Regional Consolidation and Rapid Subsurface Screening for REE and RM and associated mineral in RSRC A block (86 Sq KM) in the Siwana Ring Complex, Balotra Dist, Rajasthan

By

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S.No	Features	Details
1	**Block ID**	RSRC-A
2	**Exploration Agency**	Shijay Projects India Pvt. Ltd.
3	**Commodity**	First-order REE–RM and systematic REE mineral phase assessment
4	**Mineral Belt**	Siwana Ring Complex
5	**Completion Period with entire Time Schedule to complete the project**	18 Months
6	**Objectives**	The primary objective of the proposed study in **Block RSRC-A (Siwana Ring Complex)** is to carry out **rapid and systematic subsurface screening of soil-covered terrain** through an integrated programme of **ground geophysical surveys and shallow exploratory drilling**, with the aim of: • Delineating **depth to bedrock and subsurface lithological architecture** • Identifying **concealed intrusive bodies and structural controls** associated with mineralization • Generating **geophysical and geochemical proxies** for Rare Earth Elements (REE) and associated critical minerals (RM) • Prioritizing **fertile zones for follow-up G3 stage exploration** • Contributing to **regional mineral system understanding and data integration** The study is designed to **de-risk exploration in**

S.No	Features	Details
		covered domains and enable **targeted, cost-effective advancement toward resource delineation** in line with national critical mineral exploration objectives.
7	**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 outsourcing agency**	Entire work will be carried using inhouse facility.
8	**Name/ Number of Geoscientists**	4
9	**Expected Field days (Geology)** **a. Geological Party Days**	NA
	b. Geophysical Party Days	150
	c. Surveyor (DGPS) – to be associated with Geophysicist Party Days	150
	Drilling (1375m) – Drilling Period	5 Months
10	**Location**	
	Latitude and Longitude	

Datum-WGS-84, UTM Zone-43N		
Name	**Easting(m)**	**Northing(m)**
A	228574.9	2851350.9
B	232147.5	2851662.1
C	234580.5	2851608.5
D	234559.6	2850605.3
E	232559.8	2850646.8
F	232516.5	2848644.1
G	230517.5	2848685.9
H	230476.2	2846679.4
I	228476.4	2846729.9
J	228434.7	2844724.2
K	232433.9	2844645.0
L	232445.9	2845628.2

S.No	Features	Details		
		M	234453.4	2845607.4
		N	234434.3	2844608.7
		O	232347.9	2840650.6
		P	230346.2	2840687.5
		Q	230330.3	2839682.9
		R	226330.2	2839759.9
		S	226350.8	2840766.3
		T	224348.9	2840806.9
		U	224329.4	2839801.6
		V	222328.9	2839844.9
		W	222366.7	2841845.8
		X	220371.8	2841885.4
		Y	220394.7	2842883.9
		Z	222394.7	2842845.5
		AA	222422.1	2844256.9
		AB	223707.3	2846820.8
		AC	226476.2	2846765.6
		AD	226518.8	2848765.1
		AE	224705.2	2848801.8
		AF	225698.0	2850782.7
		AG	226561.5	2850762.9
		AH	228519.9	2848724.6
	Villages	Sindhari Cluster		
	Tehsil/ Taluk	Sindhari		
	District	Balotra		
	State	Rajasthan		
11	**Area (hectares/ square kilometers)**			
	Block Area	86 Sq. Km		
12	**Accessibility**			
	Nearest Rail Head	Balotra Railway Station (~60–70 km approx.)		
	Road	The block is accessible via: • **NH-68 (Barmer–Jodhpur Highway)** • Internal **PWD roads from Sindhari toward nearby villages**		

S.No	Features	Details
	Airport	Jodhpur Airport (~150–170 km approx.)
13	**Hydrography**	
	Local Surface Drainage Pattern (Channels)	The project area exhibits a sub-dendritic to inland drainage pattern, characterized by ephemeral, low-order channels (seasonal nalas) with low drainage density. Surface runoff is monsoon-controlled, and channels typically terminate in local depressions or sandy plains, indicating endorheic basin conditions. Drainage morphology is strongly influenced by aeolian landforms and micro-relief, resulting in discontinuous and poorly integrated flow paths.
	Rivers/ Streams	The project area does not host any perennial river or stream. The nearest significant drainage system is the Luni River, located approximately 60–80 km from the site. The local hydrology is characterized by ephemeral seasonal nalas, which remain dry for most of the year and carry runoff only during monsoon rainfall events.
14	**Climate**	
	Mean Annual Rainfall	The project area receives a mean annual rainfall of approximately **250–300 mm**, with the majority occurring during the southwest monsoon season (July–September). Rainfall is highly variable and episodic, often resulting in short-duration, high-intensity events typical of arid environments.
	Temperature	The project area experiences a **hot arid climate**, with summer temperatures reaching **46–51°C during May and June** and winter temperatures ranging between **8°C and 25°C in December and January**. The region exhibits **high diurnal temperature variation** and is

S.No	Features	Details
		prone to **intense heatwave conditions during peak summer months**
15	**Topography**	The area is covered with **rugged topography** with scanty isolated outcrops of granite in a semicircular fashion. **The highest peak is 498m msl** and **the lowest peak is 125 m msl**. This area is characterized by **arcuate ridges** arranged in a **semicircular fashion.**
	Toposheet Number	45C/5, 45C/6 and 45C/2
	Morphology of the Area	The project area is characterized by **low-relief, gently undulating desert terrain** dominated by **aeolian landforms**, including **linear and barchan sand dunes interspersed with interdunal plains**. Localized **alluvial patches and shallow depressions (playas)** are present, reflecting limited fluvial activity under arid climatic conditions. The morphology is primarily controlled by **wind action**, with minor influence from seasonal surface runoff
16	**Availability of baseline geoscience data**	
	Geological Map (1:50K/ 25K)	Available
	Geochemical Map	Available
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	Aero Geophysical Available
17	**Justification for taking up Reconnaissance Survey / Regional Exploration**	The **Siwana Ring Complex (SRC)** has been identified as a **highly prospective peralkaline igneous province** with significant potential for **Rare Earth Elements (REE), particularly Heavy Rare Earth Elements (HREE), and associated critical minerals such as**

S.No	Features	Details
		Niobium (Nb). **The later intrusive dykes intruding the granite and rhyolite at the periphery of Siwana Ring Complex** are even **more enriched with REE potential.** Within the framework of India's **Critical Minerals Mission**, systematic exploration of SRC is of **national strategic importance** to support supply security of critical minerals. A major portion of SRC is **covered by thick soil/sediment (up to ~150 m)**, which restricts direct geological mapping and surface-based targeting. • The **RSRC-A block falls within this priority category (~330 sq. km identified zone)** • These covered terrains represent **underexplored but high-potential domains** Out of ~725 sq. km prospective area: • Only ~141 sq. km is under active exploration • ~584 sq. km remains available • ~330 sq. km (including RSRC-A) prioritized for **geophysics + shallow drilling** RSRC-A represents part of this **critical "gap area"**, making it a **high-impact exploration block**

Detailed Description of the Proposed Block of Siwana Ring Complex, Barmer District, Rajasthan Province (G-3 level) for Mineral Exploration under NMET for REE–RM

1. **Block Summary**

   a. **Physiography**

      i. **Topography and Geological Formation -** The RSRC-A block is situated within the western Thar Desert terrain and is characterized by low-relief, gently undulating topography dominated by aeolian landforms. The area comprises sand dunes, interdunal plains, and localized alluvial patches.

      Geologically, the block forms part of the Siwana Ring Complex (SRC), a peralkaline igneous suite consisting of alkali granites, syenites, rhyolites, and associated intrusive phases, largely concealed beneath thick soil and sediment cover (locally up to ~150 m).

      ii. **Geological Setting -** The Siwana Ring Complex represents a Proterozoic anorogenic magmatic complex, known for its peralkaline affinity and enrichment in incompatible elements.

      Key geological characteristics include:

      - Presence of alkaline to peralkaline intrusive bodies
      - Association with ring structures, fractures, and deep-seated lineaments
      - Favourable environment for Rare Earth Elements (REE), especially HREE, and rare metals such as Nb, Zr, and Y

      The RSRC-A block lies within a **soil-covered segment of this complex**, where direct geological observations are limited.

      iii. **Major Physiographic Features -** The block exhibits typical desert geomorphology, including:

      - Linear and barchan sand dunes (wind-controlled)
      - Interdunal plains (relatively stable and accessible zones)
      - Shallow depressions/playas (runoff accumulation zones)
      - Alluvial plains associated with ephemeral drainage

      These features reflect dominant aeolian processes with minor fluvial influence.

iv. **Drainage Pattern -** The drainage system is **poorly developed and ephemeral** in nature.

- **Drainage Type:** Sub-dendritic to inland (endorheic)
- **Channel Characteristics:**
  - Seasonal nalas (active only during monsoon)
  - Discontinuous and shallow channels
- **Drainage Density:** Low due to high infiltration and low rainfall
- **Regional Influence:** The area falls within the broader influence of the **Luni River basin**, though no perennial stream traverses the block.

v. **Elevation Profile –**

- **Elevation Range:** ~100 to 200 m above mean sea level
- **Relief:** Very low (<50 m local variation)
- **Slope:** Gentle (<1–2°), controlled by dune morphology and micro-relief

The terrain is largely **planar with localized undulations due to dune systems**.

vi. **Mineral Resources** - The Siwana Ring Complex is recognized for its **significant potential for critical and strategic minerals**, including:

1. **Rare Earth Elements (REE)** (particularly Heavy REE)
2. **Niobium (Nb)**
3. **Zirconium (Zr)**
4. **Yttrium (Y)**

Existing exploration has confirmed **favourable geochemical signatures and mineral occurrences**, while large parts of the area, including RSRC-A, remain **underexplored due to cover conditions**.

vii. **Background of the block**

As per the deliberations of the Technical-cum-Cost Committees (TCC-I & TCC-II) of NMEDT, the Siwana Ring Complex has been identified as a **priority area for regional consolidation and rapid subsurface exploration**.

Out of the total **~725 sq. km prospective area**, a significant portion remains unexplored, particularly **~330 sq. km of soil-covered terrain (>10 m overburden)**.

Average concentration for Zr, Nb, Y, tREE, Hf and Ta in bed rock samples of granites is 5529ppm, 278ppm, 850ppm, 2710ppm, 207ppm and 16.3ppm respectively. Average concentration for Zr, Nb, Y, tREE, Hf and Ta in petrochemical samples of granites is 5972ppm, 311ppm, 990ppm, 2489ppm, 257ppm and 24ppm respectively. Average concentration for Zr, Nb, Y, tREE, Hf and Ta in channel samples of granites is 6582ppm, 278ppm, 763ppm, 2400ppm, 259ppm and 21.1ppm respectively. All these elements are found at least ten times their crustal abundance. Average tREE+ Y concentrations for core samples of Borehole numbers RJBNK-1 to RJBNK-07 is 3212ppm, 3075ppm, 2157ppm, 1933ppm, 3335.6ppm, 1708ppm and 2535ppm respectively. The highest tREE and Y values observed in core samples are 6700ppm and 3962ppm respectively in granites. LREE: HREE ration in Siwana area is 4:1 approximately. Out of 403 samples analysed, Σ REE+Y ranges between 2.2%-2.6% in 3 samples, 1.0%-1.8% in 9 samples, 0.50 to 0.98% in 36 samples, 0.10% to 0.49% in 258 samples and <0.1% in rest of the samples. 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).

The RSRC-A block (~86 sq. km) has been delineated within this priority zone for:

- **Ground geophysical surveys**

The proposed study in Block RSRC-A of the Siwana Ring Complex is designed to enable rapid and systematic subsurface screening of a predominantly soil-covered terrain through an integrated ground geophysical programme. The area, known for its alkaline intrusive setting and potential for Rare Earth Elements (REE) and associated critical minerals, requires high-resolution geophysical investigation to overcome the limitations posed by poor surface exposure. The primary objective is to develop a robust subsurface geological framework that can guide subsequent exploration and drilling activities.

The study will cover a total area of 86 sq. km using detailed ground gravity and magnetic surveys with a grid spacing of 100 m × 200 m, ensuring adequate spatial resolution to detect subtle variations in subsurface density and magnetic susceptibility. Gravity data acquisition will focus on delineating depth to bedrock, mapping density contrasts, and identifying buried intrusive bodies, while magnetic surveys will be instrumental in imaging lithological variations, structural features,

and magnetically susceptible zones associated with alkaline and carbonatitic intrusions. Together, these datasets will provide complementary insights into the subsurface lithological architecture.

An integrated interpretation workflow will be adopted, combining gravity and magnetic datasets with available geological and remote sensing information. Advanced processing techniques such as regional-residual separation, derivative analysis, and 2D/3D inversion modelling will be employed to enhance anomaly resolution and depth estimation. These methods will help delineate structural controls such as faults, fractures, and ring structures that are often associated with emplacement of mineralized intrusions.

- **Shallow drilling programmes**

The block has been allocated to enable **systematic evaluation of concealed geological features and mineralization potential**. 11 Drill holes have been planned of cumulative minimum 1375m for minimum 125m depth at each drill hole. in 2nd phase, each drill holes are planned in 4 sq km, having 15 drill holes of 125m depth, total cumulative depth is 1875m. In 3rd phase each drill holes are planned in 2sq km, i.e; total 20 drill holes of 125m depth, cumulative drill holes are of 2500m. Hence in 3 phase cumulative no of drill holes are 46 and cumulative meter is 5750m, can be considered as 6000m.

b. Mineral potentiality based on geology, geophysics, ground geochemistry etc. Scope for proposed exploration

In the north of Indrana village ΣREE+Y values of 7441 ppm (BRS – 186), 7809 ppm (BRS – 181) 5491 ppm (BRS – 194) 4667 ppm (BRS 195) in a granite dominated lithology is a promising zone for further exploration. The TREE & TREE+Y concentration of 422ppm & 445ppm observed in a soil sample collected from soil profiles near buriwara village.

LREE: HREE ration in Siwana area is 4:1 approximately. Out of 403 samples analysed, Σ REE+Y ranges between 2.2%-2.6% in 3 samples, 1.0%-1.8% in 9 samples, 0.50 to 0.98% in 36 samples, 0.10% to 0.49% in 258 samples and <0.1% in rest of the samples. 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).

Presence of REE bearing mineral monazite mostly containing radioactive elements contribute to the total count in the study area. The hilly areas containing mostly acidic rocks show higher

radiation values as compared to basic or background rocks. The radiation comes from the surface and sensor can detect atomic minerals up to few centimetres from surface.

c. Observation and Recommendations of previous work

Recommendation In light of the synthesis of scientific data generated through large scale mapping, petrographic study and chemical analysis of various geological units of Indrana – Siwana area following recommendations are made 1. Detailed exploration is recommended in the following blocks on the basis of surface distribution of ΣREE+Y and RM values surrounding of Indrana village, REE and RM mineralization at deeper level may be established by deep drilling. 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 potential. Detailed work is needed to identify more dykes of microgranite/felsites and to identify locale for REE and rare metal potential. • The unique occurrence of REE mineralization in felsites dykes of Siwana Eastern block indicates total REE ranging from 0.17% to 3.49% and U upto 169.25 ppm, Th upto 761 ppm, Nb upto 1468 ppm, Zr upto 9957 ppm, Hf upto 428.8 ppm, W upto 49.6 ppm and the Pb+Zn upto 0.18%. The deeper level extension of these felsite dykes may be established by drilling.

Cost Sheet

Projects - Regional Consolidation and Rapid Subsurface Screening for REE and RM and associated mineral in RSRC A block (86 Sq KM) in the Siwana Ring Complex, Balotra Dist, Rajasthan

Block Area - 86 Sq Km
Schedule Time - 18 Months

S. No.	Job Description	Unit	Rates as per NMEDT SoC (2025-26)		Estimated Cost of the Proposal	
			SoC-Item Sl	Rates as per SoC (2025-26)	Qty.	Total Amount (Rs)
Phase I						
Geophysical Survey (Phase 1) - (Reinterpretation of existing ground and airborne database, characterize the GP signals with the rock types and host lithology by overlay analysis)						
1	Geophysicist: at HQ	Mandays	3.18 a	10500	90	945000
2	Gravity - Magnetic Method - Regional / Detailed (0.5 to 200 sq.km depending on the objective)	Per Station	3.1b	4500	4300	19350000

3	Charges of one qualified surveyor with Total Station for carrying out topographical survey in different RF and surface contouring at different interval, fixation of borehole and determination of co- ordinates & Reduced Level (RL) of the horeholes with total station etc a) Charges of one Surveyor per day (without labour) (Up to 4 labours will be allowed per surveyor)	Charges for one Surveyor per day	1.3.1	10500	90	945000
Drilling (1st Phase)						
4	Miscellaneous Charges (Transportation of Drilling Rig, Accommodation for Drill Camp, Camp setting and winding, construction of Approach road and Drill core preservation	Lumpsum	2.2.9	2000000	1	2000000
5	Drilling (Hard rock) (HQ size)	per m	2.2.1.1d	10000	1375	13750000
6	Land Compensation	Per Borehole	5.6	30000	11	330000
7	Concrete Pillar Construction	Per Borehole	2.2.7	2000	11	22000
8	Borehole Plugging by cement	Lumpsum per borehole	2.2.8	10000	11	110000
Laboratory Studies - Phase 1						
9	HR-ICP MS (REE & Trace)	Per sample	4.1.16f	7400	450	3330000
10	Major oxides (WD XRF)- (oxides+ traces -24 elements)	Per sample	4.1.17a	4200	50	210000
11	Major oxides (WD XRF)- (oxides+ traces -24 elements) 10% check samples	Per sample	4.1.17a	4200	5	21000

12	XRD analysis for identification of minerals (Random)	Per sample	4.5.2	4000	10	40000
Sub Total (Phasse 1)						**41053000**
Geophysical Studies for Phase 2						
13	I.P. cum - resistivity, S.P., Magnetic	Per LKM	3.4b	1448693	10	14486930
14	Induced Polarisation (Dipole Dipole)	Line Km	3.4a	69950	6	419700
Drilling (2nd Phase)						
15	Drilling (Hard rock) (HQ size)	per m	2.2.1.1d	10000	1875	18750000
16	Land Compensation	Per Borehole	5.6	30000	15	450000
17	Concrete Pillar Construction	Per Borehole	2.2.7	2000	15	30000
18	Borehole Plugging by cement	Lumpsum per borehole	2.2.8	10000	15	150000
Laboratory Studies - Phase 2						
19	HR-ICP MS (REE & Trace)	Per sample	4.1.16f	7400	800	5920000
20	Major oxides (WD XRF)- (oxides+ traces -24 elements)	Per sample	4.1.17a	4200	80	336000
21	Major oxides (WD XRF)- (oxides+ traces -24 elements) 10% check samples	Per sample	4.1.17a	4200	15	63000
22	XRD analysis for identification of minerals (Random)	Per sample	4.5.2	4000	20	80000
	Sub Total (Phase 2)					**40685630**
Drilling - Phase 3						
23	Drilling (Hard rock) (HQ size)	per m	2.2.1.1d	10000	2500	25000000
24	Land Compensation	Per Borehole	5.6	30000	20	600000
25	Concrete Pillar Construction	Per Borehole	2.2.7	2000	20	40000
26	Borehole Plugging by cement	Lumpsum per borehole	2.2.8	10000	20	200000
Laboratory Studies - Phase 3						

27	HR-ICP MS (REE & Trace)	Per sample	4.1.16f	7400	1000	7400000
28	Major oxides (WD XRF)- (oxides+ traces -24 elements)	Per sample	4.1.17a	4200	80	336000
29	Major oxides (WD XRF)- (oxides+ traces -24 elements) 10% check samples	Per sample	4.1.17a	4200	15	63000
30	XRD analysis for identification of minerals (Random)	Per sample	4.5.2	4000	20	80000
	Sub Total (Phase 3)					**33719000**
Total for Phase 1, Phase 2, and Phase 3						**115457630**

Time Sheet

Item of Work / Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Phase 1																		
Mobilization & Camp Setting																		
Collation of geological, geophysical, and remote sensing data with Ground CheckCollation of geological, geophysical, and remote sensing data with Ground Check.																		
Geologist Work in HQ (1 Party)																		
Topographical Survey																		
Ground Gravity and Magnetic Survey																		
Surveying for Geophysical Survey																		
Reconnaissance drilling (1 borehole per 8 sq. km)																		
Core Sampling																		
Chemical Analytical Work for Drill Core Samples																		
Review																		
Phase 2																		
Geophysical Survey																		
Drilling -Increased density																		
Sample Preparation (Drill Core) for Phase 2																		
Chemical Analytical Work for Drill Core Samples																		
Review																		
Phase 3																		
Drilling - Detailed phase (1 borehole per 2 sq. km)																		
Sample Preparation (Drill Core) for Phase 3																		
Chemical Analytical Work for Drill Core Samples																		
Camp Winding																		