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GARNET

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GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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23 Garnet

Garnet is the collective name for a group of minerals which crystalise in cubic system with different chemical composition. 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.

RESOURCES

In India, garnet deposits suitable for use in abrasive industry occur in Andhra Pradesh, Chhattisgarh, Jharkhand, Kerala, Odisha, Rajasthan and Tamil Nadu. Gem variety of garnet occurs in Ajmer, Jaipur, Kishangarh, Tonk and Udaipur districts, Rajasthan; Krishna, Nellore and Warangal districts, Andhra Pradesh; and Coimbatore, Nilgiri,Tirunelveli, Kanyakumari, Madurai, Tiruchirappalli, Thoothukudi and Salem 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 resources of garnet in India as on 1.4.2010, as per UNFC system are placed at 56.96 million tonnes of which reserves under proved and probable categories together constitute 19.32 million tonnes. Of the total resources, about 21.56 million tonnes are of abrasive grade, whereas resources of semi-precious grade are mere 5,352 tonnes. Tamil Nadu alone accounts for more than 59% of the total resources followed by Andhra Pradesh 30% and Odisha 6% and Telangana 3%. The remaining states together shared less than 2% (Table- 1).

EXPLORATION & DEVELOPMENT

During 2014-15, GSI investigated 51 sq km within the territorial waters off north of Bhimunipatnam, (off Santapalle) Andhra Pradesh. 69 seabed sediment samples varying in length from 0.13 m to 2.77 m with an average core length of 1.30 m were collected in 1x1 km grid pattern within 21 to 37 m sea water depths. The important heavy minerals in the area include ilmenite (39.15%), sillimanite (28.84%) and garnet (23.02%). A total of 2.95 million tonnes of heavy mineral resources are estimated of which garnet is 0.68 million tonnes. GSI also investigated Gopalpur-Sonapurpeta sector in Ganjam district, Odisha for heavy mineral concentration in the beach sand and nearshore region. Fifty onshore, surface and subsurface samples were collected for granulometry and heavy mineral potential analysis. The SEM & EDX analysis reveals heavy minerals comprising ilmenite, garnet and sillimanite as major constituents followed by zircon, rutile, monazite suggesting their source from crystalline host rocks like migmatites, khondalite, charnockite, granite gneiss, pyroxene granulite etc off Eastern Ghat Mobile Belt.

Indian Rare Earths Ltd. carried out drilling in Chatrapur areas in Ganjam district, Odisha. 409 boreholes with a total meterage of 3385 meters were drilled. 202.24 million tonnes of total reserves of beach sand minerals including garnet were proved.

PRODUCTION, STOCKS AND PRICES

Garnet (Abrasive)

Production of garnet (abrasive) at 79,000 tonnes during 2014-15 decreased by 84% as compared to that in the preceding year. The huge decrease can be mainly attributed to suspension of mining activity among private sector mines in Tamil Nadu. There were 6 reporting mines during 2014-15 as against 69 in the previous year. Besides, production of garnet (abrasive) was reported as an associated mineral by one sillimanite mine in Odisha. Three principal producers accounted for about 99% of the total output during the year. The share of public sector in the total output was about 28% in 2014-15 and 5% in the previous year.

In 2014-15, 71% of the total production was reported from Andhra Pradesh, 15% from Odisha and the remaining 14% was from Tamil Nadu and Rajasthan. (Tables - 2 to 4).

Mine-head closing stocks of Garnet (Abrasive) for the year 2014-15 were 63 thousand tonnes as against 90 thousand tonnes in the previous year (Table -5).

The average daily employment of labour during 2014-15 was 1,570 as against 3,300 in the previous year.

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

Table – 1 : Reserves/Resources of Garnet as on 1.4.2010
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining resources							
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Total (B)	Total resources (A+B)
		STD121	STD122			STD221	STD222					
All India : Total	**3252107**	**4712202**	**11360484**	**19324793**	**9270**	**81901**	**207041**	**117887**	**10226689**	**26995243**	**37638032**	**56962824**
By Grades												
Abrasive	3048526	4710071	11091469	18850066	214	39774	114044	102848	15645	2438410	2710935	21561001
Semi-precious	283	481	227	991	5	94	553	39	1293	2378	4361	5352
Others	-	-	5534	5534	9051	6033	-	-	-	215573	230657	236191
Unclassified	203298	1650	263254	468202	-	36000	394	15000	10208995	23951287	34211676	34679878
Not-known	-	-	-	-	-	-	92051	-	756	387596	480403	480403
By States												
Andhra Pradesh	2911387	4500	710000	3625887	-	-	-	-	8800000	4731800	13531800	17157687
Chhattisgarh	-	-	-	-	-	-	-	-	-	28800	28800	28800
Jharkhand	-	-	-	-	-	-	88303	-	-	21768	110071	110071
Kerala	-	-	45797	45797	-	-	-	100874	-	52190	153064	198861
Odisha	-	3185605	-	3185605	5	-	-	-	-	348000	348005	3533610
Rajasthan	6251	10700	9299	26250	214	39868	26687	2013	17694	85690	172167	198416
Tamil Nadu	334469	1511397	10595388	12441254	-	-	92051	15000	1408995	19871019	21387065	33828319
Telangana	-	-	-	-	9051	42033	-	-	-	1855976	1907060	1907060

Figures rounded off.

Table – 2 : Principal Producers of Garnet (Abrasive), 2014-15

Name & address of producer	Location of mine	
	State	District
Trimex Industries Pvt. Ltd, Vill. Govindam Palli, Mandal: Obuavari Palli, Kodur- 516 101, Hyderabad, Andhra Pradesh.	Andhra Pradesh	Srikakulam
Indian Rare Earths Ltd., Plot No. 1207, Prabhadevi, Veer Savarkar Marg, Near Siddhivinayak Temple, Dadar- 400 028 Maharashta.	Tamil Nadu Odisha	Kanyakumari Ganjam*
Transworld Garnet India Pvt. Ltd, New No. 34, M. G. R. Road, Kalakshetra Colony, Besant Nagar, Chennai- 600 090, Tamil Nadu.	Andhra Pradesh	Srikakulam

*Producing as an associated mineral with Sillimanite.

Table – 3 : Production of Garnet (Abrasive) 2012-13 to 2014-15 (By States)

(Qty in tonnes; Value in ₹'000)

State	2012-13		2013-14		2014-15(P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**768248**	**924683**	**483559**	**1113231**	**78924**	**702729**
Andhra Pradesh	83683	497499	108409	831543	55803	564497
Odisha	23898	128022	19091	106012	11999	68153
Rajasthan	614	565	715	807	725	993
Tamil Nadu	660053	298597	355344	174869	10397	69086

Table – 4 : Production of Garnet (Abrasive), 2013-14 & 2014-15 (By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State	2013-14			2014-15(P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**69(1)**	**483559**	**1113231**	**6(1)**	**78924**	**702729**
Public sector	2(1)	25269	159285	2(1)	22396	137239
Private sector	67	458290	953946	4	56528	565490
Andhra Pradesh	**2**	**108409**	**831543**	**2**	**55803**	**564497**
Srikakulam	2	108409	831543	2	55803	564497
Odisha	**(1)**	**19091**	**106012**	**(1)**	**11999**	**68153**
Ganjam	(1)	19091	106012	(1)	11999	68153
Rajasthan	**1**	**715**	**807**	**1**	**725**	**993**
Ajmer	-	-	-	1*	-	-
Bhilwara	1	715	807	1	725	993
Tamil Nadu	**66**	**355344**	**174869**	**2**	**10397**	**69086**
Kanyakumari	8	26178	59273	2	10397	69086
Madurai	2*	-	-	-	-	-
Thoothukudi	3	9850	2990	-	-	-
Tiruchirapalli	2	2000	800	-	-	-
Tirunelveli	51	317316	111806	-	-	-

Figures in parentheses indicate associated mine of sillimanite.
** Only Labour Reported.*

Table – 5 : Mine-head closing stocks of Garnet (Abrasive) 2013-14 & 2014-15 (By States)

(In tonnes)

State	2013-14	2014-15(P)
India	**89886**	**63263**
Andhra Pradesh	27401	7409
Odisha	10741	515
Rajasthan	475	405
Tamil Nadu	51269	54934

Garnet (Gem)

No production of garnet (gem) was reported during 2014-15.

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. 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 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.

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 specfic 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 2013, India produced about 48% of total global production, followed by China 31% and Australia 16% and remaining 5% 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.

Worldwide the end uses of garnet and market shares are: abrasive blasting media 30%, abrasive grains for waterjet 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*	19000
USA	5000
Other countries	6500

***Source**:Mineral Commodity Summaries, 2016.*
** India's total UNFC resources of garnet as on 1.4.2010 are estimated at 56.96 million tonnes.*

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

(In tonnes)

Country	2012	2013	2014
World: Total	**1670000**	**1660000**	**1660000**
Australia	263000	263000	260000
China	510000	510000	520000
India*	800000	800000	800000
USA	46900	33900	32200
Other countries	50000	50000	50000

Source: Mineral Commodity Summaries, 2016
Note: Figures are rounded off.
** India's production of garnet during 2012-13, 2013-14 and 2014-15 was 0.77 million tonnes, 0.48 million tonnes and 0.79 million tonnes, respectively.*

FOREIGN TRADE

Exports

Exports of abrasive garnet decreased by 6.7% to 448,559 tonnes in 2014-15 from 480,774 tonnes in 2013-14. Exports were mainly to USA (19%), UAE (14%), Saudi Arabia and Germany (6% each) and Qatar (4%). Exports value of garnet (cut & uncut) also decreased in 2014-15 to 3.11 crore from 3.94 crore in the previous year. Out of total cut and uncut garnet, about 91% exports earnings were from cut garnet. Exports of cut variety were mainly to Thailand, UK, Japan and Czech Republic (Tables- 8 to 11).

Imports

In 2014-15, imports of abrasive garnet increased to 647 tonnes from 626 tonnes in the previous year. Imports value of cut and uncut garnet also increased in 2014-15 to ₹687 lakh from ₹469 lakh in 2013-14. Imports were mainly from Hong Kong (33%), Kenya (16%) and Mozambique (12%) in terms of value. Out of the total imports in 2014-15, uncut garnet accounted for 87% value and the remaining 13% was accounted for by cut garnet (Tables- 12 to 15).

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

Country	2013-2014		2014-15(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**480774**	**6060269**	**448559**	**5673828**
USA	73289	845380	85057	986186
UAE	106077	1372415	64003	840193
Saudi Arabia	28473	357837	26374	361999
Germany	24047	301088	27095	338476
Qatar	20209	289302	18084	260867
Kuwait	24987	316159	18900	245464
Thailand	7790	112011	15326	215114
Malaysia	13138	152209	16946	196578
Italy	19522	239868	16071	192302
Australia	13412	181978	12745	178004
Other countries	149830	1892022	147958	1858645

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

Country	2013-14	2014-15(P)
	Value (₹'000)	Value (₹'000)
All Countries	**39395**	**31070**
Czech Republic	10538	8964
USA	3688	7035
Thailand	20415	9028
UK	336	1898
Japan	1507	1643
Hong Kong	395	789
Italy	19	702
Qatar	-	534
Germany	2438	201
Sri Lanka	-	69
Other countries	59	207

Table- 10: Exports of Garnet (Cut) (By Countries)

Country	2013-14		2014-15(P)	
	Qty ('000 Carats)	Value (₹'000)	Qty ('000 Carats)	Value (₹'000)
All Countries	**1373**	**36673**	**902**	**28200**
Czech Republic	116	10538	76	8964
USA	151	3688	15	7035
Thailand	982	20183	254	6892
UK	96	336	304	1898
Japan	23	1507	96	1643
Hong Kong	5	395	37	789
Italy	++	19	5	354
Qatar	-	-	3	317
Germany	-	-	++	111
Sri Lanka	-	-	70	69
Other countries	++	7	42	128

Table- 11: Exports of Garnet (Uncut) (By Countries)

Country	2013-14		2014-15(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**3**	**2722**	**++**	**2870**
Hong Kong	2	232	++	2136
Sri Lanka	-	-	++	348
UK	-	-	++	217
USA	++	2438	++	90
Thailand	1	51	++	36
Poland	-	-	++	36
China	++	1	++	6
Other countries	-	-	++	1

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

Country	2013-14		2014-15(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**626**	**10542**	**647**	**10297**
Australia	52	351	228	5622
China	217	3660	136	2335
UAE	348	6446	276	1815
UK	-	-	7	525
Other countries	9	85	-	-

Table – 13 : Imports of Garnet (Cut & Uncut) (By Countries)

Country	2013-14	2014-15(P)
	Value (₹'000)	Value (₹'000)
All Countries	**46894**	**68743**
Hong Kong	2939	26697
Kenya	2026	10764
Mozambique	11513	8378
South Africa	-	7152
Thailand	14109	4701
Sri Lanka	160	3182
Tanzania	7975	2399
Zambia	1795	2224
USA	603	1418
Nigeria	605	1270
Other countries	5169	558

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

Country	2013-14		2014-15(P)	
	Qty ('000 crt)	Value (₹'000)	Qty ('000 crt)	Value (₹'000)
All Countries	**2**	**1585**	**210**	**8990**
Hong Kong	++	56	2	4166
Sri Lanka	1	109	185	3182
USA	1	603	11	1418
Thailand	++	762	11	80
Zimbabwe	-	-	1	54
Japan	++	49	++	48
China	++	5	++	42
Other countries	++	1	-	-

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

Country	2013-14		2014-15(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**57**	**45309**	**33**	**59753**
Hong Kong	2	2883	10	22531
Kenya	++	2026	1	10764
Mozambique	15	11513	17	8378
South Africa	-	-	1	7152
Thailand	++	13347	++	4621
Tanzania	39	7975	3	2399
Zambia	1	1795	1	2224
Nigeria	++	605	++	1270
Czech Republic	-	-	++	160
Madagascar	++	977	++	136
Other countries	++	4188	++	118

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. 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. Domestic production of garnet is very high, while the current domestic demand is limited and the major chunk is exported.