

GOVERNMENT OF RAJASTHAN



RAJASTHAN'S MINERALS

FEBRUARY 1970

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DEPARTMENT OF MINES AND GEOLOGY



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Amongst the natural resources minerals by far enjoy a very important position because they are wasting asset compared to the agricultural and forest resources where if any mistakes have been committed at any time they can be rectified and resources position improved through manual effort. In case of minerals man has only his ingenuity to depend on in the search and so that exploitation of rock material which will give him the desired metals and other chemicals made from minerals. He cannot grow them or ever create them but has only to fulfil his requirements through the arduous trek from rich concentrations of minerals to leaner ones as they become fewer and exhausted. His technical ingenuity is constantly put to a challenge in bringing more dispersed metals to economic production. He has always to be careful that the deposit is not spoiled in winning the mineral by any chance. Any damage done to a deposit cannot easily be rectified.

The position of minerals in the State of Rajasthan all the more becomes very important for its economy because the agricultural and forest resources are meagre and only a small portion of the States area is under cultivation.

Not more than 20 years ago the potentiality of minerals in the State was not so well known and one could hardly say whether minerals would be able to play any important part in the economic development of the State.

Entering the 21st year since the formation of the state, it is now becoming clear that the mineral deposits in the state can successfully meet the requirements of the country to a large extent and thus help improve the per capita income of the people through establishment of extractive metallurgical plants, chemical and fertilizer plants all based on the minerals.

The last two decades have brought to light beyond doubt occurrences of valuable deposits of non-ferrous metals at several places and in the field of industrial and non-metallic minerals the position has likewise improved several times. To day almost every thing we use consume or we see has in one way or the other mineral associated with it. To

maintain the progressive trend of the present day civilisation and to keep the economy buoyant an ever increasing quantity of minerals are required to be produced and mineral technology improved to make use of leaner resources.

There are about six metallic and more than twenty important non-metallic industrial minerals being worked in the State at present. The principal minerals are lead, zinc, silver and cadmium ores, manganese ore, wolframite (tungsten ore) and iron ore among the metallic group and asbestos, barytes, calcite, china-clay dolomite, emerald, felspar, fireclay, fluorite, garnet, fullers-earth, gypsum, limestone, marble, mica quartz, silica-sand, soapstone, pyrophyllite and vermiculite in the non-metallic field. Besides these there is a small production of graphite, kyanite, red and yellow ochre, slatestone and tourmaline. Large deposits of magnesite have been located recently and its economic utilisation is being explored. In case of copper ore the state is on the threshold of major production schedule and very soon with the coming up of Khetri complex Rajasthan will be the main producer of copper ore and metal in the country. With the start of production of phosphate rock from Jhamar-kotra deposit near Udaipur the State has achieved another first in the mineral field.

Rajasthan is the only State in the country producing emerald, garnet (both abrasive and gem variety) and lead zinc, cadmium, silver ores and has been traditionally first in the production of gypsum, wolframite, asbestos, calcite, felspar, soapstone, fluorite and glass-sand.

The total value of major minerals produced in the State during 1968 amounted to rupees forty million and Rajasthan held the 10th position among the States in mineral production. The value of minerals produced in 1968 recorded an increase of 18% over the 1967 figure. It is expected that the figures relating to 1969 will show a marked improvement over those of 1968.

Among the mineral fuels, mention can be made of the lignite deposit of Palana which was worked intermittently during the last six decades. Detailed exploration for lignite in Bikaner district has helped to improve the reserves position to some extent. Exploration for petroleum is also continuing in the north western district of the State but success is yet to be achieved.

2. METALLIC MINERALS

Copper

Rajasthan holds the first place in the base-metal field and in the years to come it will not only maintain its place but will also figure in the inter-national map of the centres of activity in respect of working and winning of these metals. It is hoped that the increase in the tempo of base metal exploitation will go a longway in curtailing the ever-increasing drain of our foreign exchange resources. The Khetri copper deposits, although they had a long tradition of being worked since the Mughal times, can well be taken as a recent discovery. Their full potential as a major mineralised belt has come to light only through recent scientific exploration. The belt, as our present knowledge indicates, extends from Singhana to Raghunathpura and several economic deposits of copper and iron pyrites have been located in this belt. While the exploitation of the bigger deposits of copper as well as iron pyrites has been taken up, some of the smaller copper deposits still await effective utilisation. Similarly the investigation for copper in the Alwar district has brought to light two small deposits of copper.

Kho-Dariba Copper Deposit (District Alwar).

The deposit is located about 35 km from Sariska in Alwar district, and has been explored in detail by the Indian Bureau of Mines. The ore occurs upto a depth of 85 metres and is confined to 4 shoots only. Ore reserves are about 0.55 million tonnes averaging 2.5% copper. Feasibility study conducted by the National Mineral Development Corporation earlier has indicated that the mine is capable of sustaining production of 200-250 tonnes per day.

Bhagoni Copper Deposit (District Alwar).

This is near to the Dariba deposit, located 13 km. away due north of it. Mineralisation has been proved to extend for about 1.5 km and it has been extensively explored by diamond drilling and underground development. It is estimated that about 1.5 million tonnes of copper ore of 1% content will be available. Some portions of the lode with richer shoots are likely to give better grade. These figures pertain to one level only and are likely to increase. It is considered that if the Bhagoni and the Kho-Dariba mines are worked together, a mill of 500 tonnes capacity can be run with ore of 1.5% copper content.

Akwali Copper Deposit (District Jhun jhunu).

The deposit is located near Babai on the Khetri Neemka-Thana road and is about 26 km from the smelter location. Detailed exploration of this deposit has been carried out and the main lode has been opened up with two inclined shafts for exploratory mining. A total of about 1 million tonne of copper ore averaging 1% copper has been proved in this deposit and in the main lode extending for 300 metres the grade is 2% and above. Cobalt is associated in a part of the deposit and its economic recovery as a by-product appears possible. The nearness of this deposit to the smelter site can obviate the necessity of setting up an independent mill. The advantageous location and the existing good communication links make this deposit a good one for opening a small mine producing 250-300 tonnes of ore per day.

Sat-Kui-Dhanota Copper Deposit (District Jhunjhunu).

The mineralised zone at Sat Kui, district Jhunjhunu, forms part of the Khetri copper belt south of Kantli river. A number of old workings are seen in the area. Mineralisation has been proved over a strike length of 1000 metres and is upto 10m wide. Copper content varies from 0.8 to 2%. Exploratory mining has been proposed by the Geological Survey of India and in all likelihood about 1 million tonne of ore averaging 1.5% copper content will be available from this deposit. The underground development contemplated for exploratory mining can well be used for working the mine at a later date and this deposit can turn out to be a good small mine with an output ranging from 250 to 500 tonnes per day.

The above four deposits are the smaller ones of the copper deposits of Rajasthan and apart from these the two well known big deposits are those of Madan-Khudan and Kolihan, located near Khetri. The exploitation of both these deposits on a large scale to feed the smelter capacity of 31000 tonnes of refined copper per annum has been taken in hand and it is expected that by 1972 the mines and the smelter will start functioning. This smelter, in addition to producing copper, will also be producing sulphuric acid as a by-product, as the ore contains around 3 to 8% sulphur. During the final electrolytic refining it will also be possible to recover gold and silver as by-products since the copper concentrates will contain 1 to 2 gms. of gold, and 8 to 10 gms. of silver per tonnes. The recovery of sulphuric acid as by-product will open up the

possibilities for setting up industries, like super phosphate manufacture, which require sulphuric acid as a raw material.

There are potential areas for copper deposits now being investigated by the State Department of Mines & Geology at Deri-Rohera belt in the Sirohi District and Korma-Gardari belt of Bundi district. Drilling has already been commenced in Sirohi District and the core samples obtained so far have confirmed the presence of good copper, lead and zinc mineralisation. Geo-chemical work carried out in Bundi District has shown favourable geo-chemical anomalies but a possible ore body causing the same can only be confirmed by drilling which will be taken up soon when more drill machines are available. There are many more favourable areas for base metal possibilities, which will gradually be taken up in different parts of Rajasthan.

Lead & Zinc

Zawar, the only zinc-lead ore mine of the country, is situated at a distance of 40 km south of Udaipur. The history of Zawar is intimately associated with the colourful and gallant past of Mewar. These deposits are believed to have been worked during the 14th century A. D. In the Zawar area mineralisation is found in the Mochia Magra, Balaria, Bawa, Baroi and Zawarmala hills. The Mochia Magra, including the Sunaria and Ruparia hills on the west, extends over a strike length of 4.6 km. The Mochia Magra property is divided into west, central and east. The ore is being mined at present in the central Mochia and the width of the ore body varies from 3 metres to as much as 60 metres and the average run of mine ore contains 3.7% zinc and 1.8% lead. The exploration so far conducted has indicated 8 million tonnes of ore in the proved category and another 22 million tonnes in the inferred category. As the major part of Mochia Magra is yet to be explored the above given figures of ore reserves may increase.

The Balaria hill is the eastern extension of the Mochia Magra beyond the Tidi river. Mineralized zone is extending for about 2000 metres and is upto 15 metres wide. Ore contains around 8% zinc and 2% lead but the metal content goes upto as 12% zinc and 6% lead in certain portions of the lode. The proved and indicated reserves of ore occurring in the Balaria hill are in the neighbourhood of 10 million tonnes and another 20 million tonnes will be available in the inferred category.

In the Zawarmala hill indications of mineralisation are seen for a distance of 5 km. Diamond drilling has indicated a fairly thick ore body in the northern portion and large reserves of ore are expected in this hill also. Mineralized dolomite in Baroi Magra, parallel to Zawarmala, extends for 1.6 km. This hill is yet to be explored but large reserves are expected. Similarly in the Bawa Magra, located 1 km south of the Mochia Magra, preliminary bore holes have indicated presence of ore body and further exploration is in progress.

Presently mining is being done in the Mochia Magra and the Balaria hills and arrangements are underway to open up the Zawarmala hill also. The Hindustan Zinc Ltd., have plans to increase their production to 10500 tonnes of ore per day from the Zavar area—from the present production of 1000 tonnes of ore per day.

The Zavar ore is treated in a mill established there and lead and zinc concentrates are produced separately. Lead concentrates are sent to Tundu in Bihar for smelting and the zinc concentrates which were earlier sent to Japan are now treated in the zinc smelter at Debari by the hydro metallurgical process to produce high quality of zinc metal. Sulphuric acid and cadmium are obtained as by-products. The Hindustan Zinc Ltd., have plans to produce 100000 tonnes of zinc, 35000 tonnes of lead, 35000 kg. of silver, 400 tonnes of cadmium and 100000 tonnes of superphosphate (utilising sulphuric acid) by 1979.

The lead-zinc deposit of Rajpura-Dariba located 16 km NNE of Fatehnagar Rly. Station on the Chittorgarh—Udaipur section of Western Railway is also an important deposit which has come to be known only during recent years. The lodes contain sulphides of lead, zinc and copper with silver, cadmium, antimony and arsenic in recoverable quantities. The indicated reserves for these deposits are around 22 million tonnes with another 22 million tonnes in the inferred category. The total strike length is 4 km and the average multimetal content is 8%—with 5 to 6% zinc and around 1.5% lead. Exploratory mining is in progress and two inclined shafts have been sunk. In near future the Rajpura-Dariba deposit will also become a large centre of mining activity in the state.

The setting up of zinc smelter at Debari is a land-mark in our efforts to cut down the base-metal imports. It has a rated capacity of 18000 tonnes of zinc metal per annum with scope for doubling the same with small additional investment. The sulphuric acid obtained as

byproduct is used to produce superphosphate to the tune of 16000 tonnes per annum. Another byproduct is cadmium, with a production of 76 tonnes per annum presently.

Iron Ore

Small iron ore deposits occur in the Jaipur, Udaipur Jhunjhunu, Sikar and Alwar districts. The main deposits are those of Chomu-Moriya (Jaipur district) and Nathara-ki-Pal (Udaipur district). These have been investigated in detail by the State department of Mines & Geology and reserve in the order of 11 million tonnes, averaging 48-52% iron, have been proved in Nathara-ki-Pal and 5.4 million tonnes averaging 60% iron have been proved in Chomu -Moriya deposit and there is possibility to get another 5 million tonnes. Both these deposits are earmarked for 3,00,000 tonne capacity pig iron plant proposed to be set up in Rajasthan.

Record out put of ,128,400 tonnes was obtained in 1955- 56 but it has since fallen considerably and in 1968 only 200 tonnes were raised. The main problems in the way of the iron ore mining industry in Rajasthan are high railway freight and quality control.

Manganese Ore

Manganese ore deposits of low grade occur in Banswara district and have been intermittently mined since 1945. The production reached 13,500 tonnes in 1957 but then due to a slump in the international market and competition faced by India from other exporters the production slackened, coming to only 1700 tonnes in 1964. It is again picking up slowly and was 8400 tonnes in 1968. The future of manganese mining industry in Rajasthan, however, depends on systematic proving of the deposits and setting up of beneficiation plants so that upgraded ore can be offered for sale.

Tungsten Ore

Rajasthan has the best known tungsten deposit of the country at Degana in the Nagaur district. Tungsten is a metal of strategic importance essential for high speed alloy and special steels used for machine tools and armour plates, gun barrels, armour piercing projectiles and other military equipment. It is also used as filaments in electric lamps, and in some electronic equipment. Tungsten carbide is much harder than the hardest steel and is used for bits, cutting tools, etc. The mines

at Degana are being run as a departmental project by the State Government and tungsten concentrates produced are supplied to defence department. These mines accounted for 68% of the country's production in 1969, producing 27 tonnes of concentrates containing 65% WO_3 .

3. INDUSTRIAL AND NON-METALLIC MINERALS.

Rajasthan is well known for its potential sources of base metals but it has got an unique position for industrial and nonmetallic minerals also. These minerals which are required by various industries can be grouped as:—

(A) Insulants, Refractories and Ceramic Minerals

In this group Rajasthan produces asbestos, felspar, glass and, quartz, fire clay, china clay and dolomite. There is enough scope for winning other minerals of this group like vermiculite, magnesite, kyanite, wollastonite, etc.

i) Asbestos

Asbestos is the main insulating mineral and is used for making asbestos cement, roofing sheets, pipes and other products for heat insulation. In Rajasthan mainly tremolite and anthophyllitic type of asbestos is found whereas the demand is mostly for the chrysotile variety. Rajasthan accounts for about 65% of the country's production. Mining leases exist in Udaipur, Dungarpur, Bhilwara, Ajmer, Jodhpur and Pali districts. The Ajmer district accounts for the major part of production, which was 8100 tonnes in 1968. Since chrysotile asbestos has only a very few occurrences in the country it is necessary that processes should be found to use more of the amphibolitic types by blending it with some imported chrysotile variety.

ii) Felspar

Felspars, a group of alkali alumina silicate minerals, the common types of which are microcline, orthoclase and albite occur in pegmatites. It is used in glass, pottery and enamel industries. Rajasthan is the main producer of Felspar in the country, accounting for almost 75% of the total. Production during 1968 was 26174 tonnes, 90% of which was contributed by Ajmer district, the rest coming from Sirohi, Udaipur, Alwar and Pali districts. There is a scope to raise its production and also develop export possibilities.

iii) Silica sand

It is an important raw material of the glass industry, but to be useful it must not contain ferruginous impurities. Rajasthan has been one of the leading producers of silica sand in the country and 88% of the State's production is reported from Jaipur and Bundi districts. During 1968 total production amounted to 43.7 thousand tonnes. Apart from the productive deposits some more areas are known which can sustain silica sand mining. One such area is near Bundi in Atru tehsil of Kota district.

iv) Quartz

Quartz is being used mainly in ceramic industry and also in optical and electronic industries. Quartz is the most abundant and widely distributed mineral and occurs as a main constituent of pegmatites. Quartz crystals of absolute purity, are rare, and have considerable export potential. Quartz is produced in Ajmer, Sikar, Sirohi and Alwar districts. During the year 1968, 19.7 thousand tonnes of quartz was produced and out of this 42% came from Ajmer district, followed by 20% from Sirohi district and the remaining from Jodhpur, Pali and Alwar districts.

v) Magnesite

Magnesite is valued for its refractory properties and is also an important source of magnesium metal. It is extensively used for the manufacture of refractory bricks and to a minor extent in glass industry, manufacture of epsom salt for rayon industry etc. The Department of Mines & Geology, Government of Rajasthan had located and investigated a deposit of magnesite in Sarupa-Chhaja area in the Ajmer district. Magnesite occurs as ramifying veins 2 to 10 cms. thick. About 1.5 million tonnes of material averaging 50% Mg CO₃ (24% MgO) is available. Due to low MgCO₃ and high silica (8- 10%) the run of mine ore will require beneficiation. Samples have been sent to the National Metallurgical Laboratory for beneficiation tests and the report is awaited. Tests conducted at the Central Glass & Ceramic Research Institute have indicated its suitability for refractory manufacture. The discovery of this deposit has opened up a new field of refractory industry in Rajasthan.

vi) Vermiculite

A small production of vermiculite is obtained from a mine in the Ajmer district. This mineral is an alteration product of biotite/phlogopite mica and differs from its in its characteristic property of

exfoliation. It is chemically inert, fire proof, non conductor of electricity and is very light and a good insulator against heat and sound. It is used, in exfoliated form, as light weight aggregate for insulator industry. From Ajmer 410 tonnes of this mineral was produced in 1968, accounting for 17% of country's production. The Department Mines & Geology investigated a couple of deposits in the Ajmer dist. a few years ago. The reserves are small—only a few thousand tonnes.

(vii) Wollastonite :

This mineral is one of the latest to enter in the field of industrial minerals but its industrial applications are fast growing. The single largest use of wollastonite is in the ceramic industry, where it is a constituent of ceramic bodies required for the manufacture of floor and wall tiles. It also finds use as an additive in ceramic bodies and glazes. Its advantages over most of the conventional ceramic bodies are its capacity of maturing at lower firing temperature and faster rate at which it can be fired. It is reported that certain wollastonite bodies can be fired along with glazes—eliminating altogether the usual second firing. It also finds use as filler in paint and paper products and in metallurgy as welding rod coating. There are good prospects of wollastonite finding use in the chemical industry.

Recently a deposit of wollastonite has been discovered in Sirohi district and there are good prospects of finding more deposits in nearby areas, thus opening up a new field of mineral activity.

(viii) China Clay :

China clay, used extensively for pottery making and electrical insulator, is found in Sawaimadhopur, Sikar, Alwar, Nagaur and Jalore districts. Some of these are used by the pottery making units of Delhi and in 1968 the production from State amounted to 37.5 thousand tonnes. For an effective utilisation of these clays for making fine pottery proper washing is essential. Recently one washing plant has been set up at Neem-ka-Thana by a private lessee but more such plants would have to be established to fully utilise the State's resources of clays. A promising deposit has recently been proved at Kharabaria-ka-Gudha near Udaipur.

(ix) Fire clay :

It is a type of secondary clay which can stand temperatures above 1500° C. A good fire clay must not fuse below 1580° C in oxidizing

ing atmosphere. They are utilised in the manufacture of fire bricks, blocks, retorts, crucibles etc. In Rajasthan such clay are found in the Bikaner district. During 1968 the production of fire clay from the State was 2500 tonnes.

Under-clay of lignite in Palana area is also a very good fire clay and it can be exploited economically in case opencast mining of lignite in Palana comes into operation.

(x) Dolomite :

Dolomite is a common term used even for magnesium limestone. Actually it is a double carbonate of calcium and magnesium and find multifarious industrial uses. It occurs in Ajmer, Alwar, Jaipur, Jodhpur, Sikar, and Udaipur districts. Rajasthan's production, 50% of which is contributed by Jaipur district, is used mainly for preparing chips and powder for the building trade and some of the production has also found its way in lime making. It is also used in place of magnesite because it is cheaper. In 1968 the State produced 22100 tonnes of dolomite.

B. Electronic and Nuclear minerals :

In this group Rajasthan produces mica and beryl.

(i) Mica :

Mica mines of Rajasthan are located in Bhilwara, Tonk, Ajmer, Jaipur and Udaipur districts. Mica forms major constituent of the pegmatites. Mica is used in three principal forms, natural sheet, splitting and ground mica. Sheet mica is used chiefly for electrical insulation in various electrical and electronic equipment. Mica splittings are used in manufacture of built up sheets which in turn are used, within the limits of its di-electric characteristics in place of natural sheets. Ground mica is used in the manufacture of mica bricks and as a dusting agent in the manufacture of rubber tyres. Other various manufactures are punched discs and built up mica. There are two mica grinding plants and one mica insulating brick factory in Rajasthan. Punched disc industry is a highly specialized industry where the mica is required to be stamped to the exact dimensions and designs required for tube spacers, capacitor films etc. as required by individual consumers. The principal consumers being Japan and U. S., technical collaboration could be had from these countries.

There is also the possibility to produce 300 tonnes a year of built up mica-heat resisting, commutator, moulding and flexible micanite, mica folium, tubes, etc and another to produce 1500 tonnes of wet ground mica.

Mica could also be used in paints, mica based aluminium.

Requirements of fillers in the rubber industry is estimated at 250,000 tonnes by 1973-74. Once production of wet ground mica starts, tyre manufactures could make use of it instead of china clay which is in short supply.

To manufacture 300 tonnes per year built up mica and 1500 tonnes wet ground mica requires an investment of about Rs. 40 lakhs.

Rajasthan contributes around 25% of India's production of mica and occupies third place after Bihar and Andhra Pradesh respectively. During the last two years there has been marked decrease in the mica production due to prevailing slump in the mica market. Bhilwara district contributes nearly 75% of the total mica output amounting to 17667 tonnes in 1968.

The mica industry in Rajasthan suffers from certain basic difficulties due to the fact that it has to depend on mica dealers of Bihar and avenues of direct export are not available to this industry. Further more, due to lesser depth continuity of mica pegmatite in Rajasthan and low water table the mining cost goes up. Yet another problem is that splittings are not produced here-although Rajasthan mica is suitable for the same.

C. Gem Stones & Abrasives :

Rajasthan is the only State in India producing emerald and till recently garnet was also its monopoly. However, last year some production of garnet was reported from Madras but this is only of statistical interest as the major portion of garnet production is from Rajasthan only.

(i) Emerald :

Rajasthan is the only state producing this highly valued gem stone. Localities from where emerald is reported are situated in Ajmer and Udaipur districts. Rarity of its occurrence and the velvety green colour greatly enhance its value. A major decline has set in the production of this gem stone. The high degree of chance involved in

prospecting for it has been the main hurdle in investment in the private sector. There is a great need to study the geological factors controlling its localisation. Prominent localities like Kalaguman, Tikhi, Rajgarh and Bubani need to be studied in detail for knowing prospecting guides. Production of Crude emerald was only 4.6 kg. in 1968 compared to 78 kg. in 1963.

(ii) Garnet :

Garnet is an important industrial mineral of Rajasthan commonly used in abrasive industry and the translucent varieties are used as semi-precious stones. Garnet, in workable quantity, is found at various localities in Ajmer, Bhilwara and Tonk districts. 1968 marked significant increase in the production of abrasive garnet in Rajasthan with a record of 1200 tonnes. The previous years production ranged from 200 to 400 tonnes. Gem variety of garnet is also produced in Rajasthan.

Fertilizer Minerals

In this group, with its abundant gypsum resources and production, Rajasthan was the most important State in the Union and now with the discovery of huge phosphate rock deposit near Udaipur, the position of Rajasthan has been further strengthened. It also has vast resources of pyrite at Saladipura.

i) Gypsum

Gypsum occupies a pride of place among the minerals of Rajasthan, the state accounts for more than 90% of the country's production and has abundant reserves of the same, totalling nearly 970 M/Tonnes. The deposits are distributed in Bikaner, Shriganganagar, Churu, Jaisalmer, Nagaur, Barmer, Jalore, and Pali districts. Previously gypsum had been used in making building plaster and later it became one of the principal raw materials in the fertilizer industry. Demand for the cement industry has however, been a constant factor for gypsum's utilisation. With the shortage of sulphur in the country adoption of gypsum as a base for the manufacture of sulphuric acid merits consideration. Such a source is being used in England in the I.C.I. plant at Billingham.

The cost of production of sulphuric acid in a plant of 100,000 tonnes per year would be Rs.103 per tonnes, which would certainly

compare favourably with acid made from imported sulphur or pyrites. In view of the requirement of 2.4 tonnes of gypsum per tonnes of acid, against 0.9 tonnes of pyrites and 34 tonnes of sulphur per tonne of acid locations away from Rajasthan may not be suitable. Therefore the establishment of a 100,000 tonnes sulphuric acid plant in Bikaner area would be helpful in retaining the current level of gypsum production and at the same time be economic.

Selenite the crystalline variety of gypsum has been found in Lunkaransar area in Bikaner district and in Thob in Barmer district.

ii) Phosphate rock :

A major break through in the mineral exploration field has been the discovery of huge phosphate rock deposits near Udaipur. As a matter of fact the phosphate rock exploration itself is rather new and dates back to hardly four years when it was discovered at Birmania in Jaisalmer district. Subsequent discoveries of phosphate rock deposit near Udaipur have gained national importance. The biggest deposit amongst these has been the Jhamar Kotra. Other smaller deposits are Maton, Kanpur, Dakan Kotra, Neemuch Mata, Bargaon, Sisarma, etc.

The State Department of Mines & Geology have also located deposits of apatite at Newania in Udaipur district and at Kerpura in Sikar district.

The Jhamar-Kotra deposit, a discovery of the State Department of Mines & Geology, is located 28 km south-east of Udaipur. Phosphate rock bed is traceable for 16 km in NW-SE direction. Part of the deposit (block D) is of very high grade, directly usable for making superphosphate and averages 30-35 % P_2O_5 . The expected tonnage of this high grade material is around 11.0 million tonnes. In other portions of the deposit where the grade varies from 15 to 25% P_2O_5 , beneficiation would be necessary and reserves of about 90 million tonnes are likely to be available bringing the total expected reserves of 100 million tonnes. Production from this deposit has been started by the state department from the 26th March, 1969 and presently 450-500 tonnes of ore per day is being mined. It is planned to step up the production to 2000 tonnes per day by October, 1970 and to ultimately increase it to 10,000 tonnes per day by 1977-78. The material being produced has helped to cut down the imports and is being utilised by various superphosphate

making units like the Hindustan Zinc Ltd., Fertilizer Corporation of India, Trombay, Delhi Cloth Mills etc. Upto Dec. 1969 total production was 67266 tonnes.

iii) Pyrites :

Sulphuric acid is an essential raw material in the fertilizer industry. So far the entire requirement of sulphuric acid has been produced from imported sulphur but with the increase in its demand the import of the amount of sulphur required will be prohibitive. In the absence of sulphur deposits the only alternative indigenous source of sulphur is pyrites of which there are extensive deposits at Saladipura in Sikar district. Intensive exploration has proved reserves of the order of 115 million tonnes averaging about 20% sulphur. Setting up of a big fertilizer complex utilising the phosphate rock deposits near Udaipur and the pyrites of Saladipura has been agreed to in principle by the Government of India.

E) Minerals of Chemical Industry :

The important minerals of this group produced in the State are limestone both of chemical and cement making grade, fluorspar and barytes.

(i) Limestone :

Rajasthan is lucky to have extensive deposits of limestone suitable for cement manufacture. Vindhyan, Aravalli, Ajabgarh and Rajalo, all these geological formations have contributed quality limestone occurring in various parts of the state. Three cement plants at Lakheri, Sawai Madhopur and Chittorgarh have been in production and three more cement plants near Nimbahera in Chittor district, near Beawar in Ajmer district and near Bundi town are likely to come up soon. A cement plant near Khemli railway station is now under construction. In addition to these there are many more areas where limestone suitable for cement making is available. These areas are: (1) Abu Road in Sirohi district (2) Ras, Pali district (3) Parsoli, Chittorgarh district (4) Ramganjmandi, Kotah district, (5) Kotputli in Jaipur district (6) Loharia and Talwara areas, Banswara district.

Limestone of chemical grade is being mined in Sojat-Gotan belt of north-western Rajasthan. Lime making industry is fairly well

established in Gotan, Sojat, Bilara, Mundwa, Maonda, Rajgarh, Abu Road etc.

(ii) Fluorspar :

The fluorspar deposit of Mando-ki-pal about 25 km. east of Dungarpur had systematically been investigated and proved to contain around 1.25 million tonnes of 17-18% grade. The deposit is now being exploited by the Rajasthan Industrial and Mineral Development Corporation and as per the project report it is envisaged to mine and mill 300 tonnes of ore per day to produce 14000 tonnes of acid grade fluorspar per year. Fluorspar has varied uses in steel metallurgy and as raw material for making hydrofluoric acid, and synthetic cryolite for aluminium extraction process.

The State Department of Mines and Geology has recently located another promising occurrence of fluorspar at Kaila village near Mando ki-pal in Dungarpur district, where prospecting work is in progress.

Apart from the Mando-ki-pal deposit another small deposit is near Chowkri-Chapoli in Sikar district, where total reserves of the order of 0.7 million tonnes were estimated averaging 15% CaF_2 . With selective mining and beneficiation it may be possible to bring the run of mine ore to marketable grade. During the last few years there has been some production from Mando-ki-pal deposit and in 1968 it went upto 15800 tonnes. This production is from the smaller veins outside the proved property.

iii Barytes :

Barytes is valued for its chemical inertness and high specific gravity. It is used in preparing muds required during oil well drilling. Other uses are in paint and lithopone industry and as a source material for barium chemicals. It is used as a filler in paper and rubber manufacture. After Andhra Pradesh Rajasthan is the largest producer of barytes in the country. Production during 1968 was 6.4 thousand tonnes, out of which almost 98% came from Alwar district. State Department of Mines & Geology recently discovered and explored fairly large deposit of barytes at Kioli near Nathdwara, containing about 41,000 tonnes

Minor Minerals :

Rajasthan has good resources of bentonite and fuller's earth. Among the building stones both decorative and common type are found

in the state and are extensively worked. The marble deposits of Makrana have come to assume now not only national but International recognition. Sandstone and limestone quarried as building and roofing stones in Kota and Jodhpur regions occupy an important place in the building activity in the State and contribute a major share to the mineral revenue.

i) Bentonite :

Bentonite is a type of very fine grained clay composed mainly of montmorillonite. Its industrial use is due to its property to swell on contact with water. It is used as a grouting material, in preparation of drilling mud, as a decoloriser and as foundry sand, and to a minor extent in cosmetics. Extensive deposits are known in the Barmer district. Work conducted on these deposits has indicated large reserves within small depth (less than 6 metre). Total proved reserves of first and second grade bentonite are 20 million tonnes with another 45 million tonnes in inferred category. A minor occurrence is located near Dargawa Pancholi in Sawai Madhopur district. During 1968, 4095 tonnes of bentonite was produced from Barmer district and 973 tonnes (valued at Rs. 1, 17,000) was exported.

ii) Fuller's earth :

Fuller's earth or Multani Mitti is a natural clay, of non swelling type, characterised by its marked ability to absorb grease and remove colouring matter from oils and other liquids. Rajasthan has extensive deposits of fuller's earth in Bikaner and Jodhpur districts. Important localities are Mudh, Kesardesar both in Bikaner district, Kopurdi-Rohili, Garandas and Dip-ki-Dhani in Jodhpur district. Chemically activated fuller's earth is preferred for decolourisation as it has low oil retention value compared to naturally occurring clays. Tests conducted on Rajasthan's fuller's earth have been successful and the product compares very favourably with imported "Fultmont Tested" and "Tonsil Optimum" clays. Further systematic work on these lines is necessary to produce high quality decolourising clays which can not only replace the imported stuff but can also build up an export market.

iii) Marble, Granite and Other Building Stones :

Marble quarries of Makrana are of historical importance having provided building stone for the Taj Mahal. Of late many new areas have come to light and have augmented the Makrana production.

Important occurrences are located in Nagaur, Pali, Sirohi, Bundi, Udaipur and Jaipur districts. Production during 1968 was 64500 tonnes out of which 37850 tonnes was obtained from Makrana alone. Steps are being taken to bring the quarries to a more scientific method of working. Ancillary facilities like approach roads and electric power have been provided and many sawing plants have come up but a modern diamond saw plant can bring a major difference in the economy of the industry.

A pink granite capable of taking polish is found in Jalore district. State Government has set up a granite sawing and polishing plant for making polished slabs. These have a potential demand as monumental stone not only in India but outside also.

Sandstone and limestone quarrying is practised on a large scale for building and roofing purposes in the districts of Jodhpur, Kota, Bharatpur, Bikaner Sawai Madhopur, Bundi, Chittorgarh and Bhilwara. Schist and phyllite are also being used as building stone and extensively being worked in the districts of Jaipur, Udaipur, Alwar, Ajmer and practically in all the districts of the central part of Rajasthan.

G. Miscellaneous:

In this group can be classed calcite, ochres and soapstone and pyrophyllite in which Rajasthan is a leading producer in the country.

i) Soapstone-Talc-Pyrophyllite :

Rajasthan is the principal supplier of talc, soapstone and pyrophyllite in the country. These minerals are directly used in making talcum powder, crayons, toys, etc. and also find use in making electronic equipment. Industries utilising these minerals in various forms are paper, rubber, pottery, roofing, tiles, paints and insecticides. With their multifarious uses there is good demand for these minerals. Important deposits are located in Udaipur, Jaipur, Sawai Madhopur, Bhilwara and Dungarpur districts. The production of these minerals has shown steady rise and in 1968 it was 152 thousand tonnes. There is a ready market for even inferior grade of soapstone due to its consumption in insecticide industry. It is necessary that in order to maintain quality control grading and classification be done on proper lines. This would also generate confidence in the consumer and would be paying to the industry in the long run. The material being mined is mostly crushed

and powdered to 200-250 mesh size though some finer grade is also produced. It is desirable that more pulverising plants with air spun separation facilities should come up.

ii) Calcite;

Calcite is chemically calcium carbonate and occurs as rhombohedral crystals. In pulverised form it is used as a filler in paper and textile industries. A considerable quantity is used in ceramic industry also (as a glaze) and in making paint, distemper, and insecticides. Flawless crystals find use in optical industry. Important calcite localities are Maonda, Raipur, Jhamas, Balupur. All in Sikar districts. Deposits are also known from Sirohi, Pali Jaipur and Udaipur districts. The deposits occur as veins, pockets and lenses. This mineral being cheap has not attracted the attention it deserves and should be systematically worked and the deposits be assessed properly. Rajasthan occupies first place in calcite production in India and in 1968 the the production from the state was 6700 tonnes, Sikar district district being the major producer.

iii) Ochres:

Ochres are mineral pigments with iron as the colouring material either in the form of hematite or limonite or as both. These earth pigments are insoluble and are used directly as paint material or to give colour, body, opacity to paints, cement, linoleum, rubber, glazes, enamels, plastics etc. In Rajasthan ochres are found at various places in Chittorgerh, Udaipur, Jaisalmer, Bikaner, and Nagaur districts. During 1968 the productiod of ochres from Rajasthan was 14 thousand tonnes almost the whole of it from Chittorgarh.

4. FUELS

Rajasthan, though rich in metallic and non-metallic mineral deposits, is deficient in fuel resources. In this category mention can only be made of lignite deposits of Palana. This lignite was earlier used for running the thermal power station of Bikaner but later, due to hydro electric power supply from Bhakra, this was stopped. After this the local consumption for firing bricks etc. remained its only use. The mine had to be completely closed during 1969 due to underground fire.

There are possibilities of finding lignite bearing areas in the districts of Barmer and Jaisalmer where prospecting work is handicapped due to acute shortage of water. Possibilities of underground

gasification from lignite should be explored which may partially solve the problem of mining thin seams of lignite.

Exploration of the lignite deposit in Palana proper has been completed and a few areas have also been located. Total reserves of lignite in the areas are round 23 million tonnes with average calorific value of 6,500 B. Th. U/lb. The mineable reserves by opencast method may, however, be nearly 12 million tonnes in blocks A and C. The Government is considering setting up of a thermal power plant based on this lignite.

5. MINERAL BASED INDUSTRIES

The mineral resources of the state provide a large variety and have great potentiality for the establishment of more mineral based industries. The commissioning of Zinc Smelter at Debari and the Cement Plant at Chittorgarh are the recent landmarks in the development of mineral based industries in the State. With the start of production at Khetri, the State will have the biggest copper complex in the country. Similarly the proposed fertilizer complex, utilising Saladipura pyrites and Udaipur Phosphate rock, will be a milestone in the industrial development of the state and will provide opportunity for ancillary industries also.

Rajasthan has got vast resources of gypsum and there are possibilities to establish cement sulphur plant based on gypsum. Even from low grade gypsum, manufacture of gypsum wall boards can be planned so that pre-fabricated house can come up which will solve partially the acute housing problem of the country. Good selenite deposits have also been located in Rajasthan, based on which surgical plaster, plaster of paris and other industries can also come up.

Development of mineral resources of the State has increased the scope both for big and small mineral based industries. There are many potential areas in the state where new cement plants can come up. Once the Khetri plant is commissioned and production of by-product sulphuric acid starts many industries using sulphuric acid as a raw material will come up. The mining and beneficiation project for fluorspar at Mando-ki-Pal will produce acid grade concentrates and provide avenues for chemical industries to come up. Ceramic unit and clay washing plants can be established in the state with its abundant resources of ceramic minerals. Similarly production of high quality decolourisers

and bleaching clays can be started by setting up an activation plant for fuller's earth found in the State. With barytes and sulphuric acid both available near Udaipur, lithopone unit can also be set up.

In field of base metals there is a strong case for setting up a lead smelter in the state. As a matter of fact the second zinc smelter in the public sector could also have been located in Rajasthan. The State has a justified claim for future zinc plants. With the commissioning of the Khetri smelter small copper mines can be profitably worked and mills can be established to treat the ore produced there.

6. MINERAL EXPLORATION, ADMINISTRATION AND REVENUE :

Prospecting and exploration of mineral resources of the state is being pursued vigorously by various agencies of the Government and also some private entrepreneurs. The efforts have brought rich dividend in the past decade in the shape of many new deposits which have been instrumental in setting up new industries, in saving foreign exchange and adding to general prosperity of the area by providing avenues for direct and indirect employment. With the ever increasing demand of minerals the efforts to locate new deposits have to be intensified.

Apart from streamlining the mineral concession rules and bringing them to a scientific and rational basis the Department of Mines and Geology has also pursued exploration of minerals right from its inception and has been successful in locating a number of mineral deposits.

Although Rajasthan's mineral potentialities have a bright future certain impediments come in the way of its proper development. Inadequate finance, difficult communications, and non-availability of water and cheap power are the patent problems. These difficulties can be overcome gradually as the development progresses. This requires proper planning and employing technical personnel for the job. Haphazard working, keeping in view only the immediate gain would be highly detrimental to the interest of the mineral property.

Mining and mineral activity has come a long way from 1950 when integrated Rajasthan was formed. There has been an all round development in the State. As against only 31 mining leases for major minerals in 1949-50, in 1968 there were 690 mining leases and 192 prospecting licences for major minerals and 1094 mining leases, 65

royalty collection contracts and 7717 rent-cum-royalty-leases for minor minerals. Similarly there has been manifold increase in value of mineral revenues from royalties. During 1968 the value of important major minerals alone was Rs. 40 millions and the total mineral revenue was around Rs. one crore and Ninety two lakhs. Mining of minerals and its ancillary industries continue to be a major source of employment in the State. Total persons employed directly in the mining industry was 22000 in 1968 compared to 15400 in 1967.

A review of the Rajasthan's mineral potential reveals that a very hopeful future lies ahead for the industrial development in the state through mineral based industries. The development in the field of base metals, that is, Khetri Copper belt, Zawar group of deposits, Dariba-Rajpura deposit, and some new nonferrous metal deposits presently under investigation in new areas such as Sirohi, would make a considerable difference in the supplies of copper, lead, zinc and associated metals. It may not be surprising that in course of a decade the country may become even self sufficient in the field of these metals.

Recent finds of phosphate rock deposits near Udaipur have now made Rajasthan geologically one of the most important areas in India to look for the requirements of agricultural nutrients and fertilizer raw materials.

It may be of interest to note that so far the rise in the production of most of the minerals in the state during last two decades is accounted for by more or less the same deposits which have been in production for the last nearly 20 years. This, however, should not be regarded as presenting a particularly pessimistic picture about coming up of new mineral deposits. Even in the most progressive countries in the west, the number of new mines coming annually into production are very few. The development in the next five years in the case of base metals and fertilizer minerals would be from new mines also.

The new centres of mining activities that would develop in Rajasthan in course of the next 5 years or so would provide new employment possibilities to technical people and men in other professions.

MINERAL PRODUCTION IN RAJASTHAN

S. Name of the No. Mineral	Unit	PRODUCTION				
		1966	1967	1968	First half of 1969 (Jan. to June)	
1	2	3	4	5	6	7
1. Lignite	Thousand tonnes	7.2	2.1	5.1	0.1	
Metallic Minerals.						
2. Copper ore	Thousand tonnes	9.4	3.6	Nil	Nil	
3. Iron ore	Thousand tonnes	0.3	Nil	0.2	2.71	
4. Lead, zinc & Silver						
(a) Run of Mine ore	Thousand tonnes	155.5	132.1	193.8	103.0	
(b) Lead Concentrate	Thousand tonnes	5.2	4.0	3.6	1.5	
(c) Zinc Concentrate	Thousand tonnes	8.9	10.0	12.8	6.5	
(d) Silver	Kilogram	923	3219	2651	2047	
5. Manganese ore	Thousand tonnes	7.9	10.2	8.4	3.9	
6. Wolframite (Tungsten ore)	Tonnes	21	24.1	26.8	18.5	
Non-Metallic Minerals.						
7. Asbestos	Thousand tonnes	5.9	6.5	8.1	4.3	
8. Barytes	Thousand tonnes	7.1	5.6	6.4	3.4	
9. Calcite	Thousand tonnes	8.1	6.2	6.7	5.5	
10. Columbite-Tantalite	Kilogram	Nil	103	Nil	Nil	
11. China clay	Thousand tonnes	14.6	29.5	37.5	20.5	
12. Dolomite	Thousand tonnes	27.8	26.3	22.1	11.4	
13. Emerald Crude	Kilogram	11	7.7	4.6	2.23	

1	2	3	4	5	6	7
14. Felspar		Thousand tonnes	18.2	18.1	26.2	12.0
15. Fire clay		Thousand tonnes	3.2	0.3	2.5	2.9
16. Fluorite		Thousand tonnes	1.5	1.0	15.8	4.2
17. Garnet						
(a) Abrasive		Thousand tonnes	0.2	0.3	1.2	0.9
(b) Gem		Tonnes	5.1	6.1	4.9	N.A.
18. Graphite		Tonnes	47	11.5	28.7	Nil
19. Gypsum		Thousand tonnes	1153.4	922.2	1196.4	602.6
20. Kyanite		Tonnes	61	37	7	Nil
21. Limestone (cement making)		Thousand tonnes	1715.2	1727.6	1892.0	953.7
22. Magnesite		Tonnes	8	9	3	Nil
23. Mica (Crude)		Thousand tonnes	6.4	4.0	3.9	1.6
24. Ochre (Red & Yellow)		Thousand tonnes	2.2	8.0	13.9	2.2
25. Pyrophyllite		Thousand tonnes	0.8	0.7	1.3	Nil
26. Quartz		Thousand tonnes	12.7	16.8	19.7	9.0
27. Silica sand		Thousand tonnes	40.8	43.6	43.7	21.7
28. Slate stone		Tonnes	236	140	63	41
29. Selenite		Thousand tonnes	4.1	7.8	12.7	6.5
30. Soapstone		Thousand tonnes	135.9	119.7	152.0	97.6
31. Tourmaline		Tonnes	5	8	18	6.0
32. Vermiculite		Tonnes	129	174	410	310

Errata

<u>Page</u>	<u>Para</u>	<u>Line</u>	<u>For</u>	<u>Read</u>
12	5	6	17667	2915
18	1	2	64500	51400
23	Cap 3	2	Thousand Tonnes	Tonnes

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