Indian Minerals Yearbook 2017

(Part- III : Mineral Reviews)

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MINOR MINERALS

30.4 CORUNDUM (Minor) AND SAPPHIRE (Major)

(FINAL RELEASE)

GOVERNMENT OF INDIA
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30-4 Corundum and Sapphire

Corundum is a natural oxide of alumina with 52.9% alumina and 47.1% oxygen. It is very hard (9 on Moh's scale) following diamond. Corundum is found in rocks containing a high percentage of alkalies, deficient in silica and excess of alumina. It is generally found in association with rocks like syenite, nepheline syenite, anorthosite. Described to be formed as a result of metamorphism of high aluminous clay, corundum is often found associated with andalusite, kyanite and sillimanite. Corundum also occurs as masses adjacent to ultramafic intrusives, associated with lamprophyre dykes and as large crystals in pegmatites. The most common occurrence of corundum would be as a detrital mineral in streams and beach sands because of its hardness and resistance to weathering. Pure corundum is colourless and clear if transparent or pale white if opaque. The vivid colours of corundum gem varieties such as ruby and sapphire arise primarily from elemental substitution in the Al site by transition metal elements. The most common cations found as substitute are Fe^{+2}, Fe^{+3}, Ti^{+4}, Cr^{+3} and V^{+3}. Pink and red colour corundum are called ruby while blue coloured corundum is called sapphire and all other colours are called fancy sapphires. Usually rubies will have more or less 1 wt% of Cr_2O_3 while blue sapphires primarily have Fe^{+2} and Ti^{+4} substituting into the crystal struture of Al. Some corundum gemstones show "asterism" or a star effect due to inclusion of rutile needles within the crystal of corundum.

RESERVES/RESOURCES

The reserves/resources of corundum in India are found in association with kyanite and sillimanite in Assam, Meghalaya and Maharashtra. It occurs in syenites and ultrabasic rocks in Telangana. A few outcrops of pegmatites containing corundum occur in Bastar district, Chhattisgarh and Morena district, Madhya Pradesh. Translucent to opaque ruby, sometimes with asterism is known to be abundant in Mysuru district in Karnataka.

Precious and semi-precious varieties of corundum have been reported from Tamil Nadu in Kangeyam belt stretching over Karur and Kulithalai tehsils in Tiruchirapalli district and Vedachandur tehsil in Dindigul district.

As per NMI database as on 1.4.2015 (provisional), that is based on UNFC Sytem, the total reserves/resources of corundum was estimated at 294 thousand tonnes of which 200 tonnes were placed under Reserves category and the bulk of over 293 thousand tonnes under 'Remaining Resources' category. The resources of corundum are located in Karnataka (68%), Telangana (26%) and Rajasthan (4%), besides a share of the Remaining Resources was contributed by Tamil Nadu, Chhattisgarh and Andhra Pradesh.

The total reserves/resources of ruby as on 1.4.2015 was estimated at 5,349 kg and the entire resources are placed under 'Remaining Resources' category and are located in Odisha. The total reserves/resources of sapphire was estimated at 450 kg, all of which is placed under 'Remaining Resources' category and is located in Jammu & Kashmir [Tables - 1(A) to 1(C)].

EXPLORATION AND DEVELOPMENT

The exploration & development details, if any, are given in the review on "Exploration & Development" in "General Reviews".

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

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved STD111	Probable STD121	Probable STD122	Total (A)	Feasibility STD211	Pre-feasibility STD221	Pre-feasibility STD222	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
All India : Total	**200**	**-**	**-**	**200**	**70844**	**1073**	**63060**	**13**	**38**	**105794**	**52675**	**293497**	**293697**
By Grades													
Semi-precious	-	-	-	-	-	34	-	-	1	895	-	930	930
Industrial	-	-	-	-	65020	1039	53767	-	28	90479	52675	263007	263007
Others	-	-	-	-	-	-	-	-	-	4	-	4	4
Unclassified	200	-	-	200	-	-	11	13	1	2533	-	2558	2758
Not-known	-	-	-	-	5824	-	9282	-	8	11883	-	26997	26997
By States													
Andhra Pradesh	200	-	-	200	-	7	-	-	-	-	-	7	207
Chhattisgarh	-	-	-	-	100	310	188	-	-	288	-	885	885
Karnataka	-	-	-	-	64920	756	53590	13	38	27575	52675	199566	199566
Rajasthan	-	-	-	-	-	-	-	-	-	11925	-	11925	11925
Tamil Nadu	-	-	-	-	-	-	-	-	-	4000	-	4000	4000
Telangana	-	-	-	-	5824	-	9282	-	-	62007	-	77113	77113

Figures rounded off

Table – 1(B) : Reserves/Resources of Ruby as on 1.4.2015
(By Grades/State)

(In kg)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
All India : Total	-	-	-	-	-	**429**	**3296**	-	-	**1623**	-	**5349**	**5349**
By Grades													
Unclassified	-	-	-	-	-	429	3296	-	-	1623	-	5349	5349
By State													
Odisha	-	-	-	-	-	429	3296	-	-	1623	-	5349	5349

Figures rounded off

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

(In kg)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
All India : Total	-	-	-	-	-	-	-	-	-	**450**	-	**450**	**450**
By Grades													
Unclassified	-	-	-	-	-	-	-	-	-	450	-	450	450
By State													
Jammu & Kashmir	-	-	-	-	-	-	-	-	-	450	-	450	450

Figures rounded off

PRODUCTION AND STOCKS

Corundum

As per Govt. of India Notification S.O.423(E) dated 10.02.2015, 'Corundum' has been declared as "Minor Mineral" hence production data is not available with IBM. However, 'Sapphire' is retained as major mineral.

Ruby

There was no production of ruby in both the years, i.e., 2014-15 and 2015-16.

CONSUMPTION & USES

It is valued mostly for its abrasive and refractory properties. Its melting point is 2010° C and hence it is used in a sintered form for the manufacture of special refractory crucibles, rods and other materials.

Corundum's bright and glassy lustre, splintery property as it is devoid of cleavage plane and inclusions makes it preferred substance by industry for the manufacture of superior grade abrasives. After processing, it is used in grinding and polishing wheels, grinding belts, emery papers and cloth and grinding pastes. High-grade corundum with low iron finds use as ramming mass in the electric arc furnace. It is also used in mortars, wire drawing dies, thread guides and gauge blocks. Gem varieties are sometimes used for pivot supporters in delicate scientific instruments, as jewel in watches. Sapphire has emerged as a versatile material useful to a range of industries in many varied applications including LEDs, optical and Radio Frequency Integrated Circuits (RFICS).

WORLD SCENARIO

Corundum & sapphire are reported from Sri Lanka, especially from the area of Ratnapura, Bibile and Rakwana. Ruby with a brownish tint comes from Chanthaburi District in Thailand. Fine gem ruby and sapphire comes from Luc Yen, Yen Bai Province, Vietnam; the Hunza Valley, Gilgit, Pakistan; and Jegdalek, Surobi District, Afghanistan. Gem quality sapphire is reported from Pailin, Cambodia. Africa has also become a significant producer of corundum, especially in Madagascar, where it is found in the Zazafotsy Quarry, Ambahatraso; and in Andranondambo, Amboasary District. Rubies are found in Longido, Kilimanjaro Region and Winza, in Arusha area, Tanzania. In the US, the Yogo Gulch near Helena and waterworn Sapphire stones are found in the Missouri River throughout its length.

The area of Mogok, Myanmar is the source of some of the best gem-quality ruby. Another significant Burmese deposit is Mong Hsu.

FOREIGN TRADE

Exports value of uncut ruby and sapphire were ` 38.99 crore in 2016-17. Exports were mainly to Singapore (74%), Hong Kong (8%) and Switzerland (5%).

Exports value of uncut ruby and sapphire decreased substantially to ` 5.17 crore in 2015-16 from ` 12.68 crore in the previous year (Tables - 2 & 3).

During 2016-17, import of uncut ruby and sapphire was 11 tonnes valued at ` 1,167 crore. Imports were mainly from Hong Kong (74%), Zambia (14%) and UAE (4%)

Imports of uncut ruby and sapphire decreased to 24 tonnes valued at ` 1,057 crore in 2015-16 from 42 tonnes, valued at ` 389 crore in the previous year. Imports were mainly from Thailand (33%), Hong Kong (21%) and Zambia (12%) (Tables - 4 & 5).

Table-2: Exports of Ruby and Sapphire: Uncut (By Countries)

Country	2016-17	
	Qty (t)	Value (`'000)
All Countries	**++**	**389887**
Singapore	++	287986
Hong Kong	++	31870
Switzerland	++	19031
Baharain	++	18821
Thailand	++	13590
UAE	++	5488
France	++	2562
USA	++	1937
Germany	++	1120
Israel	++	959
Other countries	++	6523

Table – 3: Exports of Ruby and Sapphire: Uncut (By Countries)

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**++**	**126769**	**12**	**51708**
US A	++	4655	12	19831
Hong Kong	++	2208	++	18117
Thailand	++	6361	++	6145
Switzerland	++	4232	++	2485
Germany	++	3063	++	2199
Israel	++	1364	++	1169
France	++	2295	++	705
UAE	-	-	++	575
Malaysia	-	-	++	469
Bulgaria	-	-	++	13
Other countries	++	102591	-	-

Table-4: Imports of Ruby and Sapphire: Uncut (By Countries)

Country	2016-17	
	Qty (t)	Value (`'000)
All Countries	**11**	**11666480**
Hong Kong	8	8596582
Zambia	2	1626126
UAE	++	409137
South Africa	++	246584
Mozambique	++	260684
Thailand	1	205142
Singapore	++	85272
USA	++	55486
Other countries	++	181467

Table – 5: Imports of Ruby and Sapphire: Uncut (By Countries)

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**42**	**3890352**	**24**	**10578425**
Hong Kong	1	2327250	5	6434727
Zambia	2	247557	3	1392510
Mozambique	1	169221	1	1014785
Singapore	++	206632	++	697817
UAE	++	142136	++	259927
Thailand	16	243669	8	244501
Ecuador	++	37686	2	130346
USA	++	6198	++	121298
Brazil	3	170523	1	48282
China	++	782	++	40359
Other countries	19	338698	4	193873

FUTURE OUTLOOK

Corundum has been produced synthetically since 1837 and gem quality of synthetic corundum entered the market place in the early 1990's. Very large sizes of crystals can be made by Czochralski's Drawing Method. Another method is Verneuil process but synthetic gem variety can be recognised by trained gemologist. The market for synthetic corundum is mainly driven by industrial abrasion applications. The natural occurring corundum has tremendous value in the gemstone market and is the most sought-after precious stones after diamod. Owing to its uncommon colours, corundum's demand in the Jewellery Segment is increasingly on the rise. Apart from rubies and sapphire, rare gemstones, such as, padparadscha sapphire, witnessed expanding market demands.

In India, the gemstone market has been expanding. The gemstone market in India (which includes ruby & sapphire) is expected to grow in the coming years.