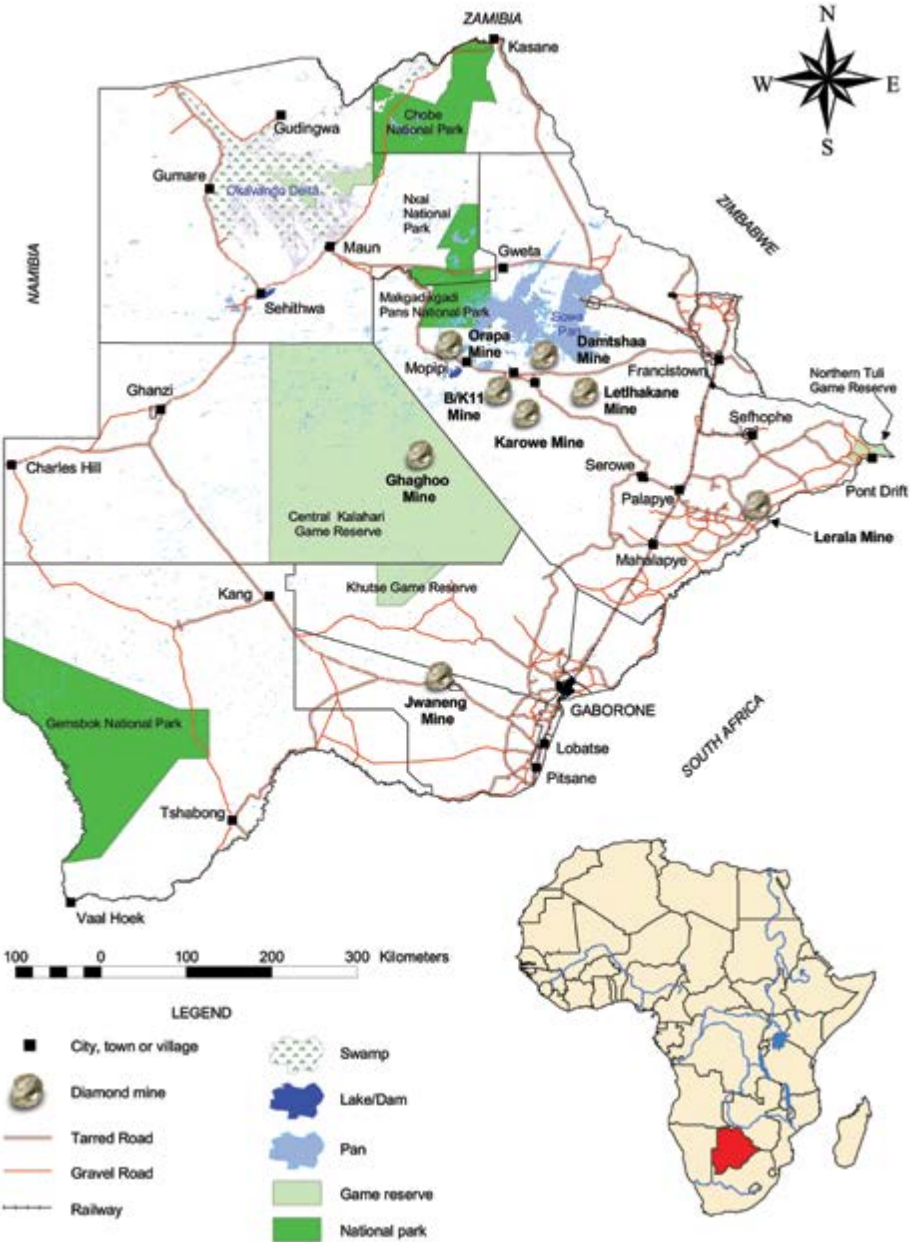
THE JOURNEY OF BOTSWANA'S DIAMONDS

Written by Michael C. Brook

DTC Botswana

Location of Botswana's Diamond Mines



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Written by Michael C. Brook

This booklet is based on a book titled
"Botswana's Diamonds - Prospecting to Jewellery"
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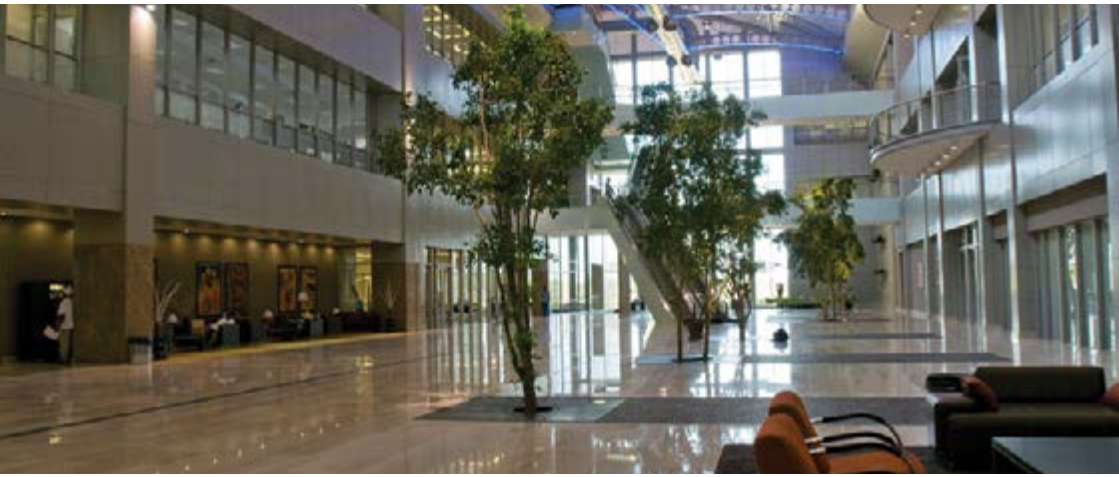
About Diamond Trading Company Botswana

Diamond Trading Company Botswana (DTC Botswana) is a 50/50 Joint Venture partnership between the Government of the Republic of Botswana and De Beers. It is the world's largest and most sophisticated rough diamond sorting and valuing operation.

DTC Botswana sorts and values Debswana Diamond Company's rough diamond production. Debswana Diamond Company (Pty) Ltd is a partnership between the Government of the Republic of Botswana and De Beers. The main purpose of the company is to mine and recover diamonds optimally and responsibly.

Debswana operates Orapa, Letlhakane, Jwaneng and Damtshaa mines in Botswana. The four mines have contributed enormously to the economic growth of Botswana, not only in terms of direct foreign exchange and government revenues generated by diamond sales, but also through the multiplier effect on taxes, employment and infrastructure in remote areas.

In addition to sorting and valuing, DTC Botswana has a Sales and Marketing function which is responsible for local sales of aggregated diamonds. Aggregation refers to a process of blending together and preparation for sale of diamonds from various producer countries. This process will guarantee our clients of a consistent supply of their desired diamonds as well as generate more value and benefits to the country.



Currently, DTC Botswana sells and markets rough diamonds to 21 cutting and polishing companies that have been licensed by the Government of Botswana to carry out cutting and polishing activities. DTC Botswana aims to facilitate, drive and support the creation of a vibrant, sustainable and profitable downstream diamond industry in Botswana that will deliver additional value for Botswana's diamonds.

With further development of the Botswana downstream diamond industry, it is estimated that there will be a good number of jobs created for Batswana in the coming years. This shows a rapid expansion of the local downstream diamond industry. The downstream activities will add value to the local diamond industry through cutting & polishing of diamonds and ultimately manufacturing of jewellery which will develop core competencies for adding higher value.

The establishment of DTC Botswana also acts as a potential catalyst for the development of new ancillary business sectors such as banking; security; information technology; and tourism; and for other international businesses to invest in Botswana. The ancillary activities will also stimulate the economic activities with further creation of jobs, increased consumer spending power, additional revenues for the country and the transfer of technology and skills.

Vision

To be the world leader in Diamond beneficiation

Purpose (Mission)

Centre of Excellence for sorting and valuing diamonds; turning Botswana's diamond dreams into lasting reality.

The Botswana Diamond Pipeline

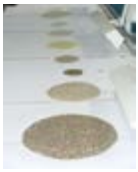
ROUGH

Prospecting

Mining

Sorting and Valuation

Aggregation



Rough Sales
DTC Botswana

POLISHED

Cutting and Polishing

Jewellery Manufacturing

Retailing

Foreword by DTCB Managing Director

This diamond educational book designed for secondary school learners, enthusiastically celebrates Botswana diamonds, with the objective of bridging the diamond knowledge gap.

Throughout this book, one will discover how diamonds were formed millions of years ago from the depths of the earth under tremendous temperature and pressure; the journey they take from extraction to various processes to turn them into spectacular pieces of jewellery.

The inspiration for the book arose from the desire to enlighten and instill a greater appreciation in society at large about diamonds - one of nature's most precious resources, and how they have and continue to contribute immensely to the Botswana economy.

Diamond Trading Company Botswana as a responsible corporate citizen acknowledges that the ability of diamonds to shape our world comes with responsibilities – continued education of the society, research and responsible use of diamond revenues. I hope that this book will contribute to the upholding of these responsibilities and help the learners to appreciate the importance of diamonds in our everyday lives and attract new talent to advance the development of the diamond industry.

This book provides exciting insights about the diamond industry and the opportunities the industry presents to young learners for future career choices. This will undoubtedly ignite a flame of curiosity and excitement for the learners.

In March 2013, DTC Botswana celebrated five years of existence. These have been years of progress and total commitment to the Botswana diamond industry. DTC Botswana is at the *"heart of the diamond industry"* in so many ways. It plays a critical role in the diamond value chain through facilitating the growth and development of the emerging downstream diamond cutting and polishing industry in Botswana.

I am quite hopeful that the wealth of knowledge contained in the book shall be of immense benefit not only to the learners but to all our stakeholders and the citizenry in general.

I hope you enjoy this book and find it valuable.

Tabake Kobedi
Managing Director

Introduction

Jwaneng Mine cubes (DTC Botswana, 2009)

Today, Botswana is the world's largest producer of diamonds by value and there are currently seven operating mines, with an eighth, Botswana's first underground mine, due to commence production in 2013. Botswana's good governance since 1966, when it became independent, has allowed the significant diamond revenue accrued by Government to be optimally used to develop a nation, which was once one of the poorest in the world to the middle-income economy of today with one of the largest Gross Domestic Products on the African Continent.

Diamond prospecting was an enormous challenge in the remoteness of the Kgalagadi Desert which makes up more than 80% of the country. In fact, it took one and a half decades after the first few rough diamonds were discovered in 1955 to open Botswana's first diamond mine at Orapa in 1971. Three other Debswana mining operations followed Orapa namely Letlhakane (1975), Jwaneng (1982) and Damtshaa (2003).

Jwaneng is the world's richest diamond mine. In addition, Lerala Mine was opened in 2008 and B/K11 and Karowe Mines in 2011. The Ghaghoo Mine is scheduled to come on line in 2013.

Botswana has now developed a full and continually expanding "diamond pipeline" encompassing the stages of diamond prospecting and evaluation, mining, processing and recovery, sorting and valuation, sales and marketing, cutting and polishing and finally diamond jewellery manufacturing and retail. The last few years have seen tremendous growth in the beneficiation of Botswana's diamond industry, involving the expanded development of the downstream stages of the pipeline, thus benefitting Botswana and Batswana substantially.

The first diamondiferous Kimberlite (the host volcanic rock which brings diamonds to the earth's surface), known as B/K1 pipe, was discovered in Botswana 15km north of Letlhakane in 1967, a year after Botswana gained independence from British colonial rule over the then Bechuanaland Protectorate. Orapa was discovered by a trio of De Beers Geologists, Jim Gibson, Manfred Marx and Dr. Gavin Lamont, who led the prospecting team. However, the first recognised diamond find in Botswana, in alluvial deposits, was made by Central African Selection Trust prospecting geologists in 1955 on the banks of the Motloutse River at Foley siding, some 250 km east of Orapa.

A very important point to make early on is just how rare and therefore valuable diamonds are. Of the approximately 6,500 kimberlites known globally to date (2010), less than 3% are diamondiferous and less than half of those are economically viable to be mined. Although more than 380 kimberlites have been found in Botswana, less than 10 are being economically mined.

Most of the other diamond production comes from mines elsewhere on the African Continent and from Russia, Australia, Canada and South America. In Africa, the other diamond producing countries are Angola, Central African Republic, Democratic Republic of the Congo, Ghana, Guinea, Ivory Coast, Lesotho, Liberia, Namibia, Sierra Leone, South Africa, Tanzania and Zimbabwe. Kimberlites have also been discovered in Gabon, Kenya, Mali, Mauritania, Swaziland, Uganda and Zambia.

2012 GLOBAL DIAMOND PRODUCTION FOR TOP 10 COUNTRIES BY VALUE

	COUNTRY	PRODUCTION	
		Value (US$)	Volume (carats)
1	Botswana	2,979,400,296.54	20,554,928.45
2	Russia	2,873,728,990.00	34,927,650.00
3	Canada	2,007,217,350.63	10,450,618.00
4	Angola	1,110,222,942.13	8,330,995.68
5	South Africa	1,027,131,959.94	7,077,431.00
6	Namibia	900,497,643.82	1,628,779.80
7	Zimbabwe	644,033,522.30	12,060,162.70
8	Lesotho	301,452,475.18	478,926.19
9	Australia	269,419,306.00	9,180,923.00
10	Democratic Republic of Congo	183,135,861.56	21,524,266.19

Source: Kimberley Process Certification Scheme

In 1967, all the tribal chiefs of Botswana signed an agreement with President Seretse Khama, surrendering all mineral rights in the tribal areas to the Botswana Government so that the prospective wealth of minerals could be shared among all their districts in Botswana.

Introduction

In the words of Dr. Gaositwe K. T. Chiepe, former Minister of Mines and Natural Resources, Trade and Industry, Foreign Affairs and Education and also the first female cabinet member in Botswana (1974), "good governance is essential to ensure that the benefits of diamonds can be spread as evenly as possible".

Dr. Chiepe was Minister of Mines and Water Affairs between 1977 - 1984 when both Orapa and Jwaneng diamond mines were opened and she took a leading role in the negotiations between the Botswana Government and De Beers.

There have been seven periods or phases in the history of Botswana's diamonds:-

1) **1954 - 1966. "The lean and mean period"** - Includes De Beers (Kimberlitic Searches) preparation for establishing prospecting units in Bechuanaland, establishing its base in Lobatse and slowly building up resources and capability. This was a lean and mean period for diamonds; the only two kimberlites, discovered near Mochudi, turned out to be non-diamondiferous.

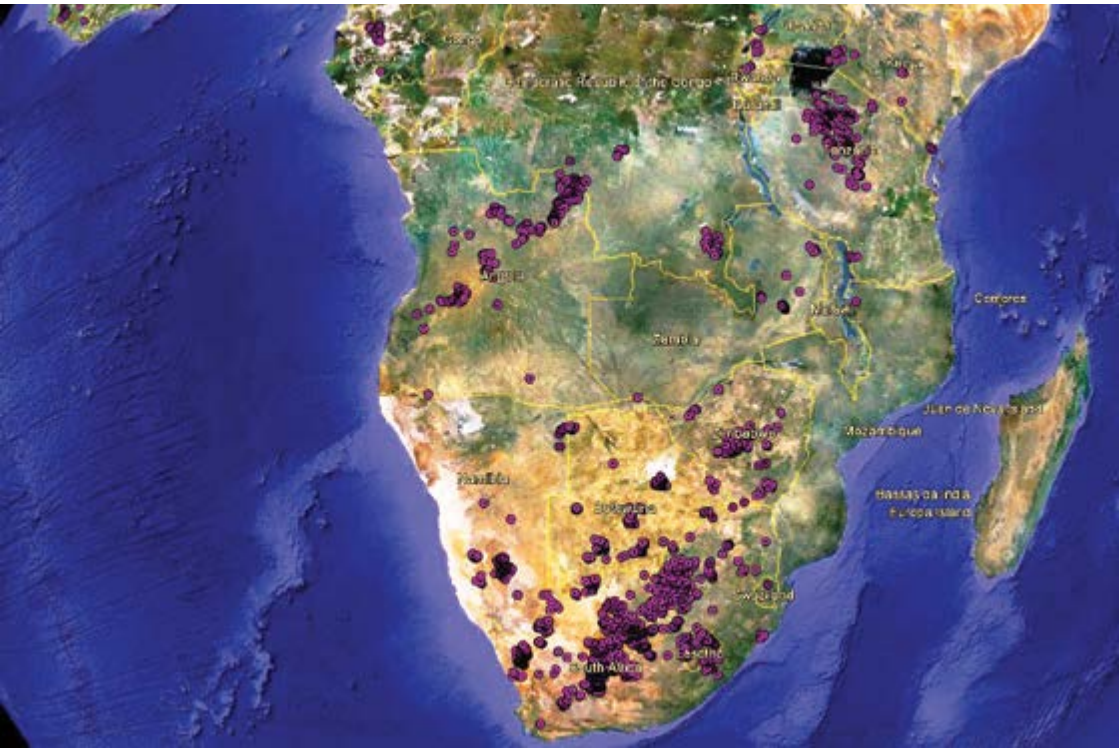
2) **1967 - 1972. "The wonderful discovery era"** and this period is in stark contrast to the previous one. Over 50 Kimberlites, mostly diamondiferous, were discovered by De Beers Prospecting, during this five year period, including Orapa A/K1, the second largest mined kimberlite in the world (after the Madui pipe at the Williamson Mine in Tanzania) and also 2125 D/K1 and D/K2, later to become the Debswana Letlhakane Mine and 2424D/K2 at Jwaneng, later to become Jwaneng Mine. There was obviously no turning back.

3) **1971 - 1982.** This was **"The decade of big mine commissionings and openings"** in Botswana which firmly placed Botswana on the world diamond scene, later to become the largest diamond producer by value.

4) **1980 - 2011. "Prospects re-visited"**. Over the last 30 years, original De Beers kimberlite discoveries in the 1960's and 1970's, which were abandoned at the time for being uneconomic, have been re-visited by others, using more advanced evaluation technology now available, and have shown the kimberlites to be now economic. Such examples are kimberlite pipes B/K 11 and A/K6 in the Orapa Kimberlite field, discovered by De Beers in 1967 and 1970 respectively, and which have now been revisited by Firestone Diamonds in 2008 and Boteti Mining in 2009, and both are now diamond mines.

5) **2003 - 2011. "The smaller mines period"**. Damtshaa Mine was opened in 2003, Lerala Mine in 2008 and both B/K11 and A/K 6 (Karowe) Mines in 2011.

6) **2006 - 2011. "The diamond valuation and trading consolidation period"**. It saw the establishment of the Diamond Trading Company Botswana (DTCB) in 2006, which replaced the former Botswana Diamond Valuing Company (BDVC), the selection of Botswana's first diamond "Sightholders" (then 16 No.) in 2007 and the construction of the DTCB HQ in 2008, the largest rough diamond sorting and valuation facility in the world.



Location of kimberlites on the African Continent (Google Earth, World Wide Kimberlite Database 2008)

Revenue from Diamond exports 1998 - 2011 (Data Source: Central Statistics Office)

Introduction

23rd June, De Beers Botswana Mining Company (Pty) Ltd - 85% De Beers, 15% Botswana Government formed, subsequently renamed Debswana in 1992

In 2011, for the first time, it was also agreed that the Botswana Government would independently sell 10% of the Debswana run-of-mine production increasing by 1% each year to 15% in 2016. De Beers also agreed to relocate Diamond Trading Company International (DTCI) from London to Gaborone by the end of 2013.

7) **2008 - 2011. "Towards Greater Diamond Beneficiation"**. Ministry of Minerals, Energy and Water Resources has stated that "Our aim and desire for diamond mining is to see all activities of the diamond pipeline undertaken sustainably in Botswana".

As a result, the Diamond Technology Park was opened in 2008 along with the Botswana Government's Diamond Hub. In 2011, Botswana became a full member of the International Diamond Manufacturing Association and hosted its annual conference in Gaborone.

In 2008, the Botswana Government clustered a number of major development projects into six hubs to attract internal and external investment. A Diamond Hub was established to facilitate beneficiation and promote Botswana as one of the world's major diamond trading centres. The following additional initiatives have also been supported by Government:-

- The construction of a new Debswana Corporate Centre in 2007
- The formation of the Botswana Diamond Manufacturer's Association in 2007
- The construction of a Diamond District incorporating a Diamond Technology Park in 2008
- The 2008 construction of a Diamond Trading Company Botswana sort house, the largest sorting and valuation facility in the world
- A strategy for the development of diamond cutting, polishing and jewellery making skills, launched in 2009
- The construction of a Secure Transfer Facility (STF) at Sir Seretse Khama International Airport in 2010
- The 2011 agreement by DTC International to move all of its sales and other operations to Botswana before the end of 2013
- The formation in early 2012 of the De Beers Aggregation Company in Botswana which will undertake the aggregation of all De Beers worldwide diamond production in Botswana for the first time
- The formation of Botswana's first state diamond trading company, the "Okavango Diamond Company", in 2012, which will sell diamonds independently from DTCB, commencing with 10% of the run of Debswana's total annual production

Following the discovery of diamonds, Botswana recorded the highest average economic growth rate in the world at about 8% per year from the 1980s to date. Growth in formal sector employment has averaged about 10% per annum over Botswana's first 30 years of independence. This sustained growth transformed Botswana from being one of the poorest countries in the world in 1966 to middle-income status by the 1990s. GDP per capita income in 2010 was US$$17,100, the third highest in Africa (after the Equatorial Guinea, $26,400 and Seychelles, $25,600).

In terms of cash flows from diamond revenues, the government receives a 10% royalty on Debswana's and other diamond mining companies' gross revenue, a company tax of 25% and withholding tax of 15% on company dividends.

Revenues from diamond mining have consistently contributed to over 30% of Gross Domestic Product and over 60% of total government revenue. Government revenue from diamonds has increased from 6.27 billion Pula in 1998 to 30.3 billion Pula in 2011, an average annual increase of 6%.

Total export earnings in 2011 increased by 24.8 % to BWP 39,998.1 million from exports in 2010, with diamond exports accounting for 75.6%.

Geological Setting and Formation of Diamonds

South pipe/quartzitic shale country rock contact at Jwaneng Mine (M. Brook, 2009)

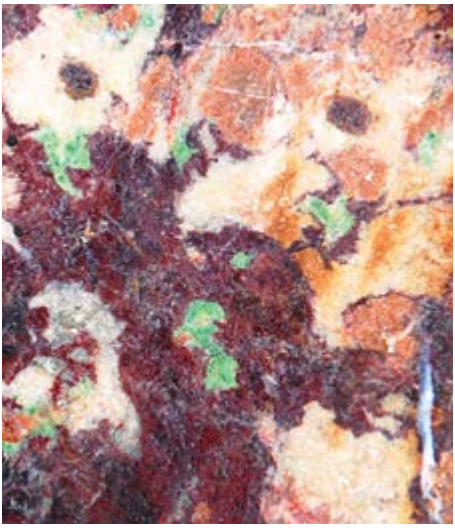
Geologically, Botswana remains relatively unexplored and undocumented, largely because of the fact that over two thirds of the country is blanketed by thick sand deposits of the Kalahari Desert. The lack of geological outcrop has made mapping difficult. In recent years however, technological advances in geophysical exploration have meant that hitherto hidden geological formations are attracting renewed attention from mining companies. Over the past decade, there has been a surge of exploration activity, not just for diamonds, but also for base metals (copper, nickel, gold, uranium etc) and coal, of which Botswana has centuries of supplies from currently un-mined deposits.

The geology of Botswana can be categorized into three main underlying groups of rock unit and sequence of geologic events:

- **Phanerozoic.** This comprises rocks which are between 500 million years old and those of the present day. Minerals that have economic potential and that are found in this time horizon, include coal, hydrocarbons, limestone, *diamonds* and brickearth.

- **Proterozoic.** Comprises rock formations that are between 500 million years old and 2.5 billion years in age. The rocks that occur in this time horizon could potentially be a source of economic minerals such as platinum, copper, silver, lead, zinc, asbestos, mineral pigments and limestone.

- **Archaean.** This is the oldest of the three categories and comprises all rock formations older than 2.5 billion years. Archaean rocks can be host to economic minerals such as gold, silver, copper, nickel, limestone and silica.



Orapa Mine Basalt Breccia Kimberlite polished section (M. Brook, 2011)

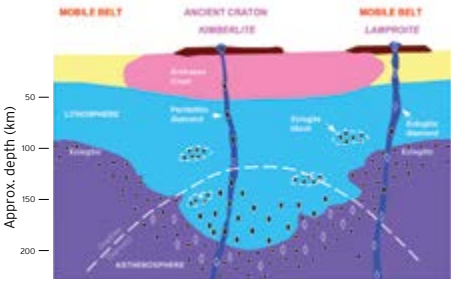
Thus the geological framework of Botswana includes cratonic regions comprising parts of ancient stable blocks of Archaean rocks.

All of Botswana's diamond mines recover kimberlite, the host rock for diamonds, and are located on or close to the Archaean cratons which played an important role in providing the right environment for diamond growth and for the formation of the kimberlite magmas that were to transport them to surface.

The reason for the association between Archaean basement and diamondiferous kimberlites (or pipes as they are called) has been explained theoretically by consideration of the structure of the cratons and the temperature/pressure relationship between graphite and diamond. Diamonds form and are preserved in a high-pressure environment present in nature at depths of over 120 kilometers beneath the earth's surface. In most parts of the Earth, the temperatures at this depth are too high for diamonds to form. However, Archaean cratons have relatively cool lithospheric roots and this region of high pressure and relatively low temperature (less than about 1200°C) provides a "window" in which diamonds can form and be preserved. Kimberlitic magmas are generated at or below these depths and may "sample" the lithospheric roots, thus collecting diamonds en route to surface. Kimberlites formed away from the craton do not sample the diamond window, and thus are unlikely to be diamondiferous.

Kimberlite is a bluish, greenish or black igneous rock with a range of minerals, including olivine, ilmenite, phlogopite, chrome diopside, garnet and calcite. They normally resemble the shape of a carrot, tapering downwards.

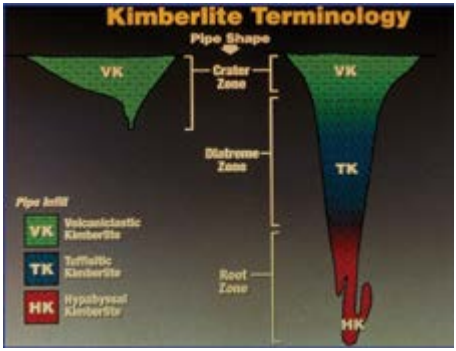
SIGNIFICANCE OF CRATONS



Significance of Cratons for Kimberlite Emplacement (De Beers Diamond Geology)

Geological Setting and Formation of Diamonds

Diamond in drill core - North pipe – Jwaneng Mine (M. Roberts, 2012)



Kimberlite Terminology (Field & Scott Smith 1998)

From work done on kimberlites in many parts of the world, three broadly distinct vertical zones are recognised, the crater, diatreme, and root zones. The crater represents the uppermost portion and is characterised by well-bedded, poorly consolidated sediments with debris-flow deposits. These sediments were sometimes laid down in a lake in the center of a volcanic crater e.g. Orapa Mine.

The middle part, the diatreme, is usually the richest in diamonds and is known as a tuffisitic kimberlite breccia or TKB. These first two parts of the kimberlite profile were termed "yellow ground" by Kimberly, South Africa mineworkers in the 19th Century.

The final part, the root zone, or "blue ground", is usually much harder and mining difficulties may be experienced due to the irregular shapes of the intrusion.

The presence and degree of preservation of these three different zones depends upon the level of erosion, the volatile content of the erupting magma and the stability and nature of the country rock surrounding the intruded kimberlite. The large, economically important kimberlites at Orapa and Jwaneng have suffered very little erosion, and their crater facies were preserved. Other pipes in South Africa at the Kimberley, Jagersfontein, and Koffiefontein mines, are eroded down to the diatreme zone.

Volcanic eruptions pass through the diamond bearing rocks deep under the Earth at depths of between 100 and more than 200 Kilometers and sometimes transport the diamonds (but always only as very rare included elements) to the surface where the

rock hardens to form the kimberlite. Often clusters of up to 50 pipes are found. In both the Orapa and Tshabong clusters and fields, over 80 kimberlites have been discovered to date. Kimberlites most commonly occur as carrot-shaped pipes, as dykes, or more rarely as sills, which have a horizontal or sub-horizontal occurrence.

The size of Botswana kimberlites varies, with the largest at 146 hectares, being the M1 kimberlite pipe in the Tshabong Field, in the Kgalagadi District, Southern Botswana.

Diamond grades within a kimberlite can vary from zero, in a non-diamondiferous pipe, to between 3 carats per hundred tonnes of kimberlite ore and greater than 200 carats per hundred tonnes in an economic diamondiferous pipe. Other factors which are important in assessing the economics of diamond pipe mining are; the average value ($) per carat and the tonnage of the resource available to be mined.

Diamond resources can be classified as primary (kimberlites and lamproites) and secondary (alluvial and marine). The dispersal of diamonds from their primary, in-situ source takes place into streams and rivers and ultimately to the coast and is generally accompanied by an increase in average value per carat, as flawed stones are progressively destroyed with greater and greater transport. The only known economically significant primary sources of diamonds are kimberlite and lamproite igneous rocks. No diamondiferous lamproites are known in Botswana where the primary sources mined are kimberlite pipes and dykes.

Of all kimberlites found, less than 1% are of economic grade. Grade is specified as carats per hundred tonnes (cpht) of kimberlitic ore. In Botswana, the eight diamond mines grades range from 8.5 cpht at B/K11 in the Orapa kimberlite field to a massive 140cpht at Jwaneng Mine, which is by far the richest diamond mine in the world with mostly gem quality diamonds.

Two distinct types of kimberlite are recognised: Group I, or olivine-rich, calcite kimberlites and Group II, or micaceous kimberlites. These distinctive groups are derived from sources in the earth's mantle that are either slightly depleted (Group I), or enriched (Group II) with respect to light rare earth elements.

Only a small proportion of kimberlites carry diamonds; for example, of the 383 kimberlites and lamproites discovered in Botswana, only 75 (19%) are diamondiferous, but only 14 (3%) of the pipes are currently mined. Kimberlites occur in twelve different kimberlite fields, the largest being at Tshabong with 86 kimberlites, followed by the Orapa field with 81 kimberlites.

It is difficult to predict whether or not a kimberlite will carry diamonds without actually testing it. This is done by bulk sampling, a stage in between the kimberlites discovery and commissioning a mine. The presence and quality of diamonds in a kimberlite can only be determined with confidence by the collection and processing of a large and representative sample.

Geological Setting
and Formation of Diamonds

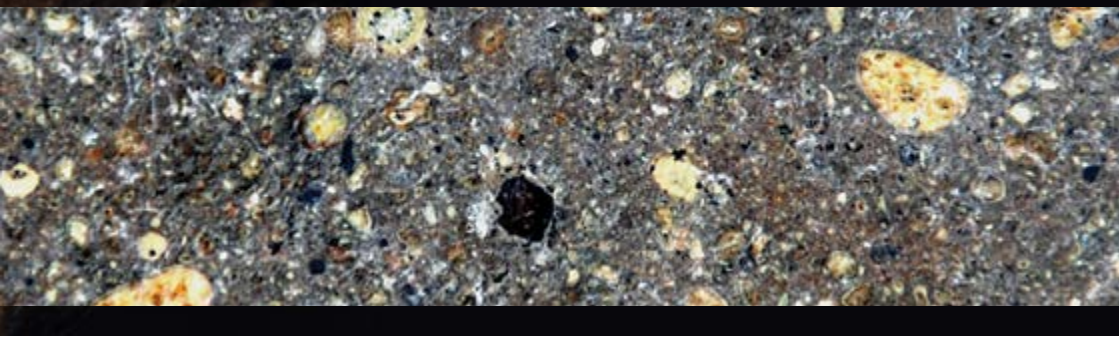
DESCRIPTION OF A DIAMOND

A diamond is not the most valuable of all precious stones, yet it unquestionably exceeds all others in interest, importance and general noteworthiness. The name diamond originates from the ancient Greek αδάμας – adámas which means "unbreakable". In hardness, in the perfection of its clearness and transparency, in its unique constants of optical refraction and dispersion, and finally in the marvellous perfection of its luster, the diamond surpasses all other minerals on earth.

Diamond is distinguished from all other precious stones no less by its chemical composition, since it has the same mineralogy as graphite (pencil lead) and charcoal, than by its unique physical characters, for no other gem consists of a single element. It is pure crystallized carbon with a cubic crystal system. The extraordinary difference in the appearance of diamond and that of other forms of carbon depends solely on the crystallization of the material and the physical characters consequent on this. Graphite has a hexagonal crystal system.

Diamonds commonly occur as octahedral crystals frequently of flattened habit, more rarely as cubes, often with curved faces. A diamond has a specific gravity of 3.5g/cm^3 and a hardness of 10 (maximum) on the Moh's scale – the hardest of all natural materials known to mankind, only a diamond can cut diamond. The mineral is transparent to opaque and may be colorless, yellowish, brown, red, blue, green and black. Gem quality diamonds are clear and grey to black and opaque, finely granular diamond is of poorer quality and is called "boart". Diamonds have a white streak and an adamantine luster, although uncut stones can appear greasy. A diamond is also the most effective heat conducting material, which also expands very little when subjected to high temperatures, unlike most other conducting materials.

Diamond is also resistant to most acids and alkalis and is transparent to X-rays – a property which is fully utilized in the



diamond recovery process. Diamonds actually luminesce or emit light when exposed to X-ray radiation. A diamond is also "un-wettable", allowing stones to be trapped on a grease belt, which is still used in some operations as a means of diamond processing or recovery.

The weight of a diamond is measured in carats. The word carat derives from the Greek word 'keration' meaning fruit of the carob. The Carob tree (Ceratonia siliqua) is an evergreen tree, with an edible pod containing seeds, which is native to the Mediterranean region. The seeds of the Carob were used on precision scales as units of weight for small quantities of precious gemstones because of their uniform size. The weight of an average carob seed is 200 milligrams. The weight of one carat is precisely 200 milligrams, or 0.2 grams.

In the Far East instead of carob beans, jewellers used rice grains to determine the weight of gemstones. Because of this fact, you may occasionally hear some jewelers referring to a 1-carat diamond as a "four grainer," which means in the past 1 carat was equal to four grains of rice. 1.5ct. would be a 6 grainer, and a 0.5ct. stone a 2 grainer.

The weight of smaller diamonds is often expressed as points, not carats. One carat is equal to 100 points. Thus, for example, a 10-point diamond has the weight of 0.1 carats. Diamonds weighing less than 1/5ct. (less than 20 points) are referred to as Melee and stones this size are set using various techniques in jewellery.

The diamond is one of the most perfectly crystallized of minerals.

There are three basic forms of diamond shapes (models) namely Octahedrons, Cubes, and Rhombic Dodecahedrons. Cubes resemble an approximate cubic shape with six faces; octahedrons have 8 faces, 4 above and 4 below; and dodecahedrons have 12 faces, roughly shaped like a football.

Having shown how kimberlites occur within "fields" within the stable craton geology, let's now explore the different prospecting methodologies which various companies have employed to discover so many kimberlites in Botswana.

Diamond Prospecting

Diamond prospecting soil sampling team, Orapa (De Beers, 1967)

With more than two thirds of Botswana covered by often thick sands and other sediments of the great Kalahari Desert, De Beers Consolidated Mines (DBCM) in Kimberly, South Africa, always knew that diamond prospecting would have its challenges here. Unperturbed, DBCM applied for their first diamond prospecting license in 1932.

After obtaining permission to prospect in the late 1930s, it was only in 1954 that DBCM, under the leadership of the late Dr. Gavin Lamont, eventually commenced preparations to enter the territory to prospect for diamonds. The delay was due to the fact that DBCM had been extremely busy already mining diamonds in South Africa at seven mines.

However, over the years, perseverance by DBCM and other prospecting companies has now led to the discovery of 383 kimberlites and by the end of 2013, there shall be no fewer than eight operating diamond mines, four belonging to Debswana, the other to four different companies, namely Boteti Diamonds – Karowe Mine, Firestone Diamonds-B/K11 Mine, Mantle Diamonds (Previously owned by DiamonEx) – Lerala Mine and Gem Diamonds – Ghaghoo Mine. The kimberlites are found in twelve different "Fields" or clusters, the one with most kimberlites being Tshabong Field (86 Kimberlites) followed by the Orapa Field (81 kimberlites). In November, 2011, there were 460 valid diamond prospecting licenses in the country, under the management of 52 different companies.

These licenses cover approximately half of the 581,730 km^2 total area of Botswana, the 47th largest country in the world.

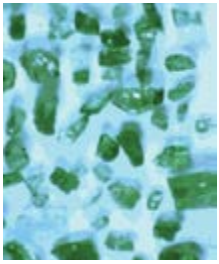
Prospecting geologists working for the Consolidated African Selection Trust (CAST) found the first confirmed diamonds in Botswana in 1955 – three small stones along the Motloutse River, near Foley, about 50km south of Francistown. They never found their source.

For the first 25 years of prospecting, geologists relied on tried and tested soil sampling methods to discover kimberlites. The diamond host rock contains a number of trace minerals, such as ruby red garnets, apple green chrome diopsides, jet black ilmenites and pale yellow olivines (collectively named "indicators") which, when found in the Kalahari sands, brought much excitement back to the old De Beers prospecting bush camps. Dr. Lamont pioneered the soil scooping method of sampling along sampling routes which spanned baselines which were cut through the Kalahari Desert. Some tracks were over two hundred kilometres long.

If a prospecting license measured 50km by 20 km a baseline would be cut through the centre and the desert sands would be sampled on each side. A prospecting team would typically comprise a team of nine people: a team leader or compass man, to keep direction, a bicycle man, to measure distance, three scoopers, to collect the soil samples, three baggers and bag carriers, to sieve, collect, label and carry the soil samples and the geologist, who would follow at the rear and ensure all bags were labelled correctly.

De Beers Roads SW Kalahari (R. Fowler, 1983)

Cr-Pyrope (ruby / purple garnets)



Cr-diopside (emerald green)

Olivine (pale yellow-green)

Mg-ilmenite (black)

Kimberlite Indicator Minerals
Source: Terrain Sciences Division, Geological Survey of Canada

Diamond Prospecting

Johaness KJ (Brot) Malema, 1935 – 2012, receiving his Presidential Certificate of Honour in 1992 (Debswana)

A working day would commence at 5am or before, depending on the time to be taken to reach the pegged baseline. A 20km walk, six days a week, was the order of the day. The team would cut their way through the bush spearheaded by the Team Leader, flanked by soil scoopers on either side and one immediately behind him. Soil samples were bagged and then sieved, to extract unwanted grasses etc. every half a kilometre until the team returned to the baseline from where they had started, to be met by a driver to return to base camp, which might be up to 50km away.

Whilst it was Dr. Lamont's leadership that directed all the prospecting operations, it was left to hard working and conscientious Batswana, from all over the country, to enact the arduous soil sampling campaigns and ensure samples were properly processed and labelled for dispatch to the laboratory. The "Docs" right hand field officer was Eleven Malema who controlled all labour in the base camps. Quietly spoken, he commanded so much respect from the youngsters fresh and keen to make an impression. His brother, the late Brot Kemang Malema, equally as competent, managed the gravitating or "jigging crews". Other senior Batswana field crew that were also instrumental in helping to find the diamondiferous kimberlites were Rexon Saranyana, Setekia Wasanena and Jacob Ramorwa.

Geophysical techniques are also often effective in diamond exploration. They can in most cases accurately detect and map kimberlite and lamproite pipes. The most cost-effective and successful geophysical reconnaissance technique used in Botswana has been airborne magnetics, flown by either fixed wing aircraft or helicopter. In 2005, De Beers also experimented with a Zeppelin. With evidence that a major contribution to kimberlite and lamproite magnetic anomalies is often remnant magnetisation, local anomalies may be of normal or reversed polarity compared to a non-magnetic background. It is common that Botswana kimberlites have reversed magnetic polarity.

Airborne electromagnetics is also extensively used in diamond exploration. While its cost is a factor of three greater than magnetics, it is particularly effective in detection of weathered or crater facies pipes and is extremely rapid to execute.

Gravity and resistivity surveys, which depend on density differences between the different country rocks of the Botswana craton environments, have also been used to successfully earmark kimberlites for drilling and delineation. Between 2005 and 2007, De Beers operated a German crewed Zeppelin, one of only three in the world at the time, in the Jwaneng and Orapa Mine lease areas to try to discover new kimberlites using high resolution gravity surveying. The Zeppelin, which weighed only 700kg, flew at less than 50m above ground and was successful in finding a small number of pipes.

In the order in which they have been extensively explored, the twelve kimberlite fields currently existing in Botswana are:-

1) **Kgatleng Field**
2) **Orapa Field**
3) **Jwaneng Field**
4) **Kikao-Khutse Field**
5) **Kokong Field**
6) **Tshabong Field**
7) **Lekgodu Field (Middlepits)**
8) **Gope Field**
9) **Mabuasehube Field**
10) **Martins Drift Field**
11) **Okwa Field**
12) **Nxaunxau Field**

Kgatleng Field (11 kimberlites)
After eleven years of prospecting work (1955-1966), young De Beers Scottish geologist, Jim Gibson, who was later to become the chief geologist at Orapa Mine for the remainder of his career, found Botswana's first two "kimberlites", Mochudi-01 and 02 at Morobe and Ramokolonyane near Mochudi in the Kgatleng District.

De Beers/Debswana Zeppelin used for Geophysics surveys (Debswana, 2005)

Despite being full of ilmenite indicators, these pipes turned out to be non-diamondiferous lamprophyre kimberlites. Prospecting by De Beers at Sikwane in 1997, discovered a further 9 non-diamondiferous kimberlites.

Orapa Field (81 kimberlites)
In 1966, De Beers, through their lack of success in Botswana, almost pulled out of prospecting in the country. Gavin Lamont pleaded with the then Consulting Diamond Geologist in Johannesburg, Dr. Louis Murray, to allow him and Jim Gibson a few months during winter of 1966 to undertake reconnaissance sampling in the western Kalahari Desert out towards Orapa.

Diamond Prospecting

De Beers Geologists Jim Gibson, Dr. Gavin Lamont and Manfred Marx at Orapa A/K1 kimberlite evaluation pit (De Beers, 1967)

"Doc" had developed a notion that the three diamonds, discovered at Foley in 1955, may have a source much further west. Dr. Murray approved the trip; thank goodness, because it was this trip that eventually led to the discovery of the Orapa Kimberlite Field in which today the Debswana Orapa, Letlhakane and Damtshaa mines operate, along with Boteti Mining's A/K6 mine and Firestone Diamond's B/K11 mine.

Firstly a five hectare kimberlite, 2125B/K1, was discovered. This became the first diamondiferous kimberlite to be discovered in Botswana, on 1st March, 1967, rapidly followed, on 17th March, by 2125B/K2. Both these kimberlites were characterized by a rise in the kalahari sand surface. Rapid baseline sampling continued in the area and another "indicator" anomaly was explored when a pit was dug over it. In the late afternoon of 19th April, 1967 Manfred Marx, De Beers geologist, climbed out of the pit with the first piece of kimberlite from the world famous 118 ha 2125A/K1 kimberlite– Orapa, soon to become Orapa Mine.

The nomenclature used for naming a kimberlite discovery, e.g. 2125A/K1, is derived from the 1:100,000 Botswana Surveys and Lands topographic map sheet – the first four numbers representing the latitude and longitude of the map sheet, the next letter shows the quadrant location, from top left to bottom right – A,B,C and D and the K1 is the sequential number used to list the kimberlites found within that quadrant.

The Orapa kimberlite was named after a nearby "moraka" or cattle post and the mine was officially opened in 1971 at a development cost of 21 million South African Rands. It has an age of 93 Million years and is situated within the Zimbabwe Craton. By the end of 1972 a total of 30 kimberlite discoveries had been made in the Orapa Field, including the Letlhakane 2125D/K1 and K2 pipes. These pipes were brought into production as the Letlhakane Mine in 1977. The last kimberlite to be discovered in the Orapa Field during this phase of exploration, 2125B/K16, was also the first kimberlite to be discovered in Botswana with the use of airborne magnetic surveys in 1970.

Between 1966 – 1976, De Beers had discovered a grand total of 79 kimberlites, 75 of which were in the Orapa Kimberlite Field and eight were diamondiferous; this was truly the heyday for them in Botswana. Between 1992 and1997, De Beers prospecting returned to the Orapa Field and discovered a further 41 kimberlites.

Today, Firestone Diamonds also holds prospecting licenses in the Orapa Kimberlite Field, in addition to the mining license for the B/K11 diamond mine. Here they have access to 21 kimberlites, 14 of which are known to be diamondiferous, including B/K 16 which was first sampled by De Beers in the 1990's. The current grade is estimated at 15 cpht (carats per hundred tonnes) and contains high value diamonds, like B/K11. However, it has a larger resources potential than B/K 11 with 17 million tonnes ore down to a depth of 200m below ground. The detailed evaluation of B/K 16 is expected to commence once B/K 11 mine is in full production by the end of 2012.

Jwaneng Field (28 kimberlites)
At Jwaneng, the main exploration method was still systematic soil sampling of surface Kalahari sediments, but only a few "indicators", mostly ilmenites, were found. Bioturbation from burrowing termites below termite mounds helped to bring what few "indicators" there were to surface. As seen at the Jwaneng Mine open pit, termites are able to burrow as deep as 70m below ground to search for moisture in the unconsolidated Kalahari sediments.

The first kimberlite discovered in the Jwaneng area, 2424D/K1, was drilled in 1972. This was followed by the discovery of 2424D/K2 in 1973.

Small diamond at centre of gravitating screen concentrate, Orapa (De Beers, 1967)

Orebonye Six Diepo undertaking a Magnetometry traverse in SW Kalahari (R. Fowler, 1983)

Diamond Prospecting

Jumper Drilling a kimberlite prospect in the Kgalagadi District (M. Brook, 1982)

The latter kimberlite was approximately 40 – 45 metres beneath Kalahari formation sediments and consisted of the coalescence of three diatremes in a single crater with a surface area of 54 ha. This 235 million year old kimberlite became known as the Jwaneng Mine which was described by De Beers Chairman, Harry Oppenheimer, at the official opening of the mine in 1982, as "the most important discovery of the century".

The Jwaneng Mine comprises three steep-sided kimberlite pipes that connect to each other approximately 100m below present day ground level. The pipes are known as the South, Centre and North Lobes, the centre lobe being the richest in diamonds. These pipes are dominated by two types of kimberlite – a volcaniclastic kimberlite and a dark pyroclastic kimberlite that intrude quartzitic shales of the Transvaal Supergroup.

A total of 28 kimberlites were discovered in this field, including 2125D/K7, a 5 ha pipe about 7km to the south east of the Jwaneng Mine.

Kikao-Khutse Field (23 kimberlites)
One of the companies, Falconbridge, a Canadian nickel company, decided to employ the aeromagnetics technique and commenced their prospecting campaign in Botswana in 1978. In 1980, Falconbridge conducted a 78,500 km^2 helicopter supported reconnaissance soil sampling program at a sample density of one sample per 165 km^2 in the semi-arid Central Kalahari area, part of which is located between Debswana's Jwaneng and Orapa diamond mines.

They began investigating areas to the east of Orapa, but were not successful. In 1981, 16 kimberlite pipes were discovered by Falconbridge in this field. They proved to be small and uneconomic and there followed a period of over 15 years of inactivity.

Four diamondiferous kimberlite intrusives, located approximately 15km west-south-west of Kikao, in the southern portion of the Central Kalahari Game Reserve, Botswana, were discovered by MPH Consulting Botswana, operating on behalf of TNK Resources, in early 1997.

Kokong Field (76 kimberlites)
In the Kokong Kimberlite Field, some 100km north – east of the Mabuasehube Kimberlite Field, Falconbridge discovered 21 kimberlites between 1978-1986, mostly from airborne magnetic geophysical surveys because the surrounding "country"rocks to the kimberlites were sandstones and shales whose magnetic signature was very quiet. Discoveries by other prospecting companies increased the number of Kokong kimberlites to 76. The most interesting Falconbridge find was the KN 70 kimberlite with a possible grade of 10 cpht. Most of the kimberlites had some crater facies associated with them. Later, a joint venture between Trivalence Mining Corporation and Rio Tinto Mining and Exploration Ltd. recovered a number of small diamonds from a kimberlite pipe in the Kokong Joint Venture Project. The joint venture discovered 39 kimberlites in addition to 37 previously discovered pipes.

Tshabong Field (86 kimberlites)
In the Tshabong area, prospected by the same joint venture of Falconbridge and Superior Oil that found Ghaghoo Mine, 86 kimberlites, of which 20 are diamondiferous, have been discovered. Most discoveries were made in 1978, when the main target was identified as "M1", which is even larger than the Orapa kimberlite pipe, in excess of 1.4 square kilometres, equivalent to the size of about fourteen English football pitches. This field has tremendous potential for a new mine discovery.

Lekgodu Field (Middlepits – 8 kimberlites)
De Beers Prospecting were the first to be active in the Middlepits area back in the early 1970's and 1980's with typical soil sampling and ground geophysics exploration.
De Beers conducted preliminary tests on 22 sites in a 250 square kilometer area and reported the presence of a fairly homogenous distribution of diamonds in the gravels present with an average thickness of 3.5 meters.

In 1995, Southern Africa Minerals Corporation drilled eight kimberlites in the field. Diamond prospecting continues in the area.

Gope Field (9 kimberlites)
Between 1978 and 1986, a Canadian company, Falconbridge, had discovered no fewer than 79 kimberlites in Botswana, 19 of which were diamondiferous, the most successful discovery being the 10.3 hectare, economical, Gope 25 kimberlite, which is currently being developed as Ghaghoo Diamond Mine by Gem Diamonds. The pipe was discovered under a Kalahari sand cover of 80m, from a small number of "Indicators" and aeromagnetics. In 1983, Falconbridge formed a joint venture with De Beers and in 1985, the Gope Exploration Company was formed and in 1988 an exploration shaft was sunk to a depth of 150m depth, with 200m of tunnels.

Diamond Prospecting

Modern Diamond Core Drill, evaluating kimberlite deposit, Northern Botswana (M. Brook, 2010)

In 2007, Gem Diamonds acquired 100% of Gope kimberlite 25 and began preparations for developing a mine under the new name Ghaghoo diamond mine.

Mabuasehube Field (9 kimberlites)
Between 1980 and 1984, De Beers Prospecting investigated the area between Tshabong and Kokong and they discovered a cluster of six non-diamondiferous kimberlites or lamproites at Mabuasehube.

There is currently no active prospecting.
Martins Drift Field (8 kimberlites)
The Martins Drift or Lerala kimberlites were first discovered by De Beers in 1991. Five pipes, K002 to K006, were discovered then with a combined size of 6.33 hectares. However, it was only in 1997 that trial mining commenced. This historical diamond production was known as the Lerala Diamond Project when De Beers Prospecting Botswana operated the "Tswapong" trial mine between April 1997 and December, 2000. 381,000 tonnes of kimberlite ore was mined from the five pipes but the grades obtained were uneconomic according to De Beers, and the project was abandoned and the prospecting license relinquished.

In 2002, DiamonEx Botswana took out their first prospecting license on the Lerala kimberlites covering an area of 71 km^2 and began to reassess the work of De Beers and also drilled additional small core and large diameter evaluation boreholes into four of the five pipes. In 2005, pitting into the kimberlite followed to allow for a bulk sampling program which recovered 851 carats from 5,476 tonnes of ore treated. The grade was found to be economic and preparations for mining began in 2008.

Okwa Field (8 kimberlites)
A detailed airborne magnetic survey was flown over the entire Okwa area by De Beers in the late 1980's in the search for kimberlites. Nothing of significance was discovered and a long period of inactivity followed. In 1990, De Beers returned and discovered seven kimberlites, OKWA-01 to OKWA -07,following up earlier geophysics targets. One additional kimberlite, OKWA-08, was discovered in 1995.

Old Prospecting Gravitating Screen with heavy "indicator" minerals at Center (De Beers, 1967)

None were found to be economic and De Beers relinquished the prospecting license. There is currently no active prospecting in this field.

Nxaunxau Field (27 kimberlites)
To date, Tsodilo Resources Limited have identified 27 kimberlites in the Nxaunxau Field in the Ngamiland District which stretches over an area of some 40km by 25km in a NW-SE orientation. An analysis of the technical characteristics of the known kimberlites in the Nxaunxau field was initiated in 2010. Two of the three kimberlites submitted for analysis had positive micro-diamond recoveries. This is the first time that such a large number of micro-diamonds had been returned from any of the kimberlites in Ngamiland. Prospecting continues.

The heyday of kimberlite prospecting took place between 1967 and 1972 during which period the kimberlite pipes belonging to most of the current eight diamond mines of Botswana were first discovered. Finding more kimberlites today is becoming increasingly more difficult, but with the current life of mines expected to end within the next 20 years or so, it is essential that all future possibilities of promising finds are exhausted by continuing with the current prospecting campaigns across the whole of Botswana.

Having understood the various prospecting and ore evaluation methods, let's now proceed to the mines where the diamonds are ultimately recovered.

Diamond Mining

Loading Waste at Jwaneng Mine Cut 8 (Debswana, 2011)

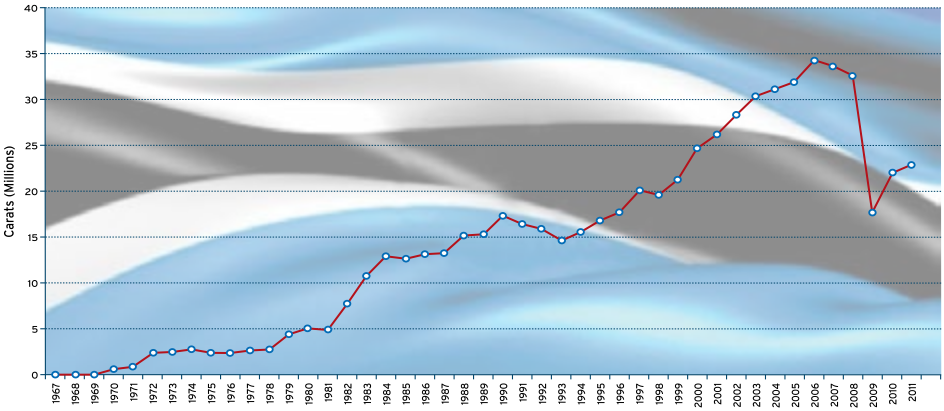
Mining in Botswana is governed by the Mines and Minerals Act, Chapter 66:01 of 1999. This main legislation governs the ownership of minerals and mineral rights (rights are vested in the Republic of Botswana), applications for mining licenses and environmental obligations.

On 23rd June, 1969, the De Beers Botswana Mining Company was formed which in 1992 was renamed Debswana.

Diamond mining in Botswana commenced on 1st July, 1971, with the official opening of Orapa Mine, 240km west of Francistown, by President Sir Sereste Khama, in the presence of Harry Oppenheimer from De Beers and John Richards, General Manager of Orapa Mine from 1970 to 1973.

The latest diamond mine to be commissioned is Boteti Diamond's A/K6 mine, some 10km west of the Debswana Letlhakane Mine which was put into operation in 2012.

There are currently seven operating diamond mines in Botswana, in order of opening; Orapa, Letlhakane, Jwaneng, Damtshaa, Lerala (formerly Tswapong Mine), B/K11 and A/K6. An eighth diamond mine, Ghaghoo Mine (previously called Gope mine) is scheduled to commence production in late 2013. The operating mines, mining about 241 hectares of kimberlite, currently typically produce about 23 million carats per year with an additional 600,000 carats being produced once Ghaghoo mine is commissioned. This combined Botswana production represents about 35% of the global diamond production.



Botswana Diamond Production 1967-2011 (Data Source: Central Statistics Office)

Diamond production in Botswana has increased year on year, with the exception of two periods, 1990 to 1993 and 2008 - 2009, because of a planned reduction in output to match lower sales caused by global financial crises. In 1967, production amounted to 1000 carats only (from the Orapa Mine bulk sampling plant), but rose to a maximum of 34.4 million carats in 2006.

In diamond mining, the mine planning process involves the optimal exploitation of the kimberlite resource.

The mine plan involves designing "cuts" into the ground, which are developed in "benches", usually 12-16m in height. The slope angle of the cut depends on the strength of the country rock mass – the stronger country rocks, e.g. Basalt, at the Debswana northern mines, may have slopes of up to 60 degrees, whereas the weaker rocks, such as mudstones, have much gentler slopes, of the order of 30 – 45 degrees. Since kimberlite diatremes are carrot in shape, with the resource tapering at depth, there is usually a requirement to mine several successive cuts before reaching the end of open pit mine life, before considering underground mining, if further cuts are uneconomical. A new mine is accurately surveyed and a production plan put in place which commences with production blast hole drilling at between 4-12 inches diameter. Benches are blasted usually one at a time by injecting liquid explosives into the bottom of the blast holes and dynamiting a sequence of holes in a single blast. Explosives are injected at predetermined quantities depending on the fragmentation required.

The next stage of mining is loading and hauling the kimberlite ore and waste rock to surface. The kimberlite ore is sent to the diamond processing plant and the country rock waste is dumped on waste dumps. If there is excess ore at the time, that ore can be dumped onto low – grade and high grade "stock or ore – piles".

Shovels as well as Front End Loaders are used to load trucks, with bucket capacities ranging from 10 – 38m^3.

Diamond Mining

Orapa Mine with Orapa Town in background (Debswana, 2011)

1st July 1971, Orapa Mine Officially opened by Sir Seretse Khama, President of Botswana and Harry Oppenheimer, Chairman of De Beers. (De Beers, 1971)

However, for the Cut 8 project in Jwaneng, a shovel was procured with a bucket capacity of 46m^3. Both mechanical and electric shovels are used and on-board electronic systems used to assist the operator in determining the load before deposition on to the trucks.

Hauling ore at Debswana Orapa Mine (Debswana)

Loading then takes place into large trucks, which at Debswana, have capacities of between 35 – 300 tonnes. GPS controlled trucks are used to haul material out of the mine to various destinations (waste dumps, plants, stockpiles). Loading and hauling is a 24-hour business, conducted usually in three shifts. All in-pit activities are monitored and recorded by an in-pit control room to ensure that safety remains the number one priority by all for all.

Botswana's Eight Diamond Mines

Orapa Mine ("Resting place for lions")
Orapa is the largest conventional open pit diamond mine in the world and the world's largest diamond mine producer by volume and is situated 240 km west of Francistown. The mine began production in July 1971 and is the oldest of Debswana's operations.

Botswana's Diamond Mines

Mine (oldest first)	Latitude	Longitude	Size (Hectares)	Typical annual production (carats)	Life of Open pit Mine (year)
Orapa (1971) A/K1	25 22 08.73	21 18 30.63	118	14,000,000	Cut 4 to 2030
Letlhakane (1977) D/K1 & D/K2	25 41 22.01	21 31 12.24	15.2	1,000,000	To 2014. thereafter 20 years tailings production
Jwaneng (1982) D/K2	24 42 07.12	24 31 25.77	54	12,000,000	Cut 9 to 2029
Damtshaa (2003) B/K9, B/K12, B/K1, B/K15	25 31 57.67	21 18 29.04	24.5	230,000	B/K12 to 2017 B/K9 to 2026
Lerala (2008) K002,003,004, 005,K006	27 45 21.78	22 46 06.65	6.33	330,000	To 2021
B/K 11 (2010)	25 30 28.25	21 28 13.77	8	225,000	To 2020
A/K 6 Karowe Mine (2012)	25 28 14.00	21 29 59.00	4,2 to 7 at depth	400,000+	To 2022
Ghaghoo (formerly Gope – GO-25) 2013 – underground mine	24 46 40.64	22 37 14.12	10.3	600,000	To 2038

The mine had to be linked to Francistown with a new road and power supply. Fortunately, ample water supply was available locally from the regional groundwater system comprising the Ntane sandstone aquifer.

A new town also had to be built from scratch; the town originally had 162 houses for married employees and single quarters for 210 men, a hospital, clinic, two schools, an adult education and training center and full recreational facilities. Today, the town's population is about 9,500 and both Orapa and Letlhakane have expanded significantly.

Justification for commencing mining at Orapa was arrived at from bulk sampling shallow pits across the whole kimbelite pipe, A/K1. A bulk sampling plant was constructed on site in 1968 and the kimberlite ore grade was evaluated to be about 50 cpht but now sits at 80 cpht. Today, the area of excavation at surface measures about 120 hectares and the 205m deep pit measures 1.2km by 1.8km.

The planned life of the current open pit is to the year 2029. But this does not include processing of the tailings dumps which have significant potential still for further diamond recovery.

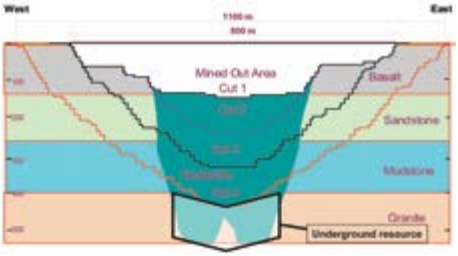
Diamond Mining

Letlhakane Mine (Debswana, 2006)

Aerial view of Debswana Damtshaa Mine and Plant, B/K9 on left, B/K12 on right, 2006 (Debswana)

In August 1996, representatives of Botswana Government, De Beers Centenary AG and Debswana Diamond Company signed an agreement to double production at the Orapa Mine. The expansion increased Orapa Mine's annual production of 6 million carats to 12 million carats from the No. 1 and No. 2 plants from the year 2000 and raised Debswana's total production to about 26 million carats per year.

In years 2005 and 2006, Orapa produced its maximum carats at 15.6 million per year. Besides the Orapa 2000 project,



Cross section of D/K1 Letlhakane Mine showing the four mined "Cuts", Letlhakane Mine designs (Debswana)

Orapa is committed to its environmental responsibilities and focuses on water conservation, waste management as well as maintenance of Orapa Game Park.

Letlhakane Mine ("Little reed")
Letlhakane Mine is situated 40km from Debswana's Orapa operation and 190 km West of Francistown, in central Botswana. The mine which was first discovered during the sampling and evaluation process at Orapa, became Debswana's second mine when it opened in 1975. The mine is managed from the larger Orapa operation.

Two kimberlite pipes are mined, D/K1 (13 hectares) and D/K2 (2.2 hectares). The D/K1 pipe has a "trouser leg" morphology and the area of excavation on surface measures 88 hectares.

The current pit depth below ground level is about 350m and the pit dimension is 1.1km x 1.1km. Ore grade is about 30 cpht and the life of the mine currently is to 2016 when both

D/K1 and D/K2 will have been mined out, after which there is potential for additional mining at D/K 1 underground or by a vertical mini-pit. In 2011, Letlhakane Mine produced 1 million carats.

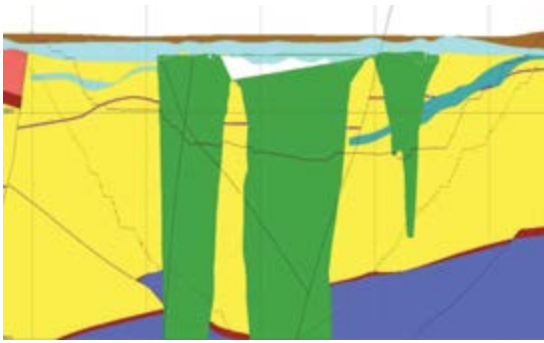
Damtshaa Mine ("Water for a tortoise")
Four small diamond pipes (B/K1, B/K9, B/K12 and B/K15) were discovered between 1967 and 1972 in an area 20km east of the Orapa kimberlite pipe. These pipes were grouped to form the Damtshaa Mine, the youngest of the Debswana mines which began operation in 2003, and are managed along with Letlhakane Mine from the Orapa operation. The ore grade for B/K9 and B/K12, the kimberlites currently mined, is about 29 cpht and annual production is a maximum of about 330,000 carats. B/K9, at 11.5 hectares, is the larger of the two mined pipes and has a current area of excavation of about 21 hectares, and a depth below surface of 50m.

B/K12 pipe area at surface measures 3.2 hectares and the current area of excavation is 7 hectares, with the pit bottom 63m below ground level. Combined with B/K9, about 2 million carats have been recovered to date. In 2008, a mining contract was awarded to a Joint Venture comprising Basil Read Mining and Bothakga Burrow Botswana. This mine, however, was temporarily closed at the end of 2008 due to the financial global crisis, but was re-opened in 2012. The life of the open pit ends in 2024.

Jwaneng Mine
("Where a small stone is found")
The Jwaneng pipe was discovered in the Naledi River Valley ('Valley of the Stars'), southern Botswana, in 1972.

Official opening of Debswana Jwaneng Mine on 14th August, 1982, by Sir Ketumile Masire, President of the Republic of Botswana, 1980 - 1998, Mike Smith, first General Manager of Jwaneng Mine, Harry Oppenheimer, Chairman of De Beers and Sir Ketumile Masire. (De Beers, 1982)

Jwaneng Mine, Cut 8 (Debswana, 2011)



Cross section of the three Jwaneng Kimberlite Pipes - Kimberlite (green), Kalahari sequence (top brown & light blue), Shales (yellow), Dolomite (lower blue)

Diamond Mining

Lerala Plant (M. Brennan, Mantle Diamonds, 2012)

At that time there were a mere 63 dwellers in the region called Jwana, the site of the present day Jwaneng Town. The mine is located on the fringe of the Kalahari Desert and at start up recruited 1,345 employees. The township of Jwaneng was developed from scratch and today has a population of just over 18,000 and has all the amenities one would expect.

Jwaneng Mine is the richest diamond mine in the world by value. It contributes about 60-70% of Debswana's total revenue. The Jwaneng mine Aquarium plant is the first of its kind in the diamond mining industry. It has the completely automated diamond recovery plant (CARP) and the fully integrated sort house (FISH).

This project brought to an end the hand sorting of diamonds. High tech x-ray scanners used at this facility ensure quick and accurate diamond recovery and maximised profit. After sorting, the diamonds from all Debswana operations are cleaned by a process of acidisation at Jwaneng.

Currently, Jwaneng is mining to a depth of 350 metres and is expected to reach 624 metres in 2017 as a result of Cut 8 mining. The resource consists of three separate volcanic pipes/vents namely north, south and centre pipes and a small kimberlite sill which erupted through Transvaal strata and the overlying Karoo sediments about 245 million years ago.

The area of the D/K2 pipe at surface is 54 hectares and the area of excavation at surface is 355 hectares. The central pipe is the richest and larger diamonds are thought to be associated with the southern pipe. The average diamond grade is 140 cpht. The pit currently measures 1.6km by 2.4km and the life of open pit is to 2027, excluding processing of the tailings dumps which have significant potential still for further diamond recovery. This extension of the pit life will be achieved by the current Cut 8 project. Production normally varies according to mining plans of approximately 12.5 to 15 million carats per year.

A/K6 Open Pit Karowe Mine (Boteti Mining, 2012)

Production blast drilling at B/K11 pit (Firestone Diamonds, 2011)

Cut 8 will extend the open pit life to the year 2027 and will recover approximately 100 million carats of mostly gem quality diamonds.

Jwaneng Mine is also surrounded by a game park, "Jwana Park", which is managed by Debswana.

Lerala Mine

The five kimberlites which make up this mine in the Central District were discovered by De Beers in 1991 but it was only in 2008 that a mine was established. The 330,000 carat per year diamond mine, originally owned by DiamondEx limited, was fully commissioned in June 2008 at a cost of US$24 million. The mine comprises five kimberlite pipes with a combined size of six hectares. The pipes are exposed at the surface and the indicated resource is 13.5 million tones of kimberlite at a grade of about 25.5 cpht. Life of mine is put at 10 years, but could possibly go deeper after that.

The mine was put on a care and maintenance basis during the 2008 global financial crisis and has yet to re-commence mining. In 2011, Lerala Mine was bought by Mantle Diamonds UK for US$3,250,000 and the latter have started preparations to re-open the mine.

B/K11 Mine

B/K11 is located approximately seven kilometres north-west and 20 kilometres south-east of Debswana's Letlhakane and Orapa mines, respectively, and is within five kilometres of Karowe Mine. The surface area of B/K11 is estimated to be eight hectares, and overburden is shallow at less than 20 metres. The pipe was originally discovered by De Beers in 1970, but was deemed to be uneconomic at the time.

Mining of this single kimberlite by Firestone Diamonds commenced in July 2010. Full production of about 10,000 carats per month was reached in 2011. The mine is expected to have a life in excess of 10 years.

Diamond Mining

General layout of Ghaghoo Mine (Gem Diamonds, 2011)

Firestone Diamonds are also evaluating another new potential mine development, B/K16, about 22km north – east of B/K11 and 12km north of Letlhakane Mine. This pipe is estimated to be at least 3.5 hectares in size and has been proved to contain 17 million tonnes of kimberlite to a depth of about 200m. Firestone also controls the rights to 21 other satellite kimberlites in the Orapa area, of which eight have been proven to be diamondiferous.

A/K6 (Karowe Mine)

The Boteti A/K6 Mine is located in the Orapa/Letlhakane kimberlite district of Botswana and was commissioned in 2012. It consists of three lobes, South, Centre and North, of which the South Lobe makes up approximately 75% of the kimberlites' resource potential.

The pipe has an area of 4.2 hectares at the surface which expands to seven hectares at a depth of 120 meters. With a grade of about 16 cpht, the reserves will be mined over a period of 11 years.

Instead of using conventional scrubbers to disaggregate the kimbelite ore in order to liberate the diamonds, this mine will utilize an AG or autogenous mill (self generating mill). The AG mill acts as a high intensity ball which produces acceleration fields 40 to 50 times stronger than gravity, producing rapid and intense breakage of kimberlite ore through high intensity tumbling. Production for 2012 is estimated at 400,000 carats which will be sold in Gaborone through the tender system. In 2011, the mine was given the name of Karowe mine, a Sesarwa name meaning a precious stone.

Blasting Kimberlite Ore at Debswana Orapa Mine (Debswana, 2004)

Ghaghoo Mine (Formerly Gope Mine)
Gope is named after the region of the Central Kalahari Game Reserve (CKGR) where the Gope 25 kimberlite pipe is located 45km within the eastern border of the CKGR. Gem Diamonds acquired Gope Exploration from De Beers and Xstrata in May 2007 for US$34 million.

In 2011, the name of the mine was changed from Gope – "Nowhere" to Ghaghoo – the Sesarwa name for the locally abundant tree – Acacia Leuderitzii – False Umbrella Thorn.

A mining license was approved in 2011 and production is expected to commence in 2013 with the life of mine currently estimated to be in excess of 30 years.

Gope's total resource is estimated at 20.5 million carats with a total average in situ value of US$3.3 billion. The average resource diamond price has been increased to US$162 per carat at a grade of about 22 cpht.

In 2011, there was a change in mine plan from open pit to underground when a box cut and 8% decline construction commenced which would expose the top of the kimberlite ore body at a depth of 150m below ground level, covered by about 80m of Kalahari sand and 70m of basalt.

Having now recovered the ore from the mines, the next stage in the diamond pipeline is to process the kimberlite in order to liberate the diamonds.

Diamond Processing

Orapa Mine Primary Crusher (Debswana, 2002)

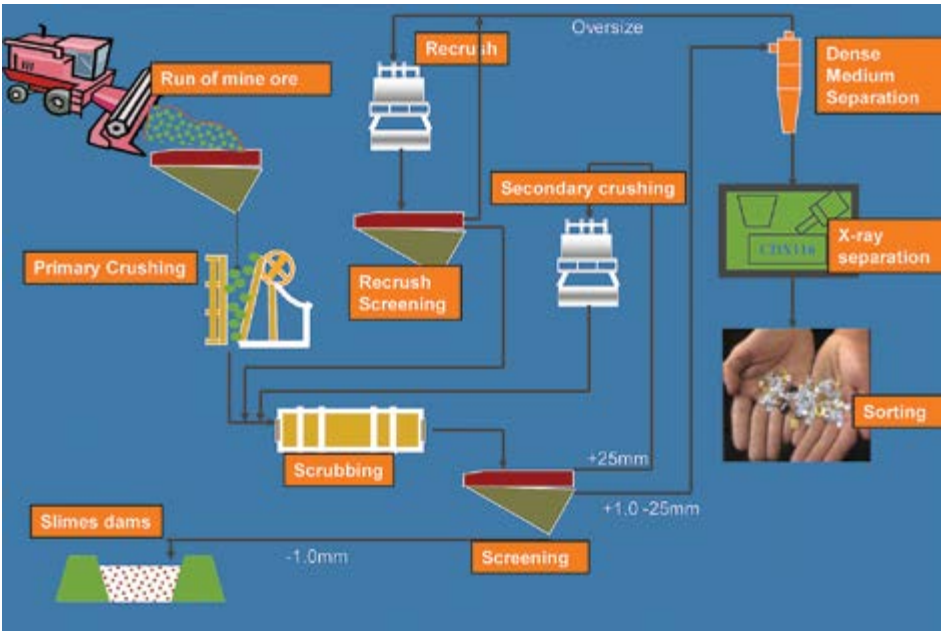
Interestingly, the methods of processing the kimberlite ore and recovering diamonds are based on processes and technology which take advantage of some of the unique properties of the diamond mineral itself.

The first, being the hardest and most robust natural material on earth, means that the mineral is resilient and can survive the first rigorous process of primary, secondary and re-crushing the kimberlite ore into smaller fragments.

The second property of the diamond which metallurgists have used in the recovery of the stones, is that of its heavier specific gravity – at 3.52 g/cm^3, it is 3½ times heavier than water and also heavier than most other minerals and as such, diamonds sink to the bottom of the chamber called a dense media separator, where they can be concentrated before undergoing X-ray processing.

This brings us to a third property of the diamond which is the fact that it is transparent to X-rays and luminesce or emit light when exposed to X-ray radiation.

When the above dense media separator concentrate is passed through beams of X-rays, diamonds show up as white objects. The X-ray technology, upon detecting the diamonds, then jets a forceful spray of air which throws the diamonds, and some surrounding concentrate, into containers which are then sorted further for the recovery of the diamonds.



A typical diamond processing plant flow chart (Debswana)

In some smaller diamond processing plants, and diamond sampling plants, a "grease table" belt is utilised which exploits another interesting characteristic of the diamond – the fact that it cannot be wetted – it repels water, just like rainwater off a duck's back, and sticks to the layer of grease coated on the conveyer belt where it is recovered by melting the collected grease once all the ore has been processed.

Although there are various diamond recovery technologies being utilized worldwide today, the two principal types are Rotary Pan plants and Dense Media Separation (DMS). Both these methods are in actual fact used for overall bulk material reduction and require yet another process before finally recovering the diamonds.

Jwanang Cut 8 replacement ore conveyor (Debswana, 2011)

Diamond Processing

Loading Kimberlite ore into the primary crusher at Jwaneng Mine (Debswana, 2004)

These systems are based on the property of diamonds having a much higher specific gravity density, as discussed above, compared to most of the other minerals which are found in situ with diamonds.

The first stage of kimberlite processing is to crush and screen the mined ore as required in order to reduce its size. The first, or primary crusher, which may be located either in – pit or at the surface of a mine, reduces the rock size from <1m to > 150mm. Some boulders several metres in size may be crushed in this process.

The reduction of the ore size by crushing therefore helps material handling and the crushed rock is then transported by rubber conveyor belts for treatment through subsequent processes, including a secondary crusher which reduces the kimberlite rock size from <150mm to > 25mm. This crushing helps to liberate (free) diamonds from the rock matrix.

A third stage of crushing, termed re-crushing, may also be used e.g. Jwaneng Recrush (inter-particle crusher) plant which then reduces the rock particle size from <25mm to > 8mm. This plant can also be used to re-crush the coarse DMS tailings (original reject material from the first crusher pass concentrate through the DMS plant). This re-crushing liberates finer locked diamonds.

Depending on the processing method being employed, material under a certain chosen size fraction may go through a scrubbing system to clean the ore prior to it being fed into the processing plant. Scrubbing basically comprises a tumbling action in a washing drum which helps disperse associated clay / agglomerated material. This scrubbing action produces a clean ore feed for efficient separation in the DMS process and also liberates entrapped diamonds from briquettes.

The next stage of processing involves screening which separates solid particles on the basis of size. Right size fractions are then produced for subsequent processing.

The final stage of diamond recovery, once the above preparatory stages have successfully been completed, is using either Rotary Pan plants or Dense Media Separation (DMS) plants.

Debswana Jwaneng Mine Main plant, seen from first benches of Cut 8 (Debswana, 2011)

Ore screening at Jwaneng Mine (Debswana, 2007)

Rotary Pan Plants

In a Rotary Pan plant, crushed ore, when mining kimberlite, or alluvial gravel and soil is mixed with water to create a liquid slurry called "puddle" which has a density in the 1.3 to 1.5 g/cm^3 range. The mix is stirred in the pan by angled rotating "teeth". The heavier minerals, or "concentrate", settle to the bottom and are pushed toward an extraction point, while lighter waste remains are suspended and overflow out of the centre of the pan as a separate stream of material which is discarded. The concentrate, representing just a small percentage of the original kimberlite ore or alluvial gravels, is drawn off for final recovery of the diamonds by a sorting process.

Dense Media Separation (DMS) Plants

In a Dense Media Separation (DMS) plant, powdered ferrosilicon (an alloy of iron and silicone) is suspended in water to form a fluid very close to the same density of diamond (3.52 g/cm^3), to which the diamond bearing material is added to begin the separation process of the heavier minerals from the lighter material. Additional separation of the denser material occurs by centrifuge in"cyclones" that swirl the mixture at low and high speeds, forcing the diamonds and other dense minerals to the walls and then out the bottom of the cyclone where it is collected. Waste water rises at the centre of the cyclones and is sucked out and screened to remove waste particles. The DMS process results in a concentrate that generally weighs less than one percent of the original material fed into the plant at the beginning of the process, and which includes a very high percentage of the diamonds originally present. The DMS tailings or discarded material may then be fed through the same process a second time to ensure complete diamond recovery is attained.

Diamond Processing

Debswana Jwaneng Mine Aquarium (Debswana, 2008)

Inside the Aquarium Diamond Recovery Plant at Jwaneng Mine (Debswana, 2009)

The final product contains mostly diamonds, with minor quantities of other material. It is fed into lockable canisters and then transported to a diamond sorting facility, such as the new Diamond Trading Company Botswana's state of the art sorting and valuation centre in Gaborone.

Rotary Pan plants are most often employed when mining alluvial deposits and DMS plants for kimberlite deposits. A primary kimberlite deposit generally has a much longer life-of-mine than an alluvial deposit and due to the nature of the deposit, allows for the development of stationary infrastructure. Thus the higher capital costs associated with a DMS plant are more easily justified.

A special mention needs to be made of the state of the art recovery and sorting building at Jwaneng, known as the "AQUARIUM", which was commissioned in 2000.

Depositing Tailings on the Orapa Mine tailings dump (Debswana, 2009)

Jwaneng Mine Paste Thickener (Debswana, 2007)

This tall set of four building structures contains a Completely Automated Recovery Plant (CARP) which is completely "hands-off" and therefore maximises security while optimising diamond recovery through the use of the latest X-ray machine technologies. CARP produces concentrate with > 50% diamond by weight. The CARP was designed to treat concentrate from the Jwaneng Main Treatment Plant (MTP), and the Jwaneng Recrush Plant, and tailings from the Jwaneng old recovery tailings dump.

Within the same "AQUARIUM" buildings, diamond sorting, cleaning, packing and weighing takes place in a fully integrated sort house (FISH) which is also completely "Hands – Off" and maximises diamond security while optimising diamond sorting through the use of laser technology.

Single Particle Sorting (SPS) is undertaken using laser technology. The feed is CARP concentrate (>50% diamond by weight) and particles are presented one at a time and detected using a laser beam, the resultant SPS product is a concentrate in excess of 95% diamond by weight. The FISH was designed to treat all Jwaneng sources, as well as diamond concentrate from Orapa CARP, consisting of

A/K6 AG Mill (Boteti Mining, 2011)

concentrates from Orapa No. 1 processing plant, Orapa No. 2 processing plant, Letlhakane Mine and Damtshaa Mine. Orapa sources are delivered on a weekly basis, while Jwaneng sources are treated as they become available.

Acid cleaning of the final SPS product is also done at FISH. Acidation using hydrochloric acid dissolves silicates or minerals attached to the diamond surface; silicates dissolve in acid but diamonds do not dissolve. Further diamond cleaning is then done at the Jwaneng Central Acidising Centre (CAC). The CAC is used to clean all of Debswana's diamond production. The final CAC product (>99% diamond by weight) is then sent to the Diamond Trading Company Botswana in Gaborone for final sorting and valuation.

Diamond Sorting, Valuation, Aggregation and Sales

Diamond sorting at DTCB

Dealing in diamonds in Botswana falls under the Precious and Semi-Precious Stones Act Cap 66:03, 1999.

In the same year that Botswana's first diamond mine at Orapa was established in 1971, the Government of Botswana formed the Botswana Diamond Valuing Company (BDVC), in Gaborone. It was then the second largest rough diamond sorting and valuing operation in the world.

BDVC was eventually registered as a company in 1972 with De Beers and Botswana Development Corporation as partners, to carry out the preliminary sorting of diamonds from Orapa Mine, which was the only operational mine at the time. In 1977, BDVC became a wholly owned subsidiary of Debswana.

Eventually, BDVC sorted and valued Debswana's entire diamond production of diamonds from the Jwaneng, Orapa, Letlhakane and Damtshaa mines, and associated various prospecting diamond deposits.

BDVC Headquarters - Orapa House, Gaborone (BDVC, 2002)

World's largest diamond and valuing sorthouse - DTC Botswana (DTCB, 2008)

Dr. Akolang Tombale and Charles Tibone, Botswana Government, and Nicky Oppenheimer, De Beers, signing the agreement to form DTCB on 23rd May 2006. (De Beers)

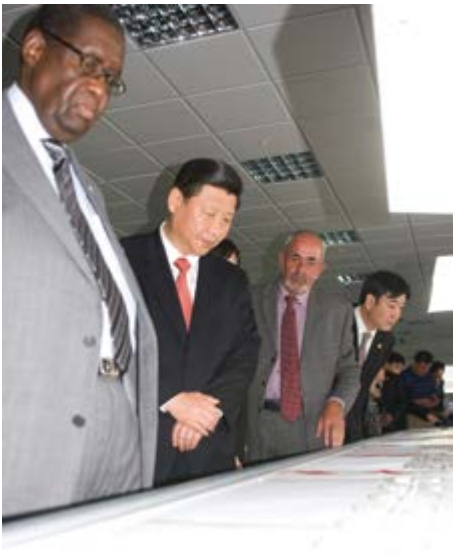
In 1974, Botswana Diamond Valuing Company Sorting building, "Orapa House" was opened in Gaborone and was the tallest and most sophisticated building in Botswana at the time. After sorting and valuation, diamonds were sold to the De Beers Central Selling Organisation (CSO) in London, which has now been replaced by Diamond Trading Company International.

The Diamond Trading Company (DTC) is the rough diamond distribution arm of the De Beers Group of Companies and is the world's largest supplier of rough diamonds, by value.

On May 23rd, 2006, the Botswana Government and De Beers signed agreements to establish the Diamond Trading Company Botswana (DTCB), a 50:50 joint venture between the Botswana Government and De Beers and which replaced the BDVC in its entirety. On March 18th, 2008, the new DTCB building opened and became the largest rough diamond sorting and valuation facility in the world funded by De Beers at a cost of US$83 million. The building is fitted with state of the art and the most advanced diamond sorting technology.

Diamond Sorting, Valuation, Aggregation and Sales

DTCB Sorting Building, Gaborone (DTC, 2008)



Xi Jimping, Chinese Vice President visiting DTCB in 2011, on his left, Minister of Minerals, Energy and Water Resources, Ponatshego Kedikilwe, and right, Brian McDonald, MD DTCB (Illustrative options, courtesy DTCB, 2011)

Unlike its predecessor, the BDVC, which only sorted and valued diamonds, DTCB also performs local sales and marketing for rough diamonds.

The building has capacity for sorting and valuing in excess of 45 million carats per year and is able to accommodate up to six hundred employees.

Through its Diamond Academy in Botswana, the DTC ensures skills transfer, training and development of local employees. DTC Botswana is the primary vehicle for creating a sustainable and profitable downstream industry in Botswana.

Today diamonds from all the Debswana mines arrive in Gaborone for sorting, however, by the end of 2013, when DTCI London's sales and aggregation function re-locates from London to Gaborone, it will additionally receive diamonds from South Africa, Canada, Namibia and any other potential mines to be opened by De Beers or from other parts of the world.

Diamonds are sorted as they arrive from the mines into different categories depending on size, shape, quality and colour, otherwise commonly known as the 4 C's – carat, cut, clarity and colour, a grading system which was invented by the Gemological Institute of America back in 1953.

DTCB supplies rough diamonds to customers called Sightholders, who are among the world's leading diamantaires. In December 2011, the number of DTCB Sightholders was increased from 16 to 21, reflecting the increased interest and confidence that the world diamond business has in Botswana.

Gem quality diamonds are based on the combination of the 4C's characteristics described below:

In terms of colour, a range of white, moving to lighter yellows and browns are regarded as gem colours, with the whiter colours being the highest value colours. Deeper colours of yellow and brown, as well as unusual colours such as orange, violet, purple, green, pink, blue and red are referred to as fancy colours.

The standard reference for size/weight is 1.00 carat = 200 milligram = 0.20 gram.

The most desired rough gem shapes are those that have high yielding forms either for rounds or fancy cuts as below:

- crystals (sharp-edged octahedrons)
- octahedrons with some rounding to the edges and points
- dodecahedrons
- rounded dodecahedral maccles
- rounded cubes

Therefore, the most desired rough gem diamonds would be those having good colour, shape and internal clarity, without ignoring the size factor.

The first step in the sorting process is to consider the size of incoming diamonds from the so called "Run of mine" production which arrives in specially sealed metal canisters.

There are three basic forms of diamonds namely Octahedrons, Cubes and Dodecahedrons.

Diamonds weighing more than 10.80 carats are classified as Large Stones or Special Stones. Each stone is assessed by hand by experts to determine its value. The next size category is for diamonds weighing between 0.66 carats and 10.79 carats which are divided into a number of weight categories using sorting technology designed and manufactured by the Diamond Trading Company (DTC).

Finally, diamonds weighing less than 0.66 carats are divided into a further six categories using sieve plates.

Unlike South Africa and Lesotho, Botswana is not renowned for the recovery of very large diamonds. Some large diamonds have been recovered but have been subsequently split in the crushing process. These larger diamonds have all been mined from Jwaneng Mine. In 1994 and 2011, several pieces of the same diamond were re-constructed to produce +600 carat stones. The largest broken diamond mined was in the year 2000 and comprised 13 pieces, the largest of which was +100 carats, which when reconstituted, formed a single diamond of 650 carats weight. The largest single, intact diamond also mined to date in Botswana also came from Jwaneng, in 1993, and weighed 446 carats.

The second step in the sorting process is termed "Model" which refers to the shape of the stone. The shape of the rough diamond often dictates the final shape and size of the polished stone.

Diamond Sorting, Valuation, Aggregation and Sales

Joseph Kabila, President of the Democratic Republic of Congo, visiting DTCB in 2011, (Illustrative options, courtesy DTCB, 2011)

Rough diamonds fall into two main model categories, "Sawable" and "Makeable". Sawable stones are often octahedral or dodecahedral in shape. The rough diamond is sawn prior to being polished. This will produce two polished stones.

Makeable diamonds tend to be broken octahedrons or dodecahedrons or flatter whole models. They usually produce one polished stone.

The third step in the sorting and valuation process is to decide on the quality of the diamond. This is a measure of the number, size, position and type of impurities, inclusions or cracks found within the stone. This significantly affects the final value of the diamond and may impact on the way it is split up into smaller stones prior to polishing. Inclusions also impact the way in which light travels through the stone, which could reduce the "fire" and brilliance of the polished diamond. An inclusion free, clean stone holds greater value because of its rarity.

The final step requires the diamond sorter to decide on the colour category. The most common colours of diamonds fall into categories from colourless to yellow and brown, although some rarer colours such as blue, orange, pink and red do appear from time to time. These very rare examples are referred to in the industry as Fancy Coloured diamonds, but these stones are rare in Botswana. Diamonds described as 'white' are actually colourless and fully transparent. Fancy coloured diamonds are generally worth much more than white diamonds due to their rarity and beauty.

It is important to supply Sightholders with a consistent assortment of rough diamonds for their factories on a regular basis to help both their production process and downstream polished diamond commitments.

Once diamonds from the individual producer countries have been valued they are carefully blended with like for like diamonds from the DTC's other producer countries to create a selling mixture. This process is called Aggregation.

The Botswana diamond industry is fully compliant to the Kimberly Process Certification Scheme (KPCS), which was launched in May 2000 in Kimberly, South

DTCB building under construction (DTCB, Courtesy, Peter McMorran, 2007)

Large sorted stones at BDVC, Gaborone (BDVC, 2002)

Africa. KPCS is an international initiative aimed at breaking the link between legitimate trade in diamonds and conflict diamonds. Conflict diamonds are rough diamonds which are used by rebel movements or their allies to finance conflict aimed at undermining legitimate governments. All DTC clients subscribe to De Beers Group of Companies Diamond Best Practice Principles which stipulate that all clients must adhere to the KPCS.

The Sales and Marketing department of DTC Botswana works as an interface between DTC Botswana and its clients to ensure that aggregated boxes of consistently sorted diamonds are distributed in the most efficient and effective way possible to local clients.

Diamonds from DTCB are sold at ten "Sights" per year.

As per the Botswana Government – De Beers 10-year sales agreement signed in September 2011, all De Beers sales to Sightholders will take place in Botswana instead of London, from the end of 2013. The 2012 De Beers sales were worth $5.5 bn.

The agreement will definitely deliver tangible outcomes and enable Botswana to achieve its aspiration to be a major diamond centre engaged in all aspects of the diamond business.

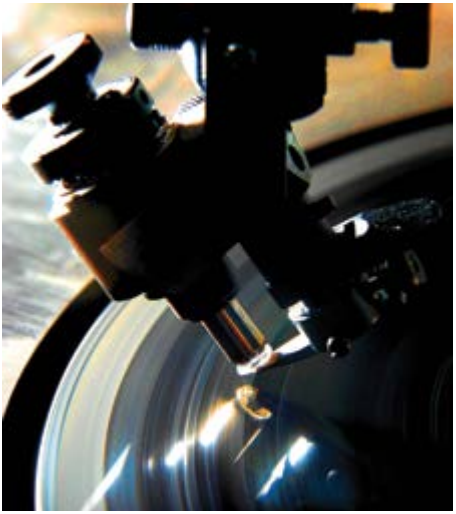
The next stage in the diamond pipeline is the cutting and polishing of the rough diamonds.

Diamond Cutting and Polishing

Diamond Technology Park Main Entrance, 2011 (M. Brook)

The diamond cutting process includes the following steps; planning, cleaving or sawing, bruting, polishing, and final inspection.

Long before the Diamond Technology Park (DTP) was set up in Gaborone in 2008 Diamond Manufacturing Botswana (DMB) established Botswana's first diamond polishing plant in Gaborone in 1976 and in 1991 Teemane Manufacturing Company was also established. Based in Serowe, and then owned by Debswana, it employed over 200 staff and exported their production to De Beers' Diamond Trading Company (DTC). In 2003, Teemane was taken over by Diarough who continue to operate the diamond cutting and polishing factory today.



Polishing the top of a rough diamond (Steinmetz, 2010)

Inside the Steinmetz diamond cutting factory, Gaborone DTP (Steinmetz, 2010)

In 1992, Lazare Kaplan Botswana opened a diamond cutting and polishing factory in Molepolole, 40km west of the capital city, Gaborone, concentrating their production on smaller stones, of less than 0.18 carats. This factory, which first employed 500 Batswana ladies was taken over by Leo Schachter Botswana in 1997. Belgium's Eurostar Group constructed a new diamond cutting and polishing factory in Gaborone in 2004 and employs about 350 staff.

However, from the mid 2000s, given Botswana's keen desire to develop more aspects of diamond beneficiation within the country, it became obvious that there was quite an urgent requirement to develop a dedicated DTP to house all the new players that would be expected to flock to Gaborone to be part of the Diamond Dream.

Diamond cutting in Botswana is regulated by the Diamond Cutting Act, Chapter 66:04, of 1979 which controls the cutting, sawing, cleaving and polishing of rough and uncut diamonds. The regulatory body for monitoring compliance with the above-mentioned Act is the Diamond Office, which is part of the Mineral Affairs division of the Ministry of Minerals, Energy and Water Resources. Currently housed in the Diamond Technology Park next to the Government Diamond Hub, the main activities of the Office are:

1) The inspection of both rough and polished stones at the diamond dealers offices;
2) Supervision of the import and export of rough and polished diamonds;
3) Issuance of Kimberly Process Certificates to diamond cutting factories;
4) Issuance of cutting and diamond dealing licences.

DTP houses diamond manufacturers as well as those servicing the diamond industry. These businesses are positioned in a secure and efficient environment, in the same neighbourhood as DTCB and the Debswana Diamond Company Corporate Centre.

Diamond Cutting and Polishing

Diamonds being prepared to be sawed by laser (Steinmetz, 2010)

The Botswana Police operate a satellite police station on site which is armed and operational 24/7, to support tenants and insurers.

The Gemological Institute of America (GIA) was established in the Botswana DTP in 2008. With a tradition of science and education, the GIA was founded in 1931 and is the world's foremost authority on diamonds, coloured stones, and pearls. The 81-year old organization created the International Diamond Grading System™ and the 4Cs (Color, Cut, Clarity and Carat weight).

Diamond cutting and polishing takes place in factories both within and outside of the DTP. Diamond cutting is the art, skill and, increasingly, science of changing a diamond from a rough stone into a faceted gem.

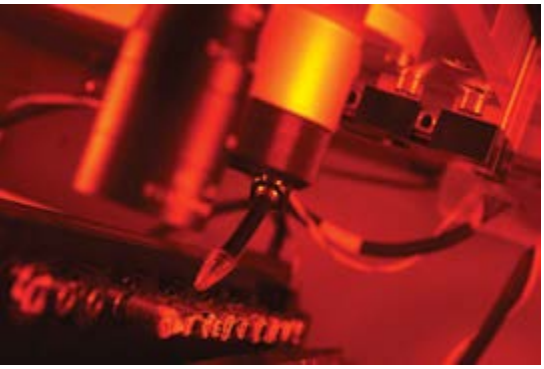
The first step of cutting and polishing a diamond is to study the rough in great detail, which is a task for a rough diamond specialist or a "Marker". He takes into account the structure of the stone and the impurities that are still in it.

Cleaving is the separation of a rough diamond into separate pieces, to be finished as separate gems. Cleaving gives the rough diamond its first shape. All irregularities of the crystal and impurities are removed at this stage. The diamond is usually divided into two or more pieces. Today cleaving is usually done by laser.

Sawing is the use of a diamond saw or laser to cut the rough diamond into separate pieces. When a diamond is sawn, the stone first needs to be positioned and with a special paste a stone is affixed in a dop (holder). The diamond cutter mounts the dop on a sawing machine or uses a laser. The saw is an extra thin blade coated with a mixture of oil and diamond powder and the rotational velocity of the disc is on average 15,000 revolutions per minute. Today, lasers are being used more often for Sawing diamonds.

Bruting is the process whereby two diamonds are set onto spinning axles turning in opposite directions, which are then set to grind against each other to shape each diamond into a round shape. This can also be known as girdling.

Polishing is the name given to the process whereby the facets are cut onto the diamond and final polishing is performed. The process takes the steps blocking, faceting, also called "*brillianteering*", and polishing. Now the diamond gets its final shape and brilliance.



Laser sawing a rough Diamond (Steinmetz, 2010)

Sawing Diamonds in the Diamond Technology Park (Steinmetz, 2010)

Firstly, 4 facets are polished on the upper part (the crown) and the lower part (the pavilion) of the diamond. The result is termed "cross work". The most famous cut is the "brilliant cut" which always consists of 57 facets: besides the table, which is the large, flat facet on the top of the diamond, it has 32 facets on the crown and 24 on the pavilion.

There are nine basic shapes to cut diamonds, namely round, oval, radiant, asscher, marquise, princess, emerald, pear and heart.

The final stage involves thoroughly cleaning the diamond in acids, and examining the diamond to see whether it meets the quality standards of the manufacturer.

The diamonds are now ready to be used in the diamond manufacturing stage of the diamond pipeline.

Close-up view of an internally flawless round brilliant cut diamond (GIA, 2011)

Diamond shapes (source, Barkevs-www.barkevs.com)

Diamond Jewellery Manufacturing and Beneficiation

Overall winning piece of the 2012-2013 Shining Light Awards designed by Banyana Mpete

Cut and polished gems (Steinmetz Botswana, 2011)

The final stage of the diamond pipeline in Botswana is the manufacture and retail of diamond jewellery, both locally, regionally and internationally. The main market currently is the USA with about 50% of the market share, however the emerging markets of China, India and other countries in Asia, will become major diamond consumers in future, dominating the overall demand for diamond jewellery globally.

Beneficiation, a strategy shared by the Government of the Republic of Botswana and De Beers, ensures that a significant portion of Botswana's currently most important natural resource, diamonds, stays in the country longer, so that value can be added through local companies and local expertise. Botswana's downstream diamond industry currently employs approximately 3,500 people.

Diamonds look dazzling in many forms and the endless options in shape, size and cut can be overwhelming for the average customer when buying a diamond. The most common basic cut diamond shapes are; Round Brilliant, Oval, Marquise, Pear-Shaped and Emerald Cut Diamonds.

In 1990, Private Collection of Botswana started its hand-made, classic diamond jewellery business in Botswana and became

Overall winning Jewellery piece of the 2008 DTCB Shining Light Awards – "Baobab Necklace" – 18ct white and red Gold, set with 674 round brilliant cut diamonds, weighing 24.95 cts (DTCB, 2009)

the first company to manufacture in Botswana, albeit on a very small, and exclusive basis. In 2011, it launched a very special unearthed Botswana Collection featuring the Okavango Delta of Botswana.

The first dedicated large scale diamond jewellery manufacturing plant in Botswana was established by Shrenuj Botswana in the Diamond Technology Park in May 2010. The firm first employed 155 people with plans to grow to 300 employees, mainly making jewellery for the United States. Botswana has preferential access to the US market under an African trade deal.

Diamond Jewellery Manufacturing and Beneficiation

Overall Winning Piece 2010-2012 DTCB Shining Light Awards by David Moatisi. Zebra Necklace - 18ct white gold neck piece set with 2,848 round brilliant black and white diamonds with a total weight of 73.17cts (DTCB, 2011)

Botswana produces rough diamonds worth about US$3 billion annually. Of this, stones worth about US$500 million are earmarked for local processing. Presently, 21 Sightholders are engaged in processing diamonds and there is a steady increase in the production of polished diamonds.

In 2007, the Botswana Diamond Manufacturers Association was established with the objective of representing the Botswana cutting and polishing industry and to assist with government policies such as labour and employment.

In 2008, the inaugural, biennial Diamond Trading Company Botswana Shining Light Diamond Jewellery Design Awards showcased the creativity and talent of designers from Botswana. The objective of these diamond studded awards is to celebrate the beauty and purpose of diamonds through jewellery design and to provide a platform for local designers to showcase their work internationally

An incredible thirty pieces of classical and beautiful jewellery, containing no fewer than 25,000 separate diamonds, were showcased at the 2010/2012 Shining Light Awards.

David Moatisi's zebra necklace was the winning design in the 2010/2012 Shining Light Awards; an 18ct white gold neck piece set with no fewer than 2,848 round brilliant black and white diamonds with a total weight of 73.17 cts.

There are a small, but increasing number of shop-based jewellery manufacturing workshops in Botswana, mostly located in the capital city, Gaborone.

As for public training and education, the new College of Applied Arts and Technology, opened in Oodi in 2012, offers, for the very first time in Botswana, a certificate, advanced certificate and Diploma in Jewellery Design and Manufacturing. The course lasts between 12-18 months, and 32 students were expected to enrol in 2012.

The Mask, Shining Lights Awards Winner, 2009 (Shrenuj, 2011)

2008-2009 Overall Winning Piece, Shining Lights Awards 'Baobab Magic', designed by Katja Nilsson and sponsored by Steinmetz (DTCB)

The opportunities for further diamond jewellery manufacturers to establish in Botswana are tremendous and many more companies are expected in the country in the next few years to take advantage of the favourable business environment and the guaranteed supply of cut and polished diamonds from the established Sightholders.

The final stage of the diamond pipeline is, in Botswana's case, to expand the beneficiation process so that Botswana becomes a recognized diamond hub for all the diamond pipeline activities from exploration, to mining, sorting, valuing, cutting, polishing, jewellery manufacturing and finally sales.

The two stages of the diamond pipeline in Botswana which are yet to be fully developed are diamond cutting and polishing and diamond jewellery manufacturing.
The development of the Diamond Technology Park is a demonstration that Government and the private sector are seriously committed to strengthening activities in these two stages of the diamond pipeline.

The inaugural 2011 Botswana meeting of the presidents of organisations affiliated to the International Diamond Manufacturers Association (IDMA) put the spotlight back on the issue of beneficiation.

Diamond Jewellery Manufacturing and Beneficiation

Botswana's Minister of Minerals, Energy and Water Resources, Dr. Ponatshego Kedikilwe and Nicky Oppenheimer, De Beers Chairman at the 16th September 2011 signing of the agreement (DTCB)

According to the Botswana Government, in November, 2011, Botswana's diamond beneficiation industry employed almost 3,262 (88% of whom are Batswana), as well as creating work in related sectors, such as banking, security and transport.

A strategy for the development of diamond cutting/polishing/jewellery making skills is also being put in place. This strategy supports the introduction of institution based diamond cutting and polishing training in Botswana. Diamond cutting/polishing and jewellery is a fast growing industry of great strategic importance to Botswana.

Employment in this sector has trebled in the last four years, and is expected to reach 6000 employees by 2016.
A number of neighbouring SADC countries have been very successful over the last 40 years or so in establishing a downstream diamond business. For example, Mauritius, which does not produce rough diamonds, employs 4,200 people in 420 domestic jewellery manufacturing units whose combined production amounts to no less than 9% of manufactured exports. Therefore, opportunities for beneficiation in Botswana are enormous!

Since diamond activities are usually developed around a central point, the area around the DTCB building and Debswana Corporate

Jim Gowans, Managing Director Debswana, 2011 - Present (Debswana)

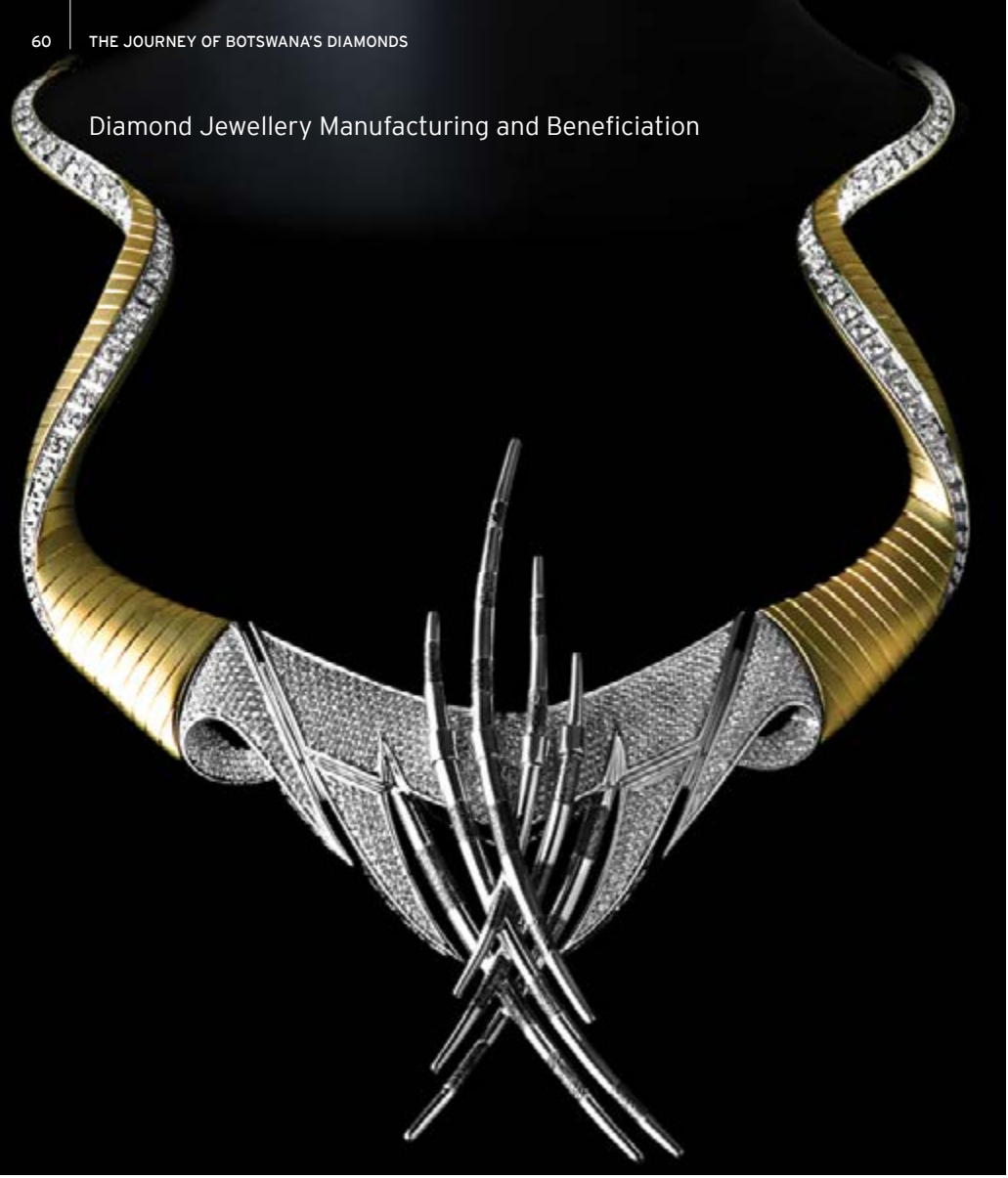
Jacob Thamage, Coordinator of the Botswana Diamond Hub 2010 - present (M. Brook, 2012)

Center are the first phase of what would become a Diamond District, since a cluster of diamond activities (located mostly within the Diamond Technology Park) are concentrated in the area with direct, secure road linkage to the airport via the STF.

In March 2012, the Botswana State Diamond Company, called the Okavango Diamond Company was formed. 2012 saw the completion of the first Government diamond trading facility at Diamond Technology Park (DTP) in Gaborone, marking the first stage of what will become a platform for independent tenders for local, regional and international diamond producers and buyers trading in Botswana.

Tabake Kobedi, appointed as first Motswana MD of DTCB, effective January, 2012

Diamond Jewellery Manufacturing and Beneficiation



Kudu Horns Necklace Shining Lights Awards, 2011 (Shrenuj, 2011)

For over 100 years diamonds have left Africa to be sorted, valued and sold in London. The announcement of the new 10-year Botswana Government – De Beers deal means that Botswana diamonds will stay in Botswana for longer to have more value added and to enable Botswana to derive more from what is essentially a finite natural resource.

The scene is at last now set for Botswana to potentially become one of the most important diamond centres of the world!!!

Glossary of Terms

Archaean	A geological era comprising rock formations older than 2500 million years.
BAHF	Bulk Acid Handling Facility
Batswana	Plural for Motswana
BOPA	Botswana Press Agency
Boart	A low quality diamond, used mostly to make industrial-abrasive grits, drill bits and also used in cutting and polishing.
Carat	Is the unit weight for diamonds and derives from the Greek word 'keration' meaning fruit of the carob. The carob tree (Ceratoniasiliqua) is an evergreen tree, with an edible pod containing seeds, which is native to the Mediterranean region. The seeds of the Carob were used on precision scales as units of weight for small quantities of precious gemstones because of their uniform size. The weight of an average carob seed is 200 milligrams. The weight of one carat is precisely 200 milligrams, or 0.2 grams.
CAC	Central Acidising Centre
CARP	Completely Automated Recovery Plant
Cluster/Field/Province	A group of individual kimberlite pipes or dykes ranging in numbers from several to 70 plus. Generally the cluster has a diameter of approximately 40 km. Several clusters form a field, whereas several fields are commonly referred to as a province.
CPHT	Carats per hundred tonnes of kimberlite ore, used to evaluate a kimberlite deposit.

Glossary of Terms

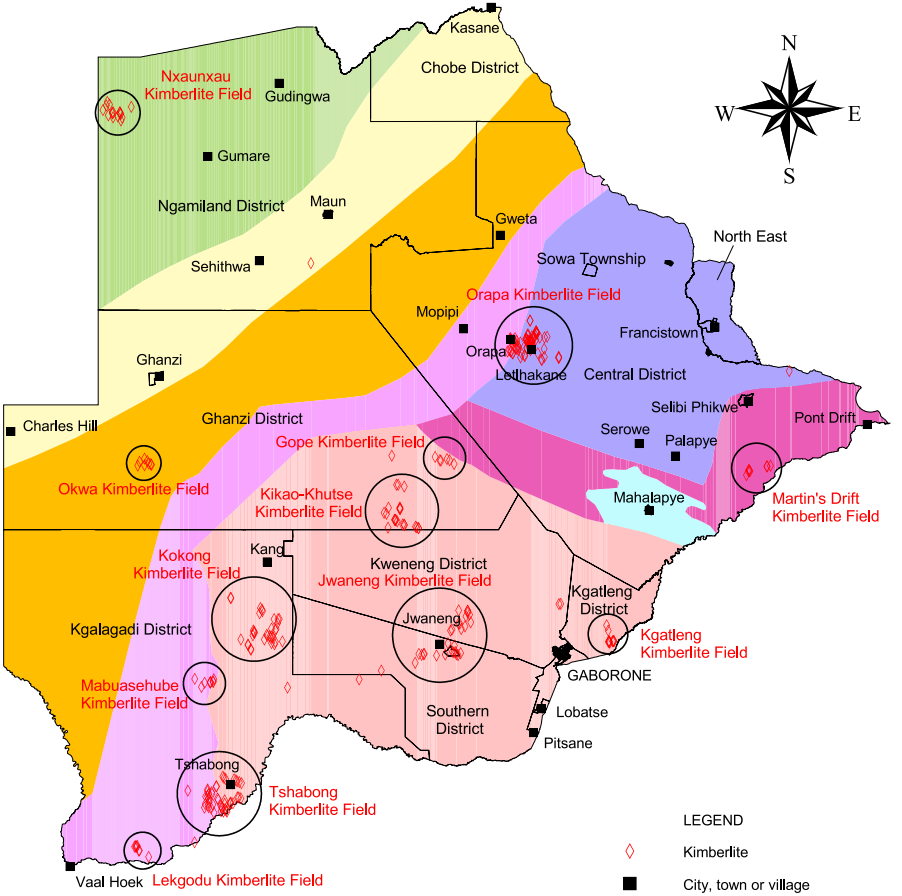
Crater	Bowl-shaped depression on the earth's surface.
Craton	Is an old and stable part of the continental lithosphere, generally found in the interiors of tectonic plates. They are characteristically composed of ancient crystalline basement rock, which may be covered by younger sedimentary rock.
Diamantaire	A highly skilled craftsman or artisan responsible for cutting, polishing and transforming a rough stone into a finished diamond ready for setting.
Diatreme	Carrot-shaped volcanic vent that has formed by explosive action.
DEBSWANA	Debswana Diamond Company
DEF	Diamond Empowerment Fund
DMS	Dense Media Separation
DTP	Diamond Technology Park
DTCB	Diamond Trading Company Botswana
Facies	Is the sum of lithologic characteristics of a kimberlite deposit in a given place.
FISH	Fully Integrated Sort House
Gabbro	A plutonic rock consisting mainly of Ca-plagioclase and clinopyroxene. An extrusive equivalent of basalt.
GIA	Gemological Institute of America
Gneiss	A high grade metamorphosed granite with a course texture of mainly biotite and plagioclase.

Hypabyssal	Applied to medium-grained, intrusive igneous rocks which have crystallized at a shallow depth below the Earth's surface.
IDMA	International Diamond Manufacturers Association
Kimberlite	A type of potassic volcanic rock best known for sometimes containing diamonds. It is named after the town of Kimberley in South Africa.
Lamproite	Are ultra-potassic mantle-derived volcanic and sub-volcanic rocks, which rarely contain diamonds.
Lithosphere	Solid outer portion of the earth including the crust and the portion of the upper mantle above the asthenosphere. Consists primarily of peridotite up to 175 km depth.
Macro-diamond	A diamond greater than 0.5mm in size.
Mantle	Zone of the earth below the crust and above the core (up to 3480 km). It is divided into the transition zone (up to 1000 km), the upper and lower mantle.
Metamorphic rock	A rock which has undergone physicochemical, mineralogical and structural changes when subjected to high temperature and pressure at depth within the earth's crust.
Micro-diamond	A diamond less than 0.5mm in size.
Motswana	Citizen of Botswana
MTP	Main Treatment Plant
Phanerozoic	This comprises rocks which are between 500 million years old and those of the present day.

Glossary of Terms

Proterozoic	Comprises rock formations that are between 500 million years old and 2500 million years in age.
PULA	The official currency of the Republic of Botswana – meaning "rain" in the national language of Setswana.
Sightholders	Diamond cutting and polishing companies that have been licenced by the Government of Botswana to carry out cutting and polishing activities in the country.
SSV	Standard Selling Values
Tuffisitic	Formed through fluidisation processes.
Xenocryst	A crystal foreign to the host magma and picked up from the wall rocks en route from melting to crystallisation site. Xenocrysts may be derived from the mantle or shallow depths.
Xenolith	A foreign inclusion in an igneous rock.
WFDB	World Federation of Diamond Bourses

Botswana's Kimberlite Fields



KIMBERLITE FIELD	NUMBER	KIMBERLITE FIELD	NUMBER
Nxaunxau	27	Jwaneng	28
Okwa	8	Mabuasehube	9
Orapa	81	Tshabong	86
Gope	9	Lekgodu	8
Kikao-Khutse	23	Kgatleng	11
Kokong	76	Other	9
Martin's Drift	8	**TOTAL**	**383**

DTC Botswana

Pride and prosperity through Diamonds

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