, with the lowest labour costs, cuts the smallest and least expensive diamonds. The literature also indicates that the average price per carat of polished diamonds produced in New York is about US$1400; in Antwerp, an estimated US$1000-$1100; in Tel Aviv, US$1000; and in India, US$250.

Employment related to diamond cutting and polishing (manufacturing) changes from year to year and varies widely from factory to factory, running anywhere from 1 to 3000 workers. Total employment (full-time and part-time) in diamond manufacturing varies widely from country to country. For example, literature indicates that there are 500-600 cutters in the United States; around 3100 cutters in some 250 factories in Belgium; some 7000-8000 cutters in 35 factories in Thailand (there were no factories there in 1980); 7000 workers in some 450 factories in Israel; approximately 7000-8000 sawers, bruters and polishers in some 50 factories in Russia; 3000 workers in Sri Lanka; 1000 workers in 3 factories in Botswana; 1500 cutters in 120 factories in South Africa; 10 000 workers in 80 factories in China; and 600 000-700 000 workers in 30 000 factories in India.

PROCESSING (REFINING) INDUSTRIAL DIAMONDS

Low-value natural and synthetic diamonds can be processed into higher-value products by simple methods. Processing methods for grit, powders and stones are as follows. Natural grit (about 40 microns to 1 mm in size) is crushed, washed, dried, screened into sizes, and separated into shapes (elongated vs. short) with the use of vibrating tables. The short are sold, while the elongated are ground again, and the cycle is repeated. Synthetic grit and powders are separated into sizes and shapes, cleaned of their surface impurities, and dried.

Stones (larger than 1 mm) are screened, separated into shapes and sold as such. These stones often find use as cutting tools in various manufacturing industries. In addition, these stones can be lightly rounded mechanically and then laser drilled for use as mechanical dies for wire production. There are no industrial diamond processing plants in Canada.

USES

Gem-Quality Diamonds

Gem-quality diamonds are used in jewellery. World retail sales of diamond jewellery increased rapidly in the 1990s. In 1997, preliminary figures indicate that some 67 million pieces of diamond jewellery were sold worth US$52 billion, with a total diamond content value of some US$12 billion and a diamond content weight of 21 Mct. The major markets for diamond jewellery in 1996 in terms of diamond content value were approximately as follows: the United States, 34%; Japan, 28%; Europe, 14%; East Asia, 8%; and other countries, 16%.

Industrial Diamonds

Industrial diamonds are diamonds that do not meet the standards of gem-quality diamonds because of their colour, clarity, size or shape. Industrial diamonds include natural and synthetic diamonds.

Diamonds are the hardest substance known. For this reason, the major use for industrial diamonds is as an abrasive. Industrial diamonds are used in equipment that drill, cut, grind and polish rocks (such as granite and marble), and in nonferrous metals, carbon fibres, composites, glass, refractories, ceramics, concrete, plastics, masonry bricks, etc. Natural and synthetic diamonds are widely used in the automotive, advanced technology and aerospace industries.

PRICES

Natural Diamonds

Natural industrial diamonds: Crushing bort sells for about US30¢/ct, casting sells for US$1-$2/ct, industrial stones sell for US$7-$10/ct, flets (e.g., a high-quality thin macle) sell for US$50/ct, and dies (larger diamonds of high quality but with poor (often yellow) colour that makes them unsuitable as gems) sell for up to US$200/ct.

Gem-quality rough diamonds: The price of a rough stone depends on its carat weight, shape, clarity and colour. The prices vary widely, but the following is an indication of the prices paid at cutting and polishing factories for gem-quality rough stones:

a 1-ct stone that sells for US$20 is very low quality, US$200 is medium quality, US$400 is good quality, and US$600 is top quality.

Synthetic Diamonds

Synthetic diamond prices depend on their particle strength, size and shape, and whether or not the diamonds are coated with a metal, etc. For this reason, there are several hundred prices for synthetic industrial diamonds. Generally speaking, synthetic diamonds used in grinding and polishing vary in price from US30¢/ct to US$1/ct. Strong and blocky material for use in sawing and drilling, and known in the trade as SDA and MBS (produced respectively by De Beers and General Electric), sells for up to US$3/ct. Large single crystals with excellent structure for use in specific applications sell for several hundred dollars per carat.

FORECAST AND OUTLOOK

Increases in the production of natural diamonds during the next few years will come mainly from an expansion at Orapa in Botswana and from the Ekati™ mine once full production is met. Production at Jubilee in Russia is increasing and, if needed, De Beers could expand the Venetia, Finsch and Premier mines in South Africa. Finally, the Catoca mine in Angola will also add to world production levels. Production decreases will come from the Argyle mine in Australia and from the Udachny mine in Russia.

Worldwide, the demand for polished diamonds of a size between 0.75 ct and 2-3 ct with good colour and clarity is expected to continue to be strong. The surplus of small inexpensive polished diamonds should continue for a few years.

Prices for natural industrial diamonds should continue to decline if world production remains at its present level, or increases, due to strong competition from synthetic diamonds.

Synthetic diamonds will continue to replace natural industrial diamonds.

On the production side, the production of synthetic diamonds should continue to grow at a healthy rate.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 65. (2) Information in this review was current as of January 31, 2000. (3) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set	Free	Free	Free	Free
7102.21	Diamonds, industrial, unworked or simply sawn, cleaved or bruted, but not mounted or set	Free	Free	Free	Free
7102.29	Diamonds, industrial, other	Free	Free	Free	Free
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted	Free	Free	Free	Free
7102.39	Diamonds, non-industrial, other	Free	Free	Free	Free
7105.10	Natural or synthetic diamond dust or powder	Free	Free	Free	Free

Sources: Customs Tariff, effective January 2000, Canada Customs and Revenue Agency; Harmonized Tariff Schedule of the United States, 2000.

TABLE 1. CANADA, PRODUCTION AND DIAMOND TRADE, 1997-99

Item No.		1997		1998		1999p	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
PRODUCTION							
	Northwest Territories	–	–	203 351	40 775	2 400 000	581 721
	Total	–	–	203 351	40 775	2 400 000	581 721
EXPORTS							
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set						
	United States	..	113	–	–	–	–
	Guyana	..	63	–	–	–	–
	India	..	47	–	–	–	–
	Total	..	223	–	–	–	–
7102.21	Diamonds, industrial, unworked or simply sawn, cleaved or bruted						
	United States	5 978	59	2 946	74	293	19
	Total	5 978	59	2 946	74	293	19
7102.29	Diamonds, industrial, other						
	United States	122	88	248	107	20	75
	Other countries	1 881	35	–	–	–	–
	Total	2 003	123	248	107	20	75
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted						
	United States	3	16	10 354	329	5 780	2 264
	Australia	1 061	220	–	–	–	–
	Total	1 064	236	10 354	329	5 780	2 264
7102.39	Diamonds, non-industrial, other						
	United States	7 707	10 491	1 556	5 210	1 531	4 871
	Belgium	1 439	1 143	502	569	248	132
	Other countries	891	1 340	441	519	–	–
	Total	10 037	12 974	2 499	6 298	1 779	5 003
7105.10	Natural or synthetic diamond dust and powder						
	United States	83 710	46	93 851	58	71 317	22
	Total	83 710	46	93 851	58	71 317	22
IMPORTS							
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set						
	India	..	6 453	..	13 322	..	10 162
	Israel	..	6 901	..	8 169	..	7 855
	United States	..	9 869	..	9 129	..	4 685
	Belgium	..	6 706	..	8 931	..	3 667
	Other countries	..	3 157	..	2 250	..	1 804
	Total	..	33 086	..	41 801	..	28 173
7102.21.00.10	Diamonds, industrial, bort and black, diamonds for borers, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	Belgium	–	–	..	322	..	525
	United Kingdom	–	–	..	310	..	407
	United States	–	–	..	524	..	393
	Other countries	–	–	..	456	..	459
	Total	–	–	..	1 612	..	1 784
7102.21.00.90	Diamonds, industrial, other, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	India	–	–	15	..	21 963	518
	United States	–	–	31 152r	229r	43 854	238
	Israel	–	–	14 922	138	30 575	200
	Belgium	–	–	52 678	374	13 761	81
	Other countries	–	–	31 319	225	47 418	312
	Total	–	–	130 086r	966r	157 571	1 349

TABLE 1 (cont'd)

Item No.		1997		1998		1999p	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
IMPORTS (cont'd)							
7102.21.10	Diamonds, industrial, bort and black, for borers, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	United States	226 395	845	–	–	–	–
	Belgium	93 223	662	–	–	–	–
	Other countries	294 914	1 220	–	–	–	–
	Total	614 532	2 727	–	–	–	–
7102.21.90	Diamonds, industrial, other than bort and black, for borers, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	Belgium	172 501	1 933	–	–	–	–
	Ireland	98 442	415	–	–	–	–
	Other countries	29 873	168	–	–	–	–
	Total	300 816	2 516	–	–	–	–
7102.29.00.10	Diamonds, industrial, other, bort and black diamonds, for borers, but not mounted or set						
	Hong Kong	–	–	–	–	398	105
	United States	–	–	1 086	181	560	97
	Australia	–	–	1 286	8	203	26
	Other countries	–	–	7 921	315	92	22
	Total	–	–	10 293	504	1 253	250
7102.29.00.90	Diamonds, industrial, other than bort and black, for borers, worked but not mounted or set						
	Ireland	–	–	299 376	1 888	187 991	1 108
	Belgium	–	–	817	215	5 964	440
	United States	–	–	4 340	176	16 664	156
	Other countries	–	–	6 137	182	1 420	114
	Total	–	–	310 670	2 461	212 039	1 818
7102.29.10	Diamonds, industrial, bort and black, for borers, worked, but not mounted or set						
	United States	1 973	70	–	–	–	–
	Other countries	6 921	47	–	–	–	–
	Total	8 894	117	–	–	–	–
7102.29.90	Diamonds, industrial, other than bort and black, for borers, worked, but not mounted or set						
	Ireland	704 328	3 241	–	–	–	–
	Other countries	134 024	2 270	–	–	–	–
	Total	838 352	5 511	–	–	–	–
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted, not mounted or set						
	Belgium	2 016	1 571	2 568	1 923	1 517	1 134
	Israel	142	116	1 454	950	1 304	1 069
	United States	88	43	830	441	137	69
	Other countries	1 087	768	12 171	958	253	106
	Total	3 333	2 498	17 023	4 272	3 211	2 378
7102.39.00.10	Diamonds, non-industrial, other, of a weight not exceeding 0.5 carats each						
	Israel	29 339	22 999	31 027r	21 860r	17 830	16 719
	Belgium	12 094	10 274	16 376r	14 482r	6 694	6 586
	United States	9 327	8 203	8 020	7 029	6 204	4 217
	India	7 631	2 703	9 347	3 172	4 060	1 818
	Other countries	609	1 156	1 737	1 015	600	424
	Total	59 000	45 335	66 507r	47 558r	35 388	29 764

TABLE 1 (cont'd)

Item No.		1997		1998		1999p	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
IMPORTS (cont'd)							
7102.39.00.20	Diamonds, non-industrial, other, of a weight exceeding 0.5 carats each						
	Belgium	45 072	37 574	53 346	45 104	35 944	32 836
	Israel	36 673	34 063	44 161	55 344	21 974	21 908
	India	60 178	20 132	66 205	23 686	39 025	13 657
	United States	17 989	22 108	16 655	20 825	10 572	11 499
	Other countries	3 888	5 039	3 102	2 266	5 542	3 708
	Total	163 800	118 916	183 469	147 225	113 057	83 608
7105.10.00.10	Diamond dust for borers; dust mixed with a carrier in cartridges or in tubes						
	United States	–	–	551 697	1 610	347 936	884
	Ireland			18 378	76	27 601	114
	Other countries	–	–	41 126	113	29 340	94
	Total	–	–	611 201	1 799	404 877	1 092
7105.10.00.91	Natural diamond dust and powder						
	United States	–	–	113 444	331	102 805	324
	Other countries	–	–	40 412r	92r	104 277	250
	Total	–	–	153 856r	423r	207 082	574
7105.10.00.92	Synthetic diamond dust or powder						
	Ireland	–	–	387 965	1 172	817 749	2 438
	United States	–	–	1 058 437	1 034	990 403	1 397
	Other countries	–	–	134 790	329	112 837	194
	Total	–	–	1 581 192	2 535	1 920 989	4 029
7105.10.10	Diamond dust for borers; dust mixed with a carrier in cartridges or in tubes						
	United States	2 309 406	6 333	–	–	–	–
	Ireland	402 040	1 139	–	–	–	–
	Other countries	62 488	171	–	–	–	–
	Total	2 773 934	7 643	–	–	–	–
7105.10.91	Natural diamond dust and powder						
	United States	125 343	389	–	–	–	–
	Other countries	12 177	49	–	–	–	–
	Total	137 520	438	–	–	–	–
7105.10.92	Synthetic diamond dust and powder						
	Ireland	1 029 604	2 785	–	–	–	–
	United States	1 006 125	1 932	–	–	–	–
	Other countries	149 857	439	–	–	–	–
	Total	2 185 586	5 156	–	–	–	–

Sources: Statistics Canada; Natural Resources Canada.
– Nil; . . Not available; p Preliminary; r Revised.
Note: Numbers may not add to totals due to rounding.