

**GEOLOGICAL REPORT OF RECONNAISSANCE SURVEY (G-4) FOR**  
**MINERAL-ROCK PHOSPHATE IN RANDHA, DISTRICT-JAISALMER,**  
**RAJASTHAN (PART OF TOPOSHEET NO 40 J 16 & 15)**

[Under NMEDT Program]

by



[CPSE]

[under the Ministry of Chemicals & Fertilizers]

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## CHAPTER-I

राजस्थान के जैसलमेर जिले के रंधा में खनिज-चूनि फॉस्फेट के लए कए गए प्रारंभिक सर्वेक्षण (जी-4) की भूवैज्ञानिक रिपोर्ट (टोपोशीट संख्या 40 जे 16 और 15 का भाग)

कार्यकारी सारांश

फॉस्फेट खनिज कृष एवं उर्वरक उद्योगों के लए अत्यंत महत्वपूर्ण संसाधन हैं, तथा पश्चिमी राजस्थान के रणधा क्षेत्र के समीप रॉक फॉस्फेट निक्षेप की संभावनाओं की पहचान हेतु प्रारंभिक सर्वेक्षण (G-4) कया गया। इस क्षेत्र का वस्तुतः भूवैज्ञानिक मानचित्रण, जो अक्षांश  $26^{\circ}11'42.70''$  उत्तरी से  $26^{\circ}16'11.52''$  उत्तरी तथा देशांतर  $70^{\circ}54'22.94''$  पूर्वी से  $70^{\circ}59'54.64''$  पूर्वी के मध्य स्थित है, 1:12,500 के पैमाने पर, राष्ट्रीय खनिज अन्वेषण एवं विकास ट्रस्ट {National Mineral Exploration and Development Trust} (NMEDT) अन्वेषण कार्यक्रम के अंतर्गत FAGMIL (FCI Aravali Gypsum and Minerals India Limited) द्वारा संपन्न कया गया।

वचाराधीन रॉक फॉस्फेट ब्लॉक का क्षेत्रफल 38.5 वर्ग किलोमीटर है, जो क गाँव वीरभाणी, कोहरा एवं रणधा, तहसील फतेहगढ़, जिला जैसलमेर, राजस्थान में स्थित है। यह क्षेत्र रॉक फॉस्फेट खनिजीकरण के लए अनुकूल भूवैज्ञानिक परिस्थितियों के लए जाना जाता है। इस क्षेत्र की पहचान, प्रस्तावित ब्लॉक से सटे बिरमानिया रॉक फॉस्फेट ब्लॉक, जैसलमेर, राजस्थान के सामान्य अन्वेषण (G-2) स्तर के आकलन के आधार पर की गई है। बिरमानिया, FAGMIL अधसूचित क्षेत्र में 1.4 कमी की स्ट्राइक लंबाई के साथ औसत 10.04%  $P_2O_5$  ग्रेड के रॉक फॉस्फेट के कुल 4.54 मलयन टन शुद्ध इन-सीटू संसाधन स्थापित कए गए हैं। निम्बली ब्लॉक (G-3 स्तर का अन्वेषण), जो रणधा ब्लॉक के समीप स्थित है, में 11.45%  $P_2O_5$  के औसत ग्रेड के साथ 2.49 मलयन टन शुद्ध इन-सीटू भूवैज्ञानिक संसाधन उपलब्ध हैं। अतः रणधा ब्लॉक में प्रारंभिक सर्वेक्षण (G-4) का उद्देश्य बिरमानिया एवं निम्बली ब्लॉकों के दक्षिण-पूर्व (SE) भाग में रॉक फॉस्फेट परत की निरंतरता की जांच करना तथा रॉक फॉस्फेट खनिजीकृत क्षेत्र का मानचित्रण करना है।

ब्लॉक क्षेत्र का अधिकांश भाग बिरमानिया एवं रणधा फॉर्मेशन की शैलों से आच्छादित है, जो असंगत (Unconformable) रूप से मालानी आग्नेय शैलसमूह (Malani Igneous Suite) की शैलों के ऊपर अवस्थित हैं। ब्लॉक क्षेत्र के दक्षिण-पूर्वी भाग में मालानी आग्नेय शैलसमूह के रायोलाइट तथा ग्रेनाइटिक शैलें वद्यमान हैं। इसके अतिरिक्त, उत्तर-पूर्वी भाग में रणधा फॉर्मेशन की फेरुजिनस सैंडस्टोन की रिज, जिसमें शैल की वैकल्पिक परतें उपस्थित हैं, पाई जाती है। बिरमानिया फॉर्मेशन की शैलें ब्लॉक के उत्तर एवं उत्तर-पूर्वी भाग में वस्तुतः हैं।

रणधा रॉक फॉस्फेट ब्लॉक के प्रारंभिक सर्वेक्षण (G-4) हेतु प्रस्ताव 29 जुलाई, 2024 को आयोजित 36वीं ईसी (EC) बैठक में ₹1,37,44,269/- की स्वीकृत राशि के साथ अनुमोदित किया गया। इस संबंध में स्वीकृति आदेश 13 सितम्बर, 2024 को जारी किया गया, जिसमें 12 माह की समय-सीमा निर्धारित की गई।

प्रारंभिक सर्वेक्षण (G-4) के अंतर्गत 1:12,500 पैमाने पर क्षेत्र का भूवैज्ञानिक मानचित्रण, टोपोग्राफिक सर्वेक्षण, बेडरॉक सैंपलिंग, पटिंगट्रेंचिंग, बोरहोल ड्रिलिंग तथा अंततः UNFC मानक के अनुसार संसाधन आकलन किया गया। इस सर्वेक्षण के दौरान कुल 186 BRS एवं ट्रेंच नमूने, 100 कोर नमूने, 7 पेट्रोलॉजिकल नमूने तथा 286 XRF नमूने संकलित किए गए। समीपवर्ती बिरमानिया एवं निम्बली ब्लॉकों में पाए गए रॉक फॉस्फेट स्तर की उपसतही निरंतरता की जांच हेतु कुल 100 मीटर की गहराई तक 2 बोरहोल ड्रिल किए गए।

बेडरॉक नमूनों के XRF विश्लेषण से फॉस्फेट की मात्रा नगण्य अथवा शून्य (<1%) पाई गई, जबकि ट्रेंच नमूनों में अधिकतम  $P_2O_5$  1.67% तथा कोर नमूनों में 1.68% तक प्राप्त हुआ। ब्लॉक क्षेत्र में कोई प्रमुख रॉक फॉस्फेट परत वर्तमान नहीं पाई गई, हालांकि फॉस्फेट युक्त सैंडस्टोन एवं लाइमस्टोन में >1%  $P_2O_5$  दर्ज किया गया। अतः निष्कर्षतः यह कहा जा सकता है कि समीपवर्ती बिरमानिया एवं निम्बली ब्लॉकों में वर्तमान रॉक फॉस्फेट परत का दिशा में रणधा ब्लॉक में विस्तार नहीं होता है। केवल कुछ सेंटीमीटर मोटाई के रॉक फॉस्फेट लेस लाइमस्टोन में पाए गए, जबकि सैंडस्टोन एवं शेल हल्के फॉस्फेट युक्त प्रकृति के हैं। इस लिए, उक्त क्षेत्र को आगे के अन्वेषण हेतु अनुशंसित नहीं किया जाता है।

## **1 EXECUTIVE SUMMARY**

The Phosphate minerals are critical resources for the agriculture and fertilizer industries, and the Reconnaissance Survey (G-4) for the Rock phosphate deposit near Randha area in western Rajasthan was carried out to identify the potential rock phosphate deposit in this area. Detailed geological mapping of the area, bounded by latitude 26°11'42.70"N to 26°16'11.52"N and longitude 70°54'22.94"E to 70°59'54.64"E at a scale of 1:12,500 has been carried out by FAGMIL (FCI Aravali Gypsum and Minerals India Limited) under the NMEDT exploration programme.

The Rock phosphate Block under consideration covers an area of 38.5 sq. km, located in Virbhani, Kohra & Randha, tehsil-Fatehgarh, Jaisalmer, Rajasthan, known for its favourable geological setting for rock phosphate mineralization. The region has been identified based on the General Exploration (G2) assessment of the Birmania rock phosphate block, Jaisalmer, Rajasthan, which is adjacent to the proposed block. A total 4.54 million tonnes of Net in situ resources of rock phosphate with an average grade of 10.04 %  $P_2O_5$  have been established along 1.4km strike length of Birmania, FAGMIL Notified Area. In the Nimbli Block (G3 level of exploration), which is also adjacent to the Randha Block, the Net-in-situ geological resource is 2.49 million tonnes with an average grade of 11.45%  $P_2O_5$ . Therefore, the aim of the reconnaissance survey in Randha Block is to check the continuity of the rock phosphate bed in the SE part of the Birmania and Nimbli Block and map the rock phosphate mineralized zone.

The block area is mostly occupied by rocks of the Birmania and Randha Formation, which are unconformably underlain by rocks of the Malani igneous suite. In the southeastern part of the block area, rhyolite and granitic rocks of the Malani igneous suite are present. Furthermore, to the northeast, the ridge of ferruginous sandstone with an alternating shale band of the Randha Formation is present. The rocks of the Birmania Formation occupy the north and north-eastern part of the block.



## Geological Report of Rock-Phosphate in Randha Block

The proposal for the reconnaissance survey of the Randha Rock phosphate Block was approved in 36<sup>th</sup> EC meeting, held on 29<sup>th</sup> July, 2024 with an approved amount of 1,37,44,269/-. The sanction order was issued on September 13, 2024, with a 12-month timeline.

The reconnaissance survey work includes geological mapping of the area at a 1:12,500 scale, topographic survey, bedrock sampling, pitting/trenching, borehole drilling, and finally, resource estimation according to the UNFC standard. During this reconnaissance survey, a total of 186 BRS and Trench samples, 100 core samples, 7 petrological, and 286 XRF samples were collected. 2 boreholes of a total of 100m were drilled to check the subsurface continuity of the rock phosphate bed encountered in the adjoining Birmania and Nimbli block. The XRF analyses of the bedrock samples show negligible or no phosphatic content (<1%), while in the trench sample the max.  $P_2O_5\%$  reaches to **1.67%**. In the core sample, the  $P_2O_5$  content reaches **1.68%**. No prominent rock phosphate bed developed in the block area, the phosphate-bearing sandstone and limestone show  $>1\% P_2O_5$ . It can be concluded that the rock phosphate bed that is present in the adjoining Birmania and Nimbli Block is not continued in the southern part further in the Randha Block. Only rock phosphate lenses of a few cm are present within the limestone, and the sandstone and shale are slightly phosphatic in nature. Therefore, this region is not recommended for further exploration.

## CHAPTER-II

### 2 INTRODUCTION

Rock phosphates, or phosphorites, are sedimentary phosphatic deposits composed of fine-grained mixtures of various calcium phosphates—most notably hydroxylapatite, carbonateapatite, fluorapatite, and their solid solutions. Globally, most phosphate production comes from rock phosphate deposits that contain one or more phosphatic minerals, typically calcium phosphate, in adequate purity and quantity to allow their direct use or processing for the manufacture of commercial products.

The primary use of rock phosphate extracted worldwide is mainly for manufacturing phosphate fertilizers. It is also utilized in animal feed supplements. Elemental phosphorus and phosphoric chemicals produced from rock phosphate have a wide range of applications, including in detergents, insecticides, pharmaceuticals, soft drinks, toothpaste, glass, photographic films, matches, fireworks, military smoke screens, and incendiary devices

According to NMI data based on the UNFC system (as of April 1, 2020), the total reserves/resources of rock phosphate stand at **311.25 million tonnes**. Of this, only **30.87 million tonnes** fall under the *reserves* category, while **280.38 million tonnes** are classified as *Remaining Resources*. In terms of distribution, **34%** of the total reserves/resources are located in **Jharkhand**, **30%** in **Rajasthan**, **19%** in **Madhya Pradesh**, and **8% each** in **Uttar Pradesh** and **Uttarakhand**. Small quantities are also found in **Gujarat** and **Meghalaya**. However, the production of rock Phosphate is mainly from two states, namely, Rajasthan and Madhya Pradesh. Rock phosphate deposits in Rajasthan occur in various lithological formations varying in age from Precambrian to Tertiary, falling in districts Udaipur, Banswara, Sikar, Jaisalmer, Jaipur, Alwar, and Chittorgarh.

India is deficient in Apatite & Rock Phosphate availability. In case of apatite, the country is fully dependent upon imports, while a major portion of the country's rock phosphate demand is fulfilled by importing it from countries like Jordan, Egypt, Morocco, etc. To bridge the gap between demand and

production, the Government of India has taken several initiatives in rock phosphate exploration. Keeping this in view, FAGMIL has taken up this rock phosphate block for the G4 level of exploration.

## **2.1 PROJECT DETAILS**

FCI Aravali Gypsum and Minerals India Limited (FAGMIL), after conducting a literature survey of the Birmania Basin and based on its past exploration activities in the Birmania area, proposed the Randha rock phosphate block to NMEDT at the 65th TCC meeting, held on 28<sup>th</sup> and 30<sup>th</sup>-3<sup>rd</sup> May 2024. The TCC recommended the proposal for consideration by the Executive Committee (EC). Subsequently, in the 36th EC meeting on 29 July 2024, the block was approved for G4-level exploration with a stipulated completion timeline of 12 months.

TCC recommended geological mapping of a 38.5 sq. km area at 1:12,500 scale, bedrock sampling, and pitting/trenching in phase I. After reviewing the chemical analyses data of the bedrock and pit/trench samples, the drilling activity was kept for Phase-II. The first review meeting was conducted on 27–28 February 2025, during which the TCC advised a further review after submission of complete chemical analysis data for pit/trench samples, as the initial BRS results indicated  $P_2O_5$  content of less than 2%. FAGMIL procured an XRF instrument to establish in-house laboratory facilities; however, delays occurred in obtaining analytical results. The delay was mainly due to non-delivery by the initial vendor, resulting in cancellation and re-tendering, as well as regulatory procedures such as AERB certification, installation, calibration, and validation using CRM standards to ensure data reliability.

During the 13<sup>th</sup> TCC-II meeting held on 22–24 September 2025, FAGMIL requested a 4-month extension of the project timeline, which was subsequently approved. TCC-II further approved drilling of two boreholes to verify the subsurface continuity of the rock phosphate band, similar to that observed in the adjacent Birmania Block, where surface  $P_2O_5$  values were also low or negligible. In 22<sup>nd</sup> TCC-II meeting held on 4 & 5<sup>th</sup> February 2026 a further extension till 15<sup>th</sup> of February 2026 was taken to submit the final geological report to NMEDT.

Based on the recommendation in 13<sup>th</sup> TCC-II, FAGMIL drilled two inclined boreholes of 50m each after considering the folded structure of the strata exposed in the nearby trench. One borehole was planned on the continuation of the **S3-S3'** section line of the Birmania Block, where the rock phosphate bed was encountered in 9 boreholes within a depth of **5 to 64m**. Another borehole was planned near further SE ward where phosphatic shale/sandstone sequence was encountered in the trench. The second borehole was drilled on the extended section line **S11-S11'** of Nimbli block where phosphate bed encountered in all 5 boreholes within a depth range of **15 to 25m**. However, unlike the adjacent Birmania and Nimbli block, overall, in the BRS, pit/trench and borehole sample the phosphatic content is less than 2%. Therefore, a reserve is not estimated for this block.

## **2.2 INVESTIGATING AGENCY**

FCI Aravalli Gypsum and Minerals India Limited (FAGMIL), operating under the Department of Fertilizers, Ministry of Chemicals and Fertilizers, has been notified to undertake prospecting and exploration activities under the second provision to sub-section (1) of Section 4 of the MMDR Act, 1957, as per the Ministry of Mines Gazette Notification No. S.O. 208(E) dated 12 January 2023. As a Notified Exploration Agency (NEA), the organization is eligible to receive funding from the National Mineral Exploration and Development Trust (NMEDT) in accordance with the provisions of sub-section (5) of Section 9C of the Act.

## **2.3 OBJECTIVES OF INVESTIGATION**

- Preparation of Geological map at 1:12,500 Scale of the 38.5 sq. km. area.
- Topographic survey of the block area and prepare a contour map at a 5m interval.
- Delineate the rock phosphate ore body by lithological mapping and sampling from the outcrops and trenches/pits, and establish its subsurface continuity by analyzing the bore hole data.
- Estimation of resources as per UNFC norms and prepare blocks with accordance Minerals (Evidence of Mineral Contents) Rules 2015 and Minerals (Evidence of Mineral Contents) Amendment Rules 2021.

- To evaluate option to upgrade the block into G-3 and facilitate the Central govt. for auctioning of the block.

## 2.4 BASIS FOR TAKING UP THE INVESTIGATION

GSI carried out a preliminary assessment of the Birmania rock phosphate deposit, Jaisalmer district, Rajasthan in 1966. Birmania rock phosphate deposit which is exposed over a strike length of 4km and width 500m was divided into three major blocks based on the geological structures and change in character of rock phosphate i.e., into (a) Birmania, (b) Kohra and (c) Ladu Singh. Geological mapping on 1:500 scale, trenching and sampling. In all 63 trenches were dug in Birmania area, out of which 17 trenches are falling in Kohra block and based on trenches probable resource of **0.553 MT** with average grade of **8.26%  $P_2O_5$**  were estimated with recommendation of 30 no of boreholes with 1600m drilling.

Further, in FS: 1968-70, GSI carried out exploratory drilling for Rock phosphate at Birmania deposit area on recommendation of 1966 exploration, Birmania block was selected for exploratory drilling owing to strike persistence of rock phosphate over a strike length 2.2 km. A total 2053.89m of drilling was carried out in 68 no of boreholes and rock phosphate was intersected in 55 no of boreholes at depths varying from 1.5 to 40.0 m. Resources were estimated at a 10%  $P_2O_5$  cut-off and a minimum width of 1.5m, and established at 3.49 MT with an average grade of **12.91%**.

In 2022, MECL carried out the techno-commercial evaluation of the FAGMIL notified Birmania Rock phosphate Block. In this G2 level exploration, a total of 4.63 million tons of resource of rock phosphate in both Birmania and Ladu Singh Sector was established with average grades of 10.04% and 6.15% respectively.

Based on this available data, FAGMIL proposed this block, which is located in the southeastern part of the Birmania Block. The block was proposed to establish the lateral and vertical continuity of the Birmania Rock phosphate deposit.

## 2.5 DETAILS AND NATURE, AND QUANTUM OF WORK PROPOSED VS ACHIEVEMENT

<b>Quantum of Work proposed vs. achieved for Reconnaissance Survey of Rock phosphate, Randha Block, District: Jaisalmer, Rajasthan</b>				
<b>Sl. No.</b>	<b>Item of Work</b>	<b>Unit</b>	<b>Quantum of work - Proposed</b>	<b>Quantum of work - Achieved</b>
1.	<b>Geological Mapping</b> (1:12,500 Scale)	Sq. km	38.5	38.5
2.	<b>Survey work</b>	Sq. km	38.5	38.5
	DGPS survey			
3.	<b>Exploratory Mining</b>			
	Excavation (Trenching)	Cu. m.	200	300
4.	<b>Laboratory Studies</b>			
	<b>A. Surface samples (Bedrock sampling/channel sampling)</b>			
	i) Chemical Analysis; Primary for 5 radicals i.e., P <sub>2</sub> O <sub>5</sub> , SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> and LOI	Nos.	200	186
	iii) External Check sample (10 %of Primary samples) for analysis of 5 radicals i.e., P <sub>2</sub> O <sub>5</sub> , SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> , and LOI	Nos.	20	5
	<b>C. BH core samples</b>			
	i) Chemical Analysis; Primary for 5 radicals i.e., P <sub>2</sub> O <sub>5</sub> , SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> and LOI		100	100 (2 BHs as recommended by TCC-II)
	External Check sample (10 %of Primary samples) for analysis of 5 radicals i.e., P <sub>2</sub> O <sub>5</sub> , SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> , and LOI	Nos.	10	16
5.	<b>Physical Studies</b>			
	Petrographic Studies	Nos.	10	7 (3BRS+trench & 4 core samples)
	Mineragraphic Study	Nos.	10	7 (3BRS+trench & 4 core samples)
	Report Preparation (Digital format)	Nos.	1	1

## 2.6 DETAILS OF THE QUALIFIED PERSON(S) / EXPLORATION AGENCY

1.	Name	FCI Aravalli Gypsum and Minerals India Limited
2.	Address	2 West Patel Nagar, Circuit House Road, Ratanada, Jodhpur-342011, Rajasthan
3.	Contact no.	0291-2948276
4.	E-mail Id	dgm-min@fagmil.nic.in

## Geological Report of Rock-Phosphate in Randha Block

5.	Affiliation to any organization/company, if yes, specify the name of the organization or company.	A Govt. of India Enterprise; A Miniratna-I PSE Ministry of Fertilizer, Govt. of India
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### DETAILS OF QUALIFICATION AND PERSONNEL ASSOCIATED WITH VARIOUS ASPECTS OF EXPLORATION

1.	Overall supervision, decision-making	Shri Rajendra Singh Rathore (GM, Mining)
2.	Overall project co-ordination,	Shri Ankush Saxena (Sr. Manager, Mining)
3.	Proposal Preparation team	Dr. Nafisa Begum (HQ Head Geologist) Ms. Priyansha Parihar (Asst. Geologist) Shri Ravi Chouhan (Asst. Geologist)
4.	Project management & Field Operation	Shri Jasraj Gehlot (Head) Dr. Nafisa Begum (HQ Head Geologist) Shri Saransh Srivastav (Field Geologist)
5.	Sampling	Shri Kamal Baswal (Sampler)
6.	Chemical Laboratory, FAGMIL	Shri K.K Bohra (Senior Chemist) Ms. Shalini Ambashta (Asst. Chemist)
7.	Petrological Laboratory, FAGMIL	Shri K.K Bohra (Senior Chemist) Ms. Shalini Ambashta (Asst. Chemist)
8.	Survey & Drawing	Shri P. Leela Kumar (Surveyor) Shri Dinesh Chandra Solanki (Asst. Manager Mechanical)
9.	Data Processing & Documentation	Shri Mukesh Baletia (IT) Shri Harshit Kachawaha (IT)
10.	Reprography & Printing	Shri Shoaib Khan (MIS)

### 2.7 MODE OF OPERATION OF DIFFERENT WORK COMPONENTS AND ASSOCIATED AGENCY

The entire reconnaissance survey work of the Randha Rock phosphate Block was carried out by FAGMIL. Any part of the work is not outsourced.

## CHAPTER-III

### 3 BLOCK DESCRIPTION

The Randha Block area is part of the Survey of India Toposheet No.40 J 16 and 40 J 15. It covers an area of 38.5 sq. km in and around villages - Virbhani, Kohra, Randha, and Barsingha of the district: Jaisalmer, state: Rajasthan (*Figure 1*). The coordinates (dd:mm:ss.ss) of the corner points of the block area are given in *Table 1*.

*Table 1. Cardinal points of the Randha Rock phosphate Block, Jaisalmer, Rajasthan*

Block Cardinal Points	dd:mm:ss.ss	
	Latitude	Longitude
A	26°11'42.70" N	70°54'22.94"E
B	26°16'11.52"N	70°58'8.29"E
C	26°14'59.04"N	70°59'54.64"E
D	26°10'29.62"N	70°56'8.81"E



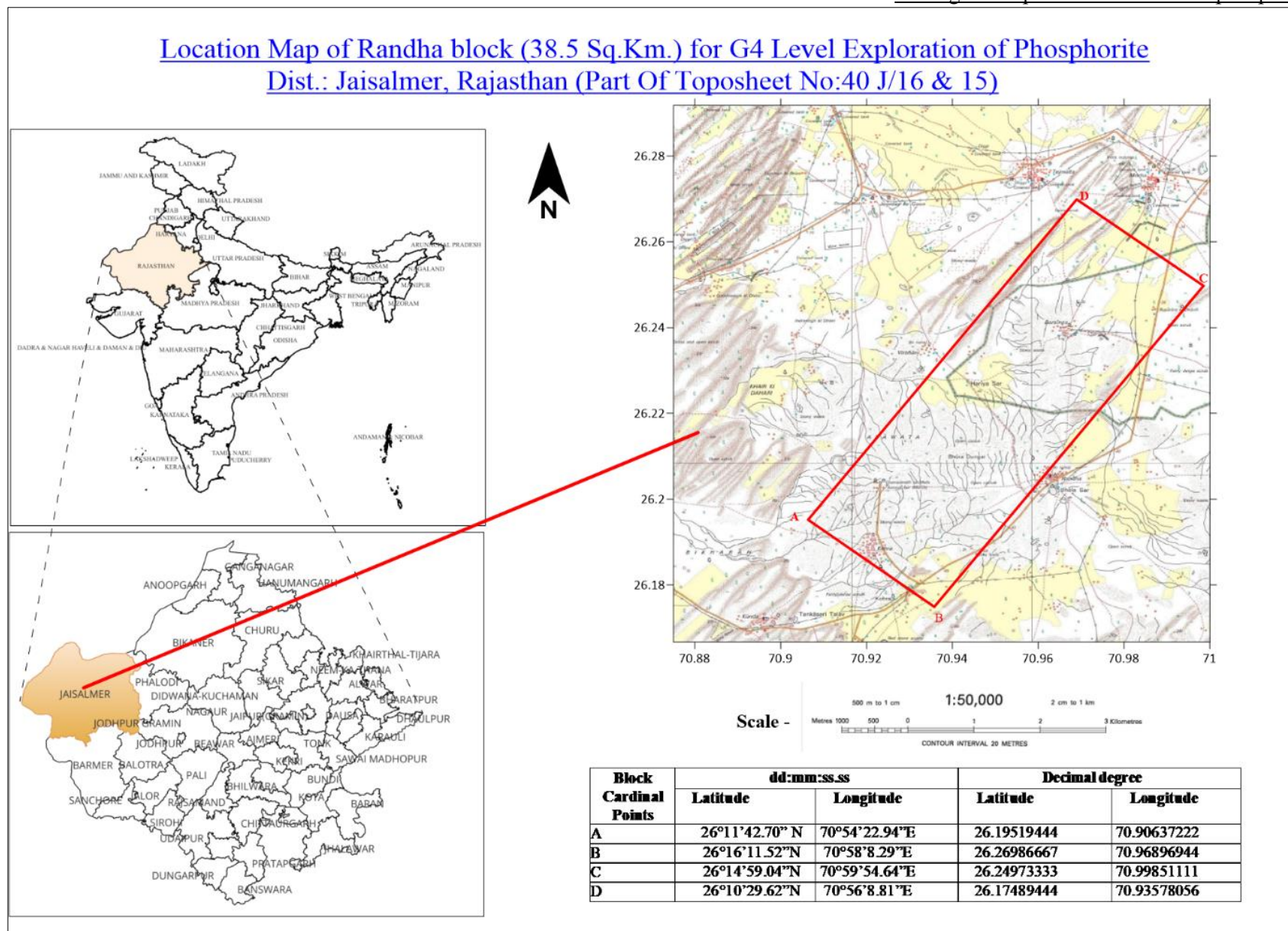


Figure 1. Location map of Randha Rock phosphate Block, Jaisalmer, Rajasthan.

### 3.1 LOCATION AND ACCESSIBILITY

The proposed block is located about 120 km north of Jaisalmer via Fatehgarh on the Jaisalmer-Barmer Road. The deposit is also approachable from Barmer, lying in the southeast via Sheo (village) at a distance of around 112 km. The area is well connected by motorable/ metaled roads.

The nearest railway station is Barmer Railway Station (112 Km.) and Jaisalmer Railway Station (120 Km). The nearest airport is Jaisalmer, around 120 km north of the block.



*Figure 2. Randha Block near Randha village, tehsil-Fatehgarh, Jaisalmer, Rajasthan.*

### 3.2 PHYSIOGRAPHY

The general surface level of the block area is around 260 meters above sea level with overall flat topography. An east-west trending ridge is present at the SW part of the block with a maximum elevation of 365m at places. Most of the area is sand-covered.

The general drainage is towards the south and south-west, but constantly shifting sand dunes change the direction frequently. Localized ephemeral streams and water courses are present in the area, apart from local streams. Regionally area is drained by the Luni River which flows from Samdari, passes through Balotra. The Luni River is also ephemeral, flowing only in response to heavy precipitation. In the year of drought there is no runoff.

The area exhibits typical features of the desert climate. Mean Maximum Temperatures reaching up to 49°C common during the summer while Mean Minimum temperatures as low as 10°C prevail during the winter. The diurnal changes in temperature are high, being of the order of 10°C. On one hand hot and dusty high winds blow continuously over the region during summer while extreme cold characterizes the winter. The area receives a rainfall of 10 cm to 13 cm a year, mainly during the months of July and August. But this is also uncertain. The precipitation is generally torrential, often accompanied by hail, and the run-off is considerably more than the seepage. A very noticeable feature during the monsoons is that heavy rain clouds pass continuously over this region at very low altitude without bursting.

### **3.3 FLORA & FAUNA**

Natural fauna and flora are scarce, the former consisting mostly of small reptiles, rodents, and insects. The vegetation is very sparse, consisting mostly of xerophytic shrubs and grass. Trees are very uncommon and are seen only near water wells and in old stream courses marked by alluvium. The main crop of the area is Millet and Jeera, entirely dependent on rainfall. There is no lift-irrigation in this region.

The proposed block is located about 120 km north from Jaisalmer via Fatehgarh on the Jaisalmer-Barmer Road. The deposit is also approachable from Barmer lying in the south east via Sheo (village) at a distance of around 112 kms. The area is well connected by motorable/ metaled roads. The nearest railway station is Barmer Railway Station (112 Kms.), Jaisalmer Railway Station (120 Km). Nearest airport is Jaisalmer and around 120 km north from the block.

### **3.4 POPULATION (LOCAL TRIBES), HUMAN SETTLEMENTS IN AND AROUND THE AREA**

Three villages -Randha, Kohra and Barsingha, are falling within the proposed block. In Randha, a total of 247 families is residing with a population of 1401 of which 769 are males while 632 are females as per Population Census 2011. The average Sex Ratio of Randha village is 822, which is lower than the

Rajasthan state average of 928. Child Sex Ratio for the Randha as per census is 919, higher than Rajasthan average of 888. In 2011, literacy rate of Randha village was 62.06 % compared to 66.11 % of Rajasthan with male literacy of 77.71 % while female literacy rate was 42.58 %. In Kohra village 228 families were residing with total population of 1394 (761- males and 633 -females) as per Population Census 2011. In Kohra village population of children with age 0-6 is 320 which makes up 22.96 % of total population of village. Average Sex Ratio of Kohra village is 832 which is lower than Rajasthan state average of 928. Child Sex Ratio for the Kohra as per census is 768, lower than Rajasthan average of 888. Kohra village has lower literacy rate compared to Rajasthan. In 2011, literacy rate of Kohra village was 59.22 % compared to 66.11 % of Rajasthan. In Kohra Male literacy stands at 73.79 % while female literacy rate was 42.11 %.

#### **4 PREVIOUS WORK**

Geological Survey of India (GSI) – W.T. Blanford (1877) and C.A. Hacket (1881 & 1887) were the first stalwarts who studied this region, followed by R.D. Oldham (1866 & 1893), T.D. La Touche (1911), A.M. Heron (1932), and Swaminathan (1960-62). A.M. Heron and E.W. Pascoe provide a general account of the geology. Narayanan, J.S. Mishra, V.S. Depura, B.P. Srivastava, and S. Srinivasan of the Oil and Natural Gas Commission carried out detailed geological mapping between 1959 and 1962.

FS: 1965-66, GSI FS: 1965-66, GSI carried out test Geophysical surveys (Electromagnetic, Radiometric and Electrical Resistivity) in the Birmania area, Jaisalmer district, Rajasthan for assessing the utility of these methods in locating rock phosphate deposits. Test surveys carried out over rock phosphate deposit did not show any characteristic anomaly. Also, no reliable depth estimates to the bedrock can be made by the study due to conductive nature of the saline bed.

FS: 1966, GSI carried out Geology and Preliminary assessment of the Birmania rock phosphate deposit, Jaisalmer district, Rajasthan. Birmania rock phosphate deposit which is exposed over a strike



length of 4km and width 500m was divided into three major blocks based on the geological structures and change in character of rock phosphate i.e., into (a) Birmania, (b) Kohra and (c) Ladu Singh. Geological mapping on 1:500 scale, trenching and sampling. In all 63 trenches were dug in Birmania area, out of which 17 trenches are in Kohra block and based on trenches a probable resource of 0.553 million tonnes with average grade of 8.26%  $P_2O_5$  were estimated in Kohra block with recommendation of 30 no of boreholes with 1600m drilling. FS: 1968-70, GSI carried out Exploratory drilling for Rock phosphate at Birmania, under Shri G.P. Deshmukh. Birmania block was selected for exploratory drilling owing to strike persistence of rock phosphate over a strike length 2.2 km. A total 2053.89m of drilling was carried out in 68 no of boreholes and rock phosphate was intersected in 55 no of boreholes at depths varying from 1.5 to 40.0 m. Resources were estimated at 10%  $P_2O_5$  cut-off and minimum width of 1.5m and established 3.49million tonnes resources with average grade 12.91%. Ore beneficiation studies were carried out at Indian Bureau of Mines (IBM) during the same year and IBM opined that both “Air and Flotation type test found that the ore is not amenable for beneficiation on account of high percentage of lime and intimate association with amorphous collophane (phosphate mineral). It also observed that sample does not produce any concentration due to uniform distribution of phosphate from coarse to fine.

In the year 2022, FAGMIL has carried out G-2 level exploration in Notified Mining Lease area (about 4 sq.km) through MECL which is part of Birmania rock phosphate deposit. A total of 3752.00m of drilling was carried out in 69 boreholes, and rock phosphate was intersected in 34 boreholes at depths varying from 0.5 to 64.0m, with an average thickness of 5.733 at 5% cut-off. A total 4.54 million tonnes of Net in-situ resources of rock phosphate with average grade of 10.04 %  $P_2O_5$  have been established along 1.4km strike length of Birmania Sector (1.78 sq. km) and 0.09 million tonnes of Net in- situ resources of rock phosphate with average grade of 6.15 %  $P_2O_5$  have been established along 0.4km strike length of Ladu Singh Sector (0.58 sq. km). A total of 4.63 million tonnes resource of rock phosphate in both Birmania and Ladu Singh Sector.

## CHAPTER-IV

### 5 GEOLOGY

#### 5.1 REGIONAL GEOLOGY

Regionally, the area falls in the Barmer-Sanchor sub-basin. Pokhran high separates the Bikaner-Nagaur sub-basin from the Jaisalmer sub-basin. The Devikot-Nachna uplift separated the Jaisalmer sub-basin from the Barmer-Sanchor sub-basin. The tectonic evolution of the Rajasthan Basin took place in four distinct phases corresponding to Precambrian - Triassic plate movement, breaking of the Indian plate from the southern continent during the Jurassic, Collision of the Indian plate with the Asian plate from the Eocene onwards, and Uplift of the Sind-Baluchistan fold belt, resulting in filling up of the Indus shelf. Three major lineament trends, along ~ NE-SW (Aravallis) direction, ~ ENE-WSW or EW direction, and ~ NW-SE (Dharwarian) direction. The NE-SW trending lineament (Aravallis), being the oldest, is offset by late sub-latitudinal lineaments. Both NE-SW and ENE-WSW or E-W trends are affected by the younger NW-SE Dharwarian lineament, which resulted in the formation of Barmer-Sanchor Sub-basin (*Figure 3*). The Generalized stratigraphy of the Barmer-Sanchor sub-basin is presented in *Table 2*.

*Table 2. Generalized Stratigraphy of Barmer-Sanchor sub-basin (After DGH, India)*

Age	Formation	Lithology	Max Thickness
Quaternary	Shumars	Laterised Ferruginous sandstones	660m
Unconformity			
Eocene	Bandha Khuiala	Chalky limestone, fossiliferous limestone, and siltstone Gypseous shales and marls, fossiliferous hard limestone	470 m
Unconformity			
Palaeocene	Sanu	Sandstone	200 m
Unconformity			
Cretaceous	Parh Goru/abur	Sandstone Araneceous limestone, fragmental and fossiliferous limestone, and quartzitic sandstone	1000 m
	Parihar	Feldspathic sandstones with occasional hard calcareous grits and ferruginous sandstone	

Unconformity			
Jurassic	Bedesar	Hard ferruginous and calcareous grits with intercalary sandstone	2000 m
	Baisakhi	Soft shales, sandy shales, silts, sandstone and quartzitic sandstone	
	Jaisalmer Lathi	Conchoidal limestone and sandstones, grits, and shales	
Unconformity			
Triassic	Shumarwali	Sandstone	700 m
Unconformity			
Permian	Karampur	Sandstone, Shale, Clay	500 m
Unconformity			
Cambrian	Birmania Randha		600 m
Unconformity			
Pre-Cambrian	Malani Igneous suite Jalore-Siwana Granite	Granites, Rhyolites, Porphyries, metamorphics	



Figure 3. Regional geological map showing different basins and sub-basins, and separations present within Rajasthan (Source: DGH)

### 5.1.1 DESCRIPTION OF FORMATIONS

**Malani Igneous Suite:** This formation comprises of granite, rhyolites, porphyries, metamorphics and Jalore-Siwana granite. In the district rhyolite is exposed towards east of Dangri village, which belongs

to the Malani Igneous Suite and comprises mostly glassy to porphyritic varieties varying from pink, green to black and chocolate in colour. In the porphyritic varieties phenocrysts of orthoclase are seen in a slightly devitrified glassy matrix. The granites usually contain hornblende and are intrusive in to the rhyolites. It is considered to be equivalent to the Siwana and Jalor Granites.

**Randha–Birmania sequence:** is exposed at the centre of the Thar Desert (western Rajasthan). It is the western most Precambrian sequence in India, with very limited exposures. Randha-Birmania sequence is part of Birmania basin which is oval shaped, roughly trending north–south and is considered as an isolated remnant of the Marwar Basin (Maheshwari et al. 2002,2007). Underlain by Malani suite of igneous rocks (780–680 Ma) and unconformably overlain by the Lathi Formation (Jurassic), it comprises about 900 m thick sequence of siliciclastic, carbonate and rock phosphate facies. The basin is divided into older Randha and younger Birmania formations. The Randha Formation, considered to be Ediacaran in age, is a sequence of mainly medium to coarse-grained siliciclastic rocks. The exposures occur as numerous hillocks around Randha Village, after which this formation has been named. Most workers consider that the Randha Formation unconformably overlies the Malani Igneous Suite. A faulted contact between the two units has also been suggested by Pareek (1984). The contact between Randha and Birmania formations is considered unconformable by some workers.

**The Birmania Formation** is essentially calcareous; the lower part is dominated by carbonates with some layers of thin, interbedded siltstones. The upper part consists of carbonates associated with rock phosphate. Thickness of the Birmania Formation is estimated to be about 536m. The upper boundary of this formation is unconformable with Lathi Formation (Singh 2006). The lithological association and occurrence of rock phosphate indicate towards a marine setting. Foetid limestone is characteristic of reducing and restricted depositional environment (Singh 2006). This is indicative of quiet water or shallow tidal environment of deposition.



The occurrence of the multicellular algal fossil *Wengania exquisita* in phosphatic chert of the Birmania Formation suggest that it was deposited during the Ediacaran. Detrital zircon age distributions contain prominent populations of 1.7-1.9 Ga grains, with subordinate younger grains that range from 650-980 Ma. Paul Myrow (2015, Precambrian Research).

**Lathi Formation:** The Lathi beds are well exposed at the base of the ENE-WSW trending ridge, 8 km south of Fatehgarh. At places, sandstone is arenitic and haematite occurs as pellet. A middle Jurassic age has been assigned to this formation on the basis of leaf impressions of *Ptylophyllum* and fossil wood.

**Jaisalmer Formation:** The Jaisalmer Formation comprising yellowish to buff coloured highly fossiliferous limestone conformably overlies the Lathi Formation. A well-defined contact between the two is seen 1.6 km N45°W of Rividi. Abundant fossils of Rhynchonellids, Terebratulids, Trigonina, Pecten, Natica, Nautilus and a host of others have been obtained from this formation. On the basis of the fossils an upper Jurassic age has been assigned to this formation.

**Baisakhi Formation:** This formation of late Jurassic age and consists of four lithostratigraphic members. The rocks are exposed along an arc, approximately 8–10 km wide, stretching from the Kanoi Fault in the southwest to the area northeast of Kanod.

**Bhadesar Formation**, overlies the Baisakhi Formation, and is represented by fossiliferous limestone followed by ferruginous sandstone with thin intercalation of clay beds, and is of Tithonian to possible Lower Cretaceous age. Bhadesar Formation is overlain by Parihar, Gor/Abur and Parh formation.

**Parihar, Gor/Abur and Parh formation** are represented by feldspathic sandstone with occasional grit and ferruginous sandstone to arenaceous limestone and quartzitic sandstone.

**Sanu formation** overlies Par, Gor/abur, Parihar Formation which consists of unconsolidated highly current bedded reddish glauconitic sandstone and silty sandstone Sanu formation is overlain by Khuiala and Bandha formation.

**Khuiala and Bandha Formation:** This formation represents regression of sea but the upper part of Sanu and subsequent Khuiala and bandha formation represent third marine transgression. This forms the closure of sedimentary cycle in Jaisalmer basin.

Most of the area in this region is covered with Quaternary aeolian sand. A regional map around the block area with rocks of different formations is provided in *Figure 4*.

### **5.1.2 REGIONAL STRUCTURE OF THE BLOCK**

In Randha block area the rocks of Birmania formation are highly folded and thrown into asymmetric doubly plunging longitudinal apex folding. The phosphate-bearing area was further divided into three major blocks, considering geological structures and change in the nature of rock phosphate, i.e., Birmania, (ii) Ladu Singh, and (iii) Kohra.

Birmania block is having two doubly plunging anticline and two doubly plunging syncline where as in Ladu Singh block there is doubly plunging anticline and in Kohra block there is one anticline and one syncline. These anticlines and synclinal folds, which are plunging northwards or southwards, are connected by smaller folds that are clearly observed in the field.

North East – South West is the general trend of the rock phosphate beds. The strike length of the folds exceeds the width of the longitudinal part of the folds. Strike length of the Birmania block is about 4 km, while the width is approximately 100m. Maximum longitudinal dimensions are seen in Birmania block, while these decrease in Ladu Singh and Kohra blocks. Dip of the beds varies between 35° to 80° with rolling dips towards eastwards and westwards. Axial plane of the folds is nearly vertical.

Most of the area is covered by sand and data cannot be measured due to intense folding in the region, however strike slip and oblique faults as displacement of beds is present near axial plane and near apex of folding, numerous minor folds are observed with frequent breaks.

The complex folding, accompanied by doubly plunging minor folds, makes it difficult to measure the exact thickness. The most conspicuous feature of the area is the quartzitic sandstone-rock phosphate

sequence, which can be used as a marker horizon for establishing the structures and stratigraphic succession. The members show facies change when traced along and across the strike. This is best exemplified by the rock phosphate horizon. In the southern part of the Kohra block the phosphatic limestone is immediately overlying the quartzitic sandstone. When traced northwards, the phosphatic limestone becomes thinner and is absent for a strike length of about 400 metres, where cherty limestone lies directly on the quartzitic sandstone. Traced northwards from this point the rock phosphate changes over to a sandy shale with chert, which is the most common rock type in the Birmania block. In the Ladu Singh block, this variation is very rapid and occurs over short distances.

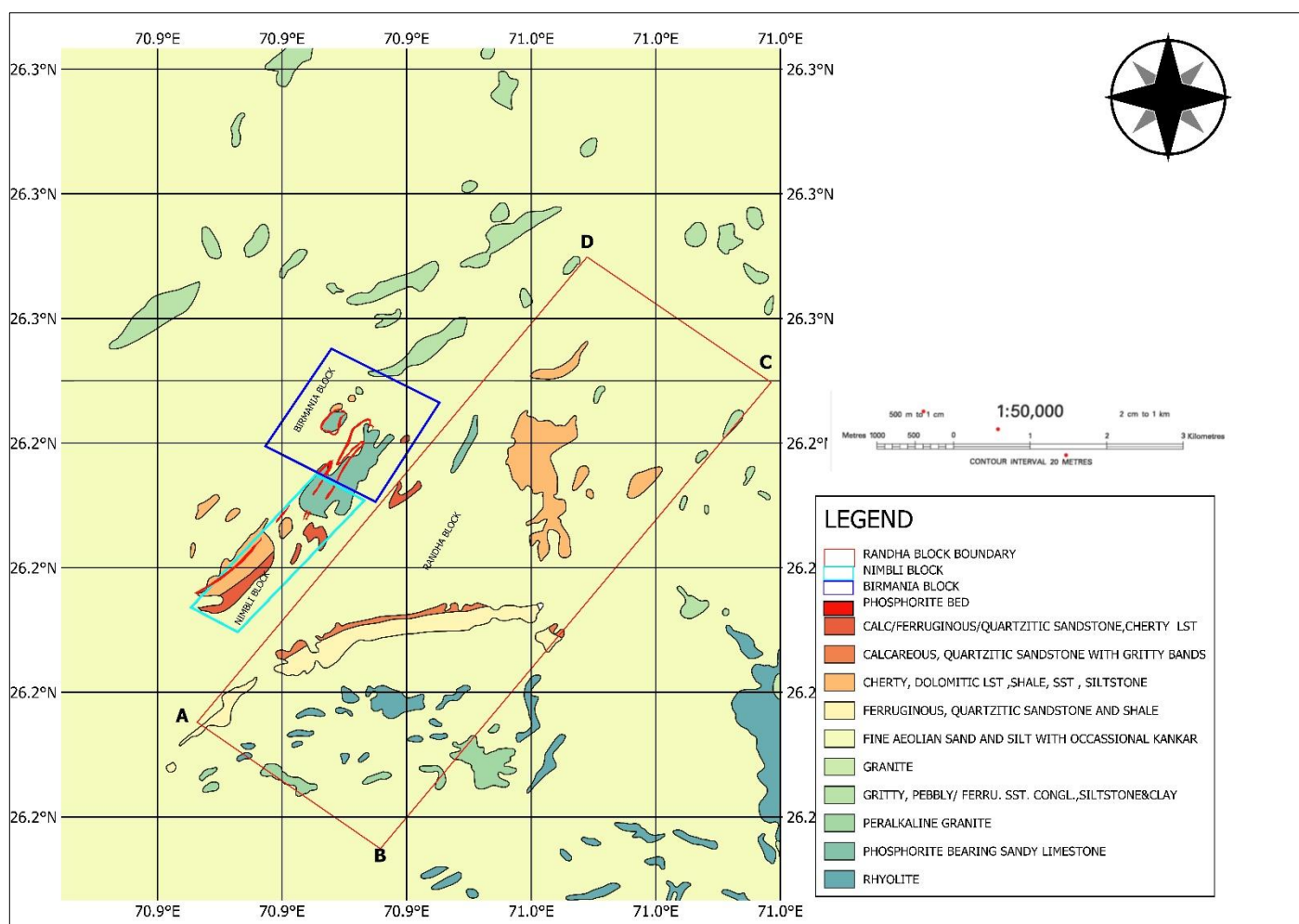


Figure 4. Regional geological map of the Birmania-Randha rock phosphate bearing area, Tehsil-Fatehgarh, Jaisalmer, Rajasthan. (After GSI) (Plate-I)

## 5.2 GEOLOGY OF BLOCK

The Randha rock phosphate block is present within the oval-shaped Birmania Basin located in Thar desert of western Rajasthan, India. It is underlain by Malani Igneous Suite of rocks which belong to precambrian (After DGH). The Birmania Basin comprises around 900-metre-thick sedimentary sequence of siliciclastic, carbonate, and rock phosphate facies. The geological map of the block area with the dip and strike of the lithounits along with contour lines at 5m intervals, is presented in *Figure 6*.

The rhyolite and granites of the Malani Igneous Suite are present in the southern part of the block. The rocks of the Randha Formation are unconformably overlying the pinkish rhyolite of the Malani Igneous Suite. At the south-western boundary of the block area, the contact between the Malani Suite and Randha Formation is present in the nullah section (*Figure 5*).



*Figure 5. Contact between the pinkish rhyolite of the Malani Igneous Suite and the Randha Formation near the southern part of Kohra village.*



## Geological Report of Randha Rock phosphate Block

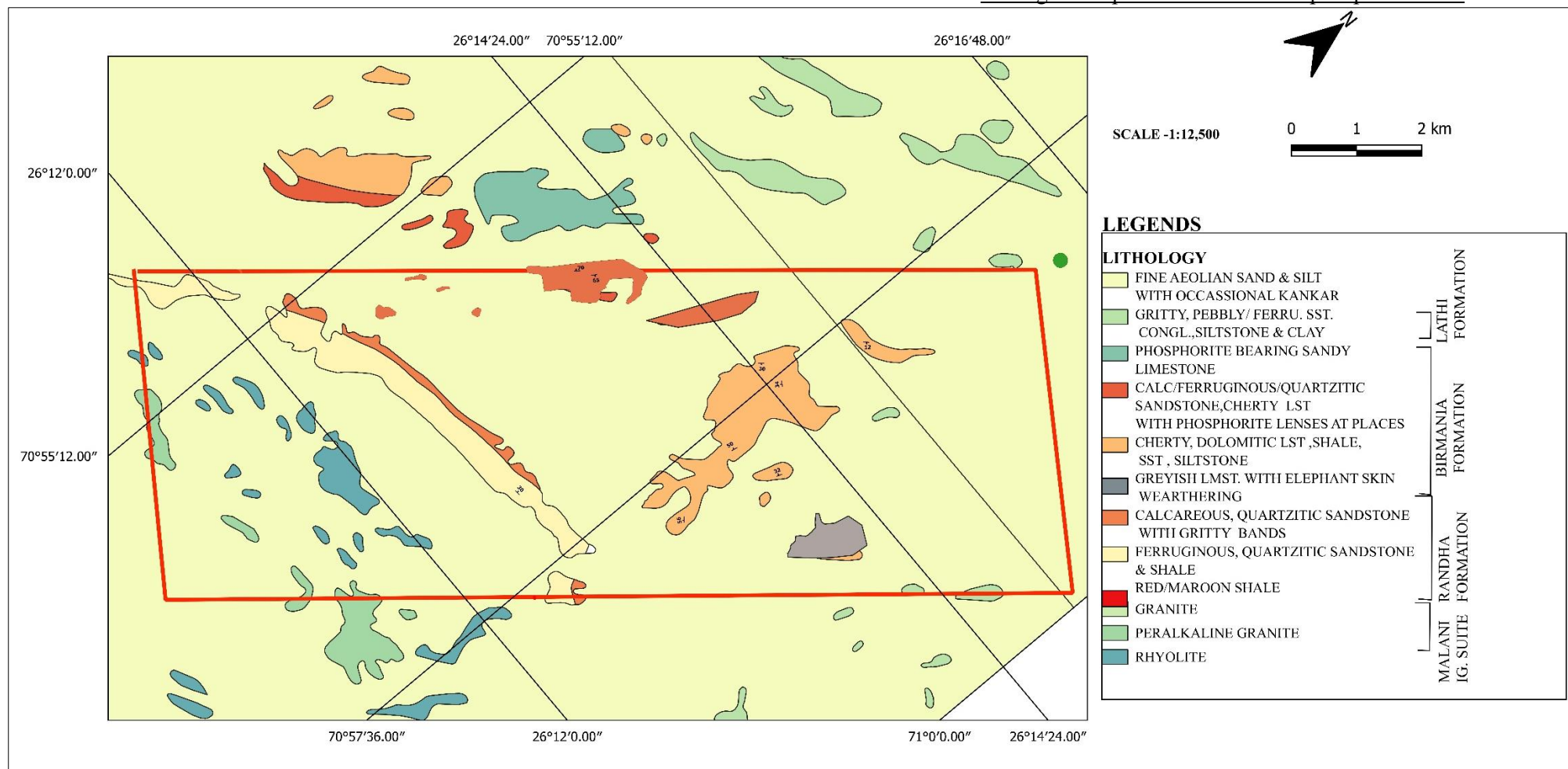


Figure 6. Geological map of Randha Rock phosphate Block, Jaisalmer, Rajasthan (Plate-II).

In the middle part of the block, almost E-W trending, the rocks of the Randha Formation are present as a ridge. Ferruginous, quartzitic sandstone with alternate shale occurring at the Randha ridge. A small exposure of reddish to maroon shale is present near the Randha village, indicating the base of the Randha Formation. Further north of the Randha ridge, the rocks of the Birmania Formation are exposed. However, the contact between the Birmania and Randha Formation is not exposed within the block area. It is covered under the alluvium. The rocks of the Birmania Formation are highly folded. The stratigraphic sequence present within the block area is provided below.

*Table 3. Generalized stratigraphic sequence of the Randha rock phosphate block area (After GSI)*

Age	Formation	Lithology	Max Thickness (m)
Cambrian	Birmania	Dolomitic limestone, cherty limestone, shale, siltstone and sandstone	>90
		Shale white brown to variegated, arenaceous to carbonaceous with siltstone and sandstone bands	60
		Rock phosphate Quartzite sandstone	Less than 1m to over 9m
		Buff colour fine grained, calcareous sandstone, dark brown calcareous and ferruginous sandstone	1-4m
		Greyish yellow or cherty grey limestone	50-270m
Unconformity			
	Randa	Sandstones and subordinate cancerous rocks and shales	>80m
		Red to Maroon Shale	
Unconformity			
Pre-Cambrian	Malani Igneous suite Jalore-Siwana Granite	Granites, Rhyolites, Porphyries, Metamorphics	

**Structure:** The rocks of the Randha Formation are trending almost E-W to ENE-WSW, and the dip varies from 20 to 30° N. The rocks of the Birmania Formation are highly folded. A broad plunging anticline and syncline are present within the block area. Further, the limbs of the anticline and syncline fold are folded. Near the eastern boundary of the block, a broad anticline is present, plunging northerly.

Near the Barsigha village, the beds are dipping towards each other and forming a southerly plunging synclinal fold. The limbs of the synclinal fold are folded to an asymmetric to an overturned fold (*Figure 7.A&B*). In places, the ferruginous cherty limestone bands are folded, forming an isoclinal fold. Minor faults can be observed in core samples.



Figure 7. A. The alternate bands of ferruginous sandstone and cherty limestone are showing asymmetric to overturned fold near Barsingha village.

B. Folded limbs. The ferruginous cherty limestone bands show isoclinal folding.

### 5.2.1 ROCK FORMATIONS:

**Cherty limestone:** The cherty limestone forms the oldest rock member in the area mapped and is exposed in the southwestern part of the block. It is greyish-yellow or grey in colour, hard, feebly jointed and thick bedded (upto 1m) rock, breaking with a sub-conchoidal fracture. It is crystalline to micro-crystalline and mainly composed of calcite, dolomite, and chert, the last making about 20 % of the rock. Thin calcite, veins of secondary origin are also seen traversing the rock at places.

**Ferruginous and calcareous sandstone:** The ferruginous sandstone is a medium-grained dark chocolate-brown coloured, usually thinly bedded rock which shows inter-calatory beds, upto 1 metre thick, of a lighter colour non-ferruginous calcareous sandstone. Bedding cleavage is well developed in the fine-grained variety. It is also slightly calcareous. Calcareous sandstone is generally fine to medium



grained, thick bedded, buff coloured rock which shows good bedding and cross bedding at places. It is mainly composed of rounded to subrounded or sub angular grain of quartz with some calcite. The calcite makes up to 30 to 35 % of the rock. The very fine-grained ferruginous sandstone shows Liesegang structures, where concentric rings of maroon and yellowish colored bands of cement are observed (*Figure 8A&B*).



*Figure 8. A. Ferruginous sandstone with Liesegang structures. B. Ferruginous sandstone with alternate yellowish calcareous sandstone.*

**Quartzitic sandstone:** It is light grey and pale-brownish, fine to medium grained, hard, compact, well bedded, and jointed rock, showing cross-bedding at places. The lower beds at the contact with the older calcareous sandstone are fine grained. The sandstone is slightly phosphatic when tested with a Sapiro solution in the field; it yields a yellow color. The thickness of the quartzitic sandstone varies from 20 cm to about 4 m.



*Figure 9. Pale brownish to grey medium to fine-grained sandstone.*



**Rock phosphates:** No prominent rock phosphate bed is present in this block. Only rock phosphate lenses of a few centimetres are present in association with a limestone bed at places. The calcareous Quartzitic sandstone is phosphatic in nature. The greyish coloured dolomitic limestone also contains phosphate. Unlike the adjoining blocks, such as Birmania and Nimbli, no prominent rock phosphate bed is present in the Randha Block. The maximum  $P_2O_5$  content of the phosphatic sandstone and limestone reaches up to 1.6%. Therefore, this block is not prospective for the phosphate rock or rock phosphate.

**Variegated shales:** The greenish-greyish to purplish shale underlying the light grey quartzitic sandstone is present in the block. This is often interlayered with silicious limestone, fine-grained calcareous sandstone, and siltstone. In the trench section and in two boreholes, the variegated shale was encountered (*Figure 10*). In RBH-01, it is encountered below 11.5m, and in RBH-02, it is encountered below 3.6m.



*Figure 10. Greenish grey to variegated shale is present in the trench and borehole.*

**Dolomitic limestone:** The dolomitic limestone is a fine-grained, dense, hard, bluish-grey, thick-bedded rock, the individual beds being between 2 and 10 m thick. It shows typical ‘elephant skin’ weather surface (*Figure 11*). Calcareous cherty limestone overlies Dolomitic limestone at the surface. The Dolomitic limestone is often phosphatic in nature. The exposure of the dolomitic limestone is present near the Barsingha village, with NE-SW strike, and the dip varies from 12 to 70° at places. Thin veins of calcite and rarely chert of secondary origin is seen traversing the rock. Bedding is very

clearly seen in this rock.



*Figure 11. Grey dolomitic limestone with elephant skin weathering near Barsingha village (A). B & C show the Sapiro test result, indicating phosphate content.*

**Cherty limestone:** Overlying the calcareous chert is a medium to fine-grained, light buff coloured, calcareous sandstone in the proposed Randha block. These rock units are the youngest members of the Birmania Formation exposed in the mapped area. It is a dark grey coloured, soft rock, which on a weathered surface shows a whitish-grey colour.

## CHAPTER-V

### 6 ACTIVITIES UNDERTAKEN DURING THE EXPLORATION WORK

#### 6.1 TOPOGRAPHICAL SURVEY:

The topography of the block area is flat to rugged. An ENE-WSW trending ridge is present at the south-western part of the block, with the highest elevation reaching 360m. In the north-eastern part of the block, a relatively high land is present with a highest elevation of 310m. A topographical survey was conducted using DGPS, and a contour map was prepared (5m contour interval) based on the DGPS data. The contour map is presented over the geological map of the block area in (*Figure 12*).



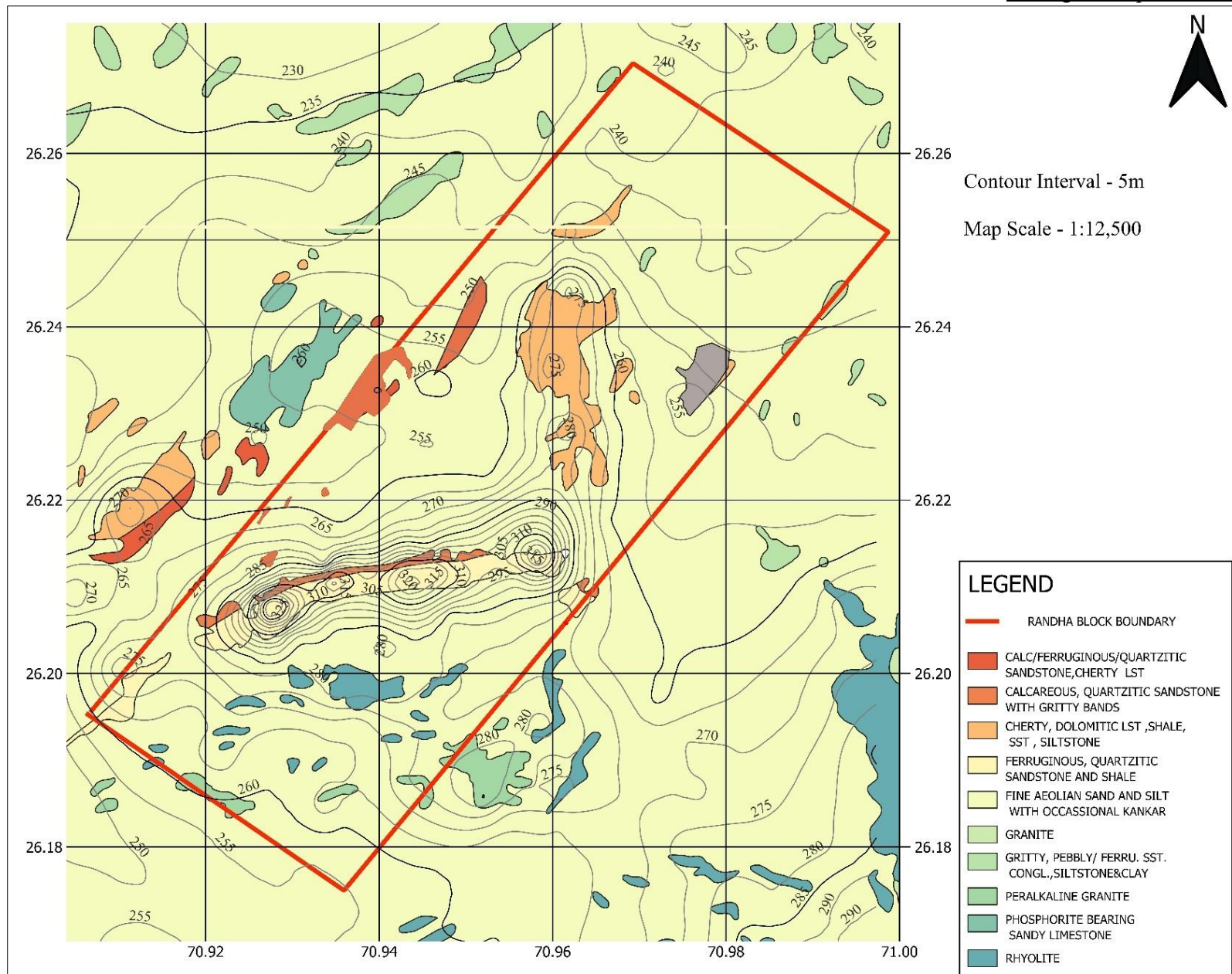


Figure 12.  
Topographic map of  
Randha Rock  
phosphate Block,  
Jaisalmer, Rajasthan  
at 5m interval (Plate-  
III).

## 6.2 GEOLOGICAL MAPPING

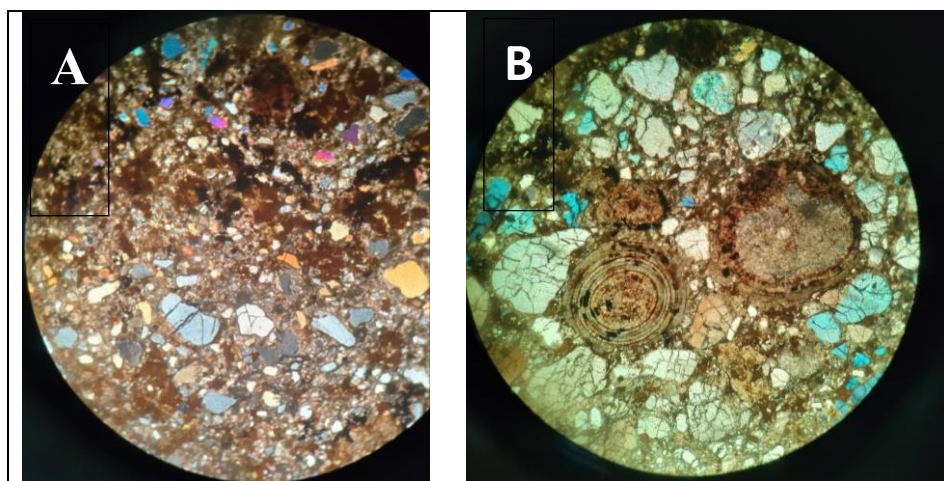
A detailed geological survey was conducted in the Randha Block, with details of the lithological boundaries, structural features, and mineralogy marked, and a 1:12,500 scale geological map was prepared (*Figure 6*). The geology of the block area, structure is described in *Section-5.2*.

A total of 286 BRS, trench, and core samples were taken for XRF analysis. The bedrock samples show a negligible amount of  $P_2O_5$ ; therefore, a larger number of trench samples (179) are taken for XRF analyses. Details of  $P_2O_5$  content and other major oxides, viz.,  $SiO_2$ ,  $Al_2O_3$ , and  $Fe_2O_3$ , are provided in **Annexure - I**.

### 6.2.1 MINERALOGY/PETROGRAPHIC STUDY

A total of 7 BRS, trench, and core samples were taken for a detailed petrographic study. Overall, quartz and calcite form the major mineral assemblage. Collophane, illite, ferruginous matter, and chlorite form the minor mineral assemblage. Tourmaline, zircon, sericite, and opaques occur as accessory minerals.

Under the microscope, the sandstone shows a clastic, granular texture. The grains are fine to medium sized and are sub-rounded to sub-angular in shape. The framework grains are suspended in a mixed clay–collophane–ferruginous matrix (*Figure 13.A*).

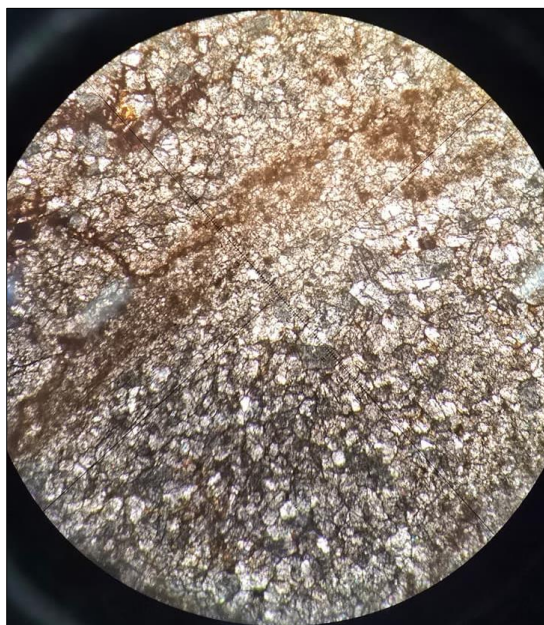


*Figure 13. A. Fine to medium-grained sandstone with sub-rounded to sub-angular quartz grains. The framework grains are floating in a mixed clay–collophane–ferruginous matrix. (Sample no. - RP/Trench–02)*

*B. Phosphatic, calcareous rock with clastic to allochemical*

*texture dominated by carbonate material. Concentric layering (ooids/oncoids) can be observed. (Sample no.- RP/Core–02). Magnification -10x.*

The light grey to brownish grey colored, very fine grained, compact, and hard limestone exhibits a **fine to very fine crystalline carbonate texture**, laminated to wavy banded predominantly composed of calcite. The calcite grains are closely packed, mostly anhedral to subhedral, forming a dense crystalline mosaic. Distinct **stromatolitic lamination** is observed, represented by alternating light and dark bands. The lighter bands are rich in microcrystalline calcite, while the darker bands contain higher concentrations of **ferruginous material, organic matter, and fine impurities**, giving a brownish appearance. These laminae are irregular, wavy, and discontinuous, typical of microbial mat-induced sedimentary structures (*Figure 14*). The details of petrographic study of 7 BRS, trench and core samples are provided in **Annexure-III**.



*Figure 14. Stromatolitic limestone with distinct stromatolitic lamination, represented by alternating light and dark bands. (Sample no. - RP/BRS-02 )*

### 6.2.2 DETAILS OF TRENCHING/PITTING, DRILLING, AND ITS DISTRIBUTION

Based on the field survey and BRS XRF analyses data a total of 28 trenches/pits were excavated in the block area. The details of trench/pit location, dimension, lithology and structure is provided in *Table 4*. BRS, Trench, and locations are provided on the map (*Figure 15*). Photographs of the trench section are provided below. Trench 20 to Trench 28 is located near the Beermani Upper Primary School and further SW of it. In those trenches, the rocks of the Birmaia Formation are highly folded; therefore, the



## Geological Report of Randha Rock phosphate Block

strike and dip vary at the trenches. Overall, the strike of the beds is NNE-SSW, and the dip amount varies from 30 to 70 degrees at places.

*Table 4. Summary of Trench/pit location, dimension, elevation, and lithology within the Randha Rock phosphate Block*

Sr No	Latitude	Longitude	Dimension (LxBxH)	Elevation (m)	Strike/Dip dip direction (°)	Lithology
1	26°12' 57.8"N	70°57' 36.6"E	3*2*2	278	278/30 NNE	Greyish to light brownish phosphatic shale with alternate bands of reddish to brownish shale.
2	26°13' 01.3"N	70°57' 22.3"E	3*2*2	286	272/32 NNW	Yellowish to creamish fine-grained sandstone overlain by dark brown cherty limestone
3	26°13' 05.9"N	70°55' 36.6"E	4*2*2	264	210/55 NW	Greyish to greenish, brownish variegated shale with alternate rock phosphate bands. A synclinal fold is observed.
4	26°12' 08.6"N	70°54' 39.5"E	5*1.5*1.5	262	220/32 NW	Whitish to creamish very fine-grained phosphatic shaley sandstone.
5	26°12' 01.9"N	70°54' 43.6"E	4*1.5*1.5	293	220/35 NW	Pale brownish sandstone with alternate shale.
6	26°12' 25.1"N	70°55' 10.1"E	3*2*1.5	275	265/32 NW	Greyish to brownish very fine-grained sandstone with laminations of rock phosphate. Liesegang rings are observed within the sandstone.
7	26°12' 29.1"N	70°55' 16.2"E	4*2*2	287	245/38 NW	Greyish to light brownish, very fine-grained, highly fractured phosphatic sandstone. A synclinal fold is observed.
8	26°12' 42.6"N	70°55' 48.3"E	5*1.5*1.5	289	250/35 NW	Whitish to creamish highly fractured phosphatic siltstone. Minor folds are present.
9	26°13' 04.4"N	70°57' 12.2"E	3*1.5*1.5	282	218/68 NW	Creamish to pinkish fine to medium-grained sandstone with very thin phosphatic bands (?) overlain by ferruginous sandstone and alternate bands of shale.
10	26°12' 55.3"N	70°57' 02.4"E	3*2*1.5	296	280/50 NW	Greyish to creamish shale with reddish to dark brown coarse-grained sandstone.
11	26°12' 25.0"N	70°57' 52.0"E	3*2*1.5	277	-	Ferruginous, very fine grained brecciated/highly fractured sandstone.

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12	26°14' 44.8"N	70°57' 58.4"E	3*3*1.5	255	10/55 NW	Greyish dolomitic limestone with alternate bands of stromatolitic limestone and shale. A major synclinal fold is observed with highly folded eastern limb.
13	26°14' 34.8"N	70°57' 28.6"E	3*2*2	270	10/25 NW	Greyish to creamish dolomitic limestone with alternate bands of stromatolitic limestone and shale. Minor folds are observed.
14	26°15' 07.0"N	70°57' 55.9"E	5*1.5*1.5	250	70/12 W	Alternate bands of variegated shale (greenish, greyish, and brownish) and sandstone.
15	26°14' 11.4"N	70°57' 43.5"E	3*1.5*1.5	274	340/56 WSW	Greyish dolomitic limestone (elephant skin weathering) phosphatic with alternate bands of pinkish and greyish shale. Tight chevron type fold is observed.
16	26°14' 09.9"N	70°58' 02.2"E	3*2*2	281	10/32 NW	Ferruginous, very fine-grained, brecciated/highly fractured sandstone. Overlain by creamish to yellowish feldspathic arenite.
17	26°13' 42.0"N	70°57' 50.3"E	5*1.5*1.5	273	10/80 NW	Large synclinal fold with dolomitic limestone at the outer core followed by ferruginous shale and stromatolitic limestone.
18	26°12' 20.3"N	70°57' 22.5"E	4*2*2	279	-	Alluvium
19	26°13'20.73" N	70°56'58.54"E	3*2*1.5	277	-	Alluvium underlain by kankar.
20	26°13'51.9"N	70°56'16.1"E	3*2*2	328	The beds are highly folded. Overall, the strike of the beds are NNE-SSW and the dip amount varies from 30 to 70 degree at places	Anticline fold of shale, phosphatic lenses, sandstone on the outer side
21	26°13'48.5" N	70°56'14.1"E	4*2*2	276		Quartzitic phosphatic sandstone and interbedded shale, with intense folding
22	26°13'51.8" N	70°56'27.0"E	5*1.5*1.5	273		Anticlinal folding, interbedded shale
23	26°13'58.9" N	70°56'22.0"E	4*2*2	272		Surface shows ripple marks, thinly laminated cherty limestone, hard and compact.
24	26°13'54.5" N	70°56'14.9"E	3*2*2	268		Sand and vegetation, below phosphatic shale
25	26°13'44.6" N	70°56'05.9"E	5*1.5*1.5	250		shale and cherty limestone
26	26°13'11.0" N	70°55'45.4"E	4*2*2	260		yellowish cherty limestone.
27	26°13'08.1" N	70°55'36.5"E	3*2*2	258		quartzitic, calcareous fine-grained sandstone, greenish to greysish to brownish-variegated shale.



28	26°13'02.9" N	70°55'34.5"E	5*1.5*1.5	262		quartzitic, calcareous fine-grained sandstone, greenish to greysish to brownish-variegated shale, with alternate limestone bed.
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### 6.3 EXPLORATORY DRILLING

After completing the XRF analyses of the BRS and Trench samples, it was observed that the  $P_2O_5$  content of the phosphatic sandstone/shale and limestone is less than 2%. The variegated shale with alternate limestone is exposed near the trenches 22,23,24,25,27, and 28, which are stratigraphically underlain by the phosphatic bed. Therefore, during the TCC-II meeting held on 22–24 September 2025, FAGMIL requested for 2 boreholes to verify the subsurface continuity of the rock phosphate band, similar to that observed in the adjacent Birmania Block, where surface  $P_2O_5$  values were also low or negligible.

Based on the recommendation in TCC-II, held in September 2025, FAGMIL initiated drilling of two inclined boreholes, each 50m in length, after considering the folded structure of the strata exposed in the nearby trench. One borehole was planned on the continuation of the S3-S3' section line of the Birmania Block, where the rock phosphate bed was encountered in 9 boreholes within a depth of **5 to 64m**. Another borehole was planned further SE, where a phosphatic shale/sandstone sequence and variegated shale were encountered in the trench. The second borehole was drilled on the extended section line **S11-S11'** of Nimbli block where phosphate bed encountered in all 5 boreholes within a depth range of **15 to 25m**. Two inclined borehole – RBH-01 and RBH-02 was drilled by FAGMIL with a total depth 100m (50m each). The borehole inclination angle and direction were decided from the adjacent trench data. The RBH-01 was drilled near Trench-20 with an inclination of 45° ENE. The RBH-02 was drilled near Trench-3 and Trench-27 with an inclination of 40°SE so that max number of different lithologies could be encountered. However, unlike the adjacent Birmania and Nimbli block, no prominent rock phosphate bed is developed in the Randha Block. Only the shale-sandstone and

limestone is slightly phosphatic in nature. The borehole cross-section in continuation of S3-S3' and S11-S11' section line of Birmania and Nimbli block, respectively, is provided in **Plate-IV**. In the borehole sample, the phosphatic content is less than 2%. Therefore, a reserve is not estimated for this block, and no further exploration work is recommended in this block. After completion of the boreholes RBH-01 and RBH-02 were plugged as per the NMEDT specifications. Details of two boreholes are tabulated below. Detailed lithology of the two boreholes, along with BRS and Trench lithology, is provided in **Annexure II**.

*Table 5. Details of Boreholes in Randha Rock phosphate Block, drilled by FAGMIL.*

Sl. No	Borehole No.	Reduced Level (m)	Latitude (N)	Longitude (E)	Dip of Borehole	Azimuth of Borehole	Date of Commencement	Date of closure	Depth of Borehole (m)
1.	RBH-01	256 m	26°13'52.7"	70°56'16.2"	45° ENE	110°	9.11.25	17.11.25	50 m
2.	RBH-02	277 m	26°13'07.3"	70°55'35.0"	40°/45°SE	130°	19.11.25	26.11.25	50 m

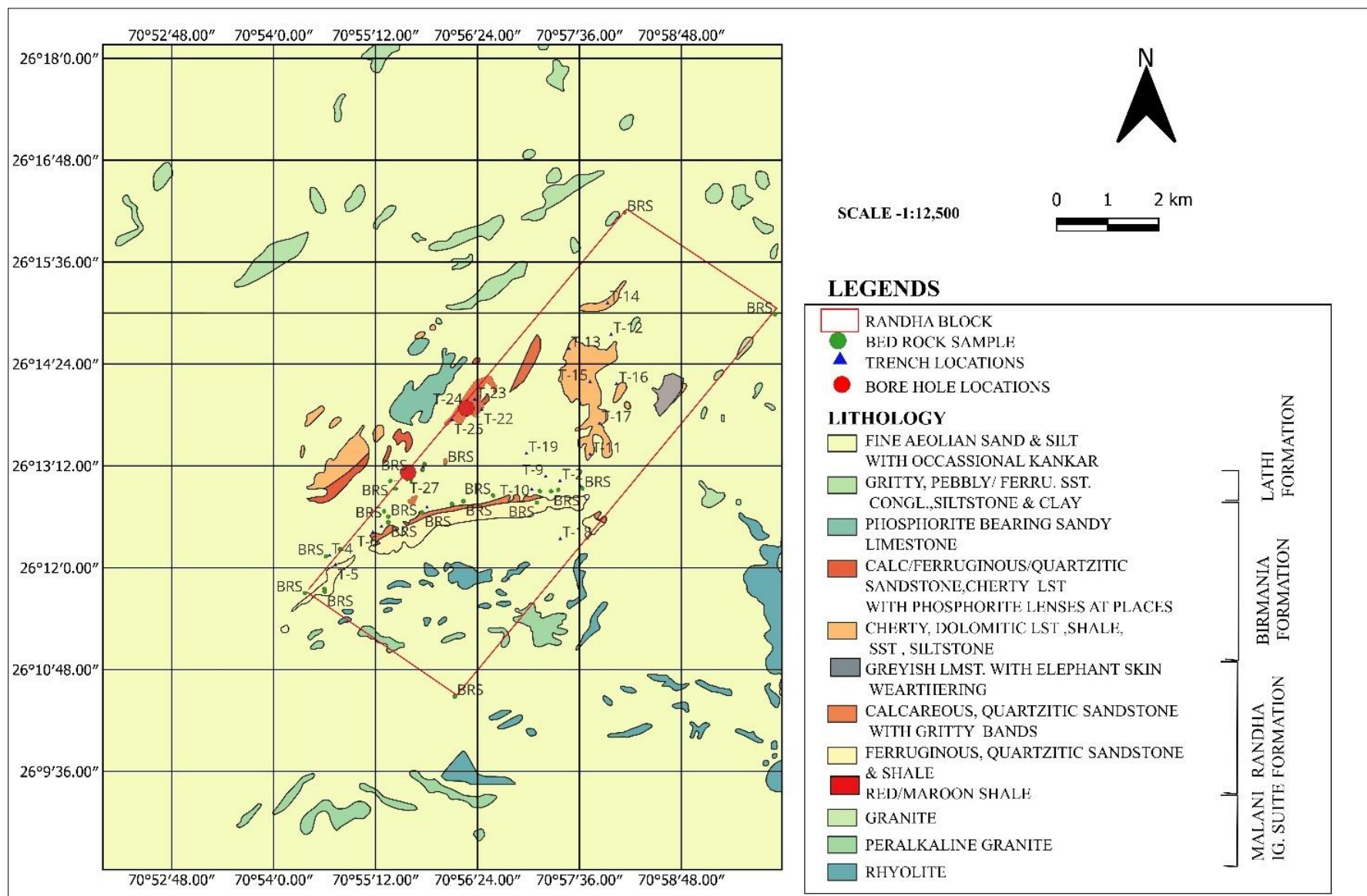


Figure 15. Geological map of the Randha Block with BRS, Trench, and Borehole locations.

## 6.4 SAMPLING AND CHEMICAL ANALYSES

### 6.4.1 SAMPLE DETAILS

During the geological field survey, depending on rock types and surface exposure, a total of 200 samples were collected, of which 186 were analysed by XRF. A few samples that show a yellowish tint when tested with Sapiro solution in the field and in the laboratory are taken for XRF analysis.

In the case of trench and pit, samples were taken at each meter, both laterally and vertically, to understand the variability.

In two boreholes, 100 samples are taken for the XRF analyses at each meter interval. Samples from each meter have been taken after observing that the trench and BRS samples show relatively higher vanadium content than its crustal abundance. However, the  $P_2O_5$  content in all the trenches, BRS, and core samples is less than 2%.

### 6.4.2 X-RAY DIFFRACTION STUDIES

The XRF analyses were carried out in FAGMIL's central laboratory facilities at Jodhpur, using Rigaku NEX DE XRF instrument. 286 samples were tested for its major and minor chemical constituents. The result is attached in **Annexure-I**.

A total of 18 samples were taken to IIT Jodhpur's Central Research Facility (IITJ CRF) to cross-check the XRF data. The  $P_2O_5\%$  of samples checked internally (FAGMIL) and externally (IIT Jodhpur) shows a good agreement with each other, indicating data reliability (*Figure 16*).

Table 6. Comparison of  $P_2O_5\%$  content tested from FAGMIL's Laboratory (Internal) and from IIT Jodhpur's Laboratory (External).

sample ID	$P_2O_5\%$ (Internal)	$P_2O_5$ %(External)	Difference in $P_2O_5\%$
RN TR1/02	1.10	1.04	0.062
RN TR1/ 03	1.03	0.97	0.06
RN TR1/06	1.07	1.03	0.042
RN TR1/07	1.31	1.15	0.159
RN TR10/01	0.99	0.99	0.003

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RN TR11/01	1.67	1.06	0.61
RN TR11/04	1.38	1.20	0.18
RN TR14/08	1.08	0.54	0.541
RN TR15/08	0.34	0.32	0.0246
RDH 01 10.5m	0.98	1.01	-0.034
RDH 01 24m	0.66	0.60	0.057
RDH 02 14m	0.43	0.44	-0.016
RDH 02 24m	0.55	0.66	-0.114
RDH 02 46m	0.60	0.58	0.021
RDH 02 50m	0.53	0.52	0.006
RDH 01 49m	1.62	1.41	0.21
BRS 1	0.72	0.51	0.212
BRS 2	0.23	0.25	-0.024

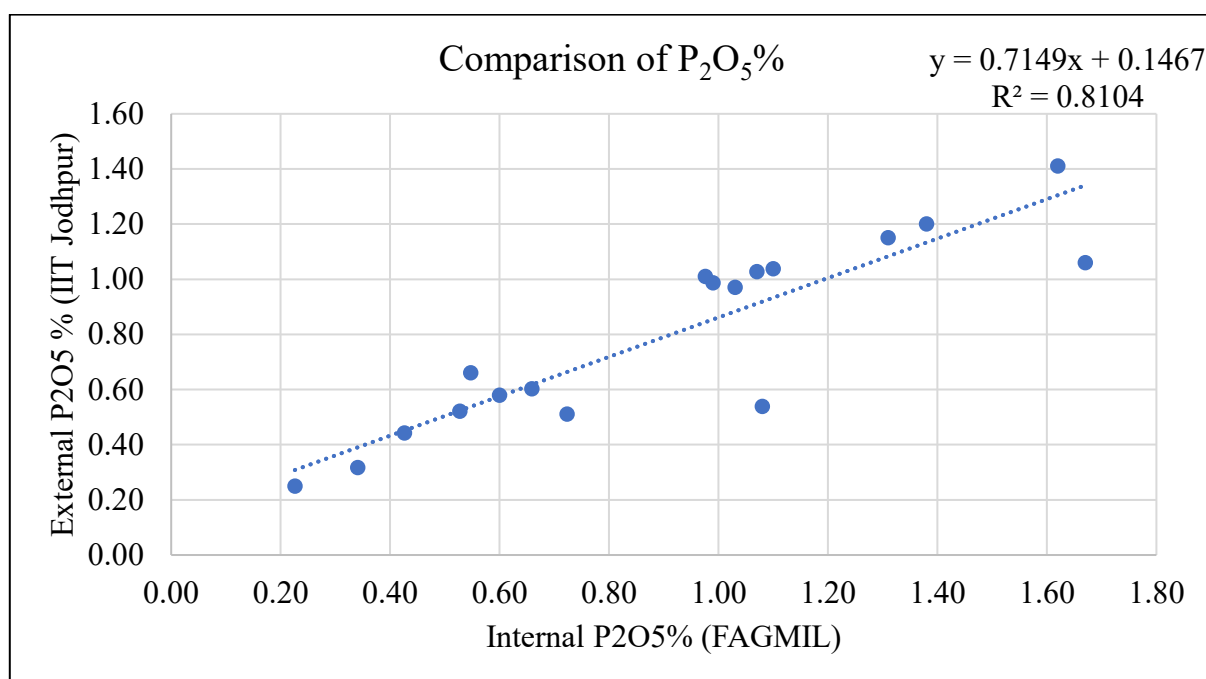


Figure 16. Comparison of  $P_2O_5\%$  content tested internally (FAGMIL) and externally (IIT Jodhpur)

## CHAPTER-VI

### 7 CONCLUSION AND RECOMMENDATION

A reconnaissance survey for rock phosphate was carried out in the Randha block, tehsil - Fatehgarh, Jaisalmer, Rajasthan. The objective of this geological survey was to assess the potentiality of the rock phosphate deposit in this area.

The Randha block falls under the toposheet numbers 40 J 15 and 40 J 16. A total of 38.5 sq. km was mapped at 1:12,500 scale and a total of 100m was drilled in two boreholes. A total of 286 BRS, trench and core samples are analysed for its chemical composition.

The Randha rock phosphate block is present within the oval-shaped Birmania Basin located in Thar desert of western Rajasthan, India. It is underlain by the Malani Igneous Suite of rocks, which belong to the Precambrian (After DGH). The Birmania Basin comprises around 900-metre-thick sedimentary sequence of siliciclastic, carbonate, and rock phosphate facies.

The rhyolite and granites of the Malani Igneous Suite are present in the southern part of the block. The rocks of the Randha Formation are unconformably overlying the pinkish rhyolite of the Malani Igneous Suite. At the south-western boundary of the block area, the contact between the Malani Suite and Randha Formation is present in the nullah section.

In the middle part of the block, almost E-W trending, the rocks of the Randha Formation are present as a ridge. Ferruginous, quartzitic sandstone with alternate shale occurring at the Randha ridge. A small exposure of reddish to maroon shale is present near the Randha village, indicating the base of the Randha Formation. Further north of the Randha ridge, the rocks of the Birmania Formation are exposed. However, the contact between the Birmania and Randha Formation is not exposed within the block area. It is covered under the alluvium. The rocks of the Birmania Formation are highly folded.

In the northern boundary of the block near the Beermani upper primary school and in further SW part, the variegated shale with arenaceous siltstone and sandstone is exposed in the trench. Stratigraphically,

the rock phosphate bed occurs below this. However, in both RBH-01 and RBH-02, no prominent rock phosphate bed is present below the variegated shale, arenaceous sandstone/siltstone bed. Other than the phosphatic shale and sandstone, the greyish limestone also shows phosphatic content when tested with Shapiro solution in the field. The XRF result shows that the  $P_2O_5$  content in the BRS, trench, and core sample is  $<2\%$ . However, data of only two boreholes for the entire block, are not adequate to draw any conclusion regarding the phosphate prospect in this area, as this block area is highly structurally controlled.

The chemical analysis data show that a good amount of cement-grade limestone is present within the block area. Furthermore, in the core sample, the  $V_2O_5\%$  ranges from 126 to 666 ppm, indicating a higher vanadium content compared to its crustal abundance. Therefore, this block could be further studied for vanadium and limestone.

## CHAPTER-VII

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## 9 APPROVED VS. ACTUAL EXPENDITURE OF THE PROJECT

EXPENDITURE OF THE RECONNAISSANCE SURVEY (G-4) FOR ROCK PHOSPHATE MINERALS IN RANDHA BLOCK DISTRICT: JAISALMER, RAJASTHAN			
Total Area - 38.50 Sq. Km; Completion Time - 12 Months+5 Months Extension, Review: after 5 Months, 12months, BHs:2 nos. Total Meterage -100m			
S.N.	QUANTUM OF WORK	APPROVED COST	ACTUAL EXPENDITURE
A	Geological Mapping, other Geological Work & Surveying	21,74,940	21,74,940
B	Trenching/Pitting	6,66,000	6,66,000
C	Drilling (Scout Drilling)	46,57,400	20,74,200
D	Laboratory Studies	33,59,310	31,30,748
E	Geological Report Preparation	5,42,882.50	4,02,294.40
F	Peer review Charges	30,000	30,000
G	Preparation of Exploration Proposal (5 Hard copies with a soft copy)	2,17,153	2,17,153
H	Total Estimated Cost without GST	1,16,47,685.00	86,95,335
I	Provision for GST (18% of H)	20,96,583.00	15,65,160
J	Total Estimated Cost with GST	1,37,44,268	1,02,60,495
		<b>137.44</b>	<b>102.60</b>

A detailed cost sheet is attached in **Annexure-IV**

## 10 LOCALITY INDEX

S. No	Locality Index (Villages)	Latitude (N)	Longitude (E)
1	Randha	20° 5'19.88"N	81°32'5.85"E
2	Kohra	26°10'48.92"N	70°52'17.24"E
3	Meharon Ki Dhani	26° 9'27.77"N	70°54'19.93"E
4	Beermani	26°12'51.69"N	70°54'46.61"E
5	Barsinga	26°14'30.58"N	70°59'25.27"E
6	Lakha	26° 7'30.11"N	70°57'58.20"E
7	Neembli	26° 9'3.67"N	70°46'56.14"E
8	Modha	26°16'31.13"N	70°59'13.44"E
9	Tejmalta	26°17'45.81"N	70°54'3.87"E
10	Jogidas	26°16'14.71"N	70°55'31.16"E

## **ANNEXURE - I**

### Details of the P<sub>2</sub>O<sub>5</sub> and other major oxide content of the BRS, Trench, and core samples

P <sub>2</sub> O <sub>5</sub> and other major oxide content of Trench Samples							
Sl. NO	SAMPLE ID	LATITUDE	LONGITUDE	P <sub>2</sub> O <sub>5</sub> %	SiO <sub>2</sub> %	Al <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> %
1	BRS-1	26°12'57.8"N	70°57'36.6"E	0.40	40.00	5.95	5.16
2	BRS-2	26°13' 01.3"N	70°57'22.3"E	0.45	44.60	3.85	4.49
3	BRS-3	26°13' 05.9"N	70°55'36.6"E	0.39	37.90	3.81	3.99
4	BRS-4	26°12'08.6"N	70°54'39.5"E	0.34	35.70	2.88	3.85
5	BRS-5	26°12'01.9"N	70°54'43.6"E	0.41	32.30	4.45	3.89
6	BRS-6	26°12'25.1"N	70°55'10.1"E	0.37	29.80	3.57	5.15
7	BRS-7	26°12' 29.1"N	70°55'16.2"E	0.42	27.90	3.92	3.37
8	BRS-8	26°12'42.6"N	70°55'48.3"E	0.38	33.30	2.33	3.77
9	BRS-9	26°13' 04.4"N	70°57'12.2"E	0.35	41.20	4.44	3.87
10	BRS-10	26°12'55.3"N	70°57'02.4"E	0.32	53.80	6.27	3.97
11	BRS-11	26°12'25.0"N	70°57'52.0"E	0.47	59.10	6.13	5.49
12	BRS-12	26°14'44.8"N	70°57'58.4"E	0.44	36.80	3.51	5.17
13	BRS-13	26°14'34.8"N	70°57'28.6"E	0.59	40.00	3.82	4.72
P <sub>2</sub> O <sub>5</sub> and other major oxide content of Trench Samples							
SR. NO	TRENCH SAMPLE ID	LATITUDE	LONGITUDE	P <sub>2</sub> O <sub>5</sub> %	SiO <sub>2</sub> %	Al <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> %
Trench-1 (3*2*2)							
1	RN/TR - 1/01	26°12'57.8"N	70°57'36.6"E	1.16	65.4	4.58	3.21
2	RN/TR - 1/02	26°12'57.8"N	70°57'36.6"E	1.1	70.3	6.28	2.27
3	RN/TR - 1/03	26°12'57.8"N	70°57'36.6"E	0.39	20.9	3.81	3.99
4	RN/TR - 1/04	26°12'57.8"N	70°57'36.6"E	0.34	18.7	2.88	3.85
5	RN/TR - 1/05	26°12'57.8"N	70°57'36.6"E	1.03	66.2	7.2	3.41
6	RN/TR - 1/06	26°12'57.8"N	70°57'36.6"E	0.41	15.3	4.45	3.89
7	RN/TR - 1/07	26°12'57.8"N	70°57'36.6"E	0.79	67	8.51	1.96

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8	RN/TR - 1/08	26°12'57.8"N	70°57'36.6"E	0.37	12.8	3.57	5.15
9	RN/TR - 1/09	26°12'57.8"N	70°57'36.6"E	0.73	59.1	13.1	5.62
10	RN/TR - 1/10	26°12'57.8"N	70°57'36.6"E	0.42	10.9	3.92	3.37
11	RN/TR - 1/11	26°12'57.8"N	70°57'36.6"E	1.07	63.5	10.3	3.59
12	RN/TR - 1/12	26°12'57.8"N	70°57'36.6"E	0.38	16.3	2.33	3.77
13	RN/TR - 1/13	26°12'57.8"N	70°57'36.6"E	1.31	60.7	10.3	3.37
14	RN/TR - 1/14	26°12'57.8"N	70°57'36.6"E	0.34	24.2	4.44	3.87
<b>Trench-2 (3*2*2)</b>							
15	RN/TR- 2/01	26°13'01.3"N	70°57'22.3"E	0.337	36.1	5.03	13.3
16	RN/TR- 2/02	26°13'01.3"N	70°57'22.3"E	0.177	24	3.54	1.56
17	RN/TR- 2/03	26°13'01.3"N	70°57'22.3"E	0.557	49.5	6.32	17.5
18	RN/TR- 2/04	26°13'01.3"N	70°57'22.3"E	0.145	16.9	3.31	5.56
19	RN/TR- 2/05	26°13'01.3"N	70°57'22.3"E	0.428	67.7	7.56	3.31
20	RN/TR- 2/06	26°13'01.3"N	70°57'22.3"E	0.508	59.3	6.32	12.7
21	RN/TR- 2/07	26°13'01.3"N	70°57'22.3"E	0.386	51.7	6.33	6.31
22	RN/TR- 2/08	26°13'01.3"N	70°57'22.3"E	0.491	43	6.18	10.7
23	RN/TR- 2/09	26°13'01.3"N	70°57'22.3"E	0.524	67.1	7.86	3.21
<b>Trench-3 (4*2*2)</b>							
24	RN/TR- 3/01	26°13'05.9"N	70°55'36.6"E	0.663	54.4	9.86	6.08
25	RN/TR- 3/02	26°13'05.9"N	70°55'36.6"E	0.65	58.5	9.05	3.93
26	RN/TR- 3/03	26°13'05.9"N	70°55'36.6"E	0.802	64.4	7.01	2.09
27	RN/TR- 3/04	26°13'05.9"N	70°55'36.6"E	0.607	62	8.25	2.24
28	RN/TR- 3/05	26°13'05.9"N	70°55'36.6"E	0.582	57.3	9.53	4.33
29	RN/TR- 3/06	26°13'05.9"N	70°55'36.6"E	0.626	59.2	8.59	3.92
30	RN/TR- 3/07	26°13'05.9"N	70°55'36.6"E	0.551	58.3	9.2	3.5
<b>Trench-4 (5*1.5*1.5)</b>							
31	RN-TR- 4/01	26°12'08.6"N	70°54'39.5"E	0.457	45.1	4.75	2.45
32	RN-TR- 4/02	26°12'08.6"N	70°54'39.5"E	0.184	4	3.72	2.56
33	RN-TR- 4/03	26°12'08.6"N	70°54'39.5"E	0.502	58.6	4.06	1.34



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34	RN-TR- 4/04	26°12'08.6"N	70°54'39.5"E	0.569	58.5	6.06	3.74
35	RN-TR- 4/05	26°12'08.6"N	70°54'39.5"E	0.419	37.4	4.47	2.17
36	RN-TR- 4/06	26°12'08.6"N	70°54'39.5"E	0.388	36	4.58	2.55
37	RN-TR- 4/07	26°12'08.6"N	70°54'39.5"E	0.245	14.9	3.85	3.45
38	RN-TR- 4/08	26°12'08.6"N	70°54'39.5"E	0.224	17.7	4.74	2.91
<b>Trench-5 (4*1.5*1.5)</b>							
39	RN/TR- 5/01	26°12'01.9"N	70°54'43.6"E	0.405	51.7	6.92	6.61
40	RN/TR- 5/02	26°12'01.9"N	70°54'43.6"E	0.458	60	9.36	4.95
41	RN/TR- 5/03	26°12'01.9"N	70°54'43.6"E	0.388	54.1	8.36	3.17
42	RN/TR- 5/04	26°12'01.9"N	70°54'43.6"E	0.329	50.6	8.23	2.68
43	RN/TR- 5/05	26°12'01.9"N	70°54'43.6"E	0.429	66	10.1	2.21
44	RN/TR- 5/06	26°12'01.9"N	70°54'43.6"E	0.348	58.9	10.8	2.75
45	RN/TR- 5/07	26°12'01.9"N	70°54'43.6"E	0.31	56.8	9.4	2.27
46	RN/TR- 5/08	26°12'01.9"N	70°54'43.6"E	0.269	39	7.83	2.52
<b>Trench-6 (3*2*1.5)</b>							
47	RN/TR- 6/01	26°12'25.1"N	70°55'10.1"E	0.469	68.2	9.08	1.74
48	RN/TR- 6/02	26°12'25.1"N	70°55'10.1"E	0.514	68.5	8.05	1.25
49	RN/TR- 6/03	26°12'25.1"N	70°55'10.1"E	0.279	34.4	7.88	1.93
50	RN/TR- 6/04	26°12'25.1"N	70°55'10.1"E	0.483	67.3	7.04	0.994
51	RN/TR- 6/05	26°12'25.1"N	70°55'10.1"E	0.362	65.1	7.06	1.52
52	RN/TR- 6/06	26°12'25.1"N	70°55'10.1"E	0.571	70.6	6.55	2.07
53	RN/TR- 6/07	26°12'25.1"N	70°55'10.1"E	0.417	73.2	5.38	1.24
54	RN/TR- 6/08	26°12'25.1"N	70°55'10.1"E	0.388	66.6	9.49	2.15
<b>Trench-7 (4*2*2)</b>							
55	RN/TR- 7/01	26°12'29.1"N	70°55'16.2"E	0.633	60.9	8.88	6.32
56	RN/TR- 7/02	26°12'29.1"N	70°55'16.2"E	0.625	67.6	7.83	2.45

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57	RN/TR- 7/03	26°12'29.1"N	70°55'16.2"E	0.503	69.2	9	0.706
<b>Trench-8 (5*1.5*1.5)</b>							
58	RN/TR- 8/01	26°12'42.6"N	70°55'48.3"E	0.701	69.9	4.77	2.23
59	RN/TR- 8/02	26°12'42.6"N	70°55'48.3"E	0.808	67.1	6.54	1.95
60	RN/TR- 8/03	26°12'42.6"N	70°55'48.3"E	0.707	66.2	6.1	3.16
61	RN/TR- 8/04	26°12'42.6"N	70°55'48.3"E	0.768	66.3	7.02	4.17
62	RN/TR- 8/05	26°12'42.6"N	70°55'48.3"E	0.462	65	10.6	2.28
<b>Trench-9 (3*1.5*1.5)</b>							
63	RN/TR- 9/01	26°13'04.4"N	70°57'02.4"E	0.549	75.3	1.55	2.2
64	RN/TR- 9/02	26°13'04.4"N	70°57'02.4"E	0.0641	16.8	2.66	1.54
65	RN/TR- 9/03	26°13'04.4"N	70°57'02.4"E	0.17	31.3	7.47	2.32
66	RN/TR- 9/04	26°13'04.4"N	70°57'02.4"E	0.236	27.6	7.91	5.84
67	RN/TR- 9/05	26°13'04.4"N	70°57'02.4"E	0.37	72	2.9	1.74
68	RN/TR- 9/06	26°13'04.4"N	70°57'02.4"E	0.904	68.9	5.52	2.71
69	RN/TR- 9/07	26°13'04.4"N	70°57'02.4"E	0.196	28.7	8.45	4.94
70	RN/TR- 9/08	26°13'04.4"N	70°57'02.4"E	0.254	36.5	6.28	1.48
71	RN/TR- 9/09	26°13'04.4"N	70°57'02.4"E	0.112	14.8	5.92	3.25
72	RN/TR- 9/10	26°13'04.4"N	70°57'02.4"E	0.0921	5.3	3.73	2.18
<b>Trench-10 (3*2*1.5)</b>							
73	RN/TR- 10/01	26°12'55.3"N	70°57'02.4"E	0.99	63.7	5.73	3.82
74	RN/TR- 10/02	26°12'55.3"N	70°57'02.4"E	0.811	64.8	4.33	2.37
75	RN/TR- 10/03	26°12'55.3"N	70°57'02.4"E	0.577	58.1	7.2	2.02
76	RN/TR- 10/04	26°12'55.3"N	70°57'02.4"E	0.66	48.2	6.16	3.96
77	RN/TR- 10/05	26°12'55.3"N	70°57'02.4"E	0.969	58.8	6.92	3.29
<b>Trench-11 (3*2*1.5)</b>							
78	RN/TR- 11/01	26°13'25.0"N	70°57'52.0"E	<b>1.67</b>	28.8	1.97	12.8
79	RN/TR- 11/02	26°13'25.0"N	70°57'52.0"E	0.786	35.5	3.56	4.84
80	RN/TR- 11/03	26°13'25.0"N	70°57'52.0"E	0.201	23	4.48	2.32
81	RN/TR- 11/04	26°13'25.0"N	70°57'52.0"E	<b>1.38</b>	9	3.72	2.24

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82	RN/TR- 11/05	26°13'25.0"N	70°57'52.0"E	0.202	10.9	3.42	2.18
83	RN/TR- 11/06	26°13'25.0"N	70°57'52.0"E	0.246	37.8	7.27	3.36
<b>Trench-12 (3*3*1.5)</b>							
84	RN/TR- 12/01	26°14' 44.8"N	70°57'58.4"E	0.254	40	4.48	2.32
85	RN/TR- 12/02	26°14' 44.8"N	70°57'58.4"E	0.112	16.8	2.66	1.54
<b>Trench-13 (3*2*2)</b>							
86	RN/TR- 13/01	26°14'34.5"N	70°57'28.3"E	0.33	8.2	5.03	4.08
87	RN/TR- 13/02	26°14'34.5"N	70°57'28.3"E	0.181	11.1	3.63	2.28
88	RN/TR- 13/03	26°14'34.5"N	70°57'28.3"E	0.287	32.5	3.19	1.96
89	RN/TR- 13/04	26°14'34.5"N	70°57'28.3"E	0.233	25.6	3.84	1.76
90	RN/TR- 13/05	26°14'34.5"N	70°57'28.3"E	0.228	39.1	3.08	1.69
91	RN/TR- 13/06	26°14'34.5"N	70°57'28.3"E	0.207	4.7	3.77	3.18
92	RN/TR- 13/07	26°14'34.5"N	70°57'28.3"E	0.145	13.4	5.66	3.79
<b>Trench-14 (5*1.5*1.5)</b>							
93	RN/TR- 14/01	26°15'07.0"N	70°57'55.9"E	<b>1.15</b>	25.3	3.8	10.3
94	RN/TR- 14/02	26°15'07.0"N	70°57'55.9"E	0.84	62.1	7.35	2.68
95	RN/TR- 14/03	26°15'07.0"N	70°57'55.9"E	0.603	54.9	7.63	2.95
96	RN/TR- 14/04	26°15'07.0"N	70°57'55.9"E	0.584	50	11.9	8.16
97	RN/TR- 14/05	26°15'07.0"N	70°57'55.9"E	0.733	62.6	7.42	1.57
98	RN/TR- 14/06	26°15'07.0"N	70°57'55.9"E	<b>1.08</b>	65.8	4.41	0.898
<b>Trench-15 (3*1.5*1.5)</b>							
99	RN/TR- 15/01	26°14'11.4"N	70°57'43.5"E	<b>1.17</b>	15	2.19	3.06
100	RN/TR- 15/02	26°14'11.4"N	70°57'43.5"E	0.37	59.7	13.4	2.26
101	RN/TR- 15/03	26°14'11.4"N	70°57'43.5"E	0.371	60	12.9	2.38
102	RN/TR- 15/04	26°14'11.4"N	70°57'43.5"E	0.406	51.8	5.91	7.7
103	RN/TR- 15/05	26°14'11.4"N	70°57'43.5"E	0.19	20.4	6.35	4.69
104	RN/TR- 15/06	26°14'11.4"N	70°57'43.5"E	0.364	60.5	13.3	1.98
105	RN/TR- 15/07	26°14'11.4"N	70°57'43.5"E	0.345	53.3	12	2.83

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106	RN/TR- 15/08	26°14'11.4"N	70°57'43.5"E	0.341	5.95	1.49	1.99
<b>Trench-20 (3*2*2)</b>							
107	RN/TR- 20/01	26°13'51.9"N	70°56'16.1"E	0.356	21.5	4.51	4.6
108	RN/TR- 20/02	26°13'51.9"N	70°56'16.1"E	0.616	15.06	59.9	0.456
109	RN/TR- 20/03	26°13'51.9"N	70°56'16.1"E	0.442	15	68.2	0.381
110	RN/TR- 20/04	26°13'51.9"N	70°56'16.1"E	0.402	43.2	10.2	5.81
111	RN/TR- 20/05	26°13'51.9"N	70°56'16.1"E	0.387	41.6	10.6	7.35
112	RN/TR- 20/06	26°13'51.9"N	70°56'16.1"E	0.271	31.3	9.06	5.14
113	RN/TR- 20/07	26°13'51.9"N	70°56'16.1"E	0.638	41.1	4.87	4.82
114	RN/TR- 20/08	26°13'51.9"N	70°56'16.1"E	0.589	53.1	4.55	2.73
115	RN/TR- 20/09	26°13'51.9"N	70°56'16.1"E	0.454	44.3	11.4	9.49
116	RN/TR- 20/10	26°13'51.9"N	70°56'16.1"E	0.451	37.4	7.18	5.2
<b>Trench-21 (4*2*2)</b>							
117	RN/TR- 21/01	26°13'48.5"N	70°56'14.1"E	0.574	38.1	7.55	5.57
118	RN/TR- 21/02	26°13'48.5"N	70°56'14.1"E	0.443	33.3	7.6	7.64
119	RN/TR- 21/03	26°13'48.5"N	70°56'14.1"E	0.494	44.3	12.3	9.1
120	RN/TR- 21/04	26°13'48.5"N	70°56'14.1"E	0.364	34.4	7.85	7.04
121	RN/TR- 21/05	26°13'48.5"N	70°56'14.1"E	0.592	44.9	4.29	2.85
122	RN/TR- 21/06	26°13'48.5"N	70°56'14.1"E	0.412	38.2	9.24	7.19
123	RN/TR- 21/07	26°13'48.5"N	70°56'14.1"E	0.405	42.8	11.6	6.11
<b>Trench-22 (5*1.5*1.5)</b>							
124	RN/TR- 22/01	26°13'51.8"N	70°56'27.0"E	0.437	38.2	8.58	6.47
125	RN/TR- 22/02	26°13'51.8"N	70°56'27.0"E	0.397	39.9	9.19	4.77
126	RN/TR- 22/03	26°13'51.8"N	70°56'27.0"E	0.405	42.9	10.4	7.03
127	RN/TR- 22/04	26°13'51.8"N	70°56'27.0"E	0.298	23.5	7.98	4.74
128	RN/TR- 22/05	26°13'51.8"N	70°56'27.0"E	0.449	47.4	7.8	3.59
129	RN/TR- 22/06	26°13'51.8"N	70°56'27.0"E	0.398	44	12.1	7.82
130	RN/TR- 22/07	26°13'51.8"N	70°56'27.0"E	0.42	47.1	11	6.96
131	RN/TR- 22/08	26°13'51.8"N	70°56'27.0"E	0.512	41.3	7.11	5.74

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Trench-23 (4*2*2)							
132	RN/TR- 23/01	26°13'58.9"N	70°56'22.0"E	0.478	42	5.58	4.25
133	RN/TR- 23/02	26°13'58.9"N	70°56'22.0"E	0.375	36.3	8.73	6.05
134	RN/TR- 23/03	26°13'58.9"N	70°56'22.0"E	0.529	41.4	4.12	2.4
135	RN/TR- 23/04	26°13'58.9"N	70°56'22.0"E	0.48	35.7	6.02	5.01
136	RN/TR- 23/05	26°13'58.9"N	70°56'22.0"E	0.372	36.4	10.9	8.79
137	RN/TR- 23/06	26°13'58.9"N	70°56'22.0"E	0.403	34.5	8.13	5.94
138	RN/TR- 23/07	26°13'58.9"N	70°56'22.0"E	0.422	38.3	9.59	8.5
Trench-24 (3*2*2)							
139	RN/TR- 24/01	26°13'54.5"N	70°56'14.9"E	0.464	22.7	4.07	5.1
140	RN/TR- 24/02	26°13'54.5"N	70°56'14.9"E	0.54	43.3	4.26	2.46
141	RN/TR- 24/03	26°13'54.5"N	70°56'14.9"E	0.443	39	6.92	3.75
142	RN/TR- 24/04	26°13'54.5"N	70°56'14.9"E	0.573	44.1	5.36	4.67
143	RN/TR- 24/05	26°13'54.5"N	70°56'14.9"E	0.602	49.4	3.86	3.83
144	RN/TR- 24/06	26°13'54.5"N	70°56'14.9"E	0.408	41.2	11.7	7.26
145	RN/TR- 24/07	26°13'54.5"N	70°56'14.9"E	0.411	35.4	8.51	6.02
Trench-25 (5*1.5*1.5)							
146	RN/TR- 25/01	26°13'44.6"N	70°56'05.9"E	0.493	18.7	3.25	4.29
147	RN/TR- 25/02	26°13'44.6"N	70°56'05.9"E	0.425	19.6	5.72	4.46
148	RN/TR- 25/03	26°13'44.6"N	70°56'05.9"E	0.369	37.2	11.4	7.55
149	RN/TR- 25/04	26°13'44.6"N	70°56'05.9"E	0.385	44.7	11.4	5.73
150	RN/TR- 25/05	26°13'44.6"N	70°56'05.9"E	0.421	37.6	10.3	6.87
Trench-26 (4*2*2)							
151	RN/TR- 26/01	26°13'11.0"N	70°55'45.4"E	0.289	15.3	4.42	3.06
152	RN/TR- 26/02	26°13'11.0"N	70°55'45.4"E	0.539	42.1	7.16	5.16
153	RN/TR- 26/03	26°13'11.0"N	70°55'45.4"E	0.383	19.2	6.47	6.85
154	RN/TR- 26/04	26°13'11.0"N	70°55'45.4"E	0.457	35.8	6.59	5.36
155	RN/TR- 26/05	26°13'11.0"N	70°55'45.4"E	0.357	15.7	6.25	7.03
156	RN/TR- 26/06	26°13'11.0"N	70°55'45.4"E	0.567	45.4	4.4	2.62



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157	RN/TR- 26/07	26°13'11.0"N	70°55'45.4"E	0.543	42.4	4.06	2.68
<b>Trench-27 (3*2*2)</b>							
158	RN/TR- 27/01	26°13'08.1"N	70°55'36.5"E	0.648	40.8	3.61	3.43
159	RN/TR- 27/02	26°13'08.1"N	70°55'36.5"E	0.494	47.9	7.93	3.68
160	RN/TR- 27/03	26°13'08.1"N	70°55'36.5"E	0.46	43.4	8.16	5.11
161	RN/TR- 27/04	26°13'08.1"N	70°55'36.5"E	0.349	0.349	8.95	10.1
162	RN/TR- 27/05	26°13'08.1"N	70°55'36.5"E	0.28	24.8	8.03	6.39
163	RN/TR- 27/06	26°13'08.1"N	70°55'36.5"E	0.431	33.7	10.4	8.26
164	RN/TR- 27/07	26°13'08.1"N	70°55'36.5"E	0.409	41.2	12.7	8.57
165	RN/TR- 27/08	26°13'08.1"N	70°55'36.5"E	0.434	43.4	8.1	5.1
166	RN/TR- 27/09	26°13'08.1"N	70°55'36.5"E	0.421	38.7	9.59	8.38
<b>Trench-28 (5*1.5*1.5)</b>							
167	RN/TR- 28/01	26°13'02.9"N	70°55'34.5"E	0.478	17	5.49	7.72
168	RN/TR- 28/02	26°13'02.9"N	70°55'34.5"E	0.411	36.1	6.92	5.85
169	RN/TR- 28/03	26°13'02.9"N	70°55'34.5"E	0.406	29.8	6.98	4.6
170	RN/TR- 28/04	26°13'02.9"N	70°55'34.5"E	0.534	49.2	5.69	3.2
171	RN/TR- 28/05	26°13'02.9"N	70°55'34.5"E	0.427	38	7.5	5.71
172	RN/TR- 28/06	26°13'02.9"N	70°55'34.5"E	0.479	47.1	7.04	4.55
173	RN/TR- 28/07	26°13'02.9"N	70°55'34.5"E	0.444	47.6	9.06	5.33

### P<sub>2</sub>O<sub>5</sub> and other major oxide content of Core Samples

#### Bore Hole RBH-01

Latitude: 26°13'07.3" N Longitude: 70°55'35.0" E

Sr. No	Sample ID	Depth (m)	P <sub>2</sub> O <sub>5</sub> %	SiO <sub>2</sub> %	Al <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> %
1	RBH-01/01	5.5 m	0.64	74.4	8.02	4.01
2	RBH-01/02	6.8 m	0.39	59.8	8.32	5.14
3	RBH-01/03	8.5 m	0.41	58.8	11.1	8.11
4	RBH-01/04	9.6 m	0.622	48.8	7.94	32.6
5	RBH-01/05	10.5 m	0.98	47.9	5.99	7.9
6	RBH-01/06	11.5 m	0.59	66.7	8.46	9.74
7	RBH-01/07	13.0 m	0.474	61.4	15.1	10.8
8	RBH-01/08	14.0 m	0.62	62.6	13.1	9.66
9	RBH-01/09	15.0 m	0.45	64	10.5	7.32
10	RBH-01/10	16.0 m	0.52	68.2	10.8	5.92
11	RBH-01/11	17.0 m	0.447	58.9	12.8	9.34
12	RBH-01/12	18.0 m	0.44	51.4	11.9	10.6
13	RBH-01/13	19.0 m	0.651	65.6	8.11	4.16
14	RBH-01/14	20.0 m	0.41	56.1	10.8	8.24
15	RBH-01/15	21.0 m	0.416	60.7	11.8	8.29
16	RBH-01/16	22.0 m	0.44	61	12.8	9.19
17	RBH-01/17	23.0 m	0.61	68.3	8.14	6.31
18	RBH-01/18	24.0 m	0.66	78.2	7.69	3.47
19	RBH-01/19	25.0 m	0.56	72.8	10.1	4.24
20	RBH-01/20	26.0 m	0.49	67.9	11.1	6.38
21	RBH-01/21	27.0 m	0.495	61.7	15.7	9.82
22	RBH-01/22	28.0 m	0.5	62.6	13.8	8.6
23	RBH-01/23	29.0 m	0.43	49.6	9.45	16.9
24	RBH-01/24	30.0 m	0.51	63.7	12.1	8.52
25	RBH-01/25	31.0 m	0.65	77.2	5.17	7.23
26	RBH-01/26	32.5 m	0.41	57.1	12.9	9.43

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27	RBH-01/27	34.0 m	0.481	60.2	13.5	9.04
28	RBH-01/28	35.0 m	0.48	60.9	13.5	8.86
29	RBH-01/29	35.5 m	0.67	77	7.04	3.5
30	RBH-01/30	37.0 m	0.382	54.3	12.8	9.27
31	RBH-01/31	38.0 m	0.496	62.2	13.8	9.27
32	RBH-01/32	39.0 m	0.512	60.5	13.4	10.2
33	RBH-01/33	39.5 m	0.462	54.5	6.4	8.29
34	RBH-01/34	40.0 m	0.579	57.6	9.71	7.77
35	RBH-01/35	40.5 m	0.44	64	11.1	7.25
36	RBH-01/36	41.0 m	0.403	53.5	10.8	10.1
37	RBH-01/37	42.2 m	0.44	57.5	12	7.27
38	RBH-01/38	43.2 m	0.404	56.9	13	7.41
39	RBH-01/39	44.2 m	0.47	62.3	7.82	4.9
40	RBH-01/40	45.0 m	0.587	45.5	9.99	10.2
41	RBH-01/41	45.5 m	0.48	62.3	13.1	8.36
42	RBH-01/42	46.0 m	0.59	47.8	7.66	9.89
43	RBH-01/43	46.5 m	0.51	51.1	10.8	8.68
44	RBH-01/44	47.0 m	0.63	46	11	21.6
45	RBH-01/45	47.5 m	0.467	64.8	7.71	4.98
46	RBH-01/46	48.0 m	0.556	56.1	10.2	15.5
47	RBH-01/47	48.5 m	0.437	57.4	13.1	13.1
48	RBH-01/48	49.0 m	1.62	51.8	4.19	30.4
49	RBH-01/49	49.5 m	0.43	61.3	11.1	10.4
50	RBH-01/50	50.0 m	0.641	70.5	6.99	3.89

RBH-02						
Latitude: 26°13'07.3" N Longitude: 70°55'35.0" E						
Sr. No	Sample ID	Depth (m)	P <sub>2</sub> O <sub>5</sub> %	SiO <sub>2</sub> %	Al <sub>2</sub> O <sub>3</sub> %	Fe <sub>2</sub> O <sub>3</sub> %
1	RBH-02/01	1 m	0.377	38.8	5.59	4.89
2	RBH-02/02	5.3 m	0.43	63	8.93	5.07
3	RBH-02/03	5.6 m	0.463	59.9	11.4	7.97

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4	RBH-02/04	6 m	0.333	59.4	14.2	7.29
5	RBH-02/05	6.4 m	0.456	58.3	10.7	8.42
6	RBH-02/06	6.6 m	0.509	65.4	11.4	7.34
7	RBH-02/07	7.2 m	0.509	61.5	13.4	8.93
8	RBH-02/08	7.5 m	0.495	66.2	12.3	6.8
9	RBH-02/09	7.6 m	0.488	63.3	13.4	8.27
10	RBH-02/10	7.9 m	0.453	60.9	12.5	8.75
11	RBH-02/11	8.2 m	0.427	51.8	11.1	9.2
12	RBH-02/12	8.4 m	0.478	55.4	8.91	7
13	RBH-02/13	8.5 m	0.352	48.7	8.75	5.84
14	RBH-02/14	8.7 m	0.851	50.5	7.94	9.88
15	RBH-02/15	9.2 m	0.498	60.1	13.5	9.53
16	RBH-02/16	9.45 m	0.376	54.5	11.8	9.59
17	RBH-02/17	9.6 m	0.416	59.1	11.7	8.41
18	RBH-02/18	10.7 m	0.62	31.9	1.75	17.1
19	RBH-02/19	11.7 m	0.388	58.9	11.7	7.78
20	RBH-02/20	12.7 m	0.432	61.8	11.1	8.58
21	RBH-02/21	13.7 m	0.499	65	11.9	8.16
22	RBH-02/22	14 m	0.426	64.8	13.7	8.15
23	RBH-02/23	15 m	0.447	65.1	10.5	6.54
24	RBH-02/24	18 m	0.359	54.8	13.1	8.65
25	RBH-02/25	20 m	0.347	51.3	11.7	11.1
26	RBH-02/26	21.2 m	0.504	66.9	8.23	6.11
27	RBH-02/27	22.7 m	0.644	81.4	5.83	3.22
28	RBH-02/28	24.1 m	0.547	65.2	11.8	8.97
29	RBH-02/29	24.9 m	0.561	69.9	10.4	7.21
30	RBH-02/30	26 m	0.501	63.9	13.4	8.31
31	RBH-02/31	27 m	0.507	64	12.8	8.67
32	RBH-02/32	28 m	0.463	61.3	12	8.57
33	RBH-02/33	29 m	0.327	56.5	14.2	9.49
34	RBH-02/34	30.1 m	0.636	69.3	11.3	5.06

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35	RBH-02/35	31.1 m	0.586	66.7	11.9	6.62
36	RBH-02/36	32.1 m	0.586	66.1	14.6	11.5
37	RBH-02/37	33.1 m	0.601	73.1	9.54	3.36
38	RBH-02/38	34.5 m	0.42	65.4	13.4	7.99
39	RBH-02/39	36 m	0.438	64.4	9.21	6.8
40	RBH-02/40	37 m	0.671	75.4	6.79	2.79
41	RBH-02/41	38 m	0.471	68.7	4.94	7.93
42	RBH-02/42	40 m	0.531	46.9	10.7	12.6
43	RBH-02/43	42 m	0.634	69.1	6.43	5.42
44	RBH-02/44	43 m	0.416	57.8	17.3	10
45	RBH-02/45	44.3 m	0.441	59.9	11.9	10.2
46	RBH-02/46	45.3 m	0.438	57.3	12.6	9.47
47	RBH-02/47	46 m	0.6	72.2	8.8	5.3
48	RBH-02/48	47 m	0.541	63.9	12.8	8.67
49	RBH-02/49	48.5 m	0.526	63.6	12.9	8.38
50	RBH-02/50	50 m	0.527	61.4	13.4	9.3

## LOI of Trench samples with P<sub>2</sub>O<sub>5</sub>% more than 1%

Sl No.	SAMPLE NO.	P <sub>2</sub> O <sub>5</sub> %	LOI
1	RN/TR - 1/01	1.16	19.03
2	RN/TR - 1/02	1.1	17.794
3	RN/TR - 1/05	1.03	17.91
4	RN/TR - 1/11	1.07	18.177
5	RN/TR - 1/13	1.31	18.31
6	RN/TR- 11/01	1.67	18
7	RN/TR- 11/04	1.38	30.773
8	RN/TR- 14/01	1.15	19
9	RN/TR- 14/06	1.08	17.697
10	RN/TR- 15/01	1.17	18.8



**ANNEXURE-II**  
**BOREHOLE LITHOLOGY**

**Borehole ID - RBH-01**

**Location – 26°13'52.7" N, 70°56'16.2" E**

<b>Depth (m)</b>	<b>Lithology</b>
0.00-0.50	0.00-0.40 m – Dark brown color, fine to medium-grained soil.
0.50-1.00	Dark brown color, medium to fine-grained soil.
1.00-2.00	Dark brown color, medium to fine grained soil, having 1-2cm thick fragments of quartzitic sandstone.
2.00-3.00	Boulders of fractured Quartzitic sandstone, greyish in color and medium to fine grained.
3.00-4.00	Dark brown colored, clay with mixed sand.
4.00-5.00	Dark brown color, medium to fine grained soil having frequent of quartzitic sandstone varying from 1-2 cm.
5.00-6.00	5 – 5.50 m – medium to fine grained quartzitic sandstone.
	5.50 – 5.80 m – weathered and fractured quartzitic sandstone.
	5.80- 6.00 m – fine to medium grained, light grey quartzite sandstone.
6.00-9.00	Fine to medium grained laminated, light grey quartzitic sandstone with some fracture.
9.00-11.50	Fine to medium grained laminated, light grey quartzitic sandstone with some fracture.
11.50-13.50	Variegated shale, laminated pale yellow to greenish greyish in color.
13.50-16.50	13.50-15.00 m - medium to fine grained quartzitic sandstone. 15.00-15.80 m - variegated shale.
	15.80-16.50 m - light grey, medium to fine grained quartzitic sandstone.

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16.50-19.50	Quartzitic sandstone, medium to fine grained.
19.50-21.00	19.50-19.70 m - quartzitic sandstone. 19.70-20.40 m - variegated shale.
	20.40-21.00 m - quartzitic sandstone.
21.00-23.00	Quartzitic sandstone.
23.00-25.00	Medium to fine grained, light grey, sandy quartzitic sandstone, and have fracture zone of about 0.10 m
25.00-26.50	25.00 to 25.30m – Medium to fine grained, light grey, sandy quartzitic sandstone.
	25.30 to 26.50m – fractured shale
26.50-28.50	fractured shale, greenish to greyish color,
28.50-29.50	Hard and compact shale,
29.50-31.00	Variegated shale shows fracture.
31.00-32.50	Variegated shale shows fracture.
32.50-34.00	Variegated shale shows fracture.
34.00-37.00	Hard and compact, greenish to greyish shale.
37.00-38.50	Laminations showing micro folding in fractured shale.
38.50-40.00	Light brown to yellowish green colored, had and compact shale.
40.00-42.00	Light brown to yellowish green, hard and compact shale
42.00-43.50	40.00 to 42.40 m – light brown shale
	42.40to 43.50m – light grey (cement colored) compact, and hard clay stone

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43.50- 45.00	Intercalation of shale and clay stone shows lamination of medium to fine-grained sandstone
45.00-47.00	Variegated shale of light brown to greyish green color intermixed with claystone
47.00-50.00	Hard and compact claystone, light grey in color show different color combinations.

## Borehole ID - RBH-02 Location -26°13'07.3" N, 70°55'35" E

Depth (m)	Lithology
0.00-1.00	0.00-0.30 m - Brownish, medium to fine-grained sand.
	0.30-1.00 m – Weathered, fragile boulders of quartzitic sandstone of grey color.
1.00-2.00	1.00-1.80 m – Brownish, medium to fine-grained sand.
	1.80-2.00 m - Greyish quartzitic sandstone.
2.00-3.00	Quartzitic gravel and compact sandstone.
3.00-4.00	3.00-3.60m – Brownish, medium to fine-grained boulders and sand.
	3.60-4.00 m - Laminated variegated shale of grey to greenish in color.
4.00-5.00	4.00-4.50 m – Medium to fine-grained, brown sand.
	4.50- 5.00 m – Fractured and weathered variegated shale.
5.00-6.00	5.00-5.10 m – Hard and compact, laminated clay stone.
6.00-7.00	6.00-6.80 m – Laminated clay stone
	6.80-7.00 m – Hard and compact clay stone

7.00-8.00	Weathered and fractured variegated shale.
8.00-9.00	Hard and compact variegated shale, laminated shale.
9.00-10.00	Hard and compact variegated shale, laminated shale
10.00-12.00	10.00-10.70 m - Sandy laminated variegated shale showing angular bedding plane and fractured along bedding plane.
	10.70-12.00 m - Weathered to fractured shale.
12.00-13.00	Weathered and fractured variegated shale.
13.00-14.00	Highly fractured weathered shale.
14.00 – 15.00	Hard and compact variegated shale, along the bedding plan.
15.00 – 16.00	Brownish colored medium to fine grained sand with boulders.
16.00 – 17.00	16.00 – 16.60 m Brownish colored medium to fine grained sand with boulders.
	16.60 – 17.00 m – fractured weathered boulders of shale.
17.00 - 1800	17.00 – 17.40 m – Variegated, finely laminated shale.
	17.40 – 18.00 m – Brownish – red colored fine-grained shale.
18.00 – 20.00	Boulders of shale.
19.10 – 20.00	Dark maroon to chocolatey colored siltstone claystone, hard and compact in nature, thinly laminated of fine-grained rock.
20.00 – 21.00	Greyish to greenish colored variegated shale.
21.00 – 22.00	Weathered and fractured boulders of shale.
22.00 -23.00	Fractured shale

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23.00 – 24.00	23.00 – 23.60m –Medium to fine-grained dark brown sandstone
	23.60 – 24.00 m –Shale
24.00 – 25.50	Green to greyish variegated shale.
25.50 – 27.00	Green to greyish variegated shale.
27.00 – 28.50	Green to greyish variegated shale.
28.50 – 30.00	Laminated variegated shale with fragile weathered boulders.
30.00 – 31.00	Laminated variegated shale with fragile weather boulders
31.00 – 33.00	Hard to compact grey colored claystone with boulders.
33.00– 34.50	Siltstone having grey to brown color.
	Fractured plane has cavity filling of quartzite or calcite
34.50 -36.00	Siltstone
36.00 – 38.00	Hard and compact clay stone with fractured and weathered boulders.
38.00 – 40.00	Weathered and fragile shale with hard and compact shale.
38.00 – 42.00	Hard to compact greyish to green colored with maroon colored laminated shale.
42.00 – 43.50	Hard to compact greyish to green colored with maroon colored laminated shale.
43.50 – 45.00	Hard to compact greyish to green colored with maroon colored laminated shale.
45.00 – 48.50	Hard to compact greyish to green colored with maroon colored laminated shale with fractured shale.
48.50 – 50.00	Fractured shale

### ANNEXURE-III

#### DETAILS OF PETROGRAPHIC STUDY

Sl. No.	Sample number & type	Texture	Mineral Composition	Description
1	RP/BRS-01  Siltstone with secondary vein filling	The rock is greyish to light brown in colour, fine to very fine grained, compact, and hard in nature. The surface shows thin linear streaks and minor cracks. No foliation or metamorphic banding is observed.	<p><b>Quartz:~55–60%</b> Present as very fine sub-angular to sub-rounded detrital grains.</p> <p>Feldspar: ~15–20% Occurs as fine detrital grains, partly altered.</p> <p><b>Clay minerals / fine matrix: ~10–15%</b> Present as fine binding material between grains.</p> <p><b>Ferruginous matter: ~3–5%</b> Seen as brownish stains along fractures and grain contacts. Secondary vein material</p> <p><b>(Quartz / Calcite): ~3–5%</b> Filling thin cracks and micro-fractures.</p> <p><b>Opaque minerals: ~1–2%</b> Present as scattered fine black grains.</p>	<p>Under the microscope, the rock exhibits a very fine-grained clastic texture characteristic of a sedimentary origin. The grains are very fine, closely packed, and sub-angular to sub-rounded, forming a massive, non-foliated fabric.</p> <p>Thin fractures and hairline cracks are present, locally filled with secondary mineral matter forming irregular, discontinuous vein-like fillings, indicating post-depositional fracturing.</p> <p>The fine, compact matrix binds the clastic grains, with minor brownish ferruginous staining along fractures and grain boundaries. No preferred mineral orientation or recrystallized texture is observed.</p>



2	RP/Trench-01 Shale to silty shale.	The rock is buff grey in colour, very fine to medium-grained, compact, and massive in nature.	<p><b>Clay minerals (mainly illite): ~55–60%</b> Occur as very fine flaky aggregates forming the main matrix.</p> <p><b>Quartz:~25–30%</b> Present as very fine silt-sized grains, sub-angular to sub-rounded in shape.</p> <p><b>Ferruginous matter: ~8–10%</b> Occurs as brownish to reddish patches and stains within the matrix and along grain contacts.</p> <p><b>Opaque minerals: ~2–3%</b> Present as fine black grains and streaky fillings.</p>	Under the microscope, the rock is very fine grained and matrix-dominated. It shows a clastic texture and is poorly sorted. Most grains are embedded in a fine clay-rich groundmass. A weak preferred orientation of platy minerals is observed, which is typical of shale to silty shale. The specimen is
3	RP/Trench-02 phosphate-bearing sandstone	The rock is light buff to brown in colour, fine grained, and shows a granular texture.	<p><b>Quartz:~40–45%</b> Present as fine to medium-grained sub-rounded to sub-angular clasts forming the main framework.</p> <p><b>Clay minerals:~20–25%</b> Occur as very fine flaky aggregates in the matrix.</p> <p><b>Collophane(phosphate mineral): ~15–20%</b> Present as brownish amorphous aggregates and patches, commonly mixed with clay and</p>	Under the microscope, the rock shows a clastic, granular texture. The grains are fine to medium-sized and are sub-rounded to sub-angular in shape. The framework grains are floating in a mixed clay–collophane–ferruginous matrix.

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			<p>ferruginous material.</p> <p><b>Ferruginous matter: ~10–12%</b></p> <p>Occurs as reddish-brown patches, stains, and coatings along grain boundaries.</p> <p><b>Rock fragments &amp; Feldspar: ~3–5%</b></p> <p>Present in minor amounts as detrital grains.</p> <p><b>Biotite (accessory): ~1–2%</b></p> <p>Occurs as very fine brown flaky grains.</p>	
4	RP/Core-01 Shale	<p>The rock is buff grey in colour, very fine grained, laminated, compact, and massive in appearance.</p>	<p><b>Illite:~45–50%</b></p> <p>Present as very fine platy flakes forming the main groundmass. The flakes are aligned parallel to each other.</p> <p><b>Quartz:~25–30%</b></p> <p>Occurs as very fine silt-sized grains, mostly sub-angular to sub-rounded, scattered within the clay matrix.</p> <p><b>Ferruginous matter: ~7–10%</b></p> <p>Appears as reddish-brown patches, streaks, and fine fillings between grains.</p>	<p>Under the microscope, the rock shows a very fine-grained clastic texture. It is matrix-supported, poorly sorted, and made up mainly of clay-sized to fine silt-sized particles. The platy minerals show a parallel arrangement, which gives the rock its typical shaly nature.</p>

			<p><b>Opaque minerals: ~5–7%</b> Present as small black grains and fine streaks, often associated with iron-rich material.</p> <p><b>Biotite:~1–2%</b> Occurs as very fine brownish flakes in minor amounts</p>	
5	RP/BRS-02  Stromatolitic limestone	<p>The rock is light grey to brownish grey in colour, fine grained, compact, and hard. Faint wavy banding and irregular lamination are visible on the surface, suggestive of stromatolitic structures. The rock is massive overall, with localized brownish staining along bands and fractures.</p>	<p><b>Calcite (CaCO<sub>3</sub>):~80–85%</b> Present as microcrystalline to fine crystalline carbonate forming stromatolitic laminae and matrix.</p> <p><b>Ferruginous material / organic matter: ~5–8%</b> Concentrated along darker stromatolitic bands and micro-fractures.</p> <p><b>Siliceous material (Quartz / Chert): ~5–7%</b> Occurs as very fine disseminated grains within the carbonate matrix.</p> <p><b>Clay minerals: ~2–4%</b> Present as fine impurities associated with darker laminae.</p> <p><b>Opaque minerals: ~1–2%</b> Occur as minor scattered grains.</p>	<p>Under the microscope, the rock exhibits a fine to very fine crystalline carbonate texture, laminated to wavy banded predominantly composed of calcite. The calcite grains are closely packed, mostly anhedral to subhedral, forming a dense crystalline mosaic. Distinct stromatolitic lamination is observed, represented by alternating light and dark bands.</p> <p>The lighter bands are rich in microcrystalline calcite, while the darker bands contain higher concentrations of ferruginous material, organic matter, and fine impurities, giving a brownish appearance. These laminae are irregular, wavy, and discontinuous, typical of microbial mat-induced sedimentary structures.</p> <p>The given specimen is Stromatolitic</p>

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				limestone, a biogenic carbonate sedimentary rock formed in a shallow marine environment.
6	RP/Trench-03 Ferruginous lithic sandstone to gritty sandstone, a clastic sedimentary rock.	The rock is brown to dark brown in colour, medium to coarse grained, compact, and hard. It shows a gritty feel on fresh surface with visible clastic grains of varying size embedded in a brownish matrix.	<p><b>Quartz:~40–45%</b> Present as sub-angular to sub-rounded detrital grains.</p> <p><b>Lithic fragments: ~20–25%</b> Includes fine rock fragments of sedimentary origin.</p> <p><b>Feldspar:~10–15%</b> Occurs as sub-angular grains, partly altered.</p> <p><b>Ferruginous matrix / cement: ~15–20%</b> Acts as the primary binding material, giving the rock its brown colour.</p> <p><b>Opaque minerals: ~2–3%</b> Present as scattered fine grains.</p>	<p>Under the Microscope, the rock exhibits a clastic, poorly to moderately sorted texture. The grains are fine to coarse sand-sized, sub-angular to sub-rounded, and show wide variation in size, indicating immature sedimentation.</p> <p>The framework is dominated by quartz and lithic fragments, embedded in a brown ferruginous matrix. Quartz grains show low to moderate interference colours under crossed polars and occur as monocrystalline and polycrystalline varieties. Lithic fragments of varying composition are common and contribute to the heterogeneous appearance. The matrix is abundant and rich in iron oxide material, imparting the brown colour to the rock.</p> <p>Grain-to-grain contacts are mostly point to long contacts, suggesting moderate compaction. No foliation or metamorphic fabric is observed.</p>
7	RP/core-02 Phosphatic Limestone	The rock is light buff to brown in colour, very fine grained, and exhibits a tabular structure, with smooth	<p><b>Calcite (carbonate material): ~60–65%</b> Occurs as ooids/oncoids, micritic matrix, and sparry</p>	Under the microscope, the rock shows a clastic to allochemical texture dominated by carbonate material. Rounded to sub-rounded calcareous grains are present, some of which

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		granular texture, compact and massive in nature.	<p>cement.</p> <p><b>Collophane (phosphate mineral): ~10–15%</b> Present as brownish amorphous aggregates and pore-filling material, locally associated with carbonate grains.</p> <p><b>Quartz:~10–15%</b> Occurs as fine sub-angular to sub-rounded detrital grains.</p> <p>Clay minerals: ~5–8% Present as very fine material mixed with the carbonate matrix.</p> <p><b>Ferruginous matter: ~3–5%</b> Occurs as brownish stains and patches along grain boundaries.</p> <p><b>Opaque minerals: ~1–2%</b> Present as minor black grains.</p>	<p>show concentric layering (ooids/oncoids). The grains are embedded in a fine carbonate matrix with minor clay content. In some thin sections, collophane is clearly observed, while in others it is absent, indicating patchy distribution of phosphate material.</p>
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# ANNEXURE-IV

FINAL COST SHEET FOR RECONNAISSANCE SURVEY (G-4) FOR ROCK PHOSPHATE MINERALS IN RANDHA BLOCK DISTRICT: JAISALMER, RAJASTHAN											
Total Area - 38.50 Sq Km; Completion Time - 12 Months+5 Months Extension, Review: after 5 Months, 12months, BHs:2 nos. Total Meterage -100m											
S. No.	Item of Work *	Unit *	Rates as per NMET SoC 2020-21		Estimated Cost of the Proposal		Remarks	Rates as per NMET SoC 2020-21		Final Cost for the Project	
			SoC-Item No. *	Rates as per SoC * (a)	Qty. (b)	Total Amount (Rs) (a*b)		SoC-Item No. *	Rates as per SoC * (a)	Qty. (b)	Total Amount (Rs) (a*b)
A	<b>Geological Mapping Other Geological Work &amp; Surveying</b>										
	Geological mapping, (1:12,500 scale) & Trenching , drilling work										
i	a. Charges for Geologist per day (Field) for geological mapping & trenching work, drilling work	day	1.3	11,000.00	120.00	13,20,000	Calculated on the basis of 2 Geologist Party Mapping- 2.5 months (2 Partys), trenching- 30 days (1 Party) & drilling- 60 days (1party)	1.3	11,000.00	120.00	13,20,000
ii	b. Labours Charges	day	5.7	522.00	240.00	1,25,280	Labour Charges (2 Nos) for two Geologist; (Base rate - Rs.504/-+PF Rs.65.2/-+ESI- Rs.16.38/-+Bonus- Rs.41.98/-+EL- Rs.28.22/-=Rs. 656.11/-)	5.7	522.00	240.00	1,25,280
	c. Charges for Geologist per day (HQ)	day	1.3	9,000.00	30.00	2,70,000		1.3	9,000.00	30.00	2,70,000



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	d. Charges for one Sampler per day (1 Party)	one sampler per day	1.5.2	5,100.00	41.00	2,09,100		1.5.2	5,100.00	41.00	2,09,100
	e. Labours (4 Nos)	day	5.7	522.00	480.00	2,50,560	Labour Charges (4 Nos) for two Geologist; (Base rate - Rs.504/-+PF Rs.65.2/-+ESI- Rs.16.38/-+Bonus- Rs.41.98/-+EL- Rs.28.22/-=Rs. 656.11/-)	5.7	522.00	480.00	2,50,560
	<b>Sub Total- A</b>					<b>21,74,940</b>					<b>21,74,940</b>
<b>B</b>	<b>Trenching/Pitting</b>										
	a) Excavation of Trenches	per cu.m	2.1.1	3,330	200	<b>666000</b>		2.1.1	3,330	200	<b>666000</b>
	<b>Sub Total- B</b>					<b>666000</b>					<b>666000</b>
<b>C</b>	<b>DRILLING (Scout Drilling)</b>										
1	Drilling up to 300m (Hard Rock)	m	2.2.1.4a	11,500	300	34,50,000	(5BH= 60 meter)	2.2.1.4a	11,500	100	11,50,000
2	Borehole deviation Survey by Multishot Camera	m	0	-	-	-		0	-	-	-
3	Land / Crop Compansation (in case the BH falls in agricultural Land)	per BH	5.6	20,000	5	1,00,000		5.6	20,000	-	-
4	Construction of concrete Pillar (12"x12"x30")	per borehole	2.2.7a	2,000	5	10,000		2.2.7a	2,000	2	4,000
5	Transportation of Drill Rig & Truck associated per drill (2 rigs)	Km	2.2.8	36	900	32,400		2.2.8	36	900	32,400
6	Monthly Accomodation Charges for drilling Camp (up to 2 Rigs)	month	2.2.9	50,000	3	1,50,000		2.2.9	50,000	2	1,00,000
7	Drilling Camp Setting Cost	Nos	2.2.9a	2,50,000	1	2,50,000		2.2.9a	2,50,000	1	2,50,000
8	Drilling Camp Winding up Cost	Nos	2.2.9b	2,50,000	1	2,50,000		2.2.9b	2,50,000	1	2,50,000
9	Road Making (Flat Terrain)	Km	2.2.10b	32,200	4	1,28,800		2.2.10b	32,200	4	1,28,800

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10	Drill Core Preservation	per m	5.3	1,590	180	2,86,200		5.3	1,590	100	1,59,000
	<b>Sub Total C</b>					<b>46,57,400</b>					<b>20,74,200</b>
<b>D</b>	<b>LABORATORY STUDIES</b>										
1	<b>Chemical Analysis</b>										
i)	<b>Primary samples (BRS/Channel)</b>										
	a. For 5 radicals i.e. P <sub>2</sub> O <sub>5</sub> , SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> and LOI	Nos	4.1.3	9,805	100	9,80,500		4.1.3	9,805	86	8,43,230
ii)	<b>Primary Check samples (BRS/Channel) (10% External)</b>										
	a. For 5 radicals i.e. P <sub>2</sub> O <sub>5</sub> , SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> and LOI	Nos	4.1.3	9,805	10	98,050		4.1.3	9,805	9	84,323
iii)	<b>Primary Samples (Trench)</b>										
	<b>Trench samples</b>										
	a. For 5 radicals i.e. P <sub>2</sub> O <sub>5</sub> , SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> and LOI	Nos	4.1.3	9,805	100	9,80,500		4.1.3	9,805	100	9,80,500
iv)	<b>Trench Check samples (10% External)</b>										
	a. For 5 radicals i.e. P <sub>2</sub> O <sub>5</sub> , SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> and LOI	Nos	4.1.3	9,805	10	98,050		4.1.3	9,805	10	98,050
v)	<b>BH Core samples</b>										
	a. For 5 radicals i.e. P <sub>2</sub> O <sub>5</sub> , SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> and LOI	Nos	4.1.3	9,805	100	9,80,500		4.1.3	9,805	100	9,80,500
vi)	<b>BH Core samples (10% External)</b>										
	a. For 5 radicals i.e. P <sub>2</sub> O <sub>5</sub> , SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> and LOI	Nos	4.1.3	9,805	10	98,050		4.1.3	9,805	10	98,050
2	<b>Physical &amp; Petrological Studies</b>										
i	Preparation of thin section	Nos	4.3.1	2,353	10	23,530		4.3.1	2,353	7	16,471

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ii	Study of thin section	Nos	4.3.4	4,232	10	42,320		4.3.4	4,232	7	29,624
iii	Preparation of polish section	Nos	4.3.2	1,549	10	15,490		4.3.2	1,549	-	-
iv	study of polished section	Nos	4.3.4	4,232	10	42,320		4.3.4	4,232	-	-
v	Digital Photographs	Nos	0	-				0	-		
vi	Whole Rock Analysis	Nos	0	-				0	-		
vii	Sp. Gravity	Nos	0	-				0	-		
	SEM Studies	per hour	0	-				0	-		
viii	EPMA studies	per hour	0	-				0	-		
	<b>Sub Total D</b>					<b>33,59,310</b>					<b>31,30,748</b>
<b>H</b>	<b>Total A to D</b>					<b>1,08,57,650</b>					<b>80,45,888</b>
<b>I</b>	<b>Geological Report Preparation</b>	<b>5 Hard copies with a soft copy</b>	<b>5.2</b>	<b>5.2 (i/ii/iii/iv)</b>	<b>1.00</b>	<b>5,42,883</b>	Reimbursement will be made after submission of the final Geological Report in Hard Copies (5 Nos) and the soft copy to NMET.	<b>5.2</b>	<b>5.2 (i/ii/iii/iv)</b>	<b>1.00</b>	<b>4,02,294</b>
<b>J</b>	<b>Peer review Charges</b>		<b>As per EC decision</b>			<b>30,000</b>		<b>As per EC decision</b>			<b>30,000</b>
<b>K</b>	<b>Preparation of Exploration Proposal (5 Hard copies with a soft copy)</b>	<b>5 Hard copies with a soft copy</b>	<b>5.1</b>	2% of the Cost or Rs. 3.8 Lakhs whichever is lower	1	<b>2,17,153</b>	EA will be reimbursed after submission of the Hard Copies and the soft copy of the final proposal along with Maps and Plan as suggested by the TCC-NMET in its meeting while clearing the proposal.	<b>5.1</b>	2% of the Cost or Rs. 3.8 Lakhs whichever is lower	1	<b>2,17,153</b>
<b>L</b>	<b>Total Estimated Cost without GST</b>					<b>1,16,47,686</b>					<b>86,95,335</b>

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<b>M</b>	<b>Provision for GST (18% of J)</b>	<b>20,96,583</b>	GST will be reimbursed as per actual and as per notified prescribed rate				<b>15,65,160</b>
<b>N</b>	<b>Total Estimated Cost with GST</b>	<b>1,37,44,269</b>					<b>1,02,60,496</b>
	<b>or Say Rs. In Lakhs</b>	<b>137.44</b>		<b>or Say Rs. In Lakhs</b>			<b>102.60</b>
<b>Note:</b>							
<b>1</b>	<b>Strict adherence to the Ministry of Finance's and GFR guidelines is mandatory. Every transaction must adhere to GFR rule 21.</b>						
<b>2</b>	<b>In case of delay/non- performance, the appropriate action will be taken by competent authority against delinquent agency as per prevailing govt. of India rules/guidelines on procurement.</b>						
<b>3</b>	<b>If any part of the project is outsourced, the amount will be reimbursed as per the Paragraph 3 of NMET SoC and Item no. 6 of NMET SoC. In case of execution of the project by NEA on its own, a Certificate regarding non outsourcing of any component/project is required.</b>						
<b>4</b>	<b>Necessary efforts should be made to minimize any adverse impact on the environment during exploration activities.</b>						
<b>5</b>	<b>Any item of work not mentioned above shall be added as per SoC.</b>						
<b>*</b>	<b>SoC Item No, Unit and Rate for each item of work must be as mentioned in the SoC.</b>						