

GARNET



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GARNET

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

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13 Garnet

Garnet is the collective name for a group of minerals which crystallise in cubic system with different chemical composition. The principal members of the Garnet group are Almandine (Fe-Al), Pyrope (Mg-Al), Spessartite (Mn-Al), Grossularite (Ca-Al), Andradite (Ca-Fe) and Uvarovite (Ca-Cr). Almandine is hardest amongst all varieties and is often used for abrasive purpose. Garnet is dense & hard with sharp angular chisel-edged fracture, containing small amounts of free silica and exhibits high resistance to physical and chemical attacks. It is used both as semi-precious stone and as an abrasive. The hardness of garnet varies from 6.5 to 7.5 on Mohs' scale. This allows it to be used as an effective abrasive.

RESERVES / RESOURCES

In India, garnet deposits suitable for use in abrasive industry occur in Andhra Pradesh, Chhattisgarh, Jharkhand, Kerala, Odisha, Rajasthan, Tamil Nadu and Telangana. Gem variety of garnet occurs in Ajmer, Bhilwara, Jhunjhunu, Sikar and Tonk districts, Rajasthan; Nellore and Srikakulam districts, Andhra Pradesh; Khammam district, Telangana and Coimbatore, Ramnathpuram, Tirunelveli, Kanyakumari, Tiruchirappalli and Tiruvarur districts, Tamil Nadu. Garnet is found to occur in beach sands along with ilmenite, rutile, sillimanite, etc. in the states of Kerala, Odisha and Tamil Nadu.

The total reserves/resources of garnet in India as on 1.4.2015, as per UNFC system are placed at 56.16 million tonnes of which reserves under proved and probable categories together constitute 12.78 million tonnes. Of the total resources, about 20.90 million tonnes are of abrasive grade, whereas resources of semi-precious grade are mere 5,803

tonnes only. Tamil Nadu alone accounts for about 48% of the total resources followed by Andhra Pradesh 31%, Odisha 17% and Telangana 3%. The remaining states together shared less than 1% (Table- 1).

EXPLORATION & DEVELOPMENT

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

PRODUCTION, STOCKS AND PRICES

Garnet (Abrasive)

Production of garnet (abrasive) at 158,154 tonnes during 2017-18 increased by 85% as compared to that in the preceeding year. There were 7 reporting mines during 2017-18 as well as in the year 2016-17. Besides, production of garnet (abrasive) was reported as an associated mineral by one sillimanite mine in Odisha. The share of public sector in the total output was about 26% in 2017-18 which was 38% in the previous year.

In 2017-18, 70% of the total production was reported from Andhra Pradesh, 22% from Odisha, 4% each from Tamil Nadu and Rajasthan (Tables-2 to 4).

Mine-head closing stocks of garnet (abrasive) for the year 2017-18 was 77,741 tonnes as against 67,943 tonnes in the previous year (Table -5).

The average daily employment of labour during 2017-18 was 806 as against 1,894 in the previous year.

Prices of garnet are furnished in the General Review on 'Prices'.

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

(In tonnes)

Grade/State	Reserves			Remaining Resources						Total Resources (A+B)			
	Proved STD111	Probable STD121 STD122	Total (A)	Feasibility STD211	Pre-feasibility STD221 STD222	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334		Total (B)		
All India : Total	9917936	278493	2587427	84320	1643412	3287667	121099	10247428	27992906	333	43377166	56161022	
By Grades													
Gem	39000	362	34	39396	2	81339	-	-	109	-	81450	120846	
Abrasive	9804483	276468	2586266	12667217	3062	1489600	3194708	106060	19428	3423374	333	8236565	20903782
Semi-precious	18	13	1128	1159	41	115	514	39	1249	2688	-	4645	5803
Others	-	-	-	-	9051	36358	-	-	-	215573	-	260982	260982
Unclassified	74435	1650	-	76085	72164	36000	394	15000	10225996	23968842	-	34318396	34394481
Not-known	-	-	-	-	-	-	92051	-	756	382321	-	475128	475128
By States													
Andhra Pradesh	1183898	4500	568750	1757148	12189	232525	791238	18	8800000	5674011	-	15509981	17267129
Chhattisgarh	-	-	-	-	-	-	-	-	-	28800	-	28800	28800
Jharkhand	-	-	-	-	-	-	88303	-	-	21768	-	110071	110071
Kerala	-	-	45797	45797	-	-	-	100874	-	52190	-	153064	198861
Odisha	8459821	-	585130	9044951	5	-	-	-	-	348000	-	348005	9392956
Rajasthan	33566	35926	5556	75048	3100	26663	29629	5207	21432	123587	333	209952	285000
Tamil Nadu	225554	238067	1382194	1845815	21936	1342191	2378497	15000	1425996	19888574	-	25072194	26918009
Telangana	15097	-	-	15097	47090	42033	-	-	-	1855976	-	1945099	1960196

Figures rounded off.

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Table – 2 : Principal Producers of Garnet (Abrasive), 2017-18

Name & address of producer	Location of mine	
	State	District
Trimex Sands Pvt. Ltd, Trimex Towers, No. 1, Subbraya Avenue, C. P. Ramaswamy Road, Alwarpet, Chennai-600 018, Tamil Nadu.	Andhra Pradesh	Srikakulam
Transworld Garnet India Pvt. Ltd, New No. 34, Old No. 46, M. G. R. Road, Kalakshetra Colony, Besant Nagar, Chennai- 600 090, Tamil Nadu.	Andhra Pradesh	Srikakulam
Indian Rare Earths Ltd, Plot No. 1207, Veer Savarkar Marg, Near Siddhivinayak Temple, Prabhadevi, Dadar- 400 028, Mumbai, Maharashtra.	Tamil Nadu Odisha	Kanyakumari Ganjam*

*producing as an associated mineral with sillimanite.

**Table – 3 : Production of Garnet (Abrasive) 2015-16 to 2017-18
(By States)**

(Qty in tonnes; Value in ₹'000)

State	2015-16		2016-17		2017-18 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	82001	648124	85413	787302	158154	1636667
Andhra Pradesh	55583	471079	51243	565747	111390	1299361
Odisha	14767	93564	22076	133979	34170	242053
Rajasthan	958	1744	1482	2567	5781	19084
Tamil Nadu	10693	81737	10612	85009	6813	76169

**Table – 4 : Production of Garnet (Abrasive), 2016-17 & 2017-18
(By Sectors/States/Districts)**

(Qty in tonnes; Value in ₹'000)

State/District	2016-17			2017-18 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	7(1)	85413	787302	7(1)	158154	1636667
Public sector	3(1)	32688	218988	1(1)	40983	318222
Private sector	4	52725	568314	6	117171	1318445
Andhra Pradesh	2	51243	565747	2	111390	1299361
Srikakulam	2	51243	565747	2	111390	1299361
Odisha	(1)	22076	133979	(1)	34170	242053
Ganjam	(1)	22076	133979	(1)	34170	242053
Rajasthan	2	1482	2567	2	5781	19084
Bhilwara	1	1482	2567	2	5781	19084
Tamil Nadu	3	10612	85009	3	6813	76169
Kanyakumari	3	10612	85009	1	6813	76169
Tiruchirapalli	-	-	-	2	-	-

Figures in parentheses indicate associated mine of sillimanite.

Table – 5 : Mine-head Closing Stocks of Garnet (Abrasive) 2016-17 & 2017-18 (By States)

(In tonnes)		
State	2016-17	2017-18(P)
India	67953	77741
Andhra Pradesh	6145	10429
Odisha	3226	2864
Rajasthan	1332	1437
Tamil Nadu	57250	63011

Garnet (Gem)

No production of garnet (gem) was reported during 2017-18.

MINING & MARKETING

Garnet is obtained generally by digging small shallow pits barring a few places in Tamil Nadu where it is recovered from sea shore. Mining is done manually with the help of pick axes and spades. Drilling and blasting are not required as garnet is excavated from soft weathered rocks. Fine abrasive garnet is recovered from processing of beach sands. The mining of beach sand is done by dry and wet dredging. In Heavy Upgradation Plant and Mineral Separation Plant, individual minerals including garnet are separated. Sands with 26% of contained garnet is upgraded to 80-88% garnet rich concentrate at TGI Plan, which is further upgraded to 98-99% pure product. The combined installed capacity of garnet at IREL plants located in Odisha and Tamil Nadu is 30,000 tonnes. The production from mines is graded into two varieties- abrasive and gem, depending on the clarity of crystals. After cutting and polishing, clear, flawless and rich-colour crystals of garnet are sold as semi-precious stones.

USES & CONSUMPTION

The most important industrial use of garnet in the form of garnet sand is as an abrasive. About 90% production of abrasive garnet is used for manufacturing of garnet-coated papers, clothes and discs. Garnet-coated abrasives are used in the form of belts, covers for drums, discs or as small sheets. It is used for cleaning spark plugs, paints, polishing

and grinding of plate-glass. The remaining 10% output is used in the form of loose grains for surfacing and polishing soft stones (marble, slate, soapstone, etc.). Clear, flawless and rich-coloured crystals of garnet are used as semi-precious stones. The principal variety among them are pyrope, deep-crimson almandine, orange-yellow grossularite, etc. Other uses are in electronic and television industry for polishing glass and TV tubes. Garnet granules are used in 'abrasive blasting' commonly called 'sand blasting' in order to smoothen, clean and remove oxidation products from metals, stone and other material. MMTC laid down specifications of garnet sand used for sand blasting/jet cutting/other uses for exports to USA, Europe, Middle East and Taiwan are as follows: Al_2O_3 : 20.8 to 21.2%, Bulk density; 2.17 kg/m^3 , Hardness in Moh's scale should be 7.5 to 8.

Water jet cutting machines generally use finely ground 80-120 mesh size garnet as cutting medium with high pressure water. Owing to its inertness to a wide range of chemicals and relatively high specific gravity, it is used as filter medium for water and other liquids.

WORLD REVIEW

Garnet group of minerals are found through out the world in metamorphic, igneous and sedimentary rocks.

World reserves of garnet are moderate to large and occur in a wide variety of rocks like gneisses, schists in crystalline limestone, pegmatites, serpentinites, vein deposits, etc. In addition, alluvial garnet also occurs in heavy minerals sand deposits throughout the world. Major garnet deposits are found in USA, Australia, China and India. Deposits of garnets are also located in Canada, Chile, Czech Republic, Pakistan, South Africa, Spain, Thailand and Ukraine.

In 2018, Australia produced about 30% of total global production, followed by South Africa 25%, India 16%, China 10% and remaining 19% was contributed by USA and other countries. Russia and Turkey are also mining garnet for domestic markets. Garnet is also mined in Canada, Chile, Czech Republic, Pakistan, South Africa, Spain, Thailand and Ukraine.

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Worldwide the end uses of garnet and market shares are: abrasive blasting media 30%, abrasive grains for water jet cutting 35%, water filtration 20%, abrasive powder 10% and other end uses 5 per cent.

The world reserves and production of industrial garnet are furnished in Tables- 6 and 7.

**Table – 6 : World Reserves of Garnet (Industrial)
(By Principal Countries)**

(In 000' tonnes)	
Country	Reserves
World: Total (rounded)	Moderate to Large
Australia	Moderate to large
China	Moderate to large
India*	13000
USA	5000
Other countries	6500

Source: Mineral Commodity Summaries, February, 2019.

* In India as per NMI data based on UNFC system the total reserves/resources of garnet as on 1.4.2015 are estimated at 56.16 million tonnes.

**Table – 7 : World Production of Garnet (Industrial)
(By Principal Countries)**

(In tonnes)			
Country	2016	2017	2018
World: Total (rounded)	1540000	974000	1100000
Australia	575000	364000	330000
China	88900	100000	110000
India*	500000	142000	180000
South Africa	271000	211000	270000
USA	56400	107000	110000
Other countries	50000	50000	60000

Source: Mineral Commodity Summaries- 2018 & 2019,

Note : Figures are rounded off.

* India's production of garnet (abrasive) during 2015-16, 2016-17 and 2017-18 was at 82 thousand tonnes, 85 thousand tonnes and 158 thousand tonnes respectively.

FOREIGN TRADE

Exports

Exports of abrasive garnet decreased by 59% to 1,57,224 tonnes in 2017-18 from 3,87,276 tonnes in 2016-17. Exports were mainly to UAE (24%), USA (9%), Italy (7%), Saudi Arabia and Canada (5% each). Exports value of garnet (cut & uncut) increased in 2017-18 to ₹ 41.67 crore from ₹ 24.17 crore in the

previous year. Out of total cut and uncut garnet, about 92% exports earnings were from cut garnet. Exports of cut variety were mainly to Thailand (41%), Hong Kong (24%), USA (16%), Japan (8%) and Italy (3%) (Tables- 8 to 11).

**Table – 8 : Exports of Garnet (Abrasive)
(By Countries)**

Country	2016-17		2017-18	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	387276	4691843	157224	2346630
UAE	48865	665396	37341	543044
USA	69306	750331	13771	196846
Italy	14448	173233	10263	155572
Germany	18404	196493	9340	136237
Saudi Arabia	18929	240727	7684	125878
Canada	10829	133316	7288	109452
Malaysia	16232	193775	7065	102383
Australia	10885	128778	6542	102114
Korea, Rep. of	20292	275208	7334	100575
Kuwait	27185	351210	5646	88619
Other countries	131901	1583376	44950	685910

**Table-9 : Exports of Garnet (Cut & Uncut)
(By Countries)**

Country	2016-17		2017-18	
	Qty (**)	Value (₹'000)	Qty (**)	Value (₹'000)
All Countries	**	241716	**	416710
Thailand	**	83942	**	157203
Hong Kong	**	106066	**	125170
USA	**	30145	**	62863
Japan	**	7809	**	28874
Italy	**	856	**	13392
Czech Republic	**	6321	**	7117
France	**	26	**	5464
Germany	**	2369	**	3842
UK	**	2983	**	3814
Russia	-	-	**	2783
Other countries	**	1199	**	6188

*Note : ** - Quantity in different units.*

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**Table – 10 : Exports of Garnet (Cut)
(By Countries)**

Country	2016-17		2017-18	
	Qty (000 carats)	Value (₹'000)	Qty (000 carats)	Value (₹'000)
All Countries	4442	229781	28085	381866
Thailand	1180	83825	5450	155844
Hong Kong	1260	94950	17734	92441
USA	818	30145	2374	62487
Japan	119	7809	462	28874
Italy	313	832	481	13392
Czech Republic	52	6321	61	7117
France	++	24	104	5464
UK	597	2983	572	3814
Germany	88	2369	349	3628
Russia	-	-	81	2783
Other countries	15	523	417	6022

**Table – 11 : Exports of Garnet (Uncut)
(By Countries)**

Country	2016-17		2017-18	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	10	11935	142	34884
Hong Kong	5	11116	141	32729
Thailand	++	117	++	1359
USA	-	-	++	376
Germany	-	-	++	214
China	5	676	1	62
Other countries	++	26	++	104

Imports

In 2017-18, imports of abrasive garnet decreased by 1% to 2,256 tonnes from 2286 tonnes in the previous year. Imports value of cut and uncut garnet increased in 2017-18 to ₹ 3359 lakh from ₹ 2,223 lakh in 2016-17. In terms of value, imports were mainly

from Hong Kong (33%), China (17%), Thailand (13%) and Kenya (10%). Out of the total imports in terms of value in 2017-18, uncut garnet accounted for 83% and the remaining 17% was accounted for by cut garnet (Tables-12 to 15).

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**Table – 12 : Imports of Garnet (Abrasive)
(By Countries)**

Country	2016-17		2017-18	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2286	22193	2256	21243
UAE	2238	21213	1754	14187
Australia	-	-	370	5781
Bahrain	26	311	130	1185
China	18	369	2	50
South Africa	-	-	++	40
USA	4	300	-	-

**Table- 13: Imports of Garnet (Cut and Uncut)
(By Countries)**

Country	2016-17		2017-18	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**	222296	**	335897
Hong Kong	**	164101	**	112462
China	**	807	**	56665
Thailand	**	12725	**	42496
Kenya	**	8674	**	32718
Mozambique	**	7035	**	25684
Sri Lanka	**	10676	**	12895
USA	**	1767	**	11094
Madagascar	-	-	**	6151
Brazil	-	-	**	5198
Unspecified	**	401	**	19719
Other countries	**	16110	**	10815

Note : ** - Quantity in different units

**Table – 14 : Imports of Garnet (Cut)
(By Countries)**

Country	2016-17		2017-18	
	Qty (000 carats)	Value (₹'000)	Qty (000 carats)	Value (₹'000)
All Countries	**	222296	**	335897
All Countries	1571	17472	3702	58096
Hong Kong	88	2376	599	13426
Sri Lanka	1437	10676	1490	12885
Thailand	25	3401	420	6429
USA	21	1019	102	2061
China	-	-	428	1074
Unspecified	-	-	583	19719
Other countries	-	-	80	2502

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**Table – 15 : Imports of Garnet (Uncut)
(By Countries)**

Country	2016-17		2017-18	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4	204824	13	277801
Hong Kong	1	161725	3	99036
China	++	807	++	55591
Thailand	1	9324	1	36067
Kenya	1	8674	2	32718
Mozambique	1	7035	1	25684
USA	++	748	1	9033
Madagascar	-	-	1	6151
Brazil	-	-	++	5198
Tanzania	-	-	1	3535
Zambia	++	79	2	3483
Other countries	++	13469	1	1305

FUTURE OUTLOOK

Garnet has wide range of applications, such as in production of abrasives, sand blasting, water filtration materials, abrasive blasting media, and water-jet cutting. Garnet is expected to continue replacing silica sand blasting media, owing to later's associated occupational health risks. Moreover,

garnet is safer for the environment and cheaper to dispose of after recycling. Hence the worldwide demand for garnet is expected to increase, especially for waterjet cutting and for abrasive blasting media. China and India are expected to steadily increase garnet production and will become significant garnet sources for other countries.