



Resource Potentiality, Mining and Mineral Economics of Commercial Granites from Rajasthan

KEY WORDS

Commercial Granite, Mining, Mineral Economics

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ABSTRACT

Rajasthan is richly endowed with large reserves of different varieties of granite spread over in 23 districts of the state, contributing 20% of the total country's resources. Granite occurs in almost all the geological horizons right from Precambrian to tertiary rocks in Rajasthan. Rajasthan granites are famous for attractive colours, shades and durability. The state has around 9190 million cubic meter of good quality granites. Both conventional and semi-mechanized mining is being done for the recovery of granite blocks. The small-scale closely clustered mining is also influencing the local ecological and environmental setup in granite potential belts. In last 30 years the granite sector activities have increased many folds contributing significantly in economical scenario of the state. There has been a constant increase of granite export from the state and an average growth rate 10.89% has been recorded in last 15 years.

INTRODUCTION

Granite is considered as a valuable mineral resource and comes under the category of dimensional and decorative stone. Technically granite refers to a light-coloured granulose plutonic rock composed of feldspars, plagioclase, quartz (35% approx.) and minor amounts (45% approx.) of mafic minerals, such as, biotite, hornblende, pyroxene, iron oxides, etc. But, in commercial parlance, the term granite has become synonymous with all those crystalline rocks which have pleasing colours, strength to bear the processes of quarrying and cutting and polishing and which are used commonly for decorative purposes. Being more resistant to wear and tear as well as weathering, granite is most sought-after stone to be used as building as well as decorative stone. Granite has been used for centuries as a construction stone because of its properties. Menkaure's Pyramid in Egypt was built of limestone and granite blocks. The third largest Egyptian pyramid was named The Red Pyramid of Egypt based on the granite color on surface. Many Hindu temples are also made of granite in southern India. Rajaraja Chola I built the world's first granite temple in Tanjore, during the 11th century AD.

GRANITE RESOURCES

Granite occurrences are widely distributed in India. However occurrences of economic importance are limited to few states only, namely Karnataka, Rajasthan, Gujarat, Jharkhand, Andhra Pradesh and Madhya Pradesh (IBM, 2015).

On the basis of available data, IBM has prepared a mineral inventory of granite reserves. As on 1.4.2010, resources of granite dimension stone of all types are estimated at 46,230 million cubic metres. Of these resources, 264 million cubic metres (less than 1%) fall under reserves category while the remaining 45,966 million cubic metres or about 99% fall under resources category. Of the total granite reserves, about 36 million cubic metres of all grades fall under proved category while 228 million cubic metres fall under probable category. Ninety-four percent reserves relate to coloured granite and the balance about six percent to black granite. Table 1 shows the reserves and resources of granite in the country as on 1-4-2010 (Ministry of Mines, 2016). The highest total resources of granite are located in Karnataka (21%) followed by Rajasthan (20%). Figure 1 gives the state wise resources of granite in the country.

Table 1: State wise Reserves and Resources of Granite (in Million Cubic Meters)

	Reserves	Remaining Resources	Total Resources
All India Total	263.69	45966.61	46230.30
<i>State Wise</i>			

Andhra Pradesh	--	2405.89	2405.89
Assam	--	583.95	583.95
Bihar	--	877.61	877.61
Gujarat	--	8501.94	8501.94
Jharkhand	--	8875.34	8875.34
Karnataka	676.58	9270.31	9337.89
Madhya Pradesh	0.16	1993.92	1994.08
Maharashtra	--	1158.84	1158.84
Orrisa	80.00	1763.06	1843.06
Rajasthan	110.46	9080.20	9190.66
Tamil Nadu	1.68	557.75	559.43
Uttar Pradesh	--	494.81	494.81
Other States	3.79	402.95	406.74

Rajasthan is richly endowed with large reserves of different varieties of granite spread over in 23 districts of the state. Granite occurs in almost all the geological horizons right from Precambrian to tertiary rocks in Rajasthan (Table 2). Important production centers are mainly spread in the districts of Jalore, Barmer, Pali, Sirohi, Barmer, Ajmer, Jaisalmer, Jhunjhunu and Jodhpur. More than 200 localities of granite have been identified so far. The important district wise locations are given in Table 3 and Map 1(DMG, 2014).

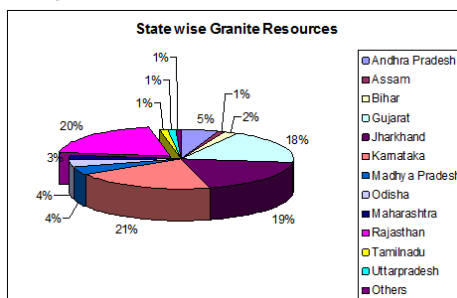


Figure 1: State wise distribution of granite resources

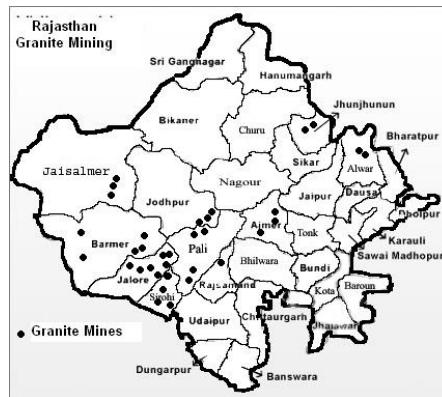
Table 2: Showing Geological Distribution of Granite Deposits in Rajasthan (After Roy and Jakhar 2002)

Neo-Proterozoic	Mokalsar Granites Siwana Granites Jalore Granites
Post - Delhi Intrusive	Abu - Sewariya Granites Sendra Granites Sirohi Granites Sai Granites Pali Granites Erinpura Granites

Delhi Supergroup (Meso-Proterozoic)	Chapoli Granites Anasagar Granites Jasrapura Granites Barodia Granites
Aravalli Supergroup (Paleo-Proterozoic)	Darwal Granites
Archean Granites	Ahar River Granites Berach Granites Gingla Granites Untala Granites

Table 3 : Important Granite Deposits in Rajasthan

District	Granite Deposits Location
Jalore	Nun, Kalkaji, Raniwara, Khambi, Saphara, Bibsalar, Bruti Kawala, Roja-Bhakar, Keshwana, Kola-Ki-Ghati, Kala-Ghati, Taskhana, Dungari Leta-Dhawala, Kota-Kasta, Tavab, Maylawas, Nabi-Bhetala.
Sirohi	Abu, Veerwada-Arasanaji, Mer-Mundwara, Koteshwara, Sanpur-Siyankara, Idarla, Padru Khera, Meerpur, Amlari, Wan, Jeerawal, Dantaria, Shivganj, Anapura, Jhar, Sivera
Bhilwara	Gyanganrh-Thana-Phakoliya, Katar, Bor-Ka-Bariya, Janarda, Dhaneri, Naya Talab, Sabadara, Nareli, Charon-Ka-Bariya, Karera, Dhani-Somani, Dhikola, Badnor, Bheru Khera, Kidimal, Udai Ram Ji Ka Guda, Rampuria, Shivpura
Pali	Bar-Sendara (Jhala-Ki-Chowki), Chittar, Manihari-Bala, Paldi, Sumerpur, Erinpura, Nana-Beda, Sarthur, Rani, Nadol-Narlai-Vinpura, Kot-Samariya, Kharda-Kerala, Dharamdhari, Jawaria, Netra, Jhakhora, Khidara, Kothar, Dani-Dantiwara
Barmer	Ludrara, Rakhi, Mokalsar, Viratara, Dhok, Bachbhar, Piplaun, Dhori Manna
Jhunjhunu	Lal-Pahari (Jhunjhunu), Rizani-Rasoda-Nand, Bakara, Makhar, Kerpura, Hukampura-Bamlwas, Gudha Gorji, Dosi, Khetri, Bagora, Dausi
Tonk	Kadila, Ganwar, Rajpura, Hatgi, Bagri, Rupawali, Dewal, Phulmaliya, Hasimpur
Alwar	Harsora, Naroli, Davson, Khatoti, Modi-Malwash, Haripur, Gadh Bashi, Dadikar, Tarwala, Kankara
Ajmer	Sodpur, Gopalpura, Bhinai, Ramaliya, Kishangarh, Harmada, Patan, Modi-Samada, Gadwari, Tarwale-Kankara, Khanpura, Daulatpura, Buharu, Bargaon, Kanpura, Jiwana, Pilua, Piplod, Rupnagar, Pisangan, Vijay Nagar, Ramgarh, Bhimpura, Sewaria, Gelpur
Jaipur	Dudu (Mal Ki Dhani), Sakhun-Ladera, Hatupura-Bigolav, Mal Ki Dhani, Kila-Danteri, Mehagi (Ramgarh), Bashi (Dagota), Balohi (Kotputli)
Jodhpur	Jasai, Bisala, Taralana, Nangris, Jodha Mali, Ransigaon, Khaniyana, Ramaniyana, Madlia, Pipar, Khejarala, Siyara, Chokri Khurd, Chokri Kalai, Padasla Kalan.
Banswara	Mungthali, Sageta, Thikria, Ganoda, Pipalkhunt, Jhupel
Sawai Madhopur	Baunli, Baragaon, Sarwar, Khajana, Dungar, Nagal, Pahar, Karwaripal.
Udaipur	Gingala, Unthala, Udai Sagar, Dakan-Kotra, Jaisamand, Salumber, Jhalara, Saira, Padrada, Kagwas, Moanda, Modi-Bathera, Kanor
Rajsamand	Lasani, Sanora-Ka-Bariya, Isharmand, Malkot, Kakroda, Kalamon Ki Anti, Bachhariya, Kania Kheda
Chittorgarh	Gangrar, Soniana, Khuntia, Ganeshpura, Nimbahera, Chhoti Sadri
Dungarpur	Ramgarh, Punawali-Bokarsal



Map 1 : Distribution of Granite Producing areas in Rajasthan

MINERAL STATISTICS OF GRANITE IN RAJASTHAN (2015 – 16)

Total Number of mining leases	: 1211
Production	: 2586617 tonnes
Sale Value	: 705.07 crores
Total Revenue earn by State Government	: 67.75 crores
Total Direct Employment	: 7810
Total Area under mining	: 2311 hectare

The district wise distribution of mining leases is given in Table 4. Jalore district is the largest producer of granite followed by Jodhpur and Bhilwara (Fig. 2).

Table 4: District wise distribution of granite mining leases

District	Number of Mining Leases
Jalore	341
Jodhpur	274
Bhilwara	120
Jaisalmer	112
Nagaur	91
Barmer	70
Rajsamand	68
Sirohi	56
Ajmer	39
Jhunjhnu	26
Jaipur	5
Others	9
Total	1211

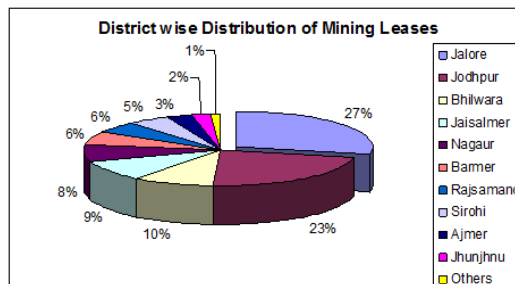


Figure 2: District wise distribution of mining leases

CLASSIFICATION OF GRANITE DEPOSITS

Department of Mines and Geology (DMG, 2014) has classified commercial granite into 12 groups on the basis of colour, shades and patterns. 1. Bala Flower Granite 2. Chima Pink Granite 3. Copper Silk Granite 4. Golden Pearl Granite. 5. Imperial Pink Granite 6. Rosy Pink Granite 7. Royal touch Granite 8. Merry gold Granite 9. Sunrise yellow Granite 10. Rakhee green Granite 11. Platinum white granite 12. Black Granite.



Photo-Plate showing types of Commercial Granites of Rajasthan

MINING AND PROCESSING

Mining of granite is different from conventional mining practices. In conventional mining method, mined out minerals are obtained in small-size fractions whereas in granite mining, large size intact blocks without minor cracks or damages are extracted. Mining of granite is done by manual, semi-mechanized and mechanized means. The mining of granite involves two important stages of operation-

- The first actual block splitting either from sheet rock or boulder.
- The second is operations involve many items of works, such as removal of weathered zone or overburden, opening of faces, lifting of cut blocks, transportation and many other ancillary work before and after block splitting.

After removal of overburden, the granite outcrop is exposed for block recovery, drilled holes are created and the block is made free from all the sides. The block than either pulled by chains or pulley system or is pushed by driving holes in a predetermined line. Mining front cut is made by using slim drill machines and chain saw machines.

Processing of granite in India is in three sectors, namely, small-scale units, medium-scale units and 100 % export-oriented units (EOU). Granite processing basically involves sawing or cutting of raw blocks in to the tiles/slabs of required size and thickness and polishing of sawn-off surfaces. Other ancillary functions involve edge cutting, milling, boring and contouring for enhancing the quality and price of production.

MINING AND ENVIRONMENTAL ISSUES

Among the various physical and biological factors, mining of natural resources is also an important factor that creates considerable environmental and pollution problems. The impacts of mining operations on environment begin with exploration activities, extended through extraction and processing of mineral and continue up to closure of operations. Mining activities are posing threat to the eco-environment system. Mining and processing of mineral resources may have considerable impacts on various components of

the environment. However, the intensity of impacts varies from mineral to mineral, methods of mining, scale and concentration of mining etc. Mining operations whether it is open cast or underground, large or small, metallic or non-metallic, mechanized or non-mechanized, it creates considerable negative impacts on bio-geo-physical and social environment (Lodha et al., 1995). The problems of land degradation, soil erosion, change in land use, water pollution, dust pollution, vibration, occupational health problems, waste disposal etc. are commonly associated with allied mineral sector activities.(IBM 2013). The exploration, exploitation and processing of granite resources can damage the environment and ecology to an acceptable degree, unless the operations are carefully planned and controlled. (Dhar, 1990).

Mining Activities	Environmental Impact
Overburden, mine waste and slurry dump sites	Land Degradation
Fragmentation of forest land	Loss f Biodiversity
Diminished green cover	
Blasting, drilling, mining equipment, heavy earth moving machinery, drills, dumpers, processing, polishing and cleaning equipments	Noise Pollution

CHANGE IN GRANITE SCENARIO DURING LAST 50 YEARS

The total granite production from Rajasthan up to 1970 was negligible but in last three decades a tremendous change has been occurred in the granite scenario of the state. First mining lease was started at Jalore in 1970. In 1984-85 there were only few mining leases of granites, mainly located at Jalore and Siwana areas. Later on number of new granite deposits have been located, explored and exploited in various parts of the state and today it is being produced in 23 districts. In 1984-85 there were 25 mining leases which has gradually increased and in 2015-16 the number of leases raised to 1211 (Fig. 3). Table 5 gives the expansion of number of mining leases and production of granite in last 30 years.

Table 5: Gives the Leases and Production in last 30 years.

Year	Number of Mining Leases	Production in Tonnes
1984-85	25	3400.00
1994-95	305	37440.00
2004-05	463	233886.00
2014-15	963	2629000.00

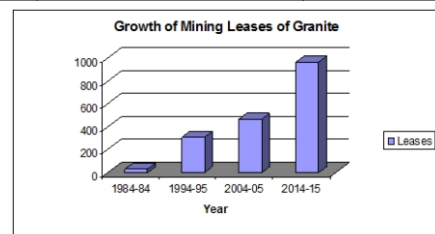


Figure 3: Mining Leases of Granites in Rajasthan

Similarly there was a tremendous growth in production. In 1984-85 the total production of granite was 3400 tonnes only, which increased to 37440 tones in 1994-95. After the growing demand of domestic and international market, the granite production multiplied by 6 time in 2004-05 in next ten years and 70 times in 2014-15 in twenty years. The production in of granite in 2004-05 was 233886 tonnes which increased to 2629000 tonnes in 2014-15 (Fig. 4).

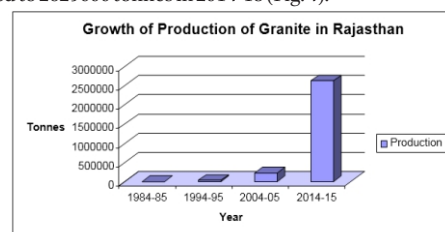


Figure 4: Production of Granites in Rajasthan

DOMESTIC AND EXPORT- IMPORT SCENARIO

India is one of the countries that are known for stocking various natural resources. It has been a major player in the world of exports. Granite export in India is one of the major revenue providers to the country. Indian Granite Industry totally exports 350 to 400 containers in a month. Presently, major exports are done to Europe with over 180 to 200 containers in a month. Whereas 50 containers are exported to United and 40 to Japan while the remaining are exported to New Zealand, Australia, South Africa and other countries.

Granite has a 95% share in India's dimensional stone export. The export of high value added items like tiles, polished slabs and monument stones has increased by over 50% average growth rate per year. India is second largest exporter of granite blocks and finished slabs and tiles (DMG, 2014). The ability of granite to receive polish, its durability and aesthetic value render it as the most preferred decorative stone. World over, the market for granite slabs and tiles is growing steadily due to the increasing use of it in residential construction, commercial establishment, public buildings, hotels and resorts etc. In India, the domestic demand for granite is also increasing day by day. The use of granite is being made all over India from middle class home to high-class society and by various commercial organization, government and public institutions. The increasing interest in the use of granite (total) can be understood by the fact that in prior to 1980 the consumption of granite in construction of residential building was only 5 to 8 % of the total area and export was negligible. Later on the demand of Indian granite increased in foreign market and India started to export the granites. In the year 2000-01 the total export value of granite was Rs. 1954 crores which constantly increased in subsequent years and in 2015-16 the total export value is around Rs. 9271.5 crores (Fig. 5). Similarly India also imports the granite blocks and slabs. During the year 2012-2013 the total import of granite was of Rs. 186 crores and during 2015-16 it was around Rs. 247 crores. The export values in past 15 years reveal that in general the granite export is showing steady growth rate ranging from 2.7 to as high as 35.35%. However in the year 2007-08 there was lowest growth rate of export which is due to the global economic crisis (Fig. 6). Table 6 gives the export value and growth rate in export from 2000-01 to 2015-16.

Table 6: Gives the Export Value earn and Growth rate

Year	Export Value (in Million Rs.)	Growth %
2001-01	19540.00	--
2001-02	20463.10	4.72
2002-03	24605.80	20.24
2003-04	26538.00	7.85
2004-05	27257.99	2.71
2005-06	34905.91	28.05
2006-07	47248.42	35.35
2007-08	42874.85	(-) 9.25
2008-09	48149.00	12.30
2009-10	49927.50	3.69
2010-11	55559.00	11.27
2011-12	63815.00	14.85
2012-13	79400.00	24.42
2013-14	98507.00	24.06
2014-15	98322.40	(-) 0.18
2015-16	92715.60	(-) 5.70

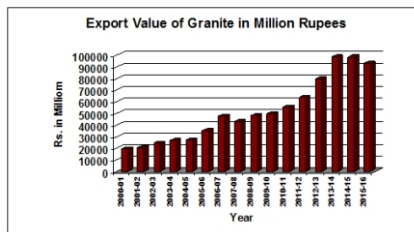


Figure 5: Export value of granite in last 15 years

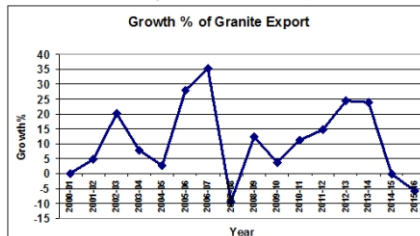


Figure 6: Growth percent of granite export in last 15 years.

FUTURE PROSPECTS

India possesses one of the best granite deposits in the world having excellent varieties comprising over 200 shades. As per the Report for 12th Plan, the Dimension stone market is said to grow at a fervent pace as the demand for granite, marble, sandstone and other dimension stones and stone products is on the rise and are anticipated to grow at around 15%. The Working Group for 12th Plan has recommended that well-planned, concerted and dedicated efforts are essentially needed for promotion of Indian stones to galvanize their export prospects. The emphasis needs to be on popularization of Indian stones in both the traditional markets as well as other niche markets and exploration of new avenues by strengthening the activities of the Centre for Development of Stones (C-DOS) in Rajasthan by upgrading it into a national centre of excellence could render the much-needed fillip to the industry as a whole.



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