

Proposal for
Prospecting scale work (G3) for REE and associated Rare Metals in the NB 1 block of the
northern part of the Siwana Ring Complex, Balotra district, Rajasthan

(REE and associated rare metals)

By

Hindmetal Exploration Service Pvt. Ltd.

Place: Udaipur

Date: 24th November 2025

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Features	Details
Block Name	NB1 Block, Siwana Ring Complex
Exploration Agency	Hindmetal Exploration Services Pvt. Ltd.
Commodity	REE and associated rare metals
Mineral Belt	Siwana Ring Complex
Completion Period with entire Time schedule to complete the project	07 months
Objectives	To explore REE and associated rare metal in Siwana ring complex.
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	M/s. HESPL would carry out major work based on in-house capabilities. Inhouse and outsource work details will be provided in budget sheet.
Name/ Number of Geoscientists	3-Geologist, 1-Geophysicist and 1-consultant
Expected Field days	Geologist: ~ HQ-75 man-days, Field~300 mandays Geophysicist: ~ 52 (HQ + Field), Consultant: 30 days



	(Geology) Geological Party Days	Geological Party Days: Approximately 07 months
1.	Location	Dist. Balotra, Rajasthan
	Latitude (N)	25.736245° to 25.752243°
	Longitude (E)	72.348048° to 72.362563°
	Localities	Siwana Town
	Tehsil/ Taluk	Siwana
	District	Balotra
	State	Rajasthan
2.	Area (hectares/ square kilometers)	2 Sq.km.
	Block Area	2 Sq.km.
	Forest Area	NA
	Nearest Rail Head	Balotra
	Road	NH-325
	Airport	Jodhpur
4.	Hydrography	
	Local Surface Drainage Pattern (Channels)	
	Rivers/ Streams	
	Mean Annual Rainfall	280mm



	Temperatures	Minimum (December): 20-29 °C Maximum (June): 46-51°C
6.	Topography	Topographically, the area is plain, agriculture land & linear hill exposures.
	Topo sheet Number	45 C/05, 45C/06
	Morphology of the Area	Mostly flat and elevated ridges
7.	Availability of baseline geoscience data	Geological map (1: 50000), Geochemistry (soil and stream) Geophysics (Regional Airborne Mag) and Radiometrics
	Geological Map (1:50K/ 25K)	1:50,000 scale after GSI
	Geochemical Map	NGCM data available (NGCM, GSI, 2*2 km grid)
	Geophysical Map (Aeromagnetic, ground geophysical, Regional/ local scale GP maps)	Regional Airborne Magnetic, Airborne Radiometrics
8.	Justification for taking up reconnaissance survey / Regional Exploration	REE and associated rare metal <ul style="list-style-type: none"> Continuity of regional of magnetic units. Spectrometric anomalies Geochemical analysis of samples LREE/HREE ratio

Block Summary

This block falls in Survey of India Toposheet no. 45C/05 and 45C/06 of Balotra district, Rajasthan. The nearest railway station is at Mokalsar and Balotra is situated at 35km northwest from study area. The field area is approachable from Jaipur and Jodhpur by train and bus up to Balotra. Further Balotra to study area is connected by roadways and local bus and auto services. Metalled, un-metalled road & Dirt connects the different villages of study area. However, township, high settlement areas are mostly accessible by metalled road Topographically, the area is plain, agriculture land & linear hill exposures. Geologically, the area is a part of Siwana Ring Complex (SRC) of Malani Igneous Suite (MIS). Location Map is given in Figure.1.

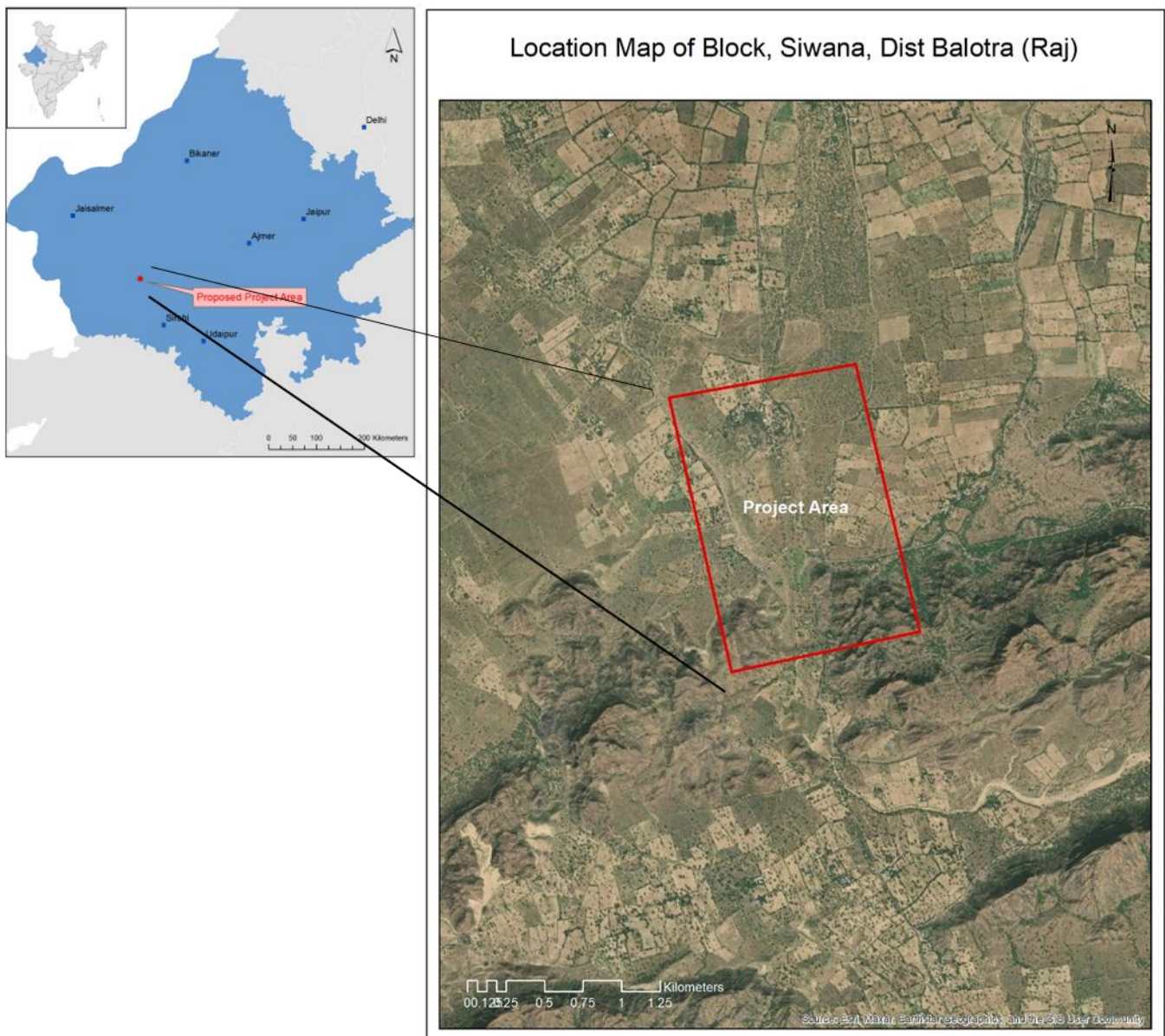


Figure 1: Location Map of the NB-1 Block

Physiography & Climate

The area is plain, undulated and rugged in places. Barmer district is situated in Thar Desert with an average rainfall 277 mm per annum and represents arid climatic conditions. 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 ° C at night.

Background Geology (Regional Geology, Geology of the Block)

Regional geology

The magmatic evolution of Siwana Ring Complex, part of Neoproterozoic Malani Igneous Suite (MIS); ca. 771±2 Ma (Torsvik *et al.* 2001), 745 Ma (Dhar *et al.*, 1996; Rathore *et al.*, 1999) can be divided into three phases (Kumar and Sharma, 2020). First phase is represented by bimodal volcanism of acid and basic flows (acid flows > basic flows). It is intruded by second, plutonic phase comprising arfvedsonite-reibeckite-aegirine bearing per-alkaline Siwana Granite. The third phase being later intrusive phase includes rhyolite, microgranite, andesite and felsite dykes. All these three phases host anomalous ΣREE+Y concentration and the third phase is more enriched (Kumar and Sharma, 2020). Peralkaline igneous rocks, carbonatites, feldspathoid bearing rocks are the main source of REE minerals (± HFSE, U & Th etc) and therefore are suitable host for targeting REE/RM mineralisation. Peralkaline granites, volcanics and associated zoned pegmatoids are considered to be storehouse of REE and rare metals (Nb-Ta, Zr-Hf, Sn, W, Be) (Pollard, 1995) and in layered intrusions, the mineralisation mostly appears in the more evolved parts of the complexes (Dostal, 2017).

In the Western Indian Craton of Rajasthan, basement rocks and overlying supracrustal belts of Aravalli and Delhi Supergroups have witnessed magmatic events of volcanics and granitoids of Palaeo- to Neo-Proterozoic ages. Granitoids of different ages (~ 1.8 Ga, ~1.7 Ga, ~1.4 Ga, ~ 1.1Ga and 850-750 Ma) have intruded these belts. MIS magmatism occurred during Neoproterozoic age and comprises peralkaline (Siwana), metaluminous to mildly peralkaline (Jalore) and peraluminous (Tusham and Jhunjhunu) granites with cogenetic carapace of acid volcanics (welded tuff, trachyte explosion braccia and perlite) and is characterised by volcano-plutonic ring structure and radial dykes (Singh and Vallinagayam, 2009). Three phases in Siwana magmatic activity are widely observed: i) the basal peralkaline (lower 24



flows), ii) middle meta-aluminous (top 21 flows), and iii) reappearance of peralkaline phase as intrusives (Siwana granite) at the end (Chittora and Bhushan, 1994).

Super group		Age in Ma.
Marwar Supergroup		550 – 500 Ma
Upper Vindhyan Supergroup (Jodhpur Sandstone)		~700 – 600 Ma
Malani Igneous Suite	Siwana, Jalore, Tusham, Jhunjhunu (India), Kirana Hills (Pakistan)	732 Ma
Erinpura Granite		900 Ma
Delhi Supergroup		1600 – 900 Ma
-----Unconformity-----		
Aravalli Supergroup		2200 – 1800 Ma
-----Unconformity-----		
Bhilwara Supergroup		2900 – 2600 Ma
Mewar Gneiss		3300 – 3000 Ma

Table- 5.1: Generalized Precambrian Tectono-Stratigraphy of Aravalli Craton, India. (Stratigraphy after Roy,



Geology of the Block area:

The mapped area, in northern half, is mainly constituted by linear ridges of predominantly acidic flows interlayered with few basic flows. In general, flow trends show elliptical pattern sloping gently towards core of the ellipse, supporting ring structure. The rhyolite country rock is later intruded by both felsic and basic dykes, which show arcuate and radial pattern with respect to ring structure. These cross-cutting dykes are observed around Nimle-Kerli- Ramdev and around Sainji-ki-Beri, SE of Meli and Muthli area. Peralkaline aegirine-arfvedsonite bearing Siwana granite is exposed and occupies southern, eastern and western periphery of SRC. In northern half, the granite is exposed around north-eastern part around NNE of Meli; in eastern

part around Mawri and in western part around Indrana respectively. The southern half of SRC is constituted by granite ridges forming Chhappan-ka-Pahar comprising maximum width of about six km. South of Chhappan-ka-Pahar, a mass of felsic-volcanic flows are exposed widespread from Dhiran in east to Kundal, Ghor Mera Pani and Siner in the west. In general, the slope of the flows is gently towards north. Depending upon rock types and field observations in the area, the present authors suggest that there are broadly two phases of igneous activities. **Phase I** is comprising of ‘**Flow phase**’ which is followed by ‘**Dyke phase**’ within flows, while **Phase II** is represented by intrusive ‘**Granite phase**’ and later intrusive **Microgranite phase**.

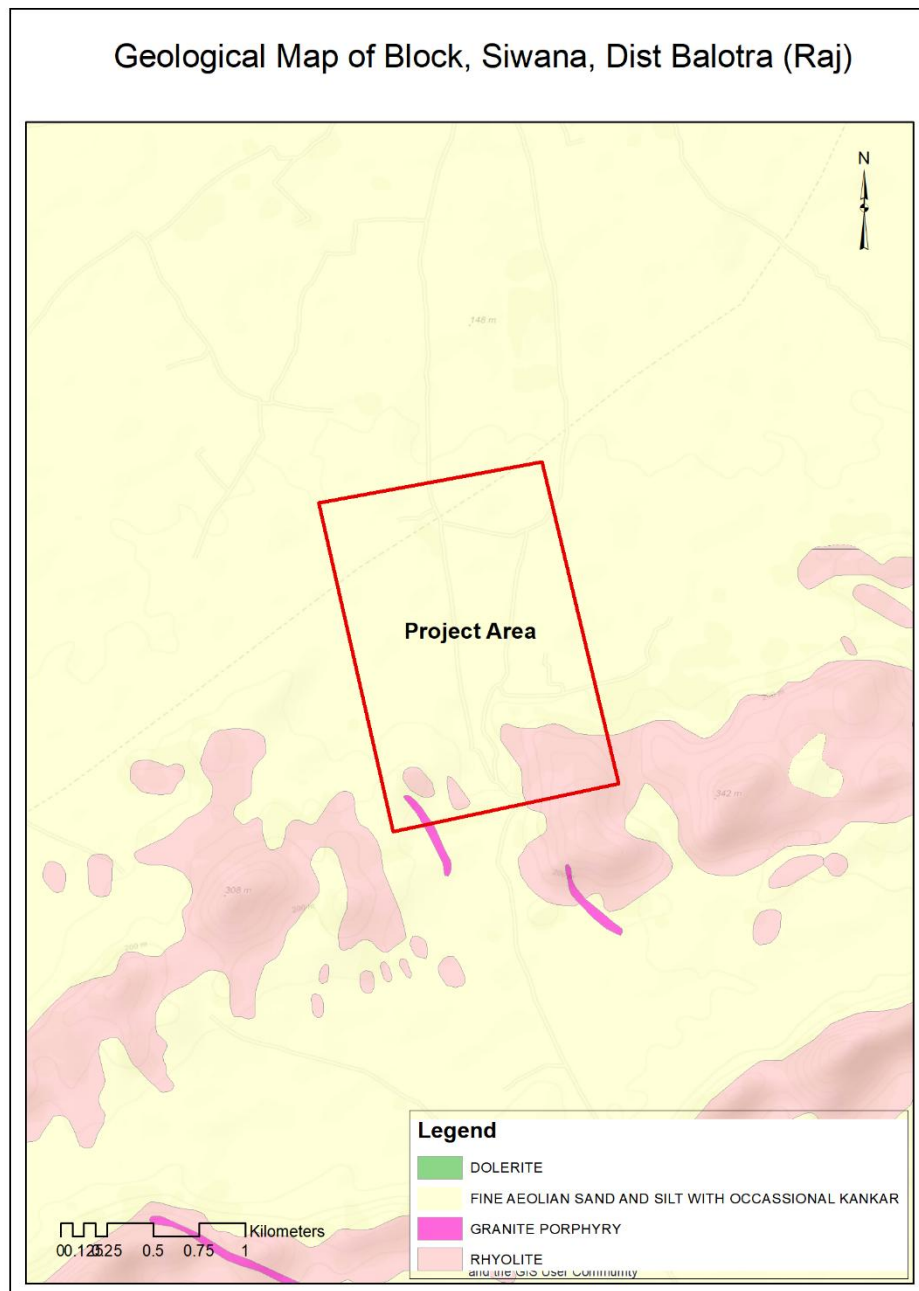


Fig.2: Geological map of NB-1 Block for G3 level work

Regional Geophysics:

1. Magnetic Survey:

Regional magnetic surveys show circular to arcuate magnetic anomalies, reflecting the ring-dyke structure of the complex. High magnetic signatures are associated with mafic dykes and syenitic intrusions, while low magnetic zones correspond to peralkaline granites and carbonatites, which are favourable hosts for rare earth element (REE) and niobium (Nb) mineralization.

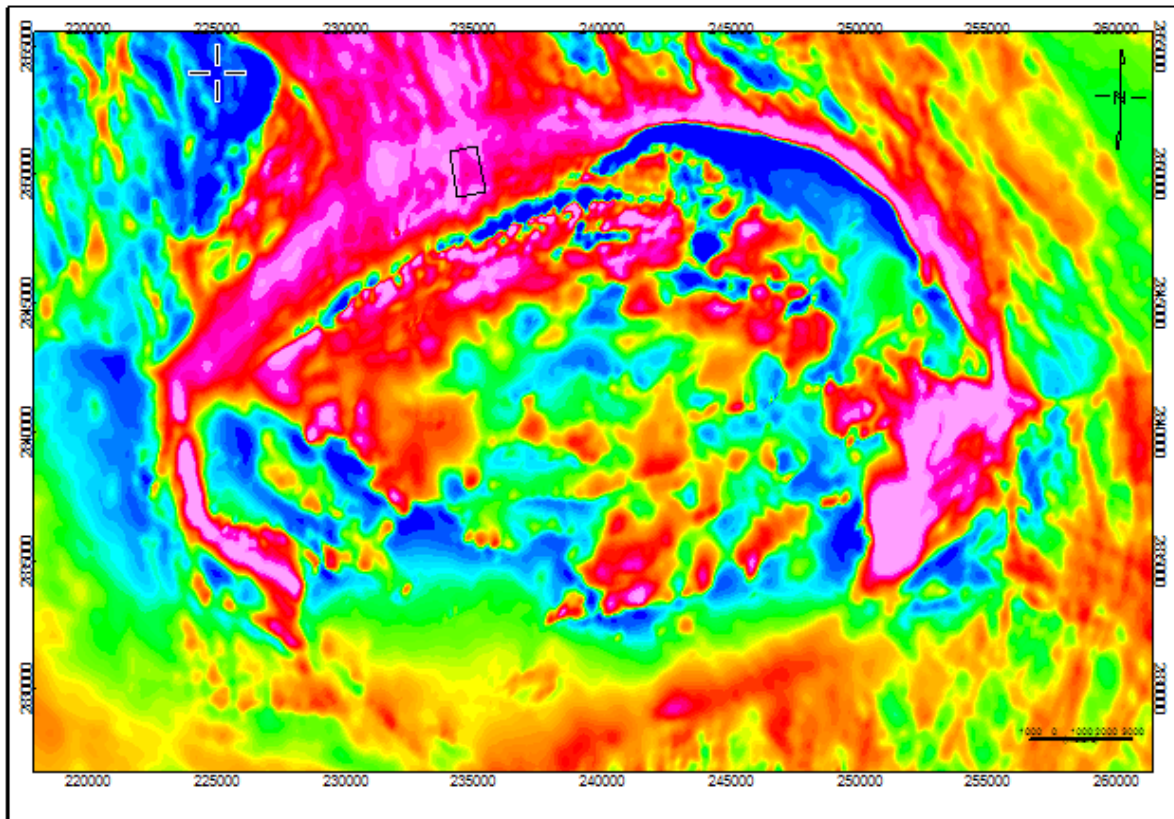


Figure 3: Airborne RTP Magnetic Map around NB-1 Block (black polygon)

2. Radiometric Survey:

Airborne radiometric surveys over the Siwana Ring Complex (SRC), Western Rajasthan reveal strong thorium, uranium, and potassium anomalies that coincide with peralkaline granites, syenites, and carbonatites. These results confirm the complex's high potential for rare earth element (REE) and niobium (Nb) mineralization. High thorium (Th) and uranium (U) counts were recorded, especially along the southern and central parts of the ring complex. Potassium (K) anomalies correlate with feldspar-rich peralkaline granites. These anomalies are spatially linked to REE-bearing minerals such as bastnäsite, monazite, and zircon.

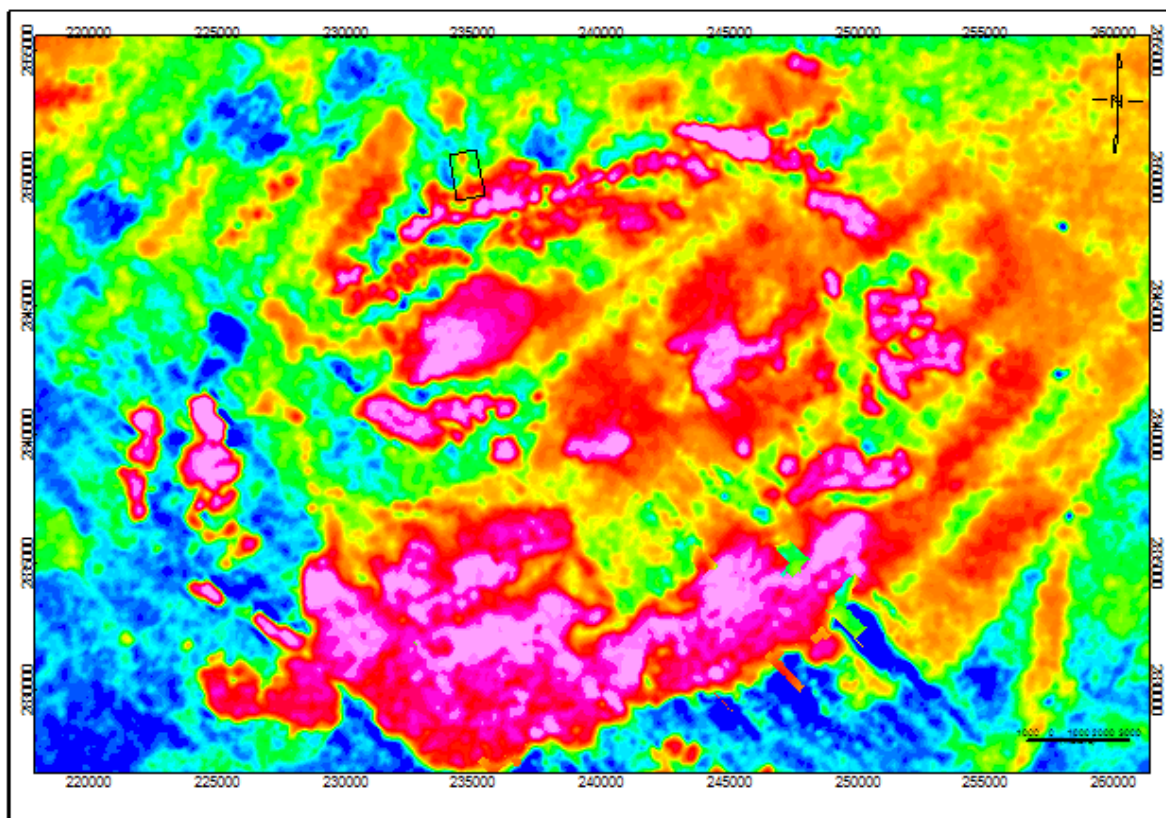


Figure 4: Airborne Radiometric Map around NB-1 Block (black polygon)

Previous work in Block:

Preliminary sampling of the rhyolites and associated tuffs of Siwana Ring Complex, Balotra district, carried out by GSI during 2013-14, indicated anomalous REE values with ΣREE ranging from 1334 to 3319ppm ΣREE (Rastogi & Mukherjee, 2015). Bidwai *et al.*, 2014, reported the presence of high LREE, Zr, Nb, Th and U along with Ag in surface samples in the Siwana Ring Complex. Das *et al.*, 2015, carried G4 investigation in Siwana eastern and central block. Kumar and Sharma, 2020, carried out G-4 investigation and reported $\Sigma\text{REE}+\text{Y}$ ranges in various lithounits are i) Plagioclase rich granite (n=79) $\Sigma\text{REE}+\text{Y} = 0.029\%-0.70\%$. ii) K-feldspar rich granite (n=116) $\Sigma\text{REE}+\text{Y} = 0.047\%-0.66\%$. iii) Younger Intrusives (n=146) $\Sigma\text{REE}+\text{Y} = 0.019\%-2.66\%$. iv) Felsic volcanic (n=43) $\Sigma\text{REE}+\text{Y} = 0.015\%-0.96\%$ and v) Enclave/Restite (n=19) $\Sigma\text{REE}+\text{Y} = 0.022\%-1.27\%$. LREE/HREE ratio indicates that LREE>>HREE in the area and LREE values ranges between 86.45ppm to 1.93%, however, HREE values ranges between 23.94ppm to 0.26%. LREE:HREE ratio in Siwana area is 4:1 approximately. Apart from REE, rare metals and some trace elements also indicate very encouraging results, Zr (0.1% to 1.1%), Nb (2.5ppm to 1039ppm), Ba (25ppm to 3948ppm), Zn (120ppm to 1258ppm), U (0.61ppm to 124ppm), Th (2ppm to 481ppm) and Hf (4.52ppm to 828.18ppm).

Barman and Neog, 2018 mapped the peralkaline – peraluminous granite (A type) and in the Siwana area extending from Mokalsar in the east to Siner in the west through Mawri, Gugrot, Piplun, Goliyan Bhairan and Kalur Ka Danta area. REE bearing carbonates

(perisite) and phosphates (monazite) were identified in both plutonic and volcanic rock types. In addition to REE bearing mineral phases, haematite, ilmenite and zircon are also identified from both plutonic and volcanic phases. The granite recorded values ranging from 182.77 ppm to 8611.11 ppm and the average being 2006.95 ppm (count=84). The volcanic recorded values ranging from 142.3 ppm to 8502.50 ppm, average value being 2008.03 ppm (count=116). Sukleswar Ka Mandir (G3) block yields tREE upto 2901ppm in microgranite dyke, 2121 ppm in alkali feldspar granite and 2996ppm in andesite.

Lal and Ghosh, 2021 carried out large scale geological mapping (1:12500 scale) at the northern periphery of the Siwana Ring Complex, stretching from Sainji ki Beri to Meli area. They marked 32 nos. of rhyolitic flows along with several felsic dykes in the area. Several flows are found to be highly enriched in tREE concentration. Chemical analysis data from rhyolite samples of study area yielded $\Sigma\text{REE}+\text{Y}$ values ranging from 91.76ppm to 9764.68ppm, with average value of 1844.84ppm. $\Sigma\text{HREE}/\Sigma\text{LREE}$ ratio of the same is 0.15. 22 BRS samples from felsic/rhyolite dykes yielded $\Sigma\text{REE}+\text{Y}$ values ranging from 144.77ppm to 7678.75ppm, with average value of 1400.14ppm. $\Sigma\text{REE}+\text{Y}$ value in channel samples ranging from 261.73 to 6224.81ppm, with $\Sigma\text{HREE}/\Sigma\text{LREE}$ ratio of 0.19. Flow no. 14 and 15 are highly enriched REE flow of rhyolite in the area. In the proposed block $\Sigma\text{REE}+\text{Y}$ in flow no. 15 ranges between 2213.43ppm to 8027.71ppm with maximum value of LREE 5079.52ppm and maximum value of HREE 992.05ppm. In flow no. 14, $\Sigma\text{REE}+\text{Y}$ ranges between 6944.16ppm to 7528.11ppm with maximum LREE 4848.19ppm and maximum HREE 941.11ppm. Remote Sensing and Aerial Survey for toposheet no. 45C/06 and 45C/10 were carried out by RSAS Division, GSI, Bangalore, during FS. 2017-18. Aeromagnetic maps help in delineating the regional continuity of magnetically susceptible lithounits of Siwana Ring Complex even under soil-covered terrain. Spectrometric maps of potassium and thorium further suggest that the proposed area possesses good potential for rare earth element (REE) mineralization in exposed area.

Mineral potentiality of the block:

- Anomalous REE values with ΣREE ranging from 1334 ppm to 3319 ppm after GSI, 2013-14.
- Potential lithology and younger granites which are the host for REE and associated metals
- Aeromagnetic and spectrometer anomalies

Scope of the present exploration:

Proposed exploration program will focus on detailed geological and geophysical work over allotted area to upgrade the block from G4 to G3 stage. Preliminary Drilling will also be executed based on quality targets identified in block.

The exploration task flow is proposed to be done in two phases, each having distinct tasks and milestone. A summary of activities for both phases of the proposed exploration is given below:

Phase I (Approximately 7 months):

For the total block area (2 sq.km.) initial assessment will be performed by litho-structural mapping (1:2,000 scale) and geochemical survey. After geological mapping and sampling results within area, geophysical survey (ground magnetic, radiometric) will be carried out to identify anomalous mineralised targets.

This phase will consist of 750 m core drilling in 05 boreholes and thereafter the chemical and petrographic analysis of the core samples will be carried out. Core drilling will help to identify and characterise potential mineralized zones.

Interpretation, report preparation and final submission of project.

Phase II (Approximately 6 months):

Based on exploration results of Phase -I, data will be presented and peer reviewed for execution of drilling (Phase-II). The proposed budget for phase – II will be submitted post completion of Phase-I programme.

Exploration program timelines are given in table.1 below.



Timeline:

	Time Schedule /Action Plan for Reconnaissance survey (G3) for Basemetal and associated minerals around Village Lakher, Arniya Salarwas District, Jaipur Rajasthan									
Sl. No	Activities		MONTHS							
		1	2	3	4	5	6	7		
1	Geological Mapping (1:2000)									Review
2	Geochemical Survey (Rock chip, Trench, Channel)									
6	Geophysical Survey									
4	Sample Analysis (samples)									
5	Petrographic Studies									
3	HQ Data processing/ Interpretation & Review									
7	Drilling									
8	Lab Analysis of core samples									
9	Peer Review									
10	Final Report Submission									
	NOTES									
1	Commencement of project may be reckoned from the day the exploration acreage is available along with all statutory clearances.									
2	Time loss on account of monsoon/agricultural activity/forest clearance / local law & order problem/ lockdown etc. will be additional to above timeline.									
3	After completion of Phase -I exploration and based on encouraging results, Phase – II drilling programme will be executed.									

Table.1: Timeline for execution of exploration Program

Proposed Budget:

Exploration budget for execution of exploration program is given below in table.2. This budget has been proposed for phase-1 exploration program. Based on success of exploration results, separate budget will be presented for approval for phase-2 program.

Summary of cost for Prospecting scale work (G3) for REE and associated Rare Metals in the NB 1 block of the northern part of the Siwana Ring Complex, Balotra district, Rajasthan	
Proposed Head Of Activities	Amount (In INR)
GeoPhysical Survey	25,09,344
GeoChemical Survey	4,16,700
Geological Mapping	54,08,040
Lab Testing Charges	1,97,88,300
Drilling Cost	1,41,99,140
Tendering Process cost	5,00,000
Operational Charges for outsource Project	42,000
Exploration Proposal Preparation	3,80,000
Report Preparation	20,00,000
Peer review	50,000
GST @18%	81,52,834
Total Proposed Charges	5,34,46,358

Table.2: Summary of proposed cost for execution of exploration Program

References:

- 1) NGDR Portal (<https://geodataindia.gov.in/>)
- 2) Report on “Reconnaissance survey for Rare Earth Elements mineralization in and around Chhappan-ka-Pahar, Siwana Ring Complex (SRC), Siwana area, Barmer district, Rajasthan” (Stage: G4), GSI.
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- 12) Rastogi S. K. and Mukherjee T., 2015. Specialized thematic mapping of the Malani Igneous Suite (MIS) around Siwana, Barmer district, Rajasthan. GSI, Unpublished Report, F.S. 2013-15.
- 13) Rathore, S.S., Venkatesan, T.R., Srivastava, R.K. 1999. Rb-Sr isotope dating of Neoproterozoic (Malani Group) magmatism from southwest Rajasthan, India: evidence 82 of younger pan African thermal event by ^{40}Ar – ^{39}Ar studies. *Gondwana Research* 2, 271–281.
- 14) Singh, A.K. and Vallinayagam, G., 2009. Radioactive element distribution and rare-metal mineralization in anorogenic acid volcano-plutonic rocks of the Neoproterozoic Malani Felsic Province, Western Peninsular India. *Jour. Geol. Soc. India*, v.73, pp.837-853.
- 15) Torsvik T. H., Ashwal L. D., Tucker R. D. and Eide E. A. 2001. Neoproterozoic geochronology and palaeogeography of the Seychelles micro-continent: The India link; *Precamb. Res.* 110 47–59.



Annexure: Detailed Activitywise Break-up of Exploration Program

Detailed list of activities for Prospecting scale work (G3) for REE and associated Rare Metals in the NB 1 block of the northern part of the Siwana Ring Complex, Balotra district, Rajasthan								
S.No	Item of Work	Unit (UOM)	No	Days	Months	Total Qty	Base Rate	Amount
1	Geo Physical Survey							-
	Magnetic Survey	No of Stations	812	1	1	812	1,800	14,61,600
	Ground Radio Metric Survey	Per Line Km	21	1	1	21	20,000	4,20,000
	Geophysict Cost - Geophysical Activity - HQ	Per Day	1	26	2	52	9,000	4,68,000
	Technician Charges / Skilled labour	Per Day	1	26	1	26	5,100	1,32,600
	Labour Charges-Magnetic	Per Day	2	26	1	52	522	27,144
2	Geo Chemical Survey / Geological Activities							-
	Pitting & Trenching	per cu m	50	1	1	50	3,330	1,66,500
	XRD Analysis	Per Sample	10	1	1	10	4,000	40,000
	EPMA Analysis	Per Hour	10	1	1	10	15,000	1,50,000
	PS (Petrological Studies) Analysis	Per Sample	10	1	1	10	6,020	60,200
3	Pre-Drilling Activities							-
	Geologist Cost - HQ	Per Day	1	25	3	75	9,000	6,75,000
	Geologist Cost - Field	Per Day	2	25	6	300	11,000	33,00,000
	Cosultant Cost (Geologist Cost - HQ)	Per Day	1	30	1	30	9,000	2,70,000
	Labour	Per Day	3	25	6	450	522	2,34,900
	Technician / Sampler	Per Day	1	25	6	150	5,100	7,65,000
	Lab Testing Charges (Rock Chip+Soil Sampling)	Samples	20	1	1	20	8,157	1,63,140
4	Drilling / Post Drilling Activities					0		-
	Drill Core Sample Preparation	Per meter	750	1	1	750	5,100	38,25,000
	Sample testing- (Drilling + Surface)	Per meter	900	1	1	900	8,157	73,41,300
	Quantitaive REE Analysis - by ICP MS Analysis	Per Sample	900	1	1	900	5,380	48,42,000
	Oxides testing by XRF	Per Sample	900	1	1	900	4,200	37,80,000
	Specific Gravity of rock Sample	Per Sample	750	1	1	750	1,605	12,03,750
	Land Compensation	Per Borehole	5	1	1	5	20,000	1,00,000
	Drill Rig Transportation - To & Fro	Kms	580	1	1	580	36	20,880
	Drilling Camp Setting Cost	Per Drill Site	1	1	1	1	2,50,000	2,50,000
	Drilling Camp Winding Cost	Per Drill Site	1	1	1	1	2,50,000	2,50,000
	Monthly Accomodation Charges	Monthly	1	1	5	5	50,000	2,50,000
	Drill Core Preservation Charges	Meters	750	1	1	750	1,590	11,92,500
	Approach Road to Drill site	Per Km	0.5	1	1	0.5	22,020	11,010
	Drilling - Upto 75 Mtr - HQ -Phase 1	Meters	375	1	1	375	15,180	56,92,500
	Drilling - Above 75 Mtr - NQ - Phase 1	Meters	375	1	1	375	12,650	47,43,750
	Borehole deviation Survey	Meters	750	1	1	750	330	2,47,500
	Concrete Pillar Construction	Per Borehole	5	1	1	5	2,000	10,000
	Borehole Plugging - HQ	Meters	375	1	1	375	200	75,000
	Borehole Plugging - NQ	Meters	375	1	1	375	150	56,250
	Borehole Fixation Survey (DGPS)	Per point of observation	5	1	1	5	19,200	96,000
5	Other Charges							
	Tendering Process cost	One time	1	1	1	1	5,00,000	5,00,000
	Operational Charges for outsource Project	For Radio metric survey	1	1	1	1	42,000	42,000
	Exploration Proposal charges	One time	1	1	1	1	3,80,000	3,80,000
	Geological report Preparation Charges	Assumed for 1 report	1	1	1	1	20,00,000	20,00,000
	Peer Review Charges		1	1	1	1	50,000	50,000
	GST@18%		1	1	1	1	-	81,52,834
Total Amount								5,34,46,358