

DIAMOND



# Indian Minerals Yearbook 2016

(Part-III : Mineral Reviews)



**55<sup>th</sup> Edition**

**DIAMOND**

**(FINAL RELEASE)**

**GOVERNMENT OF INDIA  
MINISTRY OF MINES  
INDIAN BUREAU OF MINES**

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# 13 Diamond

**D**iamond has been the most valuable among gems for more than 2,000 years. Diamond occurs in two types of deposits primarily in igneous rocks of basic or ultrabasic composition and in alluvial deposits derived from the primary sources. Its composition is pure carbon and has cubic crystal system and common form octahedron. India is known for its diamond cutting & polishing business especially for small sized diamonds. Most of the world's diamond cutting and polishing business comes to India, particularly to Surat in Gujarat. Indian Diamond Industry handles about 80% of the global polished diamond market. India depends largely on imports of rough gem diamonds for its Cutting and Polishing Industry as there is no notable production except for one producer in Madhya Pradesh whose limited production is too sparse to meet the Cutting and Polishing Industry's requirements. The cut and polished diamonds are re-exported. Being the hardest natural substance known, industrial variety of diamonds are used in grinding, drilling, cutting and as polishing tools. In addition, diamond exhibits highest thermal conductivity amongst minerals and has high electrical resistivity making it suitable for application in semiconductors. The prices of gem diamonds depend upon their rarity, weight, quality, shape and flawlessness.

Diamond has a high refractive index and strong dispersion which gives it exciting brilliance when cut as a faceted stone. Gem diamonds are transparent and colourless or show faint shades of different colours. The transparent water-clear diamonds are known as "first water" or "blue-white". When yellowish or honey colour tinge is present, they are termed as off-colour stones. The industrial diamonds are dark brown in colour. Diamonds with green, blue or red shades are rare and attract higher price than the common varieties.

Flawless stones of good colour are abundantly used in gem trade while off-colour, flawed & defective stones, chips & cuttings as well as small grains & dust are used in industry. Industrial grade diamond, i.e., diamond that does not meet gem quality standards in terms of colour, clarity, size or shape and those that are produced as a by-product of mining for gem diamonds continue to be used principally as abrasives in many applications despite their initial cost. Although diamond is more expensive than the other abrasive materials, it is more cost-effective in numerous industrial processes because it lasts longer than any other material.

Broadly, industrial diamonds have three varieties viz, 'ballas' which is mass of minute diamond crystals difficult to cleave; 'bort'; is yellowish grey to black colour and massive, flawed or irregular in shape and 'carbonado' is black, very hard opaque and without cleavage.

## RESERVES/RESOURCES

Diamond occurrences are reported since pre-historic times in the country. Presently, diamond fields of India are grouped into four regions:

- 1) South Indian tract of Andhra Pradesh, comprising parts of Anantapur, Kadapa, Guntur, Krishna, Mahabubnagar and Kurnool districts;
- 2) Central Indian tract of Madhya Pradesh, comprising Panna belt;
- 3) Behradin-Kodawali area in Raipur district and Tokapal, Dugapal, etc. areas in Bastar district of Chhattisgarh; and
- 4) Eastern Indian tract mostly of Odisha, lying between Mahanadi and Godavari valleys.

As per the NMI data, based on UNFC system as on 1.4.2015, all India reserves/resources of diamond have been placed at 31.83 million carats. Out of these, 0.95 million carats are placed under Reserves category and 30.87 million carats under Remaining Resources category. By grades, about 2.37% resources are of Gem variety, 2.64% of Industrial variety and bulk of the resources (95%) are placed under Unclassified category. By States, Madhya Pradesh accounts for about 90.18% resources followed by Andhra Pradesh 5.72% and Chhattisgarh 4.09% (Table-1).

## EXPLORATION & DEVELOPMENT

GSI continued exploration activities for search of kimberlite, the source rock of diamond, in Andhra Pradesh, Jharkhand, Chhattisgarh, Karnataka and Telangana. Details of exploration activities by GSI are furnished in Table - 2.

**Table –1 : Reserves/Resources of Diamond as on 1.4.2015  
(By Grades/States)**

State/Grades	Reserves				Remaining resources				Total resources (A+B)			
	Proved	Probable	Total	Feasibility	Pre-feasibility	Measured	Indicated	Inferred		Reconnaissance		
	STD111	STD121	STD122	STD211	STD221	STD331	STD332	STD333		STD334		
<b>All India:Total</b>	<b>959500</b>	<b>-</b>	<b>159</b>	<b>959659</b>	<b>-</b>	<b>-</b>	<b>304601</b>	<b>1524317</b>	<b>29047514</b>	<b>-</b>	<b>30876432</b>	<b>31836091</b>
<b>By Grades</b>												
Gem	-	-	-	-	-	-	158819	1017	596929	-	756765	756765
Industrial	-	-	-	-	-	-	41664	223	798936	-	840823	840823
Unclassified	959500	-	159	959659	-	-	104118	1523077	27651649	-	29278844	30238503
<b>By States</b>												
Andhra Pradesh	-	-	-	-	-	-	200483	1524317	98155	-	1822955	1822955
Chhattisgarh	-	-	-	-	-	-	-	-	1304000	-	1304000	1304000
Madhya Pradesh	959500	-	159	959659	-	-	104118	-	27645359	-	27749477	28709136

*Figures rounded off*

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**Table-2: Details of Exploration Activities for Diamond, 2015-16**

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
<b>GSI</b>							
<b>Chhattisgarh</b>							
Mahasamund Balodabazar & Janjgir-Champa	Mahasamund		700	-	-		Aerial reconnaissance mapping was completed using IGRF - corrected aeromagnetic maps, LISS-III image and PAN data. A total 14 aeromagnetic anomaly zones and 7 intersecting lineament zones were identified and ground checked.
-do-	Banglapali Sarasdol- Mahkam area	1:25000	50	-	-	1.8 cu m 60 samples 17 stream samples	Large scale mapping was carried out. Seven new mafic dykes and one ultramafic body were identified and sampled for characterization. The ultramafic body exposed in the northern part of Banglapali is constituted of pyroxene, olivine and mica. Detailed stream sediment sampling and closed space traverses were carried out around location of earlier reported magnesio-chromite. Sample processing work was carried out to recover heavy minerals followed by binocular studies. The stream sediment samples collected from target area yielded good number of spinels, ilmenite, garnets, pyroxenes and gold flakes: The spinels were typical of KCR type and have been selected for further SEM-EDX and EPMA analysis. Detailed sampling was also carried out in the upslope direction of gold incidences. Seven thin sections were prepared for petrographic studies. Trace element data and REE data of 5 petrochemical samples were received.  As per the recommendations of Term Review Committee, aerial reconnaissance was also carried out. Closed-space traverse were carried out in Kesharpur area and stream sediment samples were collected from where magnesio-chromite was reported earlier. These stream sediment samples yielded spinels, which were selected for SEM-EDX and EPMA analysis. Aeromagnetic maps, LISS-III images and PAN data were consulted and anomalous zones were ground checked. A total of 145 polished mounted grains were submitted to SEM Lab for further analysis. The investigation will be continued.

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Table-2: (Contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
<b>Chhattisgarh</b>							
Mahasamund			700	-	-	54	An exploration project of G-4 stage was carried out in search of KCR by integrating PGRS and aeromagnetic data of 1400 sq km .Ten target blocks were demarcated . Ground checks were also carried out in the targeted blocks on priority basis.
		1:50000	495	-	-	8 petrographic 6 petrochemical 140 stream sediment samples (SSS)	Reconnaissance mapping and stream sediment sampling was carried out. Petrological samples along with petrochemical were also collected for laboratory studies. A total of 140 stream sediment samples were collected for heavy mineral separation. At places pedogeological samples were collected and processed for heavy mineral separation. Eighteen thin sections were prepared for petrographic studies. Stream sediment samples were also collected for heavy mineral separation and heavy minerals were studied under binocular microscope and 525 grains (including 200 garnet, 150 spinel, 150 ilmenite and 25 pyroxenes) were selected and epoxy mounted for further studies under SEM-EDX and EPMA. The investigation will be continued.
<b>Jharkhand</b> Simdega	-		700	-	-	150 stream sediment samples(SSS)  25 petrographic samples (PS)  20 petrochemical samples (PCS)  20 ..... samples (CA)	Mineral investigation project for search of kimberlite/lamproite was carried out. It is a part of Chhotanagpur Gneissic Complex (CGC). The SSS were processed to get heavy mineral concentrates (coarser between 1.25 and 0.5 mm and finer between 0.5 and 0.17 mm). Scanning of heavy mineral samples (HMS) was carried out under trinocular stereo-zoom microscope. The heavy- mineral concentrates mostly consist of garnet, ilmenite, tourmaline, amphiboles, spinels, epidote, zircon, rutile and a few suspected

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Table-2: (Contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
<b>Karnataka</b> Gulbarga Raichur	-	-	-	-	-	-	microdiamonds. EPMA analysis of some garnets reveals that they are eclogitic in nature. Also an inclusion of forsterite (olivine) within garnet, confirms their derivation from mantle. Raman spectrometry will be carried out to confirm the microdiamonds. Indicator heavy minerals will be submitted for EPMA. PS, PCS and CA samples have been submitted to Petrology Laboratory and Chemical Laboratory, Kolkata respectively. Apart from that, traverses were taken and a few ultramafic bodies including two lamprophyre dykes were reported in these area.
<b>Andhra Pradesh</b> Anantapur and <b>Telangana</b> Mahabubnagar	-	-	-	-	-	-	Gold search for kimberlite/lamproite and secondary diamonds was carried out in Southern Region. One MoU between De Beers India Pvt. Ltd and GSI was also done in Narayanpet and Wajrakarur areas of Raichur district of Karnataka and Anantapur and Mahabubnagar district of Andhra Pradesh and Telagana resectively. Based on mineralogy four ultramafic dykes around Kettepalli-Telralapalli area and two bodies around Ankiraopalli locality are classified as alkali lamprophyres. One lamprophyre dyke indentified in Sekhpalli locality is mica and pyroxene rich variant.
<b>Andhra pradesh</b> Kadapa	Pennar river basin	-	-	-	-	260 cu m 318 tonnes of bulk sample	The alluvial diamond deposits along the River Pennar, between Jammalamadugu and Chennur-Kanuparthi-Kondapeta belt, have been known from ancient times, however, no systematic studies were carried for placer diamonds in modern era. A reconnaissance survey was initiated through detailed PGRS studies, geophysical line traverses, sedimentological studies and detailed drainage morphometric analysis of the area between Pushpagiri and Siddavatam, Kadapa district, to map the distribution of surface gravels and buried/paleo-channels of Pennar River and prove its diamond potential. This resulted in identification of hidden gravel bed 50 cm beneath the soil cover in village Obulampally . Test pitting was carried out using ground geophysical data. A 2.5 to 4 m thick gravel bed extending up to 1 km in length in E-W direction was identified for bulk sample collection. The sample mainly consists of brown to black

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Table-2: (Contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
<b>Andhra Pradesh</b> Kurnool						178 stream sediment samples	soil mixed with a bed of rolled stones of various sizes, from that of paving-stone to a nut. Stones are mingled with mud and gravel. Two Gem Quality diamonds of 0.45 carat and 0.15 carat, which are resorbed and modified from dodecahedron were recovered from +2.5 mm and +1.25 mm fraction of the gravel processed, proving the diamondiferous nature of the Pennar River. The study has conclusively proved the diamondiferous nature of Pennar River gravel. Associated Kimberlite Indicator Minerals (KIMS) like garnet, ilmenite, spinel, etc. from the gravel material were also separated and its mantle origin was confirmed by EPMA studies, this will help in narrowing down the provenance for the diamonds of Pennar River. The study has conclusively proved the diamondiferous nature of Pennar River gravel which needs to be further systematically evaluated and explored to prove its resources.
<b>Telangana</b> Mahabubnagar	Kollapur and Srirangapur block	-	-	-	-		Investigations (G-4) were carried out for search of kimberlite/lamproite. An integrated structural liement map was prepared by the study of LISS-III satellite images, aerial photographs, aerogeophysical maps and topographic/tonal lineaments from Google images. The lineaments and their intersections were identified for ground evaluation to find kimberlite/ lamproite bodies along with traditional orientation stream sediment survey. Stream sediment samples were collected from appropriate trap sites and processed for recovering heavy mineral concentrates. A number of suspected kimberlite indicator minerals were separated from heavy mineral concentrates and their kimberlite affinity was confirmed by EPMA as picro ilmenites, Cr spinels and pyrope garnets. During field traverse, seven lamprophyre dykes were located. Four lamprophyres were located around Kettepalli-Telralapalli area, two at village Ankiraopalli and one near village Shaikhpalli . Based on petrological and bulk chemistry, most of the dykes are classified as alkaline lamprophyres.

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Table-2: (Contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
<b>Karnataka</b> Ballari Chitradurga	Kudaligi block	-	-	-	-	162 stream sediment samples	Reconnaissance survey was carried out to locate kimberlite in this block. Major part of the area is occupied by granite gneisses and migmatite gneiss of PG-1. Many shear zones were observed in the area. Search for kimberlite was carried out in three steps- (1) PGRS study for preparation of lineament map, (2) Indicator mineral survey and (3) Geological traverse along and across the lineaments delineated through PGRS and at the place where the inter section of lineaments were inferred. Downloaded ETM+ data were used for digital image processing to prepare lineament map on a regional scale so as to cover the known Wajrakarur Kimberlite field and the area under investigation. Locations of known kimberlites were plotted. The structural elements observed in the Wajrakarur Kimberlite Field also prevail in the area under investigation. A subset of regional imagery was prepared in order to produce a detailed lineament map of the area. This image in turn, was pan-sharpened and lineament map was prepared. The lineaments are mainly basic dykes, major joints and shears. In search of indicator minerals/heavy minerals, a total of 162 stream-sediment samples were collected from lower order stream. To recover indicator minerals, stream-sediment samples were sieved through screens of 4 mm, 2 mm, 1 mm, 0.5 mm and 0.3 mm aperture. The -4 mm to +2 mm size fractions were also scanned for kimberlite fragments, if any. The heavy minerals were picked up from size fraction -2 to +1 mm and -1 mm to +0.3 mm size were concentrated through hand-operated jig. The jigged concentrates were studied under binocular microscope to recover kimberlite indicator minerals, if any. The study revealed that the area contains heavy minerals namely amphiboles, epidote, garnet, ilmenite, magnetite, pyroxenes, zircon, tourmaline, spinel and sphene. 25 grains suspected to be KIMs have been submitted for EPMA analysis.

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Table-2: (Contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
<b>Karnataka</b>							
Ballari Chitradurga Davangere	Molakalmuru block	-	720	-	-	183	Study area falls under Kudligi taluk of district Ballari and Jagalur taluk of district Davangere. Area is characterised by a rugged granitic terrain in SW and central part and is flanked by rolling plains in the east. As a part of pre-field preparation lineament map was prepared by studying IRS ID LISS III imagery of topo sheet No. 57B/6. Reconnaissance mapping was carried out with special attention to the zones of intersecting lineaments and mafic dyke swarms as they form probable loci for emplacement of kimberlites. All the lineaments drawn were checked in the field. A majority of lineaments, controlling the straight course of streams, are only master joints. 172 stream sediment samples, in-situ soil sample, 5 petrochemical samples and 5 petrographic samples were collected. Processing of samples involved recovery and study of the heavy minerals in the size range of 2 mm to 0.3 mm. After scanning 1 mm and 0.3 mm size fractions was taken up for further concentration by Garytz-type jig and then packed separately for iso-dynamic/bromoform separation. The jig concentrates were then subjected to bromoform separation or isodynamic separation. Heavy minerals recovered were studied under binocular microscope to recover the kimberlite indicator minerals. The heavy minerals namely garnet ilmenite, spinel, magnetite, zircon, amphiboles, pyroxenes, epidote and sphene were recovered. Most of the minerals are of crustal origin as per the morphological characteristics. A total of 28 suspected grains were submitted for EPMA study. (13 ilmenites, 7 diopsides, 3 spinels and 5 zircon).

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Table-2: (Concl.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
<b>Telangana</b>							
Khammam	Jaggayyapeta block	-	800	-	-	103 (stream sediment samples)	In field season 2015-16, area has been mapped for the distribution of surface gravels and buried/paleo-channels of River Munneru and Paleru, tributaries of Krishna river. Aerial photographs, geological maps, geomorphological maps and drainage maps have been consulted as pre-field studies. Terrace mapping has been done and a total of 11 gravel patches have been identified on the basis of clast morphometry and difference in elevation of the terrace. Cross-profile traverse along both the Munneru and Paleru Rivers in the E-W direction has been taken up at different locations and the clast size, roundness, sphericity, composition of different types of river sediments have been noted at different gravel patches. T2 surfaces have been distinguished from the T3 surfaces on the basis of clast size, composition and elevation differences. Dominantly quartzite, dolerite, hematite float ores and quartz are the composition of gravels. T2 patches have been identified near Lakkavaram, Gondrala, Nallabandagudem, Balasupadu and Budavada for Paleru River and near Wallapuram and Lingala for Munneru River. A probable T3 patch has been identified near Gandrayi. Lamprophyre dyke has been suspected near Lakkavaram. Stream sediment samples (SSS) have been collected and scanned for heavy minerals and KIMs (Kimberlite Indicator Minerals). Nine trial pits were dug for buried gravel bed. The Heavy minerals identified under the binocular microscope are garnet, ilmenite, amphiboles/diopside, spinel, epidote and zircon and they were also separated and submitted for EPMA analysis to study the provenance of these minerals.

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## PRODUCTION & STOCKS

Production of diamond was 36,070 carats in 2015-16 as against 36,107 carats in the previous year. There were two operating mines, both under Public Sector located in Panna district of Madhya Pradesh. The one mine out of these two mines that is operated by NMDC Ltd contributed almost the entire production of diamond and a very small quantity of production was reported by the Department of Geology and Mining, Government of Madhya Pradesh.

Out of the total output, gem variety covering only rough & uncut constituted 35% and the remaining 65% was of industrial grade covering both off-colour and dark brown varieties. (Tables - 3 to 5).

Mine-head closing stocks during the year 2015-16 were 14,083 carats as against 15,304 carats in the previous year (Table-6).

The average daily employment of labour during 2015-16 was 156 as against 176 in the previous year.

**Table – 3 : Principal Producers of Diamond, 2015-16**

Name & address of producer	Location of Mine	
	State	District
National Mineral Development Corporation Ltd 10-3-311-/A, Khanij Bhavan, Castle Hills, Masab Tank, Hyderabad-500 028, Andhra Pradesh	Madhya Pradesh	Panna
Directorate of Geology & Mining, (Diamond Project) Government of Madhya Pradesh, Khanij Bhavan, 29-A, Arera Hills, Bhopal - 462 016, Madhya Pradesh.	Madhya Pradesh	Panna

**Table – 4 : Production of Diamond, 2013-14 to 2015-16  
(By State)**

(Quantity in carats; value ₹'000)

State	2013-14		2014-15		2015-16 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
<b>India /Madhya Pradesh</b>	<b>37517</b>	<b>614087</b>	<b>36107</b>	<b>613504</b>	<b>36070</b>	<b>621441</b>

**Table – 5 : Production of Diamond, 2014-15 & 2015-16  
(By Sector/State/District/Grades)**

(Quantity in carats; value in ₹'000)

State/District	No. of mines	2014-15				Value	2015-16 (P)			
		Quantity			Value		Quantity			Value
		Gem (rough & uncut)	Industrial*	Total			Gem (rough & uncut)	Industrial*	Total	
<b>India/Public Sector</b>	<b>2</b>	<b>12031</b>	<b>24076</b>	<b>36107</b>	<b>613504</b>	<b>2</b>	<b>12788</b>	<b>23282</b>	<b>36070</b>	<b>621441</b>
<b>Madhya Pradesh/ Panna</b>	<b>2</b>	<b>12031</b>	<b>24076</b>	<b>36107</b>	<b>613504</b>	<b>2</b>	<b>12788</b>	<b>23282</b>	<b>36070</b>	<b>621441</b>

\* Includes off-colour and dark-brown varieties of diamond.

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**Table – 6 : Mine-head Closing Stocks of Diamond, 2014-15 & 2015-16  
(By State)**

(In carats)

State	2014-15	2015-16 (P)
<b>India/Madhya Pradesh</b>	<b>15304</b>	<b>14083</b>

### **MINING & PROCESSING**

Majhgawan in Madhya Pradesh, is a fully mechanised mine operated by National Mineral Development Corporation Ltd. It is worked by opencast method in tuff rock by deploying 4.1 cu m hydraulic shovel and 40 tonnes dumpers in combination. The mine benches have been designed with a height of about 10 m. Few benches are of 4-5 m height. Drilling is done by 4-inch diameter drills and charged with slurry explosives, and about 40-50 holes are blasted at a time with delay pattern. The capacity of the mine is about 30,000 carats per year. Diamonds are also recovered from conglomerate and gravel beds at shallow depths by small operations on the basis of annual permits granted by Diamond Officer, Government of Madhya Pradesh. At Majhgawan, kimberlite rock after mining is stockpiled for weathering action and then is fed to crushing plant. It is processed through Heavy Media Separation System in processing plant for recovery of diamond. Recently, X-ray diamond sorter has been installed for sorting of diamonds from ore and this has increased the recovery of raw diamonds to 98%.

#### **Diamond Mining Factors**

**Grade:** Grade is the weight of diamond expressed as carats per tonne (ct/t) of ore. It varies widely from one mine to another but generally falls somewhere between 0.3 and 1.3 ct/t. One carat is equivalent to 0.2 grams.

**Size (weight) of rough diamonds in deposit:** Individually, rough diamonds can range from microweight to stones weighing more than 1,000 carats. Depending on the mine, the average size of rough diamond recovered can weigh from 0.01 ct (about 1 mm) to more than 0.7 ct. Many mines in the world show an average of about 0.4 to 0.5 ct per tonne.

### **INDUSTRY**

Indian Diamond Industry enjoys credible standing and reputation in the world market,

particularly for small diamonds used in jewellery. Indian diamond manufacturing standards are reckoned as the best in the world. Workmanship & skill of Indian artisans at polishing small diamonds economically and efficiently has been widely acknowledged. Surat in Gujarat is the main centre of the Cutting and Polishing Industry.

As per the Southern Gujarat Chambers of Commerce there are about 3500 to 4500 diamond processing units in Surat employing about 1.5 million people. Most of them now use computerised cutting machines with deployment of the latest technology. India continues to be the dominant player in the world Diamond Cutting and Polishing Industry. According to India's Gem & Jewellery Export Promotion Council (GJEPC), India has further strengthened its world dominance.

India's predominance as leader in the world market is due to a combination of pragmatic policies of the Government and sustained efforts of exporters. Policy changes, such as, creation of Special Economic Zones (SEZ) is expected to boost the export prospects further. Several diamond polishing companies have already established offices in India for trading in rough & polished diamonds. India obtains rough diamonds from Belgium, UK, Hong Kong, UAE, Israel, etc. Indian diamond traders seek opportunities to establish direct trade ties with mining countries and companies. The expectations of the Indian Diamond Industry are to access rough diamonds at competitive rates directly from the producers to maintain its lead in the world market.

### **CONSUMPTION**

Industrial diamonds are mostly consumed by manufacturers of drill bits, grinding tools and stone cutting & polishing machines and demand of industrial diamonds is mostly met by imports. There are many small-scale sector units that operate in cutting & polishing trade.

## SUBSTITUTES

### Synthetic Diamond

Today, market for industrial diamond is dominated by synthetic stones, first developed in 1950s. Synthetic diamonds, manufactured using high pressure and high temperature methods compete as an abrasive mineral with natural industrial diamonds and also with manufactured materials like silicon carbide (SiC), alumina (Al<sub>2</sub>O<sub>3</sub>), tungsten carbide (WC) and carbide boron nitrate (CBN). Synthetic diamonds being marketed are mostly 0.6 - 0.8 mm and smaller in size. Synthetic Diamond Abrasives (SDA) are used for sawing, drilling or milling hard stones, concrete aggregate, refractory materials, masonry and asphalt. In general, large crystals are used for cutting softer materials and smaller crystals for tougher jobs. Synthetic diamonds now account for bulk supply of industrial diamonds and are preferred over natural diamonds because their quality can be controlled to suit customer's requirements.

Synthetic diamonds were produced earlier by using graphite with a metal catalyst under very high pressure & temperature.

Of late a new process, such as, Chemical Vapour Deposition (CVD) has been evolved which requires relatively low pressure for production of synthetic diamonds. This process involves depositing tiny crystals of diamond on a film which can be built in complicated shapes and used at desired places or instruments such as machine part, heat conductors in micro circuit, shortwave UV, microwave sources and radiation detectors. In future, CVD can be a substitute for silicon in Computer Industry. In USA, developments have taken place in CVD method of growing 100% pure diamond using microwave plasma technology. This method is more economical and also enables production of larger crystals.

## TRADE POLICY

Import of diamond under HS Code 7102, whether or not worked, but not mounted or set, fall under 'Free' category as per the Export-Import Policy 2015-2020. Foreign Direct Investment (FDI)

in diamond mining up to 100% is admissible for automatic approval of Reserve Bank of India.

## WORLD REVIEW

The world reserves of industrial diamond are about 750 million carats located mainly in Australia (28%), Congo (Kinshasa) (20%), Botswana (17%), Russia (13%) and South Africa (9%). The world reserves of diamond are furnished in Table-7.

The total world production of diamond increased by about 2% from 124 million carats in 2014 to 127 million carats in 2015.

The principal producers were Russia (33%), Botswana (16%), Congo, Dem. Rep. and Australia (11%) each, Canada (9%), Angola (7%) and South Africa (6%). During the year, increase in diamond production was observed in Australia (46%), Russia (9%), Angola (3%) while the production in Botswana (16%), Canada (4%), Congo, Dem. Rep. (3%) reported declining trend (Table 8).

Natural diamonds are cut in 52 countries. The major diamond cutting centres in the world are Antwerp in Belgium, Ramat Gan in Israel, New York in USA, Surat in India and Guangzhou & Shenzhen in China.

**Table – 7 : World Reserves of Diamond (Industrial) for the year 2016 (By Principal Countries)**

(In million carats)	
Country	Reserves
<b>World : Total (rounded off)</b>	<b>750</b>
Australia	210
Botswana	130
Congo (Kinshasa)	150
Russia	100
South Africa	70
USA	NA
Other countries	90

*Source: Mineral Commodity Summaries, 2017*

## DIAMOND

**Table – 8 : World Production of Diamond  
(By Principal Countries)**

(In '000 carats)			
Country	2013	2014	2015
<b>World: Total</b>	<b>129953</b>	<b>124469</b>	<b>126579</b>
Angola	8599	8791	9016
Australia	11482	9288	13561
Botswana	22597	24658	20824
Canada	10562	12082	11600
Congo, Dem.Rep.of	16653	14689	14284
Ghana	159	241	174
Guinea	202	164	162
Lesotho	414	346	304
Namibia	1776	1898	1988
Russia	37884	38304	41912
Sierra Leone	605	594	500
South Africa	8168	8060	8233
Zimbabwe	10412	4772	3491
Other countries	441	581	529

*Source: World Mineral Production, 2011-2015.*

### Canada

In 2016, two new diamond mines commenced production in Canada one Gahcho Kue mine in North West Territories of Canada and second Renard mine in Quebec, Canada.

Mountain Province Diamonds with the Gahcho Kue mine, in partnership with De Beers, in North West Territories of Canada announced the commissioning of the Gahcho Kue plant in August 2016. The mine is expected to produce an average of 4.5 million carats per year once fully operational. Gahcho Kue located 280 km northeast of Yellowknife has total indicated reserves of approximately 49 million carats with an estimated base operational life of 11 years.

Second mine Renard in Quebec operated by Stornoway Diamond Corporation began production in the third quarter of 2016; annual production expected to average 1.6 million carats.

The above two projects are expected to contribute an increase in rough diamond production in the medium term.

Dominion Diamond Corporation announced that it will proceed with the development of the Sable and Jay pipes at the Ekati Mine in Canada, extending the life of the production at the mine until 2033. Rio Tinto and Dominion Diamond Corporation are developing the A-21 pipe at Diavik Mine in Canada which is expected to begin production in 2018 and extend production life at the mine to 2023.

### Botswana

The Cut - 8 project at Jwaneg Mine in Botswana owned by De Beers will begin producing diamonds in 2017.

### Russia

In September 2016, Russian Government removed a 6.5% export duty on rough diamonds but since ALROSA the Russian diamond major was already subsidising the tax for international clients the move did not have direct impact on global diamond prices.

### Zimbabwe

In 2016, Government of Zimbabwe nationalised diamond mining under moniker, Zimbabwe Consolidated Diamond Company, revoking mining licenses from a handful of private companies primarily Chinese, since the Government has failed to effectively take on operations independently, especially as the alluvial mines reach economic depletion.

## FOREIGN TRADE

### Exports

Value of exports of diamond decreased by about 4% to ₹ 1,42,734 crore in 2015-16 against ₹ 1,48,102 crore in the previous year. Diamond (mostly cut) alone accounted for almost cent-percent exports in terms of value. The share of industrial diamonds and diamond powder was about ₹ 34 crore and ₹ 36 crore, respectively in 2015-16. Exports were mainly to Hong Kong (36%), USA (30%), Belgium and UAE (10%) each and Israel about (5%) (Tables- 9 to 12).

### Imports

In 2015-16 imports value of diamond decreased by about 12% to ₹ 1,10,565 crore from ₹ 1,25,214 crore in the previous year. Uncut diamond shared the bulk, i.e., almost cent-percent of the imports. Imports of industrial diamond and diamond powder were about 0.53 million carats and 287 million carats respectively valued at ₹ 50 crore and ₹ 137.11 crore respectively. Imports were mainly from Belgium (39%), UAE (22%), Hong Kong (11%), Russia (7%), Israel (6%) and Saudi Arabia (3%) (Tables-13 to 16).

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**Table – 9 : Exports Value of Diamond : Total  
(By Countries)**

Country	2014-15	2015-16 (P)
	Value (₹'000)	Value (₹'000)
<b>All Countries</b>	<b>1481021701</b>	<b>1427340191</b>
Hong Kong	562796247	515660381
USA	393506812	426775000
Belgium	160742386	145177411
UAE	155041337	143162330
Israel	71911495	65219100
Thailand	37262011	36570823
Singapore	9881402	14566160
Japan	15594603	14200147
Switzerland	13135361	13119569
Australia	10066613	10620220
Other countries	51083434	42269050

*Note : Quantity not given due to partial coverage; value figures, however, have full coverage.*

**Table – 10 : Exports of Diamond  
(Industrial)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (carats)	Value (₹'000)	Qty (carats)	Value (₹'000)
<b>All Countries</b>	<b>4351127</b>	<b>168693</b>	<b>5651009</b>	<b>342213</b>
UK	813817	27041	1754200	68184
Belgium	498302	40761	1271305	63124
UAE	-	-	200528	59560
Israel	1659447	26744	1199300	51839
Ireland	139410	9124	436046	31220
USA	910824	45844	425225	30926
China	62905	5342	211650	18141
Hong Kong	64500	4597	78142	11869
Chinese				
Taipei/Taiwan	140	753	3025	3367
Germany	101300	3620	56700	2909
Other countries	100482	4867	14888	1074

**Table – 11 : Exports of Diamond (Mostly Cut)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (carats)	Value (₹'000)	Qty (carats)	Value (₹'000)
<b>All Countries</b>	<b>74999043</b>	<b>1480557682</b>	<b>60737949</b>	<b>1426640488</b>
Hong Kong	15304209	562757037	12983767	515643397
USA	7582016	393373221	10602356	426641928
Belgium	12721672	160674217	10082880	145021344
UAE	29295199	155031605	18100065	143056634
Israel	1596657	71860524	1310706	65134122
Thailand	1501877	37261962	1477504	36570653
Singapore	402466	9880970	615979	14565988
Japan	1036810	15585010	826695	14186480
Switzerland	265389	13128862	236566	13111622
Australia	123611	10066613	107112	10620220
Other countries	5169137	50937661	4394319	42088100



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**Table – 12 : Exports of Diamond (Powder)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (‘000 carats)	Value (₹‘000)	Qty (‘000 carats)	Value (₹‘000)
<b>All Countries</b>	<b>18705</b>	<b>295326</b>	<b>9702</b>	<b>357490</b>
USA	3384	87747	2721	102146
Belgium	753	27408	875	92943
UAE	225	9732	148	46136
Israel	967	24227	1461	33139
Germany	522	20766	710	22700
Ireland	588	23252	893	16272
Japan	59	8922	29	12761
UK	909	38776	286	10500
Switzerland	181	6499	132	7947
Hong Kong	10356	34613	308	5115
Other countries	761	13384	2157	7831

**Table – 13 : Imports Value of Diamond : Total  
(By Countries)**

Country	2014-15	2015-16 (P)
	Value (₹‘000)	Value (₹‘000)
<b>All Countries</b>	<b>1252140913</b>	<b>1105651211</b>
Belgium	547601092	426029350
UAE	246220048	244340863
Hong Kong	135536847	126934094
Russia	46935304	72046802
Israel	66438542	68585039
Saudi Arabia	37070845	33259930
Botswana	55940629	32860354
USA	36328269	31816285
Canada	18349497	25544469
South Africa	6424596	12604242
Other countries	55295244	31629783

*Note: Quantity not given due to partial coverage; value figures, however, have full coverage.*

**Table – 14 : Imports of Diamond  
(Industrial)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (carats)	Value (₹‘000)	Qty (carats)	Value (₹‘000)
<b>All Countries</b>	<b>520983</b>	<b>298568</b>	<b>527650</b>	<b>495371</b>
Russia Congo,	334276	125124	333324	263655
P. Rep.of	40749	27561	85823	111164
UAE	-	-	44038	67266
Netherlands	-	-	25104	23515
Belgium	32507	38783	24947	21493
UK	2242	3129	1690	3729
South Africa	20441	11498	11755	2663
Congo, Dem Rep.of	28339	27611	242	657
USA	13146	14486	55	548
Australia	-	-	354	332
Other countries	49283	50376	318	349

**Table – 15 : Imports of Diamond (Powder)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (‘000 carats)	Value (₹‘000)	Qty (‘000 carats)	Value (₹‘000)
<b>All Countries</b>	<b>351378</b>	<b>1494388</b>	<b>287431</b>	<b>1371128</b>
China	313840	1151011	262914	1120520
Ireland	5405	72024	6418	85501
USA	5933	60129	5402	58329
Korea, Rep. of	2698	35328	3833	41133
Belgium	2207	39669	1530	22601
Switzerland	725	16244	815	14242
Hong Kong	19432	43704	4593	12946
Netherlands	45	844	488	4164
Russia	1	1396	229	3751
UAE	462	7633	248	2123
Other countries	630	66406	961	5818



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**Table – 16 : Imports of Diamond (Mostly Uncut)  
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (carats)	Value (₹'000)	Qty (carats)	Value (₹'000)
<b>All Countries</b>	<b>150487349</b>	<b>1250347957</b>	<b>151535456</b>	<b>1103784712</b>
Belgium	72213876	547522640	63359688	425985256
UAE	34460027	246212415	41592023	244271474
Hong Kong	10301636	135493143	9106084	126921148
Russia	7727040	46808784	14221029	71779396
Israel	4566305	66437968	3149337	68584617
Saudi Arabia	2680462	37070845	2122952	33259930
Botswana	5626424	55927638	2591664	32860354
USA	4806933	36253654	3556020	31757408
Canada	2693723	18349497	5278462	25544469
South Africa	864572	6413098	811507	12601579
Other countries	4546351	53858275	5746690	30219081

### FUTURE OUTLOOK

Rio Tinto India has decided to abandon the Bunder Diamond Project, district Chattarpur, Madhya Pradesh. Rio Tinto India announced that it would not proceed with the development of Bunder Diamond Project due to commercial considerations and would be closing all project infrastructure. However, other companies like Vedanta & Adani have shown interest in this project.

Hatupur Diamond Block, Brijpur, district Panna, Madhya Pradesh was successfully auctioned and the successful bidder was Bansal Construction Company, Bhopal.

The Diamond Industry in the country currently employs over 8 lakh artisans who are experts in

cutting and polishing of small diamonds and are now in a position to process full range of sizes and qualities of gemstones using latest technology.

The Indian Cutting & Polishing Sector is facing growing competition from China due to the fact that the diamond producing African countries are demanding a greater share for processing of roughs within their countries. Thus, according to KPMG analysis, by 2015, India's share in value terms will come down to 49.3% of the world diamond roughs from the present 65%. In the same period, China's share is expected to grow to 21.3%, Russia to 7.1%, South Africa to 5.5%, Israel to 4.7% and USA to 1.4%.