PROPOSAL FOR PRELIMINARY EXPLORATION (G-3) FOR REE AND ASSOCIATED MINERALIZATION IN LUDRADA SOUTH BLOCK (2.75 SQ KM), SIWANA RING COMPLEX, DISTRICT- BALOTRA, RAJASTHAN

COMMODITY: REE AND ASSOCIATED MINERALS

BY

MINERAL EXPLORATION AND CONSULTANCY LIMITED

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SEMINARY HILLS

PLACE: NAGPUR

DATE: JULY, 2025

Summary of the Block for Preliminary Exploration (G3)

GENERAL INFORMATION ABOUT THE BLOCK

	Features	**Details**
	Block ID	Ludrada South Block
	Exploration Agency	Mineral Exploration and Consultancy Limited (MECL)
	Commodity	REE and associated minerals
	Mineral Belt	Siwana Ring Complex
	Completion Period with entire Time schedule to complete the project	18 Months
	Objectives	i. To carry out detail geological mapping on 1:2000 scale for distribution of REE mineral bearing formation. ii. To collect systematic bedrock and channel samples for analyses 34 elements by IC-PMS which include REE to understand the distribution on primary s iii. ource. iv. To carry out systematic drilling of boreholes at 200 m interval in accordance to MEMC rule to establish subsurface occurrence of REEs. v. To establish the inferred category resource for REE bearing minerals as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.
	Whether the work will be carried out by the proposed agency or through outsourcing and details thereof. Components to be outsourced and name of the outsource agency	Geological mapping and Chemical analysis will be carried out by the proposed agency.
	Name/ Number of Geoscientists	Three nos. of Geoscientist (1 Field + 1 HQ)
	Expected Field days (Geology) Geological Party Days	Geologist Party Days: 180 Days (Field) Geologist Party Days: 60 Days (HQ)

1	**Location**	
	The coordinates of corner points of proposed Ludrada South Block are as follows:	

Points	Latitude	Longitude
A2	25° 38' 21.34" N	072° 29' 41.17" E
B2	25° 38' 23.04" N	072° 30' 39.02" E
C2	25° 38' 34.25" N	072° 31' 39.75" E
D2	25° 38' 2.74" N	072° 31' 19.34" E
E2	25° 37' 47.64" N	072° 29' 39.03" E
F2	25° 38' 12.86" N	072° 29' 38.22" E

	Villages	Ludrada, Arjiyana, Mokalsar
	Tehsil/ Taluk	Siwana Tehsil
	District	Balotra
	State	Rajasthan
2.	**Area (hectares/ square kilometers)**	
	Block Area	2.75 sq km
	Forest Area	Part of the block is covered by forest area as observed in PM Gatishakti portal
	Government Land Area	Data Not Available
	Private Land Area	Data Not Available
3.	**Accessibility**	
	Nearest Rail Head	Nearest railhead is at Mokalsar which is around 6 km South of the blocK
	Road	The State Highway-64A passing through the eastern side of the block.
	Airport	Jodhpur Airport is around 120 km from the Block
4	**Hydrography**	
	Local Surface Drainage Pattern (Channels)	There are only perennial Nalas present inside block.
	Rivers/ Streams	The drainage system of the proposed area is manifested by Luni River.
5	**Climate**	
	Mean Annual Rainfall	
	Temperatures (December) (Minimum)	During summer (March to June), the maximum temperature generally varies between 46 and 51˚C. Night temperatures decrease considerably to 20–29˚ C. January is the coldest month. During winter (December to February), minimum temperatures may fall to 0℃ at night.

	Temperatures (June) (Maximum)	
6	**Topography**	
	Toposheet Number	Part of topo sheets 45C/06 and 465C/10
	Physiography of the Area	The area shows hilly topography with variation of rl from 160 mRl to 500 mRl. Granitic and Rhyolitic cliffy hills are lying in the central part of the block and the aeolin sand is covering the foot hills. The peak is recorded around 497 mRl.
7	**Availability of baseline geosciences data**	
	Geological Map (1:50K/ 25K)	1:12500 (LSM map)
	Geochemical Map	NGCM Data is available in NGDR
	Geophysical Map	NGPM Data is available in NGDR
8.	**Justification for taking up Reconnaissance Survey / Regional Exploration**	1. The proposed block has been carved out from the Indrana - Siwana area, which is characterized by a Neoproterozoic Siwana Ring Complex (SRC) composed of peralkaline rocks of the Malani Igneous Suite. These include rhyolite, granite, and late-phase microgranite and felsite dykes. The area is also known for its bimodal volcanics (acid and basic) and occurrence of REE minerals. 2. Petrographic and EPMA analyses confirmed the presence of several primary rare earth element (REE) minerals, including monazite, xenotime, and allanite. These minerals occur as accessory phases within both granite and volcanic rock units. Their presence, along with favorable ΣREE+Y values and associated high-value trace elements, supports the interpretation of a late- to post-magmatic metasomatic or hydrothermal REE mineralization event in the region. These mineralogical indicators, in combination with the observed enrichment in total REE content, point to a robust and widespread REE-bearing system.

		3. During the G4 stage of exploration, a total 43 Nos of bed rock samples were collected from the granite. The ΣREE+Y analysis value range from 621.10 ppm to 5439.48 ppm, with mean of 2052.44 ppm. The standard deviation (SD) has been calculated as 1111.25 ppm. Out of 43 no of granite samples it has been observed there are 18 samples which are showing ΣREE+Y value more than mean value, there are 4 samples which are showing ΣREE+Y value more than mean + 1 SD value (3163.69 ppm) and same 4 nos of samples which are ΣREE+Y value more than mean + 2 SD value (4274.95 ppm). 4. Similarly, during the G4 stage of exploration, a total 16 Nos of bed rock samples were analysed from the rhyolite. The ΣREE+Y analysis value range from 634.57 ppm to 6049.69 ppm, with mean of 2313.79 ppm. The standard deviation (SD) has been calculated as 1399.61 ppm. Out of 16 no of rhyolite samples it has been observed there are 4 samples which are showing ΣREE+Y value more than mean value, there are 2 samples which are showing ΣREE+Y value more than mean + 1 SD value (3713.40 ppm) and same 1 nos of samples which are ΣREE+Y value more than mean + 2 SD value (5113.01 ppm).During the G4 stage of exploration, 3 no of channels (CH-6, CH-7 and CH-8) were cut on the outcrop of the proposed block. Total 13 nos of samples were generated from these three channels. It has been observed that ΣREE+Y analysis values in the channels varying from 476.25 ppm in Dyke to 6216.72 ppm also in dyke, However, in granites ΣREE+Y values is varying from 1184.94 ppm to 2732.70 ppm with an average of 1894.69 ppm. 5. Based on the anomalous values of REE analysed for samples in the area and supported by previous investigations, the proposed Ludrada area has been curved for further G3 stage of investigation of REE and associated minerals. But, dur to presence of vertical hill in the area, the identified area has been divided into Ludarada North Block and Ludrada South Block having avoiding the central cliff due to exploration difficulty. The present proposal is for the Ludrada South Block.

PROPOSAL FOR PRELIMINARY EXPLORATION (G-3) FOR REE AND ASSOCIATED MINERALIZATION IN LUDRADA SOUTH BLOCK, SIWANA RING COMPLEX, DISTRICT –BALOTRA, STATE -RAJASTHAN (AREA 2.75 SQ. KM.)

1.1.0 INTRODUCTION

1.1.1 Development of renewable energy infrastructure requires critical raw materials, such as the rare earth elements (REEs, including scandium) and niobium, and is driving expansion and diversification in their supply chains. Although alternative sources are being explored, the majority of the world's resources of these elements are found in alkaline-silicate rocks and carbonatites. These magmatic systems also represent major sources of fluorine and phosphorus. Exploration models for critical raw materials are relatively less developed than those for major and precious metals, such as iron, copper, and gold, where most of the mineral exploration industry remains focused. The diversity of lithologic relationships and a complex nomenclature for many alkaline rock types represent further barriers to the exploration and exploitation of REE-high field strength element (HFSE) resources that will facilitate the green revolution.

1.1.2 Rare earth elements are characterized by high density, high melting point, high conductivity and high thermal conductance with distinctive electrical, metallurgical, catalytic, nuclear, magnetic and luminescent properties make them indispensable for a variety of emerging high end and critical technology applications which are relevant to India's energy security i.e., clean energy, defense, civilian application, environment and economic areas. REE demand is expected to continue its growth, especially for their use in low carbon technology. The ever-increasing demand for these REE necessitates a concerted effort to augment the resource position of our country.

1.1.3 The Rare earth elements (REE) are a collection of 17elements in the periodic table, namely scandium, yttrium and lanthanides (15 elements in the periodic table with atomic numbers 57 to 71 namely: lanthanum (La), cerium (Ce), praseodymium(Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu). In spite of its low atomic weight Yttrium (atomic no. 39) has properties more similar to the heavy lanthanides and is included with this group. Scandium (atomic no. 21) is found in a number of minerals although it may also occur with other rare earth elements (REE).

1.1.4 Although these elements tend to occur together, the lanthanide elements are divided into two groups. The light rare earth elements (LREE) are those with atomic numbers 57 through 62(La, Ce, Pr, Nd, Pm, Sm) and the heavy rare earth elements (HREE) are those with atomic numbers from 63 to 71 (Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu) and Y, Sc. However, because of their geochemical properties, rare earth elements are typically dispersed and not often found concentrated as rare earth minerals in economically exploitable ore deposits.

1.1.5 Generally, the light rare earth elements (LREE) are more abundant in the earth's crust and easily extracted than heavy rare earth elements (HREE). It was the very scarcity of these minerals (previously called "earths") that led to the term "rare earth". The first such mineral discovered was gadolinite, a compound of cerium, yttrium, iron, silicon and other elements. This mineral was extracted from a mine in the village of Ytterby in Sweden; several of the rare earth elements bear names derived from this location.

1.1.6 In the other hand, critical minerals are those minerals that are essential for economic development and national security. The lack of availability of these minerals or concentration of extraction or processing in a few geographical locations may lead to supply chain vulnerabilities and even disruption of supplies. The future global economy will be underpinned by technologies that depend on minerals such as lithium, graphite, cobalt, titanium, and rare earth elements. These are essential for the advancement of many sectors, including high-tech electronics, telecommunications, transport, and defence. They are also vital to power the global transition to a low carbon emissions economy, and the renewable energy technologies that will be required to meet the 'Net Zero' commitments of an increasing number of countries around the world. Hence, it has become imperative to identify and develop value chains for the minerals which are critical to our country.

1.1.7 Considering important parameters such as resource/ reserve position in the country, production, import dependency, use for future technology/ clean energy, requirement of fertilizer minerals in an agrarian economy, the Committee has identified a set of 30 critical minerals. These are Antimony, Beryllium, Bismuth, Cobalt, Copper, Gallium, Germanium, Graphite, Hafnium, Indium, Lithium, Molybdenum, Niobium, Nickel, PGE, Phosphorous, Potash, REE, Rhenium, Silicon, Strontium, Tantalum, Tellurium, Tin, Titanium, Tungsten, Vanadium, Zirconium, Selenium and Cadmium. (Critical Minerals for India, Report of the Committee on Identification of Critical Minerals, Ministry of Mines, June 2023)

1.1.8 A study, conducted by the Council on Energy Environment and Water, identified 12 minerals out of 49 that were evaluated as 'most critical' for India's manufacturing sector by Vision 2030 which makes more thrust for exploration in Strategic Mineral, Precious Metals, Platinum Group of Elements by Government of India.

1.2.0 BACKGROUND

1.2.1 Emphasis has been given to explore the more numbers of blocks for strategic and critical minerals in the different states of India by Govt of India. Keeping this in view, the present proposal Preliminary Exploration (G-3) for REE and associated elements in proposed Ludrada Block in Balotra district, Rajasthan is being put up for evaluation under NMET funding and execution.

1.3.0 LOCATION AND ACCESSIBILITY

1.3.1 The proposed Ludrada South block comprises of 2.75 sq km area and lies in Siwana Tehsil of Balotra District (part of Toposheet No. 45C06 and 45C10), Rajasthan. The major villages falling in and around the proposed block are Ludrada, Arjiyana, Mokalsar, etc. All the villages in the area are well connected to each other and to the highways by motorable roads and tracks. The State Highway-64A passing through the eastern side of the block. The district headquarter Balotra is about 50 km north west from the block. The nearest railway station is Mokalsar Railway station which is about 6 km south of the proposed block. The location map of the proposed block is provided as Plate No- I. The detailed location of the boundary points are given in Table 1.

Table 1: Coordinates of Corner Points of Proposed Ludrada South Block, Balotra District, Rajasthan

Points	Latitude	Longitude
A2	25° 38' 21.34" N	072° 29' 41.17" E
B2	25° 38' 23.04" N	072° 30' 39.02" E
C2	25° 38' 34.25" N	072° 31' 39.75" E
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1.4.0 PHYSIOGRAPHY, DRAINAGE AND CLIMATE

1.4.1 The area shows hilly topography with variation of rl from 160 mRl to 500 mRl. There is Granitic and Rhyolitic cliffy hills in the central part of the block and the arealian sand is covering the foot hills. The peak is recorded around 497 mRl.

1.4.2 The drainage system of the proposed area is manifested by Luni River.

1.4.3 The climate is characterized by low rainfall with erratic distribution, extremes of diurnal and annual ranges of temperatures, low humidity and high wind velocity. The arid climate has marked variations in diurnal and seasonal ranges of temperature, characteristic of warm-dry continental climates. During summer (March to June), the maximum temperature generally varies between 46 and 51 ˚C. Night temperatures decrease considerably to 20–29 ˚C. January is the coldest month. During winter (December to February), minimum temperatures may fall to 0℃ at night. Occasional secondary western disturbances, which cross mostly western, northern and eastern Rajasthan during the winter months, causing light rainfall and increased wind speeds which result in a wind-chill effect.

1.5.0 FLORA AND FAUNA

1.5.1 Xerophytic plants can survive in hot arid conditions and can be easily found in the study area. Flora observed in the area is mostly comprises of thorny trees and bushes. Xerophytic plants such as the kumatiyo (*Acacia senegal*), ber (*Zizyphusmauritiana*), and googal (*Commiphoraightii*), kair (*Capparisdecidua*), aak (*Caliotropisprocera*), Thhoris, khejri (*Prosopis cineraria*) are present in the study area. The wild fauna found in the area include foxes, desert cat, desert rat, jackals, chinkaras, deer, snakes, forest rabbits, camels, nilgai (*Boselaphustragocamelus*) and several varieties of Indian and migratory birds such as sparrow, crow, bulbul, kite, peacock, white-rumped vulture and eagle etc.

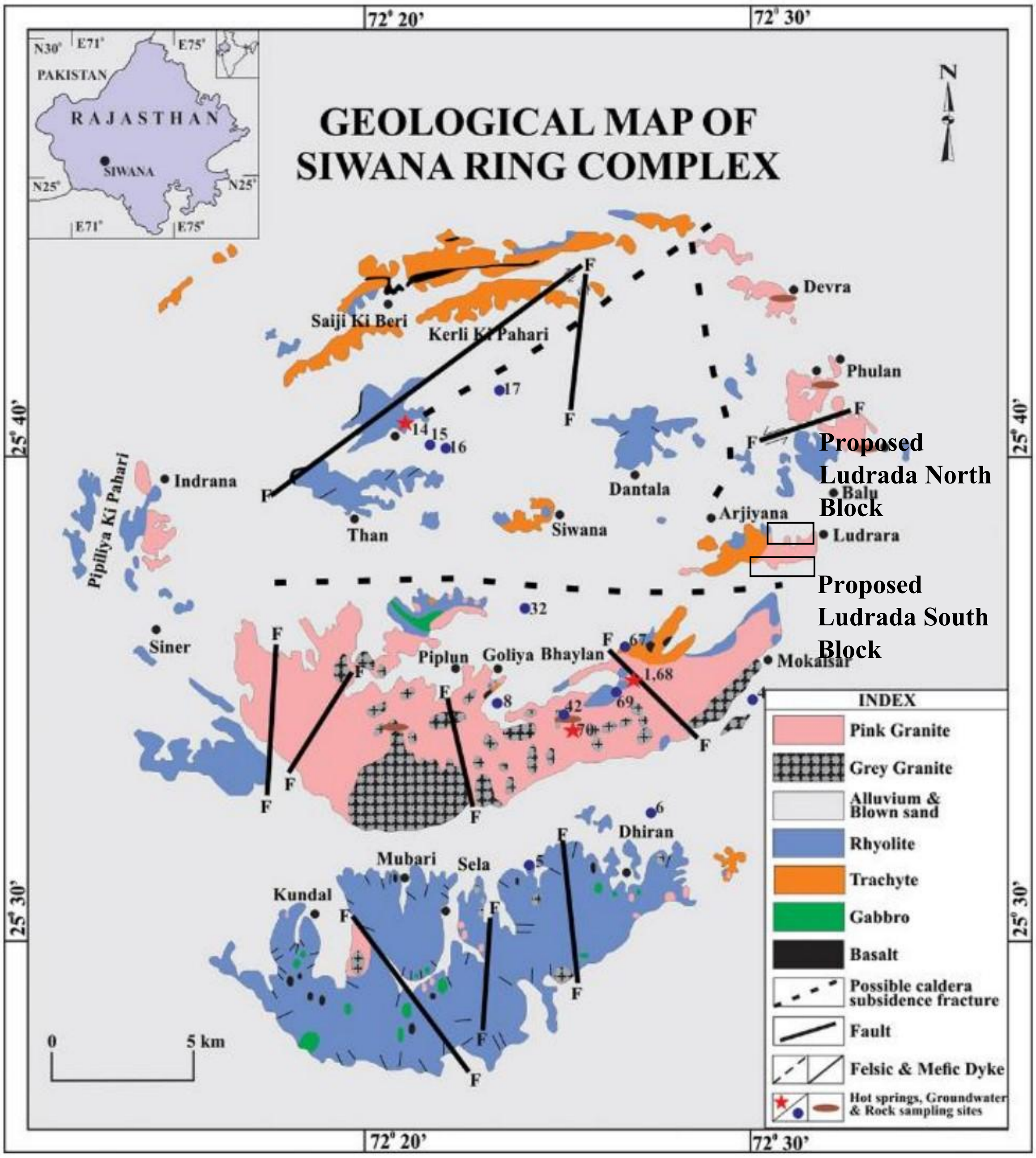
2.0.0 REGIONAL GEOLOGY

2.1.1 The proposed area comes under the Trans-Aravalli region, exposed around west and south west of Aravalli Mountain Range. Malani Igneous Suite (MIS) is the largest acid, predominantly volcanic, magmatic assemblage in India representing rocks of polyphase igneous activity. Throughout the time, the rocks have been referred by various names like 'The Malani Volcanic Suite', 'Malani Volcanic Series', 'Malani Igneous Province', 'Malani Beds', 'Malani Volcanics,' 'Malani Rhyolites' or simply 'Malanis'. But the term 'Malani' is strictly associated to describe the rocks of Neoproterozoic polyphase igneous activity, happened roughly in-between 830Ma and 680Ma, age range representing gap between Sirohi Group of Delhis (Choudhary et al., 1984) and Marwar Supergroup (Rathore et al., 1999) respectively. The MIS unconformably overlies the Mesoproterozoics of Delhis (Bhushan, 2000). The contact between the two has been studied near Manihari and Kankani (La Touche, 1902; Bhushan, 1984; Bhushan, 2000).

2.1.2 Malani Igneous Suite (MIS) is the largest acid, predominantly volcanic, magmatic assemblage in India representing rocks of polyphase igneous activity which covers almost 51,000 Sq. Km. The term 'Malani' is strictly associated to describe the rocks of Neoproterozoic polyphase igneous activity, happened roughly in-between 830Ma and 680Ma, age range representing gap between Sirohi Group of Delhis (Choudhary et al.,

1984) and Marwar Supergroup (Rathore et al., 1999) respectively. The MIS unconformably overlies the Mesoproterozoics of Delhis (Bhushan, 2000). MIS is devoid of any major deformation

2.1.3 Based on field relationship, mode and type of magmatism, texture and composition, MIS has been divided into three phases of magmatic activity. The first phase commenced with the eruption of basic flows, followed by voluminous outpouring of felsic lava flows and culminating in ash flow deposition. The second phase experienced intrusion of peraluminous, per-alkaline and meta-aluminous granitoids as plutons, ring dyke, bosses and plugs within the extrusive phase. The third phase represents the mafic and felsic dyke swarms and sills within the earlier two phases.



2.1.4 Generalized classification of Malani Igneous suite (after Bhushan and Chandrasekaran, 2002) is given in the Table no 2 below

Table No 2

Generalized classification of Malani Igneous suite (after Bhushan and Chandrasekaran, 2002).

Super Group	Group	Formation	Mode of Magmatism	Lithology
Marwar Supergroup (Vendian to lower Cambrian)				Sandstone, shale, limestone and evaporates
--------------------------------Unconformity---				
Malani Igneous Suite (upper Proterozoic)	Dykes warms	Basic dyke; Acid dykes Trachyte porphyry Andesite and Porphyry Dykes Aplite and Diorite plugs	Intrusive dyke Phase–III	Gabbro, dolerite, basalt, granite rhyolite porphyry Trachyte porphyry andesite porphyry porphyritic/non-porphyritic Dyke &boss and aplite veins.
	Granitoid plutonism	Malani granite, Siwana granite Jalorgranite	Intrusive phase-II	Hornblende granite riebeckite Aegirine granite biotite/Hornblende granite
	Bimodal volcanism	Rhyolite, Trachyte and Basalt flow	Extrusive phase-I	Rhyolite, dacite, trachyte and rhyodacite flows, Basalt and trachyandesite flows
---Unconformity---				
Pre Malani basement (Middle to Lower Proterozoic		Aravalli and Delhi Supergroup		

2.1.5 Regional Structure and Metamorphism Earlier workers reported no deformational structures except some local faults in the volcanic and plutonic rocks exposed in and around Siwana area. Various primary structures such as flow layers, vesicular and amygdular structures, columnar joints and megaspheruites in volcanic rock. Flow lobes, joints and minor faults are reported in both the volcanic and plutonic phase (Rastogi and Mukerjee, 2015). Murthy, *et al.* (1962) formally established the "Siwana ring structure". Later studies by Mukherji and Roy (1981) also supported this view and they attributed collapse of a caldera to the ring dyke intrusion. No authors reported significant metamorphism in the area.

However D F Strong 1982, Baginski et al 2016, J Rong et al 2016. S Mondal et al 2021 have discussed late magmatic and post magmatic metasomatic aspects of Siwana granite and its significance in REE enrichment in detail. Kumar and Sharma 2020 reported various late to post magmatic replacement textures such as coarsening of perthite lamellae due to albitization / Na metasomatism event, formation of chess board perthite, dueteric alteration of alkali feldspar grains, psuedomorphic replacement of alkali feldspar by aegirine, formation of secondary minerals like zircon, apatite within the grains as inclusions as well as intergrowths within the grain boundaries, formation of albite rims etc. The original magmatic inosilicates such as aneagmatite, aegirine - augite, astrophyllite etc were replaced to aegirine and arfvedsonite under the influence of late/post magamatic alkaline fluids (Kumar and Sharma, 2020)

2.1.6 **Regional mineralization:** Siwana granites and Malani rhyolites are considered to be important sources of REE in the Siwana area. The peralkaline granite of Siwana Ring Complex (SRC) is enriched with REE potential and the later intrusive dykes intruding the granite and rhyolite at the periphery of Siwana Ring Complex are even more enriched with REE (Das et al. 2015). Barman and Neog, (2019) also reported appreciable occurrences of REE in Siwana Granite. Notable occurrence of REE and RM mineralization in younger intrusive> plag-rich granite> K-rich granite> felsic volcanic were observed by Kumar and Sharma (2020). Majumdar (1976-1978) considered that the Siwana suite is definitely enriched in Nb, La, Y and Zr. At present the granites and rhyolites are being used as building stones and road materials.

3.0.0 GEOLOGY OF THE BLOCK

3.1.0 The proposed block area is the part of the area covered by Large scale mapping in 1: 12,500 scale by GSI (Item Code No.:M2AFGBM-MEP/NC/WR/SU- RAJ/2021/36826) around Indrana- Siwana area, Barmer District, Rajasthan in part of the Toposheet no. 45C/06 & 10. The proposed area comprises, plutonic, volcanic and the younger intrusive phases of Malani Igneous Suite.

Felsic volcanic flow phase exposed in and around Siwana town, Indrana, Ludrara, Arjiyana, Devandi, Mawadi and Mokalsar villages whereas, per-alkaline Siwana granite is exposed in and around Mokalsar, Ludrara and Indrana villages. Younger dyke phases are intruded in both the volcanic and plutonic phases. The sharp contact of the Siwana Granite with older volcanics can be observed at south of Ludrara and north of Mokalsar. However, in soil covered area the contact is inferred as the exposures are scanty and sand covered. The stratigraphy of study area is given in table below

Table No 3

Stratigraphy of Indrana – Siwana area

Group/Supergroup	Rock Types	Igneous Activity
Quaternary	Aeolian sand and silt with occasional Kankers	---
Malani Igneous Suite	Pegmatite Rhyolite dyke, basic volcanic dykes Siwana Granite (Granite & Alkali-feldspar granite) ----------------Intrusive contact---------- Felsic volcanics	Phase-III (Younger intrusive phase) Phase- II (Plutonic phase) Phase-I (Volcanic phase)

3.2.0 DESCRIPTION OF THE ROCK TYPES

3.2.1 **Felsic volcanics:** Felsic volcanics are dominant litho unit observed in the LSM mapped area. The exposures are plenty around Siwana, Mokalsar, Mailawas, Arjiyana, Devandi and Indrana area. Both porphyritic and aphanitic verities of rhyolite are representing the felsic volcanics of the area. The aphanitic variety is the most common volcanic phase exposed in the area. It is well exposed near Siwana town and Arjiyana, Maliavas, Indrana villages. It also occurs as small isolated hillocks parallel to Siwana – Mokalsar road. Occurrences of ferruginous red coloured variety and greenish grey coloured variants are common. They are characterized by the presence of vesicles, cavity fillings and flow bandings at places. Thin veins of iron oxide with a maximum of 1 cm width are ubiquitous along the fracture planes of this variety of rhyolite. The porphyritic variety of rhyolite is well exposed as hill near Mailawas village. It is characterized by the presence of alkali feldspar phenocrysts with varying dimensions. The measured maximum size of the feldspar phenocryst is 2.5 x 1 cm. Ground mass is typically dark colored, signifying the volcanic genesis of the rock.

3.2.2 **Siwana Granite** Siwana granite is the major intrusive granite exposed in the area. It is exposed as hills around Indrana, Mokalsar, Maliawas, Ludrara area. Mainly two varieties of granites are observed in the area. The pink coloured, porphyritic, alkali feldspar rich variety and grey coloured medium to coarse grained variety; both are found intruding into the volcanic phases with a sharp intrusive contact. These granites are characterized by their alkaline nature, well evident from the presence of alkali amphiboles and pyroxenes. The contact relation between the granite variants of the area appears to be diffusive in nature.

The grey coloured medium to coarse grained granite has more plagioclase component in comparison to the other variety. The coarse-grained alkali feldspar granite is mostly exposed in the south eastern part of the area with alkali feldspar as a major constituent along with quartz and mafics (alkali amphiboles and alkali pyroxenes). This granite exhibits the presence of rims of feldspar signifying the possibility of deuteric alteration or magmatic re– equilibration process. In this kind of granite, feldspars are observed as inclusions within mafic minerals as well.

3.2.3 **Dykes:** The youngest intrusive phases of the area are dykes intruded along the joint planes with discordant as well as sheet type field relation. Mainly two categories of dykes are observed in the area. The flesh colored, fine grained rhyolitic dykes are observed in various localities. Dark colored mafic dykes mostly observed associated with the granites have a typical discordant field relation. The maximum traceable length of the dyke is up to 400 m with variable width. Sub parallel flesh coloured dykes are exposed near Ludradra and Arjiyana villages. They have a typical anastomosing nature noticed at Ludrara. The dark coloured and relatively coarse grained mafic variety of dykes are commonly found in the granite hills of Mokalsar area.

4.0.0 PREVIOUS WORK

4.1.1 Blanford (1877) was the first person who coined the term 'Malani' for the volcanic rocks that comprises of porphyritic lavas and ash beds. Hacket (1881) also discussed the geology of the Malani volcanic suite. La Touche (1902) opined that Malani flows are mostly the acidic rhyolites. He concluded that Siwana granite has intruded the rhyolites. He described similar rocks as Malani occurring in other parts of the Rajasthan. Coulson (1933) used the term 'Malani System’ for these litho units and said Siwana hornblende granite occur more or less as continuous ring occupying the interiors of the volcanic area. As per Mukherjee (1958), the Siwana granite is a porphyritic coarse grained, hornblende bearing granite. Murthy et al. (1961) recorded presence of riebeckite and aegirine in the rhyolites and granites of the Malani Igneous suite of rocks. The ‘Siwana ring structure’ was established later by Murthy (1962). Majumdar (1976-78) opined there are enrichments of Nb (250 ppm), Y (700 ppm), La (500 ppm), Zr (1000 ppm) in Siwana Suite of rocks. Mukherji and Pyne (1977-78) proposed two and three phases of igneous activities in the rhyolites and Siwana granites respectively. The ring structure of Murthy (1962) around Siwana granite was later supported by Mukherji and Roy (1981). They said collapse of a caldera to the ring dyke intrusion and the structure was later modified by regional fold movement with NE-SW axial trend. Kochhar (1984) opined that Malani magmatism is related to the hot spot activity and cratonization process during the post-Delhi period. Bhushan (1985) pointed out that minor folds or faults present in the Malanivolcanics are related to the collapse structures, viscosity and drag of flows. Bimodal volcanism (basaltic and rhyolitic) was also reported by Bhushan and Mohanty (1988). Geochronological studies of Malani rhyolite say these are contemporaneous with the Erinpura granite (Srivastava, 1988). In the Siwana area, 45 volcanic flows were mapped by Chittora and Bhushan (1991-1992). The composition of older one varies from dacite/rhyodacite to trachytic whereas the younger one being rhyolitic or trachytic in composition. Chittora and Bhushan (1990-1994) said three phases of magmatic activity in Siwana area such as basal Peralkaline, middle meta-aluminous and top intrusives granite phase at the end. In and around Siwana area, earlier workers (Singh and Vallinayagam, 2013; Bhushan et al., 2013; Bidwai et al., 2014; Rastogi & Mukherjee, 2015;

4.1.2 Das et al., 2015; Barman and Neog, 2019; Kumar and Sharma, 2020) reported preferential enrichments of RERM (ΣREE+Y, ΣREE) mineralization in varied litho units such as alkali granites, micro granite, intrusive dyke systems and rhyolites. Rastogi& Mukherjee (2015) indicated anomalous REE values ranging from 1075 to 3319ppm. Singh and Vallinayagam (2013) reported about the potentiality of Siner granites and microgranites for hosting rare metal and rare earth mineralizations based on characteristics of certain pathfinder elements (Rb, Ba, Sr, K, Zr and Nb) and their elemental ratios (K/Rb, Zr/Rb, Ba/Rb). Bidwai et al. (2014) reported presence of high LREE, Zr, Nb, Th, U and Ag in the litho units of the Siwana Ring Complex. Das et al. (2015) reported 0.14 % to 0.75% ppm (in granite), 0.094% ppm to 0.47% (in rhyolite) and 0. 59% ppm to 2.19% (in felsites) of ΣREE+Y in Siwana Eastern Block. BRS from Indrana and Guranal areas shows ΣREE+Y values from 0.107% to 0.390%. Barman and Neog (2019) reported total REE+Y value in granite ranges from 0.018% to 0.86% ppm and 0.014% to 0.85% in volcanics of the study area. Based on integrated result they further highlighted three areas viz. one being between Mawri and Mokalsar railway station and other two to the east and west of Kalur Ka Danta which warrant G3 stage investigation. Kumar and Sharma (2020) reported ΣREE+Y values in various litho units such as granite (0.029% to 0.70%), alkali feldspar granite (0.047% to 0.66%), younger intrusives (0.019% to 2.66%), felsic volcanic (0.015% to 0.96%) and enclave/restite/soil (0.022% to 1.27%). They highlighted the areas around Maylawas, south of Gorian, south of Piplon and south of Guda nal are significant for future prospecting activities.

4.1.3 During the 2021–22 field season, large-scale geological mapping was conducted at a 1:12,500 scale in the Indrana–Siwana region, Barmer District, Rajasthan, covering Toposheet Nos. 45C/06 and 45C/10. The mapped area reveals exposures of both volcanic and plutonic litho-units. The volcanic phases are primarily represented by porphyritic and aphanitic varieties of rhyolite. Porphyritic rhyolite, mostly seen in the southeastern part of the area, contains prominent alkali feldspar phenocrysts, some reaching up to 2.5 x 1 cm in size. The aphanitic rhyolite, the most widespread volcanic rock, is characterized by a greenish-grey, fine-grained texture. The plutonic phases are dominated by grey, medium to coarse-grained granites, often containing two distinct feldspar varieties. Pink, coarse-grained alkali feldspar granite is typically observed in the southeastern hills, with a diffusive contact between different granite types. Intrusive dykes, both discordant and sheet-like, represent the youngest magmatic activity. These include flesh-colored rhyolitic dykes and darker, more mafic variants, some traceable up to 400 meters. Additionally, rare pegmatitic rocks with aegirine needles (up to 3.5 cm) were identified. Structurally, the area shows minimal deformation, with two major joint sets trending NNW–SSE and E–W. Petrographic observations confirm the presence of alkali feldspar, quartz, aegirine, arfvedsonite, perthite, and accessory minerals such as apatite, zircon, aenigmatite, astrophyllite, and riebeckite, indicating a subsolvus to hypersolvus granite system with late- to post-magmatic metasomatic overprints.

4.1.4 A comprehensive suite of samples was collected during the mapping, including 300 bedrock, 100 channel, 25 petrological, 20 petrochemical, 10 EPMA, and 5 XRD samples. Geochemical analysis indicates that the litho-units exhibit a peralkaline composition with an anorogenic tectonic setting. The volcanic rocks show intermediate to acidic silica saturation, and some suggest a comendite-pantellerite affinity. The plutonic granites are generally silica oversaturated and highly evolved, with significant geochemical differentiation. The REE data is particularly encouraging. Among the 300 bedrock samples, ΣREE+Y values range from 265.47 ppm to 8984.74 ppm, with 107 samples exceeding the mean value of 2446 ppm. The 100 channel samples returned ΣREE+Y values between 476.25 ppm and 8582.98 ppm. Granite samples yielded ΣREE+Y values ranging from 935.95 ppm to 7808.84 ppm, while volcanic rock samples showed a similar range. The HREE/LREE ratio in granites and volcanics averaged 0.19 and 0.18 respectively, suggesting light REE enrichment. Notably, the intrusive dykes showed the highest average HREE/LREE ratio (0.26), indicating potential for heavy REE enrichment. Additional trace element analysis revealed elevated concentrations of Zr (up to 10,173 ppm), Nb (up to 853 ppm), Zn (up to 920 ppm), Th (up to 77 ppm), and Hf (up to 666.41 ppm), underscoring the economic significance of the area.

4.1.5 Petrographic and EPMA analyses confirmed the presence of several primary rare earth element (REE) minerals, including **monazite**, **xenotime**, and **allanite**. These minerals occur as accessory phases within both granite and volcanic rock units. Their presence, along with favorable ΣREE+Y values and associated high-value trace elements, supports the interpretation of a late- to post-magmatic metasomatic or hydrothermal REE mineralization event in the region. These mineralogical indicators, in combination with the observed enrichment in total REE content, point to a robust and widespread REE-bearing system.

4.1.6 Based on the promising surface geochemical data and widespread distribution of ΣREE+Y and associated rare metals, detailed exploration is strongly recommended in specific blocks within the study area. The suggested blocks include:

(i) Arjiana–Ludrara Block,
(ii) Mokalsar–Maylawas East Block,
(iii) Mokalsar–Maylawas West Block,
(iv) Indrana South Block, and
(v) Indrana North Block.

These zones exhibit consistent geochemical enrichment and favorable geological settings for REE mineralization. Further exploration, including sub-surface sampling and geophysical investigations, is warranted to delineate potential resources and evaluate their economic viability.

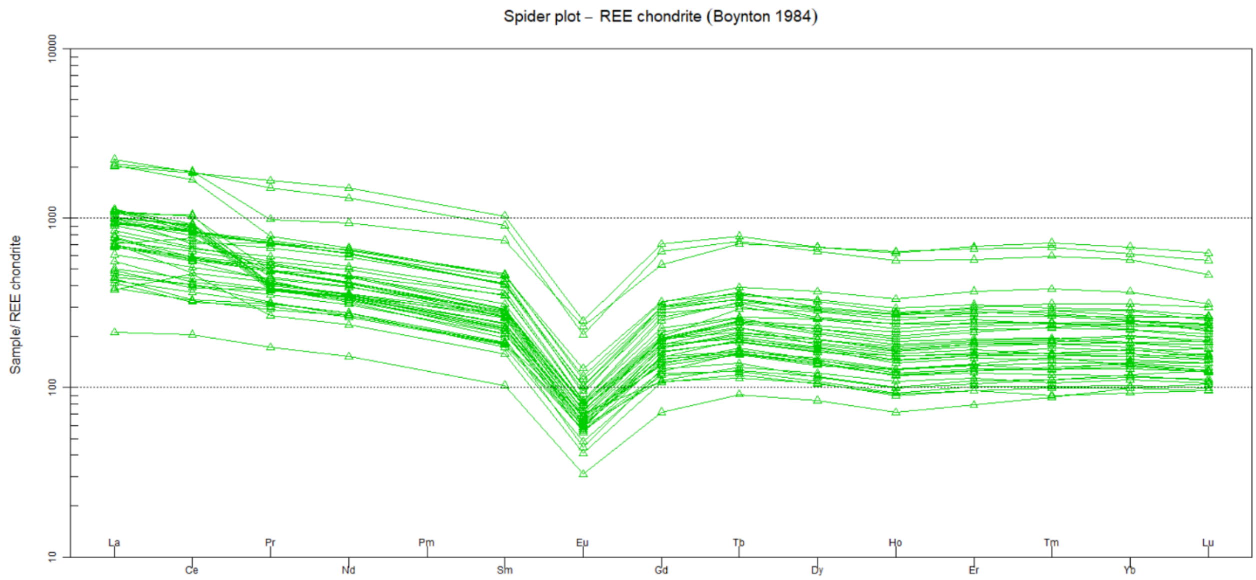
4.1.7 Based on the anomalous values of REE analysed for samples in the area and supported by previous investigations, an area of interest has been curved out near Ludrada village other than areas recommended by GSI as mentioned above. However, due to presence of cliff and to avoid exportation difficulties, two blocks names Ludrada North block and Ludrada South block has been prepared for further G3 stage of investigation of REE and associated minerals. The present exploration proposal is for Ludrada South Block.

5.0.0 MINERAL POTENTIALITY AND JUSTIFICATION FOR TAKING UP THE EXPLORATION

5.1.0 The proposed block has been carved out from the Indrana - Siwana area, which is characterized by a Neoproterozoic Siwana Ring Complex (SRC) composed of peralkaline rocks of the Malani Igneous Suite. These include rhyolite, granite, and late-phase microgranite and felsite dykes. The area is also known for its bimodal volcanics (acid and basic) and occurrence of REE minerals.

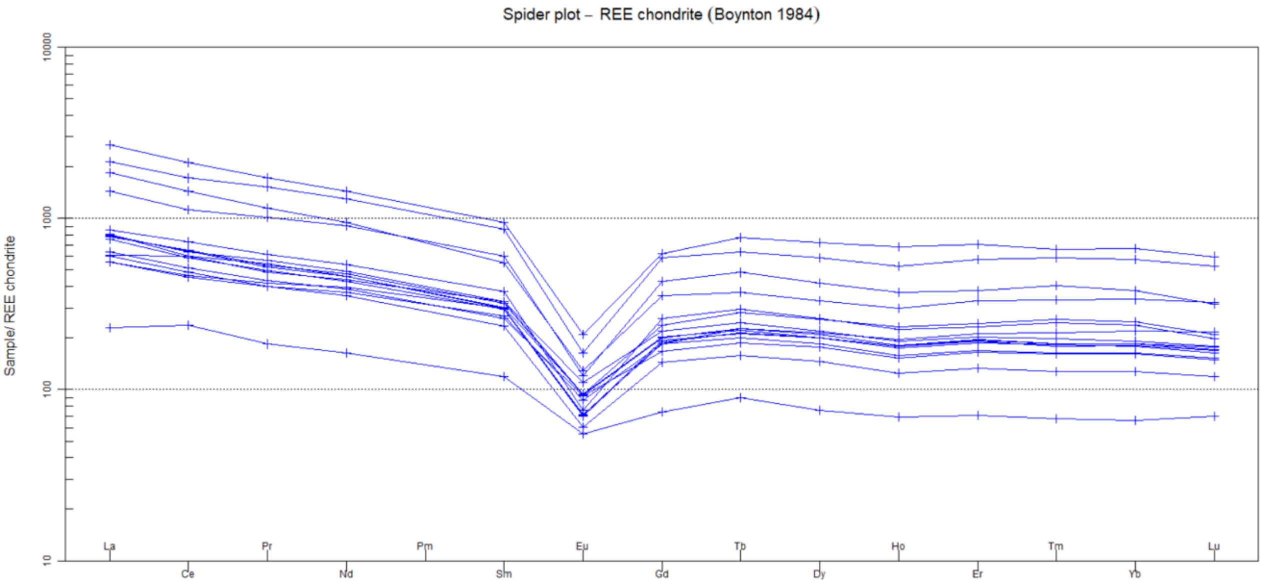
5.2.0 Petrographic and EPMA analyses confirmed the presence of several primary rare earth element (REE) minerals, including monazite, xenotime, and allanite. These minerals occur as accessory phases within both granite and volcanic rock units. Their presence, along with favorable ΣREE+Y values and associated high-value trace elements, supports the interpretation of a late- to post-magmatic metasomatic or hydrothermal REE mineralization event in the region. These mineralogical indicators, in combination with the observed enrichment in total REE content, point to a robust and widespread REE-bearing system.

5.3.0 During the G4 stage of exploration, a total 43 Nos of bed rock samples were collected from the granite. The ΣREE+Y analysis value range from 621.10 ppm to 5439.48 ppm, with mean of 2052.44 ppm. The standard deviation (SD) has been calculated as 1111.25 ppm. Out of 43 no of granite samples it has been observed there are 18 samples which are showing ΣREE+Y value more than mean value, there are 4 samples which are showing ΣREE+Y value more than mean + 1 SD value (3163.69 ppm) and same 4 nos of samples which are ΣREE+Y value more than mean + 2 SD value (4274.95 ppm).



5.3.0 The Chondrite normalized spider plot (Boynton 1984) reveals the flat trend of REE with slightly enriched LREE. The strong negative Eu anomaly has been observed in the diagram.

5.4.0 Similarly, during the G4 stage of exploration, a total 16 Nos of bed rock samples were analysed from the rhyolite. The ΣREE+Y analysis value range from 634.57 ppm to 6049.69 ppm, with mean of 2313.79 ppm. The standard deviation (SD) has been calculated as 1399.61 ppm. Out of 16 no of rhyolite samples it has been observed there are 4 samples which are showing ΣREE+Y value more than mean value, there are 2 samples which are showing ΣREE+Y value more than mean + 1 SD value (3713.40 ppm) and same 1 nos of samples which are ΣREE+Y value more than mean + 2 SD value (5113.01 ppm).



5.5.0 The Chondrite normalized spider plot (Boynton 1984) for samples analysed from rhyolites reveals the flat trend of REE with slightly enriched LREE. The strong negative Eu anomaly has been observed in the diagram.

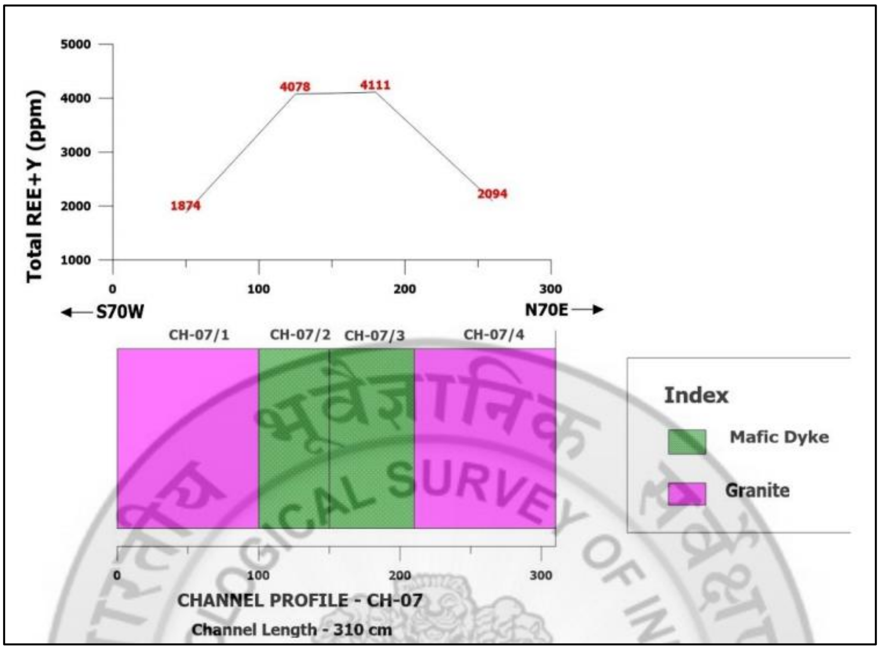
5.6.0 The summarized distribution of REEs and other trace elements from the rhyolite and granite has been represented in the table below

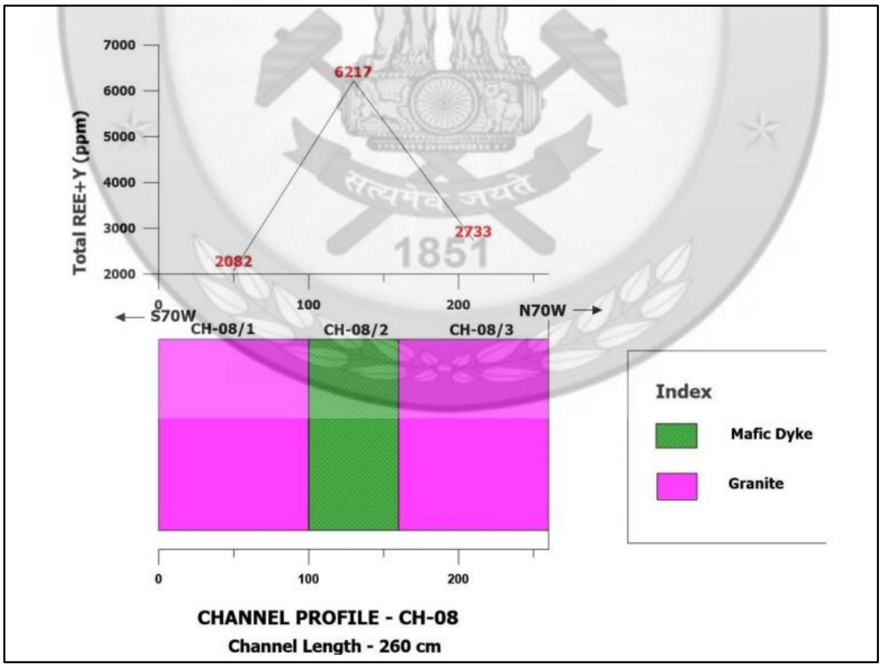
Table No 4

Table Showing summarized statistics of analysis of elements of the collected Bed rock samples (N=60)

Element	Minimum Value (ppm)	Maximum Value (ppm)	Mean Value (ppm)
Y	137.02	1653.84	493.62
La	65.59	831.27	284.19
Ce	165.99	1712.26	618.62
Pr	21.05	210.52	69.66
Nd	91.62	901.46	299.14
Sm	20.07	201.27	66.32
Eu	2.26	18.21	6.44
Gd	18.58	182.30	59.64
Tb	4.27	37.09	12.75
Dy	24.47	233.23	77.64
Ho	4.98	49.16	15.45
Er	14.91	148.59	47.94
Tm	2.20	23.17	7.45
Yb	13.82	141.72	47.21
Lu	2.25	19.98	6.74
LREE	366.58	3824.58	495.53
HREE	86.05	808.26	113.60
ΣREE+Y	621.10	6049.69	2112.81
Hf	24.82	443.29	108.83
Ta	2.18	31.55	9.55
U	1.60	30.27	9.15
Cu	19.00	43.00	29.95
Ga	42.00	82.00	60.43
Nb	131.00	662.00	246.83
Pb	14.00	109.00	36.18
Rb	122.00	341.00	207.90
Sc	1.00	9.00	4.08
Sr	59.00	91.00	70.45
Th	35.00	77.00	43.53
V	32.00	178.00	75.68
Zn	174.00	594.00	287.38
Zr	728.00	9576.00	2609.60
Be	9.36	42.48	19.05
Ge	1.62	4.94	2.64
Mo	0.66	8.51	3.46
Sn	8.24	199.59	52.31

5.7.0 Moreover, during the G4 stage of exploration, 3 no of channels, i.e., CH-6, CH-7 and CH-8 were cut on the outcrop. Total 13 nos of samples were generated from these three channels. It has been observed that ΣREE+Y values in the channels varying from 476.25 ppm in Dyke to 6216.72 ppm also in dyke, However, in granites ΣREE+Y values is varying from 1184.94 ppm to 2732.70 ppm with an average of 1894.69 ppm.





5.8.0 Based on the anomalous values of REE analysed for samples in the area and supported by previous investigations, the proposed Ludrada area has been curved for further G3 stage of investigation of REE and associated minerals. But, dur to presence of vertical hill in the area, the identified area has been divided into Ludarada North Block and Ludrada South Block having avoiding the central cliff due to exploration difficulty. The present proposal is for the Ludrada South Block.

6.0.0 PLANNED METHODOLOGY

Based on the evaluation of geological data available, the present exploration program has been formulated to fulfill the following objectives:

i. To carry out detail geological mapping on 1:2000 scale for distribution of REE mineral bearing formation.

ii. To collect systematic bedrock and channel samples for analyses 34 elements by IC-PMS which include REE to understand the distribution on primary source.

iii. To carry out systematic drilling of boreholes at 200 m interval in accordance to MEMC rule to establish subsurface occurrence of REEs.

iv. To establish the inferred category resource for REE bearing minerals as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.

The details of different activities to be carried out are presented in subsequent paragraphs.

6.1.0 GEOLOGICAL MAPPING

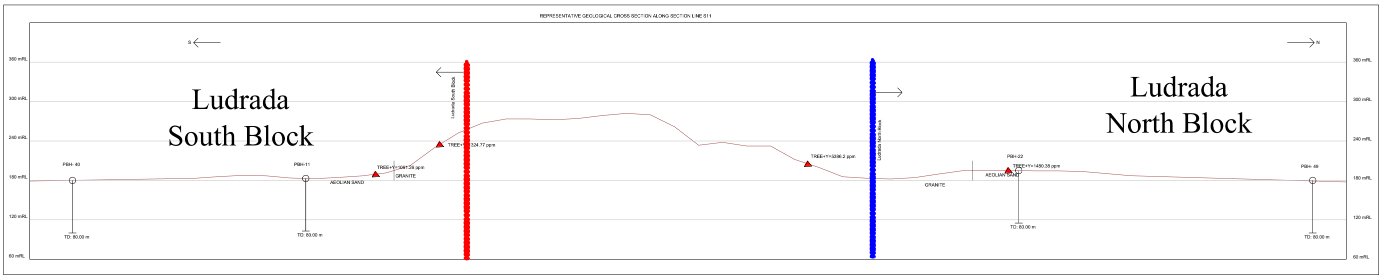
6.1.1 Geological mapping will be carried out in the entire 2.75 sq.km area on 1:2000 scale. Rock types, their contact, structural features will be mapped. Surface manifestations of the mineralization (REE) available along with their surface disposition will be marked on map.

6.2.0 GEOCHEMICAL SAMPLING

6.2.1 **Bed Rock Sampling:** 80 nos. of bedrock samples by means of chipping or channel will be collected systematically in grid pattern during mapping from the various lithounits present in the area, to understand the distribution of REE in granite, rhyolite and mafic dykes.

6.3.0 EXPLORATORY DRILLING

6.3.1 Exploratory drilling has been planned in systematic manner in 200 m interval as specified in MEMC rule. Vertical boreholes have been planned and drilling will be carried for intersection of mineralization upto the vertical depth of 60 m from the foothill average Rl. Thus, a total 31 Bhs has been planned with average depth of 80 m each due to presence of alluvium cover. Hence a total 2480 m drilling quantum is proposed for G3 stage of exploration of Ludrada South Block. However, initially 7 Bhs will be drilled in 400 m X400 m grid. Subsequent drilling will be decided after review of outcomes of these boreholes. A representative cross section is furnished below.



6.3.2 Borehole Geophysical Logging: 50% of the drilled borehole will be logged by Dual Density, Spectral gamma, SP and Resistivity method to identify the potential REE mineralized zones which will lead to precise sampling.

6.3.3 **Borehole Samples:** Core sampling is carried out after detailed core and geophysical logging of the borehole. Since the REE & RM mineralization cannot distinguished easily by naked eye or petrographic studies, sampling can be done on the basis of the mineralized zone established on surface by channel sampling, the geophysical inferred zones delineated during geophysical borehole logging. The sample interval is kept at 1m. However, to avoid mixing of samples of different lithologies, variable lengths samples may be collected near to the litho contacts. Taking into account of the G3 stage exploration carried out in the adjacent areas, nearly 60% of the drilling length may be sampled. Moreover, the first borehole will be sampled completely. Hence a provision of 1500 Nos of borehole core samples have been kept in the quantum.

6.4.0 Chemical Analysis

6.4.1 All the 1580 nos of samples including bedrock samples (80 Nos) and borehole core samples (1500 Nos) will be subjected to chemical analysis of Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, Rb, Zr, Ge, Sr, Sn, W, V, Be, Ga, Nb, Mo, Pb, Li, Cs, U & Th through ICPMS at MECL's chemical laboratory facility Nagpur.

6.4.2 20 Nos of samples will be subjected to whole rock analysis through XRF.

6.4.3 10% of primary samples, i.e., 125 nos will be analysed at NABL accredited laboratory as external check sample and will be analysed for Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, Rb, Zr, Ge, Sr, Sn, W, V, Be, Ga, Nb, Mo, Pb, Li, Cs, U & Th through ICPMS.

6.5.0 PETROLOGICAL STUDIES:

6.5.1 During the course of Geological mapping, drilling and sampling 15 nos. of samples from outcrops and borehole core samples of various lithounits will be collected for Petrographic Studies.

6.6.0 XRD STUDY

6.6.1 To know the different mineral phases which can possibly host REE, 30 samples will be studied by XRD method. The samples for XRD will be selected from the samples which will analyze higher values of REE in bedrock, channel and core samples

6.7.0 EPMA Study

6.7.1 EPMA study on different REE and silicate phases will be carried out in few silicate samples.

6.8.0 Specific Gravity

30 Nos of samples will be subjected to specific gravity analysis.

Details of the particular, Quantum and the targets are tabulated in **Table No.-5**

Table No- 5

Envisaged Quantum of proposed work

Sl. No.	Item of Work	Unit	Target
1	**Detail Geological Mapping** (on 1:2,000 Scale)	Sq km	2.75
2	**Topographic Survey** (on 1:2,000 Scale)	Sq km	2.75
3	**Surface Geochemical Sampling**		
i	Bedrock samples	Nos	80
4	**Core Drilling**		
i	Systematic Drilling in 200 m interval (25 Bh X 80 m Depth)	m	2480
ii	Borehole Geophysical logging	m	1240
iii	Borehole Core Sampling	Nos	1500
5	**Laboratory Studies** (34 elemental analysis by ICPMS Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, Rb, Zr, Ge, Sr, Sn, W, V, Be, Ga, Nb, Mo, Pb, Li, Cs, U & Th		
	i)Primary Samples	Nos	1580
	ii) External Check Samples	Nos	158
	iii) Bedrock samples for Major oxides by XRF	Nos	20
6	**Petrological Samples**	Nos	15
7	**XRD Mineral phase analysis**	Nos	30
8	**EPMA studies**	Hrs	10
9	**Specific Gravity**	Nos	30
9	**Report Preparation (5 Hard copies with a soft copy)**	Nos.	1
10	**Preparation of Exploration Proposal (5 Hard copies with a soft copy)**	Nos.	1

7.0.0 BREAK-UP OF EXPENDITURE

7.0.1 Tentative Cost has been estimated based on Schedule of Charges (SoC) of projects funded by National Mineral Exploration Trust (NMET) w.e.f. 01/04/2020. The total estimated cost is **Rs. 649.41 Lakhs.** The summary of cost estimates for preliminary exploration (G-3) is given in **Table No. - 6.** The detailed cost sheet is given as Annexure-I.

Table No. 6

Summary of cost estimates for Preliminary Exploration (G-3) in Ludrada South Block, District- Balotra, Rajasthan

Sl. No.	Item	Total Estimated Cost (Rs.)
1	Geological Mapping (LSM), Other Geological Work and Survey	5,494,120
2	Geophysical Survey	0
2	Drilling	33,544,759
3	Laboratory Studies	13,878,403
4	**Sub Total (1 to 4)**	**52,917,282**
5	Exploration Report Preparation	1,587,518
6	Proposal Preparation	500,000
7	Peer review charges	30,000
8	**Sub Total (1 to 7)**	**55,034,800**
9	GST 18%	9,906,264
10	**Total:**	**64,941,064**
	Say Rs. In Lakh	**649.41**

8.0.0 TIMELINE

8.0.1 The entire project is planned tentatively for 15 months. Initially, geological mapping, geophysical survey and surface bedrock sampling shall be carried out followed by drilling provided positive results are obtained in the first phase of sampling.

Table No. 7

Tentative Time schedule / Action plan

Estimated timeline for Preliminary Exploration (G-3) for REE and associated minerals in Ludrada South Block, Districts: Balotra, State: Rajasthan [Block area- 2.75 sq. km; Schedule timeline- 15 months]

S. No.	Particulars	Months/ Days	1	2	3	4	5		6	7	8	9	10		11	12	13	14	15
1	Camp Setting	**months**	■																
2	Geological Mapping & BR sampling	**months**	■	■	■														
3	Geophysical Survey	**Months**		■	■	■	■												
4	Topographic Survey	**months**			■	■													
5	Core Drilling	**m**		■	■	■	■	**REVIEW**	■	■	■	■		**REVIEW**					
6	BH Geophysical Logging	**m**		■	■	■	■		■	■	■	■							
7	BH Core Sampling	**Nos**			■	■	■		■	■	■	■							
8	Camp winding	**months**											■						
9	Laboratory Studies	**months**					■		■	■	■	■	■		■	■			
10	Report Writing with Peer Review	**months**														■	■	■	■

9.0.0 List of Plate :

1. Location Map of Ludrada South Block, District Balotra, Rajasthan
2. Large Scale Geological Map of Ludrada South Block, District Balotra, Rajasthan
3. Large Scale Geological Map of Ludrada South Block with BRS sample location with analysis value of ΣREE+Y
4. Proposed Borehole location map of Ludrada South Block
5. Representative Geological Cross section for proposed Boreholes in Ludrada South Block, District Balotra, Rajasthan

Estimated cost for Preliminary Exploration (G-3) for REE and associated minerals in Ludrada South Block, Districts: Balotra, State: Rajasthan Block area- 2.75 sq. km; No of BH:31, Average Depth of BH: 80 m, Total Drilling : 2480 m Schedule timeline- 15 months, Review: after 05 months and 10 months							
Sl. No.	Item of Work	Unit	Rates as per NMET SoC 2020-21		Estimated Cost of the Proposal		Remarks
			SoC- Item- S. No.	Rates as per SoC	Qty.	Total Amount (Rs)	
A	**GEOLOGICAL WORK**						
1	**Geological Mapping (1:2000)**						
	Geologist man days (1 No.) for Geological map & Report (HQ)	days	1.1b	9,000	60	540,000	
	a) Geologist man days (2 No) for Large scale (LSM) Geological mapping/Channel Sampling/ Drilling	days	1.2	11,000	180	1,980,000	
	b) Labour (field)	per worker	5.7	541	360	194,760	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
	c) Sampler for Suface Samples/ Trench Samples / Core Samples Labour charge not included (1 sampler)	day	1.5.2	5100	220	1,122,000	Total 1758 Nos of Samples / 8 Nos of sample per day =220 Days
	d) 4 labours/ party (As per rates of Central Labour Commissioner)	day	5.7	541	880	476,080	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
2	**Survey**						
i	Bore Hole Fixation and determination of co-ordinates & Reduced Level of the boreholes by DGPS	Per Point of observation	1.6.2	19,200	37	710,400	31 Core Drilling Boreholes and 6 Boundary Points
ii	Charges of one qualified surveyor with Total Station for carrying out topographical survey in different RF and surface contouring at different interval	days	1.6.1a	8,300	45	373,500	Contouring at 2 m interval for preparation of base map on 1:2000 scale
iii	4 labours/ party (As per rates of Central Labour Commissioner)	days	5.7	541	180	97,380	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
					Sub-Total A	**5,494,120**	
B	SURFACE GEOPHYSICAL SURVEY						
i	Gravity - Magnetic Method	Per Station	3.1b	4500	0	-	
ii	Geophysicist Man days for interpretation in HQ	days	3.2	9,000	0	-	
					Sub-Total B	**-**	
C	**DRILLING**						
i	Core Drilling upto 300m Hard Rock	per m	2.2.1.4a	11,500	2,480	28,520,000	31 Nos of BH with 80 m Depth =2480 m In first phase 8 BHs will be taken up with 400m interval. Subsequent drilling will be after review.
ii	Land / Crop Compensation (in case the BH falls in agricultural Land)	per BH	5.6	20,000	31	620,000	Amount will be reimbursed as per actuals or max. Rs. 20000 per BH with certification from local authorities
iii	Construction of concrete Pillar (12"x12"x30")	per borehole	2.2.7a	2,000	31	62,000	
iv	Borehole plugging by cement	m	2.2.7b	150	2,480	372,000	
v	Transportation of Drill Rig & Truck associated per drill	Km	2.2.8	36	4,400	158,400	2 Rig Transport, 1100 Km from nagpur to Ludrada
vi	Monthly Accommodation Charges for drilling Camp (Rs 50000/- per Month upto 2 rigs, 50% Additional Charge for additional rigs)	month	2.2.9	50,000	7	350,000	2 Rig Operation
vii	Drilling Camp Setting Cost	Nos	2.2.9a	250,000	2	500,000	
viii	Drilling Camp Winding up Cost	Nos	2.2.9b	250,000	2	500,000	
ix	Road Making (Flat Terrain)	Km	2.2.10a	22,020	5	110,100	Amount will be recalculated after Completion of Tender Process
x	Drill Core Preservation	per m	5.3	1,590	1,000	1,590,000	
xi	Borehole Geophysical logging (5 BHs of 350m each) (In House)	5 BHs of 350m each	3.12	1,088,941	0.70	762,259	5 BH X350m =1750m , Geophysical logging will be dine on 50% of boreholes
					Sub Total- C	**33,544,759**	
D	**LABORATORY STUDIES**						
1	**Chemical Analysis**						
	i) Primary Samples for 34 elemental analysis by ICPMS Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, Rb, Zr, Ge, Sr, Sn, W, V, Be, Ga, Nb, Mo, Pb, Li, Cs, U & Th	per sample	4.1.14	7,731	1580	12,214,980	Bed Rock Sample: 80 BH Core Sample: 1500 Tentative. The sampling plan will be firnalised after 1st phase of drilling.
	ii)External Check Samples for 34 elemental analysis by ICPMS Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, Rb, Zr, Ge, Sr, Sn, W, V, Be, Ga, Nb, Mo, Pb, Li, Cs, U & Th	per sample	4.1.14	7,731	158	1,221,498	10% of primary samples
	iii) Major Oxides by XRF Method: CaO, MgO, K2O, SiO2, Na2O, P2O5, Al2O3, Fe2O3, SO3 & LOI	per sample	4.1.15a	4200	20	84,000	
2.0	**Petrological / Mineralographic studies**						
	a) Preparation of thin section	per sample	4.3.1	2,353	15	35,295	
	b) Study of thin section for petrography	per sample	4.3.4	4,232	15	63,480	
	c) Digital photomicrograph of thin polished section	per sample	4.3.7	280	20	5,600	
3	XRD Mineral Phase Analysis	per sample	4.5.1	4,000	30	120,000	
	Specific Gravity	per sample	4.8.1	1,605	30	48,150	
4	EPMA Studies	per hour	4.4.1	8,540	10	85,400	
					Sub-Total D	**13,878,403**	
					Total (A TO D)	**52,917,282**	
E	**Geological Report Preparation**	**Nos**	**5.2**	For the projects having cost exceeding Rs. 300 Lakhs: A minimum of ₹ 9 lakh or 3% of the value of work whichever is more subject to a maximum amount of ₹ 20 lakh and ₹ 10,000/- per each additional copy.	**1**	**1,587,518**	
F	**Preparation of Exploration Proposal**	**Nos**	**5.1**	2% or Rs. 500000 whichever is less	**1**	**500,000**	EA has to submit 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.
G	**Report Peer Review Charges**	**lumpsum**	**As per EC decision**	**30000**	**1**	**30,000**	
H	**Total Estimated Cost without GST**					**55,034,800**	
I	**Provision for GST (18%)**					**9,906,264**	GST will be reimburse as per actual and as per notified prescribed rate
J	**Total Estimated Cost with GST**					**64,941,064**	
					Say, in Lakhs	**649.41**	
Note:							
*	Marked items not indicated in SoC and required to be taken up during the course of exploration shall be charged separately (as peractuals)						
$	Trenching/Pitting dimensions are tentative may vary depending upon the geology and field conditions						
#	2nd level of work shall be carried out after review of 1st level work i.e. Geological mapping, geochemical sampling and analysis						