

**GEOLOGICAL REPORT
OF
JODHPUR-SATAPAR BLOCK
(FIELD SEASON-2023-24)
KALYANPUR TALUKA
DEVBHUMI DWARKA DISTRICT - GUJARAT.**

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CONTENTS

Hindi abstract.....	(i)
English abstract.....	(iii)
Chapter 1: Executive Summary	4
Chapter 2: Introduction.....	6
2.1 Details of Project.....	6
2.2 Investigation Agency.....	6
2.3 Objective of the investigation.....	6
2.4 Basis for taking up investigation.....	6
2.5 Details, nature and quantum of work proposed V/s achievement.....	7
2.6 Personal involved.....	8
Chapter 3: Property description.....	10
Chapter 4: Previous work.....	14
Chapter 5: Geology of the area.....	15
Chapter 6: Activity during the period (Geoscience investigation).....	18
6.1 Geological Mapping.....	18
6.2 Sampling.....	19
Chapter 7: Integration of Geology, Geophysics and Geochemical exploration and interpretation.....	20
Chapter 8: Mineral prospect.....	21
Chapter 9: Exploration Systematic Drilling.....	22
9.1 Spacing of the Boreholes.....	22
9.2 Methodology of drilling with details of type of drilling.....	22
9.3 Methodology of core zone sampling and sample preparation.....	23
9.4 Chemical analysis and Laboratory procedure.....	26
Chapter 10: Geotechnical studies on borehole core samples of mineralized zone, hanging wall and foot wall side.....	28
Chapter 11: Resource Estimation.....	29
11.1 Reporting of resources.....	30
Chapter 12: Core preservation.....	32
Chapter 13: Conclusion and recommendation	33
Chapter 14: Expenditure.....	34
Chapter 15: References.....	35
Chapter 16: Locality Index.....	36

List of Tables

Table: 1 Details, nature and quantum of work proposed V/s achievement	8
Table: 2 Mode of operation of different work components and associated agency.....	9
Table: 3 Coordinates of corner points of Jodhpur-Satapar Block Boundary.....	10
Table: 4 Coordinates of drilled boreholes of Jodhpur-Satapar Block.....	11
Table: 5 Regional Geology of the Area.....	15
Table: 6 Local Geology of the Study Area	16
Table: 7 In-situ resources of Jodhpur-Satapar Block, Devbhumi Dwarka.....	31
Table: 8 Average quality of individual litho-unit zone.....	31
Table: 9 Expenditure of project.....	34
Table: 10 Locality Index.....	36

List of Figures

Figure: 1 DGPS survey in Jodhpur-Satapar block, Devbhumi Dwarka.	18
Figure: 2 <i>Geological Mapping of the Jodhpur-Satapar Block, Devbhumi Dwarka</i>	19

List of Annexure

Annexure 1: Resource Estimation Sheet	
Annexure 2: Overburden to Mineral Ration sheet	
Annexure 3: Borehole wise and Grade wise thickness	
Annexure 4: Individual Bed thickness	
Annexure 5: Core Log Samples Analysis Results	
Annexure 6: Co-ordinates of Boundary of Jodhpur-Satapar Block	
Annexure 7: Certified Chemical check analysis	
Annexure 8: Corelog photographs of drilled boreholes	
Annexure 9: Lithologs of drilled boreholes with RQD	

List of Plates

Plate 1: Key and Location Plan	
Plate 2: Aerial View of Study Area	
Plate 3: Study Area Location on Toposheet	
Plate 4: Cadastral Plan with Borehole Locations	
Plate 5: Resource Estimation Map as per UNFC Guidelines	
Plate 6: Isopach Maps (Cement Grade Limestone, Limestone & Marl)	
Plate 7: Surface Geological Map	
Plate 8: Graphic Lithologs	
Plate 9: Cross Sections	

सारांश

गुजरात सरकार के उद्योग और खनिज विभाग के भूगर्भशास्त्र और खनन आयुक्त के अन्वेषण शाखा का कार्य राज्य में खनिज संसाधनों की पहचान करना है। इस शाखा ने अतीत में व्यापक अन्वेषण किया है, और संसाधनों की पहचान विभिन्न स्तरों पर की गई है, जैसे प्री-डीटेल्ड खनिज सर्वेक्षण, विस्तृत खनिज सर्वेक्षण और कोर ड्रिलिंग अन्वेषण। इन प्रयासों के माध्यम से कई औद्योगिक दृष्टि से महत्वपूर्ण खनिजों की पहचान की गई है, जैसे बॉक्साइट, चूना पत्थर, लिग्नाइट, सिलिका रेत, बेंटोनाइट, चाक, ग्रेनाइट और अन्य। अन्वेषण शाखा का मुख्य उद्देश्य राज्य में खनिज संसाधन संभावित क्षेत्रों की पहचान करना और नए MMDR संशोधन अधिनियम, 2015 और खनिज (खनिज सामग्री का प्रमाण) नियम 2015 के तहत रिजर्व स्थापित करना है। गुजरात मिनरल रिसर्च एंड डेवलपमेंट सोसाइटी (GMRDS) खनिज उद्योगों को समर्थन देने और भूगोल और खनन आयुक्त की देखरेख में खनिज प्रशासन के लिए तकनीकी सहायता प्रदान करने के लिए समर्पित है। GMRDS राज्य के भीतर खनिज वस्त्रों और संसाधनों की स्थापना और विकास पर कार्य करता है। अपनी मुख्य मिशन के अतिरिक्त, GMRDS राज्य के खनिज संपदा के लिए नए खनिज संसाधनों की खोज में सक्रिय रूप से संलिप्त है।

गुजरात मिनरल रिसर्च एंड डेवलपमेंट सोसाइटी (GMRDS) खनिज उद्योगों का समर्थन करने और खनिज अन्वेषण और खनिज प्रशासन के लिए तकनीकी सहायता प्रदान करने के लिए समर्पित है, जिसे भूगर्भशास्त्र और खनन आयुक्त की देखरेख में किया जाता है। GMRDS राज्य के भीतर खनिज वस्तुओं और संसाधनों की स्थापना और विकास पर काम करता है। अपनी मुख्य मिशन के अलावा, यह भूगर्भीय अन्वेषण भी करता है।

2023-24 के क्षेत्रीय मौसम में, गुजरात सरकार के भूविज्ञान और खनन आयुक्त की अन्वेषण शाखा ने भारत सरकार के खनिज मंत्रालय के राष्ट्रीय खनिज अन्वेषण ट्रस्ट (NMET) को जोधपुर-सातापार ब्लॉक, देवभूमि द्वारका जिले, गुजरात में चूना पत्थर और बौक्साइट खनिजों के लिए G3 स्तर के अन्वेषण हेतु एक प्रस्ताव प्रस्तुत किया। इस परियोजना को सितंबर 2023 में NMET द्वारा 1,387 हेक्टेयर क्षेत्रफल पर G3 स्तर के अन्वेषण के लिए स्वीकृति मिली, जो कालयनपुर तालुका, देवभूमि द्वारका जिले, गुजरात के जोधपुर, सातापार, नवदरा और भगत गांवों को कवर करता है।

गुजरात मिनरल रिसर्च एंड डेवलपमेंट सोसाइटी (GMRDS), गांधीनगर द्वारा कुल 1,387 हेक्टेयर क्षेत्रफल का अन्वेषण किया गया। इस ब्लॉक के भीतर, जोधपुर-सातापार ब्लॉक में 800 x 800 मीटर के ग्रिड पर 11 बोरहोल ड्रिल किए गए, जो कुल 165 मीटर की गहराई तक पहुंचे। कुल 151 सैंपल्स ड्रिल किए गए बोरहोल से प्राप्त कोर से तैयार किए गए और विश्लेषण के लिए पेट्रोग्राफी और खनिज रसायन

प्रयोगशाला (PMC लैब), गांधीनगर भेजे गए। सभी कोर ड्रिलिंग सैंपल्स का विश्लेषण प्रमुख और गौण ऑक्साइड्स के लिए किया गया, जिसमें LOI, SiO_2 , Al_2O_3 , Fe_2O_3 , CaO , MgO , Na_2O , K_2O , TiO_2 , MnO , और SO_3 शामिल हैं, साथ ही विशिष्ट गुरुत्वाकर्षण (Specific Gravity) भी मापा गया। विश्लेषण परिणामों के आधार पर, पेट्रोलॉजी (Lithology) को संशोधित किया गया, और संसाधनों की गणना थाईसेन पोलिगन (Thiessen Polygon) पद्धति का उपयोग करके की गई ताकि प्रत्येक बोरहोल का प्रभाव आंका जा सके। इस परियोजना के परिणामस्वरूप, गुजरात के खनिज संसाधनों के तहत निम्नलिखित खनिज संसाधनों की स्थापना की गई: 114.67 मिलियन टन बौक्साइट (एल्यूमिनस लेटराइट) जिसमें Al_2O_3 की मात्रा 21.97%, SiO_2 की मात्रा 45.01%, और Fe_2O_3 की मात्रा 12% है; 44.67 मिलियन टन सीमेंट ग्रेड चूना पत्थर जिसमें CaO की मात्रा 43.51%, MgO की मात्रा 0.66%, SiO_2 की मात्रा 8.46%, और Fe_2O_3 की मात्रा 5.23% है; 41.00 मिलियन टन ब्लेन्डेबल ग्रेड चूना पत्थर जिसमें CaO की मात्रा 37.89%, MgO की मात्रा 0.95%, SiO_2 की मात्रा 8.46%, और Fe_2O_3 की मात्रा 6.97% है; और 52.38 मिलियन टन मार्ल जिसमें CaO की मात्रा 25.05%, MgO की मात्रा 1.25%, SiO_2 की मात्रा 25.79%, और Fe_2O_3 की मात्रा 7.34% है।

Abstract

The Exploration branch of Commissioner of Geology and Mining, Industries and Mines Department, Government of Gujarat operates to establish mineral resources in the state. The branch has conducted extensive exploration in the past, and resources have been established at various levels through pre-detailed mineral surveys, detailed mineral surveys, and core drilling explorations. These efforts have identified several industrially important minerals such as Bauxite, Limestone, Lignite, Silica sand, Bentonite, Chalk, Granite, and others. The main objective of the Exploration branch is to identify mineral resource potential area in the State and establish reserves under the applicable legislative framework of the new MMDR Amendment Act, 2015 and Mineral (Evidence of Mineral Content) Rules 2015.

The Gujarat Mineral Research & Development Society (GMRDS) is dedicated to supporting the mineral industries and providing technical assistance for mineral exploration and mineral administration under the supervision of the Commissioner of Geology & Mining. GMRDS works on the establishment and development of mineral commodities and resources within the state. In addition to its core mission, geological exploration.

In the 2023-24 field season, the Exploration Branch of the Commissioner of Geology & Mining, Government of Gujarat, submitted a proposal to the National Mineral Exploration Trust (NMET), Ministry of Mines, Government of India, for G3-level exploration of Limestone and Bauxite minerals in the Jodhpur-Satapar Block, Devbhumi Dwarka District, Gujarat. The project was approved by NMET in September 2023 for G3-level exploration over an area of 1,387 hectares, covering the villages of Jodhpur, Satapar, Navadara, and Bhogat in Kalyanpur Taluka, Devbhumi Dwarka District, Gujarat.

The total block area of approximately 1,387 hectares was explored by the Gujarat Mineral Research & Development Society (GMRDS), Gandhinagar. Within the block, 11 boreholes were drilled on an 800 x 800 meter grid, reaching a total depth of 165 meters in the Jodhpur-Satapar Block. A total of 151 samples were prepared from the core recovered from the drilled boreholes and sent to the Petrography & Mineral Chemistry Laboratory (PMC Lab), Gandhinagar, for analysis. All core drilling samples were analysed for major and minor oxides, including LOI, SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Na₂O, K₂O, TiO₂, MnO, and SO₃, along with specific gravity. Based on the analysis results, the lithology was revised, and resources were calculated using the Thiessen Polygon method to assess the influence of each borehole. As a result of this project, the following mineral resources were established in Gujarat's mineral wealth: 114.67 million tonnes of Bauxite (Aluminous Laterite) with an Al₂O₃ content of

21.97%, SiO₂ of 45.01%, and Fe₂O₃ of 12%; 44.67 million tonnes of Cement Grade Limestone with CaO at 43.51%, MgO at 0.66%, SiO₂ at 8.46%, and Fe₂O₃ at 5.23%; 41.00 million tonnes of Blendable Grade Limestone with CaO at 37.89%, MgO at 0.95%, SiO₂ at 8.46%, and Fe₂O₃ at 6.97%; and 52.38 million tonnes of Marl with CaO at 25.05%, MgO at 1.25%, SiO₂ at 25.79%, and Fe₂O₃ at 7.34%.

CHAPTER-1

Executive Summary

Sr. No.	Parameter	Data			
01	Name of the Block	Jodhpur-Satapar Limestone Block			
02	Location	Village: Jodhpur, Satapar, Bhoogat, Maleta, Navadra Taluka: Kalyanpur, District: Devbhumi Dwarka			
03	Block Area	1387 Hectare			
04	Block Boundary Co-ordinates	Boundary Pillar	DMS (WGS 84)		
			Latitude	Longitude	
		BP-1	21°58'17.64"N	69°15'43.40"E	
		BP-2	21°59'03.48"N	69°17'10.94"E	
		BP-3	21°59'17.13"N	69°17'56.13"E	
		BP-4	21°58'58.36"N	69°17'56.58"E	
		BP-5	21°58'57.82"N	69°17'50.79"E	
		BP-6	21°58'45.92"N	69°17'50.52"E	
		BP-7	21°58'47.16"N	69°18'04.89"E	
		BP-8	21°57'08.56"N	69°18'31.60"E	
		BP-9	21°56'27.45"N	69°17'18.40"E	
		BP-10	21°57'06.21"N	69°16'50.52"E	
		BP-11	21°57'19.28"N	69°16'32.07"E	
		BP-12	21°57'21.69"N	69°16'28.80"E	
BP-13	21°57'50.71"N	69°16'06.99"E			
05	Total Area Covered under Geological Exploration	1387 Hectare			
06	No. of Boreholes Drilled	11 Nos.			
07	Total Meterage Drilled	165 mts			
08	Borehole Spacing	800 mts x 800 mts			
09	Depth of the Mineralized Zone	0.2 mts to 15 mts			
10	Economic Mineral Resource with Quality	Commodity	Average Thickness	Resource (In million tons)	Quality

		Laterite	3.66 mts	114.67	Al ₂ O ₃ :21.97%, SiO ₂ :45.01%, Fe ₂ O ₃ : 12%
		Cement Grade Limestone	1.19 mts	44.67	CaO:43.51%, MgO:0.66%, SiO ₂ : 8.46%, Fe ₂ O ₃ : 5.23%
		Blendable Grade Limestone	0.95 mts	41.00	CaO:37.89%, MgO:0.95%, SiO ₂ :13.43%, Fe ₂ O ₃ : 6.97%
		Marl	1.40 mts	52.38	CaO:25.05%, MgO:1.25%, SiO ₂ :25.79%, Fe ₂ O ₃ :7.34%
11	Average Overburden to Mineralized zone	6.95 mts: 7.22 mts			
12	Linear Ratio Mineralized zone to OB (mts : mts)	1.03:1			
13	Toposheet No.	41G/5			
14	Topography	Gently undulating			
15	Average Rainfall	1002 mm			
16	Lowest Temperature	7 ° C (December)			
17	Maximum Temperature	44° C (June)			
18	Nearest Railway station	Bhatiya Railway station- 10.06 km			
19	Road	Accessible through SH-25, NH-51 adjacent to block area			
20	Airport	Porbandar airport- 50 km			
21	Port	Okha intermediate type approx. 82 km away			

CHAPTER-2

Introduction

2.1 Details of Project:

On 06/07/2023 a proposal for G3 level Limestone & Bauxite exploration in Jodhpur Satapar Block, Devbhumi Dwarka district, Gujarat was submitted to NMET by commissioner of Geology and Mining.

The proposal was discussed in the 55th TCC meeting held in July – 23 and it was conveyed that, CGM may submit revised proposal only for Limestone with the drilling at 800 mts x 800 mts as Limestone occurs as bedded deposit. Accordingly, CGM Gujarat had submitted a modified proposal with drilling of 165 mts in 11 boreholes at a grid spacing 800 mts x 800mts. and finally the proposal was approved by TCC for Limestone Exploration in proposed block.

In the 31st meeting of EC held on 12th September 2023 the matter was discussed and EC approved the project with an estimated cost of Rs. 35.91 Lakhs (including GST) within the time schedule of 03 months. Since the Petrography and Mineral Chemistry Laboratory of Commissioner of Geology and Mining, Government of Gujarat was overloaded by priority based mineral analysis work of Gujarat Geo Chemical Mapping Project (GGCMP) samples, the project proponent requested for time limit extension and after detailed discussion the matter was approved in 62nd TCC meeting with revised date of submission 30/04/2024.

2.2 Investigation Agency:

Commissioner of Geology and Mining, Government of Gujarat, Gandhinagar

2.3 Objective of the investigation:

Quantitative and Qualitative assessment of Cement grade & Blendable grade Limestone along with Marl and Low-grade Bauxite (Laterite)

2.4 Basis for taking up investigation:

The Saurashtra Peninsula has established Milliolitic Limestone parallel to the sea-cost. Laterite is the oldest rock exposed in the area and is unconformably overlain by Tertiary sediments. The Tertiary rocks were deposited in shallow marine to beach environment and are represented by rocks of the Gaj Formation and the Dwarka Formation (Lower Miocene to Pliocene). The rocks of Dwarka Formation are well-exposed around Kalyanpur

and Dwarka, the Gaj Formation is seen around Jodhpur and surrounding area. The Milliolute Formation occurs along the sea-coast.

Based on the huge cement grade and chemical grade Limestone deposit M/S. Ambuja cement, M/S. Hi-Bond Cement, M/S. Ultratech cement, etc. had established cement plants in this region. In addition, M/S. Gujarat Alkanies and Chemical Company Limited (GACL) has also established soda ash plant near Okha in Devbhumi Dwarka district. Both this cement and soda ash plant are required different grade of limestone as their basic raw material. In addition different vibrant Gujarat summit more and more private entrepreneur are showing interest in establishment of new cement plant and capacity expansion of their existing cement plant. All these developments require more and more limestone deposit in this region and as such, it is need of the time that we may established additional limestone deposit in this region to feed the raw material to the existing and upcoming cement plant in the Saurashtra area.

The part of proposed area under exploration was previously explored by CGM, 1966-67 by means of pitting and estimated resource for bauxite of about 0.37 Mt. The block is also surrounded by a number of bauxite leases.

A part of the proposed area was previously explored by drilling in Jodhpur village in the year 2018-19, which proved positive results of Limestone. Lithology of the target area comprises of Gaj Formation. Reported CaO% of Limestone varies from 40 to 52%. Leases of Limestone are also present within and surrounding the block. According to the CGM report the estimated resource for Limestone is 8.05 MT.

Exploration increases the level of confidence on quantity and quality of reserve/resource, which will attract the investors. Hence, based on lithology and previous exploration report, the block is suggested for G3 level of exploration for Limestone and Bauxite.

2.5 Details, nature and quantum of work proposed V/S achievement:

Sr. No.	Item Proposed	Achievement
01	Survey & Geological Mapping	Carried out DGPS survey to established block boundary co-ordinates and topography of the area. Completed Geological mapping with necessary sample collection from the outcrop area over an area of 1387 Hectare.

02	Laboratory Studies	
	Chemical Analysis	
	Chemical Analysis of 100 samples for 9 radicals (CaO, MgO, Al ₂ O ₃ , SiO ₂ , Fe ₂ O ₃ , SO ₃ , P ₂ O ₅ , K ₂ O and LOI by XRF	Chemical Analysis of 151 samples for 9 radicals (CaO, MgO, Al ₂ O ₃ , SiO ₂ , Fe ₂ O ₃ , SO ₃ , P ₂ O ₅ , K ₂ O and LOI by XRF
	Check samples from External NABL approved laboratory – 10 Nos	Total 13 Nos. samples was submitted to M/S. Lucid Laboratory, Hyderabad for cross checking
	05 Nos. of samples for XRD	
	Petrographic study – 10 Nos.	
	Bulk density – 05 Nos.	
03	Core Drilling of 165 mts	Completed core drilling 165 mts
04	Geological Report preparation with 5 hard copy and soft copy	CGM has prepared Geological report as per prescribed format.
05	Preparation of Exploration proposal in 5 hard copy and soft	Work completed and proposal is approved by competent authority.
06	Peer review of Exploration report	Work completed
07	Tendering process cost	Work completed
08	Operational charges	Work completed

Table: 1 Details, nature and quantum of work proposed V/S achievement

2.6 Personal involved:

The entire work was carried out by Gujarat Mineral Research and Development Society (GMRDS), a technical arm of Commissioner of Geology and Mining, Gujarat. A team of senior technical officers from GMRDS along with Surveyor, Samplers, Geologists, GIS experts and Chemists are involved in this work.

Mode of operation of different work components and associated agency:

Sr. No.	Work Components	Involved agencies
01	Survey & Geological Mapping	Departmental by CGM & GMRDS
02	Laboratory Studies	Petrography and Mineral Chemistry Laboratory (PMC), CGM, Gandhinagar, Gujarat
	Samples for XRD	
	Petrographic study	
	Bulk density	

03	Check samples from External NABL approved laboratory	M/S. Lucid Laboratory, Hyderabad (NABL approved laboratory)
04	Core Drilling	External Drilling agency- M/S. Vinayak Engimech Pvt. Ltd., Ahmedabad
04	Geological Report preparation	GMRDS, Gujarat
05	Preparation of Exploration proposal	CGM, Gujarat
06	Peer review of Exploration report	Exploration Branch - CGM, Gujarat
07	Tendering process	GMRDS, Gujarat

Table: 2 Mode of operation of different work components and associated agency

CHAPTER-3

Property description

Entire project area falls in parts of Jodhpur, Satapar villages of Kalyanpur taluka of Devbhumi Dwarka District, Gujarat. Devbhumi Dwarka District consists of four talukas namely Dwarka, Bhanwad, Kalyanpur and Khambhalia. District headquarter is situated in Khambhalia. Devbhumi Dwarka District is situated in the Saurashtra region of western Gujarat which is surrounded by Jamnagar District (East), Porbandar District (South), Gulf of Kutch (North) and to the West is the Arabian Sea.

The area falls under the Survey of India Toposheet No. 41 G/5 of Kalyanpur Taluka of Devbhumi Dwarka District, Gujarat. A map showing area on toposheet can be referred for the same, Scale: 1: 50,000 (i.e. Plate-3). The sheet of coordinates of Block boundary has given as separate annexure-6.

Sr. No.	Boundary Pillar	DMS (WGS 84)	
		Latitude	Longitude
1	BP-1	21°58'17.64"N	69°15'43.40"E
2	BP-2	21°59'03.48"N	69°17'10.94"E
3	BP-3	21°59'17.13"N	69°17'56.13"E
4	BP-4	21°58'58.36"N	69°17'56.58"E
5	BP-5	21°58'57.82"N	69°17'50.79"E
6	BP-6	21°58'45.92"N	69°17'50.52"E
7	BP-7	21°58'47.16"N	69°18'04.89"E
8	BP-8	21°57'08.56"N	69°18'31.60"E
9	BP-9	21°56'27.45"N	69°17'18.40"E
10	BP-10	21°57'06.21"N	69°16'50.52"E
11	BP-11	21°57'19.28"N	69°16'32.07"E
12	BP-12	21°57'21.69"N	69°16'28.80"E
13	BP-13	21°57'50.71"N	69°16'06.99"E

Table: 3 Coordinates of corner points of Jodhpur-Satapar Block boundary

Sr. No.	BH ID	R.L. (m)	DMS (WGS 84)	
			Latitude	Longitude
1	JS-8	37.00	21°57'34.70"N	69°17'32.20"E
2	JS-10	22.00	21°57'08.90"N	69°17'32.90"E
3	JS-11	35.00	21°57'08.90"N	69°18'00.80"E
4	JS-3	25.00	21°58'01.00"N	69°17'05.00"E
5	JS-4	32.00	21°58'00.90"N	69°17'33.10"E
6	JS-1	29.00	21°58'25.60"N	69°16'37.80"E
7	JS-2	28.00	21°58'00.60"N	69°16'37.50"E
8	JS-6	42.00	21°57'34.40"N	69°16'38.50"E
9	JS-5	32.00	21°58'01.00"N	69°18'01.00"E
10	JS-9	37.00	21°57'34.70"N	69°18'01.20"E
11	JS-7	28.00	21°57'35.10"N	69°17'04.90"E

Table: 4 Coordinates of drilled boreholes of Jodhpur-Satapar Block

The area is accessible through SH-6 and NH-51 connecting Dwarka to Bhavnagar. The area is also accessible from Jamnagar via NH-151A. A Key and Location plan can be referred for the same (i.e. Plate-1). The nearest airport from the study area is Porbandar airport which is around 50 Km away from the Jodhpur-Satapar Block and accessible through NH-51. Nearest Railway station is Bhatiya on Jamnagar- Okha Broad Gauge Railway line which is approx. 23 Km away from the Jodhpur-Satapar Block. The area is accessible throughout the year. Okha which is an intermediate type port is located around 82 km away from the present Block. An aerial view of study area map of Jodhpur-Satapar Block has been also given (i.e. Plate-2).

The Climate of Devbhumi Dwarka District can be regarded as one of extreme kind with hot summers & cold winters except in the coastal region, where it is generally pleasant all throughout the year. The air is humid due to coastal location. The Details of coastal villages are as under semi-arid climate. Extreme temperatures, erratic rainfall and high evaporation are the characteristic features of this type of climate. The temperature in

Devbhumi Dwarka District ranges from 44° C higher in the summer and 7° C lowest in the winter. The average temperature during summer it is 38° C, while in winter is around 20° C. The average annual normal rainfall is 1002 mm.

The common flora of the area is species of *Cassia italica* (Aval), *Ischamum indicum* (Bordi), *Prosopis Juliflora* (Ganda Bawal), *Balasmiodendron wightii* (Gugal), *Euphorbia nerifolia* (Thor), *Accacia indica* (Babool) and mangrove. Among the fauna's *Canis aureus* (jackal), *Felis catus* (cat), *Oryctolagus cuniculus* (rabbit), *Antelope cervicapra* (blackbuck), *Ursus* (wild bear), *Vulpes bengalensis* (fox) and varieties of *Lacertilia* (lizards) and *Serpentes* (snakes) are common.

The area is located at the NW tip of an isolated patch of the Saurashtra region and is well connected. The surface is undulatory with small hillocks. The south-western coast is remarkably straight, towards the land it is fringed by low lying parallel ridges. The minimum elevation observed in the block area is 22.50 m and maximum are 35.50 m.

Devbhumi Dwarka District is bounded by Jamnagar District in the East, Porbandar District in South, the Arabian Sea in the West and the Gulf of Kachchh in the North. The district can be divided into three physical regions viz., (i) the coastal plains including the offshore islands, (ii) the plains and (iii) the undulatory and hilly terrains. Topography of the whole area is flat with some undulations. There are no perennial rivers. There are seasonal rivers flowing only during monsoon. Amongst these are the rivers Sani, Sinhan, Vartu, Ghee and Kabarka. Flow of the river is towards the Gulf of Kutch in the North and in North-West. There are no major dams in Devbhumi Dwarka District. There are 10 medium and minor dams in the district. There are many small seasonal tributaries, which forms dendritic drainage pattern. Major tributaries are of first and second order.

The local infrastructure, such as Bus stop, Petrol Pump, ATMs, hotels/restaurants, primary health centres, police station, school, college and temples are present within the periphery of 15-20 km from Jodhpur-Satapar Block. The Devbhumi Dwarka District covers an area of 1412.22 Km. and population of the district is 160579 as per 2011 census. Population density of the district is 139/Sq. Km. Devbhumi Dwarka District is bifurcated on August 15, 2013 from Jamnagar District. Navadra, Bhogat, Satapar, Bankodi, Hadmatiya are the nearby villages to Jodhpur-Satapar Block. This Block is located around 27 Km towards west from District headquarters Devbhumi Dwarka and around 453 Km from state capital Gandhinagar. Kalyanpur is around 23 Km far from this block.

Dwarka is an important pilgrimage centre and it is approx. 40 km away from the JodhpurSatapar Block. Dwarka has its pilgrimage importance due to Dwarkadish temple built between 6th to 7th centuries. Gaga wildlife sanctuary is protected area which was established in November, 1988 consisting 332.70 Hectare area which is located in Kalyanpur Taluka. It is 37.2 Km away from the Jodhpur-Satapar Block and accessible through NH-51.

CHAPTER-4

Previous work

Near the Jodhpur-Satapar Block, exploration for the Limestone was carried out by the Commissioner of Geology and Mining in the year of 2018-19. Total 13 boreholes were drilled on 200 m × 200 m grid covering an area of 36.09 Hectare. The geology of the area covered the soil, limestone, marl, clay, laterite minerals. As per the chemical analysis results, the average CaO% for cement grade limestone was 43.96% and for Blendable grade Limestone was 37.83%. The total estimated resources of the explored block was 8.05 million tonnes.

CHAPTER-5

Geology of the area

Laterite is the older rock exposed in the area and is unconformably overlain by Tertiary sediments. The Tertiary rocks were deposited in shallow marine to beach environment and is represented by rocks of the Gaj Formation and the Dwarka Formation (Lower Miocene to Pliocene). The rocks of Dwarka Formation are well-exposed around Kalyanpur and Dwarka, the Gaj Formation is seen around Jodhpur and surrounding. The Miliolite Formation occurs along the sea-coast.

Devbhumi Dwarka District has volcanic rocks and associated intrusives belonging to the Deccan Volcanics (Upper Cretaceous to Eocene age); Laterites of Bhatia Formation (Paleocene age); sediments belonging to the Gaj Formation of Lower to Middle Miocene age, the Dwarka Formation of Middle Miocene to Pliocene age; Miliolite Formation of Pleistocene age and undifferentiated alluvium sand dunes, clay, mud of Recent period. Basalt is the prominent rock type and is traversed by basalt and dolerite dykes. The Eocene sediments include clays, limestone, sandstone, marl and conglomerate. These rocks are fossiliferous. Miliolite Formation, containing limestone, sandstone, clay and conglomerate, forms blanket like deposits. The Recent deposits have been deposited by marine, fluvial and Aeolian agencies. A geological map has been provided for the same. Limestone associated with the Dwarka and the Gaj Formations occur in Okhamandal and Kalyanpur Talukas.

The regional geology of the area is as follows:

Age	Formation	Litho-units/Rock Type
Pleistocene to Holocene	Recent to Sub Recent	Alluvium / Soil Clay and Mud
Lower Miocene	Gaj Formation	Yellowish to Cream coloured clayey Limestone. Hard, fine grained calcareous clay and Marl
Paleocene to Eocene	Laterite and Bauxite	Hard and compact Laterite and Clay and Bauxite
-----Deccan Trap-----		

Table: 5-Regional Geology of the Area

With the help of core-drilling, sampling and data assessment of the Jodhpur-Satapar Block local geological successions of the area are given as below:

Age	Formation	Litho-units/Rock Type
Pleistocene to Holocene	Recent to Sub Recent	Alluvium / Soil, Clay
Lower Miocene	Gaj Formation	Yellowish, fine grained, hard Limestone, calcareous clay and Marl
Paleocene to Eocene	Bhatia Formation	Lateritic clay, aluminous laterite
Upper Cretaceous to Eocene	Deccan Trap	Fine grained Basalt

Table: 6-Local Geology of the Study Area

Soil: The soil found in the Jodhpur-Satapar Block is blackish to brownish in colour, with fine to medium grain size. The black soil is regarded as alluvial black soil. The soil often contains smaller kankar, pebbles and also clayey material of underlying limestone. Soil layer extend to 0.24 m to 1.00 m.

Limestone:

The limestone found in the Jodhpur-Satapar Block belongs to Gaj formation of Lower Miocene age. Freshly broken limestone is yellowish and brownish in colour. Generally, it is fine grained but at some places it is medium in grain size and contains fossilized fragments and occasionally sand grains. At some places it is highly compact in nature. Fractured limestone is also observed in the Jodhpur-Satapar Block. The thickness of the limestone varies in different part of the Jodhpur-Satapar Block.

Marl:

Marl is the calcium carbonate non-clastic sedimentary rock found in the present block along with the limestones. It is found mostly as greyish colour, fine to medium grained mineral. It is formed from the erosion of the other rocks during the weathering. The thickness of the marl ranges from 0.50 m to 3.00 m in the present block.

Clay:

Clay found in the Jodhpur-Satapar Block also belongs to Gaj formation. The clay is brownish, greyish, greenish and yellowish in colour. It is called variegated clay. It is soft and fine to coarse grained. At places, it is intermixed with gritty material and also contains gypsum. At some places lithomarge clay is also observed.

Laterite:

Laterite of Paleocene to Eocene age is found in the Jodhpur-Satapar Block. Laterite is hard and compact in nature. The thickness of Aluminous Laterite varies from 0.30 to 1.00 m. Some laterites are rich in aluminium content while others are rich in ferruginous content in the present study area.

Trap:

Trap found in Jodhpur Block is mostly blackish in colour. It is generally fine to medium grain in nature. It is hard and compact. Fractured and weathered trap is found at some places in Jodhpur-Satapar Block. These trap rocks are commonly in form of lava of varying thickness.

It was noted that the limestone deposit found in the area is of bedded type which adds up to potential of limestone occurring in the proposed block area. Besides, the limestone upto cement grade is reported to be present in the area as per the chemical analysis of the samples. Several existing mines of limestone are present surrounding the proposed block area which adds up to evidence of mineral potentiality and need for further exploration in the area.

CHAPTER-6

Activity during the period (Geoscience investigation)

6.1 Geological Mapping:

The DGPS survey in Jodhpur-Satapar Block was carried out with Triangulation network have been laid down during G3 level exploration in the proposed study area with the help of DGPS. Boreholes have been fixed on the ground at 800 x 800 m grid interval. The block boundary as provided by the GMRDS, was surveyed by DGPS and Total Station in WGS-84 Datum. In the DGPS Survey report, the details of location, identification and demarcation of area, methodology of Topographic Survey and methodology adopted for vectorized cadastral map have been provided. DGPS Survey was carried out by two methods: 1) Rapid Static Mode and 2) Real Time Kinematic mode. To carry out this survey Dual Frequency Sokkia (GSX2) DGPS, Total station Theodolite CHCNAV Total Station (CTS-112R4 Make) and Electronic Total Station (ETS) Theodolite equipment's were used in various stage of Topographic survey. After topographic survey, draft drawing was generated at site and a complete topographical representation was drafted with the help of AutoCAD. List of boundary pillar Points of the block boundary along with the co-ordinates are given in Annexure-6.



Fig. 1 DGPS survey in Jodhpur-Satapar block, Devbhumi Dwarka.

The geological mapping was carried out in 1387.00 Ha area by taking traverses. At places, mounds of hard rocks were also observed. The geological map of the proposed area was prepared. 10 nos. of outcrop samples were collected from outcrops/exposures of Limestone formations. These samples were subjected to petrographic analyses.



Fig. 2 Geological Mapping of the Jodhpur-Satapar Block, Devbhumi Dwarka.

6.2 Sampling:

The selected recovered core was arranged properly in core boxes of 1 m long with 5 riffles covered with lid. Each run was marked properly by plastic tag and the core boxes were numbered properly.

Then core containing mineral was cut vertically from the centre with the help of core splitter dividing it into two equal halves. One half of core was kept aside for preservation purpose and other half was crushed upto desired mesh size of 200 mesh. Then coning and quartering was done for representative sample. Sampling was done to understand the quality of Limestone encountered in boreholes as per the instruction given by the authority.

The entire sampling process was carried out in presence of Site Geologist of GMRDS and according the suggested procedures of GMRDS. Samples were collected during this exploratory drilling programme and sent to Petrography and Mineral Chemistry Lab, Gandhinagar for chemical analyses.

CHAPTER-7

Integration of Geology. Geo physics and Geochemical exploration and interpretation

Since the area is having bedded & stratiform type of deposit, such type of integration and interpretation work will not be required.

CHAPTER-8

Mineral Prospect

Devbhumi Dwarka District is endorsed with mineral deposits. Limestone is the major mineral of the District other minerals are Bauxite, Laterite, Building Limestone, Black trap, Ordinary Clay and Ordinary sand are minor minerals.

As per the regional geology of the area, the formations are non-deformed and sedimentary formations of each period rest unconformable over the previous one. This shows the periodic invasion and regression of sea. The surface of the study area is covered by the recent sediments which underlain by the Gaj Formation. Limestone is a sedimentary rock composed primarily of calcium carbonate (CaCO_3) in the form of mineral calcite. It most commonly forms in clear, warm, shallow marine waters. It is usually an organic sedimentary rock that forms from the accumulation of shell, coral, algal, and fecal debris. It can also be a chemical sedimentary rock formed by the precipitation of calcium carbonate from lake or ocean water. The occurrence of the Pleistocene beach limestone all over Tertiary coastal plains fringing the Deccan Trap plateau and deep in the interior of the Deccan Trap country at high elevations tends to lead to the conclusion that during Pleistocene period the sea level stood much higher than at present. This may be true in respect of the areas of the coastal plain and the foothill regions. But the occurrence of the Miliolite rocks at higher elevation in the interior areas also point to an Aeolian origin indicating that the windblown particles from the fragmented beach sediments might have been deposited in the valleys of the high hills which acted as natural wind barrier and the sea need not have transgressed to such great heights in order to form the thinner layers of the Miliolite rocks at such higher altitudes. Laterites are sandwiched between the lower Deccan Traps and upper Tertiary rocks. Laterites are the rocks containing iron and aluminium. Considering Miocene age of the Gaj sediments and Cretaceous age of Deccan Trap magmatism, Palaeocene to Eocene age is a reasonable estimate for the laterite deposits. It is well known that lateritisation is a process of chemical weathering of rocks, essentially in a tropical climate comprising of alternation of very hot summers and heavy rainfall during the monsoon season. So, laterites of the study area are formed by the same process of lateritisation.

Weathering may result in the formation of authigenic clay minerals. Traps are essentially basaltic flows having general horizontal to near horizontal disposition over large area.

CHAPTER-9

Exploration Systematic Drilling

9.1 Spacing of the Boreholes:

It was decided to carry out G-3 level exploration in this block and as per guideline of MEMC rule, 2015, the spacing between two boreholes in case of stratified/bedded deposit is 800 mts x 800 mts. Accordingly we have planned and carried out drilling at a grid interval of 800 mts x 800 mts in this block.

9.2 Methodology of drilling with details of type of drilling:

Drilling technique and drill sampling employed:

i) Drill type (eg. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc.) and details (eg. core diameter, triple or standard tube)

Core drilling was carried out by GMRDS through M/s Vinayak Engimech Private Limited. Drilling in the Jodhpur-Satapar block was carried out during December, 2023 by deploying hydraulic core drill rigs using NQ diamond bits with core diameter of 47.6 mm.

ii) Whether core and chip sample recoveries have been properly recorded and results assessed

Core recovery of every run of drilling for all the drilled boreholes was recorded properly. The core recovery of the boreholes drilled in the area is varying from 85% to 98% and is considered to be well within acceptable limit for resource/reserve estimation purposes. There is minimal core loss due to washing of clay intercalations, loose and fractured formation etc.

iii) Measures taken to maximize sample recovery and ensure representative nature of samples.

In order to maximize the core recovery, the rate of penetration, bit pressure and speed of rotation was controlled while drilling and more significantly in the fractured/loose formation and at depth. Sufficient numbers of core barrels were maintained at site and were regularly checked for any undue bends.

iv) Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material

The limestone of the area is medium hard and compact rock. The recovery loss was mainly in the porous, fractured nature of limestone and within clay bands. Thus, no difference was observed between the sample recovery and grade of limestone. Also, no sample bias is expected due to recovery loss as the limestone quality in the area is varying within certain range.

v) Logging: Whether core and chip samples have been logged to a level of detail to support appropriate Mineral Resources estimation, mining studies and metallurgical studies

The core retrieved from individual boreholes drilled in the Jodhpur-Satapar block area was logged in detail to record characteristic features like lithology, colour, weathering, structure, core recovery and mineralization details etc. The core logging has well correlated with the chemical analysis of Individual samples and will support the Mineral Resource estimation and mining studies. The metallurgical studies are not required as the limestone of the area after comminution is proposed to be used for clinker/cement manufacturing.

vi) Discussion on the analysis results of handheld X-ray fluorescence (XRF), if used in the investigation

Handheld X-ray fluorescence (XRF) was not used by GMRDS for analysis during investigation.

9.3 Methodology of core zone sampling and sample preparation:

During the exploration of the Jodhpur-Satapar block, the core sampling method was deployed for drilled boreholes. Boreholes were drilled on a systematic 800 meters by 800 meters grid interval. This approach ensures comprehensive coverage of the exploration area, reducing the risk of sampling bias and ensuring that the entire area is adequately represented. Samples were collected at regular intervals, typically every meter, along the length of each borehole. This method ensures consistent and representative sampling of the mineralized zones, providing a detailed understanding of the geological formations and mineral content. Samples were meticulously handled to prevent contamination or loss of material. This includes using appropriate tools and techniques during the extraction and packaging of the core samples.

The selected recovered core was arranged properly in core boxes of 1 m long with 5 riffles covered with lid. Each run was marked properly by plastic tag and the core boxes were numbered properly. Each sample was carefully labelled with detailed information, including

the borehole ID, depth interval, date of extraction, and any other relevant data. Comprehensive documentation was maintained to track each sample from the field to the laboratory.

Maintaining the integrity of the samples throughout the process ensures reliable and accurate analysis results. This includes proper storage and transportation of samples to the laboratory. The core sampling method used during the exploration of the Jodhpur-Satapar block, combined with systematic borehole drilling and rigorous handling and documentation protocols, ensures the representativeness and quality of the collected samples. These measures are crucial for accurate geological analysis and mineral resource estimation.

i) If core, whether cut or sawn and whether quarter, half or all core taken

The cores recovered from the boreholes after logging were split longitudinally into two halves by core splitter. One half of the split core was kept in the core box while the other half was subjected to sampling.

ii)

a) If non-core, whether riffled, tube sampled, rotary split etc. and whether sampled wet or dry

Only core samples were collected from the boreholes drilled in the area during exploration. Due to the use of water pressure during drilling, the core samples collected were wet. Wet samples were carefully handled to maintain their integrity during collection and transportation to the laboratory. Upon arrival at the laboratory, the wet core samples were thoroughly dried. This step is crucial to remove any moisture that could affect the sample's weight and geochemical analysis. The drying process was carefully monitored to ensure that the samples were completely dry before any further analysis was performed.

b) For all sample types, the nature, quality and appropriateness of the sample preparation technique

For sampling the ore zone, the drilled cores were logged, sample numbers were marked and then split longitudinally to equal halves. One half was kept for core repository. The other half of the split cores was crushed to 200 mesh size. The weight of the crushed core samples varied from 2 to 4 kg depending upon the sample length and recovery. After coning and quartering of the crushed 200 mesh size fraction, individual samples of about 500 gm samples each were sent to Petrography and Mineral Chemistry Laboratory, CGM, Gandhinagar for further processing and chemical analysis.

iii) Quality control procedures adopted for all sub-sampling stages to maximize representation of samples

Before and after preparation of each sample, the crusher, pulverizer, pestle & mortar, sieves and sample trays were properly cleaned to avoid intermixing of samples. The samples were packed properly to avoid entry of any foreign material as well as moisture. The samples were properly labeled for easy identification.

iv) Measures taken to ensure that the sampling is representative of the in-situ material collected

Prior to drilling, each borehole was given a unique label for easy identification. The core retrieved from the drill holes was stored in galvanized iron core boxes. For easy identification and traceability, the core was preserved from the left to the right side of the box with increasing depth and the core was marked with an arrow giving down the hole direction. Galvanized Iron (GI) plates were inserted at the end of each run. The length of the borehole at the end of each run was also marked on the inserted GI plates. Loose soil /sludge collected in the course of drilling was packed in polythene, properly marked and kept at their respective depth.

The core boxes were marked properly on the top, inner side of the lid and the front side giving details like, drill hole number, box number, indicating meterage i.e. From.....m tom. The core boxes were properly preserved and stored for protection from inclement weather and any other damage.

The above procedures ensure the representation of the material collected at each place in the area in terms of its location, depth and litho-unit sample.

v) Whether sample sizes are appropriate to the grain size of the material being sampled

The individual core samples were formulated for a linear length of 0.30 to 1.00 m. However, 86% of the total samples generated are 1 m of linear length. Overburden soil and trap rock samples were not prepared for chemical analysis but clay and laterite samples were taken into consideration. Each sample was subjected to crushing, coning and quartering by applying the standard method of size and weight reduction. The crushed sample was finally pulverized to 200 mesh size to prepare sample pellets. The pellets were then used in XRF for chemical analysis.

Since entire mineralized area has been sampled and analyzed and in view of the homogenous quality of the limestone, the sample size is appropriate to the grain size.

9.4 Chemical analysis and Laboratory procedure:

a) The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total

The cores recovered from the boreholes after logging were split longitudinally into two halves. One half of the split core was kept in the core box while the other half was subjected to sampling. Sampling intervals were marked after identifying the different litho-units in the process of core logging.

The individual core samples were formulated for a varied linear length of 0.30 to 1.00 m. The sample length varied depending upon the change in lithology or physical appearance. However, 86% of the individual samples were formulated for 1 m of linear length.

A total of 151 nos. of core samples were analyzed for major and minor oxides i.e. LOI, SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Na₂O, K₂O, TiO₂, MnO and SO₃ and specific gravity. Also 151 nos. samples of limestone, clay and laterites were analyzed for specific gravity and bulk density.

b) Nature of quality control procedures adopted (e.g. standard, blanks, duplicates, external laboratory checks) and whether acceptable level of accuracy (i.e. lack of bias) and precision has been established

The samples have been analysed in the Petrography and Mineral Chemistry Laboratory, Commissioner of Geology and Mining, Gandhinagar laboratory by wet chemical and instrumental method following standard procedures.

c) Check analysis of at least 10% of samples may be analyzed from third party National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited or Department of Science and Technology (DST) or Bureau of Indian Standards (BIS) recognized laboratories or government laboratories for assessing the acceptable level of accuracy.

The check analysis of 13 samples have been analyzed from NABL approved laboratory LUCID Laboratories Pvt. Ltd., Hyderabad. The analysis has been attached as Annexure-7.

Moisture

Whether the tonnages are estimated on a dry basis or with natural moisture and the method of determination of moisture content whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of measurements, the nature, size and representativeness of the samples

Tonnages for mineral are estimated on a dry basis, after removing moisture content.

The laboratory tests are also carried out for specific gravity measurements on limited number of core samples on air dried basis. The specific gravity for limestone varies from 2.59 to 2.71 and for Laterite from 2.60 to 2.61. The specific gravity of 2.67 and 2.62 are considered for estimation of resources of cement grade limestone and blendable grade limestone respectively.

Bulk density of the submitted samples were calculated. The bulk density was measure at 1st stock and 49th stock. The bulk density of submitted samples at 1st stock varies from 0.52 to 0.95 ton/m³ and at 49th stock it varies from 0.63 to 1.29 ton/m³.

CHAPTER-10

Geotechnical studies on borehole core samples of mineralized zone, hanging wall and foot wall side

The Geological mapping, Exploration result are indicating soft surficial limestone deposit up to depth of 10 to 12 mts and as such the mining activity involved will be an open cast mining method as such type of studies are not required in this block.

CHAPTER-11

Resource Estimation

Based on exploration data, resource estimation was done for Cement Grade Limestone, Blendable grade Limestone, Laterite and Marl.

Based on analysis result of CaO % and MgO %, Limestone is categorized as Cement Grade, Limestone and Marl. For the categorization of Limestone, we have used Threshold value of minerals, Indian Mineral yearbook 2018 and National Mineral Inventory. The Threshold value for Limestone published by Indian Bureau of Mines, Ministry of Mines, Nagpur vide notification no. C284/3/CMG/2017 dated 25th April, 2018. In the above notification the threshold values for Limestone and laterite are as given below: For Limestone: CaO% (34% Min.) and MgO% (5% Max.) and for Laterite: Al₂O₃: 20% (Min.) Hence, Chemical specification of CaO % for different grades of limestone as below:

- | | |
|--------------------|----------------------------|
| 1. Chemical Grade | : > 52 % CaO, ≤ 5 % MgO |
| 2. Cement Grade | : 40 to 52 % CaO, ≤ 5% MgO |
| 3. Blendable Grade | : 34 to 40 % CaO, ≤ 5% MgO |
| 4. Marl | : 20 to 34 % CaO, ≤ 5% MgO |

The following parameters and assumptions have been taken into consideration for resource estimation: -

1. In each borehole area of influence has been considered for resource calculation, as this area is little undulating and the mineral deposit is of regular habit.
2. Tonnage is estimated on dry basis, after removing moisture content.
3. Average cumulative thickness is taken for each borehole fall under different category regions, i.e., G3.
4. As per UNFC guidelines for the deposits of Regular habit, the area covered by wide spaced bore holes with bore holes spacing is 800 m are marked for G3 category resource.
5. Specific Gravity has been estimated grade wise and average specific gravity for Cement Grade Limestone is 2.67, for Blendable Grade Limestone is 2.62, for Laterite is 2.61 and for Marl is 2.62 in Jodhpur-Satapar block.
6. Recovery loss has not been considered.
7. Total resources estimated here are insitu resources.

8. Clay part intersected in between the Cement Grade Limestone, Blendable Grade Limestone, Laterite and Marl bands were not considered for resource estimation, for calculating average thickness and for estimating average grade of mineralized zone.
9. No cut off was fixed for thickness for delineation of mineralized zone Cement Grade Limestone, Blendable Grade Limestone, Laterite and Marl.
10. To separate out different grades of Cement Grade Limestone, Blendable Grade Limestone and Marl CaO % & MgO % values has been considered.

The method of chemical analysis of samples and elements to be analyzed were decided by the state government and analysis results were given by State government which is accepted for the estimation of average grade of Cement Grade Limestone, Blendable Grade Limestone and Marl.

Resource estimation has been done by using an Arc GIS Software. Area of influence each borehole is estimated by considering the multiplication of length and width of rectangle covered by the borehole of Cement Grade Limestone, Blendable Grade Limestone, Laterite and Marl deposits, thickness of Cement Grade Limestone, Blendable Grade Limestone, Laterite and Marl specific gravity etc. and the classification of the estimated resource was done as per UNFC guidelines. The length, width and thickness of Cement Grade Limestone, Blendable Grade Limestone and Marl are considered in meters. The surface area covered by this Jodhpur-Satapar block is about 1387 Hectare. The various terms expressed for computation of resource are mentioned in short term as below:

$$L \times W \text{ (or } A) \times Th \times Sp. Gr. = R$$

Where;

L = Length in m

Sp. Gr. = Specific Gravity

W = Width (in m)

R = Resources in Tonnes

A = Area in m²

Th = Thickness (in m)

Average grade of different grade of Limestone i.e. Cement Grade Limestone, Blendable Grade Limestone and Marl was calculated. In this method the average value of thickness of each grade, CaO% and MgO% values were taken borehole wise. Then average value of these previously taken values was calculated for average grade of cement grade limestone, Limestone and Marl CaO% and MgO%.

11.1 Reporting of resources:

The resources have been categorized under Inferred Mineral Resource (333) category considering the drilling grid of boreholes drilled in the area.

The summary of litho-unit zone wise in-situ resource under various categories as per Minerals (Evidence of Mineral Contents) Rules 2015 is presented in Table 6:

Litho-Unit	In-situ Resources (million tonnes)	
	UNFC 333	Total
Cement Grade Limestone	44.67	44.67
Blendable Grade Limestone	41.00	41.00
Marl	52.38	52.38
Laterite	114.67	114.67

Table: 7-In-situ resources of Jodhpur-Satapar Block, Devbhumi Dwarka

The average quality of individual litho-unit zone is given in Table 7:

Litho-Unit	Chemical Composition (%)									
	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	Na ₂	K ₂ O	SO ₃	LOI
Cement Grade Limestone	8.46	4.31	5.23	0.37	43.59	0.69	0.14	0.41	0.05	36.42
Blendable Grade Limestone	13.43	6.23	6.97	0.55	38.24	0.91	0.18	0.63	0.10	32.37
Marl	25.78	10.95	7.34	0.83	25.94	1.32	0.44	1.40	0.30	25.37
Laterite	45.01	23.32	12.56	1.66	2.54	1.02	0.46	1.60	0.48	11.01

Table: 8-Average quality of individual litho-unit zone

The detail of litho-unit zone wise and level wise insitu resources is enclosed as Annexure-1. The resource discussed above, portrays an overall picture of the available resources within the block area and does not entail the mineability of the deposit. Following observations could be drawn from the In-situ resources discussed above.

A total of 44.67 million tonnes in-situ resource of cement grade limestone is available within Jodhpur-Satapar block area. The cement grade limestone is comparatively low in silica alumina and iron content and would require suitable correctives to compensate their deficiency in the raw mix.

Also 41.00 million tonnes in-situ resource of blendable grade limestone is available in Jodhpur-Satapar block area. These are comparatively low in CaO and medium in SiO₂, Al₂O₃ and FeO. Qualitatively, this can be judiciously blended with cement grade limestone for its use in cement manufacturing.

CHAPTER-12

Core preservation

After completion of the drilling work, core boxes were carefully shifted to Bhatiya camp where sampling was carried out. Half-splitted cores were taken for sampling purpose and remaining half cores were stored in core boxes. On completion of all the field investigation, the core boxes were handed over in safe custody of Senior Geologist, Mineral Exploration Circle, Rajkot and placed at godown of Mineral Exploration Circle, Rajkot, Gujarat.

CHAPTER-13

Conclusion and recommendation

Out of the block area of 1387 ha, about 1322.67 ha is potentially mineralized with limestone from north to south and east to west. The limestone and other litho-units of the area has horizontal to nearly horizontal dips. All the boreholes have been drilled for varying length and have intercepted the complete thickness of limestone in the block area. The Jodhpur-Satapar block is explored at wide interval (800 m x 800 m grid) and the lateral continuity and thickness of some mineralized zones may vary if substantiated with further exploration by close spaced boreholes. Thus it is recommended to explore the entire potentially mineralized area on 400 m x 400 m or even on 200 m x 200 m grid spacing by core drilling as per MEMC Rules 2015.

In consideration of nature of occurrence of limestone, the Jodhpur-Satapar block can be categorized as "Bedded Stratiform and Tabular Deposit of Regular Habit as Minerals (Evidence of Mineral Contents) Rules 2015.

A total of 44.67 million tonnes resources of cement grade limestone and 41.00 million tonnes resources of blendable grade limestone have been estimated in the area by under 333 category of UNFC.

Qualitatively, the cement grade limestone is comparatively low in silica, alumina and iron content and would require suitable correctives to compensate their deficiency in the raw mix. The blendable grade limestone can be used after blending with cement grade limestone in cement raw mix.

CHAPTER-14

Expenditure

The segment wise estimated expenditure incurred for geological exploration and preparation of Geological report for Jodhpur-Satapar Limestone Block is as under:

Sr. No.	Nature of Work	Estimated Cost (in Rupees)
1	Geological Work	10,95,420/-
2	Laboratory Studies	4,16,060/-
3	Outsourcing Components	11,69,375/-
4	Geological Report Preparation	1,50,000/-
5	Preparation of Exploration proposal	53,417/-
6	Peer Review	30,000/-
7	Tendering Processing Cost	23,188/-
8	Operational Charges	1,15,938/-
9	GST @ 18%	5,47,811/-
Total Cost		35,91,209/-

Table: 9 Expenditure of project

CHAPTER-15

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CHAPER-16
Locality Index

<u>Name of village</u>	<u>Latitude</u>	<u>Longitude</u>
Jodhpur	21°58'51.27"N	69°17'37.92"E
Bhogat	21°59'33.16"N	69°14'30.43"E
Maleta	21°59'40.34"N	69°19'57.13"E
Satapar	21°58'04.01"N	69°19'24.76"E
Navadra	21°56'35.15"N	69°16'11.99"E

Table: 10-Locality index