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(Part- III : Mineral Reviews)

60th Edition

MINOR MINERALS

30.4 CORUNDUM (Minor) AND SAPPHIRE (Major)

(ADVANCE 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 Mohs scale) next only to 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 and 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 is 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 structure 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 data as on 1.4.2015 based on UNFC System, 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 & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

Corundum

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'Corundum' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, 'Sapphire' has been retained as Major Mineral. Statewise production of corundum and sapphire is not available.

Ruby

There was no production of ruby reported since the year 2015-16.

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		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
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/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	**-**	**-**	**-**	**-**	**-**	**429**	**3296**	**-**	**-**	**1623**	**-**	**5349**	**5349**
By Grade													
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 Grade/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	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**450**	**-**	**450**	**450**
By Grade													
Unclassified	-	-	-	-	-	-	-	-	-	450	-	450	450
By State													
Jammu & Kashmir	-	-	-	-	-	-	-	-	-	450	-	450	450

Figures rounded off.

CONSUMPTION & USES

Corundum is valued mostly for its abrasive and refractory properties. Its melting point is 2,010 °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 & 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).

FUTURE OUTLOOK

Corundum has been produced synthetically since 1837 and gem quality of synthetic corundum entered the market place in the early 1990s. 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 desirable precious stone after diamond. 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 ramp-up in the coming years.