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(Part- III : Mineral Reviews)

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PYROPHYLLITE

(FINAL RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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41 Pyrophyllite

Prophyllite ($Al_2O_3 \cdot 4SiO_2 \cdot H_2O$) is a hydrous silicate of aluminium. It resembles closely with talc in many physical and optical properties but differs in chemical composition. Talc contains magnesia instead of alumina. Pyrophyllite finds application in high-grade ceramics & refractories and also as a filler in Pesticide Industry. Production of pyrophyllite is mainly reported from Chhatarpur, Tikamgarh and Shivpuri districts of Madhya Pradesh; Mahoba, Hamirpur, Jhansi and Lalitpur districts of Uttar Pradesh; Bhandara district of Maharashtra; Bhilwara and Udaipur districts of Rajasthan; Ananthapur and Cuddapah districts of Andhra Pradesh; and Keonjhar district of Odisha.

RESOURCES

The total resources of pyrophyllite in India as per UNFC system as on 1.4.2010 are placed at 56.08 million tonnes of which about 41%; i.e., 23.27 million tonnes are in reserves category. Among the states Madhya Pradesh accounted for 56% resources, followed by Odisha (22%) and Uttar Pradesh (10%). The remaining (12%) resources are in Andhra Pradesh, Maharashtra, Jharkhand and Rajasthan. Gradewise, Refractory grade accounts for 24%, followed by Insecticide grade and Ceramic grade (22% each) and Insecticide & Ceramic mixed grade 18%. The remaining 14% belongs to Others, Unclassified and Not-known grades (Table - 1).

EXPLORATION & DEVELOPMENT

Exploration carried out by GSI and DGM, Maharashtra is provided in Table-2.

Table – 2 : Details of Exploration Activities for Pyrophyllite, 2014-15

Agency/ State/ District	Location Area/ Block	Scale	Mapping		Drilling		Sampling Meterage (No.)	Remarks Reserves/Resources estimated
			Area (sq km)	No. of boreholes				
GSI								
Uttar Pradesh Lalitpur	Dingrakhurd Gatholikalan		1:2000	85	5	518.22	-	Reconnaissance stage (G4) investigation was carried out to delineate & to assess the pyrophyllite/diaspore mineralisation. Pyrophyllite mineralisation was observed in quartz-sericite-pyrophyllite schist at various depths in drill hole KH-1, KH-2, JH-1 and JH-2 at Kherpura and Jhankar area. Pyrophyllite is light green with greasy lustre.
DGM								
Maharashtra Chandrapur	Khatgaon		1:50	1.60	63	5477.9	1369	Based on exploration 4.87 MT reserves/resources were estimated.

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

Grade/State	(In tonnes)												
	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	12146045	6888351	4241055	23275450	3256515	4919285	6595687	3976532	3963980	9786687	308766	32807450	56082901
By Grades													
Refractory	3823529	3102412	907499	7833439	624548	780518	215441	1622096	437442	2155126	17161	5852332	13685771
Ceramic	73495	1718367	1422374	3214236	2084359	585761	860549	1712387	1155394	2416999	43200	8858648	12072884
Insecticide	2530529	1034194	179740	3744463	100714	2061915	1627759	213300	2045592	2357243	-	8406523	12150986
(Insecticide &													
Ceramic mixed)	4550634	763591	828162	6142387	439128	1292905	606892	327187	139811	998364	-	3804287	9946674
Others	855667	263541	610850	1730058	-	-	3200000	-	60570	60585	-	3321155	5051213
Unclassified	222979	6246	163180	392405	2300	195037	63895	94450	49848	1571161	248405	2225095	2617500
Not-known	89212	-	129250	218462	5466	3150	21150	7112	75323	227209	-	339410	557872
By States													
Andhra Pradesh	245019	41841	171143	458003	121475	33360	-	-	75201	662193	-	892229	1350232
Jharkhand	858	-	328	1185	-	-	-	-	-	-	-	-	1185
Madhya Pradesh	6779943	5239637	2622217	14641797	585596	3451594	2062603	2407790	3753640	4418648	248405	16928276	31570073
Maharashtra	702680	-	281072	983752	-	-	-	958000	-	2185696	-	3143696	4127448
Odisha	3329278	1001802	525100	4856180	1973032	194121	3920129	80	40	1331393	17161	7435955	12292135
Rajasthan	139650	-	187041	326691	54308	38989	110709	232212	68587	277249	-	782054	1108745
Uttar Pradesh	948617	605071	454154	2007842	522104	1201221	502246	378450	66512	911508	43200	3625241	5633083

Figures rounded off

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**PRODUCTION, STOCKS &
PRICES**

As per the Government of India notification S.O.423(E), dated 10th February 2015, Pyrophyllite has been declared as 'minor mineral' hence the production beyond January, 2015 is not available with IBM. The production of pyrophyllite at 147 thousand tonnes during 2014-15 (till January, 2015) registered a decrease by 34% as compared to that in the previous year.

There were 33 reporting mines in 2014-15 as against 38 in the preceding year. In addition to this pyrophyllite was also reported as an associated mineral by two mines in Maharashtra. Seven principal producers accounted for 87.89% of total production during the year.

Three mines, each reporting more than 10,000 tonnes accounted for about 55% of the total production and 15 mines with production between

1,000 and 10,000 tonnes contributed about 42% of the total output. Remaining production was from 15 mines and two associated mines.

Madhya Pradesh continued to be the leading producing state which accounted for 78% of output, followed by Uttar Pradesh 17% & Odisha 2%. Nominal production was also reported from Andhra Pradesh and Maharashtra during the year (Tables- 3 to 6).

Mine-head closing stock of pyrophyllite for the year 2014-15 (till January, 2015) was 127 thousand tonnes as against 130 thousand tonnes in the previous year (Table - 7).

The average daily employment of labour in pyrophyllite mines during 2014-15 was 1,140 as against 994 in the previous year. Domestic prices of pyrophyllite are furnished in the General Review on "Prices".

**Table – 3 : Principal Producers of
Pyrophyllite, 2014-15**

Name and address of producer	Location of mine	
	State	District
Khajuraho Minerals, Post Box No-25, Chhatarpur- 471 001, Madhya Pradesh.	Madhya Pradesh	Chhatarpur
Eastern Minerals, 35, Vivekanand Marg, Cantt. Jhansi- 284 001, Uttar Pradesh.	Madhya Pradesh	Tikamgarh Chhatarpur
Jindutta Mineral Pvt. Ltd, Post Box No. 27, Chhatarpur – 471 001, Madhya Pradesh.	Madhya Pradesh	Chhatarpur
The Ishwar Mining & Industrial Corp.(P) Ltd, 7, Ishwar Nagar, Mathura Road, New Delhi – 110 065.	Madhya Pradesh	Shivpuri (Contd.)

Table - 3 (Concl.)

Name and address of producer	Location of mine	
	State	District
J. K. Minerals, C-1 & C-2 Industrial Estate, Gwalior Road, Jhansi-284 003, Uttar Pradesh.	Uttar Pradesh	Jhansi Lalitpur
Diwakar Sharma, Flat No.-707, Leela Place, 7/85 Tilak Nagar, Kanpur-208 002, Uttar Pradesh.	Uttar Pradesh	Hamirpur
Devendra Minerals, 279, Civil Lines, Tikamgarh- 472 001, Madhya Pradesh.	Madhya Pradesh	Tikamgarh

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**Table -4 : Production of Pyrophyllite, 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	247968	156004	224677	186193	147431	121085
Andhra Pradesh	176	141	1980	1584	1603	1122
Madhya Pradesh	207768	143904	166896	166418	115655	107321
Maharashtra	714	259	1527	865	1030	692
Odisha	-	-	10066	4914	3388	1743
Rajasthan	7697	1145	17968	3641	-	-
Uttar Pradesh	31613	10555	26240	8771	25755	10207

* Production figures are up to January, 2015.

**Table -5 : Production of Pyrophyllite, 2013-14 and 2014-15
(By Sectors/States/Districts)**

(Qty in tonnes; Value in ₹'000)

State/District	2013-14			2014-15 (P)*		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	38(4)	224677	186193	33(2)	147431	121085
Public sector	1(2)	2971	4805	1(1)	820	557
Private sector	37(2)	221706	181388	32(1)	146611	120528
Andhra Pradesh	2	1980	1584	2	1603	1122
Ananthapur	1	1970	1576	1	1203	842
Cuddapah	1	10	8	1	400	280
Madhya Pradesh	19	166896	166418	18	115655	107321
Chhatarpur	7	96358	88578	7	61013	53209
Shivpuri	1	18518	9722	1	21522	12128
Tikamgarh	11	52020	68118	10	33120	41984
Maharashtra	(4)	1527	865	(2)	1030	692
Bhandara	(4)	1527	865	(2)	1030	692
Odisha	2	10066	4914	2	3388	1743
Keonjhar	2	10066	4914	2	3388	1743
Rajasthan	3	17968	3641	-	-	-
Udaipur	3	17968	3641	-	-	-
Uttar Pradesh	12	26240	8771	11	25755	10207
Hamirpur	1	7410	3401	1	7876	3848
Jhansi	5	11357	2684	4	6786	1445
Lalitpur	4	5239	1987	4	4757	1430
Mahoba	2	2234	699	2	6336	3484

Figures in parentheses indicate number of associated mines with kyanite & sillimanite.

* Production figures are up to January, 2015.

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**Table –6 : Production of Pyrophyllite, 2013-14 and 2014-15
(By Frequency Groups)**

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage in total Production		Cumulative Percentage	
	2013-14	2014-15 (P)*	2013-14	2014-15 (P)*	2013-14	2014-15 (P)*	2013-14	2014-15 (P)*
All Groups	38(4)	33(2)	224677	147431	100.00	100.00	-	-
Up to 500	12(3)	13(1)	2387	1882	1.06	1.28	1.06	1.28
501-1000	4	2(1)	3339	2446	1.49	1.66	2.55	2.94
1001-2000	5(1)	4	8848	6079	3.94	4.12	6.49	7.06
2001-5000	4	6	16309	22392	7.26	15.19	13.75	22.25
5001-10000	7	5	52531	33224	23.38	22.54	37.13	44.79
10000 & above	6	3	141263	81408	62.87	55.21	100.00	100.00

Figures in parentheses indicate number of associated mines with kyanite & sillimanite.

* Production figures are up to January, 2015.

**Table-7 : Mine-head Closig Stocks of Pyrophyllite, 2013-14 & 2014-15
(By States)**

(In tonnes)

State	2013-14	2014-15 (P)*
India	129669	127220
Andhra Pradesh	2093	3680
Jharkhand	104	104
Madhya Pradesh	49403	55245
Maharashtra	965	2290
Odisha	6940	7242
Rajasthan	23320	6953
Uttar Pradesh	46844	51706

* Up to January, 2015.

MINING, MARKETING AND TRANSPORT

Most of the pyrophyllite mines in the country are operated manually with exception of a few semi-mechanised opencast mines in Madhya Pradesh which deploy excavators and payloaders. In some mines, benches of height varying from 1.5 to 3.5 m and width varying from 4 to 10 m have been developed in overburden. Pyrophyllite is sorted out by experienced workers on visual assessment and then transported to grinding units. The ore as mined is crushed with suitable jaw crusher down to 20 mm size and then is

ground to 250 mesh size using ceramics balls as grinding media or the requirement as specified by the consumers. For ensuring qualitative improvement in the mine environment and ecology, some mine owners have planted trees like Acacia, Shishum, Eucalyptus, Jamun and Mango.

CONSUMPTION

The domestic consumption of pyrophyllite was at 13,700 tonnes in 2014-15. Refractory was the main consuming Industry that accounted for about 80% followed by Ceramic Industry (18%) and remaining 2% by the calcination (Table -8).

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**Table – 8 : Estimated Consumption* of Pyrophyllite
2012-13 to 2014-15 (P)
(By Industries)**

Industry	2012-13	2013-14 (R)	2014-15 (P)
All Industries	13300	15500	13700
Calcination	-	1500(1)	300(1)
Ceramic	2400(6)	2400(6)	2400(6)
Refractory	10900(11)	11600(12)	11000(12)

(In tonnes)

Figures rounded off,

Figures in parentheses denote the number of units in organised sector .

**Owing to paucity of data consumption may not be giving complete picture.*

USES AND SPECIFICATIONS

Pyrophyllite is harder than talc and unlike talc, pyrophyllite does not flux when fired and maintains its strength after heating. It is, therefore, used in high-grade ceramic products, electric insulators and refractories. Pyrophyllite imparts thermal shock resistance to ceramic bodies. It is also used as filler and dusting powder in various industries. In Glass Industry, pyrophyllite is used as a source of aluminium instead of felspar. Owing to its softness and mode of occurrence in lumps, it is used extensively in handicraft industries for making various articles.

Low thermal expansion and shrinkage characteristics of pyrophyllite make it a useful ingredient in ceramic blends and may substitute either pitcher (grog) or silica. Pyrophyllite allows faster firing cycles in the manufacture of whiteware. In production of stoneware and chinaware, more mechanical strength as well as improved whiteness can be achieved at lower firing temperature. Pyrophyllite is quite stable up to 800°C & hence, pyrophyllite is consumed in refractory as well as in wall tiles, sanitaryware, electrical porcelain and other ceramic and vitreous china products. Pyrophyllite is non-abrasive, inert with a neutral pH, as well as absorbant providing good flowability which

allows it to be used as a diluent, extender, vehicle and carrier for liquids such as fungicide, insecticide, herbicide and fertilizer.

The BIS has prescribed the specifications for pyrophyllite for Ceramic Industry (IS:11477-2011 first revision) reaffirmed on March 2012.

The consumers in Refractory Industry generally prefer pyrophyllite containing 26 to 28% Al₂O₃ 3 to 4% alkali and having 23 to 25 Pyrometric Cone Equivalent (PCE). For Insecticide Industry, the specifications of talc/steatite can also be applicable to pyrophyllite as given below:

Loss on Ignition	: 7% max.
Matter soluble in HCl	: 3% max.
Fe ₂ O ₃	: 1.5% max.

WORLD REVIEW

The world reserves of pyrophyllite are quite large and sufficient to meet the world demand. The world reserves of talc and pyrophyllite are provided in Table - 9. Reserves of pyrophyllite are not available separately.

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**Table – 9 : World Reserves of Talc and Pyrophyllite
(By Principal Countries)**

(In '000 tonnes)

Country	Reserves
World : Total (rounded)	Large
Brazil (crude)	44000
China(Unspecified Mineral)	Large
Finland	Large
France (Crude)	Large
India*	4300000
Japan	100000
Korea, Rep. of	11000
USA	140000
Other countries	Large

Source: Mineral Commodity Summaries, 2016.

**India's resources as per NMI as on 1.04.2010 have been placed at 56.08 million tonnes.*

The world production of pyrophyllite in 2014 increased marginally to 1.40 million tonnes from 1.30 million tonnes in the previous year. The Republic of Korea was the leading producer accounting for 45% followed by Japan 25%, India 15% and Turkey 7% (Table-10)

The prices of pyrophyllite are normally influenced by alumina content, levels of iron and other impurities, colour, abrasiveness, absorbency, etc.

**Table –10: World Production of Pyrophyllite
(By Principal Countries)**

(In '000 tonnes)

Country	2012	2013	2014
World : Total	1267	1296	1397
India*	248	208	211 ^e
Japan ^e	340	350	350
Korea, Rep. of	483	525	623
Morocco ^e	5	5	5
Peru	30	32	31 ^e
Saudi Arabia	6	6	7
South Africa	19	17	19
Thailand	35	35 ^e	35 ^e
Turkey	85	102	100 ^e
Vietnam ^e	16	16	16

Source: World Mineral Production, 2010-2014.

**India's production of pyrophyllite in 2012-13, 2013-14 and 2014-15 was 248 thousand tonnes, 225 thousand tonnes and 147 thousand tonnes respectively.*

FUTURE OUTLOOK

The consumption of pyrophyllite in Ceramic Industry seems to be static. Pyrophyllite will continue to face competition from bentonite and attapulgite in carrier applications. However, use in filler applications appears to be stable.

The apparent demand of pyrophyllite is estimated at 442 thousand tonnes by 2016-17 at 9% growth rate, as per the report of the Sub-Group-II of Working Group for 12th Five Year Plan of Planning Commission of India (Now NITI Aayog).

