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(Part- III : Mineral Reviews)

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KYANITE, SILLIMANITE AND ANDALUSITE

(ADVANCE RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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17 Kyanite, Sillimanite and Andalusite

Kyanite, sillimanite and andalusite are unhydrous aluminosilicate minerals that have the same chemical formula Al_2O_3 but differ in crystal structure and physical properties. When calcined at high temperature around 1350 ^{0}C to 1380 ^{0}C for kyanite and slightly higher for andalusite and sillimanite, these minerals are converted to mullite, ($3\ Al_2O_3.2SiO_2$) and silica (SiO_2) which are refractory minerals.

Synthetic mullite is made by heating mixtures of alumina and silica or bauxite and kaolin at around 1550 ^{0}C to 2000 ^{0}C. Refractory are heat resistant materials used in high temperature applications such as furnances, ladles, kilns, in the metallurgical, glass, chemical, cement and other industries.

RESOURCES

Kyanite

The total reserves/resources of kyanite as per NMI database, based on UNFC system as on 1.4.2015 in the country have been placed at 104.98 million tonnes. Out of these resources, only 0.68 million tonnes are the reserves and 104.29 million tonnes are the remaining resources. Out of total resources, high and medium-grade resources together account for merely 1.74%, low grade 8%, mixed grade 0.73%, quartz kyanite rock, kyanite gneiss rock and kyanite schist 87.1% and granular, others and not-known grades 2.41%. Statewise, share of Telangana is 46% of total resources followed by Andhra Pradesh 30.5%, Karnataka 12.67% and Jharkhand 7.23%. Remaining 3.60% resources are in Kerala, Maharashtra, Rajasthan, Tamil Nadu and West Bengal collectively (Table-1).

Sillimanite

The total reserves/resources of sillimanite as per NMI database, based on UNFC system in the country as on 1.4.2015 have been placed at 70.20 million tonnes. Out of these resources, the reserves are only 6.50 million tonnes, while about 63.70 million tonnes are the remaining resources. Out of total resources, more than 73.33% are granular high-grade, while quartz sillimanite rocks and sillimanite bearing rocks are about 21.64%. Resources of massive sillimanite of all grades are about 4.83%. The resources are located mainly in Odisha (25.15%), Tamil Nadu (24.87%), Uttar Pradesh (16.30%), Andhra Pradesh (12.52%), Kerala (10.17%) and Assam (6.55%). Remaining 4.44% resources are in Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Rajasthan and West Bengal (Table-2).

Andalusite

The total reserves/resources of andalusite in the country as on 1.4.2015 as per NMI database, based on UNFC system have been placed at 28.20 million tonnes. Most of the resources are of reconnaissance category located in Uttar Pradesh (Table-3).

EXPLORATION & DEVELOPMENT

Details of exploration & development are given in the review of "Exploration & Development" in General Reviews.

Table – 1 : Reserves/Resources of Kyanite 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	**639121**	**-**	**48958**	**688079**	**1505114**	**568205**	**2193427**	**579619**	**3577402**	**95869713**	**-**	**104293480**	**104981559**
By Grades													
High grade	-	-	-	-	-	4317	21867	-	297827	114689	-	438700	438700
Medium grade	212881	-	48958	261839	430490	-	276651	-	34410	381532	-	1123083	1384922
Low grade	426240	-	-	426240	234210	15930	1178813	386247	2214900	3952872	-	7982972	8409212
High & medium mixed	-	-	-	-	-	100550	53103	-	93640	106928	-	354221	354221
Medium & low mixed	-	-	-	-	-	-	-	-	-	48000	-	48000	48000
High, medium & low mixed	-	-	-	-	13097	89650	10606	-	45000	210025	-	368378	368378
Granular	-	-	-	-	-	-	-	-	167000	81359	-	248359	248359
Quartz kyanite rock	-	-	-	-	-	-	-	-	-	81105358	-	81105358	81105358
Kyanite gneiss rock	-	-	-	-	-	-	-	-	-	5370800	-	5370800	5370800
Kyanite schist	-	-	-	-	-	-	-	-	724625	4250000	-	4974625	4974625
Others	-	-	-	-	593710	23491	303166	1012	-	12530	-	933909	933909
Not-known	-	-	-	-	233607	334267	349221	192360	-	235620	-	1345075	1345075
By States													
Andhra Pradesh	-	-	-	-	-	-	399	-	-	32003829	-	32004228	32004228
Jharkhand	426240	-	-	426240	824472	524467	881313	-	1754900	3182363	-	7167515	7593755
Karnataka	-	-	-	-	637460	15930	113630	386247	1610502	10531529	-	13295298	13295298
Kerala	-	-	-	-	-	-	-	192360	-	10000	-	202360	202360
Maharashtra	212881	-	48958	261839	30085	27808	1187479	1012	45000	1684113	-	2975497	3237336
Rajasthan	-	-	-	-	13097	-	10606	-	-	-	-	23703	23703
Tamil Nadu	-	-	-	-	-	-	-	-	167000	81359	-	248359	248359
Telangana	-	-	-	-	-	-	-	-	-	48350000	-	48350000	48350000
West Bengal	-	-	-	-	-	-	-	-	-	26520	-	26520	26520

Figures rounded off.

Table – 2 : Reserves/Resources of Sillimanite as on 1.4.2015
(By Grades/States)

(In tonnes)

Grade/States	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	**323231**	**5728868**	**450016**	**6502115**	**1020187**	**135278**	**20257525**	**4580083**	**17790664**	**16068690**	**3849600**	**63702027**	**70204142**
By Grades													
Massive high grade	-	-	-	-	-	-	-	-	-	11903	-	11903	11903
Massive medium grade	-	-	-	-	-	4000	-	-	-	29705	-	33705	33705
Massive low grade	44021	-	15000	59021	300	-	519	-	850000	2273786	-	3124605	3183626
Massive high & medium	-	-	-	-	-	-	-	-	-	19800	-	19800	19800
Massive medium & low	136981	-	7274	144255	-	-	-	-	-	-	-	-	144255
Massive high, medium & low	-	-	-	-	-	-	-	-	-	38	-	38	38
Granular high	128789	5728868	427742	6285399	1019887	120208	20257006	2480083	7590600	13732942	-	45200726	51486125
Quartz sillimanite rock	-	-	-	-	-	-	-	-	-	-	3748000	3748000	3748000
Sillimanite bearing rock	-	-	-	-	-	-	-	2100000	9350000	-	-	11450000	11450000
Others	-	-	-	-	-	11070	-	-	-	-	-	11070	11070
Unclassified	13440	-	-	13440	-	-	-	-	-	-	-	-	13440
Not-known	-	-	-	-	-	-	-	-	64	516	101600	102180	102180
By States													
Andhra Pradesh	2045	-	37	2082	15	11278	12	267	7430300	1346988	-	8788861	8790943
Assam	-	-	-	-	-	-	-	-	850000	6700	3748000	4604700	4604700
Jharkhand	-	-	-	-	-	-	-	-	-	83000	-	83000	83000
Karnataka	-	-	-	-	-	-	-	-	-	982725	-	982725	982725
Kerala	-	-	-	-	1015625	120000	-	2479816	160300	3369200	-	7144941	7144941
Madhya Pradesh	-	-	-	-	-	-	-	-	-	-	101600	101600	101600
Maharashtra	181002	-	22274	203276	-	-	-	-	64	15516	-	15580	218856
Meghalaya	-	-	-	-	-	-	-	-	-	55807	-	55807	55807
Odisha	-	5728868	427705	6156573	-	-	6557013	-	-	4943600	-	11500613	17657186
Rajasthan	-	-	-	-	300	-	519	-	-	-	-	819	819
Tamil Nadu	140184	-	-	140184	4246	4000	13699981	-	-	3612154	-	17320381	17460565
Uttar Pradesh	-	-	-	-	-	-	-	2100000	9350000	-	-	11450000	11450000
West Bengal	-	-	-	-	-	-	-	-	-	1653000	-	1653000	1653000

Figures rounded off.

Table – 3 : Reserves/ Resources of Andalusite as on 1.4.2015

(In '000 tonnes)

State	Total Reserves (A)	Remaining Resources			Total Resources (A+B)
		Inferred STD333	Reconnaissance STD334	Total (B)	
All India : Total	**–**	**4000**	**24201**	**28201**	**28201**
By Grades					
Unclassified	-	-	24201	24201	24201
Low	-	4000	-	4000	4000
By States					
Jharkhand	–	4000	1	4001	4001
Uttar Pradesh	–	-	24200	24200	24200

Figures rounded off

PRODUCTION & STOCKS

Kyanite

During 2016-17 production of kyanite at 3,254 tonnes increased by 12% as compared to the previous year. There were 5 reporting mines in both the years.Two principal producers contributed almost the entire production of kyanite during the year (Tables- 4 to 6).

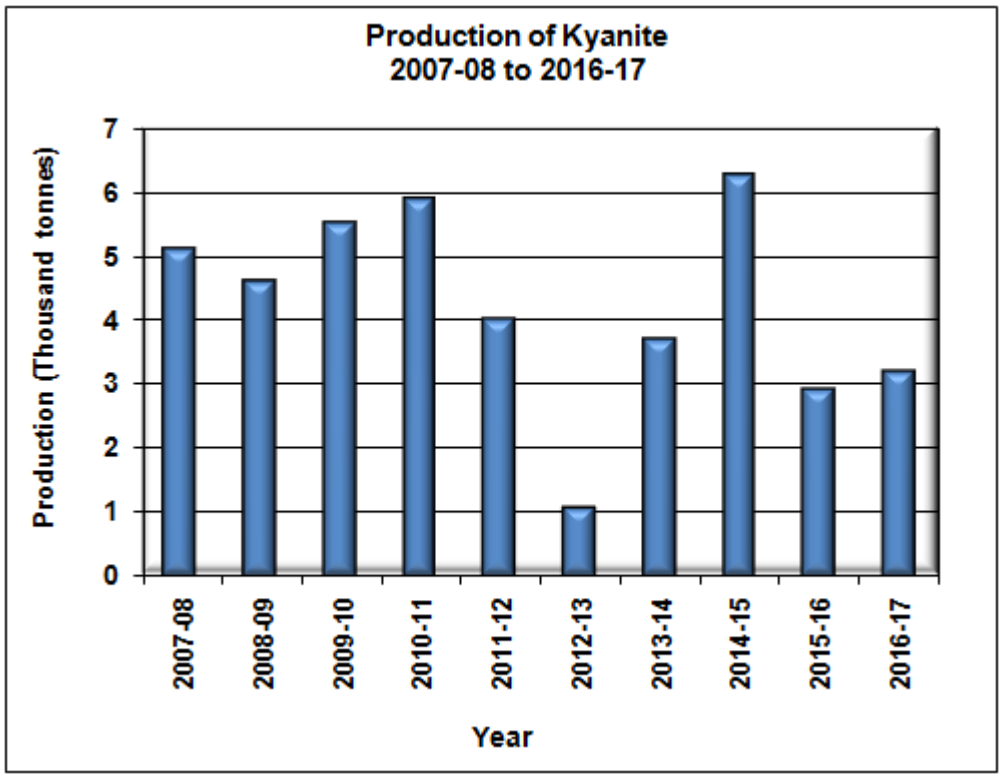
In 2016-17, 3154 tonnes i.e. about 97% of total production of kyanite was of grade 40% Al_2O_3 and above and 100 tonnes i.e. about 3% of total production of kyanite was of grade below 40% Al_2O_3. About 30% of the total production was reported by the public sector.

Mine-head closing stocks at the end of the year 2016-17 were 12,892 tonnes (Table - 7).

The average daily employment of labour was 65 in 2016-17 as against 98 in the preceding year.

Table – 4 : Producers of Kyanite, 2016-17

Name & address of producer	Location of mine	
	State	District
Pavri Kyanite Mines, Cimmco House, A-1 Indra Sagar Apartment, Ravindranath Tagore Marg, Civil Lines, Nagpur- 440 001, Maharashtra.	Maharashtra	Bhandara
Maharashtra State Mining Corporation Ltd Plot No. 7, Ajani Chowk, Wardha Road, Nagpur - 440 015, Maharashtra.	Maharashtra	Bhandara



(By States)

(Qty in tonnes; Value in ₹'000)

State	2014-15		2015-16		2016-17 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**6255**	**12185**	**2901**	**14180**	**3254**	**13632**
Karnataka	4400	3520	-	-	-	-
Maharashtra	1855	8665	2901	14180	3254	13632

Table – 6 : Production of Kyanite, 2015-16 and 2016-17
(By Sectors/States/Districts/Grades)

(Qty in tonnes; Value in ₹ '000)

State/District	2015-16					2016-17 (P)				
	No. of mines	Quantity			Value	No. of mines	Quantity			Value
		40% & above Al_2O_3	Below 40% Al_2O_3	Total			40% & above Al_2O_3	Below 40% Al_2O_3	Total	
India	**5**	**2566**	**335**	**2901**	**14180**	**5**	**3154**	**100**	**3254**	**13632**
Public sector	1	123	79	202	322	1	877	100	977	1909
Private sector	4	2443	256	2699	13858	4	2277	-	2277	11723
Karnataka	**1***	**-**	**-**	**-**	**-**	**1***	**-**	**-**	**-**	**-**
Mysuru	1*	-	-	-	-	1*	-	-	-	-
Maharashtra	**4**	**2566**	**335**	**2901**	**14180**	**4**	**3154**	**100**	**3254**	**13632**
Bhandara	4	2566	335	2901	14180	4	3154	100	3254	13632

** : Only labour reported.*

Table – 7 : Mine-head Closing Stocks of Kyanite, 2015-16 and 2016-17 (By States/Grades)

(Qty in tonnes)

State	2015-16			2016-17 (P)		
	40% Al_2O_3 & above	Below 40% Al_2O_3	Total	40% Al_2O_3 & above	Below 40% Al_2O_3	Total
India	**465**	**14054**	**14519**	**810**	**12082**	**12892**
Jharkhand	-	1327	1327	-	1327	1327
Karnataka	-	12182	12182	-	10430	10430
Maharashtra	465	545	1010	810	325	1135

Sillimanite

During 2016-17 the production of sillimanite at 68,137 decreased by 3% as compared to previous year.There were 4 reporting mines in the current and the previous year. All the four mines reported production of sillimanite as an associated mineral either with garnet or kyanite during 2016-17.

Ninety nine percent of total production during the year 2016-17 was contributed by three producers. About 37% of total production of sillimanite was reported by the public sector, while remaining 63% of production was reported by the private sector. Andhra Pradesh, the main producing state contributed 54% of the total production of sillimanite during 2016-17 followed by Odisha (23%), Kerala (14%) and Maharashtra (9%) (Tables - 8 to 10).

Mine-head closing stocks for the year 2016-17 were 28,531 tonnes as against 24,430 tonnes in the previous year (Table - 11).

The average daily employment of labour during 2016-17 was 1,723 as against 1,759 in the previous year.

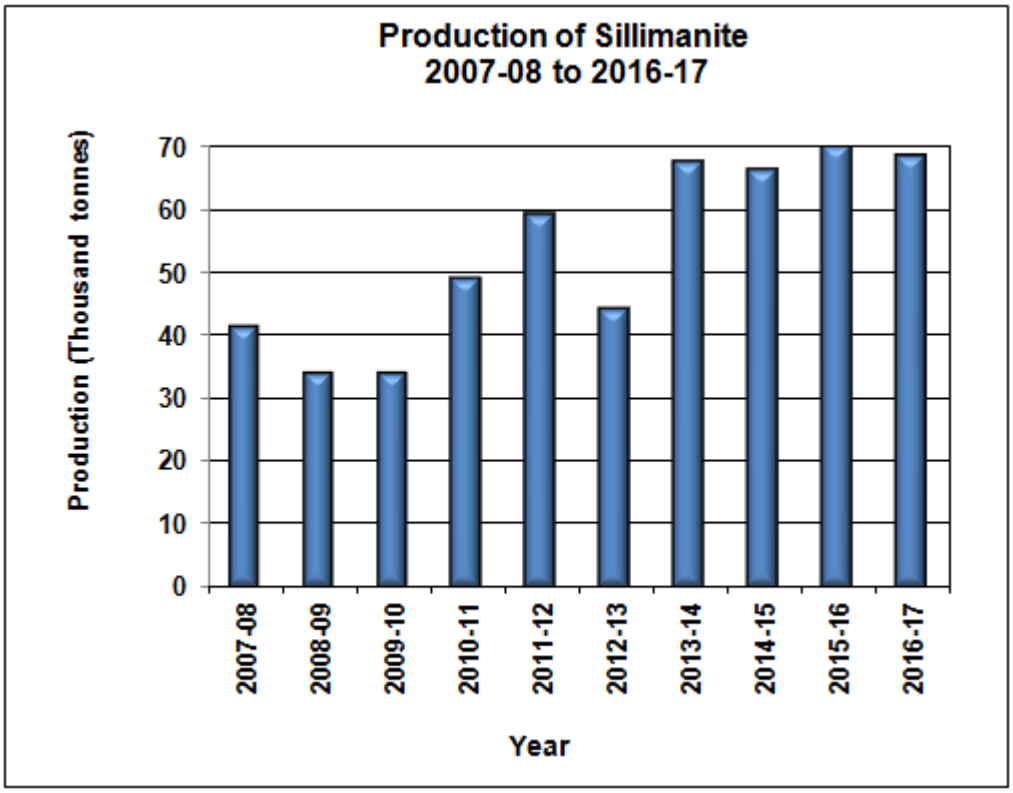


Table – 8 : Producers of Sillimanite, 2016-17

Name & address of producer	Location of mine	
	State	District
Indian Rare Earths Ltd, Plot No. 1207, Veer Sawarkar Marg, Near Siddhi Vinayak Temple, Prabhadevi, Mumbai-400 028, Maharashtra.	Odisha Kerala	Ganjam Kollam
#Trimex Sands Private Limited, Trimex Towers, No.-1, Subbraya Avenue, C.P. Ramaswamy Road, Alwarpet, Chennai - 600 018. Tamil Nadu.	Andhra Pradesh	Srikakulam
*Pavri Kyanite Mines, A/1, Indrasagar Apartments, Ravindranath Tagore Road, Civil Lines, Nagpur- 440 001 Maharashtra.	Maharashtra	Bhandara

 # Producing as an associated mineral with garnet.
** Producing as an associated mineral with kyanite.*

Table – 9 : Production of Sillimanite, 2014-15 to 2016-17 (By States)

(Qty in tonnes; Value in ₹'000)

State	2014-15		2015-16		2016-17 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**66273**	**456050**	**69942**	**509314**	**68137**	**534098**
Andhra Pradesh	33801	250026	42409	340841	37109	322265
Kerala	7689	69201	5121	49585	9260	86929
Maharashtra	6472	17948	9091	27133	6196	21447
Odisha	18311	118875	13393	91755	15572	103457

Table – 10 : Production of Sillimanite, 2015-16 and 2016-17 (By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/District	2015-16			2016-17 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**4(4)**	**69942**	**509314**	**4(4)**	**68137**	**534098**
Public sector	4	18514	141340	4	24942	190757
Private sector	(4)	51428	367974	(4)	43195	343341
Andhra Pradesh	**(1)**	**42409**	**340841**	**(1)**	**37109**	**322265**
Srikakulam	(1)	42409	340841	(1)	37109	322265
Kerala	**2**	**5121**	**49585**	**2**	**9260**	**86929**
Kollam	2	5121	49585	2	9260	86929
Maharashtra	**1(3)**	**9019**	**27133**	**1(3)**	**6196**	**21447**
Bhandara	1(3)	9019	27133	1(3)	6196	21447
Odisha	**1**	**13393**	**91755**	**1**	**15572**	**103457**
Ganjam	1	13393	91755	1	15572	103457

Figures in parentheses indicate the number of associated mines with garnet and kyanite.

Table – 11: Mine-head Closing Stocks of Sillimanite 2015-16 & 2016-17 (By States)

(In tonnes)

State	2015-16	2016-17 (P)
India	**24430**	**28531**
Andhra Pradesh	2709	3435
Kerala	1980	2388
Maharashtra	16095	18908
Odisha	3646	3800

Andalusite

There was no production of andalusite in the country since 1988.

MINING & MARKETING

Kyanite

Kyanite mines are worked by opencast manual as well as semi-mechanised methods. Generally, the mineral is marketed under three grades: 60% Al_2O_3 and above, 50-60% Al_2O_3 and less than 50% Al_2O_3. These three grades are used in the manufacture of refractories.

Sillimanite

Sillimanite mines are also worked by opencast method. Pohra mine of Maharashtra State Mining Corporation Ltd is semi-mechanised.

Granular sillimanite is obtained from beach sands in Kerala, Odisha and Tamil Nadu as a by-product along with ilmenite, rutile, zircon, garnet, etc. while recovering monazite. The Odisha Sands Complex of IREL in the coastal region of Chatrapur in Ganjam district, Odisha, has the capacity to recover 10,000 tpy granular sillimanite at present. At Chatrapur, mining is carried out by suction dredging with gravel pump. IREL's Chavara plant in Kollam district, Kerala, presently has an installed capacity of 10,000 tpy granular sillimanite.

At Chavara in Kerala, beach sand mining operations are carried out by IREL in two stages: (i) by means of bulldozers and wheel loaders, and subsequently loading by front-end loaders, wheel loaders and belt conveyors; and (ii) upgrading it to around 93% heavy minerals at Dredge & Wet Concentration Plant and concentrate upgrading unit. The Mineral Recovery Plant (MRP) essentially consists of a dredging system to mine the deposit and a pre-concentration system to separate the valuable minerals and dispose of the waste at the same place from where it was mined. The two systems are mounted on a combined floating platform which keeps moving with the progress of mining. For details regarding mining and processing, etc. of beach sand minerals, review on 'Ilmenite and Rutile' may be referred.

USES

Kyanite, sillimanite and andalusite are mainly used in refractories and ceramic products because of their ability to form mullite phase at high temperature. Mullite is an essential component of high - alumina refractories forming the inner lining of furnaces and high temperature vessels widely used in the production of metals,ceramics, glass and cement.These are used to manufacture refractory products like dense bricks, insulating bricks, monolithic & castables. Sillimanite refractory bricks are extensively used in steel and glass industries and also in ceramics, cement kilns, heat treatment furnaces and petrochemical industries.

SPECIFICATIONS

BIS has prescribed IS:14301-1995 (reaffirmed in 2011) for kyanite used in refractory industry. There are two grades i.e. Grade-1 and Grade-2. Composition of kyanite under this specification is Al_2O_3 58% min for Grade-1 and 54% min for Grade-2; Fe_2O_3 1.50% max, $K_2O + Na_2O$ 1% max; other constituents as agreed between the supplier and purchaser and Pyrometric Cone Equivalent (PCE) not less than 36 (for Grade-1) and 35 (for Grade-2). Size of the material is 50 to 150 mm or 10 to 50 mm.

BIS has laid down IS:14302-1995 (reaffirmed in 2011) in respect of beach sand sillimanite for use in refractory industry, while IS:2045-1962 in respect of natural sillimanite blocks for glass melting tanks furnaces has been withdrawn.

CONSUMPTION

Kyanite

The consumption of kyanite in various industries was 3,400 tonnes in 2016-17 which is about 10% more than previous year. About 91% consumption of kyanite was accounted for by the refractory industry and rest of 9% consumption is reported by other industries (Table-12).

Sillimanite

The consumption of sillimanite was 24,200 tonnes in 2016-17, decreased by about 15% over the previous year. Refractory industry alone accounted for about 83% of consumption and Ceramic industry (8%) (Table-12).

Table – 12 : Consumption* of Kyanite and Sillimanite 2014-15 to 2016-17 (By Industries)

(In tonnes)

Industry	2014-15	2015-16(R)	2016-17 (P)
Kyanite			
All Industries	**3200**	**3100**	**3400**
Refractory	2900	3000	3100#
Others	300	100	300#
Sillimanite			
All Industries	**28200**	**28400**	**24200**
Ceramic	2400	2400	2400
Foundry	++	1100	1300
Refractory	25500	23700	19300
Others (abrasives, cement, chemicals etc.)	300	1200	1200

Figures rounded off.

(Due to paucity of data, consumption may not be complete).*

 # Consumption taken from despatches of 2016-17. whereas the apparent consumption for kyanite was 3849 tonnes and 54079 tonnes for sillimanite for the year 2016-17.

WORLD REVIEW

World reserve of kyanite and related minerals is large in the USA. Andalusite is limited to only a few countries. The main producer and exporter of andalusite is South Africa. USA and India are the main producers of kyanite. India is the leading producer of sillimanite. World production of kyanite and related minerals is given in Table-13.

Table – 13 : World Production of Kyanite and Related Minerals (By Principal Countries)

(In tonnes)

Country	2013	2014	2015
Brazil			
Kyanite[eb]	200	200	200
France			
Andalusite[e]	68000	68000	68000
India*			
Kyanite	3679	6255	2901
Sillimanite	67265	66273	70447
Madagascar	4500	4500[e]	4500[e]
Nepal			
Kyanite	19	12	7
South Africa			
Andalusite[e]	270000	270000	270000
USA			
Kyanite[(a)]	110000	110000[e]	110000[e]

Source: *World Mineral Production, 2011-2015.*
(a) Including related minerals.
(b) Including beneficiated & directly shipped material.
** India's production of kyanite during 2013-14, 2014-15 and 2015-16 was 3,679 tonnes, 6,255 tonnes and 2,901 tonnes respectively, while that of sillimanite was 67,265 tonnes, 66,273 tonnes and 70,447 tonnes, respectively.*

The availability of inexpensive refractory-grade bauxite from China, which accounted for about 75% of the refractories market share worldwide, continued to decrease. Andalusite and mullite could receive increasing demand as alternative aluminosilicate refractory minerals to refractory bauxite, but the availability of andalusite has been hampered by heavy rains and flooding that took place during the first quarter of 2017 in major andalusite-producing areas in South Africa and Peru. China was expected to have an economic growth rate approaching 7% in 2017 and continue to be the largest-market for refractories. Slowing, but still above-average, growth is expected in most other parts of Asia. The economies of North America and Europe are expected to increase in 2018 with continued recovery in manufacturing and steel production. Demand for refractories in iron and steel production is expected to have larger increases in countries with higher growth rates in steel production. Increased demand also is anticipated for refractories used to produce other metals and in the industrial mineral market because of increasing production of cement, ceramics, glass, and other mineral products.

FOREIGN TRADE

Exports

During 2016-17 exports of kyanite were at 153 tonnes, exports of sillimanite were at 14,263 tonnes while an export of 150 tonnes of andalusite was registered andalusite's entire exports were to Germany. While during 2015-16 exports of kyanite were at 144 tonnes which increased drastically by 269% more than the previous year. Exports were mainly to China (39%), Greece (32%) and Saudi Arabia (22%). While exports of sillimanite decreased by 13% to 15,078 tonnes in 2015-16 from 17,304 tonnes in the previous year. Sillimanite was exported mainly to China (67%) and Nepal (26%). There were no exports of andalusite during 2015-16 (Tables - 14 to 19).

Imports

During 2016-17 imports of kyanite werw at 748 tonnes, imports of sillimanite were at 24 tonnes and imports of andalusite were at 10,909 tonnes. In 2015-16, imports of kyanite were at 478 tonnes as against 508 tonnes in the previous year. Imports of sillimanite were 214 tonnes in 2015-16 as compared to 116 tonnes in the previous year. Imports of andalusite increased to 14,072 tonnes in 2015-16 from 9,350 tonnes in the previous year. The entire imports of kyanite were from USA . France (45%) and Turkey (37%) were the main supplier of sillimanite, while South Africa (91%) was the main supplier of andalusite in 2015-16 (Tables - 20 to 25).

Table – 14 : Exports of Kyanite
(By Countries)

Country	2016-17 (P)	
	Qty (t)	Value (₹'000)
All Countries	**153**	**3052**
Greece	139	2675
Nepal	5	35
UAE	5	163
Kenya	4	179

Table – 15 : Export of Kyanite
(By Countries)

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**39**	**505**	**144**	**2696**
Greece	-	-	46	924
Saudi Arabia	-	-	32	842
China	++	2	56	783
UAE	-	-	++	81
Nepal	22	203	10	62
Jordan	-	-	++	2
Singapore	-	-	++	2
Iran	5	164	-	-
Kenya	12	126	-	-
UK	++	7	-	-
Other countries	++	3	-	-

Table – 16 : Exports of Sillimanite
(By Countries)

Country	2016-17 (P)	
	Qty (t)	Value (₹'000)
All Countries	**14263**	**114680**
China	6507	69402
Nepal	6384	25355
Japan	480	9346
Belgium	234	2853
Germany	125	1838
Thailand	120	2053
Other countries	413	3833

Table – 17 : Exports of Sillimanite
(By Countries)

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**17304**	**141262**	**15078**	**110846**
China	12958	105524	10160	79494
Nepal	3262	19413	3867	11671
Japan	261	5027	474	10664
Belgium	312	3518	208	2545
Thailand	75	1674	76	1368
UAE	1	59	20	1192
Netherlands	-	-	104	1192
Greece	138	2518	46	887
Germany	5	8	22	403
Sri Lanka	-	-	25	365
Other countries	292	3521	76	1065

Table – 18 : Exports of Andalusite
(By Countries)

Country	2016-17 (P)	
	Qty (t)	Value (₹'000)
All Countries	**150**	**2063**
Germany	150	2063

Table – 19 : Exports of Andalusite
(By Countries)

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**4**	**127**	**-**	**-**
UAE	2	74	-	-
Nepal	1	35	-	-
China	1	18	-	-
Other countries	-	-	-	-

Table –20 : Imports of Kyanite
(By Countries)

Country	2016-17 (P)	
	Qty (t)	Value (₹'000)
All Countries	**748**	**16618**
USA	478	14606
China	270	2012

Table – 21 : Imports of Kyanite
(By Countries)

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**508**	**17006**	**478**	**16913**
USA	503	15988	478	16913
Nepal	2	932	-	-
China	3	86	-	-
Other countries	-	-	-	-

Table – 22 : Imports of Sillimanite
(By Countries)

Country	2016-17 (P)	
	Qty (t)	Value (₹'000)
All Countries	**24**	**3029**
Japan	22	2143
USA	2	886

Table – 23 : Imports of Sillimanite
(By Countries)

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**116**	**10754**	**214**	**9043**
France	-	-	96	3288
USA	-	-	19	2954
Japan	11	1551	19	2039
Turkey	-	-	79	527
China	-	-	++	150
Hong Kong	-	-	++	56
Taiwan	-	-	1	29
Nepal	24	7271	-	-
Peru	81	1893	-	-
Thailand	++	33	-	-
Other countries	++	6	-	-

Table – 24 : Imports of Andalusite during 2016-17 (By Countries)

Country	2016-17 (P)	
	Qty (t)	Value (₹'000)
All Countries	**10909**	**222534**
South Africa	10368	205494
France	454	14614
Peru	79	1684
Japan	8	656
China	++	86

Table – 25 : Imports of Andalusite (By Countries)

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**9350**	**201731**	**14072**	**306082**
South Africa	8488	179375	12817	267491
France	815	21192	1127	34855
USA	20	498	120	3105
Japan	-	-	8	631
Peru	27	666	-	-
Other countries	-	-	-	-

FUTURE OUTLOOK

The demand for high quality raw and calcined sillimanite minerals is closely linked to the need for high performance refractories with increased operational lifespans. As the predominant consumer of refractory products, the steel manufacturing industry provides a reliable market indicator of the demand for sillimanite minerals. The Asia-Pacific region remains the largest market for refractories. As per the Report of the Working Group for 12th Plan (2012-17), the current demand of sillimanite is 32,000 tpy. Projected demand for next five years is 35,000 to 40,000 tpy at GDP growth rate of 8%, 9% and 10%. The production of sillimanite is likely to be increased in coming years to meet the demand. China will remain the leading market on global front. Demand for refractory minerals is likely to scale up as the steel production is increasing in India.