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COMMERCIAL MARBLE DEPOSITS OF RAJASTHAN: GEOLOGY, DISTRIBUTION, RESOURCE POTENTIALITY AND SWOT ANALYSIS

Earth Science

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ABSTRACT

Rajasthan is the largest producer of commercial marble in the country. It has vast resources of marble, spread over 20 districts. There are many varieties of marble, in the state, depending up on the colour, composition, texture, shades and structure. Most of marble deposits of Rajasthan are of Precambrian age. The important marble producing districts in Rajasthan are Ajmer, Alwar, Banswara, Dungarpur, Jaipur, Jaisalmer, Nagaur, Rajsamand, Sirohi, and Udaipur. The total number of mining leases of marble in the state is 1874 with an annual production of 113.01 lakh tons. Mining of marble is done by manual, semi-mechanized and mechanized means. In the state the marble sector activities have been accelerating with a high growth rate and contributing significantly in the economic development of society and the state.

KEYWORDS

Commercial Marble, Geology, Resource Potential

INTRODUCTION:

The term marble is derived from the Greek word "*mármaron*" meaning a shining stone. Marble has the same chemical composition as limestone or dolomite, but the main characteristic of the marble is its granularity and formation by recrystallization due to metamorphic process. Texturally marble is recrystallized (metamorphosed) limestone but in commercial terminology, however, marble is any soft rock capable of extraction as blocks sawed and taking good polish.

Marble is considered as a valuable mineral resource and comes under the category of dimensional and decorative stone. With amazing colours and beautiful designs, marble is a versatile stone that is great for various applications. Marbles are used principally for buildings and monuments, interior decoration, statuary, table tops, and novelties. Marble's popularity began in ancient Rome and Greece, where white and off-white marble was used to construct a variety of structures, from hand-held sculptures to massive pillars. It is being used as a building and monumental material since ancient time in India also. The world famous Taj Mahal of Agra, Victoria Memorial of Kolkata, Temples of Delwara and Ranakpur in Rajasthan and many more are the living examples of its decorative and ornamental utilities. The use of marble has to stay as the latest fashion in today's architectural design. The extensive use in residential and commercial building has increased its demand many folds. Its suitability for any purpose depends chiefly on fascinating colours, shades, lusture, and designs (Jha and Agrawal, 2015).

Global and National Distribution

Resources of commercial marble are substantial in the world and many countries produce marble stones. Major exporting countries of marble in the world are Turkey, Italy, Greece, Spain, Iran and India. Italy and China are the world leaders, each representing 16% of world production, while Spain and India produced 9% and 8%, respectively. In 2018 Turkey was the world leader in marble export, with 42% share in global marble trade, followed by Italy with 18% and Greece with 10%.

The occurrences of marble have been reported from many states, viz, Rajasthan, Gujarat, Haryana, Andhra Pradesh, Madhya Pradesh, Jammu & Kashmir, Maharashtra, Sikkim, Uttar Pradesh and West Bengal. Among the above states, marble deposits of economic importance are localized in Rajasthan, Gujarat, Haryana and Madhya Pradesh. Rajasthan has the distinction of having the best among Indian resources of good quality marble (IBM, 2018). On the basis of available data, IBM has prepared a mineral inventory of marble reserves/resources as per UNFC system as on 1 – 4 - 2015. The total resources of all grades of marble have been estimated at 1,945 million tones. Of these, only about 4.5 million tones (0.23%) fall under 'reserves' category and about 1941.3 million tonnes (99.77%) under 'remaining resources' category. Grade-wise, about 27% resources fall under unclassified and not-known grades, 55% under off-colour grade and 17% under white colour grade. The available data on marble resources reveal that about 63 % resources are in Rajasthan, 21% in Jammu & Kashmir, Gujarat 6% and Chhattisgarh 4%. The remaining resources are distributed mainly in Maharashtra, Haryana, Uttarakhand and Sikkim in descending order. Rajasthan alone accounted for about 89% production of marble in the country, followed by Gujarat (10%) and nominal 1% shared by Madhya Pradesh and Andhra Pradesh.

Types of Commercial Marbles:

The Indian Standard Institute (IS:1130:1969) has categorized the commercial marble in 10 groups on the basis of colour, shades and pattern (Dwivedi, 1991). These are : (1) Plain white marble (2) Panther marble (3) White veined marble (4) Plain black marble (5) Black zebra marble (6) Green marble (7) Pink adanga marble (8) Pink marble (9) Grey marble and (10) Brown marble. In addition, many new varieties of marble have been brought into the folds of categorization especially after opening of new mining areas. The important new types as given by BIS are as follow (IBM, 2018): (11) Yellow marble (12) Pista marble (13) Brown green marble (14) Chocolate-brown marble (15) Parrot green marble (16) Wood-finish marble (17) Purple marble and (18) Blue marble.

Marble Occurrences in Rajasthan

Rajasthan has unique position in the mineral Map of India. Large number of metallic, non-metallic, industrial minerals and, dimensional and decorative stones are produced in the state. The state is a leading contributor of production of many minerals at the national level. In case of commercial marble, Rajasthan is an important and largest producer in India and contributes about 89% of the country's total production.

Rajasthan has the distinction of having the best among Indian resources of good quality marble. Out of 33 districts, 20 districts have marble in one or the other form. The important regions of marble occurrences in Rajasthan are (Dwivedi, 1991; DMG, 1996; DMG, 2001; Jha, 2003; DMG, 2014; IBM, 2015):

(1) Udaipur - Rajsamand - Chittorgarh region
(2) Makrana – Kishangarh - Ajmer region
(3) Banswara - Dungarpur region
(4) Aburoad (Sirohi) region
(5) Andhi (Jaipur) - Jhiri (Alwar) region and
(6) Jaisalmer region.

The important deposits of marble in Rajasthan are given in Table 1 (IBM, 2018)

Table 1: Distribution of Marble Deposits in Rajasthan

District	Deposit Located At
Rajsamand	Agaria, Amet, Kelwa, Morwad, Kotri, Parvati, Morchana,Vani, Talai, Saprav Ka Guda, Thodi Nijharana, Umti, Jhanjer, Arna, Dharmita, Koyal.
Nagaur	Makrana, Borawad (White), Chausira, Dungri, Paharkuan (pink) Kumari, Ulodi, Pink Range, Kala Nada Talab.
Udaipur	Rikhabdeo,Odwas, Darauli, Tidi, Jaspura, Masaron Ki Obri (Green), Paduna, Babarmal, Devimata (Pink), Sarvadi, Manpur, Lohagarh, Kela Kuan (Black), Modi Chipala (White)
Banswara	Tripura Sundari, Bhimkund, Khema-Talai, Bhanwaria-Talai, Kotharia, Vithaldeo, Prithvipura, Paloda, Oda-Bassi.
Jaipur	Andhi, Bhainslana, Todi-ka-Bas, Kotputli, Raisala, Nimla.
Alwar	Jhiri, Rajgarh, Badampur, Moti-Dungri, Dadhikar, Kho, Baldegarh, Malana, Goverdhanpura.
Sirohi	Selwara, Ideria, Perwa-Serwa, Khandra, Deri, Morthala, Ajari.
Bhilwara	Jahajpur, Manohargarh, Asind, Banera, Shahpura, Sarankhera, Kanti, Munjras, Panchanpura, Malola, Pansel.
Ajmer	Narwar, Sardhana, Sursura, Kali-Dungari, Torka, Ladpura, Roopnagar, Kekri, Umaria, Sawar, Ganeshnagar.
Sikar	Patan, Kela-Dungari (Maonda).
Dausa	Dagota
Bundi	Umar, Pagara
Dungarpur	Sabla, Nandli-dad, Peeth, Manpur, Dachki, Mal Surata (Green Serpentinite)
Chittorgarh	Mandal Deh
Jodhpur	Pachori Chadi, Moriya-Munjasar, Au, Indolai ki Dhani
Pali	Bar-Sendra Sarangwa, Ras, Desuri, Kundal, Dujara, Diyana, Khiwandi, Kantatiya, Sewari
Churu	Dunkar, Bidasar, Charla.
Jaisalmer	Moolsagar, Amarsagar, Habur, Narpia, Sipla, Badabag, Jethwai

Figure 1: Distribution of commercial marble mining areas in Rajasthan

Geology of Marble Deposits

Marble of one type or another, occurs in almost all the horizons right from Precambrian to Mesozoic rocks in Rajasthan. Table 2 shows the geological distribution of commercial marble deposits in Rajasthan (After Gupta, 1980; Roy, 1988; Jha, 2003; Goyal, 2003; Jha and Agrawal, 2015).

Table 2 : Showing Geological Distribution of Marble Deposit in Rajasthan

Age	Supergroup/ Formation	Deposits (District)
Mesozoic (Middle Jurassic)	Jaisalmer Formation	Yellow marble of Jaisalmer
Upper Proterozoic	Vindhyan Supergroup	Mandaldah (Chittorgarh)
Lower to Middle Proterozoic	Delhi Supergroup	Makrana – Devi – Gunawati – Dungri (Nagaur), Andhi – Bhainslana (Jaipur), Jhiri – Rajgarh – Moti-Dungri (Alwar), Dagota – Bandikui (Dausa), Bar – Sendra – Ras – Desuri (Pali), Selwara – Perwa – Serwa – Ajari (Sirohi), Dunkar _ Bidasar (Churu), Patan – Kela-Dungari (Sikar), Kayampura (Ajmer)
Middle to Lower Proterozoic	Aravalli Supergroup	Agaria – Amet – Kelwa – Morwad – Kotri – Saprav Ka Guda – Nijharana belt (Rajsamand), Tripura Sundari – Talai – Vithaldeo – Oda-Bassi (Banswara), Babarmal – Devimata pink marble (Udaipur), Rikhabdev – Kherwara green marble (Udaipur), Dewal – Rohanwada green marble (Dungarpur)
Archean	Bhilwara Supergroup	Sawar (Ajmer), Jahajpur – Asind – Kanti belt (Bhilwara), Umar – Pagara (Bundi)

Resource Potentiality of Commercial Marble in Rajasthan

As per the mineral statistics of Department of Mines & Geology, Rajasthan (DMG, 2019 – 20) the total number of mining leases of marble in the state is 1874 (DMG, 2021). Out of these 1626 leases are of marble while 248 leases are of green marble (serpentinite).

The total area covered under mining of commercial marble is 3197.24 hectors. During the year 2019 – 2020, the total production of commercial marble from the state was 113.01 lakh tons. The state government received a sum of Rs. 263.51 Crores as mineral revenue from the mining of marble. As per the available data a 22592 persons are getting direct employment in the marble mining sector in the state (Table 3).

Table 3 : Mineral Statistics of Commercial Marble in Rajasthan

S. No.	Mineral	No. of Leases	Area under Mining in Hectors	Production in Lakh Tons	Revenue Received (in Lakh, Rs.)	Employment Nos.
1	Marble	1626	2872.71	106.20	24172.36	21097
2	Serpentinite	248	318.53	6.81	2179.62	1495
TOTAL		1874	3197.24	113.01	26351.98	22592

Rajsamand district is having highest number of mining leases (about 51% of all leases), followed by Udaipur district (13.5%). Green marble (serpentinite) is mainly mined out from Dungarpur an Udaipur districts. Table 4 gives the distribution of mining leases of marble in the state of Rajasthan.

Table 4 : Distribution of Marble Mining Leases in Different Districts (DMG, 2019-20)

S.No	District	Number of mining leases of marble
1	Ajmer	98
2	Alwar	85
3	Banswara	83
4	Bhilwara	23
5	Bundi	10

6	Chittorgarh	21
7	Churu	27
8	Dausa	2
9	Dungarpur	98 (including green marble)
10	Jaisalmer	47
11	Jaipur	30
12	Jhunjhunu	9
13	Jodhpur	5
14	Nagaur	1
15	Pali	2
16	Pratapgarh	14
17	Rajsamand	963
18	Sikar	22
19	Sirohi	81
20	Udaipur	253 (including green marble)
	TOTAL	**1626 + 248 (Green Marble) = 1874**

Marble Mining in Rajasthan

Mining of marble is different from conventional mining practices. In conventional mining method, mined out minerals are obtained in small-size fractions whereas in marble mining, large size intact blocks without minor cracks or damages are extracted. Mining of marble is done by manual, semi-mechanized and mechanized means. Now a day, majority of mines adopt the semi-mechanized method of mining.

The removal of overburden is generally carried out with heavy earth-moving machinery. After removal of overburden and capping, the marble outcrop is exposed for block recovery. In manual operation, a line of shallow holes is made and by driving in wedges with feathers by continuous hammering. This creates a fracture along the already drilled holes, 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 logs. In the semi-mechanized operation, jackhammers, slim drills, line drilling machines are used for drilling holes in a predetermined line. Quarry front cut is made by using slim drill machines, diamond wire saw, quarry master, diamond belt saw machines and chain saw machines. The remaining operation is more or less similar to manual mining except for lifting and pulling where cranes, winches, dozers, etc. are used (Jha, 2003, Jha and Agrawal, 2015).

Marble Production Trend

If we examine the trend of mineral development in marble sector in last 14 years, with respect to mining leases and production, it can be noticed that the number of mining leases are decreasing gradually (Figure 2). In 2006 – 07 the total number of marble mining leases was 2019, which decreased to 1612 in the year 2019 – 20. Similar is with the case in serpentinites leases, which show a decreasing trend from 327 (in 2006 – 07) to 248 (in 2019 – 20).

However, there is different trend observed in case of production. The year wise production statistics shows the increasing trend in following few years but in last 4 – 5 years the production is decreasing gradually. This tendency is probably due to the fact that in initial few years the increasing mechanization in marble and serpentinite sector has accelerated the production but in later years the popularity and attractiveness of granite and ceramic tiles has reduced the international and domestic demand of marble and serpentinite. Table 5 below gives an overview of mineral development in marble sector in last 14 years.

Table 5: Trend of Mineral Development in Marble Sector in Rajasthan

Year	Number of Leases		Production (Lakh Tons)	
	Marble	Serpentinite (Green Marble)	Marble	Serpentinite (Green Marble)
2006 – 07	2019	327	68.15	8.27
2007 – 08	1971	299	78.47	9.05
2008 – 09	1946	311	85.60	10.09
2009 – 10	1902	296	104.70	13.00
2010 – 11	1889	292	103.32	11.37
2011 – 12	1936	282	128.46	15.56
2012 – 13	1943	288	138.77	15.07
2013 – 14	1910	299	132.09	14.19
2014 – 15	1921	288	126.85	13.08
2015 – 16	1848	293	156.77	10.86
2016 – 17	1752	274	135.24	9.66
2017 – 18	1754	269	131.99	8.99
2018 – 19	1756	259	82.52	8.27
2019 – 20	1612	248	106.20	6.81

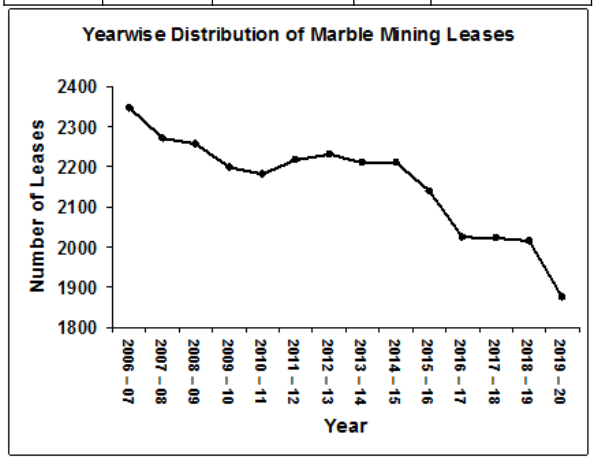

Figure 2: Trend of Marble Mining Leases in Last 14 Years

SWOT Analysis for Marble of Rajasthan:

(a) Strength :

- Huge and widespread commercial marble deposits.
- High quality exportable marble.
- Well developed mining clusters.
- Availability of skilled manpower and cheap labour.
- Large domestic and foreign market.
- A tradition of stone architecture and usages.
- Innovative entrepreneurship.
- Availability of export technical know-how and consultancy.

(b) Weaknesses:

- Unorganized mining sector.
- Poor quality consciousness among producers.
- Lack of scientific exploitation techniques in quarries (traditional mining methods are still being adopted)
- Lack of understanding about the need for testing of marble.
- Lack of value addition practices.
- Lack of testing facilities for geo-technical properties.
- Lack of coordination among industries and research departments.
- Lack of funds for R & D.
- Lack of global outlook.
- Lack of training to create skill manpower.

(c) Opportunities :

- Increasing domestic and foreign market.
- Globalization and liberalization.
- Export demand for marble handicrafts.
- Infrastructures and congenial atmosphere for export.
- Promotion through setting up of stone park and CDOS.
- Attractive and encouraging marble and mineral policies.

(d) Threats :

- Increasing use of ceramic tiles.
- Opening up of import regulations.
- Fluctuation of prices in international market.
- Issues related with environmental degradation.
- Closure due to unscientific mining.
- Conservation of available mineral resources.

Photograph 1: Manual method of marble block recovery

Photograph 2: Mechanize method of marble block recovery

Photograph 3: Panoramic view of marble mining cluster at Agaria (Rajsamand)

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