DETAILED PROPOSAL ON

PRELIMINARY EXPLORATION FOR REE AND RARE METALS IN THE NB 5 BLOCK OF THE SIWANA RING COMPLEX, BALOTRA DISTRICT, RAJASTHAN

AREA: 2.00 SQ. KM.

COMMODITY: REE AND ASSOCIATED MINERALS

To

खान मंत्रालय
MINISTRY OF
MINES

सत्यमेव जयते

NATIONAL MINERAL EXPLORATION TRUST (NMET), MINISTRY OF MINES, GOVERNMENT OF INDIA

Submitted by

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SUMMARY OF THE BLOCK FOR PRELIMINARY EXPLORATION (G3 STAGE)

Sr. No.	**Features**	**Details**
I	Block ID	GEO/NMET/RAJ/09/2025-26
II	Exploration Agency	GeoExpOre Private Limited
III	Previous Exploration Agency	G4 Stage by GSI
IV	G4 stage Geological Report (Previous stage Geological Report)	Final report on reconnaissance survey for Rare Earth Elements and associated mineralisation around Indrana-Siwana area, central part of Siwana ring complex, Siwana (src), Barmer district, Rajasthan (g-4 stag, Enclosed as Annexure-1)
V	Commodity	REE and Associated Minerals
VI	Mineral Belt	Siwana-Indrana ring complex
VII	Completion Period with entire time schedule to complete the project	24 months
VIII	Objectives	1. Carry out geological and structural mapping on a 1:2000 scale for demarcation of REE and associated mineral-bearing formations with the structural features to identify the surface manifestations and lateral disposition of the

		mineralised zones 2. Carry out Geochemical sampling and surface analysis by collecting samples from REE-bearing formations to demarcate mineralised zones. 3. Carry out Geophysical surveys (i.e. Gravity, Radiometry borehole geophysics and magnetic) to demarcate concealed mineralisation of REE and associated mineral-bearing formations. 4. To drill 24 boreholes up to 125m each vertical depth to prove the strike and depth persistence of ore-bearing formation mapped in the area, which in turn will aid in deciding the future course of the exploration program. 5. To estimate preliminary REE resources along with any accessory elements (if any) as per UNFC norms and minerals (evidence of mineral contents) rules – 2015 at the G-3 level.
IX	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	The mapping and mineral exploration activities by the GeoExpOre. Drilling and chemical analysis will be done through empanelled agencies by NMET / GeoExpOre Pvt Ltd. Drilling: In-House Lab Tests: SHIVA ANALYTICALS (INDIA) PRIVATE LIMITED, Hoskote, Bangalore. JNRDCC/ IISc or Govt labs (HGML, IBM, NGRI, IIMT (CSIR) & GSI) will be used whenever required
X	Name/ Number of Geoscientists	Sr. Geologist: 1 (Field) + 1 (HQ) Jr. Geologists: 2 (Field) Geophysicist: 1

XI	Expected Field days (Geology, Geophysics, Surveyor)	Geologists: 75 (HQ) + 240 days (Field) Geophysicist: 30 days Surveyor: 30 days

1	Location	Khera Kindawara area around Siwana-Indrana ring complex. The block lies about 12 km NW of Siwana town.
	Latitude & Longitude	

CARDINAL POINTS	LATITUDE	LONGITUDE
A	25.736430°	72.370108°
B	25.738085°	72.375291°
C	25.740357°	72.387152°
D	25.736964°	72.387960°
E	25.738550°	72.396093°
F	25.738535°	72.401446°
G	25.736338°	72.401448°
H	25.734687°	72.392152°
I	25.727530°	72.374971°

	Villages	Khera Kindawara village
	Tehsil/ Taluk	Reodar Taluk
	District	Balotra District

	State	Rajasthan
2	Area (hectares/ square kilometres)	
	Block Area	2.00 sq. km.
	Forest Area	5%
	Government Land Area	45%
	Private Land Area	50%
3	Accessibility	
	Nearest Rail Head	Mokalsar Railway Station (MKSR)
	Road / Airport	Jodhpur airport
4	Hydrography	
	Local Surface Drainage Pattern (Channels)	Sub-dendritic to Dendritic drainage patterns
	Rivers/ Streams	The area is devoid of major rivers. Luni River, Ver Nadi and Mamaji-ka-Nal present in the vicinity of the block
5	Climate	Balotra district, situated in the Thar Desert, has an arid climate with an average annual rainfall of 277 mm. It experiences low humidity, high winds, and large diurnal and seasonal temperature variations. Summers (March–June) are extremely hot, with

		maximum temperatures of 46–51 °C and nights of 20–29 °C. Winters (December–February) can be cold, with nighttime temperatures sometimes dropping to 0 °C, occasionally affected by light rainfall from western disturbances. The average annual temperature is around 27.1 °C.
	Mean Annual Rainfall	The average annual rainfall of the area is 277 mm.
	Temperatures (December) (Minimum) Temperatures (June) (Maximum)	20 °C. 51 °C.
6	Topography	The area has gentle undulating topography with isolated ridges. The highest elevation in the area is 560 m above the mean sea level.
	Toposheet Number	45C/06
	Morphology of the Area	The area is dominated by sub-arcuate ridges. The highest peak recorded in the area is Δ414m msl situated at top of Kerliki Pahari. The drainage system of the study area is manifested by Luni River, Ver Nadi and Mamaji-ka-Nala.
7	Availability of baseline geoscience data	**Annexure 1.**
	Geological Map	Plate 2

	(1:50K/)	
	Geochemical Map Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	Plate 4 Plate 5
8	Justification for taking Preliminary Exploration under G3	The results of large-scale mapping and geochemical investigations in the Indrana–Siwana area (Toposheet Nos. 45C/06 & 45C/10; Item Code: M2AFGBM-MEP/NC/WR/SU-RAJ/2021/36826), carried out by the Geological Survey of India (GSI) during 2021–2022, clearly indicate significant potential for Rare Earth Element (REE) mineralization, providing strong justification for G3-stage exploration. Analysis of 300 bedrock samples revealed that 107 samples exceed the mean ΣREE+Y value of 2,446 ppm, with concentrations ranging from 265.47 ppm to 8,984.74 ppm. Channel samples similarly show ΣREE+Y values from 476.25 ppm to 8,582.98 ppm. Granite samples display ΣREE+Y values between 935.95 ppm and 7,808.84 ppm (average HREE/LREE ratio 0.19), while volcanic rocks range from 265.47 ppm to 8,984.74 ppm (average HREE/LREE ratio 0.18). Later intrusive dykes show ΣREE+Y values from 621.10 ppm to 7,316.14 ppm, with an average

		HREE/LREE ratio of 0.26. Elevated concentrations of critical trace and rare metals such as 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) were also observed. Further, large-scale mapping by Lal and Ghosh (2021) at the northern periphery of the Siwana Ring Complex (1:12,500 scale) from Sainji ki Beri to Meli identified 32 rhyolitic flows and several felsic dykes, with many flows highly enriched in total REEs. Chemical analyses of rhyolite samples yielded ΣREE+Y values ranging from 91.76 ppm to 9,764.68 ppm (average 1,844.84 ppm, ΣHREE/ΣLREE = 0.15), while 22 bedrock samples from felsic/rhyolite dykes ranged from 144.77 ppm to 7,678.75 ppm (average 1,400.14 ppm). Channel samples varied from 261.73 ppm to 6,224.81 ppm with ΣHREE/ΣLREE = 0.19. Notably, flows 14 and 15 were highly enriched, with flow 15 showing ΣREE+Y values of 2,213.43 ppm to 8,027.71 ppm (maximum LREE 5,079.52 ppm, HREE 992.05 ppm) and flow 14 ranging from 6,944.16 ppm to 7,528.11 ppm (maximum LREE 4,848.19 ppm, HREE 941.11 ppm).The systematic collection of 300 bedrock samples, 25 petrological, 20 petrochemical, 10 EPMA, and 5 XRD samples provides a robust dataset, clearly indicating both surface and near-surface enrichment of REEs and associated rare metals. These findings strongly support the need for G3-stage exploration to delineate economically significant

		mineralized zones in the area.

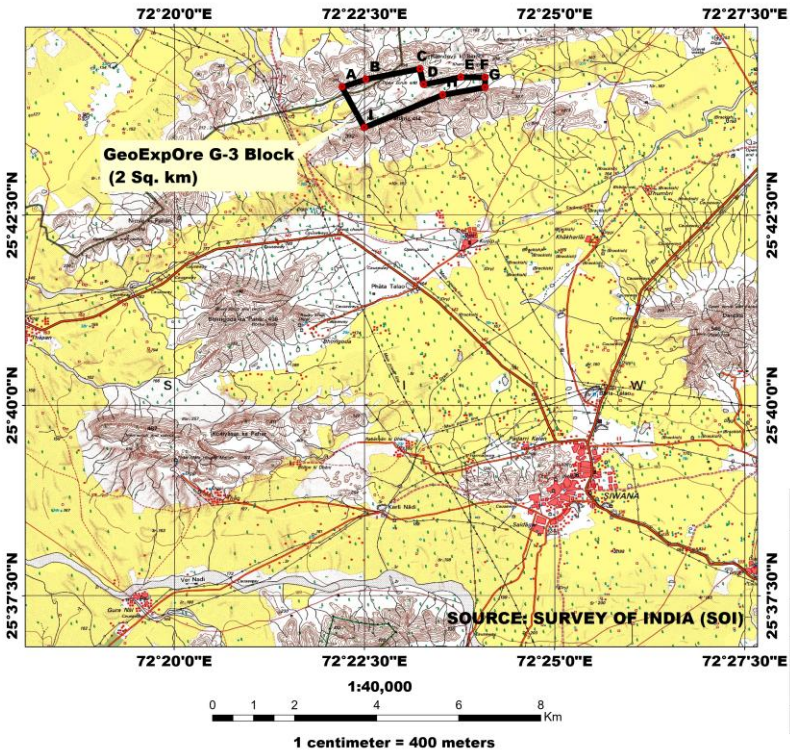
BLOCK SUMMARY

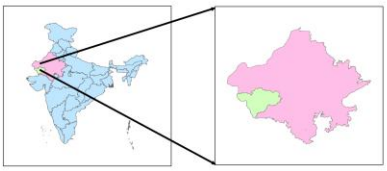
1.1.0 Physiography

The proposed block is demarcated on Survey of India toposheet no. 45C/06 on a scale of 1:50,000, covering an area of 2.00 sq. km Khera Khindawara villages in Reodar Tehsil of Sirohi District, Rajasthan. About 55% of the proposed block is covered by private agricultural lands, 43% by freehold government land, and the remaining 2% is covered by forest land. The area exhibits undulating topography. It exhibits sub-dendritic to dendritic drainage patterns, flows towards the northeast and ultimately joins the Kothari River. The area experiences a dry climate with extreme temperatures with very hot summers (46ºC) and cold winters (5ºC). The average annual rainfall of the area is 682 mm. As the area experiences semi-arid to arid climatic conditions, the natural vegetation is sparse and devoid of dense forests.

PLATE-1

Topographic Map for the Preliminary Exploration for REE and associated Rare Metals in the NB 5 block of the Northern part of the Siwana Ring Complex, Balotra district, Rajasthan





Legend

GeoExpOre_G3 Block

GeoExpOre (G-3) Block (2 sq. kms)		
Cardinal Points	Latitude	Longitude
A	25°44'11.148"	72°22'12.389"
B	25°44'17.106"	72°22'31.048"
C	25°44'25.285"	72°23'13.747"
D	25°44'13.070"	72°23'16.656"
E	25°44'18.780"	72°23'45.935"
F	25°44'18.726"	72°24'05.206"
G	25°44'10.817"	72°24'05.213"
H	25°44'04.873"	72°23'31.747"
I	25°43'39.108"	72°22'29.896"

GeoExpOre Pvt. Ltd		
PLATE-2		
GEOLOGICAL MAP FOR THE PRELIMINARY EXPLORATION FOR REE AND ASSOCIATED RARE METALS IN THE NB 5 BLOCK OF THE NORTHERN PART OF THE SIWANA RING COMPLEX, BALOTRA DISTRICT, RAJASTHAN		
1:50,000		
1 centimeter = 500 meters		
MAP SOURCE: NATIONAL GEOSCIENCE DATA REPOSITORY (NGDR)		
DOC NO: NMET/RJ/GM-02/R0/2025-26 (21-11-2025)		
PREPARED BY	Mr. SHASHANK S MAHAPATRA (Asst. Geologist)	
VERIFIED BY	Mr. MANOJ VP (Senior Geologist)	

1.2.0 Background Geology (Regional Geology, Geology of the Block)

1.2.1 Brief regional geology and structural framework

The area investigated in this study is situated within the Trans-Aravalli tract, occupying zones to the west and southwest of the Aravalli Mountains. This region contains the Malani Igneous Suite (MIS), a vast assemblage of chiefly acidic volcanic rocks that together record a long and complex igneous history. Over time, researchers have used many informal terms—such as Malani Volcanics, Malani Rhyolites, Malani Beds, and Malani Igneous Province—to describe

these rocks. Despite this variety, "Malani" specifically denotes the Neoproterozoic multi-stage magmatism that took place roughly between 830 Ma and 680 Ma. This interval represents a significant geological break separating the Sirohi Group of the Delhi Supergroup (Choudhary et al., 1984) from the younger Marwar Supergroup (Rathore et al., 1999). The MIS rests upon the Mesoproterozoic Delhi rocks with a marked unconformity (Bhushan, 2000). This boundary relationship has been examined in classic sections near Manihari and Kankani, as reported by La Touche (1902) and later by Bhushan (1984, 2000).

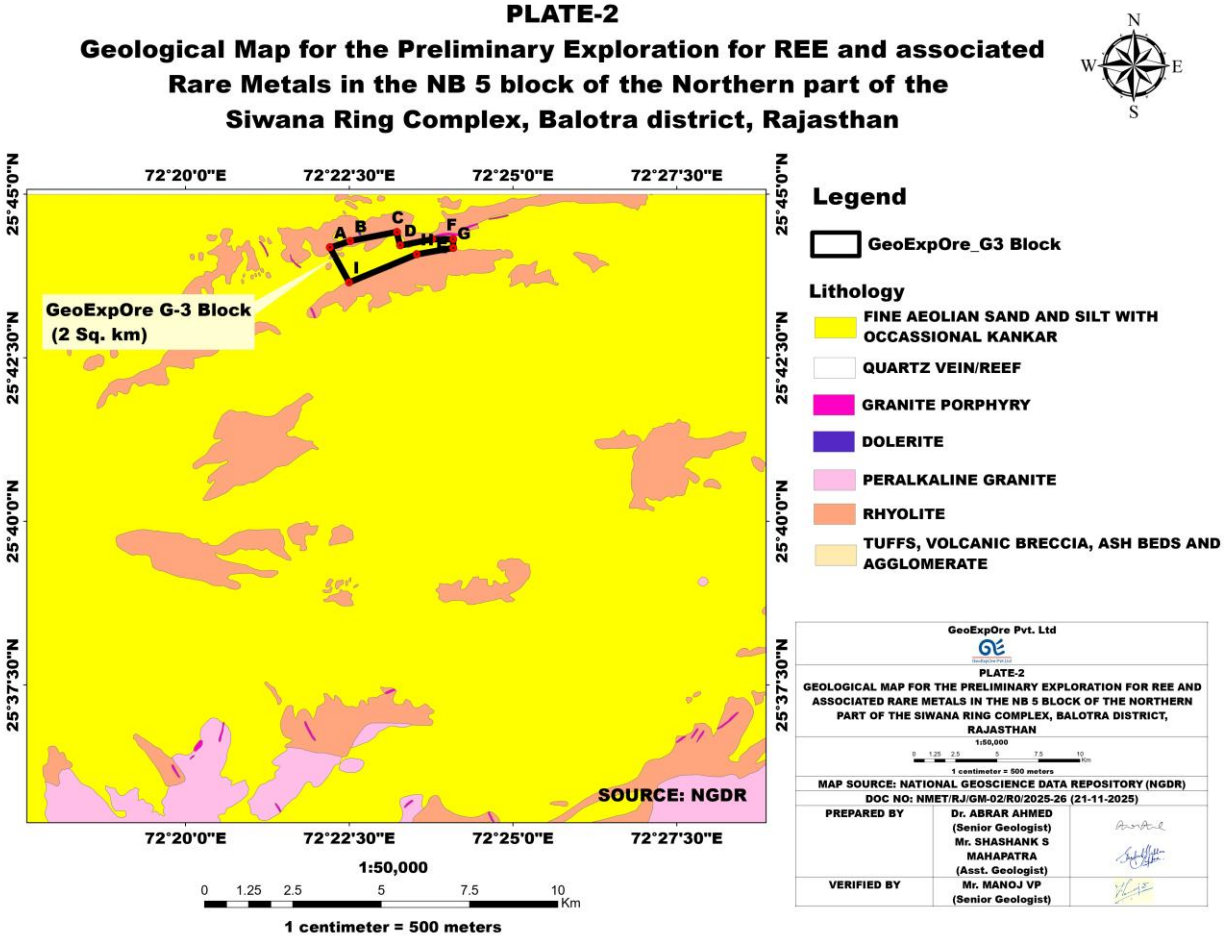
The Siwana Ring Complex, a component of the Neoproterozoic Malani Igneous Suite (MIS) dated at ~771 ± 2 Ma (Torsvik et al., 2001) and ~745 Ma (Dhar et al., 1996; Rathore et al., 1999), records a three-stage magmatic history (Kumar and Sharma, 2020). The earliest stage is characterised by bimodal volcanic activity dominated by acidic lava flows with subordinate basic flows. This volcanic package was subsequently intruded by the second, plutonic stage, represented by the arfvedsonite–riebeckite–aegirine–bearing peralkaline Siwana Granite. The final stage comprises a suite of late-stage intrusions including rhyolite, microgranite, andesite, and felsite dykes. All three stages show anomalously high ΣREE + Y abundances, with the third intrusive stage being the most enriched (Kumar and Sharma, 2020). Peralkaline igneous systems—along with carbonatites and feldspathoid-rich rocks—are recognised worldwide as key sources of REE as well as HFSE and radioactive elements such as U and Th. Consequently, they form prime targets for REE and rare-metal mineralisation. Peralkaline granites, volcanic equivalents, and their zoned pegmatites are regarded as important repositories of REE and rare metals (Nb–Ta, Zr–Hf, Sn, W, Be) (Pollard, 1995). Within layered or composite intrusions, enrichment typically accumulates in the most evolved portions of the complexes (Dostal, 2017).

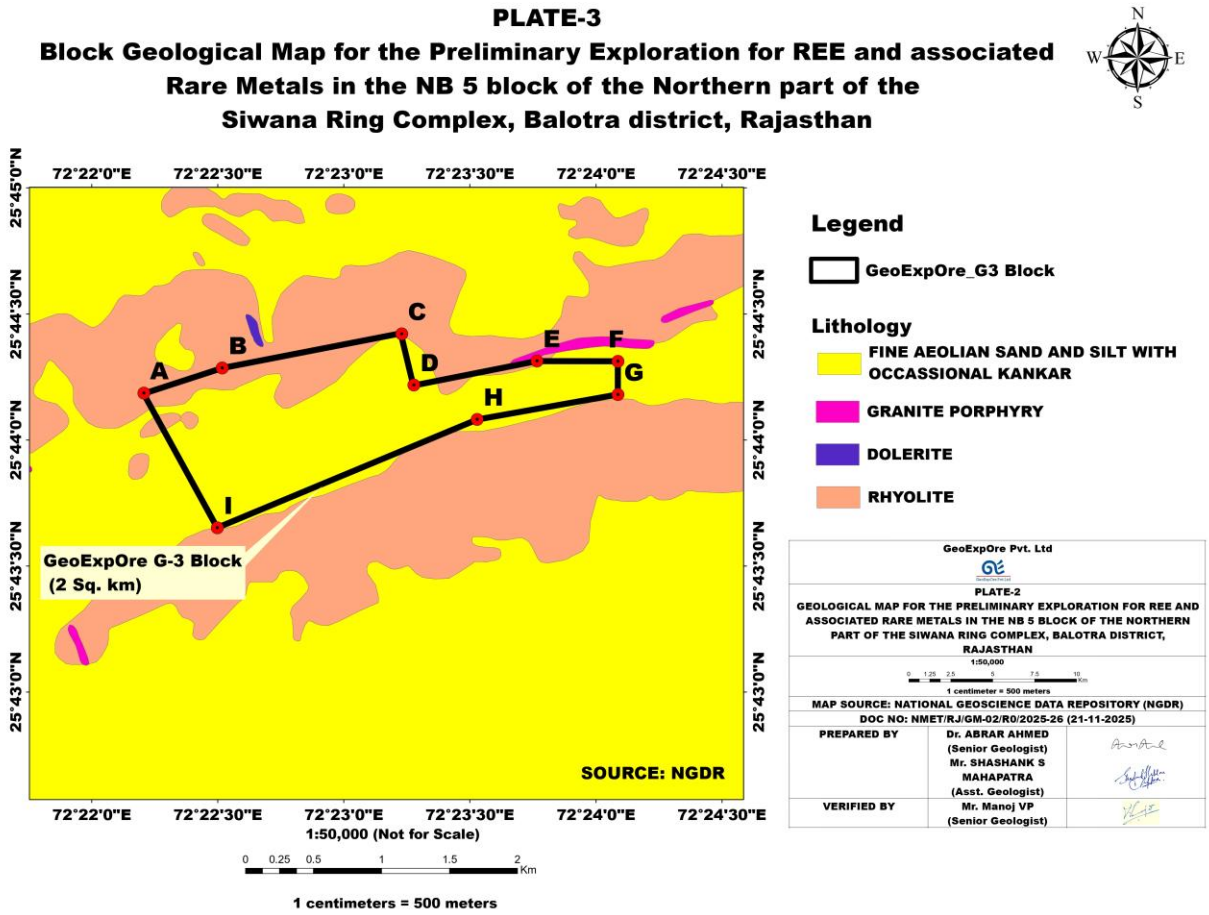
Across the Western Indian Craton in Rajasthan, the basement complexes together with the supracrustal sequences of the Aravalli and Delhi Supergroups record a long history of Proterozoic magmatism. These terrains were repeatedly intruded by granitoid bodies emplaced at

various times—around 1.8 Ga, 1.7 Ga, 1.4 Ga, 1.1 Ga, and again between 850–750 Ma. The Neoproterozoic phase of this activity is represented by the Malani Igneous Suite (MIS), which includes a spectrum of granite types: strongly peralkaline granites of Siwana, metaluminous to slightly peralkaline granites of Jalore, and peraluminous granites exposed in the Tusham and Jhunjhunu areas. These plutons are accompanied by co-genetic acidic volcanic rocks such as welded tuffs, trachytic explosion breccias, and perlite, and the entire system exhibits classic volcano–plutonic ring features with radial dyke swarms (Singh and Vallinagayam, 2009).

PLATE-2

Geological Map for the Preliminary Exploration for REE and associated Rare Metals in the NB 5 block of the Northern part of the Siwana Ring Complex, Balotra district, Rajasthan





1.2.2 Regional Stratigraphy

A volcanoclastic conglomerate near Kankani represents a distinct angular unconformity between granites, phyllite and quartzites of Delhi Super group and the overlying pyroclastics of Malani Igneous Suite observed 30km south of Jodhpur. At Siyana, The Mt. Abu granitoid is overlain by rhyolite of Malani Igneous Suite (Choudhury et al.1984). The volcano-plutonic association of Malani Igneous Suite is either overlain by glacial Pokhran bed or sediments of the Marwar Supergroup. Malani Igneous Suite magmatism is post Mt. Abu granitoid plutonism and pre-Vendian glaciation.

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 per-aluminous, 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. A regional and generalized stratigraphic succession is given in the Table 1 below

Generalized classification of Malani Igneous suite (after Bhushan and Chandrasekaran, 2002).				
Super Group	Group	Formation	Mode of magmatism	Lithology
Marwar super group (Vendian to lower Cambrian)				Sandstone, shale, Limestone and evaporates
----------UNCONFIRMITY----------				
Malani igneous suite (Upper Proterozoic)	Dyke swarms	Basic dyke, acidic dyke, 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
	Granitoid pluton	Malani granites, Siwana granite, Jalor granite	Intrusive phase-II	Hornblende granite riebeckite Aegirine
	Bimodal	Rhyolite,	Extrusive Phase-I	Rhyolite, Dacite,

	Volcanism	Trachyte and basalt flow		trachyte and rhyodacite flows, Basalt and trachyandesite flows
----------UNCONFIRMITY----------				
Pre Malani basement (Middle to lower Proterozoic)		Aravalli and Delhi super group		

1.2.3 Structures

Within the mapped region, both the volcanic and plutonic units are generally well preserved and show minimal deformation, apart from a few localized faults and remnants of volcanic layering. The primary and secondary structural features observed in the field are outlined in the following sections.

1.2.4 Metasomatism

Late-stage magmatic processes and post-magmatic metasomatism in peralkaline igneous suites—and their importance in concentrating rare-earth elements—have been extensively discussed by several researchers (D.F. Strong, 1982; B. Bagiński et al., 2016; J. Rong et al., 2016). For the Siwana Granite, S. Mondal et al. (2021) have provided a detailed account of how these metasomatic events contribute to REE enrichment.

In the Siwana region, both the volcanic and plutonic rocks exhibit clear metasomatic overprinting, reflected in significant modifications to their textures and mineralogy. Common

features include the coarsening of perthite lamellae resulting from albitization or sodium-rich metasomatism, development of chessboard perthite, and deuteric alteration of alkali feldspar. Alkali feldspar is also frequently replaced pseudomorphically by aegirine. Secondary minerals such as zircon and apatite occur as inclusions within feldspar grains as well as intergrowths along grain boundaries, accompanied by the formation of albite rims.

Primary magmatic inosilicates—such as aenigmatite, aegirine-augite, and astrophyllite—have been altered and replaced by minerals like aegirine and arfvedsonite. These transformations indicate the action of late- to post-magmatic alkaline fluids that drove metasomatic re-equilibration within the system.

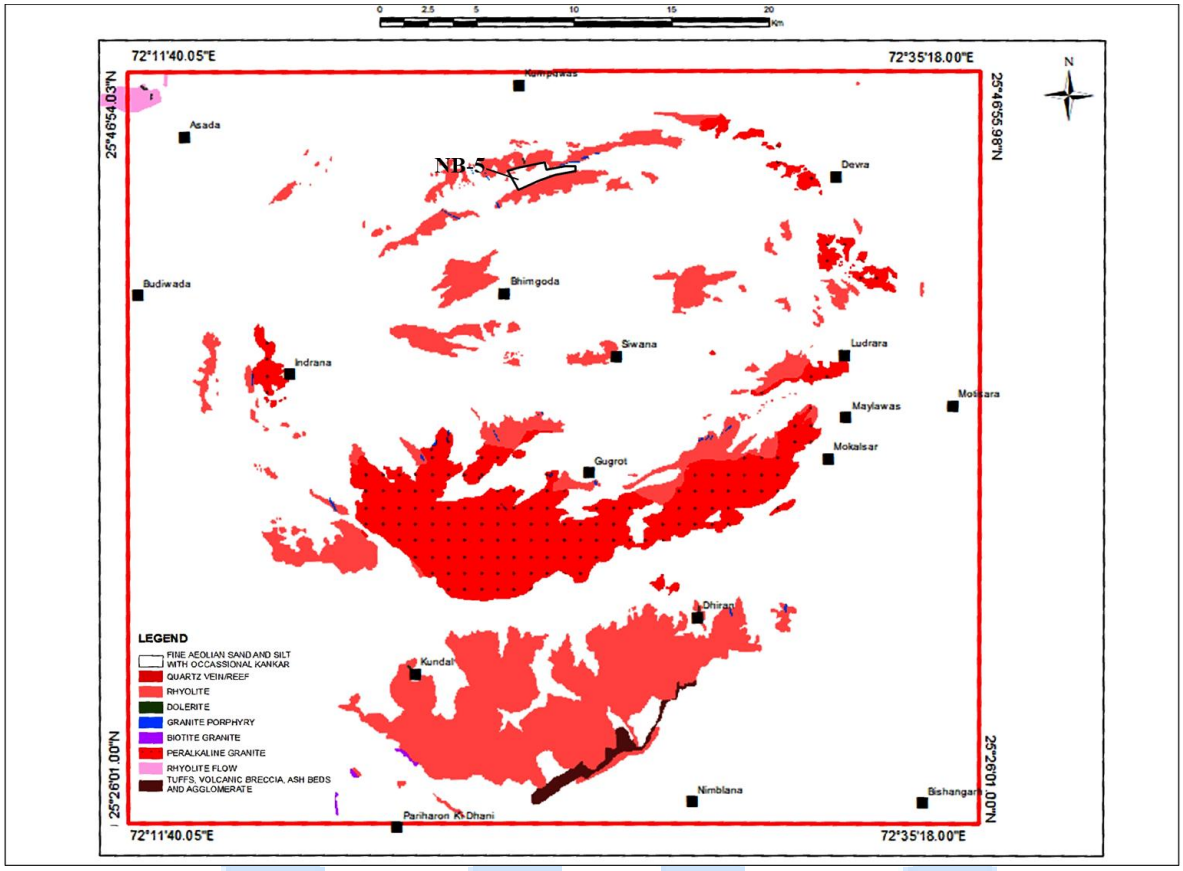


Figure:1 Regional geology map of the Mangalwar Complex

1.2.5 Geology of the Block

The northern sector of the Siwana Ring Complex forms part of the Neoproterozoic Malani Igneous Suite and is characterized by a well-preserved assemblage of volcanic and plutonic rocks arranged in a classic ring–dyke and volcano–plutonic complex architecture. The geology reflects a multistage evolution dominated by peralkaline magmatism.

The table shows the Local stratigraphy of the area, Table 2

Group/super group	Rock type	Igneous activity
Quaternary	Aeolian sand and silt with occasional kanker	
Malani igneous suite	Pegmatite, Rhyolite dyke, basic volcanics dyke, Siwana granite (Granite & alkali feldspar granite) ----------Intrusive contacts----------	Phase-III (Younger intrusives phase) Phase-II (Plutonic phase) Phase-I (volcanic phase)

1.2.6 Description of Litho units:

Peralkaline Volcanic Sequence

In the northern part, the exposed succession begins with extensive peralkaline volcanic flows. These include rhyolitic and trachytic lava units, ignimbrites, and tuffaceous horizons. The flows often show well-developed flow banding and local volcanic layering. These volcanic rocks represent the earlier eruptive phases of the complex.

Metaluminous to Weakly Peralkaline Volcanics

Higher in the sequence, the volcanic flows transition into metaluminous varieties. These units are typically more massive, darker, and less evolved than the basal peralkaline flows, indicating a shift in magma chemistry during the middle stage of volcanism.

Siwana Peralkaline Granite

Intruding the volcanic succession in the northern region is the Siwana peralkaline granite, a distinctive rock type rich in alkali amphiboles and pyroxenes (commonly arfvedsonite, riebeckite, aegirine). This granite forms a major part of the northern exposures and represents the late intrusive phase of the magmatic cycle.

Radial and Ring Dykes

The northern area is cut by numerous dykes displaying both radial and circular patterns relative to the complex. These include rhyolite, microgranite, felsite, and andesite dykes. Their cross-cutting nature reflects the waning stages of magmatism and the structural control of the ring-fracture system.

Metasomatic and Alteration Features

The northern exposures show strong evidence of alkali metasomatism, with alkali feldspar alteration, development of perthitic textures, albitization, formation of aegirine rims, and replacement of primary mafic minerals by late-stage alkali amphiboles. These metasomatic effects are most pronounced in the plutonic rocks and along fracture-controlled zones.

1.2.7 Structural Framework

The extreme northernmost sector of the Siwana Ring Complex is characterized by a well-preserved ring-complex architecture, with the peralkaline Siwana Granite forming the dominant plutonic body. Surrounding and intruding this granite are remnants of peralkaline rhyolitic and trachytic volcanic flows, along with minor trachy-dacite units. The region is cut by a network of late-stage dykes, including microgranite, felsite, rhyolite, and minor andesitic–basaltic

intrusions. Pegmatoid and pegmatitic patches occur locally within the granite, representing pockets of highly evolved residual melts. The rocks are generally undeformed, but small-scale faults, joints, and shear fractures are present locally. These structures often guide dyke emplacement and late-stage fluid movement.

Structurally, the northern sector exhibits a volcano–plutonic framework with clear evidence of a ring–dyke system. Radial and concentric dykes are widespread, reflecting emplacement along fractures controlled by the central uplift and ring fractures of the complex. The rocks are largely undeformed, with primary volcanic layering and plutonic textures largely intact, although small-scale faults, joints, and shear zones occur locally. Late- to post-magmatic metasomatic alteration is structurally controlled, often concentrated along dyke margins, fracture zones, and granite–volcanic contacts, producing albite-rich zones, aegirine-rich selvages, and quartz–feldspar veining. Overall, the structural arrangement reflects a combination of magmatic emplacement, fracture-controlled fluid flow, and localized deformation along ring-fracture and radial systems.

1.3.0 Mineral Potentiality Based on Geology, Geophysics, Ground Geochemistry

Preliminary investigations conducted by the Geological Survey of India (GSI) in 2013–14 on the rhyolites and associated tuffs of the Siwana Ring Complex in Balotra district revealed elevated concentrations of rare-earth elements (REE), with total REE (ΣREE) values ranging from 1,334 to 3,319 ppm (Rastogi & Mukherjee, 2015).

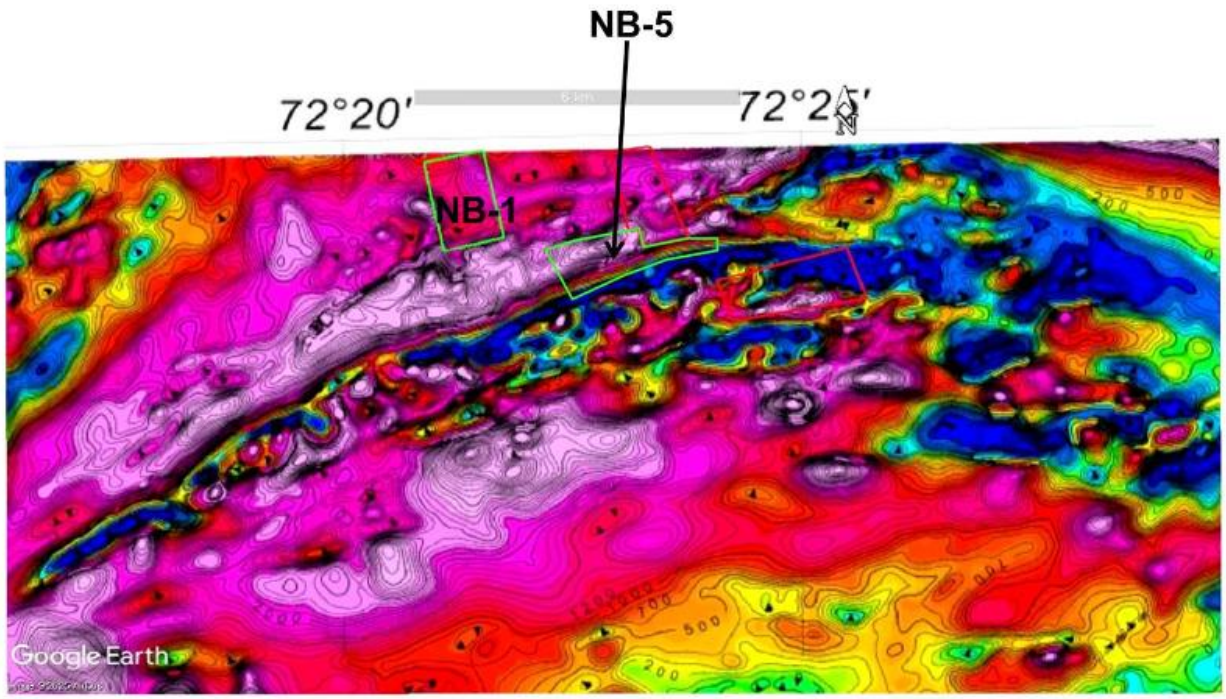


Figure 2: Proposed block NB-5 shown on aeromag. (Source NMET)

In Figure 2 we can observe the aeromagnetic features of the proposed block area which delineates promising areas in and around proposed block.

Surface sampling studies by Bidwai et al. (2014) further reported anomalously high levels of light rare-earth elements (LREE), zirconium (Zr), niobium (Nb), thorium (Th), uranium (U), and silver (Ag) in the region. Das et al. (2015) carried out G4-level investigations in the eastern and central blocks of Siwana. Later, Kumar and Sharma (2020) performed comprehensive G4 investigations and provided detailed REE+Y data across various lithological units: plagioclase-rich granite (n = 79) showed ΣREE+Y values of 0.029%–0.70%; K-feldspar-rich granite (n = 116) ranged from 0.047%–0.66%; younger intrusives (n = 146) had 0.019%–2.66%; felsic volcanic units (n = 43) ranged 0.015%–0.96%; and enclaves/restite (n = 19) recorded 0.022%–1.27%. Analysis indicated a strong LREE dominance over HREE in the area, with LREE

concentrations varying from 86.45 ppm to 1.93% and HREE from 23.94 ppm to 0.26%, yielding an approximate LREE:HREE ratio of 4:1. Beyond REEs, several rare metals and trace elements also showed promising concentrations: Zr (0.1%–1.1%), Nb (2.5–1,039 ppm), Ba (25–3,948 ppm), Zn (120–1,258 ppm), U (0.61–124 ppm), Th (2–481 ppm), and Hf (4.52–828.18 ppm). Few samples can be seen plotted on the Figure 3 as well of TREE in and around the proposed block.

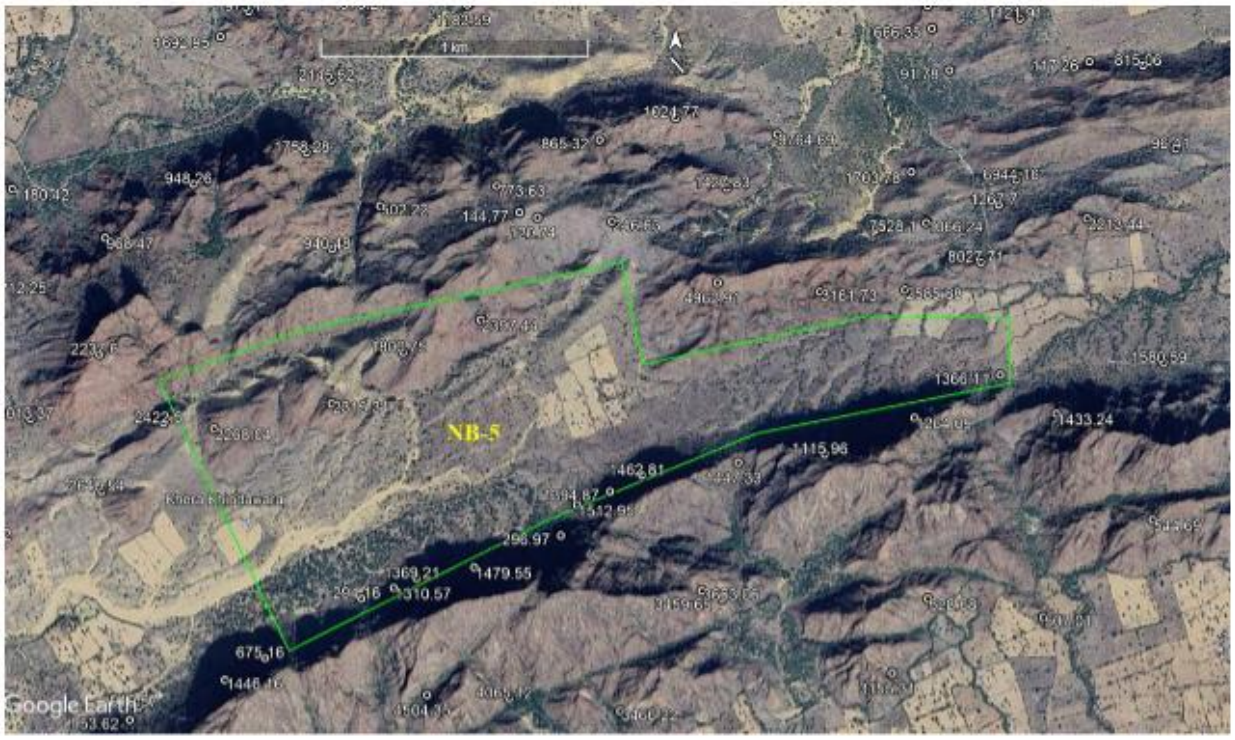


Figure 3: Proposed block NB-5 and TREE concentration in surface samples plotted on google earth image (Source NMET)

Barman and Neog (2018) mapped A-type peralkaline to peraluminous granites across the Siwana area, extending from Mokalsar in the east to Siner in the west, passing through Mawri, Gugrot, Piplun, Goliyan Bhairan, and Kalur Ka Danta. They identified REE-bearing mineral phases such as carbonates (perisite) and phosphates (monazite) in both plutonic and volcanic rocks, along

with accessory minerals like hematite, ilmenite, and zircon. The granitic rocks displayed ΣREE values ranging from 182.77 ppm to 8,611.11 ppm, with an average of 2,006.95 ppm (n = 84), while volcanic rocks recorded 142.3–8,502.50 ppm, averaging 2,008.03 ppm (n = 116). In the Sukleswar Ka Mandir (G3) block, total REE (TREE) concentrations reached 2,901 ppm in microgranite dykes, 2,121 ppm in alkali feldspar granite, and 2,996 ppm in Andesite.

Lal and Ghosh (2021) conducted detailed geological mapping at 1:12,500 scale along the northern periphery of the Siwana Ring Complex, from Sainji ki Beri to Meli. They identified 32 rhyolitic flows and numerous felsic dykes, with several flows exhibiting high total REE concentrations. Geochemical analyses of rhyolite samples yielded ΣREE+Y values ranging from 91.76 to 9,764.68 ppm, averaging 1,844.84 ppm, with ΣHREE/ΣLREE ratios of 0.15. Additionally, 22 bulk-rock-sample (BRS) analyses of felsic/rhyolite dykes gave ΣREE+Y values between 144.77 and 7,678.75 ppm, averaging 1,400.14 ppm. Channel sampling within these flows produced ΣREE+Y values ranging from 261.73 to 6,224.81 ppm, with ΣHREE/ΣLREE ratios around 0.19. Notably, flows 14 and 15 were the most REE-enriched in the area: flow 15 showed ΣREE+Y values between 2,213.43 and 8,027.71 ppm, with maximum LREE of 5,079.52 ppm and HREE of 992.05 ppm, while flow 14 recorded ΣREE+Y between 6,944.16 and 7,528.11 ppm, with LREE up to 4,848.19 ppm and HREE up to 941.11 ppm.

1.4.0 Scope for Proposed Exploration

This project proposes a preliminary survey at the G-3 stage consisting of detailed geological mapping of a 2.00 sq. km. area on a 1:2000 scale along with surface/geochemical sampling (bedrock, soil, stream sediment), pitting and trenching, geophysical survey (gravity and

magnetic methods), drilling of 24 nos. of boreholes up to a depth of 125m each, chemical analysis, petrological analysis and estimation of resources under G3 category and report preparation.

1.5.0 Objectives for Exploration

- To carry out geological and structural mapping on a 1:2000 scale to demarcate REE and associated mineral-bearing formations with the structural features to identify the surface manifestations and lateral disposition of the mineralized zones.
- To collect surface (grab/bedrock/soil/stream sediment) samples and analyze them for REE and decide on further courses for the exploration program.
- To conduct a ground geophysical survey with gravity, magnetic, and radiometric methods to demarcate concealed mineralization of REE and associated mineral-bearing formations.
- To drill 24 boreholes up to 125m vertical depth (total 3000 m) to prove the strike and depth persistence of ore-bearing formation mapped in the area, which in turn will aid in deciding the future course of the exploration program at the G3 category of UNFC.
- To estimate preliminary REE resources along with any accessory elements (if any) as per UNFC norms and minerals (evidence of mineral contents) rules – 2015 at the G-3 level.

1.6.0 Observation and recommendation from previous work

The magmatic history of the area can be divided into three main phases: an initial phase of volcanism, followed by the emplacement of the Siwana Granite pluton, and finally, the intrusion of younger dykes and minor intrusives. Among the volcanic units, the aphanitic rhyolite is the most widespread, while porphyritic rhyolite is predominantly found in the southeastern part of the mapped region.

The plutonic rocks are mainly medium- to coarse-grained granites. Grey-coloured granites dominate most exposures, whereas pink, coarse-grained alkali feldspar granites are concentrated in the southeastern sector. The contact between these two granite varieties is generally diffuse, lacking a sharp boundary.

Two primary categories of dykes are observed in the area. Light-coloured, fine-grained rhyolitic dykes occur at several locations, whereas dark-coloured mafic dykes are mostly associated with the granitic bodies and display typical discordant relationships with the host rocks.

Based on the petrographic and geochemical investigations of the northern part of the Siwana Ring Complex, it is recommended that the area be prioritized for detailed REE and rare-metal exploration. The volcanic rocks, characterized by euhedral and subhedral alkali feldspar phenocrysts and ubiquitous alkali pyroxenes and amphiboles, along with fine-grained groundmass, indicate well-preserved primary magmatic features. The granites, composed of alkali feldspar, quartz, arfvedsonite, aegirine, and perthite, with accessory minerals such as apatite, zircon, aenigmatite, astrophyllite, and REE-bearing phases like monazite, xenotime, and allanite, demonstrate significant potential for REE mineralization.

Geochemical results further support this potential: a substantial portion of bedrock samples (107 out of 300) exceed the mean ΣREE+Y value of 2,446 ppm, with bulk-rock and channel samples ranging up to 8,984.74 ppm. Granite, volcanic, and later intrusive rocks all show appreciable ΣREE+Y values, with favourable LREE enrichment (average HREE/LREE ratios 0.18–0.26). In addition, high concentrations of critical trace and rare metals, including 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), highlight the area as a promising target for rare-metal exploration.

Accordingly, detailed systematic exploration, including channel sampling, trenching, and high-resolution mapping, is recommended to delineate zones of REE and rare-metal enrichment.

Advanced geochemical and mineralogical studies, including EPMA and petrographic analyses, should be integrated to guide resource evaluation and potential development.

Based on the synthesis of large-scale geological mapping, petrographic studies, and geochemical analyses of the Indrana–Siwana area, it is recommended that detailed exploration be undertaken in the blocks showing high surface ΣREE+Y and rare-metal concentrations, including Arjiana–Ludrara, Mokalsar–Maylawas East, Mokalsar–Maylawas West, Indrana South, and Indrana North. In addition, deep drilling is suggested to evaluate the presence and continuity of REE and rare-metal mineralization at depth, providing critical data on the vertical extent and grade of the deposits. These investigations will help in delineating zones of economic potential and guiding further systematic exploration.

2.0 PREVIOUS WORK

2.1.0 Previous Exploration details in the proposed block area

Baseline Geological Work

Previous investigations in the Siwana Ring Complex, Balotra district, have revealed significant potential for REE and associated rare-metal mineralization. Preliminary sampling of rhyolites and tuffs conducted by the Geological Survey of India (GSI) during 2013–14 indicated anomalous ΣREE values ranging from 1,334 to 3,319 ppm (Rastogi & Mukherjee, 2015). Bidwai et al. (2014) reported elevated levels of LREE, zirconium (Zr), niobium (Nb), thorium (Th), uranium (U), and silver (Ag) in surface samples. Subsequent G4-level investigations by Das et al. (2015) in the eastern and central blocks, and by Kumar and Sharma (2020), provided detailed geochemical data across different lithounits. They reported ΣREE+Y values of 0.029–0.70% in plagioclase-rich granites, 0.047–0.66% in K-feldspar-rich granites, 0.019–2.66% in younger intrusives, 0.015–0.96% in felsic volcanics, and 0.022–1.27% in enclave/restite units. The LREE/HREE ratios indicate a strong enrichment of LREE over HREE, with approximate LREE:HREE ratio of 4:1. Additional trace and rare metals also show encouraging concentrations: Zr (0.1–1.1%), Nb (2.5–1,039 ppm), Ba (25–3,948 ppm), Zn (120–1,258 ppm), U (0.61–124 ppm), Th (2–481 ppm), and Hf (4.52–828.18 ppm).

Barman and Neog (2018) mapped the peralkaline–peraluminous (A-type) granites extending from Mokalsar in the east to Siner in the west, including areas such as Mawri, Gugrot, Piplun, Goliyan Bhairan, and Kalur Ka Danta. They identified REE-bearing carbonates (perisite) and phosphates (monazite) in both plutonic and volcanic rocks, along with accessory phases such as hematite, ilmenite, and zircon. Granites showed ΣREE values ranging from 182.77 to 8,611.11

ppm, averaging 2,006.95 ppm, while volcanic rocks ranged from 142.3 to 8,502.50 ppm, averaging 2,008.03 ppm. In the Sukleswar Ka Mandir (G3) block, total REE (TREE) concentrations reached 2,901 ppm in microgranite dykes, 2,121 ppm in alkali feldspar granite, and 2,996 ppm in andesite.

Large-scale mapping at 1:12,500 scale by Lal and Ghosh (2021) along the northern periphery of the complex, from Sainji ki Beri to Meli, identified 32 rhyolitic flows and numerous felsic dykes, several of which were highly enriched in total REE. Rhyolite samples from this area showed ΣREE+Y values between 91.76 and 9,764.68 ppm, with an average of 1,844.84 ppm and a ΣHREE/ΣLREE ratio of 0.15. Analysis of 22 bulk-rock samples from felsic/rhyolite dykes yielded ΣREE+Y values of 144.77–7,678.75 ppm (average 1,400.14 ppm), while channel samples ranged from 261.73 to 6,224.81 ppm with ΣHREE/ΣLREE ratios around 0.19. Flows 14 and 15 were particularly enriched, with flow 15 showing ΣREE+Y of 2,213–8,027 ppm (LREE up to 5,079 ppm, HREE 992 ppm) and flow 14 recording 6,944–7,528 ppm (LREE 4,848 ppm, HREE 941 ppm).

Remote sensing and aerial surveys (RSAS Division, GSI, Bangalore) conducted over toposheets 45C/06 and 45C/10 during 2017–18 provided further support for exploration. Aeromagnetic maps delineated magnetically susceptible lithounits even beneath soil cover, while spectrometric potassium and thorium maps indicated favourable zones for REE mineralization. Based on the integration of geochemical data and RSAS results, the NB 5 block has been identified as a promising target for G3-stage exploration.

3 PROPOSED G3 INVESTIGATION AREA

Corner points	Latitude (°N)	Longitude (°E)
A	25.736430°	72.370108°
B	25.738085°	72.375291°
C	25.740357°	72.387152°
D	25.736964°	72.387960°
E	25.738550°	72.396093°
F	25.738535°	72.401446°
G	25.736338°	72.401448°
H	25.734687°	72.392152°
I	25.727530°	72.374971°

Above area has been selected basing GSI exploration (G4). Significant concentration of REE values were observed in the proposed area.

4 PLANNED METHODOLOGY

The exploration program has been proposed in accordance with the objective set for the preliminary survey (G-3) of the block. The Exploration shall be carried out as per Minerals (Evidence of Mineral Contents) Rule-2015 and Minerals (Evidence of Mineral Contents) Amendment Rules-2021. Accordingly, the following scheme of exploration is formulated to achieve the objectives. The details of the different activities to be carried out are presented in the following paragraphs.

4.1.0 Geological Mapping (1: 2,000 Scale)

Geological mapping will be carried out on the entire 2.00 sq. Km area on 1:2,000 scale. It is proposed that the rock types, their contact, demarcate mineralised zones, and associated mineralization-bearing formations (host rock) be mapped with the structural features to identify the surface manifestations and lateral dispositions of the mineralised zones.

4.2.0 Geochemical Sampling (Surface sampling/Bedrock /Stream sediment)

A comprehensive sampling program will be undertaken to thoroughly evaluate the mineral potential of the study area. This will include the collection of 100 channel samples to assess the lateral distribution of mineralization along exposed rock faces, 50 pitting and trenching samples to investigate near-surface variations and continuity of the mineralized zones, and 800 core samples to provide detailed subsurface information on the vertical extent, grade, and structure of

the deposits. Together, these samples will form a robust dataset for geochemical, mineralogical, and resource evaluation studies.

4.3.0 Surveying

The block boundary will be surveyed by DGPS, and the total station in the WGS-84 datum will be used for the demarcation of the proposed area boundary points. The survey party will also carry out surface features, contouring in the proposed area and associated with Geological activities for taking up locations of outcrop, Pitting/ Trenching, channel sample collection for taking up the location of sample points and plotting it on the map for proper interpretation of the sample data. Further, during the drilling programme, the survey party will carry out borehole fixation and determine the reduced levels and coordinates of the boreholes.

4.4.0 Geophysical Survey

In the area it is proposed to carry out the Gravity, As part of the subsurface investigation, a total of 1,000 meters of geophysical borehole logging will be conducted. This will involve systematic recording of physical properties of the rock along the boreholes, including variations in density, magnetic susceptibility, electrical conductivity, and other relevant parameters. The data obtained will help in delineating lithological boundaries, identifying structurally controlled zones, and mapping the continuity and concentration of mineralization at depth. Integration of borehole geophysical data with core sample analysis will provide a detailed three-dimensional understanding of the subsurface geology, guiding further exploration and resource evaluation.

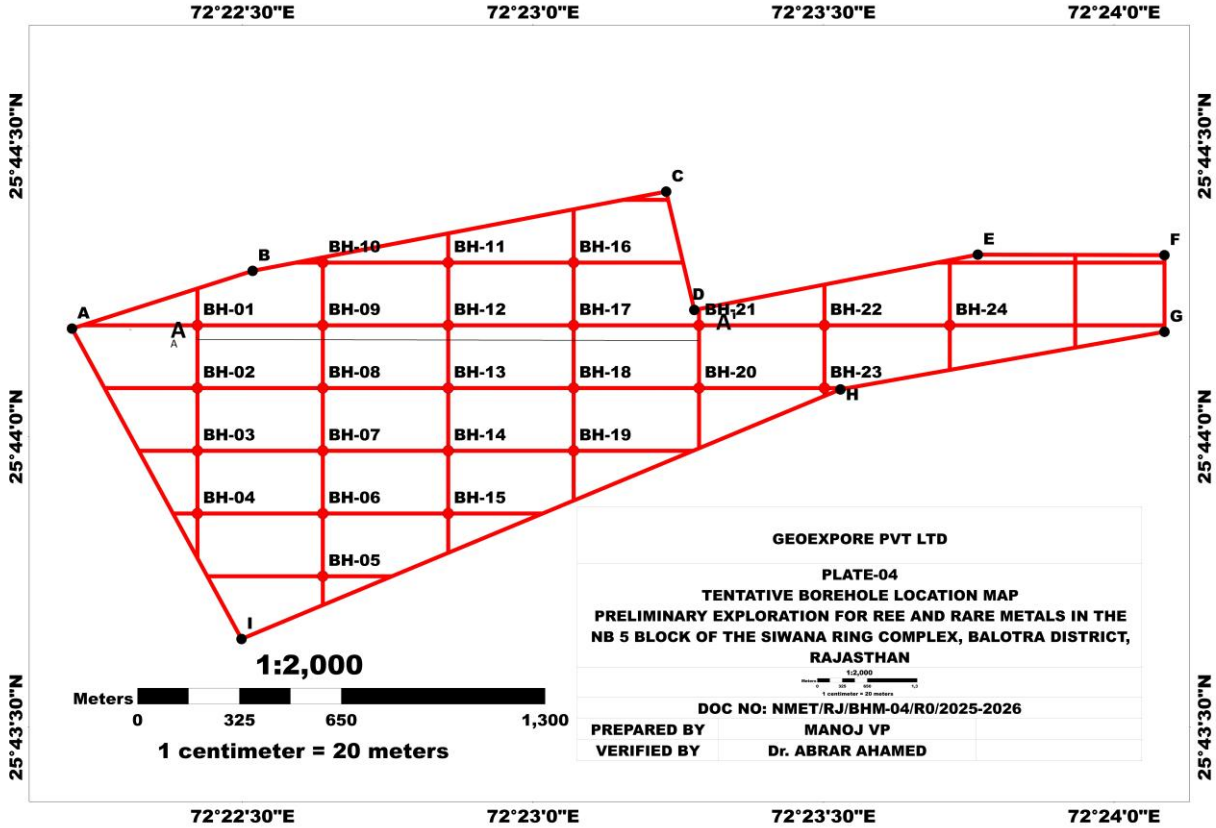
4.5.0 Pitting/Trenching

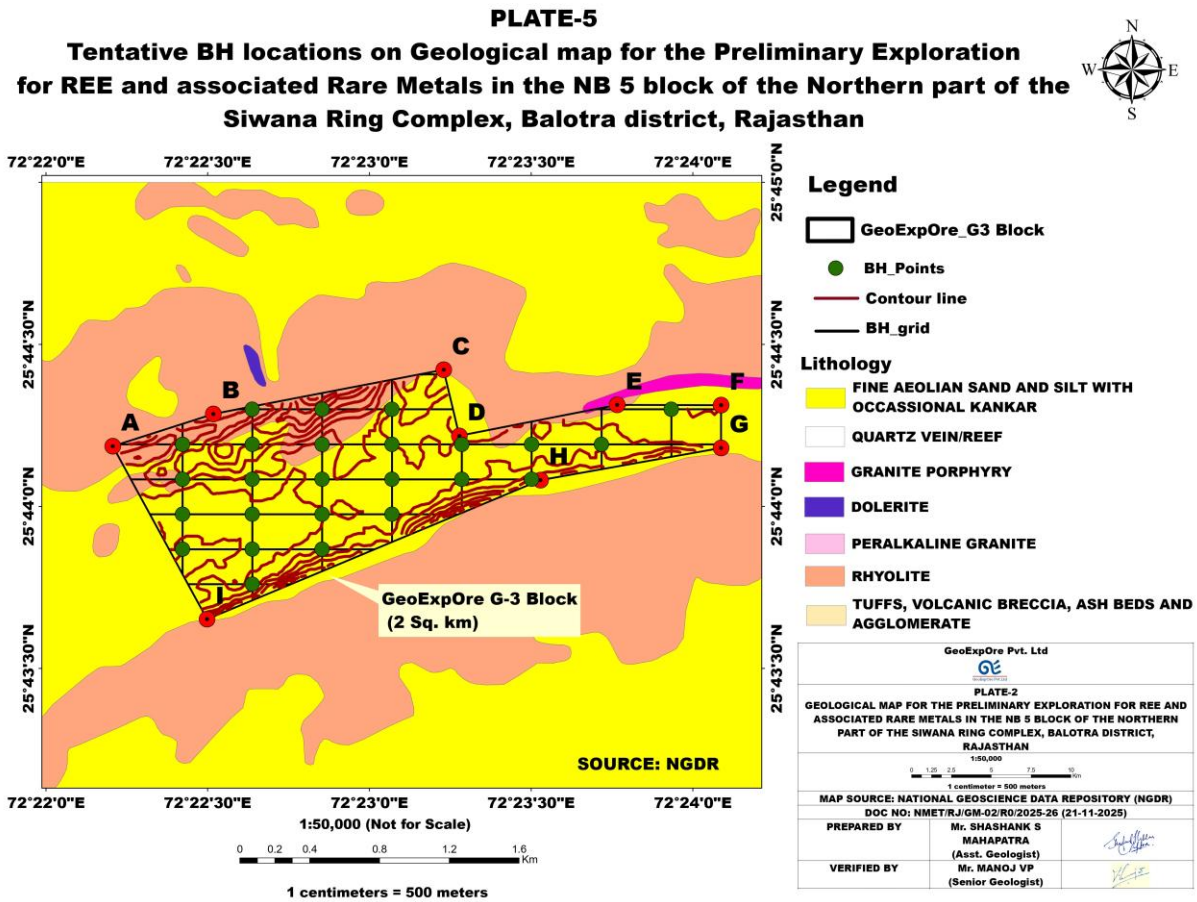
A total of 50 cubic meters will be excavated through pitting and trenching to expose near-surface lithologies and mineralized zones. This will provide fresh samples for geological and geochemical analysis and help assess the lateral continuity, thickness, and grade of mineralization.

4.6.0 Core Drilling

A total of 3,000 meters of drilling is planned, consisting of 24 boreholes with each borehole drilled to a depth of 125 meters. This drilling program will provide detailed subsurface information on lithology, structure, and mineralization patterns, allowing for the assessment of both vertical and lateral continuity of REE and associated rare-metal deposits. Core samples obtained from these boreholes will be analysed for geochemical, mineralogical, and petrographic characteristics, enabling accurate resource estimation and guiding further exploration and development strategies in the study area. Proposed Borehole locations in the block has been depicted in the Plate 4 below.

PLATE-04
TENTATIVE BOREHOLE LOCATION MAP
PRELIMINARY EXPLORATION FOR REE AND RARE METALS IN THE NB 5 BLOCK OF THE SIWANA RING COMPLEX, BALOTRA DISTRICT, RAJASTHAN





4.7.0 Drill Core Logging

The borehole core will be systematically logged for rock types, structural features, textures, intersection of ore zones, types of mineralisation, and the occurrence of various ore minerals. Rock Quality Designation/determination (RQD) will also be determined using the borehole cores. Core logging methods like Neutron Logs, Resistivity Logs, Callipers and Gamma Ray logging will be deployed.

4.8.0 Drill Core Sampling

During the geological logging of drill cores, mineralised zones will be marked on the basis of the concentration of ore minerals and lithology. A total of 800 nos. primary samples will be analysed for REE and associated Mineralization.

4.9.0 Analytical studies

A detailed analytical program has been planned to thoroughly characterize the geological and geochemical attributes of the collected samples. This will include 15 analyses of major, minor, trace, and rare-earth elements (PCS) to quantify elemental concentrations and understand the overall geochemical framework. In parallel, 15 petrographic studies (PS) will be conducted to examine the mineralogical and textural features of the rocks. X-ray diffraction (XRD) analyses on 5 representative samples will provide precise mineral identification, while 5 electron probe micro-analyser (EPMA) measurements will allow for in-situ chemical characterization of key mineral phases. Furthermore, an extensive set of 950 chemical analyses focusing on REEs, yttrium (Y), hafnium (Hf), zirconium (Zr), niobium (Nb), and tantalum (Ta) will be performed to assess the concentration, distribution, and potential economic significance of these critical elements. Together, this integrated analytical approach will provide a robust dataset for evaluating the mineral potential and guiding future exploration and development in the study area.

4.10.0 Estimation of resources

Estimate resources according to UNFC norms and the Minerals Evidence & Mineral Contents (MEMC) Rule—2015 at the G-3 level and meet the NMET objectives.

4.11.0 Report preparation

Submission of reports and recommendations in compliance with G3 level as per MEMC 2021 and suggestions for follow-up work to upgrade the project, if deemed necessary.

5. NATURE, QUANTUM AND TARGET

5.1 Nature and Quantum of Work Proposed

The details of the particulars, quantum and targets are tabulated below in Table 3

Sr. No.	Nature of Work	Total Workload Envisaged
A	Geological Survey:	
	Detail Mapping (Scale: 1:2,000)	2.0 km²
B	Technological Survey:	
	a) Subsurface Exploration: Drilling	3000 m (24 BH of 125 m depth)
	b) Pitting & Trenching	50 m³
	3. Geophysical BH logging	3000 m
C	SMPL:	
	a) Channel Samples (number)	100
	b) Pitting & Trenching Samples (number)	50
	c) Core sample (number)	800
	d) PCS (Major, Minor, Trace, REEs)	15
	e) PS (number)	15
	f) XRD (number)	5
	h) EPMA (number)	5
D	Chemical Analyses	
	*REEs: Y, Hf, Zr, Nb, Ta (number)	950

The nature and quantum of the proposed work are given in Table 4

PRELIMINARY EXPLORATION FOR REE AND RARE METALS IN THE NB 5 BLOCK OF THE SIWANA RING COMPLEX, BALOTRA DISTRICT, RAJASTHAN

Total Area 2 Sq. Km, Mapping 1:2000 Scale, No. of Boreholes 24, Timeline: 24 months, Review: After 6 and 12 months

S. No.	Activity	Months/Days	2	4	6		8	10	12		14	16	18	20	22	24
1	Camp Setting	Months/Days														
2	Geological Mapping & Sampling	days														
3	Geophysical survey	days														
4	Geophysicist party days (HQ) for data interpretation & Report	Days				REVIEW				REVIEW						
5	Pitting/Trenching	cu. m														
6	Drilling	m														
7	Survey Party days	days														
8	Camp Winding	months														
9	Laboratory Studies	Nos.														
10	Report Writing with Peer Review	months														

6. MANPOWER DEPLOYMENT

Manpower requirement: Total Geological activity shall be for 24 months (22 field and two months for report writing), which includes 2 geologists,1 surveyor, 2 sampling technicians, 1 geophysicist, 1 geochemist, and 1 or 4 labourers. Followed by exploratory diamond core drilling activities.

7. BREAK-UP OF EXPENDITURE

The tentative cost has been estimated based on the Schedule of Charges (SoC) of projects funded by the National Mineral Exploration Trust (NMET) w.e.f. 01/04/2020, and the total estimated cost is Rs. 362 lakhs. The details of tentative cost estimates are given in table 5 below.

Cost Estimate - Title: Preliminary Exploration (G3 Stage) for REE and associated Rare Metals in the NB 5 block of the northern part of the Siwana Ring Complex, Balotra district, RAJASTHAN. Area 2.0 sq. km; No. of BH 24, Borehole depth range- 125m; Schedule timeline-24 months; Review: After 6 & 12 Months						
S. No.	**Item of Work ***	**Unit***	**Rates as per NMET SoC 2020-21**		**Estimated Cost of the Proposal**	
			SoC-Item No. *	**Rates as per SoC * (a)**	**Qty. (b)**	**Total Amount (Rs) (a*b)**
A	**GEOLOGICAL MAPPING OTHER GEOLOGICAL WORK & SURVEYING**					
	Geologist mapping (1:2000), Trenching, Drilling Work					
i	Geologist mapping (1:2000) , Trenching and Drilling work - 2 party days (120x2)	day	1.3	11,000	240	26,40,000
ii	Labours Charges; Base rate	day	5.7	504	480	2,41,920
iii	Charges for Geologist per day (HQ)	day	1.3	9,000	75	6,75,000
iv	Charges for one Sampler per day (1 Party)	one sampler	1.5.2	5,100	120	6,12,000

		per day				
v	Labours (4 Nos)	day	5.7	504	480	2,41,920
	Sub Total- A					**44,10,840**
B	**GEOPHYSICAL INVESTIGATION**					
i	Gravity Method-- spacing 100 mtsX100mts - 85 stations	Per station	3.1b	4500	200	9,00,000
ii	Radiometric survey	Per station				
iii	Magnetic Survey	Line kms	3.2a	1800	200	3,60,000
iii	Geophysicist-Monitoring of Geophysical Investigation (Field)-Geophysicist	Per Day	3.19	11000	30	3,30,000
	Labourers (Rs 504/day/labour) Geophysical Survey(2Nos)	Days	5.7	504	120	60,480
iv	Expert Charges for Geophysicist (HQ)	Per Day	3.18	9000	10	90,000
	Sub Total - B					**17,40,480**
C	**SURVEY WORK**					
i	DGPS Survey for BH fixation & RL determination of the Boreholes and 1 no of Base Station + 8 boundary coordinates	Per Point of observatio n	1.6.2	19,200	33	6,33,600
ii	Charges of Surveyor (1 party) for Geophysical survey layout work & Block boundary demarcation	one surveyor per day	1.6.1a	8,300	45	373500
iii	Labours Charges for survey work;	day	5.7			90720

				504	180	
	Sub-Total C					**10,97,820**
D	**PITTING & TRENCHING (120 cu m)**					
i	Trenching (1m x 2mx 10 m) - 5nos	Per Cu.M	2.1.1	3330	50	166500
	Sub-Total D					**166500**
E	**DRILLING (400mx200m grid)**					
i	Drilling up to 125m (Hard Rock)	m	2.2.1.5a	12,650	3,000	3,79,50,000
ii	Land / Crop Compensation (BH falls in agricultural Land)	per borehole	5.6	20,000	24	4,80,000
iii	Construction of concrete Pillar (12"x12"x30")	per borehole	2.2.7a	2,000	24	48,000
iv	Transportation of Drill Rig & Truck associated per drill (2 rigs)	Km	2.2.8	36	7,200	2,59,200
v	Monthly Accommodation Charges for drilling Camp (4 rigs 50000 +(50000X50%)X2)=100000)	month	2.2.9	1,00,000	24	24,00,000
vi	Drilling Camp Setting Cost	Nos	2.2.9a	2,50,000	2	5,00,000
vii	Drilling Camp Winding up Cost	Nos	2.2.9b	2,50,000	2	5,00,000
viii	Road Making (hilly Terrain)	Km	2.2.10b	32,200	5	1,61,000
ix	Drill Core Preservation	per m	5.3	1,590	3,000	47,70,000
	Sub-Total E					**91,18,200**
F	**BOREHOLE GEOPHYSICAL LOGGING**					

i	Dual Density	m	3.11d	102	3,000	3,06,000
ii	Spectral Gamma	m	3.11o	164	3,000	4,92,000
v	Calliper	m	3.11g	19	3,000	57,000
vi	Expert Charges for Geophysicist HQ	day	3.18	9,000	30	2,70,000
vii	Expert Charges for Geophysicist Field	day	3.18	11,000	60	6,60,000
	Sub -Total F					**17,85,000**
G	**LABORATORY STUDIES - SMPL**					
	Chemical Analysis (Outsourced component)					
i)	**Primary Samples**					
	Analysis of one rock/soil samples for determination of 34 elements by ICP-AES / ICP-MS sequential technique- Channel 100 and Pitting/Trenching 50= Total 150	Nos	4.1.14	7,731	150	11,59,650
ii	**External Check Samples (10%)**					
	Check Samples 10% (other than Drill core)	Nos	4.1.14	7,731	15	1,15,965
iii	**CORE Samples -**					
	Analysis of one rock/soil samples for determination of 34 elements by ICP-AES/ICP-MS sequential technique	Nos	4.1.14	7,731	800	61,84,800
iv	**External Check Samples (10%)**					

	Drill Core					
	Analysis of one rock/soil samples for determination of 34 elements by ICP-AES / ICP-MS sequential technique	Nos	4.1.14	7,731	80	6,18,480
v	**Petrographic studies**					
	Preparation of thin section	per sample	4.3.1	2,363	15	35,445
	Complete Petrographic/ore microscopic study/Mineralogical study	per sample	4.3.4	4,232	15	63,480
	Preparation of polished section	per sample	4.3.2	1,549	15	23,235
	Study of polished section	per sample	4.3.4	4,232	15	63,480
vi	**PCS (Major, Minor, Trace REE)**					
	Whole rock analysis	per sample	4.1.15a	4,200	15	63,000
	XRD analysis for identification of minerals random	no's	4.5.1	4,000	15	60,000
viii	**EPMA**	per hour	4.4.1	8,540	5	42,700
ix	**Specific Gravity Determination**					
	Specific Gravity Determination	no's	4.8.1	1605	15	**24,075**
	Subtotal F					**83,91,310**
H	**OUTSOURCED OPERATIONAL COST**	per project	3 (i)	10%		**6,20,652**
	TOTAL (A to H)					

						2,73,30,802
I	**Geological Report Preparation**	**5 Hard copies with a soft copy**	**5.2**	3% of the project cost	**1.00**	**8,19,924**
J	**Peer review Charges**		**As per EC decision**			**30,000**
K	**Preparation of Exploration Proposal (5 Hard copies with a soft copy)**	**5 Hard copies with a soft copy**	**5.1**	2% of the Cost or Rs. 3.8 Lakhs whichever is less		**3,80,000**
L	**Total Estimated Cost without GST**					**2,85,60,726**
M	**Provision for GST (18% of L)**					**51,40,931**
N	**Total Estimated Cost with GST**					**3,37,01,656**
				or Say Rs. In Lakhs		**337.02**

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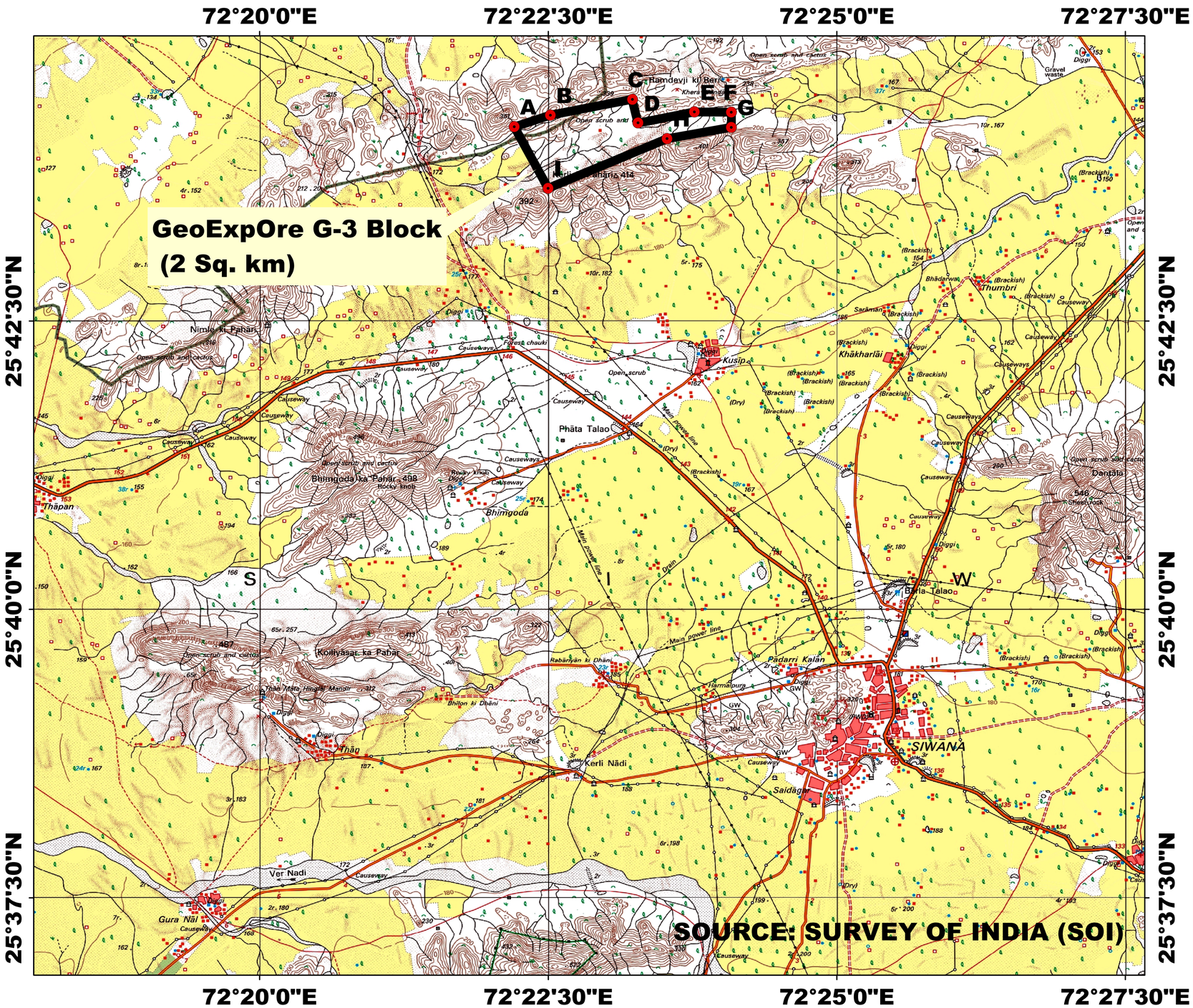
PLATE-1

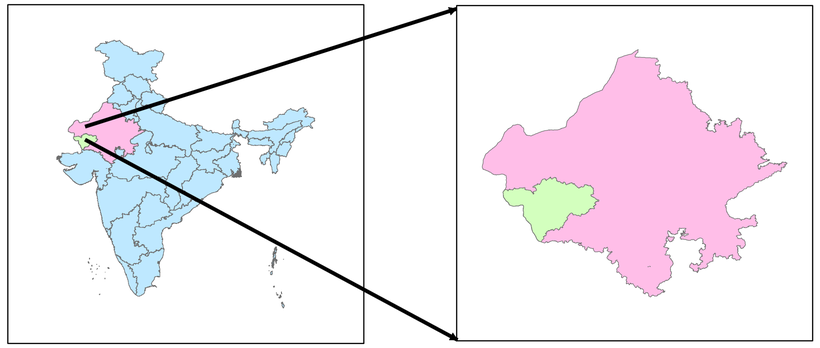
Topographic Map for the Preliminary Exploration for REE and associated Rare Metals in the NB 5 block of the Northern part of the Siwana Ring Complex, Balotra district, Rajasthan



1:40,000

0 1 2 4 6 8 Km

1 centimeter = 400 meters



Legend

GeoExpOre_G3 Block

GeoExpOre (G-3) Block (2 sq. kms)		
Cardinal Points	**Latitude**	**Longitude**
A	25°44'11.148"	72°22'12.389"
B	25°44'17.106"	72°22'31.048"
C	25°44'25.285"	72°23'13.747"
D	25°44'13.070"	72°23'16.656"
E	25°44'18.780"	72°23'45.935"
F	25°44'18.726"	72°24'05.206"
G	25°44'10.817"	72°24'05.213"
H	25°44'04.873"	72°23'31.747"
I	25°43'39.108"	72°22'29.896"

GeoExpOre Pvt. Ltd

PLATE-2

GEOLOGICAL MAP FOR THE PRELIMINARY EXPLORATION FOR REE AND ASSOCIATED RARE METALS IN THE NB 5 BLOCK OF THE NORTHERN PART OF THE SIWANA RING COMPLEX, BALOTRA DISTRICT, RAJASTHAN

1:50,000

0 1.25 2.5 5 7.5 10 Km

1 centimeter = 500 meters

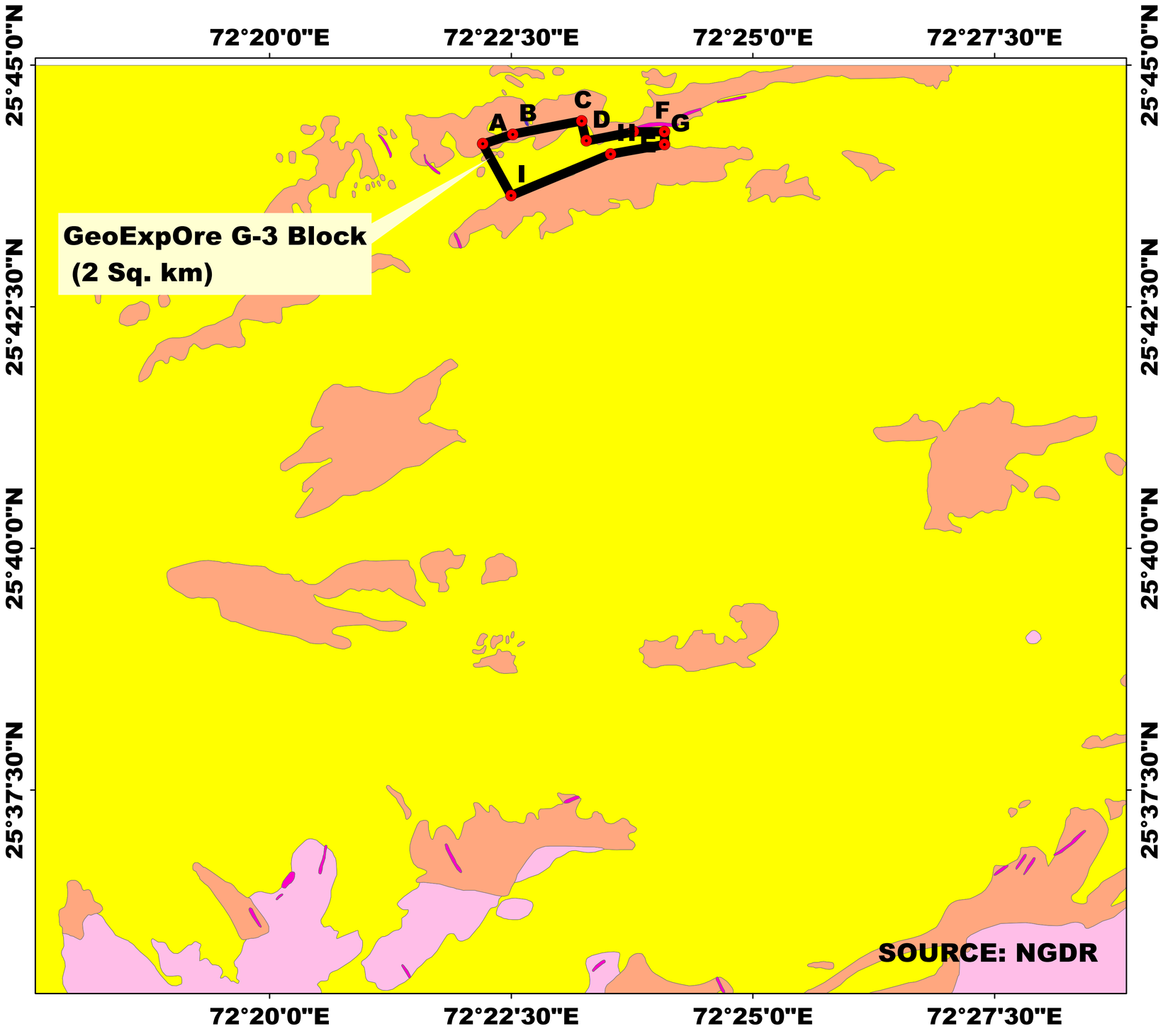
MAP SOURCE: NATIONAL GEOSCIENCE DATA REPOSITORY (NGDR)

DOC NO: NMET/RJ/GM-02/R0/2025-26 (21-11-2025)

PREPARED BY	Mr. SHASHANK S MAHAPATRA (Asst. Geologist)	
VERIFIED BY	Mr. MANOJ VP (Senior Geologist)	

PLATE-2

Geological Map for the Preliminary Exploration for REE and associated Rare Metals in the NB 5 block of the Northern part of the Siwana Ring Complex, Balotra district, Rajasthan



1:50,000

0 1.25 2.5 5 7.5 10 Km

1 centimeter = 500 meters

Legend

GeoExpOre_G3 Block

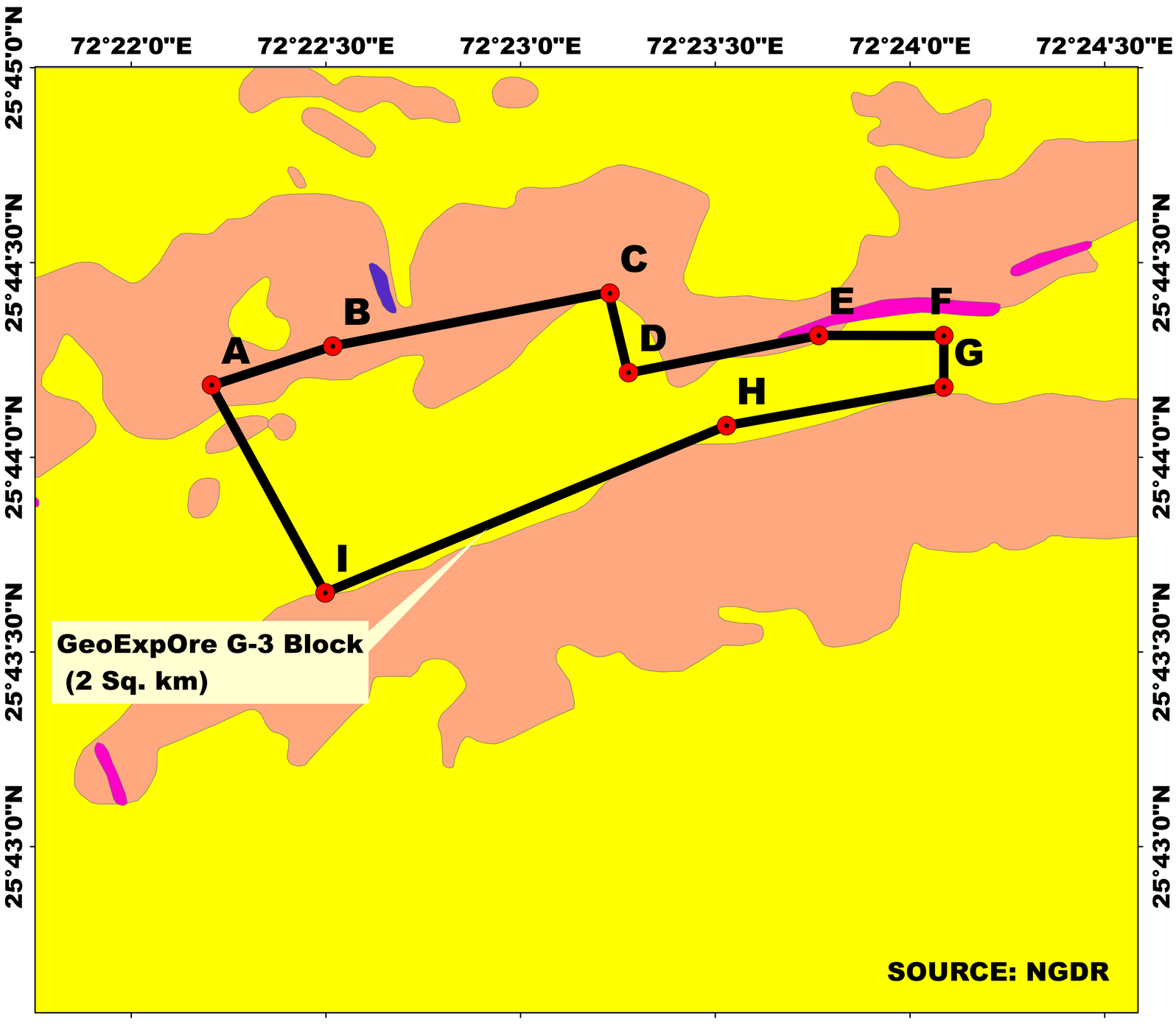
Lithology

- FINE AEOLIAN SAND AND SILT WITH OCCASSIONAL KANKAR
- QUARTZ VEIN/REEF
- GRANITE PORPHYRY
- DOLERITE
- PERALKALINE GRANITE
- RHYOLITE
- TUFFS, VOLCANIC BRECCIA, ASH BEDS AND AGGLOMERATE

GeoExpOre Pvt. Ltd		
PLATE-2 GEOLOGICAL MAP FOR THE PRELIMINARY EXPLORATION FOR REE AND ASSOCIATED RARE METALS IN THE NB 5 BLOCK OF THE NORTHERN PART OF THE SIWANA RING COMPLEX, BALOTRA DISTRICT, RAJASTHAN		
1:50,000 0 1.25 2.5 5 7.5 10 Km 1 centimeter = 500 meters		
MAP SOURCE: NATIONAL GEOSCIENCE DATA REPOSITORY (NGDR)		
DOC NO: NMET/RJ/GM-02/R0/2025-26 (21-11-2025)		
PREPARED BY	Dr. ABRAR AHMED (Senior Geologist) Mr. SHASHANK S MAHAPATRA (Asst. Geologist)	
VERIFIED BY	Mr. MANOJ VP (Senior Geologist)	

PLATE-3

Block Geological Map for the Preliminary Exploration for REE and associated Rare Metals in the NB 5 block of the Northern part of the Siwana Ring Complex, Balotra district, Rajasthan



1:50,000 (Not for Scale)

0 0.25 0.5 1 1.5 2 Km

1 centimeters = 500 meters

Legend

GeoExpOre_G3 Block

Lithology

- FINE AEOLIAN SAND AND SILT WITH OCCASSIONAL KANKAR
- GRANITE PORPHYRY
- DOLERITE
- RHYOLITE

GeoExpOre Pvt. Ltd		
PLATE-2 GEOLOGICAL MAP FOR THE PRELIMINARY EXPLORATION FOR REE AND ASSOCIATED RARE METALS IN THE NB 5 BLOCK OF THE NORTHERN PART OF THE SIWANA RING COMPLEX, BALOTRA DISTRICT, RAJASTHAN		
1:50,000 0 1.25 2.5 5 7.5 10 Km 1 centimeter = 500 meters		
MAP SOURCE: NATIONAL GEOSCIENCE DATA REPOSITORY (NGDR)		
DOC NO: NMET/RJ/GM-02/R0/2025-26 (21-11-2025)		
PREPARED BY	Dr. ABRAR AHMED (Senior Geologist) Mr. SHASHANK S MAHAPATRA (Asst. Geologist)	
VERIFIED BY	Mr. Manoj VP (Senior Geologist)	

PLATE-04

TENTATIVE BOREHOLE LOCATION MAP

PRELIMINARY EXPLORATION FOR REE AND RARE METALS IN THE NB 5 BLOCK OF THE SIWANA RING COMPLEX, BALOTRA DISTRICT, RAJASTHAN

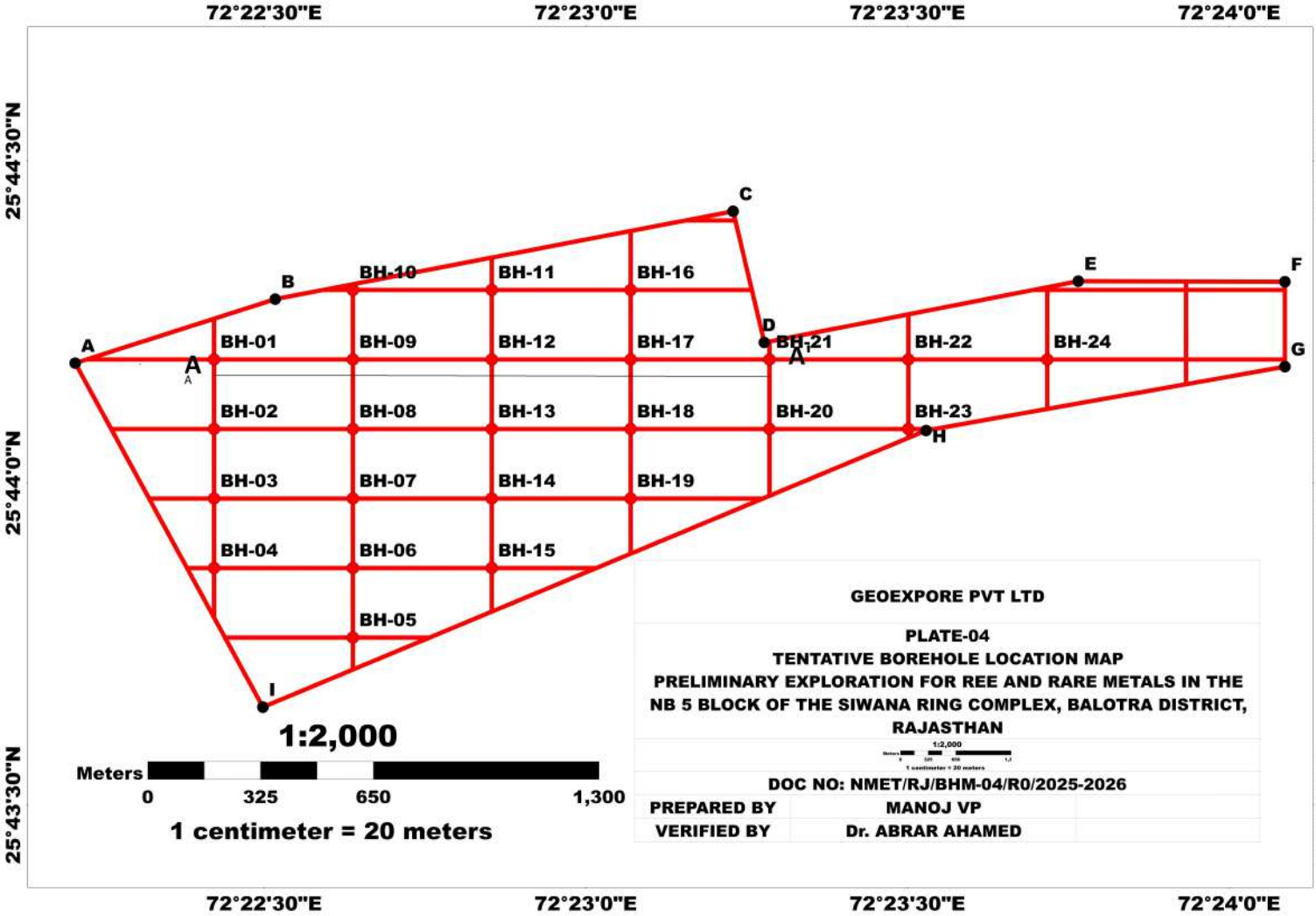
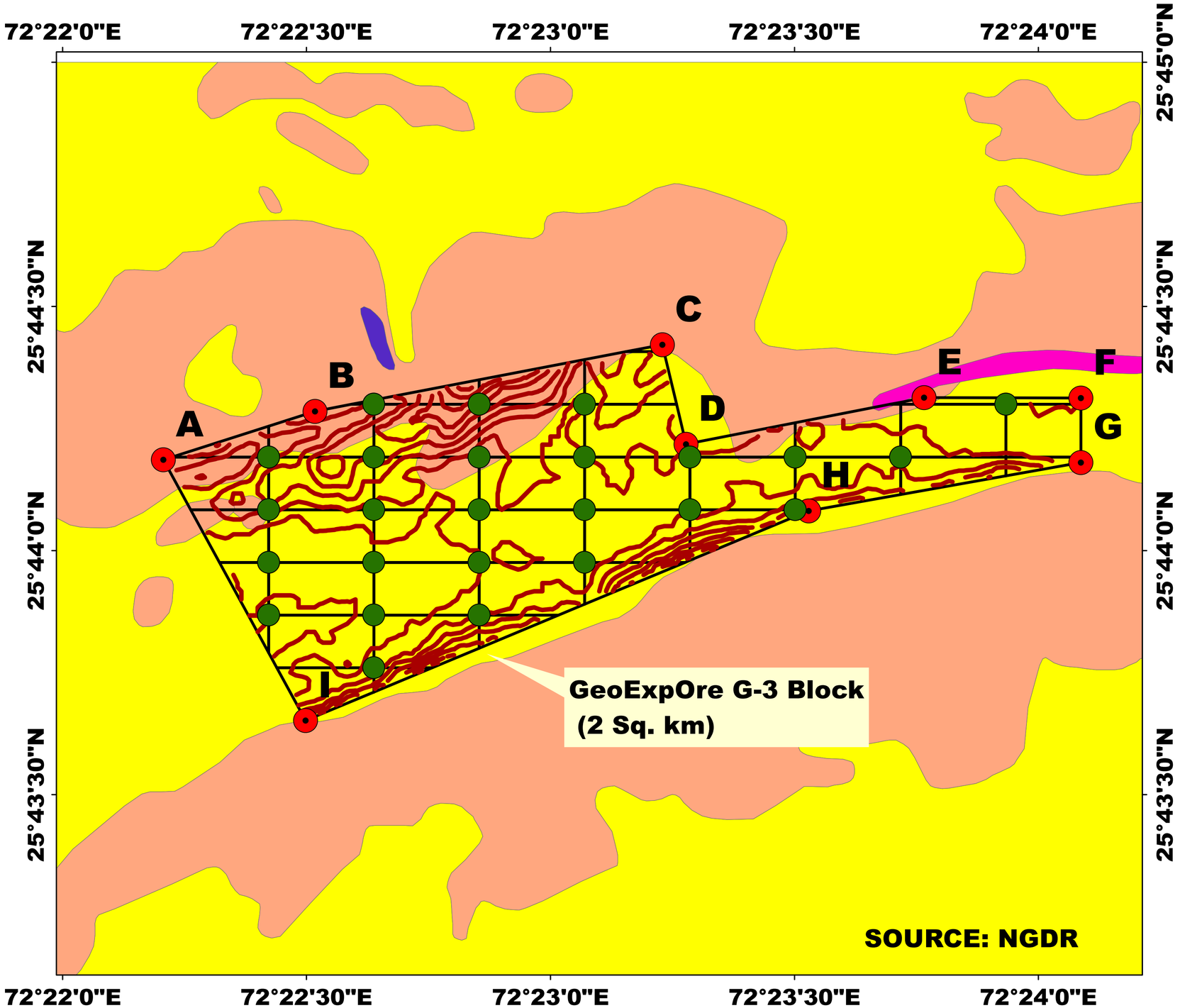


PLATE-5

Tentative BH locations on Geological map for the Preliminary Exploration for REE and associated Rare Metals in the NB 5 block of the Northern part of the Siwana Ring Complex, Balotra district, Rajasthan



1:50,000 (Not for Scale)

0 0.2 0.4 0.8 1.2 1.6 Km

1 centimeters = 500 meters

Legend

- GeoExpOre_G3 Block
- BH_Points
- Contour line
- BH_grid

Lithology

- FINE AEOLIAN SAND AND SILT WITH OCCASSIONAL KANKAR
- QUARTZ VEIN/REEF
- GRANITE PORPHYRY
- DOLERITE
- PERALKALINE GRANITE
- RHYOLITE
- TUFFS, VOLCANIC BRECCIA, ASH BEDS AND AGGLOMERATE

GeoExpOre Pvt. Ltd		
PLATE-2 GEOLOGICAL MAP FOR THE PRELIMINARY EXPLORATION FOR REE AND ASSOCIATED RARE METALS IN THE NB 5 BLOCK OF THE NORTHERN PART OF THE SIWANA RING COMPLEX, BALOTRA DISTRICT, RAJASTHAN		
1:50,000 0 1.25 2.5 5 7.5 10 Km 1 centimeter = 500 meters		
MAP SOURCE: NATIONAL GEOSCIENCE DATA REPOSITORY (NGDR)		
DOC NO: NMET/RJ/GM-02/R0/2025-26 (21-11-2025)		
PREPARED BY	Mr. SHASHANK S MAHAPATRA (Asst. Geologist)	
VERIFIED BY	Mr. MANOJ VP (Senior Geologist)	

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भारत सरकार
GOVERNMENT OF INDIA
भारतीय भूवैज्ञानिक सर्वेक्षण
GEOLOGICAL SURVEY OF INDIA

राजस्थान राज्य के बाड़मेर जिले के इन्द्राना-सिवाना क्षेत्र, सिवाना रिंग कॉम्प्लेक्स का मध्य भाग में दुर्लभ मृदा तत्व और संबंधित खनिजकरण के लिए टोही सर्वेक्षण की अंतिम रिपोर्ट (जी-4 चरण)

FINAL REPORT ON RECONISSANACE SURVEY FOR RARE EARTH ELEMENTS AND ASSOCIATED MINERALISATION AROUND INDRANA-SIWANA AREA, CENTRAL PART OF SIWANA RING COMPLEX, SIWANA (SRC), BARMER DISTRICT, RAJASTHAN (G-4 STAGE)

टोपोशीट संख्या: 45सी/06 और 45सी/10
Toposheet No: 45C/06 and 45C/10

मद संख्या: एम2एएफजीबीएम-एमईपी/एनसी/डब्ल्यूआर/एसयू-आरएजे/2021/36826
Item No: M2AFGBM-MEP/NC/WR/SU-RAJ/2021/36826

कायटसत्र 2021-22 का अंनतम प्रनतवेदि
Final report forfor field season 2021-22

विवेक वी कुमार, वरिष्ठ भूवैज्ञानिक Vivek V. Kumar, Sr. Geologist
डॉ. किरण ज्योति मिश्रा, वरिष्ठ भूवैज्ञानिक Dr. Kiran Jyoti Mishra, Sr. Geologist

मिशन -II
MISSION-II

राज्य इकाई: राजस्थान/State Unit : Rajasthan
पश्चिमीक्षेत्र/ Western Region
जयपुर/ Jaipur

नवंबर 2022
November 2022

केवल कार्यालय उपयोग के लिए
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भारत सरकार
GOVERNMENT OF INDIA
भारतीय भूवैज्ञानिक सर्वेक्षण
GEOLOGICAL SURVEY OF INDIA

राजस्थान राज्य के बाड़मेर जिले के इन्द्राना-सिवाना क्षेत्र, सिवाना रिंग कॉप्लेक्स का माध्यम भाग में दुर्लभ मृदा तत्व और सम्बन्धित खनिजकरण के लिए टोही सर्वेक्षण की अंतिम रिपोर्ट (जी-4 चरण)

REPORT ON RECONAISSANACE SURVEY FOR RARE EARTH ELEMENTS AND ASSOCIATED MINERALISATION AROUND INDRANA-SIWANA AREA, CENTRAL PART OF SIWANA RING COMPLEX, SIWANA (SRC), BARMER DISTRICT, RAJASTHAN (G-4 STAGE)

टोपोशीटसंख्या: 45 सी/06 और 45 सी/10
Toposheet No: 45C/06 and 45C/10

मद संख्या: एम 2 एएफजीबीएम-एमईपी/एनसी डब्ल्यू आर/ एसयू-आरएजे/2021/36826
Proposal ID: M2AFGBM-MEP/NC/WR/SU-RAJ/2021/36826

कायटसत्र 2021-22 का अंनतम प्रनतवेदि
Final report for field season 2021-22

विवेक वि कुमार, वरिष्ठ भूवैज्ञानिक **Vivek V. Kumar, Sr. Geologist**
डॉ. किरण ज्योति मिश्रा, वरिष्ठ भूवैज्ञानिक **Dr. Kiran Jyoti Mishra, Sr. Geologist**

मिशन-II
MISSION-II

राज्य इकाई: राजस्थान/State Unit : Rajasthan
पश्चिमीक्षेत्र/ Western Region
जयपुर/ Jaipur

नवंबर 2022
November 2022

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Plate - 4	Large scale geological map of the area, Siwana Ring Complex (SRC), Barmer District, Rajasthan with demarcated suitable blocks for detailed exploration
Plate - 5	Field photographs

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Appendix –II: Details of Work Input
Appendix –III: Certificate of Quality of Report
Appendix –IV: Data sheet on report movement in connection with its scrutiny

अध्याय 1

सारांश

दुर्लभ मृदा तत्वों की संभाव्यता संभाव्यता को आंकलन करने के लिए इंद्राना - सिवाना क्षेत्र, बाड़मेर जिला, राजस्थान (टोपोशीट संख्या 45सी/06 और 10) के आसपास 1:12,500 पैमाने पर बड़े पैमाने पर मानचित्रण, आइटम कोड: एम2एएफजीबीएम-एमईपी/एनसी/डब्ल्यूआर/एसयू-आरएजे/2021/36826 लिया गया है | मानचित्रण के दौरान इंद्राना-सिवाना क्षेत्र में कुल 300 बेड रॉक, 25 पेट्रोलॉजिकल, 20 पेट्रोकेमिकल, 10 ईपीएमए, 5 एक्सआरडी नमूने एकत्र किए गए।

मानचित्रण के दौरान मानचित्रण किए गए क्षेत्र में विभिन्न लिथो यूनिट का जोखिम है जिसे मोटे तौर पर ज्वालामुखी और प्लूटोनिक चरणों में समूहीकृत किया जा सकता है। रेयोलाइट की पोर्फिरीटिक और एफ़ानिटिक प्रकार इस क्षेत्र में पाए जाने वाले प्रमुख ज्वालामुखीय चरण हैं। मैप किए गए क्षेत्र के दक्षिण-पूर्वी भाग में ज्यादातर पोर्फिरीटिक रेयोलाइट देखा जाता है, जिसमें अलग-अलग आयामों के साथ क्षार फेल्डस्पार फेनोक्रिस्ट्स की उपस्थिति है। फेल्डस्पार फेनोक्रिस्ट का मापा गया अधिकतम आकार 2.5 x 1 मी है। रैयोलाइट की अपानिटिक किस्म क्षेत्र में सबसे आम ज्वालामुखी चरण है। वे मुख्य रूप से हरे भूरे रंग के, महीन दाने वाली चट्टानें हैं। क्षेत्र में देखे गए प्लूटोनिक चरणों में ग्रे रंग, मध्यम से मोटे अनाज वाले ग्रेनाइट का वर्चस्व है। यह ग्रेनाइट फेल्डस्पार अनाज की दो अलग-अलग किस्मों की उपस्थिति की विशेषता है। गुलाबी रंग का, मोटे दाने वाला क्षार फेल्डस्पार ग्रेनाइट ज्यादातर मैप किए गए क्षेत्र के दक्षिण पूर्वी भागों में देखा जाता है। ग्रेनाइट की दोनों किस्मों के बीच संपर्क प्रकृति में बिखरा हुआ दिखाई देता है। क्षार स्फतीय ग्रेनाइट ज्यादातर क्षेत्र में पहाड़ी जोखिम के निचले रूपों के साथ पाया जाता है। क्षेत्र के सबसे कम उम्र के दखल देने वाले चरण संयुक्त विमानों के साथ घुसपैठ के साथ-साथ शीट प्रकार के क्षेत्र संबंध वाले डाइक हैं। क्षेत्र में मुख्य रूप से दो प्रकार के डाइक पाए जाते हैं। विभिन्न इलाकों में मांस के रंग के, महीन दाने वाले रयोलिटिक डाइक देखे जाते हैं। गहरे रंग के डाइक ज्यादातर ग्रेनाइट से जुड़े देखे गए। डाइक की अधिकतम पता लगाने योग्य लंबाई परिवर्तनीय चौड़ाई के साथ 400 मीटर तक है। क्षेत्र में 3.5 सेमी लंबाई तक की ऐग्रीन सुइयों वाली अनुपयोगी पेगमाटाइटिक किस्में कम बार-बार देखी गईं।

मैप किए गए क्षेत्र में चट्टानें शायद ही किसी विकृति से गुजरी हों। क्षेत्र में प्रमुख संयुक्त पैटर्न के दो सेट देखे गए। ये जोड़ NNW और EW चलन में हैं, जो क्रमशः पश्चिमी और दक्षिण की ओर झुक रहे हैं।

क्षेत्र के ज्वालामुखीय चरणों के पेट्रोग्राफिक अध्ययन में यूहेड्रल और सबहेड्रल क्षार फेल्डस्पार फेनोक्रिस्ट्स की उपस्थिति की विशेषता है। ज्वालामुखी चरणों के बीच क्षार पाइरोक्सीन और क्षार अम्फिबोल सर्वव्यापी हैं। ग्राउन्ड मास बहुत महीन दाने वाला प्रतीत होता है। कुछ ही सेक्सन में ग्राफिक टेक्शर देखा जाता है। ग्रेनाइट पेट्रोग्राफी आवश्यक खनिज चरणों के रूप में क्षार फेल्डस्पार, क्वार्ट्ज और क्षार एम्फिबोल (आर्फवेदसोनाइट) और क्षार पाइरॉक्सीन (एग्रीन) और पर्थाइट की उपस्थिति का संकेत देती है। एपेटाइट, जिरकोन, एनिग्माटाइट, एस्ट्रोफिलिट, एग्रीन-ओगाइट और रीबेकाइट को सहायक चरणों के रूप में देखा जाता है। क्षेत्र के ग्रेनाइट एक विशिष्ट हाइपिडियोमोर्फिक टेक्सचर प्रदर्शित करते हैं। फेल्डस्पार कणिकाओं की दो अलग-अलग किस्मों की उपस्थिति के साथ क्षेत्र के ग्रेनाइट प्रमुख रूप से सब सॉल्वस हैं। मोकलसर क्षेत्र में ग्रेनाइट की हाइपर सॉल्वस किस्म पाई जाती है। पेर्थाइट परतों का मोटा होना, क्षार फेल्डस्पार फेनोक्रिस्ट्स का ड्यूटेरिक परिवर्तन, क्षार फेल्डस्पार का स्यूडोमोर्फिक प्रतिस्थापन देर से / पोस्ट मैग्मैटिक एग्राइन द्वारा, मैग्मैटिक एग्राइन का प्रतिस्थापन - एग्रीन द्वारा संवर्धित और आर्फवेदसोनाइट द्वारा निश्चित रूप से देर से पोस्ट एमजीमैटिक मेटासोमैटिक / के लिए काफी सबूत हैं। हाइड्रोथर्मल घटना।

CHAPTER -1

SUMMARY

Large scale mapping in 1:12,500 scale around Indrana - Siwana area, Barmer District, Rajasthan, (Toposheet no. 45C/06& 10) with Item Code: M2AFGBM-MEP/NC/WR/SU-RAJ/2021/36826 was taken up with an objective to evaluate potentiality of Rare Earth Elements. A total of 300 bed rock, 25 petrological, 20 petrochemical, 10 EPMA, 5 XRD samples were collected during the course of mapping in Indrana - Siwana area.

The mapped area has exposures of various litho units which can be broadly grouped among volcanic and plutonic phases. The porphyritic and aphanitic varieties of rhyolite are the major volcanic phases observed in the area. The porphyritic rhyolite observed mostly in the southeastern part of the mapped area 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. The aphanitic variety of rhyolite is the most common volcanic phase in the area. They are dominantly greenish grey colored, fine-grained rocks. The plutonic phases observed in the area are dominated by grey colored, medium to coarse grained granite. This granite is characterized by the presence of two distinct verities of feldspar grains. The pink colored, coarse grained alkali feldspar granite is mostly observed in the south eastern parts of the mapped area. The contact between both varieties of granite is diffusive in nature. The alkali feldspar granite is mostly found along the lower contours of the hilly exposures in the area. 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 dykes mostly observed associated to the granites with typical discordant field relation. The maximum traceable length of the dyke is up to 400 m with variable width. Unmappable pegmatitic varieties with aegrine needles up to 3.5 cm length were observed less frequently in the area.

The rocks in the mapped area hardly underwent any deformation. Two sets of major joint patterns noticed in the area. These joints are NNW and EW in trend, dipping westerly and southerly respectively.

Petrographic studies of volcanic phases of the area are characterized by presence of euhedral and subhedral alkali feldspar phenocrysts. Alkali pyroxenes and alkali amphiboles

are ubiquitous among the volcanic phases. The ground mass appears to be very fine grained. Graphic texture is noticed in a few thin sections.

The granite petrography indicate presence of alkali feldspar, quartz and alkali amphibole (arfvedsonite) and alkali pyroxene (aegirine) and perthite as essential mineral phases. Apatite, zircon, aenigmatite, astrophyllite, aegrine- augite and riebeckite are observed as accessory phases. Granites of the area exhibit a typical hypidiomorphic texture. The granites of the area are dominantly sub solvus in nature with the presence of two distinct varieties of feldspar grains. The hyper solvus variety of granite is observed in Mokalsar area. The coarsening of perthite layers, deuteric alteration of alkali feldspar phenocrysts, pseudomorphic replacement of alkali feldspar by late / post magmatic aegrine, replacement of magmatic aegirine – augite by aegirine and to certain extend by arfvedsonite are considerable evidences for a late to post mgmatic metasomatic / hydrothermal event. Hematite is the major opaque mineral observed in both granite verities. Monazite, xenotime and allanite are the REE mineral phases identified under microscope and EPMA analysis.

Based on geochemical analysis results, most of the litho units of the area have peralkaline nature with anorogenic origin. The volcanic phase exhibit intermediate to acidic silica saturation whereas the plutonic phases are silica oversaturated. At places the volcanic phases indicate comendite - pantellerite affinity. The trace element data indicate highly differentiated nature of the granitoids. Chemical analysis implies encouraging results of total REE in the mapped area. Out of the 300 bed rock samples analyzed, 107 samples resulted in ΣREE+Y values greater than mean value (2446ppm). The ΣREE+Y of the BRS samples vary between a minimum of 265.47 ppm to a maximum of 8984.74 ppm. Among 100 channel samples analyzed, ΣREE+Y values ranges from 476.25 ppm to 8582.98 ppm. The granite samples from the area yielded ΣREE+Y values ranging from 935.95 ppm to 7808.84 ppm, with avg. HREE/LREE ratio of 0.19. Volcanic rock samples from the area yielded ΣREE+Y values ranging from 265.47 ppm to 8984.74 ppm, with avg. HREE/LREE ratio of 0.18. The later intrusive rocks (Dykes) yielded ΣREE+Y values ranging from 621.10 ppm to 7316.14 ppm, with avg. HREE/LREE ratio of 0.26. Apart from REE+Y, encouraging chemical analysis result was observed for certain rare metals and trace elements such as Zr (up to 10173 ppm), Nb (up to 853 ppm), Zn (up to 920 ppm), Th (up to 77 ppm), Hf (up to 666.41 ppm).

CHAPTER-2

INTRODUCTION

2.1 Details of FSP:

The item was taken up under Project/Division: Strategic Metals-II (SM-II), vide item code No.: M2ASMIF-MEP/NC/WR/SU-RAJ/2021/36826 for FS: 2021-22 of State Unit: Rajasthan as per the instructions of the Deputy Director General, State Unit: Rajasthan, Geological Survey of India. It is approved by the Ministry of Mines, Government of India. The title of the project is "Reconnaissance survey for Rare Earth Elements and associated mineralization around Indrana-Siwana area, central part of Siwana Ring Complex Siwana (SRC), Barmer District, Rajasthan, (G4). The objective of investigation is to evaluate potentiality of rare earth elements and associated mineralization. This is a spin off item of the projects carried out earlier during FS: 2014-15 (STM), FS: 2014-15 (G4) and FS: 2017-18 (G4).

Association of rare earths and rare metals (RERM) with lithounits like granite, syenite, pegmatite and carbonatites is a well-known fact. In and around the study area, preferential enrichments of RERM mineralization has been reported by earlier workers (Rastogi & Mukherjee, 2015; Das et al., 2015; Barman and Neog, 2019; Kumar and Sharma, 2020). Keeping in view of these facts and presence of fertile litho units like alkali granites and related younger micro granite and intrusive dyke systems, this item was proposed with an aim to locate potential zones of rare earth elements and associated mineralization in the area. The detailed background information will be discussed in the later chapters. The nature and quantum of work and brief synopsis of the project is given in table- 2.1 and 2.2.

Table-2.1: Nature and quantum of work carried out during FS: 2021-22.

Nature of work	Target for FS: 2020-21	Achievements during FS: 2020-21
Aster Data Processing (1: 50,000) (in Sq. Km)	720	720
Large Scale Mapping (1:12,500) (in Sq. Km)	100	100
BRS	300	300
PCS	20	20
Channel Samples	100	100
PS	20	20
EPMA	10	10
XRD	5	5
Chemical Analyses	420	420

Table-2.2: Brief Synopsis of the project, FS: 2021-22.

Name of field officers	Field days	Transit days	RCA expenditures (in Rs.)
Shri Vivek V. Kumar, Sr. Geologist & PI	108	5	Wages: 179783.00 OC: 63852.00 POL: 20048.00 Total: 263683.00
Dr. Kiran Jyoti Mishra, Sr. Geologist	111	7	
Shri Rohan Das, Director & Supervisory officer	5		

2.2 Acknowledgements:

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CHAPTER – 3

PROPERTY DESCRIPTION

3.1Title of Ownership

Geological Survey of India, Western Region (State Unit: Rajasthan)carried out this project under the aegis of Project Strategic Metals (SM)-II, Mission-II, Mineral Assessment-Strategic Minerals, Industrial and Fertilizer Minerals for the Field Season 2021-22 vide FSP ID:M2ASMIF-MEP/NC/WR/SU-RAJ/2021/36826

3.2Details of the area

3.2.1 Village name/District/State

The villages located in and around investigation area are Siwana, Mokalsar, Mailavas, Indrana, Devandi, Ludrara, Mawri, and Arjiyana falling under the jurisdiction of Siwana tehsil of Barmer district of Rajasthan.

3.2.2 Toposheet No.:

The study area falls in Survey of India Toposheet no. 45C/06 and 46C/10 of Barmer district, Rajasthan.

3.2.3 Geo-coordinates of Block:

The coordinates of present study area is tabulated below.

Table 3.1 coordinates of the study area.

Points	Latitude	Longitude
A	25° 40' 00" N	72° 15' 00" E
B	25° 40' 00" N	72° 16' 40" E
C	25° 37' 40" N	72° 16' 40" E
D	25° 37' 40" N	72° 24' 00" E
E	25° 40' 00" N	72° 24' 00" E
F	25° 40' 00" N	72° 32' 30" E
G	25° 35' 00" N	72° 32' 30” E
H	25° 35' 00" N	72° 30' 00” E
I	25° 37' 30" N	72° 30' 00” E
J	25° 37' 30" N	72° 15' 00" E

3.2.4 Cadastral details:

The mapped area is covered by approximately 30% outcrop composed of volcanic and plutonic phases; rest of the area is covered by aeolian soil. The area is dominated by sub-arcuate ridges. The highest peak recorded in thearea is Δ414m msl situated at top of Kerliki Pahari. The drainage system of the study area is manifested by Luni River, Ver Nadi and Mamaji-ka-Nala.

3.2.5Free hold/Leasehold:

The mapped area is a free hold area. A few dimension stone quarries are being operated in the area.

3.2.6 Location and Accessibility

The area is the part of toposheets 45C/06 & 45C/10 of Barmer district, Rajasthan. The nearest railway station is at Mokalsar and Balotra situated at a distance of 23 km southeast and 44 km northwest of study area respectively from Meli village. Siwana town is about 10km southwest of Meli village. The field area is approachable from Jaipur 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 (Fig. 3.1).

3.2.7 Climate

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℃ 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. The average annual temperature in Barmer district is 27.1 °C.

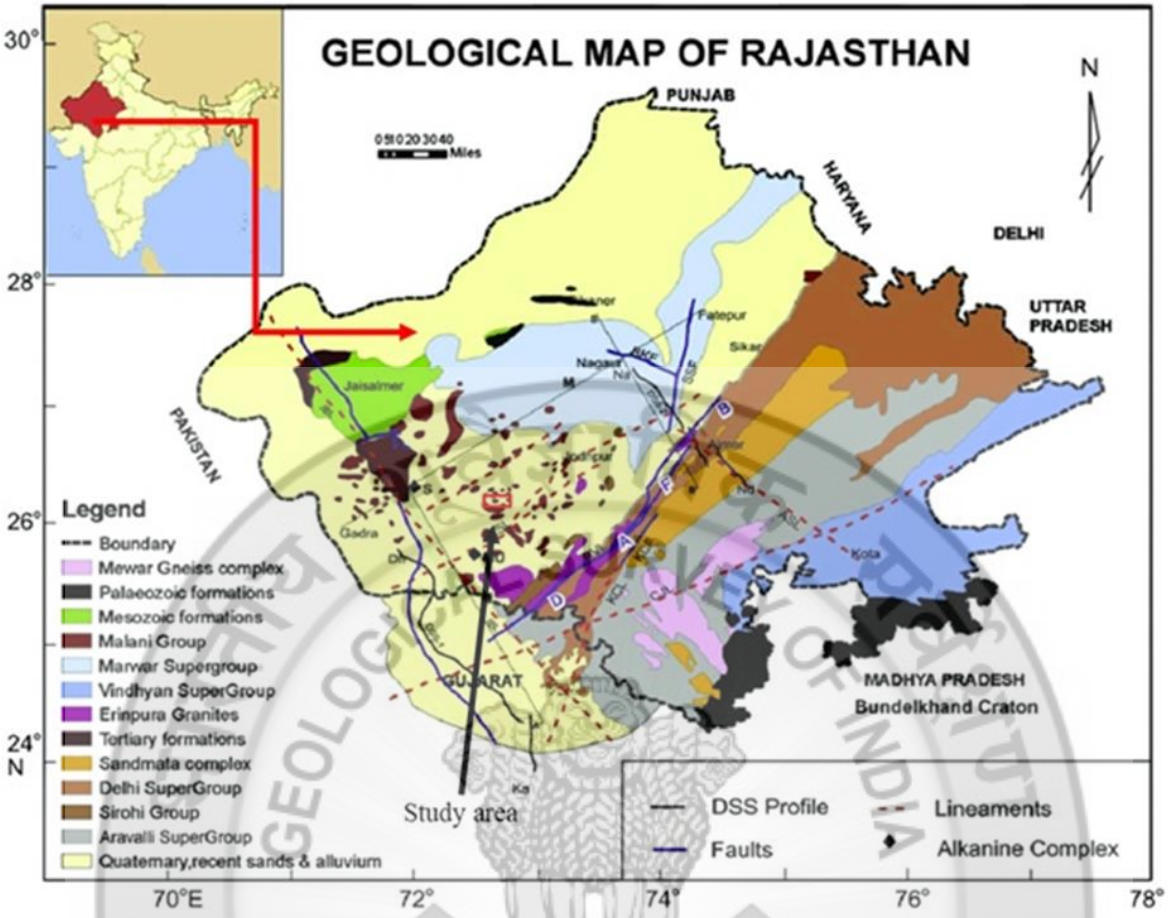


Fig. 3.1: Location of the toposheets and Indrana – Siwana area

3.2.8 Flora and fauna

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.

CHAPTER – 4

PREVIOUS EXPLORATION

4.1 Details of previous exploration/investigation carried by other agencies/parties

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 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 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;

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.

4.2 Details of aero-geophysical and geophysical mapping, if any

The aero-geophysical work is not yet carried out. Geophysical mapping data are not available. Projects are under progress.

4.3 In case the area forms part of the area covered earlier by exploration then the same should be shown in the map with proper scale and a brief description

The area has not been covered earlier by exploration

CHAPTER – 5

GEOSCIENCE INVESTICATION

5.1 Regional Geology

The present study 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).

5.1.1 Aerial Reconnaissance:

Remote Sensing is the science of detecting and monitoring the physical characteristics of an area or objects under investigation by measuring its reflected and emitted radiation at a distance i.e. without touching it. It is an excellent tool that uses multispectral and high resolution data which enhances the quality of the geological work. Though, this technique is not a substitute for field work, but, prior to actual field initiation, this study helps in gathering information of a large area, even the inaccessible one, in a short period of time that save time, energy, money and effort in field and ultimately enhances the quality of geological works. In mineral exploration the principal use of this cost and time effective technique is to identify the altered portions of the study area affected by hydrothermal fluids which can be targeted subsequently in the field for further studies. The hydrothermally altered rocks are characterized by unusually colorful rocks representing the results of chemical interaction between the host and the reacting fluids. The rocks generally produce distinctive mineral assemblages due to alteration processes.

The Advanced Space borne Thermal Emission and Reflection Radiometer (ASTER) dataset have been consistently used for alteration mineral mapping since the launch of the NASA Terra Satellite in December 1999. This is an advanced multispectral imager with high

spatial, spectral, and radiometric performance built for the EOS-AM1 polar orbiting spacecraft. The ASTER data consists of 14 bands from the visible to the thermal infrared with high spatial, spectral and radiometric resolution (Table-1). It has three optical-sensing sub-systems viz. visible and near-infrared (VNIR), shortwave infrared (SWIR) and thermal infrared (TIR) to cover its wide spectral bands. However, the VNIR subsystem has two telescopes (nadir and backward telescopes) for stereo data acquisition. The spatial resolution varies with wavelength: 15 m in the visible and near infrared (VNIR), 30 m in shortwave infrared (SWIR), and 90 m in thermal infrared (TIR). The processing of 3 bands of VNIR and 6 bands of SWIR was carried out through colour composites, band ratio and principal component analysis (PCA). The freely available cross-talk corrected ASTER data was downloaded and processed in PGRS Division, WR using ENVI software. The false colour composite of ASTER bands 4, 6, 8 have been prepared to study the alteration pattern in the area (Figure-5.). From this figure, it is observed that the rocks have not undergone profound alteration. There is not much lithological variation in the study area.

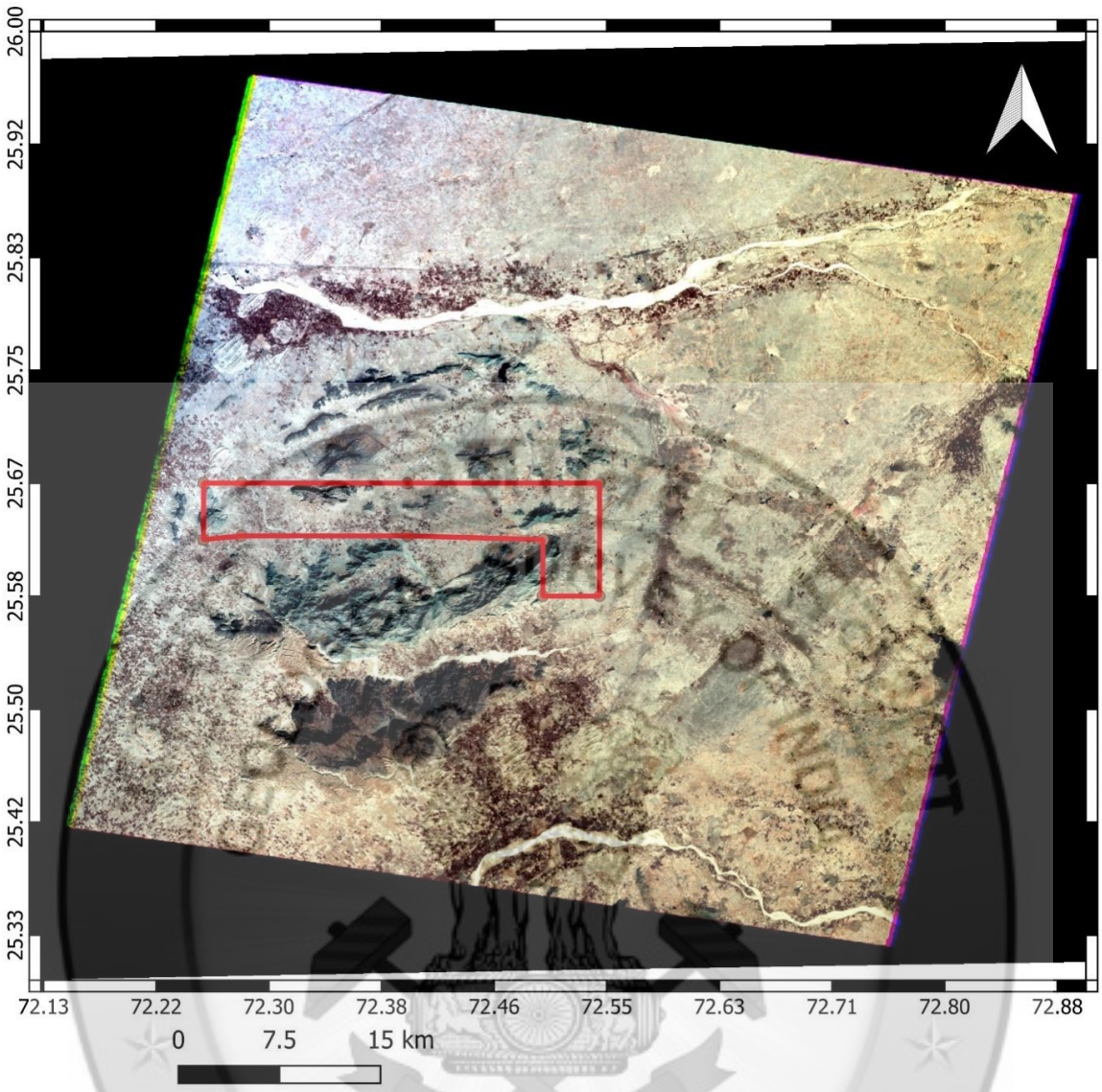


Fig. 5.1: Litho-discrimination map prepared using ASTER image band ratio 9:3:1. Red boundary is showing study area

5.1.2 Brief regional geology with outline of broad geological and structural framework

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

5.1.3 Regional Stratigraphy

A volcanoclastic conglomerate near Kankani represents a distinct angular unconformity between granites, phyllite and quartzites of Delhi Super group and the overlying pyroclastics of Malani Igneous Suite observed 30km south of Jodhpur. At Siyana, The Mt. Abu granitoid is overlain by rhyolite of Malani Igneous Suite (Choudhury et al.1984). The volcano-plutonic association of Malani Igneous Suite is either overlain by glacial Pokhran bed or sediments of the Marwar Supergroup. Malani Igneous Suite magmatism is post Mt. Abu granitoid plutonism and pre-Vendian glaciation.

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 per-aluminous, 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. A regional and generalized stratigraphic succession isgiven in the Tables-5.1 and 5.2 below:

Table- 5.1: Generalized Precambrian Tectono-Stratigraphy of Aravalli Craton, India. (Stratigraphy after Roy, 1988; Isotopic ages after Crawford, 1970; Crawford and Compston, 1970; Davis and Crawford, 1971; Gopalan and Choudhry, 1984; Kochhar et al., 1985; Dhar et al., 1996).

Super group	**Age in Ma.**
MarwarSupergroup	550 – 500 Ma
Upper VindhyanSupergroup (Jodhpur Sandstone)	~700 – 600 Ma
Malani Igneous Suite	732 Ma
Erinpura Granite	900 Ma
Delhi Supergroup	1600 – 900 Ma
---------Unconformity---------	
Aravalli Supergroup	2200 – 1800 Ma
---------Unconformity---------	
BhilwaraSupergroup	2900 – 2600 Ma
Mewar Gneiss	3300 – 3000 Ma

Table 5.2: 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)	Dyke swarms	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 Jalor granite	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		

5.1.4 Metamorphism and structure

There is no evidence of metamorphism observed during field work as well as during petrographic study. Significant evidences of metasomatism are observed during petrographic studies which are described in the following paragraphs.

The volcanic and plutonic phases exposed in mapped area are mostly undeformed except some local scale faults and volcanic layering. The details of primary and secondary structures are described below.

5.1.4.1 Metasomatism

The late magmatic and post magamatic metasomtism in peralkaline suites and their significance in REE enrichment has been discussed in detail by various workers; D F Strong 1982, B Bagiński 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. The volcanic and plutonic phases of Siwana area exhibit significant metasomatic changes in texture and mineralogy. Various late to post magmatic replacement textures, coarsening of perthite lamellae due to albitization / Na metasomatism event (Fig 5.2, 5.5), formation of chess board perthite (Fig 5.3), dueteric alteration of alkali feldspar grains (Fig 5.9, 5.10), psuedomorphic replacement of alkali feldspar by aegirine (Fig 5.6, 5.7), 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 arfedsonite (Fig 5.4, 5.8, 5.9) under the influence of late/post magamatic alkaline fluids owing to metasomatism.

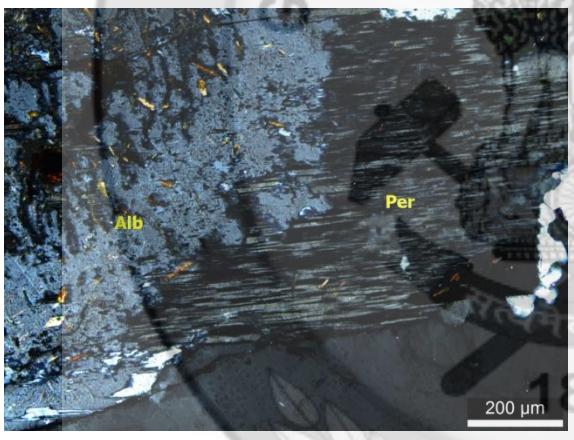


Fig 5.2:Albitization of perthite in granite (TPS -1 XPL)

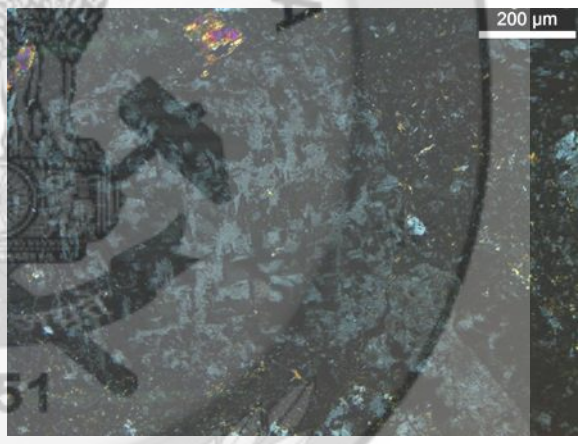


Fig 5.3: Chess board perthite formation in granite (TPS - 6 XPL)

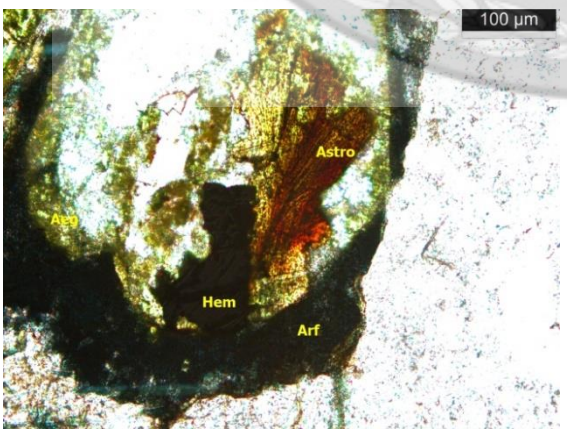


Fig 5.4: Astrophyllite replaced by hematite and arfvedsonite in granite (TPS-9 PPL)

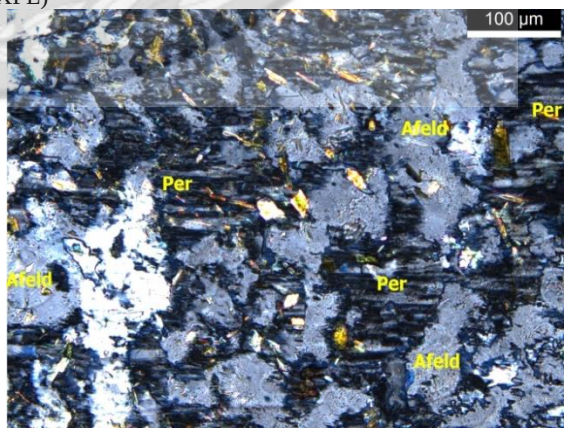


Fig 5.5: Coarsening of braided perthite to patch perthite in granite (TPS-1 XPL)

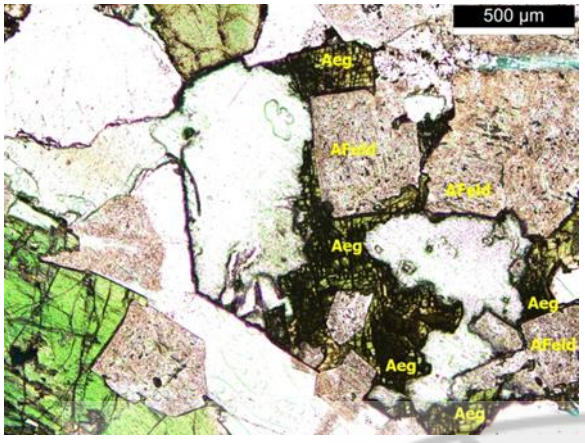


Fig 5.6: Psuedomorphic replacement of alkali feldspar by aegirine in granite (TPS-1 PPL)

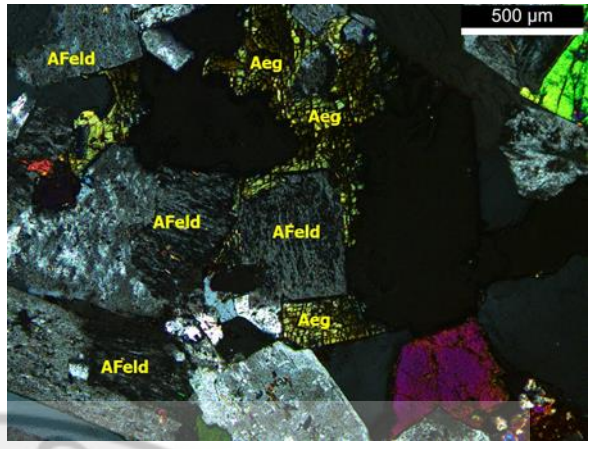


Fig 5.7: Psuedomorphic replacement of alkali feldspar by aegirine in granite (TPS -1 XPL)

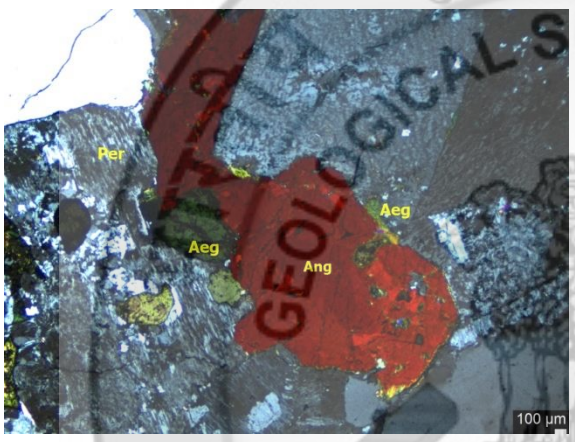


Fig 5.8: Aenigmatite replaced by aegirine in granite (TPS -23XPL)

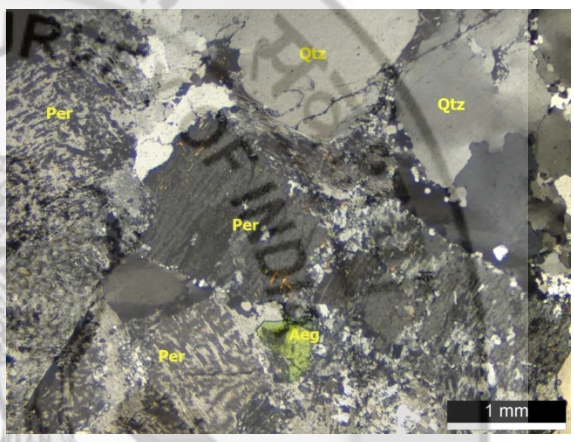


Fig 5.9: Perthitic alkali feldspar surrounded by Albite + Quarts rims in granite (TPS-1 XPL)

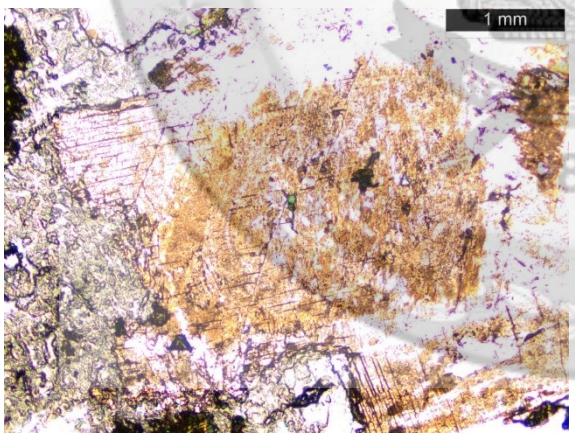


Fig 5.10: Deuteric alteration of alkali feldspar in alkali feldspar granite (TPS -24 PPL)

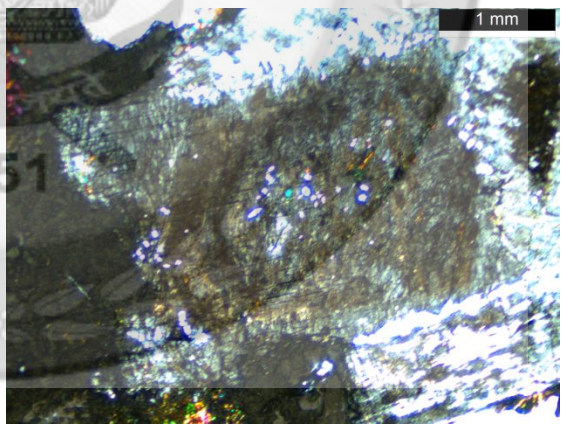


Fig 5.11: Deuteric alteration of alkali feldspar in alkali feldspar granite (TPS - 24XPL)

5.1.4.2 Primary Structure

(i) Flow layering

Near Mailawas and Mawadi villages flow layering is observed which is characterized by sharp change in size and number of phenocrysts across the layers. Fine laminae of ash beds are observed near Mawadi.

5.1.4.3 Secondary Structure

(i) Joints

Two sets of major joint patterns observed in the area. These joints are NNW- SSE and E-W in trend dipping westerly and southerly respectively. A vertically dipping NNE - SSW joint trend also noted occasionally.

5.2 Detailed Geological Investigation

5.2.1 Large scale mapping on 1:12,500 Scale

An area of 100 sq. km. has been mapped on scale 1:12,500 in the Siwana area in parts of toposheet no. 45C/6 and 10, Barmer district of Rajasthan for REE and RM investigation in pursuance with FSPID M2ASMIF-MEP/NC/WR/SU-RAJ/2021/36826 of FS 2021-22 (Plate-1). The study 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 in the study area whereas, per-alkaline Siwana granite is exposed in and around Mokalsar, Ludrara and Indrana villages in the study area (Plate - 1). Younger dyke phases are intruded in both the volcanic and plutonic phases. The sharp contact of the Siwna 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 5.3 below:

5.2.1 Large scale mapping on 1:12,500 Scales

Large scale mapping in 1: 12,500 scale around Indrana- Siwana area, Barmer District, Rajasthan, (Toposheet no. 45C/06 & 10) with Item Code No.:M2AFGBM-MEP/NC/WR/SU-RAJ/2021/36826 was taken up with an objective to evaluate potentiality of Rare Earth Elements. The mapped area has exposures of various geological identities which can be broadly grouped among volcanic, plutonic and later intrusive phases. The porphyritic and aphanitic varieties of rhyolite are the major volcanic phases observed in the area. The porphyritic rhyolite observed mostly in the southeastern part of the mapped area, north of

Mokalsar village is characterized by the presence of akali feldspar porphyries with varying dimensions. The aphanitic variety of rhyolite is the most common volcanic phase in the area. They are dominantly greenish grey colored, fine-grained rocks. The plutonic phases observed in the area are dominated by grey colored, medium to coarse grained granite. The pink colored, coarse grained alkali feldspar granite is mostly observed in the south eastern parts of the mapped area, in and around Mokalsar village. The contact between both varieties of granite appears diffusive in nature. The alkali felspar granite is mostly found along the lower contours of the hilly exposures in the area. 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 dykes are mostly observed associated to the granites with typical discordant field relation.

Table: 5.3 Stratigraphy of Indran – Siwana area

Group/Super group	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)

5.2.2 Description of rock types

5.2.2.1 Felsic volcanics

Felsic volcanics are dominant litho unit observed in the 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 (Fig 5.12), 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 (Fig 5.13). 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

Fig 5.12: Aphanitic rhyolite with vesicles exposed near Mokalsar village

Fig 5.13: Porphyritic rhyolite exposed near Mokalsar village

Fig 5.14: Pyroclastic flow exposed south east of Arjiyana village

Fig 5.15: Contact between granite and rhyolite exposed near Ludrara village

5.2.2.2 Pyroclastic Flow

Pyroclastic flow unit is exposed south east of Arjiyana village (Fig 5.14). Light green coloured volcanic clasts are surrounded by rhyolitic material. The clasts exhibit varying shape and dimension. Volcanic lapilli are also observed (Fig 5.19) towards south east of Arjiyana village.

5.2.2.3 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 (Fig 5.15). 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 (Fig 5.16). The coarse grained alkali feldspar granite is mostly exposed in the south eastern part of the area (Fig 5.17) 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 (Fig 5.18). In this kind of granite, feldspars are observed as inclusions within mafic minerals as well.

The youngest granite variant in the area is a pegmatite phase with needles of alkali pyroxenes / amphiboles (up to 4 cm). These pegmatites are mostly found in association with the plagioclase rich variety of granite (Fig 5.20). Mappaple units of such pegmatites are rare in the study area. Enclaves of porphyritic rhyolites are observed in the granite near Mailawas village (Fig 5.21). The enclaves have a maximum dimension of 15*6 cm

Fig 5.16: Granite exposed in quarry section south of Mokalsar village

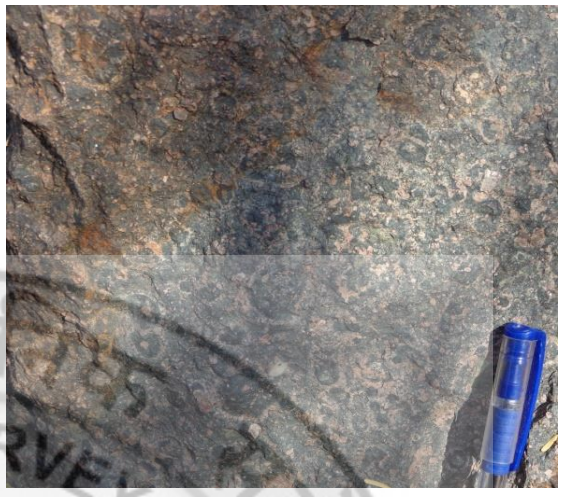
Fig 5.17: Alkali feldspar granite exposed near Milavas village

5.2.2.4 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 (Fig 5.22). 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.

5.18: Alkali feldspar rims in granite exposed near Maliavas village



5.19: Suspected volcanic lapilli exposed south east of Arjiyana village

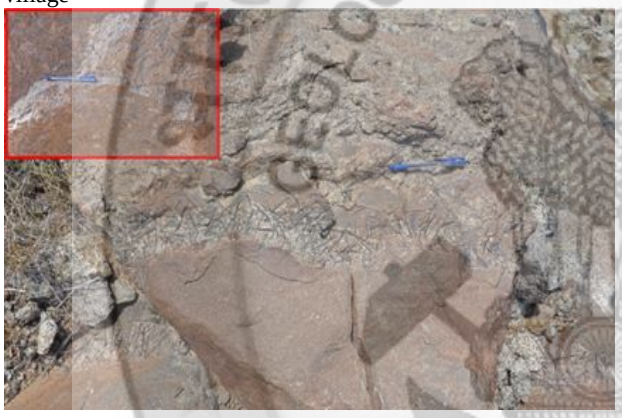


Fig 5.20: Aegirine bearing pegmatite near Mokalsar village

Fig 5.21: Enclave of porphyritic rhyolite within granite near Mailawas viilage

5.3 Sampling

5.3.1 Bed rock samples (BRS)

A total of 300 Bed Rock Samples (BRS) were collected systematically from selected points in 200*200 grid pattern (Plate - 2). About 2 kg -3 kg of sample in the form of small chips in 34 a radius of about 1m was collected from each location to make a representative sample. The collected rock chips were crushed and grounded using iron mortar and pestle, sieved to -80 mesh, coned and quartered. About 250 gms of the prepared sample was sent to Chemical Laboratory for analysis. Initially the sampling was carried out from all litho units with preference to dykes. Afterwards based on the recommendations of the midterm review meeting 200*200 grid pattern was followed. Details of Bed Rock Samples (BRS) are given in Annexure - I

5.3.2 Channels samples (CS)

A total of hundred channel samples were collected from favorable locations and submitted for chemical analysis (Fig 5.23). As the dykes are reported to be most favorable zone of enrichment of REE minerals; channel sampling was concentrated in area of dyke occurrences. Details of Channel Samples (CS) are given in Annexure-III .

Fig 5.22: Rhyolite dyke exposed near Mokalsar village

Fig 5.23: Channel Sample collected from south of Mokalsar village

5.3.3 Petrological Samples (PS)

A total of 24 rock samples were collected from field area for petrological studies. These samples were sent to Petrological Division, GSI, WR, Jaipur for preparation of polished thin sections.

5.3.4 Petro Chemical Samples (PCS)

Twenty petrochemical samples (PCS) were collected and processed for geochemical characterization of important lithological units of the study area and sent to Regional Chemical Laboratory, WR, Jaipur for analysis. The details of collected PCS samples are given in Annexure-II

Other than the aforesaid samples10 EPMA, 5 XRD and were collected during the course of mapping.

5.4 Discussion of results of chemical analysis

5.4.1 Bed Rock Samples

5.4.1.1 Total REY (ΣREE+Y)

Chemical analysis indicates encouraging values of total REE in the mapped area. Out of the 300 bed rock samples analyzed 107 samples resulted in ΣREE+Y values < mean value (2446) (Plate – 3) with a standard deviation of 1414. The ΣREE+Y of the BRS samples vary within a minimum of 265.47 ppm to a maximum of 8984.74 ppm. Out of 100 channel

samples analyzed TREY values ranges from 476.25 ppm to 8582.98 ppm. Details of the chemical analysis results of Bed Rock Samples are given in Annexure IV

5.4.1.2 LREE and HREE

The ΣLREE values of bed rock samples from the study area ranges from a minimum value of 185.42 ppm to 5896.88 ppm. The mean value of ΣLREE is 1578.027 with a standard deviation of 966.8. The ΣHREE values ranging from 31.09 ppm to 1128.07 ppm. The mean value of ΣHREE distribution is 285 ppm with standard deviation of 173.76

5.4.1.3 Other significant trace elements

a) Yittrium (Y)

Yittium (Y) with similar geochemical characteristics of REE has analyzed values of bed rock samples ranging from 49 ppm to 2532 ppm. The mean value is 593 with a standard deviation of 376.

b) Zirconium (Zr)

Zirconium (Zr) silicates can be one of the significant host for HREE has analyzed values of bed rock samples ranging from 202 ppm to 10131 ppm. The mean value is 2689.12 with a standard deviation of 1662.70.

c) Neobium (Nb)

Neobium (Nb) values of the bed rock samples from the study area ranges from 84 ppm to 853 ppm. The mean value is 272.3 with a standard deviation of 122.40.

d) Hafnium (Hf)

Hafnium (Hf) values of the bed rock samples from the area ranges between 7.4 ppm to 666.40. The mean value is 119 ppm with standard deviation of 81.70.

e) Tin (Sn)

Tin (Sn) values of the bed rock samples from the area ranges between 4.6 ppm to 199.60. The value is 48.8 with standard deviation of 25.350.

f) Thorium (Th)

Thorium (Th) values of the bed rock samples from the area ranges between 16 ppm to 77 ppm. The mean value is 45.3 with a standard deviation of 8.3

g) Gallium (Ga)

Gallium (Ga) values of the bed rock samples from the area ranges between 22 ppm to 82 ppm. The mean value is 56.73 with a standard deviation of 10.7410.

h) Zinc

Zinc (Zn) values of the bed rock samples from the area ranges between 46 ppm to 920 ppm. The mean value 280.6 with standard deviation of 137.09.

5.4.2 Channel Samples

Out of 100 channel samples analyzed ΣREE+Y values ranges from 476.25 ppm to 8582.98 ppm. The mean value is 2202.22 with standard deviation of 1791.80. Channel no. 2, 3, 4,5,7,8,9,11 have given positive results of REE.

a) Channel -1

The channel -1 was proposed near the quarry section towards south of Mokalsar village. Fifty mtr long channel was made across granite and sub parallel mafic dykes cutting across the granite. The ΣREE+Y values of channel - 1 ranges from 816 ppm to 2520.13 ppm.

b) Channel - 2

The channel – 2 was proposed towards south of Arjiyana village. Four mtr long channel was made across pyroclastic flows and intruding Rhyolite dyke. The ΣREE+Y values of channel - 2 ranges from 693 ppm to 5642.7 ppm (Fig 5.24). The mean value is 3032. The Yittrium values ranging from 151.49 ppm to 1424.05 ppm. Zirconium from 921 ppm to 7622 ppm, Neobium from 167 ppm to 609 ppm and Hafnium from 35.91ppm to 319.52 ppm

c) Channel -3

The channel – 3 was proposed towards south of Arjiyana village. 6 mtr long channel was made along the pyroclastic flows and intruding rhyolite dykes. The ΣREE+Y values of channel - 3 ranges from 695.16 ppm to 6572.76 ppm (Fig 5.25). The mean value is 3032. The Yittrium values ranging from 151.49 ppm to 1424.05 ppm. Zirconium from 901 ppm to 7414 ppm, Neobium from 132 ppm to 664 ppm

d) Channel - 4

The channel – 4 was proposed towards south of Arjiyana village. 3 mtr long channel was made along the pyroclastic flows and intruding rhyolite dykes. The ΣREE+Y values of channel - 4 ranges from 768.68 ppm to 2837.11 ppm (Fig 5.26). The mean value is 1697.38. The Yttrium values ranging from 164.06 ppm to 624.51 ppm. Zirconium values from 848 ppm to 3463 ppm.

e) Channel -5

The channel – 5 was proposed towards south of Arjiyana village. 3 mtr long channel was made along the pyroclastic flows and intruding rhyolite dykes. The ΣREE+Y values of channel - 5 ranges from 1280.65 ppm to 8582.97 ppm (Fig 5.27). The mean value is 4905.41 ppm. The Yittrium values ranging from 255.84 ppm to 2005.14 ppm. Zirconium from 1454

ppm to 9311 ppm, Neobium from 163 ppm to 851 ppm and Hafnium from 45.19 ppm to 407.15 ppm

f) Channel -6

The channel – 6 was proposed in Ludrara village. 4.5 mtr long channel was cut across granite and intrusive mafic dykes. Four mtr long channel was made across granite and intruding mafic dykes. The ΣREE+Y values of channel - 6 ranges from 476.25 ppm to 2470. 16 ppm

g) Channel -7

The channel – 7 was proposed towards south west of Ludrara village. 3.1 mtr long channel was made across granite and intrusive mafic dykes. The ΣREE+Y values of channel - 7 ranges from 1874.32 ppm to 4111.48 ppm (Fig 5.28). The mean value is 3039.45. The Yittrium values ranging from 378.85 ppm to 1353.87 ppm. Zirconium from 1319 ppm to 6088 ppm, Neobium from 198 ppm to 683 ppm and Hafnium from 55.89 ppm to 267 ppm

h) Channel - 8

The channel – 8 was proposed towards south west of Ludrara village. 2.6 mtr long channel was made across granite and intrusive mafic dykes. Total TREY values of channel - 8 ranges from 2082.34 ppm to 6216.72 ppm (Fig 5.29). The mean value is 3677.25. The Yittrium values ranging from 337.68 ppm to 1448.17 ppm. Zirconium from 1504 ppm to 4940 ppm, Neobium from 241ppm to 607 ppm and Hafnium from 60.14 ppm to220.16 ppm

i) Channel - 9

The channel – 9 was proposed towards south west of Ludrara village. 2.8 mtr long channel was made across granite and intrusive mafic dykes The ΣREE+Y values of channel - 9 ranges from 4144.62 ppm to 5940.12 ppm (Fig 5.30). The mean value is 5228.35. The Yittrium values ranging from 944.59 to 1531.85 ppm. Zirconium from 3688 ppm to 6849 ppm, Neobium from 512 ppm to 617 ppm and Hafnium from 159.74 0 ppm to 301.52 ppm

j) Channel – 10

The channel – 10 was proposed towards south west of Ludrara village. 3.1 mtr long channel was made across granite and intrusive mafic dykes. The ΣREE+Y values of channel - 10 ranges from 1836 ppm to 3836 ppm (Fig 5.31).

k) Channel – 11

The channel – 10 was proposed towards south west of Ludrara village. 3.1 mtr long channel was made across granite and intrusive mafic dykes. The ΣREE+Y values of channel - 11 ranges from 3795 ppm to 7158.63 ppm (Fig 5.32). The mean value is 5309.39. The Yittrium values ranging from 887.54 ppm to 1679.22 ppm. Zirconium from 3032 ppm to

6330 ppm, Neobium from 398 ppm to 679 ppm and Hafnium from 138.48 ppm to 278.76 ppm

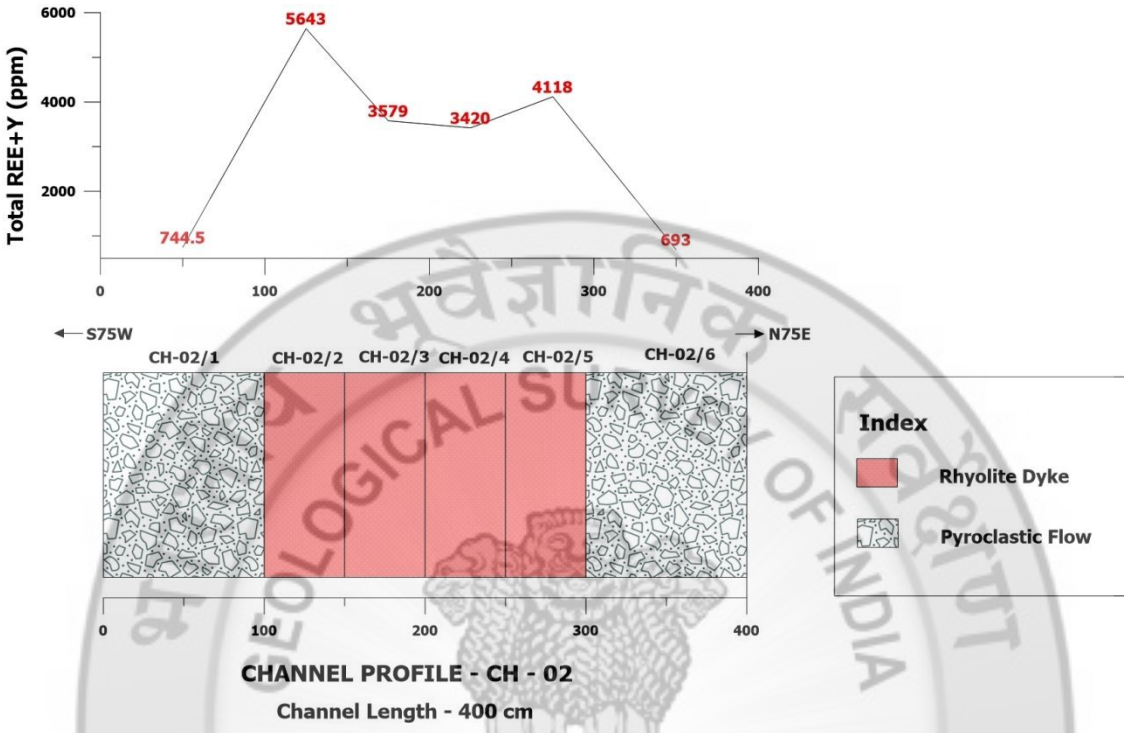


Fig 5.24: Channel profile of channel CH-02

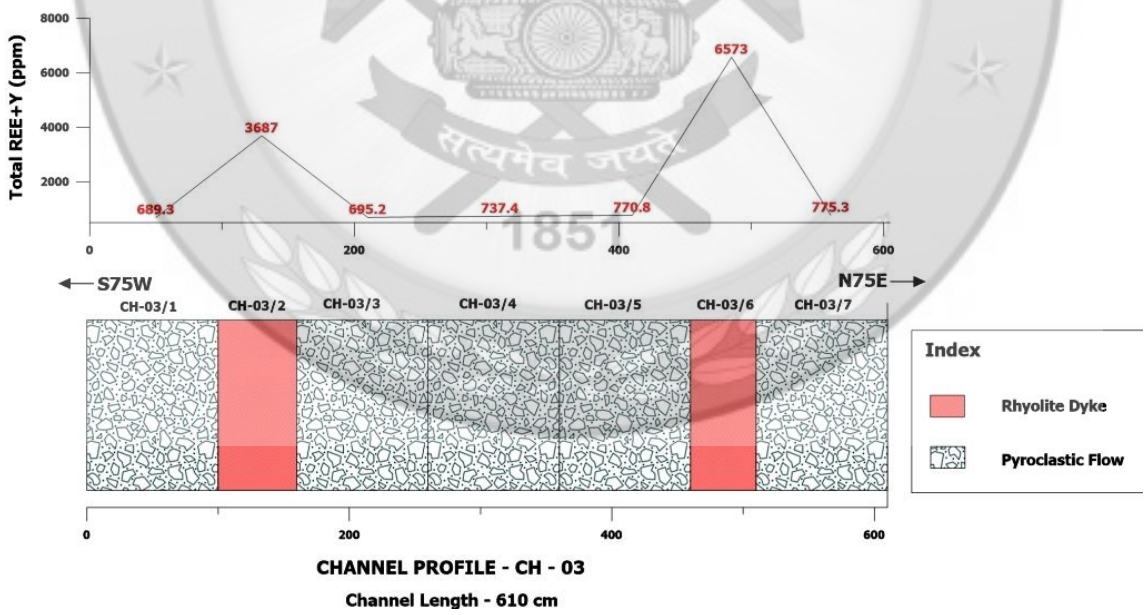


Fig 5.25: Channel profile of channel CH-03

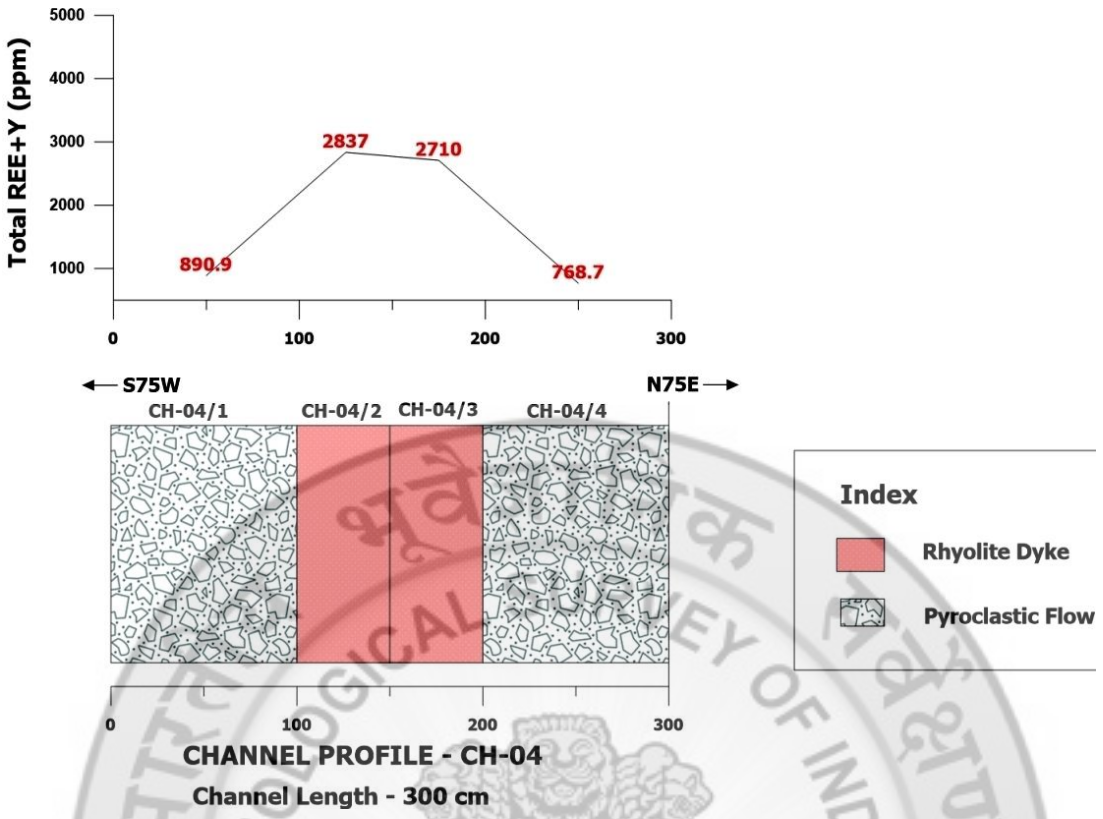


Fig 5.26: Channel profile of channel CH-04

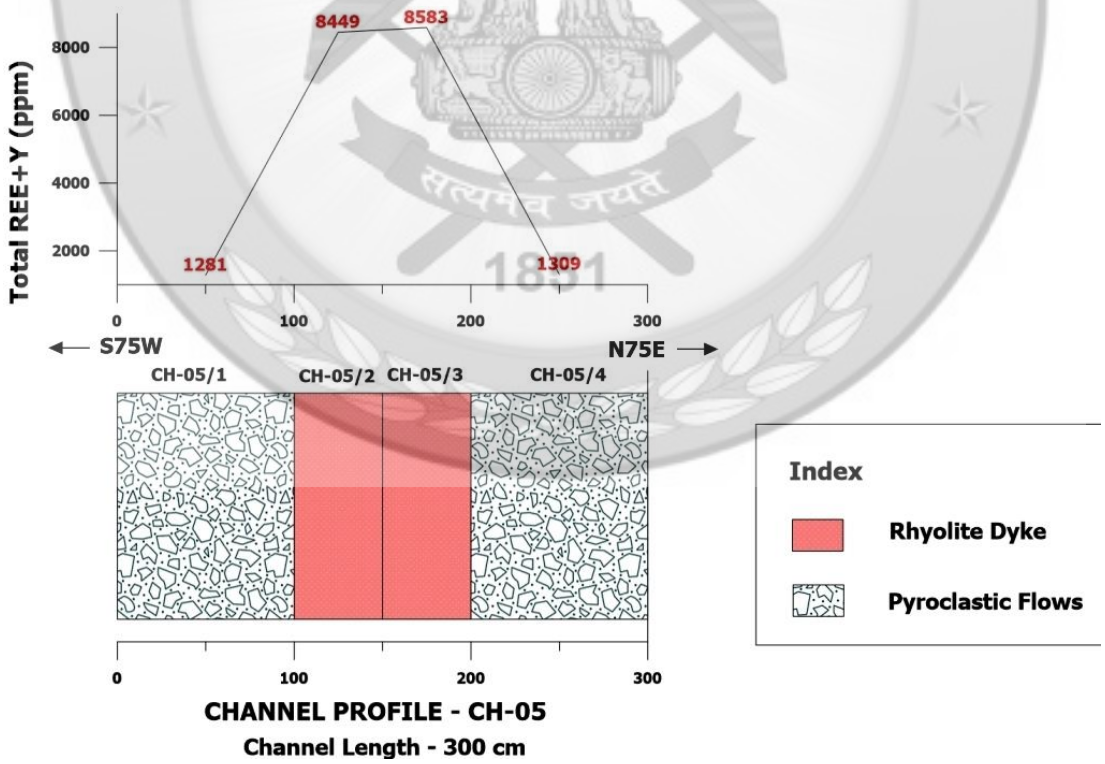


Fig 5.27: Channel profile of channel CH-05

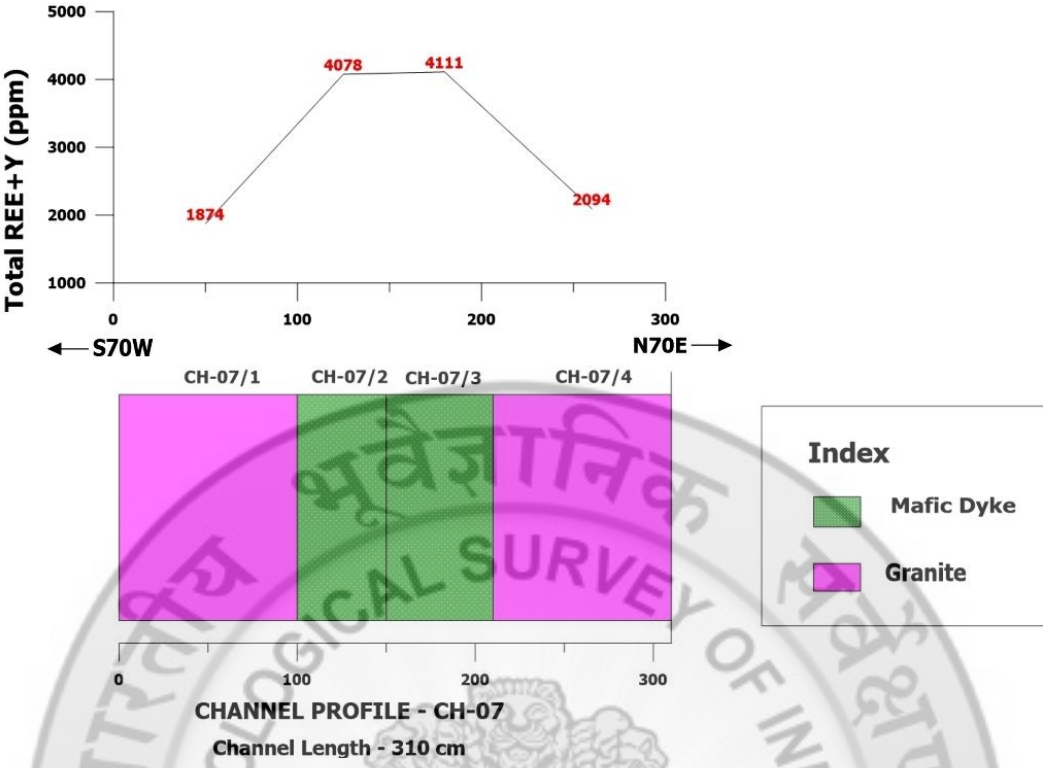


Fig 5.28: Channel profile of channel CH-07

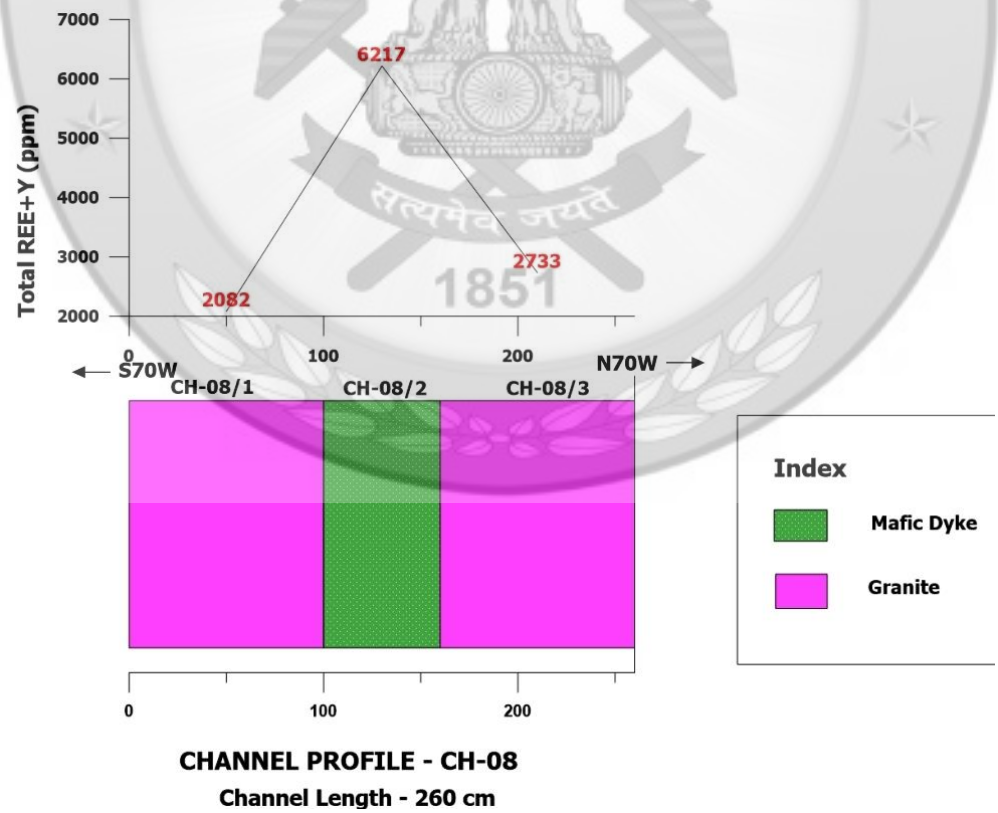


Fig 5.29: Channel profile of channel CH-08

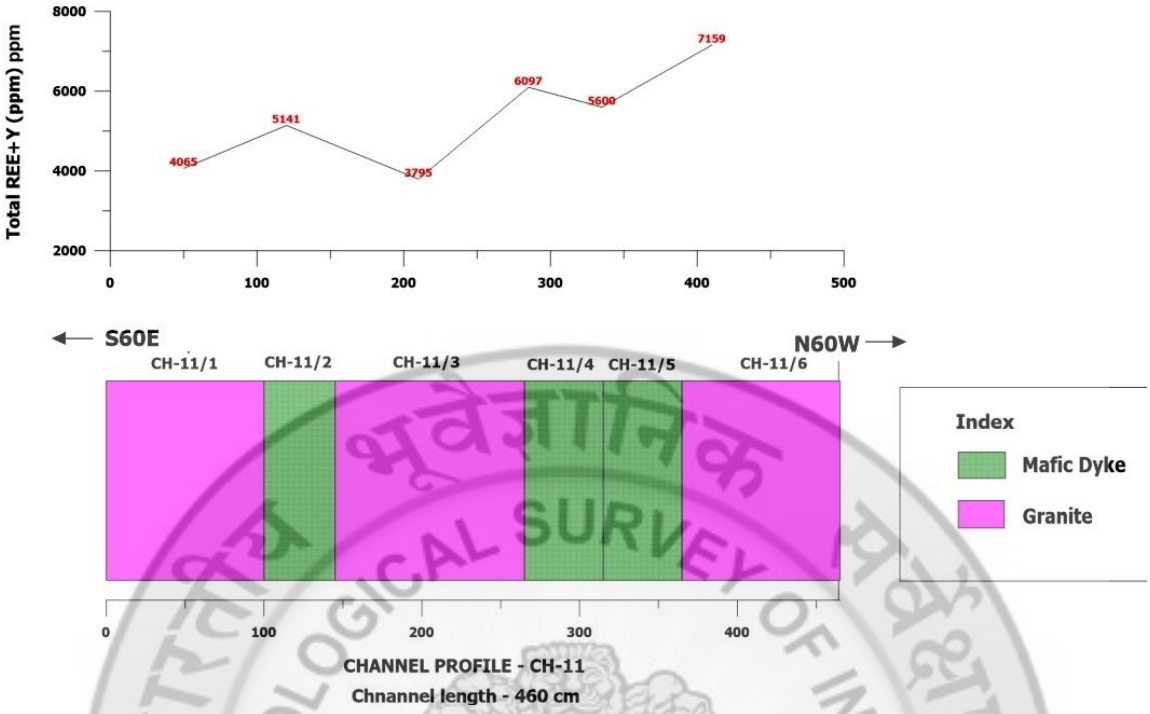


Fig 5.30: Channel profile of channel CH-09

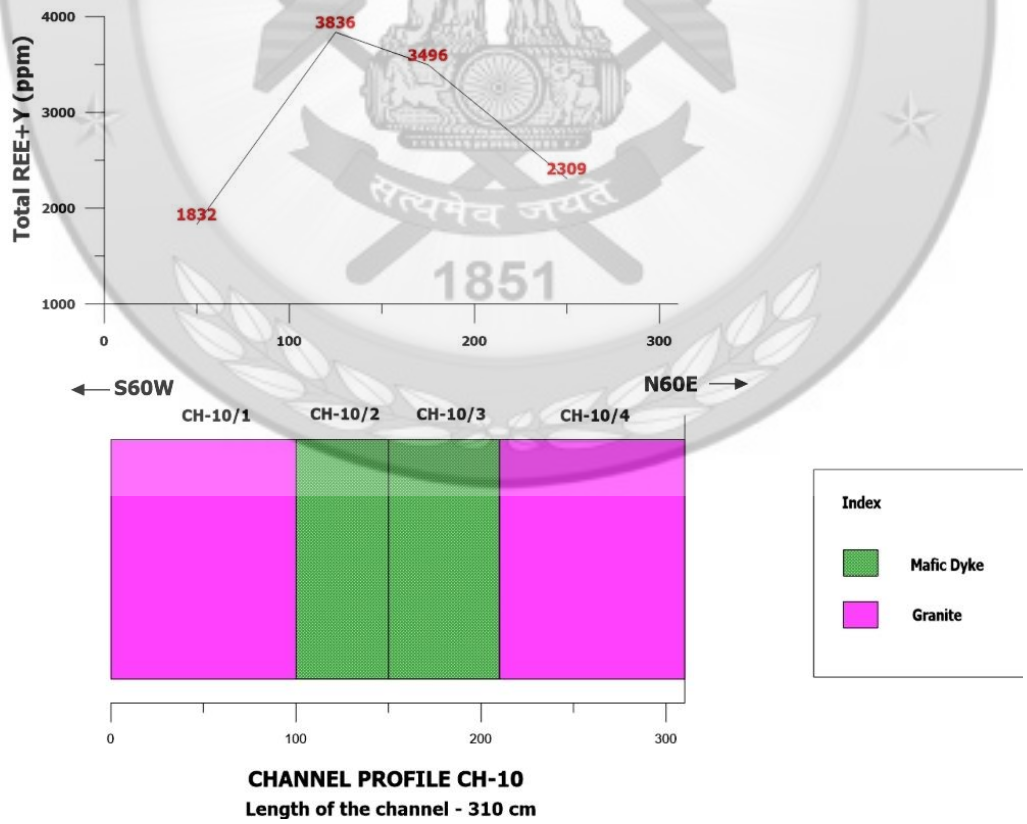


Fig 5.31: Channel profile of channel CH-10

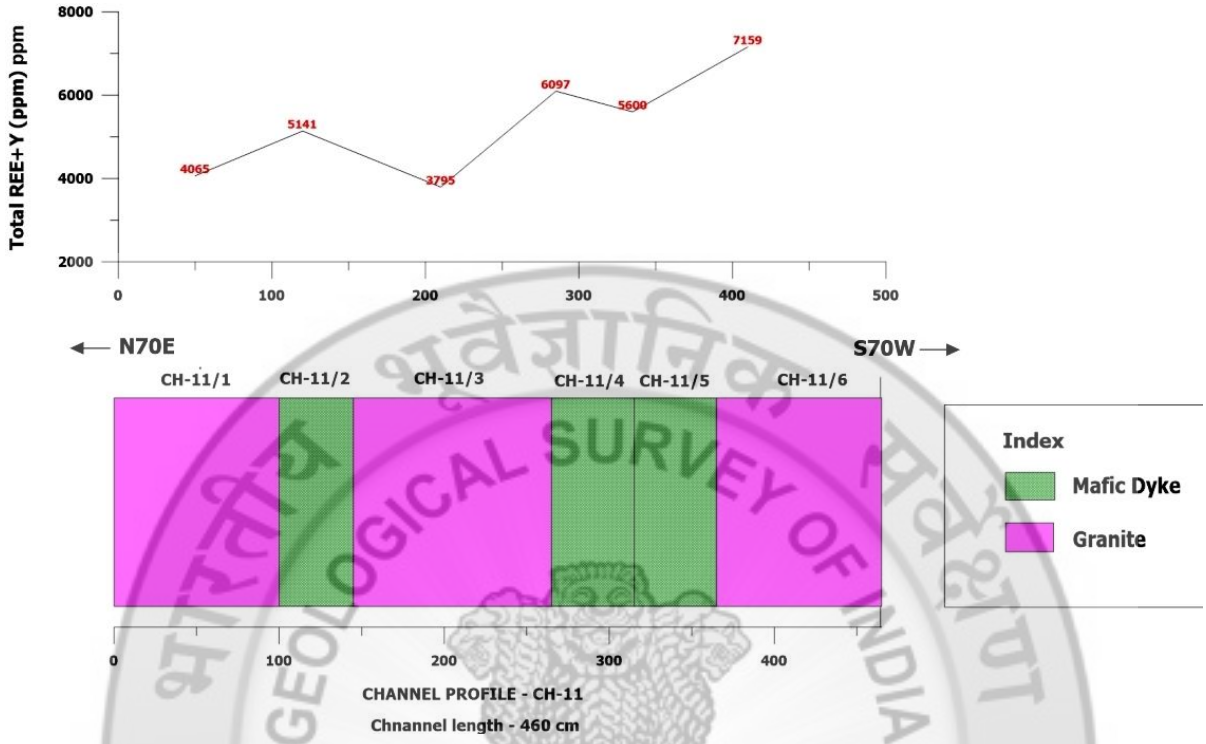


Fig 5.32: Channel profile of channel CH-11

5.4.3 Petro Chemical Samples

5.4.3.1 Geochemistry of granites

Major and trace element concentrations of the granitic rock samples from the study areas are shown in Annexure –VI. Eleven granitic samples analyzed are characterized by their silica oversaturation and sub alkaline to alkaline to alkaline geochemical oddity. SiO_2 content of these granites ranging from 66.61 to 74.21% inferring the silica oversaturated character of the granite variants from the study area. Al_2O_3 content of the samples are ranging from 5.76 to 11.59%, Fe_2O_3 ranging from 3.72 to 14.71%, CaO from 0.15 to 0.63%, MgO from 0.03 to 0.63%, Na_2O from 3.14 to 4.61%, K_2O from 3.46 to 5.27%, TiO_2 from 0.21 to 0.59 %, MnO_2 from 0.06 to 0.20%, P_2O_5 from 0.03 to 0.25%.

The classification of granites were attempted on the basis of oxides concentration. In Total Alkaline Silica diagram after Cox et al 1979., (Fig 5.33) all the samples except PCS-19 are plotted in the granite field. PCS-19 is plotted in granodiorite field. PCS - 1 and 13 are plotted in alkaline field and rest of the samples in sub alkaline field. In Total Alkaline Silica diagram after Middlemost et.al 1994., (Fig 5.34) all the samples are plotted in the granite

field. In A/NK_A/CNK plot of Shand 1943., (Fig 5.35) the granites falls in peralkaline field where A/NK is molar Al_2O_3/ (Na_2O+K_2O) and A/CNK is molarAl_2O_3/(CaO+Na_2O+K_2O). In SiO_2 – K_2O plot after Peccerillo and Tylor 1976., (Fig 5.36) the samples PCS -13, 14 and 17 are plotted in the field of Shoshonite series and rest of the samples in high K- Calc alkaline series. The FeOt (FeOt+MgO) Vs SiO_2 plot after Frost et al, 2001 (Fig 5.37) has all the samples plotted in the ferroan field. In the plot to distinguish A type granites by Whalen et al 1987, (Fig 5.38) all the samples are plotted in the A Type field**.** Rb-Sr-Ba ternary plot after Tarney & Jones, 1994 (Fig 5.39) suggest that all the granites are highly differentiated type. In the ternary source diagram after Laurent et al. 2014, (Fig 5.40) the granite samples are plotted in the field of metasediments suggesting the possible involvement of metasediments in the origin of granites. The tectonic discrimination diagram after Batchelor-and-Bowden-1985., (Fig 5.41) in which R1= 4 Si- 11 (Na+ K) – 2 (Fe+Ti) is plotted against R2 = 6 Ca+ 4 Mg+ Al has all the granite samples plotted in the anorogenic field.

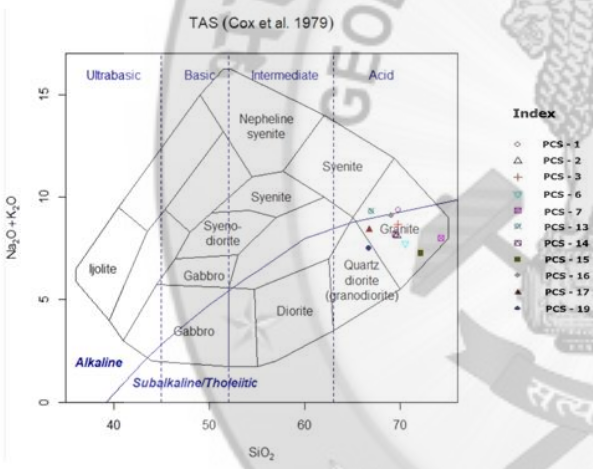


Fig 5.33: Total Alkaline Silica diagram after Cox et al 1979., for plutonic rocks

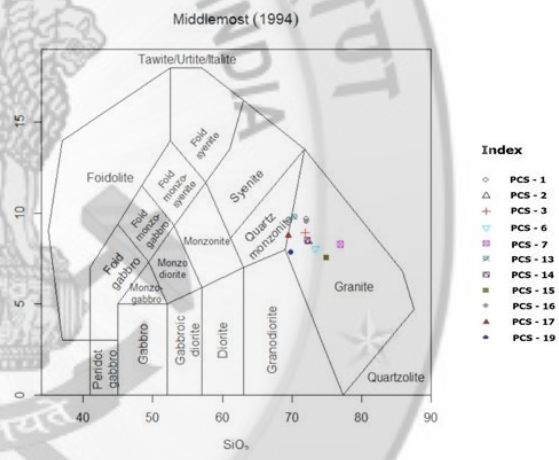


Fig 5.34: Total Alkaline Silica diagram after Middlemost et.al 1994., for plutonic rocks

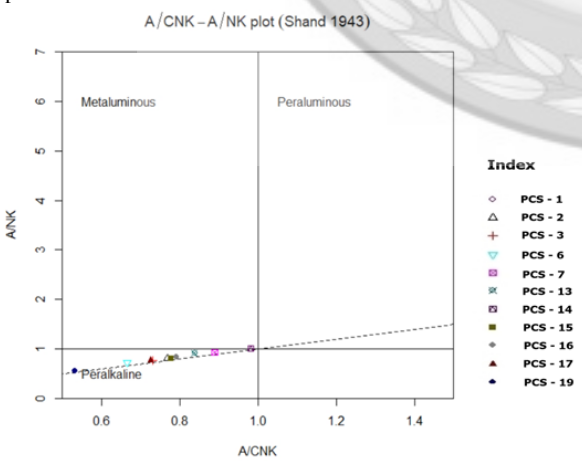


Fig 5.35:A/NK_A/CNK plot of Shand 1943., for plutonic rocks

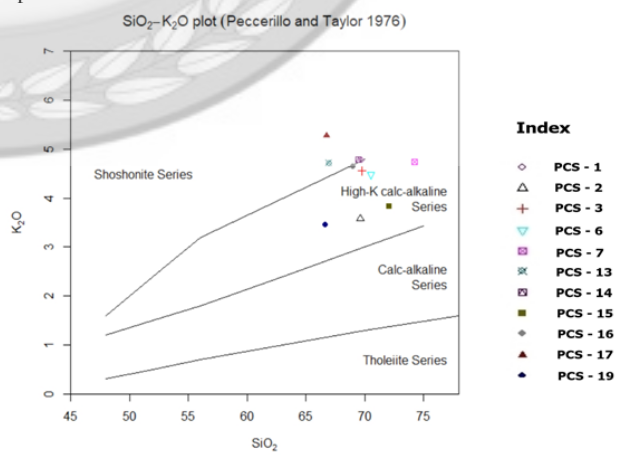


Fig 5.36: SiO_2 – K_2O plot after Peccerillo and Tylor 1976., for plutonic rocks

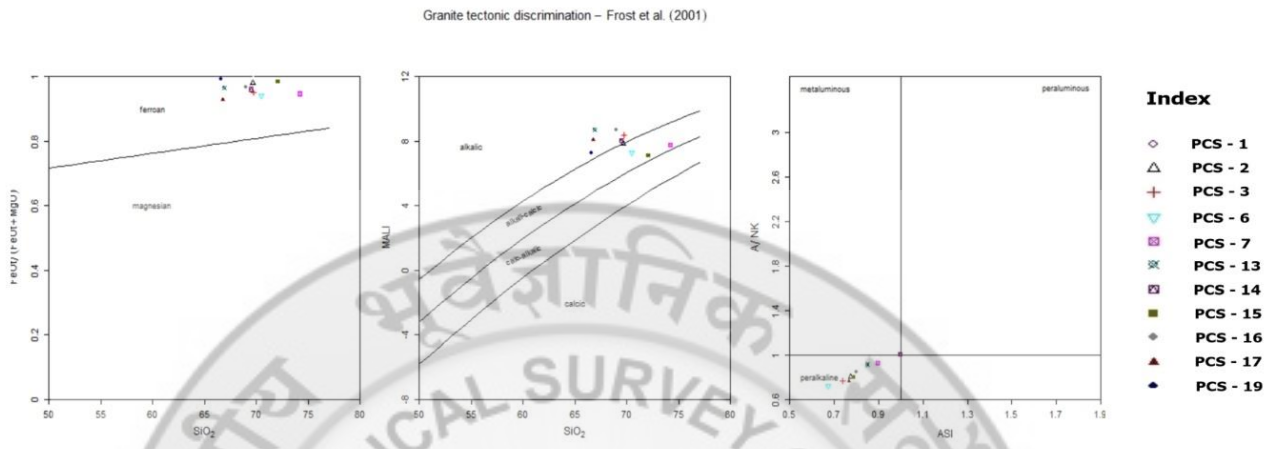


Fig 5.37: FeOt (FeOt+MgO) Vs SiO_2 plot after Frost et al, 2001., for granites

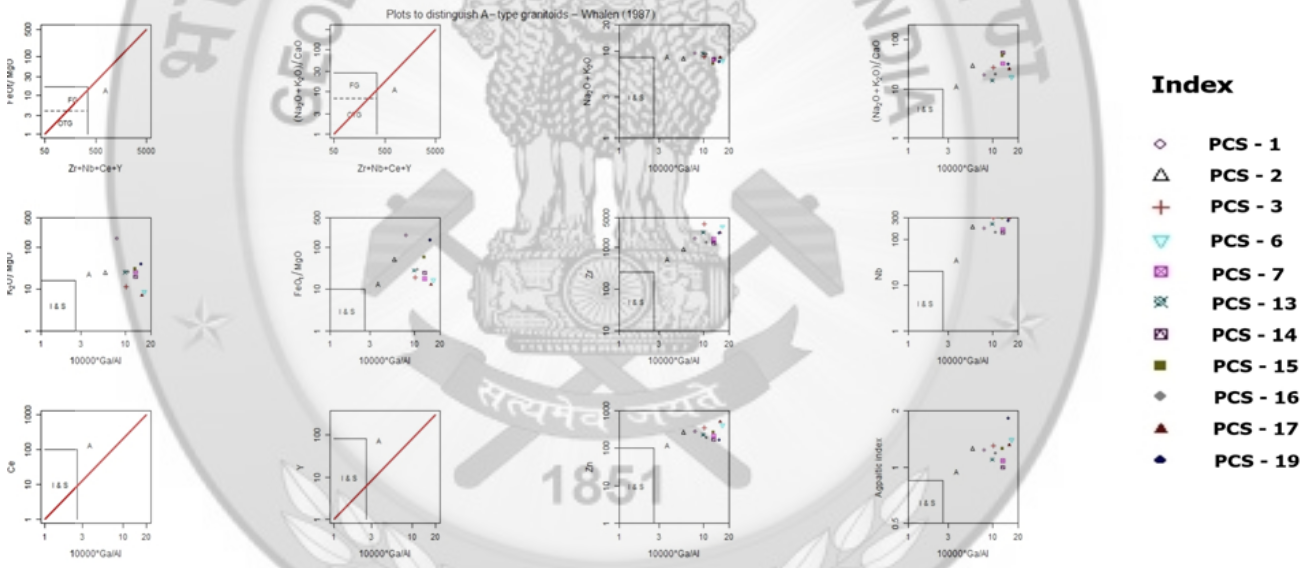


Fig 5.38: Plot to distinguish A type granites after Whalen et al 1987

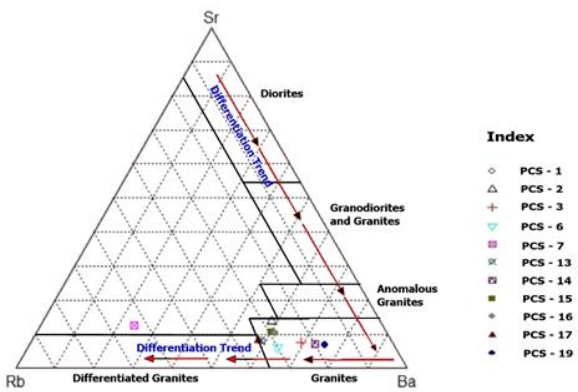


Fig 5.39: Rb-Sr-Ba ternary plot after Tarney & Jones, 1994 for granites

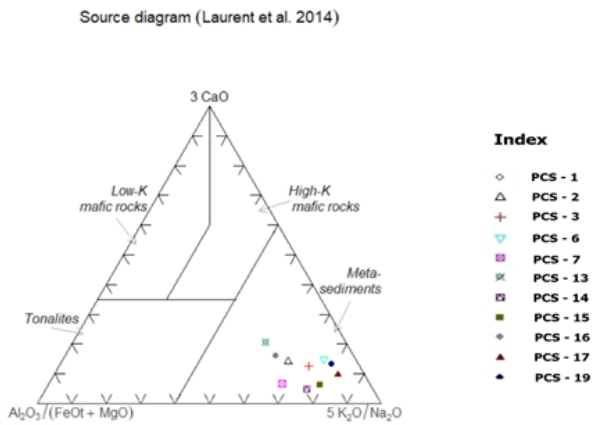


Fig 5.40: Ternary source diagram after Laurent et al. 2014

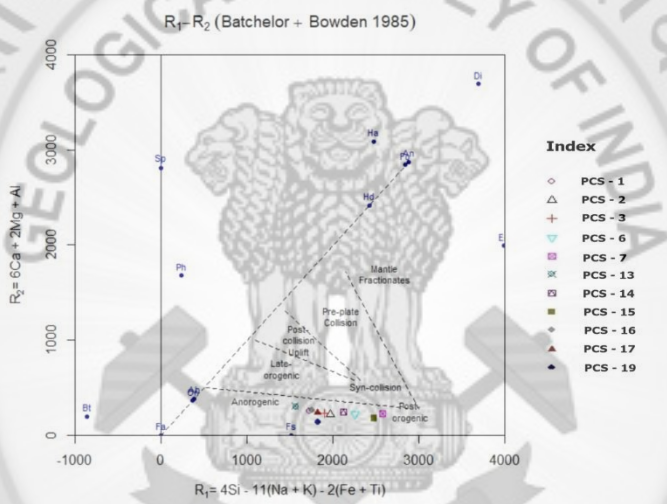


Fig 5.41: Tectonic discrimination diagram after Batchelor-and-Bowden-1985

5.4.3.2 Geochemistry of volcanics

Major and trace element concentrations of the volcanic rock samples from the study areas are shown in Annexure-VI. The SiO_2 content of the volcanic rocks ranges from 53.88 to 71%. Al_2O_3 content of the samples is ranging from 9.78 to 15.74%, Fe_2O_3 ranging 5.32 to 12.28%, CaO from 0.27 to 2.01%, MgO from 0.19 1.20%, Na2O from 1.86 to 5.74%, K_2O from 4.06 to 6.97%, TiO_2 from 0.41 to 1.10 %, MnO_2 from 0.08 to 0.34%, P_2O_5 from 0.05 to 0.26%.

Classification of volcanics were carried out on the basis of major element concentration In Total Alkaline Silica (TAS) diagram after Cox et al 1979., (Fig.42) samples PCS -12 and 18 were plotted in the rhyolite field. PCS -11 was plotted in trachy andesite field, PCS - 4 got plotted in trachyte field, PCS - 9 and 10 in benmoreite field and PCS - 8 in

Phonolite field. This indicates the possible involvement of a progressive silica saturation process during the volcanic episodes. In A/NK_A/CNK plot of Shand 1943.,(Fig.43), the volcanics are plotted in peralkaline and peraluminous field where A/NK is molar $Al_2O_3/(Na_2O+K_2O)$ and A/CNK is molar $Al_2O_3/(CaO+Na_2O+K_2O)$.The SiO_2 Vs K_2O plot after Peccerillo and Tylor, 1976., (Fig.44) the sample PCS – 18 is plotted in the high K- calc alkaline series field and rest of the samples are plotted in the Shoshonite series field suggesting the high potassic nature of the volcanics from the study area. The Zr/TiO_2 – SiO_2 plot after Winchester and Floyd 1977, (Fig.45) has samples PCS – 8, 9 and 10 plotted in phonolite field PCS - 4 and 11 plotted in Trachyte field, samples PCS - 12 and 18 are plotted in the commendite - pantellerite field. Enrichment of REE and RM is notable in many of the alkaline volcanic suites of commendite – pantellerite affinity.

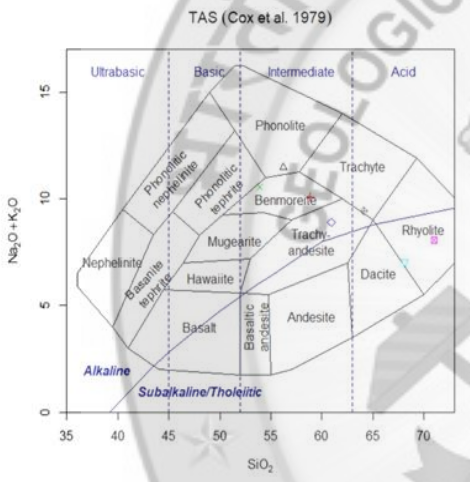


Fig 5.42: Total Alkaline Silica (TAS) diagram after Cox et al 1979., for volcanic rocks

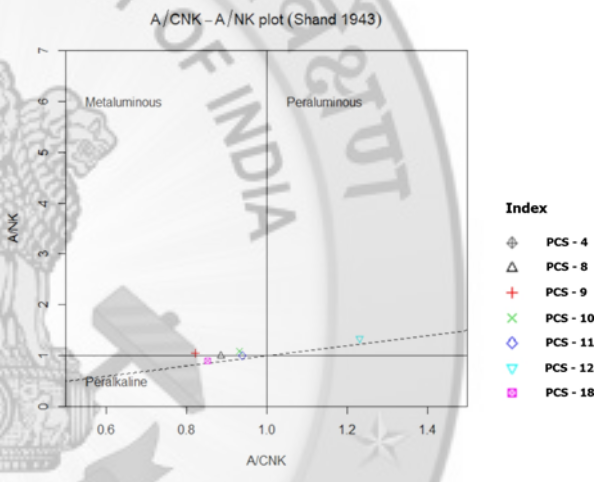


Fig 5.43: A/NK_A/CNK plot of Shand 1943., for volcanic rocks

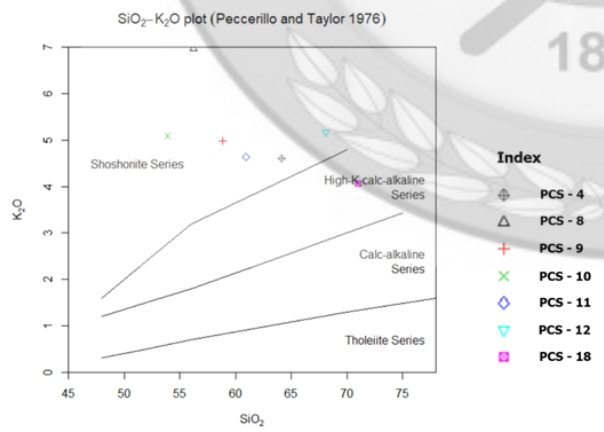


Fig 5.44: SiO2 Vs K2O plot after Peccerillo and Tylor, 1976., for volcanic rocks

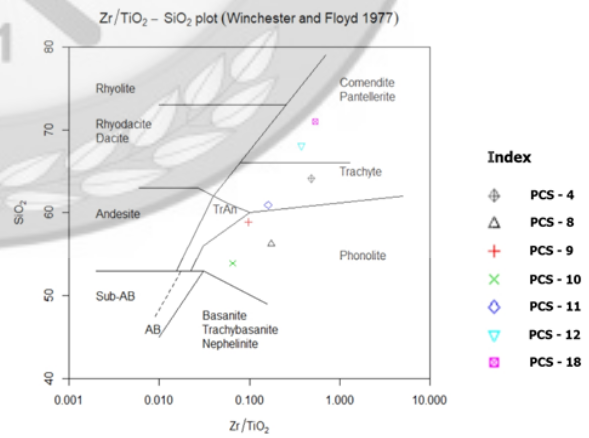


Fig 5.45: Zr/TiO2 – SiO2 plot after Winchester and Floyd 1977

5.5 Petrographic study

5.5.1 Rhyolite

The porphyritic rhyolite is characterized by the presence of euhedral and subhedral alkali feldspar phenocrysts surrounded by ground mass mostly of volcanic glass (Fig 5.46). Micrographic texture is observed in a few samples (Fig 5.47), indicative of the hydrous nature of the melt. Iron oxide veins and disseminations are also observed in the ground mass. Distinct sanidine grains were also noticed in TPS -12 (Fig 5.48).

5.5.2 Granite

The presence of abundant alkali pyroxenes and amphiboles under microscope reveals the alkaline nature of the Siwana Granite. Granite in the area mostly exhibits a hypidiomorphic texture with quartz and K feldspar as subhedral to anhedral grains. Perthite, alkali amphiboles and alkali pyroxenes are mostly euhedral to subhedral in nature. In Thin polished section-1 (TPS-1) of granite, the grains of perthitic alkali feldspar is replaced by albite partly (Fig 5.2) The perthitic alkali feldspar surrounded by Albite + Quarts rims (Fig 5.49), both suggesting a possible albitization event. Post magmatic evolution aegirine from alkali feldspar (Fig 5.49) is also evident.

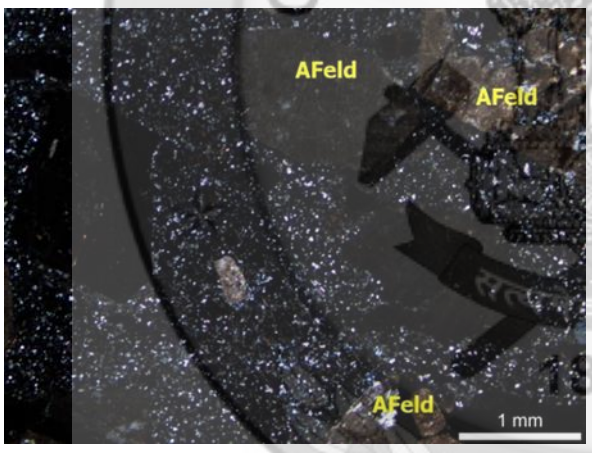


Fig. 5.46: Alkali feldspar phenocrysts of porphyritic rhyolite in (TPS-3 XPL)

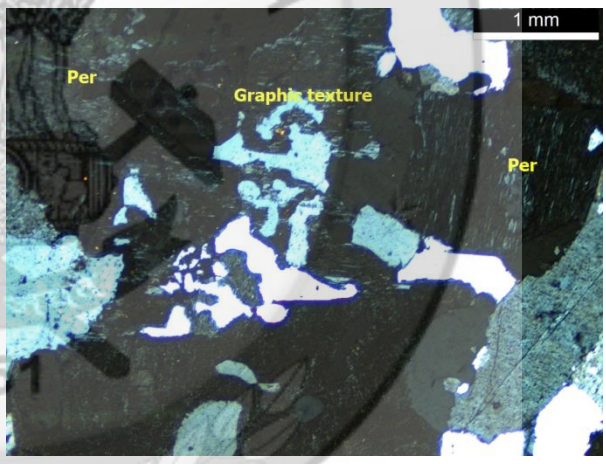


Fig. 5.47: Micrographic texture observed in rhyolite (TPS-12 XPL)

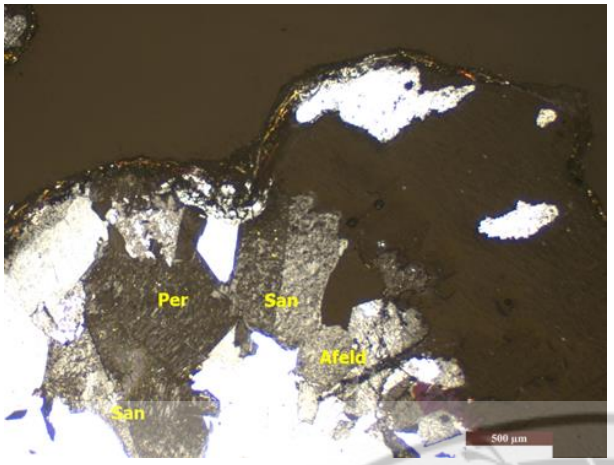


Fig. 5.48: Sanidine observed in rhyolite (TPS -12 XPL)

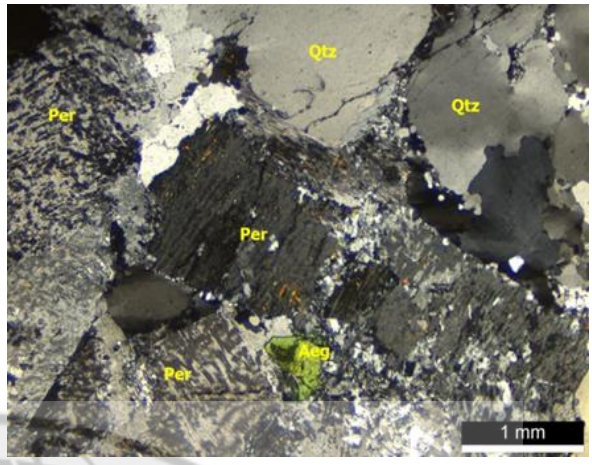


Fig.5.49: Perthitic alkali feldspar surrounded by Albite + Quarts rims in granite (TPS-1 XPL)

The replacement of earlier / magmatic aegirine – augite by post magmatic aegirine (Fig 5.50, 5.51) in granite (TPS-11), the formation of post magmatic arfvedsonite (alkali amphibole) from magmatic aenigmatite (Na,Ti bearing amphibole) is also observed (Fig 5.52) in TPS-1, presence of recrystallized albite + quartz rim (Fig 5.53) separating two alkali feldspar grains in granite (TPS-1), replacement of aegrine by later formed riebeckite and arfvedsonite (Fig 5.54,5.55) can be considered as an indicator for Na metasomatism. The mafic minerals in the granite variants are clearly not of single generation. The granite of TPS-5 (Thin polished Section) is relatively coarse grained with a single variety of feldspar possibly suggesting itself as a hyper solvus variety. The discrete grains for K feldspar (microcline) and albite in the granite of TPS -20, TPS -1 (Fig 5.56) are indicators for the Trans to sub solvus nature of these granites. Both the granite variants have petrographic evidences suggesting at least one episode of albitization /alkali metasomatism.

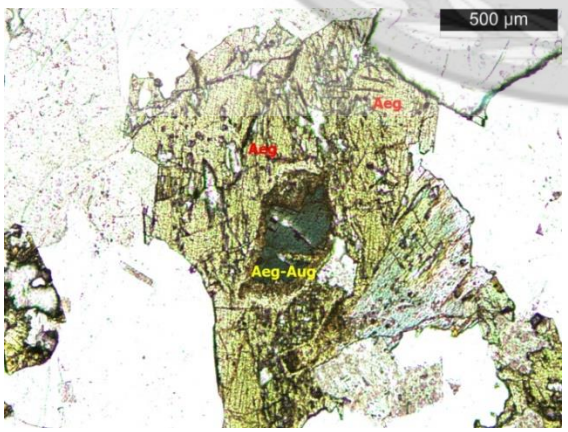


Fig 5.50: Replacement of aegirine – augite by aegirine in granite (TPS – 11PPL)

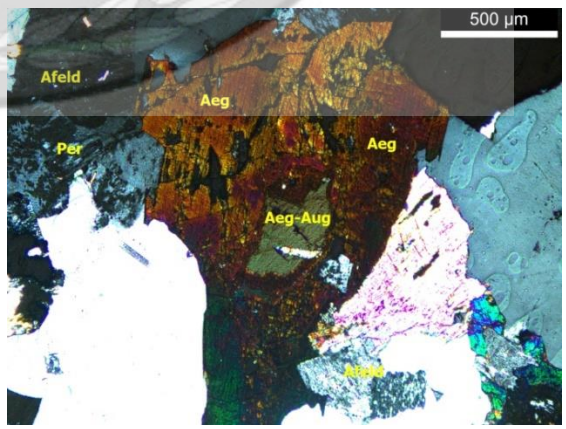


Fig 5.51: Replacement aegirine – augite by aegirine in granite (TPS - 11 XPL)

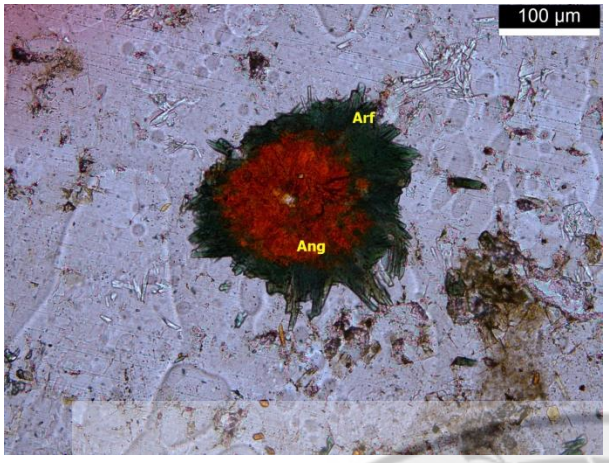


Fig 5.52: Formation of post magmatic arfvedsonite (alkali amphibole) from magmatic aenigmatite in granite (TPS-1 PPL)

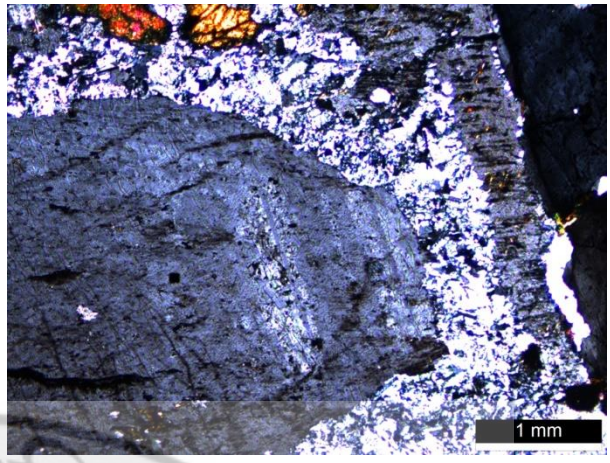


Fig 5.53: Recrystallized albite + quartz rim separating two alkali feldspar grains in granite (TPS -1 XPL)

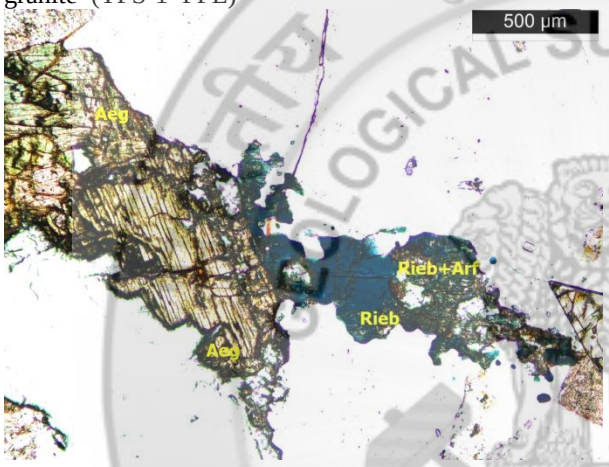


Fig 5.54: Riebeckite + arfvedsonite replacement of aegirine in granite (TPS-25 PPL)

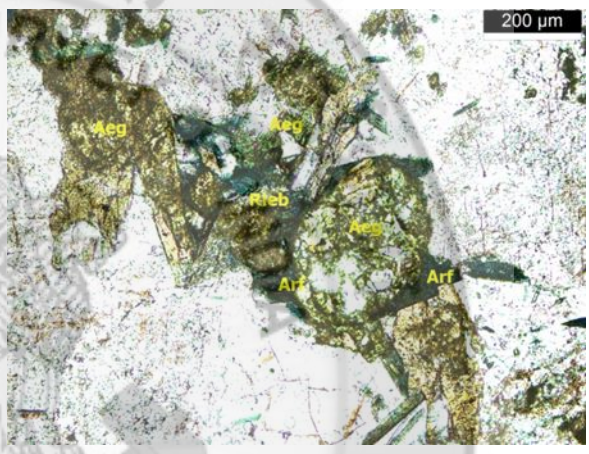


Fig 5.55: Riebeckite + arfvedsonite replacement of aegirine in granite (TPS-9 PPL)

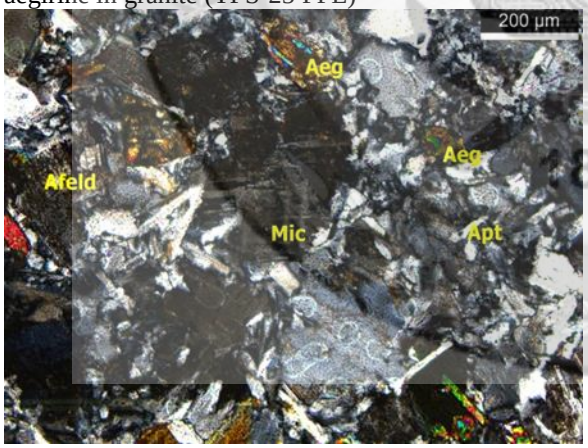


Fig 5.56: Altered microcline in sub solvus granite (TPS – 20 XPL)

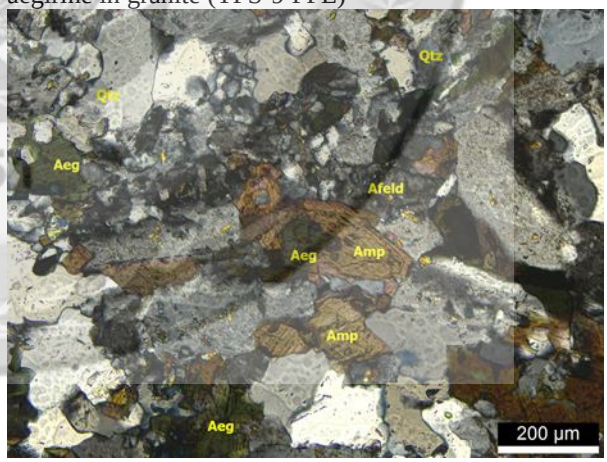


Fig 5.57: Alkali amphibole rich dyke rock in (TPS-2 XPL)

The presence of aegirine to riebeckite/arfvedsonite replacement fronts were noticed in TPS 9 and TPS – 25, Fig 5.54 and Fig 5.55 respectively. The presence of riebeckite and arfvedsontie in general are regarded as indicative of a relatively high temperature crystallization event under high oxygen fugacity conditions. The presence of Ti bearing amphiboles such as astrophyllite and aenegmatite* (Fig 5.4, 5.8, 5.52) are possible indicators of an agpaitic affinity of the rocks. It is noticed that clino pyroxenes like aegirine - augite and amphiboles like astrophyllite and aenigmatite* are replaced by aegrine and arfvedsonite in these granites. These replacements along with an aegrine to rebeckite/arfvedsonite replacement may be an indication of magmatic →late magmatic →post magmatic replacement mechanism under a progressive increase in oxygen fugacity conditions.

5.4.3 Dyke

The dyke rock observed as TPS-2 appears to be alkali feldspar, quartz, alkali amphibole rich rock (Fig 5.56). Most of the dyke thin sections were characterized by very fine grained mineral phases for a study in detail under microscope. The dykes were notably albitized with presence of fine grained clusters of alkali feldspar grains.

**Abbreviations used in the figures

Alb: Albite, Per: Perthite, Astro: Astrophyllite, Hem: Hematite, Arf: Arfvedsonite, Afeld: Alkali Feldspar, Aeg: Aegirine, Ang: Aenigmaite, Qtz: Quartz, San: Sanidine, Aeg – Aug: Aegirine – Augite, Rieb: Riebeckite, Mic: Microcline, Apt: Apatite, Flour: Flourite, Monz: Monazite, Xen: Xenotime, Zir: Zircon,Thor: Thorite

CHAPTER – 6

INTEGRATION OF GEOLOGICAL, GEOPHYSICAL AND GEOCHEMICAL DATA

6.1 Description of geophysical anomaly

No geophysical surveys/exploration of any type have been carried out during the course of present work or during past field season programmes in the study area. Hence no discussion is attempted to explain geophysical anomaly.

6.2 Integration of geological, geophysical and geochemical data

Since no geophysical surveys/exploration of any type have been carried out in the study area in present or in past, no geophysical anomaly could be demarcated. Further the results of REE and RM of bed rock samples are utilised to demarcate prospective area for further detailed exploration.

6.3 Discussion of integration of results

The integration of geochemical analysis results of bed rocks samples with geological data generated through field observations, petrographic and microprobe data warrants scope of further detailed investigation in the area. 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. Towards south of Indrana village 7034 ppm (BRS – 196), 8984 ppm (BRS – 199), 5699 ppm (BRS – 200) in a porphyritic rhyolite lithology is another promising area for further detailed exploration. In the south of Arjiyana village ΣREE+Y values of 7316 ppm (BRS – 175), 6621 ppm (BRS – 176) in rhyolite dyke samples cutting across a pyroclastic flow is promising zone for further detailed exploration. Other promising high ΣREE+Y value zones are identified around Mokalsar village. The integration of geochemical and geological data suggest that the younger intrusive dykes, the microgranite, granite and porphyritic rhyolites are condusive litho units for REE mineralization with varying HREE/ LREE ratio.

CHAPTER -7

MINERAL PROSPECT

7.1 Surface indication of mineralization

During the course of field work no specific surface indication of REE mineralization was noticed.

7.2 Mode of occurrence

The characteristic features of REE mineral phases present in the concerned geological identities are such that none of them are sized enough to be identified through naked eye. A thorough study under highly magnifying optical microscope can only lead to suspect occurrences of very few mineral phases. In view of the chemical analysis results combined with field observations and petrographic studies, the mineralization is essentially magmatic. Later, younger intrusions in the form of dykes and pegmatites are proved to be significant in REE potential. The petrographic evidences suggesting a late magmatic metasomatic episode of mineralization by which certain late magmatic REE mineral phases are formed along with alkali amphiboles amphiboles and alkali pyroxenes. These newly formd minerals are found maily as inclusions within the silicate minerals or as separate growths along the grain boundaries.

7.3 Nature of mineralization

The nature of REE mineralization was examined through petrographic studies. As the REE mineral phases are relatively small aforesaid petrographic examinations have certain limitations. The REE phosphates such as monazite (La, Ce, Nd, Th) PO4 and xenotime (YPO4), are the significant REE mineral phases identified under microscope (Fig 7.1). The REE phosphates are commonly observed as discrete primary (magmatic) grains (Fig 7.2,7.3,7.4) within volcanic, plutonic and later intrusive litho units of the the area. Zircon metamicts are observed in granite (Fig 7.5, 7.6) with presence of thorite in them. Apatite is another phosphate mineral observed in the granites of the study area under microscope. Apatite can host REE conditionally. The apatite grains from the study area mostly found as inclusions within alkali pyroxenes (Fig 7.8). Magmatic and post magmatic apatite variants observed during petrographic studies.

Zircon ($ZrSiO_4$) is the prominent silicate mineral observed under microscope which can host REE. Zircon also was noted mainly as inclusions or as discrete grains along grain

boundaries. (Fig 7.7). The occurrence of Zircon metamicts under microscope is indirect evidence zircon hosting REE Fig (7.5, 7.6).

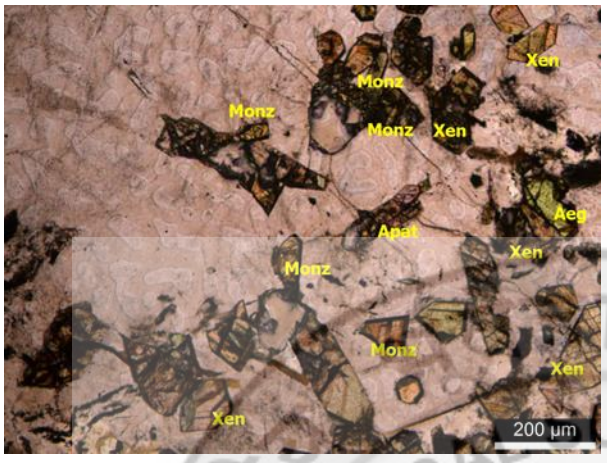


Fig 7.1: Monazite and xenotime observed in granite (TPS-15 PPL)

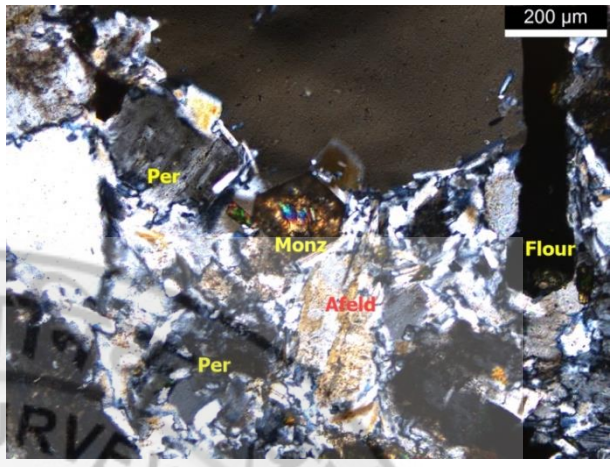


Fig 7.2: Monazite basal section in granite (TPS 20 XPL)

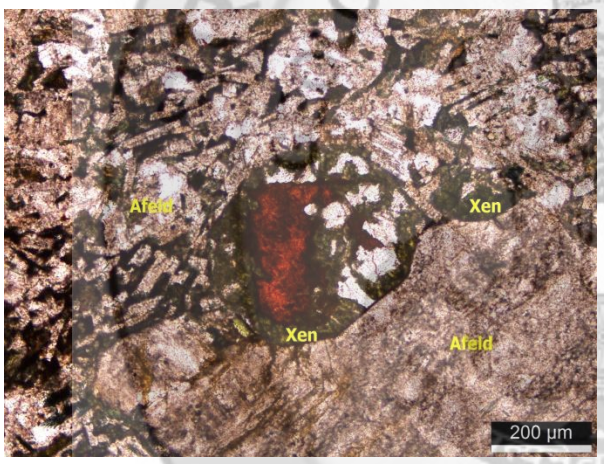


Fig 7.3: Xenotime replacing REE phase in granite (TPS 18 PPL)

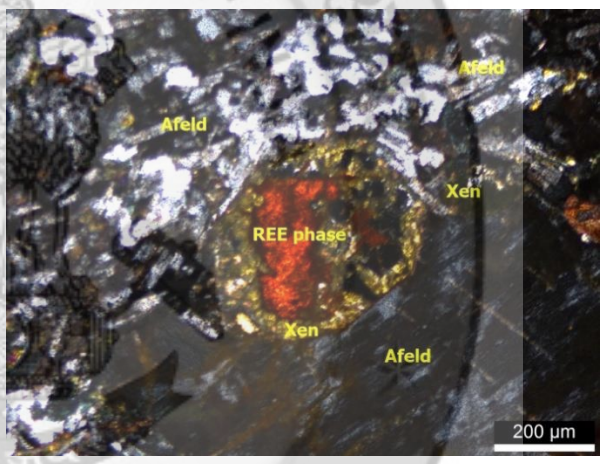


Fig 7.4: Xenotime replacing REE phase in granite (TPS 18 XPL)

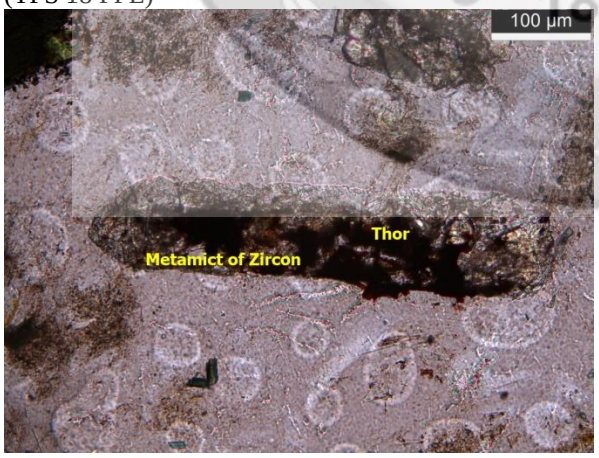


Fig 7.5: Metamict of zircon with thorite in granite TPS-20 (PPL)

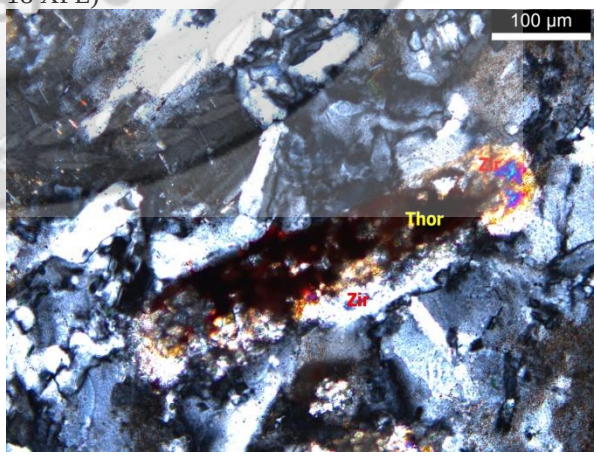


Fig 7.6: Metamict of zircon with thorite in granite TPS-20 (XPL)

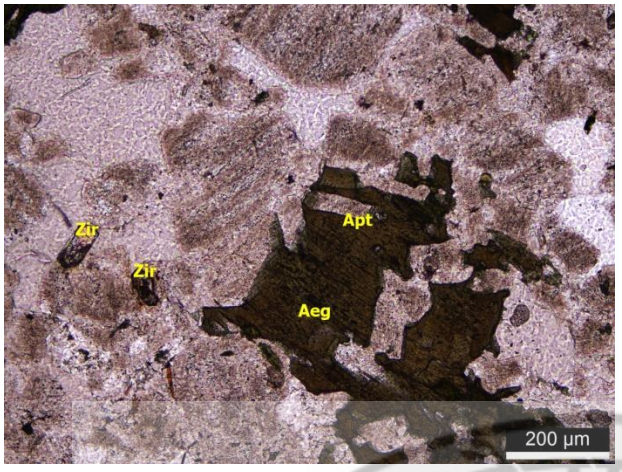


Fig 7.7: Apatite inclusion in aegirine and zircon in granite (TPS 20 PPL)

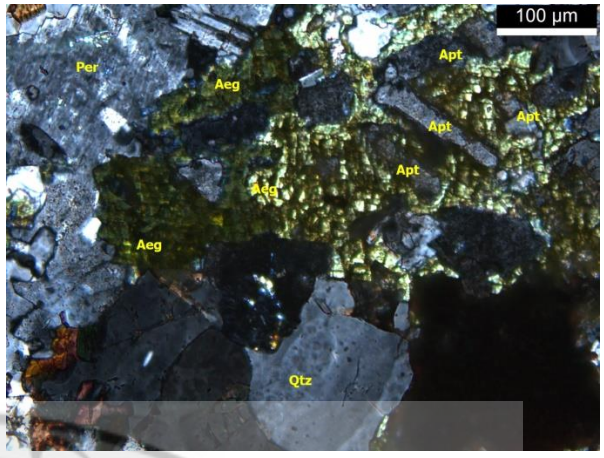


Fig 7.8: Aegirine replacing alkali feldspar; apatite inclusion within aegirine in granite (TPS 20 XPL)

Electron microprobe analyses of selected samples were carried out at EPMA laboratory, GSI, Faridabad. During the analysis different REE phases and silicate phases were probed. Monazite (REE Phosphate), Xenotime (Y Phosphate) and Allanite (REE silicate) are the major REE phases identified in EPMA analysis (Fig 7.9, 7.10, 7.11, 7.12). Aegrine (Fig 7.13), alkali feldspar, apatite (Fig 7.14), plagioclase etc are the other mineral phases identified.

7.4 Details of Mineralized Zones

As part of the current work 300 bed rock samples and 100 channel samples were analyzed for REE and RM potential. The results imply that the area is very promising for REE and associated RM mineralization. The chemical analysis of volcanic, plutonics and later intrusives impy that all major litho units of the area have zones of enriched REE.

Based on the synthesis of chemical analysis data the granite samples from the area have ΣREE+Y values ranging from 935.95 ppm to 7808.84 ppm, with avg. HREE/LREE ratio of 0.19. Volcanic rock samples from the area yielded ΣREE+Y values ranging 265.47 ppm to 8984.74 ppm, with avg. HREE/LREE ratio of 0.18. The later intrusive rocks (Dykes) yielded ΣREE+Y values ranging from 621.10 ppm to 7316.14 ppm, with avg. HREE/LREE ratio of 0.26.

As per the point anomaly distribution map developed based on the statistical analysis of geochemical results generated the area can be divided into five blocks, (Plate – 4) of promising potential zones for advance exploration activities. These blocks are as follows.

1. Arjiana – Ludrara Block
2. Mokalsar – Maylawas East Block

3. Mokalsar – Maylawas West Block

4. Indrana South Block

5. Indrana North bock

Fig 7.9: BSE image of monazite in granite

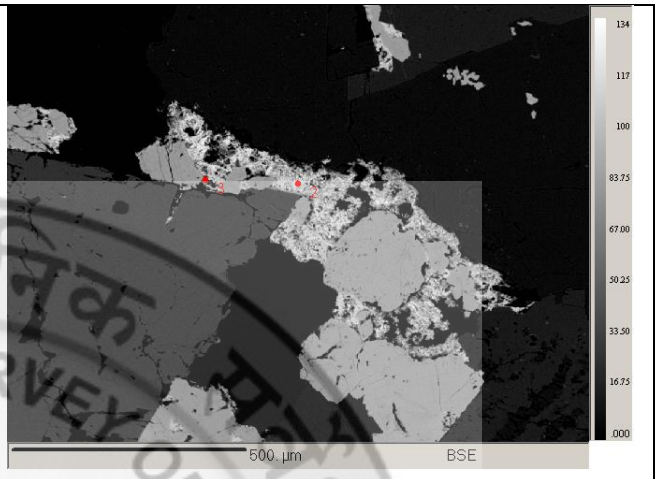


Fig 7.10: BSE image of monazite in granite

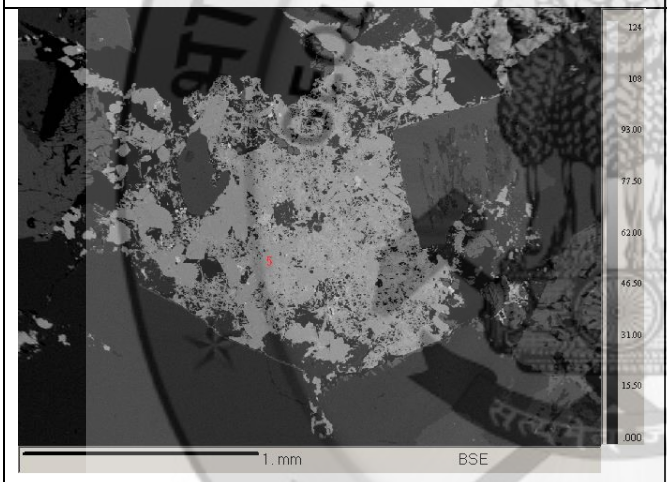


Fig 7.11: BSE image of allanite in granite

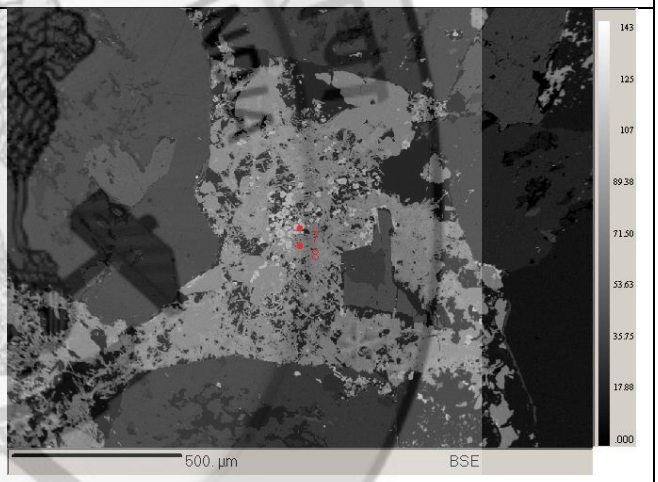


Fig 7.12: BSE image of allanite in granite

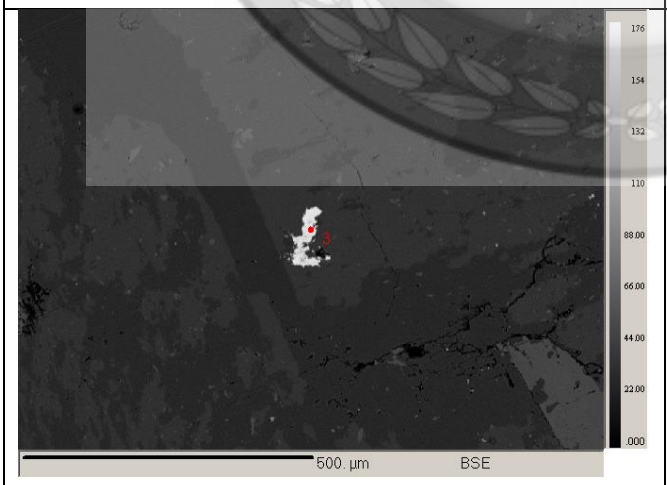


Fig 7.13: BSE image of aegirine in granite

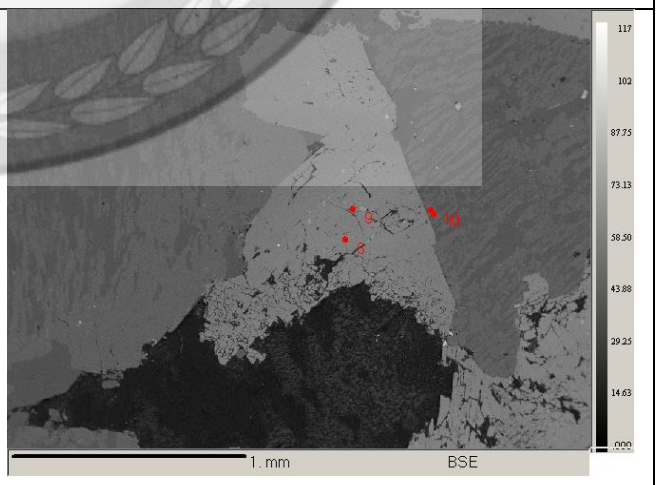


Fig 7.14: BSE image of apatite in granite

7.5 Genesis of Mineralization

In the scientific world, the REE and RM mineralization associated with peralkaline rocks is still a matter of debate. The origin of the HFSE and REE mineralization associated with peralkaline rocks is not clear and there is debate as to mineralization, i.e., magmatic, hydrothermal or the combination of both (Salvi and Williams Jones, 1990, 1996, 2005; Dostal et al. 2004; Halter and Webster, 2004; Vekster, 2004; Carney et al., 2005; Linnen and Cuney, 2005). The magmatic model assumes that REE enriched due to fractional crystallization. However, mineralization is associated with altered parts of alkaline intrusion in a number of world class deposits; suggest enrichment due to hydrothermal activity. Volatiles play major role in development of highly evolved peralkaline rocks (Marks et.al. 2003; Markl et.al. 2010). Therefore both magmatic and hydrothermal are likely to contribute for the formation of REE deposit in alkaline rocks.

The REE and associated RM mineralization in Siwana area broadly described as Siwana Ring Complex was studied for its genetic aspect by various workers. A nearly comprehensive genetic model was proposed by Suresh Kumar et al., 2020. In the aforesaid model the Siwana REE and RM mineralization is described as an essentially magmatic mineralization in which progressive enrichment happened through various Tectono-magmatic events i.e rifting > volcanism > plutonism > later intrusions. The deficiency of this model is that it had not mentioned about any possible metsomatic / hydrothermal latest enrichment aspect. The possibility of such a hydrothermal enrichment aspect has not been ruled out by Bhushan et al., 2019. Latest work by Atanu et al., 2021 has dealt this aspect in detail and substantiated the late to post magmatic hydrothermal enrichment of REE and RM through detailed petrographic study and EPMA analysis of various silicate phases. In the said work the evidences of metasomatic / hydrothermal activities are documented through petrographic studies and enrichment of REE in the post magmatic alkali pyroxenes and amphiboles are well documented through detailed EPMA analysis.

In the current study the evidences of metasomatic / hydrothermal changes in the silicate phases of plutonic and later intrusive geological identities are well evident from the petrography. The coarsening of perthite layers, deuteric alteration of alkali feldspar phenocrysts, pseudomorphic replacement of alkali feldspar by late / post magmatic aegrine, replacement of magmatic aegrine – augite by aegrine and to certain extend by arfvedsonite are considerable evidences for a late to post mgmatic metasomatic / hydrothermal event. The authors would only be able to link this metasomatic / hydrothermal event to REE and RM

enrichment only after detailed micro probe by EPMA. Based on the evidences generated hitherto in the current study, it can be concluded that the REE and RM mineralization of Siwana area is essentially the product of protracted fractionation of alkali enriched magmatic source; crustally distributed as volcanic, plutonic and later intrusive phases. A late to post magmatic remobilization and redistribution of REE and RM is ambiguously possible.

CHAPTER – 8

CONCLUSION AND RECOMMENDATION

8.1 Conclusion

Field season program with Item Code No.: M2AFGBM-MEP/NC/WR/SU-RAJ/2021/36826 was taken up around Indrana- Siwana area, Barmer District, Rajasthan, (Toposheetno. 45C/06& 10) with an objective to evaluate potentiality of Rare Earth Elements. Large scale mapping of 100 sq km area in 1: 12,500 scale, petrographic study, chemical analysis, EPMA and XRD analysis were employed for the cause.

The magmatic evolution of the area happened in three phases. A phase of volcanism followed by a plutonic phase (Siwana Granite) and later by younger intrusive phase. The aphanitic variety of rhyolite is the most common volcanic phase in the area. The porphyritic rhyolite observed mostly in the south eastern part of the mapped area. The plutonic phases observed in the area are dominated by grey colored, medium to coarse grained granite. The pink colored, coarse grained alkali feldspar granite is mostly observed in the south eastern parts of the mapped area. The contact between both varieties of granite appears diffusive in nature. 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 to the granites with typical discordant field relation.

Petrographic studies of volcanic phases of the area are characterized by presence of euhedral and subhedral alkali feldspar phenocrysts. Alkali pyroxenes and alkali amphiboles are ubiquitous among the volcanic phases. The ground mass appears to be very fine grained. The granite petrography indicate presence of alkali feldspar, quartz and alkali amphibole (arfvedsonite) and alkali pyroxene (aegrine), perthite as essential mineral phases. Apatite, zircon, aenigmatite, astrophyllite, aegrine- augite and riebeckite are observed as accessory phases. Granites of the area exhibit a typical hypidiomorphic texture. Monazite, xenotime and allanite are the REE mineral phases identified under microscope and EPMA analysis.

Out of the 300 bed rock samples analyzed 107 samples resulted in ΣREE+Y values greater than mean value (2446ppm). The ΣREE+Y of the BRS samples varies within a minimum of 265.47 ppm to a maximum of 8984.74 ppm. Among 100 channel samples analyzed, ΣREE+Y values ranges from 476.25 ppm to 8582.98 ppm. The granite samples from the area have ΣREE+Y values ranging from 935.95 ppm to 7808.84 ppm, with avg. HREE/LREE ratio of 0.19. Volcanic rock samples from the area yielded ΣREE+Y values

ranging 265.47 ppm to 8984.74 ppm, with avg. HREE/LREE ratio of 0.18. The later intrusive rocks (Dykes) yielded ΣREE+Y values ranging from 621.10 ppm to 7316.14 ppm, with avg. HREE/LREE ratio of 0.26. Apart from REE+Y encouraging chemical analysis result was observed for certain rare metals and trace elements such as Zr (up to 10173 ppm), Nb (up to 853 ppm), Zn (up to 920 ppm), Th (up to 77 ppm), Hf (up to 666.41 ppm).

8.2 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

i. Arjiana – Ludrara Block

ii. Mokalsar – Maylawas East Block

iii Mokalsar – Maylawas West Block

iv Indrana South Block

v. Indrana North bock

2. REE and RM mineralization at deeper level may be established by deep drilling.

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Locality Index

Place Name	Latitude	Longitude
Siwana	25°38’49.7’’	72°25’38.6’’
Mokalsar	25° 37’50.5’’	72°31’46’’
Mawri	25° 37’49’’	72° 27’37.3’’
Indrana	25° 38' 27.6"	72° 16' 19.2"
Devandi	25° 39' 10.8"	72° 27' 43.2"
Ludrara	25° 39' 3.6"	72° 31' 33.6"
Arjiyana	25° 39' 18"	72° 28' 26.4"

Appendix I

INFORMATION SHEET FOR BIBLIOGRAPHY DATABASE IN UNPUBLISHED REPORT

TITLE OF FIELD	REQUIRED INFORMATION
TITLE	**TITLE OF THE REPORT:** Reconissanace survey for rare earth elements and associated mineralization around Indrana-Siwana area, central part of Siwana ring complex, Siwana (src), Barmer district, Rajasthan (G - 4 stage)
AUTH Name of authours (s):	Shri Vivek V Kumar., Sr. Geologist Dr. Kiran Jyoti Mishra., Sr.Geologist
TDOC	**Type of Document:** Final Report
CONF	**Identification of the confidentiality of the report:** Open Fill in any of the following: Secret/Confidential/Classified/Restricted/Open,General/Unclassified
CORP	**Corporate body (ies):** Fill in the following from where report is being issued **Region :** Western **Operation :** Rajasthan **Division/ Project :** SM-II
BENE	**Name of beneficiary of the study when GSI has worked for some external organization or ministries:** Not applicable
DCNU	**Document Number: FSPID** 36826 **FSP ID:** M2AFGBM-MEP/NC/WR/SU-RAJ/2021/36826
FSPR	**Field Season Programme Year :** 2021-22
DPUB	**Date of publication of the document:** (Year and Month only)
ABST	**Concise abstract of the document restricted to 2000 characters (inclusive of blank spaces) :**
MPRF	**Mapping Reference:** Toposheet no. 45C/06 and 45 C/10

Appendix-II

Details of Work Input

A. Title of the report: Reconissanace survey for rare earth elements and associated mineralization around Indrana-Siwana area, central part of Siwana ring complex, Siwana (src), Barmer district, Rajasthan (G - 4 stage)

B. Number of days spent in field by the geologists: Man days

1. Vivek V Kumar, Sr. Geologist 109 days
2. Dr. Kiran Jyoti Mishra, Sr. Geologist 111 days

C. Distance of operational area from Headquarters: 412kms

D. Sampling:

LSM (1:12,500): 100 sq km
BRS: 300 nos
CS: 100 nos.
PS: 20 nos.
PCS: 20 nos.
EPMA: 10 nos.
XRD: 05 nos
Stream sediment samples: 5 Nos

E. Laboratory analysis:

BRS: 300 nos.
CS: 100 nos
PS: 20 nos.
PCS: 20 nos.
EPMA: 10 nos.
XRD: 05 nos
Stream sediment samples: 5 Nos

Signature 01.12.22	Signature 01.12.22
Name: Shri Vivek V Kumar	Name: Dr. Kiran Jyoti Mishra
Designation: Sr. Geologist	Designation: Sr.Geologist
Project- SM-II	Project- SM-II
SU:Rajasthan	SU:Rajasthan
GSI: W.R-Jaipur	GSI: W.R-Jaipur

Appendix-III

Geological Survey of India

Certificate of Quality of Report

Project/Division: Project SM-II, **FSP ID:** M2AFGBM-MEP/NC/WR/SU-RAJ/2021/36826, Mission II

Title: Reconissanace survey for rare earth elements and associated mineralization around Indrana-Siwana area, central part of Siwana ring complex, Siwana (sic), Barmer district, Rajasthan (G - 4 stage)

PART –A

This is to certify that the following officer(s) have carried out the above mentioned FSP, and are responsible for the collection of the field data, carrying out the required laboratory analysis, compilation and synthesis of field data, coalition of the data and writing of the report as per the approved guidelines. The duration of the field stay of the officer(s) is as against his/her name.

Sr. No	Name of Officer	Field Season	No. of field Days	Signature with Date
1	Vivek V Kumar., Sr.Geologist (Project-in-charge)	2021-22	109	01.12.22
2.	Dr. Kiran Jyoti Mishra., Sr. Geologist	2021-22	111	01.12.22

PART-B

This is to certify that drilling has been carried out and completed as per the details given below:

Drilling unit No.	Borehole No.	Date of commencement of drilling	Date of completion of drilling	Name and signature of the director drilling
-	-	-	-	-
-	-	-	-	-

PART- C

This is to certify that geophysical component of the item has been carried out as per the table given below:

Name/designation of the Geophysicist	Date of commencement of work	Date of completion of work	Signature with date of the Geophysicist

-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
Name and designation with date of the Director (Geophysics)			-

PART- D

This is to certify that that chemical analysis of the geological samples has been carried out as per the table given below:

Name of director in charge of the chemical lab	Dates of receipt of the samples from the officer/party	Date of providing complete analytical results to the Officer	Signature with date of the director chemistry
	28/12/2022	05/05/2022	
	10/01/2022	23/05/2022	
	10/05/2022	11/09/2022	
	22/03/2022	30/05/2022	
	15/02/2022	30/09/2022	
	15/02/2022	30/09/2022	

PART- E

This is to certify that the below mentioned supervisory officer(s) have supervised the above item and have provided the guidance to the field officer(s). the number of the inspection visits and total duration of the field visits is as per the table given below. It is also certified that the work carried out under the project is of high standards, the norms of the field work, lab work etc. have been followed. It is also certified that thorough scrutiny of the report for maintaining the scientific contents and its quality has been overseen.

Name/designation of the supervisory officer	No. of inspection visits made to the field area	Total no. of days spent on inspection visit	Signature with Date
Rohan Das, Director	03	09	Rohan Das 30/11/22

PART-F

This is also certified that the report has also been thoroughly scrutinized at the regional mission head level. The scientific contents and the quality of the report are certified. The report has been peer reviewed and the needful corrections have been attended to.

Name/designation of the Regional Mission Head	Signature with date
L.M.S. Maura Dy.D.G. & RMH-II GSI, WR, Jaipur	02/12/2022 ललित मोहन सिंह मौरा Lalit Mohan Singh Maura उप महानिदेशक एवं क्षेत्रीय मिशन प्रमुख-II Dy. DG & RMH-II

PART- G

This is also certified that the report has also been scrutinized at various levels and has also been peer reviewed on being satisfied regarding the scientific contents and the quality of the report, the undersigned has accorded the approval for its circulation.

Name/designation of the regional HOD	Signature with date
S.D. Palbhye ADG & HOD GSI, WR, Jaipur	D.G. & Add. Charge HOD 06.12.22

Appendix-IV

Geological Survey of India
Data sheet on report movement in connection with its scrutiny

Project/Division BM-XI FSP ID: M2AFGBM-MEP/NC/WR/SU-RAJ/2021/36826 Mission: II
Title of the report:Reconissanace survey for rare earth elements and associated mineralization around Indrana-Siwana area, central part of Siwana ring complex, Siwana (src), Barmer district, Rajasthan (G - 4 stage)

Name of author(s) 1. Vivek V Kumar., Sr.Geologist 2. Dr. Kiran Jyoti Mishra., Sr. Geologist	Date of submission of report to the Supervisory Officer 30.6.2022 Signature of the senior most author
Name of Supervisory Officer Rohan Das, Director	Date of receipt of report 30.6.2022 Date of completion of scrutiny 12.7.2022 Date of handing over report to the author after scrutiny 12.7.2022 Signature Rohan Das
Name of author(s) To whom the report has been handed over by the Supervisory Officer Vivek V. Kumar	Date of receipt after scrutiny 21.7.2022 Signature Date of resubmission 12.8.2022 Signature
Name of author(s) 1. Vivek V Kumar., Sr. Geologist 2. Dr. Kiran Jyoti Mishra., Sr.Geologist	Date of submission of report to the Supervisory Officer 12.8.2022 Signature of the senior most author
Supervisory Officer Rohan Das, Director	Date of receipt of 2nd Draft 10.11.2022 Date of handing over report to the Author 15.11.2022 Signature Rohan Das

Name of Regional Mission Head LMS Maura	Date of receipt of report 15.11.2022 Date of handing over the report after peer review to the Project Director 29.11.2022 Signature
Name of Supervisory Officer Rohan Das, Director	Date of receipt from the Regional Mission Head after peer review 29.11.2022 Date of handing over to author(s) 29.11.2022 Signature Rohan Das
Name of author(s) Vivek V. Kumar	Date of receipt of report from Supervisory Officer 29.11.2022 Date of handing over report after modification to Supervisory Officer 01.12.2022 Signature
Name of Supervisory Officer Rohan Das, Director	Date of receipt of report after modification from Authors 01.12.2022 Date of handing over report to Regional Mission Head 01.12.2022 Signature Rohan Das
Name of Regional Mission Head LMS Maura	Date of receipt after modification from the Project Director 01.12.2022 Date of handing over the report to the HoD of the Region for approval 02.12.2022 Signature 02/12/22
Name of the HoD of the Region S.D. Pathak DDG & Add charge HOD	Date of receipt of report for approval 02.12.2022 Date of approval 26.12.22 Date of sending back report to Project Director 26.12.22 Signature of the HOD
Name of the Project Director Rohan Das, Director	Date of receipt of report after approval of HOD..... Date of circulation of report..... Signature.....

Annexure- I: Details of bed rock samples collected from Indrana - Siwana Area

Sl. No.	Sample No.	Lat	Long	Lithology
1	SM-II/VVK/BRS-1/21-22	25.5925	72.4999	Dyke sample intruding host granite
2	SM-II/VVK/BRS-2/21-22	25.5926	72.4997	Host rock/Granite sample
3	SM-II/VVK/BRS-3/21-22	25.5926	72.4997	Dyke sample intruding host granite
4	SM-II/VVK/BRS-4/21-22	25.5924	72.4991	Dyke sample intruding host granite
5	SM-II/VVK/BRS-5/21-22	25.5944	72.4992	Granite sample frpm quarry site
6	SM-II/VVK/BRS-6/21-22	25.6173	72.5143	Granite sample
7	SM-II/VVK/BRS-7/21-22	25.6172	72.5133	Dyke sample intruding host granite
8	SM-II/VVK/BRS-8/21-22	25.6174	72.5127	Dyke sample intruding host granite
9	SM-II/VVK/BRS-9/21-22	25.6163	72.5152	Rhyolite
10	SM-II/VVK/BRS-10/21-22	25.6311	72.4979	Altered rock sample/Ash bed rock
11	SM-II/VVK/BRS-11/21-22	25.6308	72.4975	Green coloured rock sample with cherty matter and iron stains
12	SM-II/VVK/BRS-12/21-22	25.6179	72.5168	Ferruginous Rhyolite
13	SM-II/VVK/BRS-13/21-22	25.6068	72.5043	Dyke
14	SM-II/VVK/BRS-14/21-22	25.6068	72.5043	Pink Granite (Weathered)
15	SM-II/VVK/BRS-15/21-22	25.6066	72.5045	Dyke
16	SM-II/VVK/BRS-16/21-22	25.6205	72.5113	Andesite?(greenish grey porphyritic rock)
17	SM-II/VVK/BRS-17/21-22	25.6194	72.5101	Flesh coloured Dyke
18	SM-II/VVK/BRS-18/21-22	25.6214	72.5088	Porphyritic Rhyolite
19	SM-II/VVK/BRS-19/21-22	25.6166	72.5097	Dyke
20	SM-II/VVK/BRS-20/21-22	25.6166	72.5097	Dyke
21	SM-II/VVK/BRS-21/21-22	25.6241	72.5125	Dyke
22	SM-II/VVK/BRS-22/21-22	25.6241	72.5138	Greenish grey coloured porphyritic rhyolite
23	SM-II/VVK/BRS-23/21-22	25.6284	72.5094	Pink Rhyolite?
24	SM-II/VVK/BRS-24/21-22	25.6281	72.5088	Dyke
25	SM-II/VVK/BRS-25/21-22	25.6275	72.5089	Dyke
26	SM-II/VVK/BRS-26/21-22	25.6399	72.5171	Granite from abandoned quarry section
27	SM-II/VVK/BRS-27/21-22	25.6447	72.5281	Ferruginous Rhyolite
28	SM-II/VVK/BRS-28/21-22	25.6463	72.5279	Porphyritic Rhyolite
29	SM-II/VVK/BRS-29/21-22	25.6460	72.5275	Granite
30	SM-II/VVK/BRS-30/21-22	25.6505	72.5261	Dyke
31	SM-II/VVK/BRS-31/21-22	25.6502	72.5257	Rhyolite dyke
32	SM-II/VVK/BRS-32/21-22	25.6477	72.5219	Granite
33	SM-II/VVK/BRS-33/21-22	25.6478	72.5198	Granite
34	SM-II/VVK/BRS-34/21-22	25.6458	72.5193	Granite
35	SM-II/VVK/BRS-35/21-22	25.6455	72.5168	Granite with chloritic and epidote alteration
36	SM-II/VVK/BRS-36/21-22	25.6483	72.5160	Granite
37	SM-II/VVK/BRS-37/21-22	25.6531	72.5065	Ferruginous Rhyolite
38	SM-II/VVK/BRS-38/21-22	25.6520	72.5058	Rhyolite
39	SM-II/VVK/BRS-39/21-22	25.6500	72.5082	Rhyolite
40	SM-II/VVK/BRS-40/21-22	25.6469	72.5098	Granite from granite and rhyolite contact
41	SM-II/VVK/BRS-41/21-22	25.6476	72.5148	Granite
42	SM-II/VVK/BRS-42/21-22	25.6454	72.5142	Granite
43	SM-II/VVK/BRS-43/21-22	25.6444	72.5014	Granite
44	SM-II/VVK/BRS-44/21-22	25.6450	72.5123	Granite
45	SM-II/VVK/BRS-45/21-22	25.6453	72.5104	Granite (Finer rock & chip fractions)
46	SM-II/VVK/BRS-46/21-22	25.6493	72.5063	Rhyolite
47	SM-II/VVK/BRS-47/21-22	25.6474	72.5066	Rhyolite
48	SM-II/VVK/BRS-48/21-22	25.6470	72.5054	Rhyolite
49	SM-II/VVK/BRS-49/21-22	25.6492	72.5046	Rhyolite
50	SM-II/VVK/BRS-50/21-22	25.6169	72.5113	Powdered granite samples from bore well site

Sl. No.	Sample No.	Lat	Long	Lithology
51	SM-II/VVK/BRS-51/21-22	25.6529	72.5046	Rhyolite
52	SM-II/VVK/BRS-52/21-22	25.6512	72.5043	Rhyolite
53	SM-II/VVK/BRS-53/21-22	25.6498	72.5023	Greenish grey rhyolite with K-feld. Phenocryst
54	SM-II/VVK/BRS-54/21-22	25.6513	72.5025	Rhyolite with iron oxides
55	SM-II/VVK/BRS-55/21-22	25.6512	72.5003	Rhyolite with iron oxides
56	SM-II/VVK/BRS-56/21-22	25.6504	72.5004	Rhyolite
57	SM-II/VVK/BRS-57/21-22	25.6523	72.5003	Dark grey coloured rhyolite with K-feld. Phenocryst
58	SM-II/VVK/BRS-58/21-22	25.6526	72.4990	Rhyolite
59	SM-II/VVK/BRS-59/21-22	25.6513	72.4986	Rhyolite wirh Iron oxides
60	SM-II/VVK/BRS-60/21-22	25.6494	72.4986	Rhyolite wirh Iron oxides
61	SM-II/VVK/BRS-61/21-22	25.6482	72.4997	Porphyritic Rhyolite
62	SM-II/VVK/BRS-62/21-22	25.6492	72.4998	Rhyolite with iron oxides
63	SM-II/VVK/BRS-63/21-22	25.6395	72.5163	Granite
64	SM-II/VVK/BRS-64/21-22	25.6404	72.5161	Granite
65	SM-II/VVK/BRS-65/21-22	25.6406	72.5147	Microgranite dyke
66	SM-II/VVK/BRS-66/21-22	25.6407	72.5144	Granite
67	SM-II/VVK/BRS-67/21-22	25.6394	72.5144	Granite
68	SM-II/VVK/BRS-68/21-22	25.6391	72.5124	Granite with black colored minerals
69	SM-II/VVK/BRS-69/21-22	25.6379	72.5125	Granite
70	SM-II/VVK/BRS-70/21-22	25.6373	72.5104	Pink colored fine grained granite
71	SM-II/VVK/BRS-71/21-22	25.6434	72.4186	Powder sample (?) from well section
72	SM-II/VVK/BRS-72/21-22	25.6388	72.5100	Granite
73	SM-II/VVK/BRS-73/21-22	25.6397	72.5085	Granite
74	SM-II/VVK/BRS-74/21-22	25.6404	72.5081	Granite
75	SM-II/VVK/BRS-75/21-22	25.6383	72.5084	Granite
76	SM-II/VVK/BRS-76/21-22	25.6399	72.5064	Granite
77	SM-II/VVK/BRS-77/21-22	25.6413	72.5063	Granite
78	SM-II/VVK/BRS-78/21-22	25.6395	72.5044	Granite
79	SM-II/VVK/BRS-79/21-22	25.6431	72.5059	Fine grained granite
80	SM-II/VVK/BRS-80/21-22	25.6429	72.5051	Greenish grey rhyolite
81	SM-II/VVK/BRS-81/21-22	25.6422	72.5039	Rhyolite
82	SM-II/VVK/BRS-82/21-22	25.6412	72.5044	Rhyolite with microgranite veins and needle shaped minerals
83	SM-II/VVK/BRS-83/21-22	25.6393	72.5026	Granite
84	SM-II/VVK/BRS-84/21-22	25.6388	72.4970	Rhyolite
85	SM-II/VVK/BRS-85/21-22	25.6378	72.4957	Rhyolite/Vey fine grained microgranite?
86	SM-II/VVK/BRS-86/21-22	25.6371	72.4944	Rhyolite with iron oxides
87	SM-II/VVK/BRS-87/21-22	25.6391	72.4980	Granite
88	SM-II/VVK/BRS-88/21-22	25.6390	72.5004	Granite
89	SM-II/VVK/BRS-89/21-22	25.6364	72.4772	Rhyolite from isolated mound
90	SM-II/VVK/BRS-90/21-22	25.6354	72.4750	Porphyritic Rhyolite
91	SM-II/VVK/BRS-91/21-22	25.6336	72.4726	Fine grained granite
92	SM-II/VVK/BRS-92/21-22	25.6334	72.4709	Pink granite
93	SM-II/VVK/BRS-93/21-22	25.6332	72.4743	Weathered granite
94	SM-II/VVK/BRS-94/21-22	25.6324	72.4752	Fine grained granite
95	SM-II/VVK/BRS-95/21-22	25.6334	72.4762	Granite
96	SM-II/VVK/BRS-96/21-22	25.6364	72.4795	Granite from small mound
97	SM-II/VVK/BRS-97/21-22	25.6354	72.4786	Granite
98	SM-II/VVK/BRS-98/21-22	25.6354	72.4769	Granite
99	SM-II/VVK/BRS-99/21-22	25.6335	72.4783	Medium grained granite
100	SM-II/VVK/BRS-100/21-22	25.6342	72.4804	Granite

Sl. No.	Sample No.	Lat	Long	Lithology
101	SM-II/VVK/BRS-101/21-22	25.6341	72.4829	Granite
102	SM-II/VVK/BRS-102/21-22	25.6333	72.4845	Granite
103	SM-II/VVK/BRS-103/21-22	25.6354	72.4804	Granite
104	SM-II/VVK/BRS-104/21-22	25.6394	72.4884	K-feld phenocryst rich greenish grey coloured rhyolite
105	SM-II/VVK/BRS-105/21-22	25.6376	72.4887	K-feld phenocryst rich greenish grey coloured rhyolite
106	SM-II/VVK/BRS-106/21-22	25.6372	72.4865	K-feld phenocryst rich greenish grey coloured rhyolite
107	SM-II/VVK/BRS-107/21-22	25.6369	72.4847	K-feld phenocryst rich greenish grey coloured rhyolite
108	SM-II/VVK/BRS-108/21-22	25.6356	72.4844	K-feld phenocryst rich greenish grey coloured rhyolite
109	SM-II/VVK/BRS-109/21-22	25.6358	72.4826	Fine grained granite from granite-rhyolite contact
110	SM-II/VVK/BRS-110/21-22	25.6427	72.4815	Weathered granite from quarry site
111	SM-II/VVK/BRS-111/21-22	25.6433	72.4825	Medium to coarse grained granite
112	SM-II/VVK/BRS-112/21-22	25.6453	72.4825	Fine to medium grained granite
113	SM-II/VVK/BRS-113/21-22	25.6454	72.4809	Fine grained granite with vein quartz and iron oxides
114	SM-II/VVK/BRS-114/21-22	25.6450	72.4793	Fine to medium grained grey colored granite
115	SM-II/VVK/BRS-115/21-22	25.6433	72.4806	Fine grained granite K-feldspar phenocryst
116	SM-II/VVK/BRS-116/21-22	25.6432	72.4845	Coarse grained granite (Loose rock fragments)
117	SM-II/VVK/BRS-117/21-22	25.6436	72.4868	Rhyolite with presence of quartz, iron oxides and green colored matters
118	SM-II/VVK/BRS-118/21-22	25.6452	72.4860	Coarse grained granite
119	SM-II/VVK/BRS-119/21-22	25.6472	72.4846	Coarse grained granite
120	SM-II/VVK/BRS-120/21-22	25.6476	72.4827	Medium to coarse grained granite
121	SM-II/VVK/BRS-121/21-22	25.6479	72.4811	Fine to medium grained granite
122	SM-II/VVK/BRS-122/21-22	25.6333	72.4863	Fine grained pink granite
123	SM-II/VVK/BRS-123/21-22	25.6338	72.4885	Porphyritic Rhyolite
124	SM-II/VVK/BRS-124/21-22	25.6350	72.4903	Porphyritic Rhyolite
125	SM-II/VVK/BRS-125/21-22	25.6354	72.4924	Granite
126	SM-II/VVK/BRS-126/21-22	25.6303	72.4922	Porphyritic Rhyolite with iron oxides
127	SM-II/VVK/BRS-127/21-22	25.6294	72.4901	Porphyritic Rhyolite with iron oxides
128	SM-II/VVK/BRS-128/21-22	25.6474	72.4980	Rhyolite dyke
129	SM-II/VVK/BRS-129/21-22	25.6493	72.4966	Rhyolite with top altered red portion
130	SM-II/VVK/BRS-130/21-22	25.6484	72.4949	Rhyolite
131	SM-II/VVK/BRS-131/21-22	25.6473	72.4945	Rhyolite with iron oxides
132	SM-II/VVK/BRS-132/21-22	25.6458	72.4926	Porphyritic rhyolite
133	SM-II/VVK/BRS-133/21-22	25.6456	72.4909	Porphyritic rhyolite
134	SM-II/VVK/BRS-134/21-22	25.6468	72.4009	Rhyolite with iron oxides
135	SM-II/VVK/BRS-135/21-22	25.6468	72.4030	Rhyolite with iron oxides
136	SM-II/VVK/BRS-136/21-22	25.6464	72.4052	Rhyolite with iron oxides
137	SM-II/VVK/BRS-137/21-22	25.6468	72.4073	Rhyolite with iron oxides and calcrete
138	SM-II/VVK/BRS-138/21-22	25.6473	72.4095	Greenish grey coloured rhyolite with black and green colour matters
139	SM-II/VVK/BRS-139/21-22	25.6480	72.4114	Rhyolite with iron oxides
140	SM-II/VVK/BRS-140/21-22	25.6483	72.4008	Rhyolite with iron oxides
141	SM-II/VVK/BRS-141/21-22	25.6480	72.4029	Rhyolite with iron oxides
142	SM-II/VVK/BRS-142/21-22	25.6515	72.4002	Rhyolite with iron oxides
143	SM-II/VVK/BRS-143/21-22	25.6520	72.4029	Rhyolite with iron oxides
144	SM-II/VVK/BRS-144/21-22	25.6534	72.4055	Rhyolite with iron oxides
145	SM-II/VVK/BRS-145/21-22	25.6531	72.4073	Rhyolite with iron oxides
146	SM-II/VVK/BRS-146/21-22	25.6503	72.4106	Rhyolite with iron oxides from quarry site
147	SM-II/VVK/BRS-147/21-22	25.6517	72.4089	Rhyolite with iron oxides
148	SM-II/VVK/BRS-148/21-22	25.6528	72.4109	Rhyolite with iron oxides
149	SM-II/VVK/BRS-149/21-22	25.6527	72.4010	Rhyolite with iron oxides
150	SM-II/VVK/BRS-150/21-22	25.6515	72.4009	Rhyolite with iron oxides

Sl. No.	Sample No.	Lat	Long	Lithology
151	SM-II/VVK/BRS-151/21-22	25.6513	72.4028	Rhyolite with iron oxides
152	SM-II/VVK/BRS-152/21-22	25.6516	72.4051	Rhyolite with more iron oxides
153	SM-II/VVK/BRS-153/21-22	25.6516	72.4072	Rhyolite with iron oxides
154	SM-II/VVK/BRS-154/21-22	25.6512	72.4113	Rhyolite with iron oxides
155	SM-II/VVK/BRS-155/21-22	25.6533	72.4134	Rhyolite with iron oxides
156	SM-II/VVK/BRS-156/21-22	25.6546	72.4166	Rhyolite with iron oxides
157	SM-II/VVK/BRS-157/21-22	25.6554	72.4154	Rhyolite with iron oxides
158	SM-II/VVK/BRS-158/21-22	25.6574	72.4129	Rhyolite with iron oxides
159	SM-II/VVK/BRS-159/21-22	25.6573	72.4154	Rhyolite with iron oxides
160	SM-II/VVK/BRS-160/21-22	25.6552	72.4131	Rhyolite with iron oxides
161	SM-II/VVK/BRS-161/21-22	25.6472	72.4051	Rhyolite with iron oxides
162	SM-II/VVK/BRS-162/21-22	25.6475	72.4072	Rhyolite with iron oxides
163	SM-II/VVK/BRS-163/21-22	25.6485	72.4123	Rhyolite with iron oxides
164	SM-II/VVK/BRS-164/21-22	25.6496	72.4115	Rhyolite with more iron oxides
165	SM-II/VVK/BRS-165/21-22	25.6490	72.4094	Rhyolite with iron oxides
166	SM-II/VVK/BRS-166/21-22	25.6484	72.4095	Rhyolite with iron oxides
167	SM-II/VVK/BRS-167/21-22	25.6501	72.4076	Rhyolite with iron oxides
168	SM-II/VVK/BRS-168/21-22	25.6493	72.4053	Rhyolite with iron oxides
169	SM-II/VVK/BRS-169/21-22	25.6501	72.4029	Rhyolite with iron oxides
170	SM-II/VVK/BRS-170/21-22	25.6503	72.4011	Rhyolite with iron oxides
171	SM-II/VVK/BRS-171/21-22	25.6433	72.4903	Fine grained granite with green colour matters/Rhyolite
172	SM-II/VVK/BRS-172/21-22	25.6434	72.4887	Porphyritic rhyolite
173	SM-II/VVK/BRS-173/21-22	25.6417	72.4901	Porphyritic rhyolite with K-feldspar phenocryst
174	SM-II/VVK/BRS-174/21-22	25.6413	72.4884	Fine grained granite (Powdered sample)
175	SM-II/VVK/BRS-175/21-22	25.6411	72.4883	Flesh red coloured rhyolite dyke
176	SM-II/VVK/BRS-176/21-22	25.6410	72.4864	Flesh red coloured rhyolite dyke
177	SM-II/VVK/BRS-177/21-22	25.6398	72.4853	Porphyritic rhyolite
178	SM-II/VVK/BRS-178/21-22	25.6555	72.2617	Grey granite
179	SM-II/VVK/BRS-179/21-22	25.6571	72.2601	Grey granite with calcrete content
180	SM-II/VVK/BRS-180/21-22	25.6553	72.2585	Medium to coarse grained grey granite
181	SM-II/VVK/BRS-181/21-22	25.6571	72.2582	Medium to coarse grained grey granite with green colour matters
182	SM-II/VVK/BRS-182/21-22	25.6569	72.2569	Loose granite fragments and associated soil
183	SM-II/VVK/BRS-183/21-22	25.6592	72.2569	Medium to coarse grained grey granite
184	SM-II/VVK/BRS-184/21-22	25.6600	72.2566	Loose granite fragments and associated soil from check dam site
185	SM-II/VVK/BRS-185/21-22	25.6610	72.2567	Loose granite fragments and associated soil
186	SM-II/VVK/BRS-186/21-22	25.6632	72.2565	Grey granite
187	SM-II/VVK/BRS-187/21-22	25.6647	72.2634	Coarse grained grey granite
188	SM-II/VVK/BRS-188/21-22	25.6474	72.2619	Coarse grained grey granite
189	SM-II/VVK/BRS-189/21-22	25.6476	72.2605	Coarse grained grey granite
190	SM-II/VVK/BRS-190/21-22	25.6480	72.2586	Coarse grained grey granite
191	SM-II/VVK/BRS-191/21-22	25.6485	72.2569	Pink granite
192	SM-II/VVK/BRS-192/21-22	25.6497	72.2579	Coarse grained grey granite
193	SM-II/VVK/BRS-193/21-22	25.6503	72.2592	Medium to coarse grained grey granite
194	SM-II/VVK/BRS-194/21-22	25.6510	72.2584	Pinkish grey granite
195	SM-II/VVK/BRS-195/21-22	25.6533	72.2620	Fine grained grey granite
196	SM-II/VVK/BRS-196/21-22	25.6256	72.2545	Porphyritic rhyolite
197	SM-II/VVK/BRS-197/21-22	25.6254	72.2526	Rhyolite with iron oxides
198	SM-II/VVK/BRS-198/21-22	25.6261	72.2512	Greenish grey coloured rhyolite with chert
199	SM-II/VVK/BRS-199/21-22	25.6292	72.2533	Porphyritic rhyolite
200	SM-II/VVK/BRS-200/21-22	25.6311	72.2538	Porphyritic rhyolite

Sl. No.	Sample No.	Lat	Long	Lithology
201	SM-II/VVK/BRS-201/21-22	25.6318	72.2561	Greenish grey coloured coarse grained granite
202	SM-II/VVK/BRS-202/21-22	25.6308	72.2574	Coarse grained grey granite
203	SM-II/VVK/BRS-203/21-22	25.6298	72.2591	Coarse grained grey granite
204	SM-II/VVK/BRS-204/21-22	25.6303	72.2617	Coarse grained grey granite
205	SM-II/VVK/BRS-205/21-22	25.6308	72.2640	Pink granite
206	SM-II/VVK/BRS-206/21-22	25.6319	72.2659	Coarse grained grey granite
207	SM-II/VVK/BRS-207/21-22	25.6281	72.2640	Coarse grained grey granite
208	SM-II/VVK/BRS-208/21-22	25.6296	72.2657	Coarse grained grey granite
209	SM-II/VVK/BRS-209/21-22	25.6301	72.2514	Fine grained granite dyke
210	SM-II/VVK/BRS-210/21-22	25.6274	72.2623	Pink granite
211	SM-II/VVK/BRS-211/21-22	25.6258	72.2604	Coarse grained grey granite
212	SM-II/VVK/BRS-212/21-22	25.6274	72.2596	Coarse grained grey granite
213	SM-II/VVK/BRS-213/21-22	25.6276	72.2591	Microgranite dyke
214	SM-II/VVK/BRS-214/21-22	25.6284	72.2581	Rhyolite from granite-rhyolite contact
215	SM-II/VVK/BRS-215/21-22	25.6377	72.2660	Coarse grained grey granite
216	SM-II/VVK/BRS-216/21-22	25.6390	72.2660	Coarse grained grey granite
217	SM-II/VVK/BRS-217/21-22	25.6344	72.2630	Coarse grained grey granite
218	SM-II/VVK/BRS-218/21-22	25.6364	72.2654	Coarse grained grey granite
219	SM-II/VVK/BRS-219/21-22	25.6390	72.2677	Coarse grained grey granite
220	SM-II/VVK/BRS-220/21-22	25.6414	72.2690	Coarse grained grey granite from quarry
221	SM-II/VVK/BRS-221/21-22	25.6495	72.2519	Coarse grained granite
222	SM-II/VVK/BRS-222/21-22	25.6538	72.2543	Coarse grained granite
223	SM-II/VVK/BRS-223/21-22	25.6554	72.2532	Pink granite
224	SM-II/VVK/BRS-224/21-22	25.6573	72.2521	Coarse grained grey granite
225	SM-II/VVK/BRS-225/21-22	25.6591	72.2517	Fine to medium grained granite
226	SM-II/VVK/BRS-226/21-22	25.6604	72.2514	Vein quartz with iron oxides and chlorite alteration intruded into coarse grained granite
227	SM-II/VVK/BRS-227/21-22	25.6631	72.2514	Coarse grained granite
228	SM-II/VVK/BRS-228/21-22	25.6649	72.2533	Fine grained grey granite
229	SM-II/VVK/BRS-229/21-22	25.6336	72.2510	Rhyolite with iron oxides
230	SM-II/VVK/BRS-230/21-22	25.6351	72.2521	Dark grey coloured rhyolite
231	SM-II/VVK/BRS-231/21-22	25.6372	72.2521	Coarse grained granite with chlorite alteration
232	SM-II/VVK/BRS-232/21-22	25.6365	72.2542	Coarse grained granite with chlorite alteration
233	SM-II/VVK/BRS-233/21-22	25.6376	72.2562	Coarse grained granite
234	SM-II/VVK/BRS-234/21-22	25.6356	72.2558	Coarse grained granite
235	SM-II/VVK/BRS-235/21-22	25.6338	72.2556	Coarse grained granite from quarry site
236	SM-II/VVK/BRS-236/21-22	25.6253	72.4856	Porphyritic rhyolite
237	SM-II/VVK/BRS-237/21-22	25.6255	72.4873	Porphyritic rhyolite
238	SM-II/VVK/BRS-238/21-22	25.6274	72.4883	Porphyritic rhyolite
239	SM-II/VVK/BRS-239/21-22	25.6649	72.5162	Porphyritic rhyolite
240	SM-II/VVK/BRS-240/21-22	25.6664	72.5162	Porphyritic rhyolite
241	SM-II/VVK/BRS-241/21-22	25.6649	72.5146	Porphyritic rhyolite
242	SM-II/VVK/BRS-242/21-22	25.6642	72.5136	Porphyritic rhyolite
243	SM-II/VVK/BRS-243/21-22	25.6637	72.5124	Greyish black coloured rhyolite with iron oxides
244	SM-II/VVK/BRS-244/21-22	25.6649	72.5118	Greyish black coloured rhyolite
245	SM-II/VVK/BRS-245/21-22	25.6513	72.4649	Ferr/Red coloured rhyolite
246	SM-II/VVK/BRS-246/21-22	25.6513	72.4631	Ferr/Red coloured rhyolite
247	SM-II/VVK/BRS-247/21-22	25.6526	72.4632	Ferr/Red coloured rhyolite
248	SM-II/VVK/BRS-248/21-22	25.6399	72.5182	Coarse grained granite
249	SM-II/VVK/BRS-249/21-22	25.6395	72.5203	Coarse grained granite
250	SM-II/VVK/BRS-250/21-22	25.6400	72.5220	Coarse grained granite

Sl. No.	Sample No.	Lat	Long	Lithology
251	SM-II/VVK/BRS-251/21-22	25.6413	72.5241	Coarse grained granite
252	SM-II/VVK/BRS-252/21-22	25.6416	72.5251	Fine grained dyke sample
253	SM-II/VVK/BRS-253/21-22	25.6423	72.5262	Black coloured dyke sample intruding host granite
254	SM-II/VVK/BRS-254/21-22	25.6433	72.5276	Coarse grained granite
255	SM-II/VVK/BRS-255/21-22	25.6335	72.5269	Pink granite
256	SM-II/VVK/BRS-256/21-22	25.6494	72.5271	Coarse grained granite
257	SM-II/VVK/BRS-257/21-22	25.6478	72.5271	Coarse grained granite
258	SM-II/VVK/BRS-258/21-22	25.5857	72.5050	Fine grained light pink granite
259	SM-II/VVK/BRS-259/21-22	25.5845	72.5040	Fine grained light pink granite
260	SM-II/VVK/BRS-260/21-22	25.5840	72.5028	Fine grained granite
261	SM-II/VVK/BRS-261/21-22	25.5838	72.5019	Fine grained granite
262	SM-II/VVK/BRS-262/21-22	25.5984	72.5038	Coarse grained pink granite
263	SM-II/VVK/BRS-263/21-22	25.5975	72.5029	Coarse grained light pink granite
264	SM-II/VVK/BRS-264/21-22	25.5966	72.5024	Fine grained dark flesh red coloured granite dyke within coarse grained pink granite
265	SM-II/VVK/BRS-265/21-22	25.5996	72.5051	Coarse grained granite
266	SM-II/VVK/BRS-266/21-22	25.6019	72.5054	Dyke sample
267	SM-II/VVK/BRS-267/21-22	25.6016	72.5044	Coarse grained granite
268	SM-II/VVK/BRS-268/21-22	25.6020	72.5023	Coarse grained granite (rubble)
269	SM-II/VVK/BRS-269/21-22	25.6035	72.5024	Coarse grained granite
270	SM-II/VVK/BRS-270/21-22	25.6050	72.5033	Dyke sample
271	SM-II/VVK/BRS-271/21-22	25.6057	72.5032	Coarse grained pink granite
272	SM-II/VVK/BRS-272/21-22	25.6070	72.5055	Coarse grained pink granite (rubble)
273	SM-II/VVK/BRS-273/21-22	25.6075	72.5063	Coarse grained pink granite
274	SM-II/VVK/BRS-274/21-22	25.6081	72.5073	Pink granite (soil sample)
275	SM-II/VVK/BRS-275/21-22	25.6095	72.5082	Coarse grained pink granite (rubble)
276	SM-II/VVK/BRS-276/21-22	25.6093	72.5103	Dyke sample
277	SM-II/VVK/BRS-277/21-22	25.6211	72.5011	Fine to medium grained granite
278	SM-II/VVK/BRS-278/21-22	25.6211	72.5021	Coarse grained pink granite (rubble)
279	SM-II/VVK/BRS-279/21-22	25.6173	72.5025	Fine to medium grained pink granite
280	SM-II/VVK/BRS-280/21-22	25.6243	72.5036	Porphyritic granite with K-feldspar phenocryst from granite-rhyolite contact
281	SM-II/VVK/BRS-281/21-22	25.6254	72.5058	Rhyolite
282	SM-II/VVK/BRS-282/21-22	25.6262	72.5068	Porphyritic rhyolite
283	SM-II/VVK/BRS-283/21-22	25.6273	72.5076	Porphyritic rhyolite
284	SM-II/VVK/BRS-284/21-22	25.6121	72.5119	Coarse grained granite (rubble)
285	SM-II/VVK/BRS-285/21-22	25.6125	72.5127	Coarse grained granite
286	SM-II/VVK/BRS-286/21-22	25.6136	72.5139	Dyke sample
287	SM-II/VVK/BRS-287/21-22	25.6153	72.5145	Rhyolite
288	SM-II/VVK/BRS-288/21-22	25.6165	72.5154	Microgranite dyke in rhyolite with black coloured needle and lath shaped black colour mineral in margins
289	SM-II/VVK/BRS-289/21-22	25.6462	72.4041	Rhyolite with iron oxides (Soil sample collected)
290	SM-II/VVK/BRS-290/21-22	25.6267	72.3525	Grey coloured porphyritic rhyolite
291	SM-II/VVK/BRS-291/21-22	25.6258	72.3555	Grey coloured porphyritic rhyolite
292	SM-II/VVK/BRS-292/21-22	25.6261	72.3563	Greenish grey coloured porphyritic rhyolite
293	SM-II/VVK/BRS-293/21-22	25.6431	72.2659	Coarse grained granite
294	SM-II/VVK/BRS-294/21-22	25.6412	72.2650	Coarse grained granite
295	SM-II/VVK/BRS-295/21-22	25.6412	72.2641	Medium to coarse grained granite
296	SM-II/VVK/BRS-296/21-22	25.6415	72.2666	Coarse grained granite with chlorite alteration
297	SM-II/VVK/BRS-297/21-22	25.6488	72.5246	Coarse grained granite
298	SM-II/VVK/BRS-298/21-22	25.6481	72.5227	Coarse grained granite
299	SM-II/VVK/BRS-299/21-22	25.6467	72.5209	Coarse grained granite
300	SM-II/VVK/BRS-300/21-22	25.6466	72.5218	Coarse grained granite

Annexure-II: Details of Petrochemical samples collected from Indrana – Siwana area

Sl. No.	Sample No/ Ref No	Lat	Long	Lithology
1	SM-II/VVK/PCS-1/21-22	25.5944	72.4992	Granite sample from quarry site
2	SM-II/VVK/PCS-2/21-22	25.6406	72.5147	Microgranite dyke
3	SM-II/VVK/PCS-3/21-22	25.6336	72.4726	Fine grained granite
4	SM-II/VVK/PCS-4/21-22	25.6394	72.4884	K-feld phenocryst rich greenish grey coloured rhyolite
5	SM-II/VVK/PCS-5/21-22	25.6411	72.4883	Flesh red coloured rhyolite dyke
6	SM-II/VVK/PCS-6/21-22	25.6632	72.2565	Grey granite
7	SM-II/VVK/PCS-7/21-22	25.6485	72.2569	Pink granite
8	SM-II/VVK/PCS-8/21-22	25.6254	72.2526	Rhyolite with iron oxides
9	SM-II/VVK/PCS-9/21-22	25.6352	72.2504	Rhyolite with iron oxides
10	SM-II/VVK/PCS-10/21-22	25.6361	72.2504	Greyish black coloured rhyolite
11	SM-II/VVK/PCS-11/21-22	25.6274	72.4883	Porphyritic rhyolite
12	SM-II/VVK/PCS-12/21-22	25.6526	72.4632	Ferr/Red coloured rhyolite
13	SM-II/VVK/PCS-13/21-22	25.5857	72.5050	Fine grained light pink granite
14	SM-II/VVK/PCS-14/21-22	25.5984	72.5038	Coarse grained pink granite
15	SM-II/VVK/PCS-15/21-22	25.5966	72.5024	Fine grained dark flesh red coloured granite dyke within coarse grained pink granite
16	SM-II/VVK/PCS-16/21-22	25.6016	72.5044	Coarse grained granite
17	SM-II/VVK/PCS-17/21-22	25.6211	72.5011	Fine to medium grained granite
18	SM-II/VVK/PCS-18/21-22	25.6262	72.5068	Porphyritic rhyolite
19	SM-II/VVK/PCS-19/21-22	25.6165	72.5154	Microgranite dyke in rhyolite with black coloured needle and lath shaped black colour mineral in margins
20	SM-II/VVK/PCS-20/21-22	25.6464	72.4052	Rhyolite with iron oxides

Annexure-III: Details of Channel Samples collected from Indrana – Siwana area

Sl. No.	Sample No.	Lat	Long	Lithology
1	SM-II/VVK/CH-1/1/21-22	25.59236	72.49986	Coarse grained granite
2	SM-II/VVK/CH-1/2/21-22	25.59236	72.49986	Dyke
3	SM-II/VVK/CH-1/3/21-22	25.59236	72.49986	Dyke
4	SM-II/VVK/CH-1/4/21-22	25.59236	72.49986	Dyke
5	SM-II/VVK/CH-1/5/21-22	25.59236	72.49986	Coarse grained granite
6	SM-II/VVK/CH-1/6/21-22	25.59236	72.49986	Dyke
7	SM-II/VVK/CH-1/7/21-22	25.59236	72.49986	Dyke
8	SM-II/VVK/CH-1/8/21-22	25.59236	72.49986	Dyke
9	SM-II/VVK/CH-1/9/21-22	25.59236	72.49986	Coarse grained granite
10	SM-II/VVK/CH-1/10/21-22	25.59236	72.49986	Coarse grained granite
11	SM-II/VVK/CH-1/11/21-22	25.59236	72.49986	Coarse grained granite
12	SM-II/VVK/CH-1/12/21-22	25.59236	72.49986	Coarse grained granite
13	SM-II/VVK/CH-1/13/21-22	25.59236	72.49986	Coarse grained granite
14	SM-II/VVK/CH-1/14/21-22	25.59236	72.49986	Coarse grained granite
15	SM-II/VVK/CH-1/15/21-22	25.59236	72.49986	Coarse grained granite
16	SM-II/VVK/CH-1/16/21-22	25.59236	72.49986	Coarse grained granite
17	SM-II/VVK/CH-1/17/21-22	25.59236	72.49986	Coarse grained granite
18	SM-II/VVK/CH-1/18/21-22	25.59236	72.49986	Coarse grained granite
19	SM-II/VVK/CH-1/19/21-22	25.59236	72.49986	Coarse grained granite
20	SM-II/VVK/CH-1/20/21-22	25.59236	72.49986	Coarse grained granite
21	SM-II/VVK/CH-1/21/21-22	25.59236	72.49986	Coarse grained granite
22	SM-II/VVK/CH-1/22/21-22	25.59236	72.49986	Coarse grained granite
23	SM-II/VVK/CH-1/23/21-22	25.59236	72.49986	Coarse grained granite
24	SM-II/VVK/CH-1/24/21-22	25.59236	72.49986	Coarse grained granite
25	SM-II/VVK/CH-1/25/21-22	25.59236	72.49986	Coarse grained granite
26	SM-II/VVK/CH-1/26/21-22	25.59236	72.49986	Coarse grained granite
27	SM-II/VVK/CH-1/27/21-22	25.59236	72.49986	Coarse grained granite
28	SM-II/VVK/CH-1/28/21-22	25.59236	72.49986	Coarse grained granite
29	SM-II/VVK/CH-1/29/21-22	25.59236	72.49986	Coarse grained granite
30	SM-II/VVK/CH-1/30/21-22	25.59236	72.49986	Coarse grained granite
31	SM-II/VVK/CH-1/31/21-22	25.59236	72.49986	Coarse grained granite
32	SM-II/VVK/CH-1/32/21-22	25.59236	72.49986	Coarse grained granite
33	SM-II/VVK/CH-1/33/21-22	25.59236	72.49986	Coarse grained granite
34	SM-II/VVK/CH-1/34/21-22	25.59236	72.49986	Coarse grained granite
35	SM-II/VVK/CH-1/35/21-22	25.59236	72.49986	Coarse grained granite
36	SM-II/VVK/CH-1/36/21-22	25.59236	72.49986	Coarse grained granite
37	SM-II/VVK/CH-1/37/21-22	25.59236	72.49986	Coarse grained granite
38	SM-II/VVK/CH-1/38/21-22	25.59236	72.49986	Coarse grained granite
39	SM-II/VVK/CH-1/39/21-22	25.59236	72.49986	Coarse grained granite
40	SM-II/VVK/CH-1/40/21-22	25.59236	72.49986	Coarse grained granite
41	SM-II/VVK/CH-1/41/21-22	25.59236	72.49986	Coarse grained granite
42	SM-II/VVK/CH-1/42/21-22	25.59236	72.49986	Dyke
43	SM-II/VVK/CH-1/43/21-22	25.59236	72.49986	Coarse grained granite
44	SM-II/VVK/CH-1/44/21-22	25.59236	72.49986	Coarse grained granite
45	SM-II/VVK/CH-1/45/21-22	25.59236	72.49986	Coarse grained granite

Sl. No.	Sample No.	Lat	Long	Lithology
46	SM-II/VVK/CH-1/46/21-22	25.59236	72.49986	Coarse grained granite
47	SM-II/VVK/CH-1/47/21-22	25.59236	72.49986	Coarse grained granite
48	SM-II/VVK/CH-1/48/21-22	25.59236	72.49986	Coarse grained granite
49	SM-II/VVK/CH-1/49/21-22	25.59236	72.49986	Coarse grained granite
50	SM-II/VVK/CH-1/50/21-22	25.59236	72.49986	Dyke
51	SM-II/VVK/CH-1/51/21-22	25.59236	72.49986	Dyke
52	SM-II/VVK/CH-1/52/21-22	25.59236	72.49986	Dyke
53	SM-II/VVK/CH-1/53/21-22	25.59236	72.49986	Coarse grained granite
54	SM-II/VVK/CH-2/1/21-22	25.64101	72.48634	Pyroclastic flow
55	SM-II/VVK/CH-2/2/21-22	25.64101	72.48634	Rhyolite Dyke
56	SM-II/VVK/CH-2/3/21-22	25.64101	72.48634	Rhyolite Dyke
57	SM-II/VVK/CH-2/4/21-22	25.64101	72.48634	Rhyolite Dyke
58	SM-II/VVK/CH-2/5/21-22	25.64101	72.48634	Rhyolite Dyke
59	SM-II/VVK/CH-2/6/21-22	25.64101	72.48634	Pyroclastic flow
60	SM-II/VVK/CH-3/1/21-22	25.64086	72.48692	Pyroclastic flow
61	SM-II/VVK/CH-3/2/21-22	25.64086	72.48692	Rhyolite Dyke
62	SM-II/VVK/CH-3/3/21-22	25.64086	72.48692	Pyroclastic flow
63	SM-II/VVK/CH-3/4/21-22	25.64086	72.48692	Pyroclastic flow
64	SM-II/VVK/CH-3/5/21-22	25.64086	72.48692	Pyroclastic flow
65	SM-II/VVK/CH-3/6/21-22	25.64086	72.48692	Rhyolite Dyke
66	SM-II/VVK/CH-3/7/21-22	25.64086	72.48692	Pyroclastic flow
67	SM-II/VVK/CH-4/1/21-22	25.64108	72.48801	Pyroclastic flow
68	SM-II/VVK/CH-4/2/21-22	25.64108	72.48801	Rhyolite Dyke
69	SM-II/VVK/CH-4/3/21-22	25.64108	72.48801	Rhyolite Dyke
70	SM-II/VVK/CH-4/4/21-22	25.64108	72.48801	Pyroclastic flow
71	SM-II/VVK/CH-5/1/21-22	25.64109	72.48839	Pyroclastic flow
72	SM-II/VVK/CH-5/2/21-22	25.64109	72.48839	Rhyolite Dyke
73	SM-II/VVK/CH-5/3/21-22	25.64109	72.48839	Rhyolite Dyke
74	SM-II/VVK/CH-5/4/21-22	25.64109	72.48839	Pyroclastic flow
75	SM-II/VVK/CH-6/1/21-22	25.64786	72.51981	Granite
76	SM-II/VVK/CH-6/2/21-22	25.64786	72.51981	Dyke
77	SM-II/VVK/CH-6/3/21-22	25.64786	72.51981	Granite
78	SM-II/VVK/CH-6/4/21-22	25.64786	72.51981	Dyke
79	SM-II/VVK/CH-6/5/21-22	25.64786	72.51981	Dyke
80	SM-II/VVK/CH-6/6/21-22	25.64786	72.51981	Granite
81	SM-II/VVK/CH-7/1/21-22	25.64983	72.52544	Granite
82	SM-II/VVK/CH-7/2/21-22	25.64983	72.52544	Dyke
83	SM-II/VVK/CH-7/3/21-22	25.64983	72.52544	Dyke
84	SM-II/VVK/CH-7/4/21-22	25.64983	72.52544	Granite
85	SM-II/VVK/CH-8/1/21-22	25.64986	72.52553	Granite
86	SM-II/VVK/CH-8/2/21-22	25.64986	72.52553	Dyke
87	SM-II/VVK/CH-8/3/21-22	25.64986	72.52553	Granite
88	SM-II/VVK/CH-9/1/21-22	25.65011	72.52572	Granite
89	SM-II/VVK/CH-9/2/21-22	25.65011	72.52572	Dyke
90	SM-II/VVK/CH-9/3/21-22	25.65011	72.52572	Granite

Sl. No.	Sample No.	Lat	Long	Lithology
91	SM-II/VVK/CH-10/1/21-22	25.6500833	72.5259444	Granite
92	SM-II/VVK/CH-10/2/21-22	25.6500833	72.5259444	Dyke
93	SM-II/VVK/CH-10/3/21-22	25.6500833	72.5259444	Dyke
94	SM-II/VVK/CH-10/4/21-22	25.6500833	72.5259444	Granite
95	SM-II/VVK/CH-11/1/21-22	25.6505278	72.5260556	Granite
96	SM-II/VVK/CH-11/2/21-22	25.6505278	72.5260556	Dyke
97	SM-II/VVK/CH-11/3/21-22	25.6505278	72.5260556	Granite
98	SM-II/VVK/CH-11/4/21-22	25.6505278	72.5260556	Dyke
99	SM-II/VVK/CH-11/5/21-22	25.6505278	72.5260556	Dyke
100	SM-II/VVK/CH-11/6/21-22	25.6505278	72.5260556	Granite

Annexure- IV: Details of the chemical analysis results of Bed rock sample from Indrana – Siwana area

Sl. No.	Sample No.	Y ppm	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Hf ppm	Ta ppm	W ppm	U ppm	ΣREE+Y ppm
1	BRS-1	655.50	177.26	349.69	56.03	265.35	65.48	6.20	64.76	16.52	110.49	23.92	81.30	12.35	83.08	11.63	234.70	15.86	0.77	9.87	1979.57
2	BRS-2	329.89	207.28	426.83	59.82	276.79	59.34	5.74	55.27	11.42	63.15	11.53	35.20	5.22	33.55	4.88	65.58	8.06	<0.50	5.84	1585.89
3	BRS-3	796.64	206.28	564.57	67.42	315.92	76.47	7.92	78.44	20.60	140.54	30.50	105.47	16.24	108.00	15.34	288.82	21.07	0.59	11.40	2550.35
4	BRS-4	682.93	189.69	430.09	58.64	275.53	65.88	6.77	72.41	17.93	116.40	24.06	80.52	12.02	79.63	11.30	236.22	15.08	1.52	10.74	2123.82
5	BRS-5	331.91	153.37	365.85	49.29	223.43	51.45	4.82	43.99	9.94	59.45	12.17	33.83	5.87	34.70	5.15	91.96	7.81	<0.50	6.97	1385.23
6	BRS-6	381.21	233.96	505.69	66.21	291.55	60.36	5.31	51.15	11.32	66.57	14.15	38.39	6.72	41.00	6.18	121.97	8.82	<0.50	8.33	1779.76
7	BRS-7	138.37	70.64	159.71	20.50	89.57	20.24	1.85	16.76	3.86	24.66	4.94	16.20	3.16	22.83	4.26	37.80	3.22	<0.50	2.43	597.53
8	BRS-8	204.96	58.04	164.61	21.05	99.12	24.64	2.46	22.65	6.16	38.24	8.52	24.27	4.76	32.17	5.77	46.42	3.80	<0.50	1.40	717.43
9	BRS-9	250.75	120.84	420.17	35.49	160.67	37.67	4.93	32.54	7.50	47.35	9.58	29.38	5.35	34.30	5.72	129.39	5.74	<0.50	6.03	1202.23
10	BRS-10	421.84	319.56	654.19	85.12	353.54	64.15	6.70	55.02	12.40	75.18	15.93	44.39	7.54	46.41	6.72	132.10	9.37	<0.50	7.07	2168.68
11	BRS-11	536.77	387.88	635.18	98.84	427.71	86.63	8.42	71.50	16.15	100.09	19.59	54.03	9.39	56.48	8.26	169.42	10.84	0.50	10.35	2516.92
12	BRS-12	162.95	101.45	230.72	30.16	134.23	29.31	4.89	22.91	5.30	30.95	6.03	16.81	3.04	19.40	3.06	54.71	3.73	<0.50	2.71	801.21
13	BRS-13	203.95	143.94	260.34	32.70	130.45	27.69	2.94	23.60	5.79	18.29	7.54	22.45	4.26	31.36	5.59	97.27	3.90	4.43	4.63	920.88
14	BRS-14	236.66	148.36	365.87	41.84	184.10	40.48	4.05	34.96	7.20	45.66	8.72	26.46	4.33	26.49	3.99	55.26	3.74	4.04	5.97	1179.17
15	BRS-15	211.01	64.70	210.76	20.69	93.76	21.87	2.17	20.90	4.75	30.96	6.33	21.12	3.70	28.29	5.11	70.96	5.20	<0.50	3.35	746.12
16	BRS-16	69.67	49.94	108.52	14.31	63.29	14.14	1.95	11.28	2.31	13.78	2.67	7.78	1.26	7.63	1.09	17.86	0.92	1.08	1.64	369.62
17	BRS-17	1654.56	565.65	1500.71	189.54	904.26	232.41	20.59	206.68	50.37	343.37	67.84	207.08	33.21	192.64	26.88	368.26	30.10	1.02	22.52	6195.79
18	BRS-18	408.56	205.22	439.17	57.85	258.16	61.37	5.90	51.07	11.53	75.19	15.23	47.49	8.07	48.60	7.24	114.35	10.23	2.59	8.41	1700.64
19	BRS-19	272.60	163.48	355.22	45.30	203.60	44.41	3.71	37.07	7.96	50.72	9.95	30.87	5.09	31.37	4.76	63.50	7.11	1.39	6.26	1266.10
20	BRS-20	328.55	279.09	631.94	70.12	297.80	65.39	5.32	53.02	11.36	72.03	13.86	43.92	7.83	51.76	8.12	41.44	10.43	0.88	6.27	1940.10
21	BRS-21	472.53	276.81	621.25	81.06	367.46	84.45	6.68	70.96	15.03	93.09	18.14	52.97	8.56	53.07	7.94	112.34	9.20	1.44	10.93	2230.02
22	BRS-22	160.95	137.30	285.15	36.50	159.87	32.94	3.75	27.00	5.42	31.93	5.95	18.04	2.82	17.66	2.78	41.40	2.53	0.71	3.22	928.05
23	BRS-23	767.10	375.06	818.75	107.08	482.13	113.28	9.73	98.47	22.35	149.07	29.55	92.58	15.51	93.46	13.59	211.99	19.59	8.22	20.05	3187.71
24	BRS-24	1111.67	637.30	1425.98	173.72	760.25	173.27	16.60	164.52	33.49	201.79	39.32	126.41	18.76	108.96	15.54	289.97	20.21	2.56	22.15	5007.58
25	BRS-25	1148.58	520.41	1202.60	138.09	620.56	147.86	14.35	144.67	31.44	195.58	38.92	128.57	19.66	113.25	15.75	286.07	9.84	5.67	24.22	4480.31

Sl. No.	Sample No.	Y ppm	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Hf ppm	Ta ppm	W ppm	U ppm	ΣREE+Y ppm
26	BRS-26	570.48	306.61	680.33	87.14	391.74	91.44	8.21	76.92	16.51	106.04	21.10	65.06	9.52	60.36	8.54	83.07	14.47	18.89	9.87	2499.99
27	BRS-27	184.06	120.07	263.14	35.32	160.75	35.27	5.20	28.30	5.41	34.11	6.41	20.16	2.91	19.50	3.08	33.74	2.77	2.75	2.55	923.69
28	BRS-28	257.42	171.78	337.86	45.88	205.19	43.68	4.45	39.73	7.78	48.23	9.22	29.10	4.91	28.35	4.05	58.31	6.85	7.68	6.25	1237.64
29	BRS-29	460.54	310.07	570.03	87.03	370.61	78.97	7.06	71.11	14.24	82.32	17.02	50.04	7.93	46.03	6.39	126.01	11.51	4.61	8.29	2179.38
30	BRS-30	1109.57	653.23	1399.79	180.72	770.03	170.74	14.71	159.02	33.00	196.59	40.63	120.99	19.28	116.42	16.37	258.71	26.92	12.25	23.88	5001.08
31	BRS-31	1060.50	638.73	1321.97	181.34	761.57	163.27	14.78	150.56	31.09	183.20	38.04	115.13	18.24	108.34	15.04	239.09	26.48	12.89	24.77	4801.80
32	BRS-32	513.48	280.16	589.37	81.11	353.18	81.30	7.48	74.53	15.93	94.24	19.36	58.02	9.27	55.85	8.29	130.40	13.62	18.60	10.89	2241.56
33	BRS-33	290.16	156.00	354.68	46.79	204.15	45.08	4.26	42.55	8.81	52.11	11.06	32.83	5.52	34.48	5.45	111.76	6.57	14.38	6.97	1293.93
34	BRS-34	525.37	288.32	668.17	86.46	373.15	79.94	7.56	76.99	15.62	91.67	18.60	55.04	8.58	51.94	7.70	123.67	12.08	26.70	11.97	2355.13
35	BRS-35	1156.09	627.98	1487.59	203.69	901.46	201.27	18.21	182.30	37.09	217.68	45.67	138.63	21.77	128.60	18.17	197.05	31.55	5.32	17.72	5386.20
36	BRS-36	319.84	189.08	413.88	53.83	235.52	55.33	5.73	49.92	10.80	57.86	11.36	35.02	5.11	32.00	5.09	112.65	7.22	20.07	7.61	1480.38
37	BRS-37	252.65	162.34	356.54	47.59	200.35	44.74	6.83	39.92	8.87	47.65	9.36	27.64	4.08	25.30	3.88	57.49	5.88	10.45	3.94	1237.73
38	BRS-38	237.57	140.71	335.16	43.65	187.50	42.12	6.46	37.97	8.52	45.41	9.04	27.54	3.92	25.65	3.90	55.99	6.78	15.38	4.30	1155.11
39	BRS-39	285.28	199.26	438.45	62.54	255.88	54.49	5.57	49.42	9.85	60.36	11.88	36.23	5.74	36.34	5.25	84.87	12.61	18.12	6.99	1516.53
40	BRS-40	456.93	247.01	531.11	72.34	311.54	72.76	6.14	67.66	15.02	83.78	17.06	52.61	7.70	47.91	7.46	110.83	11.51	11.57	8.95	1997.02
41	BRS-41	505.58	297.35	642.92	88.40	368.98	85.38	6.75	78.40	17.34	96.08	19.50	58.99	8.65	54.20	8.42	112.85	12.58	9.43	9.49	2336.94
42	BRS-42	351.89	225.88	514.72	66.06	272.59	60.68	5.82	55.12	12.25	68.32	13.42	40.94	6.35	38.87	6.02	72.45	10.48	11.06	7.81	1738.93
43	BRS-43	397.06	173.27	377.37	51.17	238.55	57.90	5.23	47.96	10.72	68.87	14.13	44.77	6.93	45.87	6.99	110.71	11.25	6.37	9.75	1546.78
44	BRS-44	469.75	261.81	547.67	68.24	299.45	67.94	6.13	58.24	12.38	81.98	15.99	51.32	7.82	51.41	7.58	161.62	12.77	5.08	13.56	2007.72
45	BRS-45	166.00	136.66	266.69	37.91	164.80	33.66	3.53	31.53	5.90	35.08	6.69	21.43	3.29	21.45	3.19	42.07	6.39	4.82	4.88	937.79
46	BRS-46	361.95	243.87	528.84	65.23	285.55	62.48	6.81	51.74	10.77	67.86	13.00	41.35	6.02	38.76	5.51	105.19	10.03	2.77	8.51	1789.74
47	BRS-47	362.20	233.96	476.99	60.70	256.84	57.70	5.14	49.12	10.23	64.90	12.89	40.11	5.81	37.84	5.45	88.62	11.19	15.61	7.88	1679.89
48	BRS-48	250.55	187.08	393.24	48.96	212.03	46.03	4.44	37.38	7.51	47.17	8.99	28.00	4.13	26.64	3.84	66.04	7.25	1.16	5.98	1305.99
49	BRS-49	355.79	245.26	521.21	63.41	275.74	58.45	5.20	50.43	10.06	64.73	12.84	40.60	6.03	38.65	5.68	97.68	6.81	0.60	8.54	1754.08
50	BRS-50	278.50	167.80	370.91	47.43	213.64	47.98	4.28	39.65	8.26	51.57	10.10	30.88	4.59	30.32	4.72	63.39	6.56	3.46	5.66	1310.64

Sl. No.	Sample No.	Y ppm	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Hf ppm	Ta ppm	W ppm	U ppm	ΣREE+Y ppm
51	BRS-51	609.36	372.78	744.86	100.37	454.71	100.35	9.16	86.37	17.68	110.46	21.54	66.63	9.91	63.80	9.14	146.75	13.92	3.12	12.82	2777.12
52	BRS-52	446.13	339.72	735.00	90.10	395.78	83.48	7.61	68.22	13.54	83.29	16.11	49.60	7.30	47.95	7.10	124.04	14.61	11.02	8.51	2390.93
53	BRS-53	169.29	129.43	280.84	34.83	152.66	32.13	3.09	26.05	5.03	30.87	6.01	19.21	2.76	18.04	2.71	40.98	4.94	1.43	3.21	912.93
54	BRS-54	179.39	108.54	258.84	33.20	154.69	35.97	5.08	28.39	5.67	34.50	6.65	20.51	3.05	20.85	3.27	35.42	4.45	3.66	2.58	898.61
55	BRS-55	349.97	216.17	473.40	57.97	258.95	57.90	6.92	48.23	9.93	65.18	12.46	39.69	6.01	38.08	5.42	95.43	10.10	0.80	5.77	1646.26
56	BRS-56	310.56	207.94	437.95	56.49	248.47	53.72	6.42	44.67	8.95	57.75	11.36	35.66	5.49	33.76	5.11	86.94	9.96	<0.50	4.61	1524.31
57	BRS-57	137.93	96.23	211.87	24.92	109.47	23.91	3.20	20.38	4.10	25.28	4.98	15.79	2.36	15.35	2.24	39.88	4.66	4.28	3.68	698.00
58	BRS-58	164.32	123.63	264.37	32.42	140.05	29.51	4.03	24.62	4.84	29.59	5.90	18.07	2.60	16.78	2.48	39.39	4.02	5.25	3.29	863.22
59	BRS-59	236.79	134.55	332.00	38.57	174.06	40.99	5.93	34.44	7.02	43.50	8.52	26.43	3.91	26.18	3.95	62.82	7.17	4.58	2.90	1116.83
60	BRS-60	302.08	197.71	417.12	52.73	232.03	51.06	6.71	43.58	8.89	56.92	10.93	34.78	5.25	34.22	4.90	85.40	9.57	1.34	5.41	1458.91
61	BRS-61	137.02	71.49	192.05	22.51	98.18	23.21	4.05	19.15	4.27	24.47	4.98	14.91	2.20	13.82	2.25	24.82	2.18	1.78	1.60	634.57
62	BRS-62	1416.86	831.27	1712.26	210.52	869.43	185.68	15.42	160.63	36.71	233.23	49.16	148.59	21.42	139.24	19.28	311.45	28.16	4.50	30.27	6049.69
63	BRS-63	218.07	139.60	329.10	38.77	159.97	35.65	4.33	28.53	6.26	39.18	7.85	23.80	3.44	23.28	3.44	41.12	4.67	<0.50	4.10	1061.26
64	BRS-64	249.89	218.51	384.65	50.91	210.69	43.14	5.01	34.83	7.39	43.68	9.13	28.69	4.13	29.62	4.48	64.01	4.39	1.49	5.50	1324.77
65	BRS-65	155.91	65.59	165.99	21.05	91.62	20.07	2.26	18.58	4.32	27.03	5.13	16.55	2.84	20.78	3.37	36.84	3.97	1.18	3.54	621.10
66	BRS-66	403.46	209.57	468.24	59.61	252.60	53.94	5.39	48.87	11.61	71.36	13.88	44.53	7.36	49.51	7.11	85.12	10.29	2.99	10.29	1707.03
67	BRS-67	370.39	216.57	462.24	58.98	249.21	51.25	5.44	46.64	10.67	62.47	11.84	38.17	6.03	41.91	5.98	114.77	7.76	2.21	9.44	1637.78
68	BRS-68	382.79	237.57	455.35	64.90	270.38	56.50	5.92	50.68	11.51	66.94	12.87	39.78	6.31	42.22	6.14	80.30	8.52	2.67	9.51	1709.87
69	BRS-69	344.54	206.74	401.13	54.18	226.57	48.91	5.13	44.20	10.23	60.43	11.22	34.91	5.41	34.80	4.83	69.06	5.64	1.70	9.10	1493.23
70	BRS-70	327.82	212.07	448.07	52.50	203.27	40.71	4.33	39.24	9.08	55.03	10.51	32.30	5.19	35.10	4.88	76.77	7.43	<0.50	8.47	1480.09
71	BRS-71	138.84	92.80	186.71	25.34	107.07	22.17	2.61	18.99	4.18	24.61	4.58	14.47	2.26	15.60	2.30	36.05	3.01	1.26	3.90	662.52
72	BRS-72	252.16	133.65	295.98	38.56	165.59	36.17	4.16	32.39	7.55	44.33	8.57	26.55	4.26	28.85	4.08	63.03	4.82	7.55	6.18	1082.83
73	BRS-73	552.41	219.43	619.16	59.78	246.35	53.47	6.05	51.81	13.84	91.30	17.88	57.92	9.23	59.91	7.98	113.33	9.03	3.19	12.26	2066.51
74	BRS-74	260.27	146.38	326.06	42.92	185.98	40.28	4.72	35.70	8.09	46.80	8.79	27.08	4.12	27.89	3.96	59.37	5.78	2.24	5.69	1169.02
75	BRS-75	196.94	128.53	259.36	36.65	156.22	34.80	4.09	30.65	6.01	37.67	7.22	23.15	3.62	24.12	3.63	49.20	3.99	<0.50	4.75	952.65

Sl. No.	Sample No.	Y ppm	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Hf ppm	Ta ppm	W ppm	U ppm	ΣREE+Y ppm
76	BRS-76	225.48	151.99	314.23	46.40	202.37	46.96	4.84	38.21	7.62	45.68	8.43	25.72	3.86	24.56	3.54	45.49	3.14	0.58	4.33	1149.89
77	BRS-77	270.88	214.09	480.49	63.90	274.80	56.80	5.83	46.74	9.15	53.91	10.03	31.47	4.72	30.46	4.48	56.39	5.59	2.31	4.89	1557.73
78	BRS-78	570.64	337.52	677.67	90.03	385.68	89.39	9.52	83.59	16.87	103.55	20.12	61.15	8.98	52.65	6.94	124.04	12.75	3.19	10.51	2514.31
79	BRS-79	346.11	249.52	488.36	66.52	273.97	58.75	6.88	52.72	10.59	64.75	12.61	39.37	5.96	37.50	5.30	98.37	6.74	2.37	8.31	1718.91
80	BRS-80	364.94	246.99	513.12	69.40	294.85	63.79	8.10	56.87	11.66	71.12	13.77	42.74	6.46	40.17	5.78	92.29	7.29	2.24	8.39	1809.77
81	BRS-81	313.82	172.02	367.54	49.06	221.16	52.52	6.38	47.85	9.52	59.57	11.37	35.76	5.29	33.70	4.81	80.41	4.05	1.86	5.22	1390.37
82	BRS-82	579.73	575.37	1167.77	140.94	571.55	107.10	9.46	91.42	17.64	106.79	21.49	69.75	10.85	70.29	10.38	270.69	16.24	1.24	15.79	3550.53
83	BRS-83	322.28	240.38	475.85	60.47	253.01	54.88	5.45	50.23	10.03	62.08	12.18	37.87	5.90	36.39	4.98	50.10	9.64	4.54	6.02	1631.98
84	BRS-84	1017.59	666.58	1390.05	185.85	784.22	169.29	12.04	152.01	30.37	190.36	37.76	121.24	19.04	120.41	17.00	208.70	22.94	2.94	17.47	4913.81
85	BRS-85	485.40	264.54	587.19	75.32	324.11	73.29	5.54	67.23	14.03	83.47	16.23	48.67	7.97	50.00	6.39	112.86	11.96	2.95	10.72	2109.39
86	BRS-86	1209.70	687.58	1504.96	184.39	789.06	176.78	15.13	165.11	34.65	205.17	40.35	119.92	19.38	118.82	14.87	230.58	25.56	5.70	23.40	5285.87
87	BRS-87	813.44	444.86	904.73	124.25	541.46	118.03	8.84	111.45	22.92	135.65	26.53	79.80	13.09	79.13	10.21	293.12	17.06	5.13	21.04	3434.38
88	BRS-88	514.35	189.41	484.80	58.96	263.91	63.41	6.92	61.55	13.39	82.48	16.70	50.83	8.32	51.99	6.73	130.74	10.12	0.84	10.10	1873.75
89	BRS-89	260.97	114.18	245.76	36.35	168.05	40.06	4.75	36.75	7.70	45.58	8.90	26.99	4.42	27.69	3.74	65.51	1.76	<0.50	4.55	1031.87
90	BRS-90	268.02	160.98	346.12	46.77	205.63	45.29	5.70	39.83	8.04	46.20	8.89	26.35	4.41	27.40	3.67	62.09	5.48	0.96	4.04	1243.27
91	BRS-91	495.88	289.76	617.51	81.61	351.02	77.41	5.93	70.01	14.57	85.00	16.92	52.13	8.79	57.32	7.78	155.81	7.19	<0.50	9.80	2231.62
92	BRS-92	424.02	187.33	476.08	50.20	213.59	49.53	4.08	49.52	11.28	72.89	14.63	45.10	7.80	50.34	6.87	126.65	5.96	<0.50	8.79	1663.26
93	BRS-93	485.37	279.49	647.48	74.05	315.89	72.17	5.49	65.76	13.74	84.18	16.74	51.10	8.64	55.25	7.64	119.14	7.50	0.52	9.45	2182.99
94	BRS-94	295.01	221.06	444.29	57.88	244.61	51.26	3.82	45.36	9.08	51.47	9.83	30.86	5.41	36.30	5.29	93.65	5.24	<0.50	5.85	1511.52
95	BRS-95	650.70	225.02	543.83	73.26	331.56	80.96	6.48	77.98	18.39	116.09	22.79	67.16	11.00	68.68	8.95	165.54	12.08	1.47	10.65	2302.84
96	BRS-96	577.88	373.65	803.75	103.75	447.36	100.56	7.80	88.17	17.87	102.15	19.77	58.73	9.86	64.03	8.70	156.06	10.10	<0.50	10.53	2784.04
97	BRS-97	400.42	208.45	451.18	59.17	259.28	59.90	4.53	51.20	10.99	74.26	13.61	45.41	6.48	42.44	6.49	112.21	5.67	<0.50	7.99	1693.79
98	BRS-98	624.96	320.74	685.03	98.33	432.00	104.14	7.34	88.77	19.11	112.16	22.74	66.32	11.18	70.11	10.46	162.08	10.07	1.54	14.24	2673.41
99	BRS-99	435.93	256.57	548.48	73.06	315.32	72.83	5.19	61.54	13.29	75.64	15.66	45.09	7.47	48.44	7.25	105.60	5.12	<0.50	8.87	1981.74
100	BRS-100	416.78	314.17	635.56	83.65	348.47	76.03	5.28	63.21	13.21	76.27	15.02	43.96	7.33	47.27	7.10	110.18	7.74	0.70	9.34	2153.31

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101	BRS-101	525.87	358.84	733.29	89.85	378.37	75.90	5.87	66.44	14.12	82.93	15.99	49.87	7.89	50.09	7.49	96.95	7.02	6.58	8.65	2462.78
102	BRS-102	328.74	223.55	449.78	52.15	211.92	41.10	3.16	37.21	8.15	51.82	10.38	33.39	5.43	36.60	5.76	107.23	2.91	13.56	7.40	1499.14
103	BRS-103	617.98	379.15	790.21	102.63	435.71	86.14	7.05	81.39	17.33	101.83	21.56	59.48	9.21	58.95	8.94	126.31	4.27	14.25	9.94	2777.53
104	BRS-104	318.95	115.92	297.67	37.14	169.54	41.76	5.33	37.30	8.38	51.30	9.79	30.61	4.82	29.71	4.34	64.31	3.13	2.07	5.49	1162.56
105	BRS-105	264.26	148.97	337.96	40.82	176.39	37.34	5.20	33.14	7.08	42.35	8.23	25.39	3.94	24.58	3.52	57.15	3.06	7.07	4.48	1159.18
106	BRS-106	536.45	322.85	686.66	81.06	339.26	69.10	8.47	60.77	13.38	82.29	16.40	51.01	7.81	47.89	6.64	118.93	3.61	6.93	9.28	2330.03
107	BRS-107	564.82	302.68	656.97	81.05	343.98	72.07	6.46	64.91	14.08	85.95	16.95	54.11	8.62	53.91	7.73	112.24	3.59	19.46	10.83	2334.27
108	BRS-108	408.14	231.08	460.14	60.65	258.60	54.03	4.61	46.58	10.07	61.86	12.00	37.82	6.02	38.22	5.60	78.59	4.34	12.64	7.38	1695.40
109	BRS-109	388.27	232.57	493.64	62.14	268.57	56.19	4.51	48.39	10.20	60.49	12.05	38.15	6.14	38.85	5.86	84.16	3.46	7.62	7.08	1726.01
110	BRS-110	775.05	410.62	1045.00	103.35	461.42	101.97	9.17	84.25	19.47	124.01	24.82	79.27	12.22	73.39	10.35	96.64	2.69	9.94	15.12	3334.33
111	BRS-111	565.03	276.03	527.93	73.70	316.20	66.52	5.92	61.06	14.34	90.68	17.96	58.29	9.55	62.02	9.14	150.51	1.58	6.98	8.37	2154.34
112	BRS-112	984.88	449.70	1058.89	130.25	587.70	125.44	12.20	113.61	25.04	154.33	30.00	95.13	14.94	95.00	13.71	262.39	5.74	5.29	20.11	3890.83
113	BRS-113	274.30	113.13	293.45	30.33	134.23	34.70	3.34	32.13	6.91	41.82	8.08	25.15	3.96	25.30	3.73	61.12	3.93	4.52	5.25	1030.56
114	BRS-114	730.12	353.03	756.33	101.33	440.55	96.63	8.28	84.77	19.02	118.40	22.90	72.91	11.54	71.87	10.32	124.42	15.77	8.61	11.68	2897.99
115	BRS-115	512.93	259.51	546.64	66.95	296.04	65.95	5.98	58.94	13.41	82.49	16.11	50.56	7.84	48.49	7.00	80.36	8.92	8.04	6.88	2038.83
116	BRS-116	244.72	104.62	251.69	30.88	137.94	30.31	3.20	27.57	6.08	37.01	7.25	23.39	3.70	23.96	3.64	50.15	4.00	3.02	4.77	935.95
117	BRS-117	1459.97	960.55	1843.64	258.61	1079.14	243.18	22.95	218.09	47.21	280.90	54.02	168.59	25.51	156.07	21.76	281.09	17.50	8.33	25.53	6840.18
118	BRS-118	746.86	407.69	914.66	113.81	494.34	104.95	10.02	93.42	20.12	120.06	22.85	70.24	10.77	67.52	9.68	147.41	5.22	8.55	13.19	3206.98
119	BRS-119	816.34	506.14	1135.81	134.24	559.71	108.40	9.91	96.69	20.50	121.79	23.61	74.22	11.37	71.90	10.27	155.98	9.36	5.87	14.34	3700.89
120	BRS-120	954.49	793.82	1631.20	206.63	830.56	164.15	15.07	141.81	30.16	179.58	35.06	111.41	17.36	108.49	15.69	191.53	8.12	9.29	21.62	5235.47
121	BRS-121	1397.43	709.59	1447.83	202.07	849.17	188.62	18.23	179.13	40.63	254.17	50.22	157.19	24.40	147.79	21.21	310.70	13.23	11.65	26.63	5687.68
122	BRS-122	358.61	157.37	395.80	45.31	197.31	44.57	3.80	40.21	9.25	55.85	11.02	34.07	5.41	34.28	5.19	68.96	4.55	8.58	5.87	1398.04
123	BRS-123	286.85	166.26	380.99	46.22	200.39	41.99	6.29	37.12	8.07	47.70	9.05	27.96	4.39	27.61	4.13	63.70	3.51	15.41	6.19	1295.01
124	BRS-124	363.12	210.69	465.28	55.40	236.65	50.73	6.71	44.22	9.63	58.35	11.14	34.81	5.47	34.23	4.96	78.30	6.13	13.70	5.02	1591.37
125	BRS-125	424.24	262.25	577.36	69.26	296.41	62.97	5.30	54.14	11.68	68.59	13.09	40.62	6.41	41.90	6.33	73.62	4.40	19.79	6.57	1940.54

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126	BRS-126	389.12	259.28	567.07	66.10	278.03	55.42	5.06	47.94	10.35	61.53	12.04	38.40	6.16	39.05	5.79	91.21	4.02	17.71	4.53	1841.32
127	BRS-127	175.04	103.19	251.84	31.87	146.13	30.60	4.72	25.78	5.25	30.24	5.89	18.14	2.86	18.52	3.00	21.04	0.50	5.96	2.26	853.06
128	BRS-128	1029.71	428.27	1112.58	108.38	473.50	110.58	11.30	105.98	25.32	159.87	31.24	97.43	15.26	96.29	13.92	207.81	10.64	22.40	19.41	3819.60
129	BRS-129	437.29	224.96	480.30	57.68	249.96	54.29	7.10	48.63	10.86	67.33	12.90	40.82	6.44	39.90	5.72	105.63	5.53	21.44	7.65	1744.20
130	BRS-130	439.29	274.88	572.12	68.81	292.46	60.76	7.89	53.45	11.49	67.79	13.07	40.74	6.38	40.27	5.70	105.27	4.50	7.21	7.44	1955.11
131	BRS-131	430.90	282.52	587.66	70.48	294.96	60.94	8.09	52.77	11.39	67.32	12.82	39.63	6.21	38.06	5.53	96.88	3.44	11.17	6.60	1969.26
132	BRS-132	459.36	187.93	437.95	54.36	238.27	55.35	7.85	51.33	11.93	72.47	13.58	41.09	6.25	38.86	5.64	92.24	4.29	16.17	7.17	1682.20
133	BRS-133	264.64	140.14	347.03	40.74	178.03	38.85	5.22	33.48	7.23	43.33	8.16	24.76	3.92	24.47	3.61	51.56	5.61	2.45	4.09	1163.62
134	BRS-134	606.96	628.30	1042.25	160.42	617.05	108.12	11.13	87.81	17.43	101.77	19.77	62.48	9.85	61.19	8.65	143.70	9.82	10.74	11.85	3543.18
135	BRS-135	671.08	457.01	881.04	110.40	453.14	91.67	10.33	81.29	17.75	106.97	20.24	62.48	9.65	60.35	8.58	157.03	9.22	9.77	9.30	3042.00
136	BRS-136	430.13	264.23	581.37	79.93	338.82	71.15	8.14	64.97	13.08	78.77	15.43	48.46	7.29	43.59	5.95	113.17	15.00	<0.5	15.59	2051.29
137	BRS-137	501.56	315.95	837.54	79.74	327.17	65.90	7.13	57.46	12.00	74.56	15.04	48.54	7.77	46.88	6.76	124.60	8.98	17.94	6.68	2404.00
138	BRS-138	48.97	34.39	75.53	10.44	51.21	10.47	3.38	8.69	1.62	8.93	1.63	4.77	0.69	4.14	0.62	7.42	0.78	21.57	1.18	265.47
139	BRS-139	282.22	180.04	393.67	47.37	198.36	40.12	6.31	35.03	7.27	43.88	8.48	26.93	4.21	26.78	3.98	63.23	4.66	13.70	5.23	1304.65
140	BRS-140	572.41	487.48	882.56	115.79	475.19	90.39	8.43	73.01	15.21	90.00	17.40	54.96	8.54	54.20	7.62	124.40	7.63	7.94	9.09	2953.17
141	BRS-141	568.70	493.53	866.62	124.16	504.99	94.47	8.62	83.58	17.16	106.42	21.40	66.51	10.18	64.61	9.16	151.97	5.81	1.62	9.24	3040.10
142	BRS-142	585.08	431.25	849.89	110.68	429.96	84.69	8.13	77.82	16.16	99.14	19.68	59.77	9.04	56.75	8.17	152.08	8.92	13.58	11.59	2846.22
143	BRS-143	553.78	352.90	956.18	79.84	340.90	72.30	7.20	67.65	13.98	85.34	16.82	51.51	7.96	50.94	7.13	137.79	9.50	5.73	8.36	2664.43
144	BRS-144	598.38	482.23	1072.58	126.07	447.98	85.20	7.83	74.18	15.15	97.34	19.96	62.66	9.87	63.27	8.85	145.73	5.32	6.64	4.83	3171.54
145	BRS-145	514.40	303.04	791.78	70.02	300.64	65.81	6.83	62.39	12.86	79.72	16.09	50.86	7.86	50.03	7.12	138.39	4.90	6.35	18.09	2339.45
146	BRS-146	636.45	470.39	979.00	122.91	465.93	91.11	10.18	83.38	17.39	106.69	20.96	64.42	9.84	61.58	8.74	166.11	10.75	5.50	16.22	3148.97
147	BRS-147	609.92	372.08	822.12	83.74	355.56	73.57	8.42	69.69	15.29	96.61	19.37	59.06	9.27	58.24	8.26	162.11	5.87	2.49	16.46	2661.20
148	BRS-148	495.59	188.50	386.74	38.74	167.42	42.17	5.68	46.39	11.21	72.07	14.37	43.70	6.76	42.36	5.88	112.07	4.03	6.04	13.48	1567.59
149	BRS-149	762.40	484.78	932.93	95.85	404.98	83.56	8.36	76.92	15.75	97.92	19.50	59.22	8.76	54.15	7.73	144.03	10.32	4.48	13.34	3112.80
150	BRS-150	608.35	314.74	811.15	64.59	275.17	70.41	7.50	67.35	14.29	86.60	16.58	48.96	7.67	49.72	7.03	152.10	8.11	5.60	9.58	2450.10

Sl. No.	Sample No.	Y ppm	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Hf ppm	Ta ppm	W ppm	U ppm	ΣREE+Y ppm
151	BRS-151	741.95	372.83	842.03	72.99	309.53	69.58	7.21	67.63	15.19	96.25	18.80	57.62	8.86	55.32	7.91	151.87	7.29	1.74	13.29	2743.68
152	BRS-152	621.42	187.15	668.33	44.36	190.59	52.32	6.23	55.59	13.01	79.34	14.54	44.28	6.93	42.63	6.00	148.00	7.50	10.28	18.33	2032.71
153	BRS-153	649.45	303.61	680.69	75.73	320.72	66.68	6.73	61.21	14.54	96.29	19.70	62.05	9.70	61.07	8.78	130.76	7.94	16.19	7.12	2436.91
154	BRS-154	537.96	475.90	986.26	119.51	488.32	95.23	9.86	74.12	14.64	86.16	16.65	52.21	8.32	52.71	7.53	131.06	2.84	10.24	12.55	3025.37
155	BRS-155	458.01	196.74	529.82	52.64	223.45	52.43	6.39	49.75	11.60	72.13	14.17	43.51	6.94	44.27	6.34	131.19	6.38	11.07	11.07	1768.17
156	BRS-156	856.55	473.54	904.59	110.02	454.83	89.49	10.09	81.01	18.43	117.00	23.45	74.83	11.47	68.52	9.69	157.75	8.37	11.15	18.25	3303.50
157	BRS-157	642.49	332.99	717.68	80.83	335.47	71.97	8.32	67.95	15.90	100.10	19.57	61.22	9.45	58.41	8.30	156.81	9.09	8.58	12.08	2530.65
158	BRS-158	180.42	111.77	303.04	32.19	140.75	29.55	5.75	25.90	5.68	33.18	6.36	19.59	3.13	20.32	3.10	45.27	2.27	9.43	4.04	920.72
159	BRS-159	151.95	78.83	177.88	22.69	100.21	21.67	4.29	19.76	4.43	27.20	5.30	16.47	2.64	17.02	2.64	36.34	3.39	10.11	4.39	652.98
160	BRS-160	569.14	304.30	677.77	73.53	312.93	69.59	8.35	65.33	14.98	91.11	17.35	53.49	8.33	51.56	7.47	163.67	9.82	9.56	10.05	2325.23
161	BRS-161	464.06	343.92	713.73	84.03	349.16	63.17	5.92	53.65	11.62	71.53	14.18	46.03	7.35	45.78	6.62	116.09	4.75	11.33	9.20	2280.74
162	BRS-162	538.39	441.47	855.29	112.75	469.86	89.25	8.31	72.56	15.41	91.67	17.46	55.61	8.84	55.50	7.83	123.66	6.32	11.87	8.79	2840.18
163	BRS-163	153.14	113.57	256.45	32.56	141.17	29.65	5.88	24.66	4.97	28.49	5.54	17.15	2.70	17.18	2.69	41.66	2.90	8.42	3.22	835.79
164	BRS-164	580.59	369.39	889.74	101.33	438.17	89.15	9.66	79.07	17.25	110.04	22.27	69.71	10.66	66.91	9.44	167.57	6.34	4.67	14.67	2863.38
165	BRS-165	559.58	947.37	2097.71	261.63	1045.42	164.09	14.35	114.92	18.07	103.90	21.30	71.02	10.81	69.74	9.77	163.75	11.53	1.36	11.62	5509.67
166	BRS-166	463.54	325.50	667.78	86.72	383.60	78.16	8.78	70.92	15.49	101.07	20.47	62.46	9.69	62.23	8.62	150.58	12.95	1.82	10.58	2365.01
167	BRS-167	220.26	275.76	608.05	81.37	347.66	73.54	7.40	57.59	10.10	54.14	9.86	29.85	4.73	31.38	4.48	123.13	5.10	4.13	3.25	1816.17
168	BRS-168	588.20	564.13	1243.00	152.93	611.52	102.83	10.31	90.58	18.34	108.87	21.26	65.57	10.12	63.77	9.02	179.75	14.43	4.10	12.12	3660.44
169	BRS-169	831.08	685.26	1351.70	171.37	481.51	90.71	9.74	80.81	16.01	98.51	19.46	62.96	9.49	58.34	8.08	170.19	4.94	9.77	12.73	3975.02
170	BRS-170	576.36	367.63	710.81	65.79	287.77	66.74	6.84	59.11	11.94	70.32	13.33	41.04	6.28	39.25	5.41	141.14	5.33	8.92	8.80	2328.61
171	BRS-171	428.05	209.99	601.85	47.86	204.41	44.05	5.68	43.73	9.44	58.78	12.43	35.77	5.67	35.50	5.02	95.14	3.68	14.80	6.50	1748.22
172	BRS-172	199.97	75.75	234.09	24.44	112.02	25.84	4.78	23.40	4.74	28.37	5.39	16.44	2.55	16.58	2.49	35.75	2.48	11.26	2.43	776.85
173	BRS-173	660.51	376.23	837.35	79.05	340.00	71.97	5.67	67.84	14.12	86.79	16.81	53.09	8.18	51.77	7.09	117.66	10.50	11.85	11.53	2676.45
174	BRS-174	357.64	295.91	608.16	55.34	241.03	49.17	6.63	44.40	8.44	47.85	9.07	27.49	4.21	26.47	3.80	63.05	3.16	7.68	4.36	1785.60
175	BRS-175	1484.74	968.49	1985.16	277.41	1198.23	268.60	27.04	252.17	52.01	314.75	60.78	190.87	29.83	181.92	24.15	346.11	31.82	8.34	27.04	7316.14

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176	BRS-176	1424.74	846.41	1974.88	231.92	1011.63	209.06	20.86	203.03	42.52	258.81	50.74	155.05	23.97	146.96	20.44	316.31	21.94	13.19	21.36	6621.00
177	BRS-177	753.96	525.01	974.40	86.78	377.96	78.14	7.41	70.26	13.65	81.29	15.52	47.65	7.42	46.67	6.71	116.99	4.66	8.10	8.29	3092.82
178	BRS-178	476.05	307.63	656.41	51.09	217.19	48.79	3.63	43.64	8.89	53.08	10.10	32.85	5.31	35.13	5.22	94.33	6.28	7.08	7.78	1955.00
179	BRS-179	1380.40	395.23	1032.60	93.31	436.04	105.43	8.46	100.68	22.95	147.98	29.24	91.56	13.93	85.04	11.43	196.57	10.06	5.81	14.13	3954.28
180	BRS-180	1298.53	720.95	1462.26	183.93	475.00	108.40	8.78	111.18	22.96	137.29	25.38	75.44	11.27	68.63	8.98	124.62	8.65	5.18	20.30	4718.97
181	BRS-181	1931.40	1051.55	2297.04	303.73	1288.75	168.90	12.84	155.69	33.78	209.57	41.86	136.46	21.75	137.05	18.50	294.49	19.56	7.68	27.87	7808.84
182	BRS-182	1129.96	556.21	1436.39	95.62	398.90	85.09	6.84	84.05	18.43	117.68	23.07	72.56	11.50	70.83	9.78	184.38	9.82	6.30	17.77	4116.91
183	BRS-183	780.03	689.19	1499.88	161.54	459.12	85.07	6.04	73.47	14.18	83.87	16.23	51.70	7.99	51.30	7.02	97.12	9.33	8.47	11.60	3986.61
184	BRS-184	335.55	109.27	361.88	28.51	117.43	25.09	2.54	25.35	5.34	34.02	6.75	20.80	3.27	19.92	2.75	40.34	1.81	10.79	5.90	1098.47
185	BRS-185	474.39	468.11	699.48	66.77	264.02	48.98	4.12	43.64	8.33	47.16	9.02	27.11	4.08	24.47	3.25	53.35	4.62	6.24	7.18	2192.91
186	BRS-186	1384.85	1079.78	2405.42	331.81	1440.00	165.99	11.76	141.16	28.82	174.00	32.29	102.13	16.81	110.44	15.66	262.70	21.60	5.81	22.86	7440.93
187	BRS-187	823.12	494.50	1039.51	80.95	344.62	76.69	5.69	68.99	14.29	87.04	16.91	52.77	8.26	51.63	7.07	114.39	6.78	5.60	11.50	3172.02
188	BRS-188	889.79	359.54	868.66	63.44	272.06	62.05	5.11	59.62	13.21	82.57	16.36	51.96	8.25	51.33	7.15	117.05	6.66	9.40	12.09	2811.09
189	BRS-189	938.31	381.87	938.36	65.79	278.43	61.22	4.99	61.22	14.16	90.07	17.87	55.26	8.81	54.22	7.66	123.27	10.11	4.83	11.66	2978.22
190	BRS-190	773.46	199.39	436.22	34.22	157.15	43.45	3.65	46.43	11.05	71.59	14.28	44.09	6.92	42.71	5.92	89.08	8.41	5.43	9.58	1890.50
191	BRS-191	590.67	418.84	834.92	76.86	325.19	68.01	5.17	61.43	12.33	74.50	14.34	45.80	7.12	45.79	6.48	105.53	1.79	6.30	10.44	2587.43
192	BRS-192	642.03	445.78	914.78	79.91	330.09	67.76	5.18	63.51	13.01	79.30	15.62	48.91	7.91	51.31	7.36	116.04	10.68	12.28	11.60	2772.46
193	BRS-193	463.19	234.24	491.53	44.22	185.41	41.01	3.34	39.95	8.87	56.14	11.18	35.30	5.77	36.78	5.24	81.05	6.67	9.00	8.05	1662.16
194	BRS-194	1234.62	882.01	1320.37	255.59	1093.72	145.26	10.35	122.27	25.40	154.43	30.33	95.03	14.87	93.87	12.94	164.16	14.51	10.62	19.70	5491.06
195	BRS-195	1772.66	395.70	1206.48	84.56	399.01	111.89	10.60	117.89	28.53	198.02	40.75	132.73	21.30	129.76	17.27	406.18	18.08	7.08	31.83	4667.16
196	BRS-196	1773.84	1115.97	1907.01	281.37	1169.17	151.06	14.64	143.92	29.39	179.28	34.99	108.86	16.03	95.01	13.09	296.20	10.37	8.19	20.56	7033.61
197	BRS-197	667.88	335.74	903.63	41.23	180.44	37.30	3.17	33.39	6.63	39.33	7.73	23.71	3.75	23.97	3.85	62.10	2.93	11.03	3.53	2311.75
198	BRS-198	857.69	860.95	1897.58	76.29	313.67	58.14	6.04	50.29	9.41	54.14	10.32	31.82	4.91	30.61	4.39	86.92	6.74	5.61	5.63	4266.25
199	BRS-199	2531.25	1611.13	3177.92	400.94	574.85	120.48	11.56	115.57	24.94	158.90	32.18	99.69	15.58	96.27	13.50	332.21	24.04	15.10	19.61	8984.74
200	BRS-200	1181.16	1168.78	2035.42	280.52	556.82	105.96	9.06	87.73	16.91	100.67	19.30	60.32	9.35	58.25	8.82	288.70	14.37	17.22	12.29	5699.05

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201	BRS-201	515.42	408.04	859.40	58.05	240.47	48.37	3.82	44.35	8.84	53.02	10.29	32.24	5.06	31.55	4.59	71.76	4.05	13.76	6.60	2323.50
202	BRS-202	446.02	453.02	604.14	62.91	253.55	49.86	3.77	43.61	8.34	48.67	9.35	28.34	4.48	28.33	4.15	81.12	2.92	11.53	6.52	2048.52
203	BRS-203	680.74	510.02	780.69	78.34	326.89	65.81	4.96	58.44	11.74	69.71	13.98	42.72	6.72	41.28	5.83	129.48	7.27	9.22	10.10	2697.85
204	BRS-204	1085.04	640.69	1422.42	107.03	448.06	97.57	7.59	89.31	18.24	112.39	21.88	66.37	10.26	60.29	8.28	134.34	12.86	7.45	13.42	4195.43
205	BRS-205	536.44	312.61	691.98	50.42	214.43	47.24	4.02	42.85	8.95	55.45	10.83	32.73	5.12	31.19	4.45	84.06	5.31	15.71	7.35	2048.69
206	BRS-206	320.51	103.00	285.88	27.22	118.45	35.62	3.42	39.03	9.72	66.26	13.53	41.22	6.69	41.00	5.81	85.24	7.44	11.49	9.68	1117.37
207	BRS-207	468.99	320.36	695.54	49.28	209.10	44.18	3.72	39.95	8.20	49.44	9.60	28.90	4.61	28.42	4.12	74.80	6.30	12.11	6.21	1964.41
208	BRS-208	675.23	449.97	973.69	69.50	291.33	61.90	4.92	55.63	11.45	68.83	13.44	41.46	6.55	39.94	5.76	116.56	6.96	6.48	9.15	2769.60
209	BRS-209	490.14	293.57	651.04	47.69	202.28	44.72	3.62	41.28	8.24	49.31	9.57	29.41	4.85	32.21	5.03	107.36	4.43	5.94	6.87	1912.93
210	BRS-210	432.32	113.78	270.20	32.15	136.38	33.35	3.04	32.52	7.02	43.64	8.51	26.18	4.15	25.56	3.63	38.45	4.70	6.06	5.90	1172.42
211	BRS-211	687.36	489.01	1076.03	76.33	322.27	68.35	6.08	61.35	11.98	69.86	13.32	40.67	6.48	39.45	5.85	51.87	4.52	9.13	9.63	2974.38
212	BRS-212	339.67	137.66	371.53	40.56	174.01	36.13	3.78	31.90	6.15	35.80	6.89	20.83	3.36	21.54	3.31	48.16	4.27	8.24	4.76	1233.12
213	BRS-213	818.60	356.86	783.49	53.15	218.66	52.09	4.21	49.51	11.73	75.99	15.86	51.04	8.41	56.27	8.36	76.12	10.46	11.91	12.55	2564.22
214	BRS-214	299.27	108.12	335.32	31.86	138.68	29.58	4.92	26.01	5.21	31.16	6.12	18.42	2.92	19.11	2.98	50.53	3.77	6.76	2.43	1059.68
215	BRS-215	674.98	397.90	868.68	59.25	245.42	51.59	4.01	48.44	10.28	64.16	12.92	39.79	6.54	40.86	6.02	112.84	7.64	7.55	9.54	2530.84
216	BRS-216	952.97	618.10	1376.60	90.65	365.17	72.42	5.64	66.05	14.39	92.89	19.05	60.25	10.07	62.33	8.95	186.61	10.40	17.47	16.47	3815.52
217	BRS-217	709.23	360.14	721.56	55.05	233.57	51.53	4.22	47.94	10.43	66.36	13.54	43.25	7.14	44.22	6.28	98.84	5.98	5.36	8.95	2374.44
218	BRS-218	992.23	410.51	1091.17	69.24	295.13	68.36	5.40	66.34	15.19	101.07	20.56	63.39	9.92	58.76	8.00	128.22	9.81	8.20	10.67	3275.27
219	BRS-219	645.40	351.65	794.74	55.16	234.73	51.15	4.29	47.51	9.96	63.04	12.53	38.98	6.26	38.60	5.56	101.63	6.57	22.59	8.63	2359.56
220	BRS-220	978.16	614.86	1407.12	97.41	404.69	84.98	6.73	76.44	15.65	96.06	18.69	57.49	8.93	53.92	7.41	117.98	15.87	13.17	10.73	3928.53
221	BRS-221	456.70	313.14	727.54	47.84	198.85	40.46	3.25	35.90	7.32	44.90	8.91	27.06	4.29	26.28	3.85	80.20	4.21	13.61	7.93	1946.30
222	BRS-222	801.35	324.77	721.76	55.49	244.10	59.19	4.61	55.47	12.32	78.00	15.49	47.94	7.58	46.46	6.69	128.85	4.41	6.78	11.18	2481.22
223	BRS-223	1672.39	496.72	979.83	88.37	392.94	107.55	9.03	107.18	24.41	156.79	31.67	97.09	15.25	90.03	12.14	312.11	14.11	7.77	26.46	4281.37
224	BRS-224	685.39	348.90	768.37	60.18	263.56	63.95	4.90	58.52	11.93	70.81	13.70	40.93	6.48	39.37	5.79	90.73	8.03	6.54	8.88	2442.78
225	BRS-225	936.85	476.98	1033.83	75.93	316.95	69.85	5.14	64.73	14.14	89.55	17.80	55.96	8.96	55.90	8.12	125.07	10.24	7.90	10.57	3230.68

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226	BRS-226	641.56	409.81	893.15	54.05	221.68	48.32	3.85	46.42	9.86	62.19	12.44	38.05	6.01	37.00	5.17	85.85	7.87	4.90	7.92	2489.55
227	BRS-227	684.00	438.28	823.31	63.69	260.36	55.03	3.84	50.68	10.58	65.78	13.19	40.87	6.52	41.10	5.90	103.03	4.36	7.01	10.29	2563.13
228	BRS-228	1436.60	866.23	1588.48	217.59	492.81	107.02	8.07	103.64	19.99	114.28	21.70	62.35	9.28	55.19	7.84	180.46	10.10	4.44	26.55	5111.05
229	BRS-229	131.42	75.57	211.47	23.81	110.37	24.28	4.07	20.71	4.08	23.77	4.47	13.64	2.14	13.87	2.16	36.26	1.70	10.46	2.14	665.83
230	BRS-230	526.63	433.43	836.90	66.39	280.83	57.65	6.40	50.37	9.83	56.68	10.66	32.27	4.99	31.17	4.58	98.29	4.98	9.65	4.31	2408.76
231	BRS-231	693.06	436.37	832.79	67.41	286.66	60.29	4.65	53.44	11.16	69.05	13.70	42.29	6.51	38.95	5.33	91.00	5.44	6.98	9.08	2621.67
232	BRS-232	658.49	428.28	931.27	67.73	288.94	60.41	5.07	54.43	10.93	65.35	12.51	37.80	5.85	35.58	5.01	94.40	4.08	6.64	7.86	2667.66
233	BRS-233	902.55	714.49	1488.03	108.20	445.13	91.29	6.78	77.37	15.59	93.18	18.20	56.10	9.11	57.91	8.06	105.49	11.38	5.80	12.08	4091.98
234	BRS-234	666.84	467.39	826.04	70.12	290.16	59.46	4.89	52.24	10.67	65.80	12.91	39.60	6.24	37.99	5.43	95.04	5.27	6.22	9.00	2615.76
235	BRS-235	741.51	455.47	1088.72	68.43	281.03	59.49	4.79	54.59	11.44	70.09	13.76	42.11	6.62	40.11	5.72	97.71	5.86	13.44	9.44	2943.86
236	BRS-236	380.73	119.51	551.12	36.60	163.45	36.60	4.57	32.34	6.53	38.91	7.43	22.13	3.51	22.01	3.42	52.74	2.04	17.31	2.73	1428.86
237	BRS-237	547.97	327.66	781.09	53.20	231.58	50.19	5.16	45.64	9.34	55.60	10.68	32.52	5.16	32.67	4.93	83.42	2.53	8.02	3.64	2193.39
238	BRS-238	207.68	132.18	300.72	37.54	169.51	37.44	4.32	31.74	6.34	37.19	7.13	21.38	3.32	22.72	3.46	66.61	2.22	<0.5	2.99	1022.68
239	BRS-239	519.32	327.40	715.35	49.60	210.75	43.86	5.05	39.06	8.21	50.24	9.71	29.14	4.67	28.71	4.20	85.26	5.20	5.97	5.29	2045.27
240	BRS-240	657.41	435.20	926.87	62.53	261.69	54.80	6.02	49.97	10.30	62.38	12.16	37.23	5.86	36.24	5.27	108.75	5.64	8.95	5.64	2623.92
241	BRS-241	626.68	454.59	960.93	66.52	276.21	56.81	6.02	47.80	9.76	60.45	12.32	38.37	6.17	38.66	5.60	117.75	4.48	5.17	7.82	2666.89
242	BRS-242	648.51	409.65	928.48	60.69	251.61	52.31	5.92	47.32	9.96	60.76	12.01	37.54	5.98	37.57	5.45	110.66	6.02	8.73	8.27	2573.76
243	BRS-243	495.15	352.66	786.54	54.63	235.46	48.85	4.97	43.24	8.61	50.43	9.70	29.47	4.63	29.12	4.32	76.89	2.50	2.52	3.09	2157.78
244	BRS-244	445.03	254.95	675.36	48.34	208.42	45.06	4.57	38.78	7.68	45.12	8.54	25.64	4.05	25.28	3.73	64.92	2.96	5.56	4.50	1840.54
245	BRS-245	1095.52	726.18	1602.54	107.36	448.30	94.25	8.59	86.87	18.28	109.50	21.67	67.30	10.44	65.23	9.31	149.50	10.61	4.70	13.80	4471.33
246	BRS-246	110.74	61.32	133.41	17.36	73.52	16.28	1.76	14.63	3.06	18.52	3.62	11.54	1.83	11.91	1.72	20.60	1.37	11.52	3.61	481.25
247	BRS-247	116.00	58.36	122.74	16.62	71.55	16.17	1.71	14.87	3.25	19.99	3.98	12.67	2.06	13.46	1.97	20.45	1.05	9.56	3.53	475.38
248	BRS-248	547.32	348.61	705.62	50.33	213.20	46.60	4.54	41.95	8.92	52.92	10.41	32.46	5.00	32.05	4.68	49.35	7.14	3.95	6.90	2104.61
249	BRS-249	1283.57	633.55	1359.17	95.90	401.40	89.98	8.56	82.89	18.51	118.73	23.91	77.66	12.34	76.85	10.06	144.16	20.37	8.84	16.47	4293.07
250	BRS-250	456.91	339.61	712.62	47.03	196.32	42.45	4.01	37.68	7.86	46.67	9.16	28.32	4.53	29.22	4.26	67.11	6.37	7.06	6.34	1966.65

Sl. No.	Sample No.	Y ppm	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Hf ppm	Ta ppm	W ppm	U ppm	ΣREE+Y ppm
251	BRS-251	360.94	351.90	696.01	46.73	192.20	38.44	3.27	33.43	6.61	37.21	7.15	22.19	3.59	24.89	4.05	48.13	4.31	2.67	4.96	1828.60
252	BRS-252	882.94	342.16	832.19	59.78	276.02	68.63	6.11	64.34	15.15	96.11	19.64	62.78	10.13	65.25	9.56	237.43	11.09	12.13	8.79	2810.80
253	BRS-253	1653.84	651.51	1529.26	120.20	563.33	144.21	16.85	137.90	33.43	216.34	44.81	142.94	23.17	141.72	19.98	443.29	13.15	16.10	19.41	5439.48
254	BRS-254	334.07	116.99	381.04	32.42	140.83	30.76	3.01	27.75	5.68	33.80	6.62	20.24	3.22	20.80	3.11	40.44	3.49	5.84	4.53	1160.31
255	BRS-255	1273.26	434.69	1187.31	76.34	352.56	87.51	8.17	85.25	19.41	121.51	24.57	76.35	11.99	74.42	10.68	194.48	8.16	2.47	16.85	3844.01
256	BRS-256	701.54	329.01	850.82	47.31	208.57	52.54	4.89	50.91	11.86	75.02	15.19	48.07	7.75	49.50	7.23	81.64	6.56	2.09	7.41	2460.20
257	BRS-257	712.71	293.07	689.04	48.94	215.29	53.69	5.15	50.41	11.34	71.94	14.41	45.95	7.29	46.18	6.67	96.00	5.95	4.64	8.19	2272.08
258	BRS-258	746.05	450.17	823.79	68.23	281.00	60.84	5.44	53.87	11.58	70.56	13.95	42.83	6.55	40.51	5.57	92.23	7.51	5.82	15.18	2680.95
259	BRS-259	600.07	329.98	638.53	48.60	203.89	45.02	4.01	41.71	9.38	58.45	11.73	36.99	5.72	35.27	4.88	77.96	7.36	3.09	14.28	2074.24
260	BRS-260	433.80	300.93	700.83	43.75	176.60	37.80	3.28	34.22	7.13	43.61	8.70	27.54	4.41	27.68	3.96	61.99	6.89	0.63	13.00	1854.24
261	BRS-261	768.48	803.52	1423.81	109.06	430.88	83.54	7.10	73.00	14.10	80.67	15.29	45.52	6.96	42.14	5.76	98.19	8.76	3.53	18.95	3909.83
262	BRS-262	353.23	147.32	587.78	42.34	184.56	39.64	3.54	34.37	6.72	38.43	7.24	22.10	3.42	21.93	3.28	42.76	2.85	1.25	3.59	1495.90
263	BRS-263	249.36	124.88	474.00	32.09	135.88	28.43	2.63	24.97	5.07	29.81	5.81	17.99	2.88	19.09	3.00	46.13	4.06	1.76	4.04	1155.90
264	BRS-264	486.71	297.26	700.06	45.90	199.29	43.58	4.78	39.80	8.37	50.00	9.83	30.63	4.84	31.51	4.73	72.11	6.04	<0.5	5.78	1957.28
265	BRS-265	348.33	140.29	496.90	35.04	147.97	30.99	2.84	27.52	5.77	34.87	6.91	22.01	3.47	22.37	3.36	47.83	4.59	0.99	4.04	1328.62
266	BRS-266	1592.03	484.14	1060.24	96.53	454.48	119.66	11.09	114.89	25.93	159.35	31.46	97.30	14.65	88.84	12.63	323.89	14.97	10.83	11.41	4363.22
267	BRS-267	1848.30	595.13	1300.14	154.35	578.58	152.33	14.37	147.53	33.01	200.86	39.96	121.50	18.21	110.47	15.66	425.55	19.04	13.70	15.17	5330.39
268	BRS-268	1055.79	105.45	253.33	39.03	188.26	60.60	6.07	66.36	19.34	141.41	31.91	107.01	17.75	110.23	15.01	666.41	28.77	3.37	32.23	2217.54
269	BRS-269	494.76	361.10	769.93	58.92	256.73	56.07	5.40	47.66	9.74	57.12	10.85	32.91	5.10	32.62	4.81	76.54	4.87	0.98	6.22	2203.69
270	BRS-270	212.38	62.12	176.77	20.56	94.41	22.04	2.18	20.22	4.50	27.79	5.71	19.26	3.49	26.11	4.61	71.70	2.66	7.05	2.69	702.16
271	BRS-271	521.29	356.93	752.72	54.36	235.69	51.87	5.32	45.64	9.39	55.53	10.76	33.32	5.21	32.96	4.73	68.12	5.75	7.12	6.81	2175.73
272	BRS-272	395.43	242.71	579.80	38.64	165.21	36.12	3.63	32.19	6.71	40.21	7.88	24.45	3.92	25.21	3.83	56.16	4.95	3.47	4.48	1605.94
273	BRS-273	629.18	297.17	710.77	30.27	128.96	30.53	3.32	34.15	9.41	62.97	12.52	37.19	5.64	33.22	4.71	69.91	6.44	8.18	6.24	2030.01
274	BRS-274	333.38	133.00	307.21	35.58	154.07	33.19	3.36	29.34	5.83	33.48	6.50	19.80	2.99	19.01	2.83	41.12	4.34	0.82	4.26	1119.55
275	BRS-275	412.34	130.05	249.00	36.93	164.97	37.55	3.73	33.87	7.00	42.00	8.12	25.11	3.97	25.40	3.75	53.39	6.23	6.60	4.72	1183.80

Sl. No.	Sample No.	Y ppm	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Hf ppm	Ta ppm	W ppm	U ppm	ΣREE+Y ppm
276	BRS-276	1806.19	442.06	908.25	88.81	409.28	121.59	12.04	127.33	34.42	237.72	50.65	165.14	26.75	163.01	21.15	384.82	46.28	19.16	26.23	4614.39
277	BRS-277	711.43	339.38	783.34	56.52	251.54	59.59	5.00	54.84	12.13	75.26	14.86	47.08	7.46	48.84	7.32	167.81	8.75	11.75	8.03	2474.58
278	BRS-278	844.95	427.01	990.89	63.36	267.26	61.10	6.17	57.46	13.14	81.62	16.40	52.18	8.17	50.37	7.02	103.14	9.22	<0.5	13.01	2947.09
279	BRS-279	726.27	569.21	1258.94	95.09	418.42	93.63	7.82	78.95	15.10	82.82	15.50	46.75	7.16	44.64	6.53	74.76	6.26	2.44	6.73	3466.82
280	BRS-280	1009.27	843.17	1761.07	163.52	558.42	119.07	10.79	103.51	20.12	111.22	20.38	59.97	8.98	55.74	7.83	102.56	5.95	5.51	10.69	4853.06
281	BRS-281	531.31	365.60	820.68	53.80	219.20	47.06	2.48	42.67	8.98	55.20	10.86	34.21	5.46	33.95	4.96	71.10	5.50	3.91	7.28	2236.43
282	BRS-282	499.39	492.35	876.92	68.11	279.68	55.60	2.75	47.66	9.35	54.23	10.53	33.14	5.37	34.64	4.98	70.95	3.85	2.36	7.21	2474.70
283	BRS-283	593.55	677.78	1031.25	101.74	417.61	79.53	4.19	65.01	12.52	68.86	12.83	38.95	6.14	40.47	5.88	77.38	4.96	4.56	9.14	3156.30
284	BRS-284	463.81	357.38	732.42	52.98	223.57	46.40	3.96	40.24	8.48	50.44	9.82	30.95	4.86	30.32	4.40	60.07	5.71	4.08	6.40	2060.03
285	BRS-285	599.01	319.12	710.78	53.36	229.88	50.57	4.69	45.11	9.34	56.11	10.81	33.26	5.23	32.77	4.70	83.92	8.04	3.47	11.78	2164.73
286	BRS-286	286.49	291.50	600.07	39.20	163.07	32.77	3.82	28.36	5.54	31.72	6.08	18.61	2.99	20.39	3.35	54.87	2.38	0.65	2.81	1533.95
287	BRS-287	313.00	111.28	366.66	31.83	139.30	30.84	4.84	27.63	5.63	33.74	6.54	20.61	3.28	21.98	3.42	57.63	2.80	0.97	4.15	1120.58
288	BRS-288	413.09	914.95	1748.23	88.73	332.54	54.32	4.21	47.14	8.59	48.39	9.29	30.10	5.00	35.52	6.06	94.21	4.73	<0.5	5.73	3746.17
289	BRS-289	222.30	208.25	513.70	38.39	155.05	29.30	3.31	24.93	5.09	30.27	6.06	18.95	2.92	18.36	2.60	53.55	3.08	4.41	4.47	1279.48
290	BRS-290	516.18	149.60	379.46	44.52	192.61	45.46	6.18	40.19	8.69	52.08	10.25	31.98	5.07	32.12	4.55	85.47	3.37	0.50	4.42	1518.91
291	BRS-291	450.18	351.85	670.02	51.83	215.95	45.56	5.92	39.60	8.18	48.16	9.17	28.04	4.33	27.12	3.89	70.36	4.66	<0.5	4.65	1959.80
292	BRS-292	484.78	220.52	418.38	34.51	153.78	38.75	5.29	35.27	8.05	48.87	9.77	30.26	4.76	29.43	4.24	78.53	3.54	<0.5	5.19	1526.65
293	BRS-293	1111.68	564.44	1259.27	90.20	386.54	89.21	6.96	82.72	18.37	111.37	21.96	67.74	10.41	63.48	8.70	164.98	7.96	<0.5	15.46	3893.05
294	BRS-294	1215.48	573.02	1120.48	91.71	387.66	89.20	6.92	82.41	18.88	121.58	24.62	79.03	12.41	76.65	10.64	194.43	11.63	<0.5	19.56	3910.71
295	BRS-295	991.95	583.14	1524.00	90.81	371.42	80.39	6.05	73.19	16.70	105.31	21.01	67.22	10.90	68.99	9.73	114.39	8.83	1.09	15.18	4020.79
296	BRS-296	701.97	470.47	895.16	66.95	287.58	62.49	5.11	54.57	11.79	71.49	14.40	44.78	6.90	41.32	5.72	103.09	4.85	<0.5	9.58	2740.71
297	BRS-297	622.06	315.61	743.03	50.31	210.94	47.03	4.63	44.35	9.92	61.66	12.54	38.90	6.14	38.40	5.48	89.69	5.43	<0.5	8.22	2210.98
298	BRS-298	557.43	311.97	731.82	50.17	214.15	49.95	4.47	44.28	9.70	58.74	11.69	36.64	5.88	38.10	5.77	85.12	5.59	<0.5	6.58	2130.75
299	BRS-299	543.58	348.76	750.13	55.01	238.63	50.86	4.93	45.43	9.42	56.07	10.94	33.63	5.20	32.89	4.77	75.08	4.99	1.51	6.26	2190.25
300	BRS-300	400.32	291.16	677.28	45.58	197.58	43.10	4.43	36.68	7.49	44.44	8.50	26.42	4.16	26.85	4.02	59.00	2.46	2.94	4.91	1818.01

Sl. No.	Sample No.	Cu	Ga	Nb	Pb	Rb	Sc	Sr	Th	V	Zn	Zr	Be	Ge	Mo	Sn
1	BRS-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	21.03	2.35	5.64	27.43
2	BRS-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12.80	2.54	5.93	19.48
3	BRS-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	18.68	3.21	14.27	29.05
4	BRS-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25.02	2.62	11.36	26.78
5	BRS-5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12.46	1.85	2.58	18.50
6	BRS-6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	19.47	2.42	5.00	33.87
7	BRS-7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11.13	2.60	2.02	8.47
8	BRS-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.32	2.57	3.07	16.28
9	BRS-9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	16.12	2.36	2.29	29.81
10	BRS-10	33	39	276	61	226	1	69	44	128	274	2554	NA	4.04	3.18	66.11
11	BRS-11	45	30	359	44	225	3	88	60	167	252	2764	NA	2.99	3.78	47.41
12	BRS-12	33	35	171	27	150	5	84	47	167	179	1026	NA	2.64	2.08	47.32
13	BRS-13	34	45	164	30	153	4	75	40	71	275	1818	NA	1.98	3.22	4.64
14	BRS-14	32	56	162	27	147	6	96	42	105	183	1326	NA	1.68	2.35	52.32
15	BRS-15	38	49	162	31	168	3	69	36	83	270	1344	NA	2.38	14.16	22.09
16	BRS-16	36	24	97	34	131	30	255	61	126	149	434	NA	1.06	2.62	109.48
17	BRS-17	34	63	509	52	207	2	79	51	91	303	7418	NA	2.38	4.46	131.27
18	BRS-18	31	60	242	29	212	6	91	33	84	238	2789	NA	1.49	3.43	47.28
19	BRS-19	35	52	196	23	180	2	66	45	107	269	1476	NA	2.13	3.13	50.93
20	BRS-20	33	52	277	42	203	7	68	41	99	270	958	NA	2.20	5.27	58.12
21	BRS-21	33	65	287	32	223	1	66	45	90	383	2790	NA	2.56	5.84	72.98
22	BRS-22	27	53	152	27	134	14	110	45	106	177	1229	NA	3.08	2.27	49.46
23	BRS-23	38	56	394	46	253	1	70	47	78	421	4317	NA	2.54	6.04	81.68
24	BRS-24	45	51	587	52	208	1	89	57	67	709	5725	NA	3.65	2.63	109.39
25	BRS-25	35	63	617	66	226	1	74	68	65	599	5434	NA	3.38	1.78	102.82
26	BRS-26	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	21.85	2.89	5.58	29.55
27	BRS-27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.36	2.29	4.37	8.24
28	BRS-28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13.92	1.62	2.39	20.89
29	BRS-29	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	16.70	2.99	2.96	25.95
30	BRS-30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	46.96	2.83	4.33	49.43
31	BRS-31	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	36.80	2.16	1.85	49.70
32	BRS-32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	20.80	2.72	2.16	39.94
33	BRS-33	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15.17	2.91	4.44	45.40
34	BRS-34	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29.46	3.18	2.15	50.47
35	BRS-35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	26.61	3.82	3.11	60.37

Sl. No.	Sample No.	Cu	Ga	Nb	Pb	Rb	Sc	Sr	Th	V	Zn	Zr	Be	Ge	Mo	Sn
36	BRS-36	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15.38	2.94	3.76	32.93
37	BRS-37	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	14.55	3.30	2.29	24.06
38	BRS-38	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12.03	3.23	2.45	32.78
39	BRS-39	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25.53	2.38	2.72	22.69
40	BRS-40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	20.15	2.71	7.54	58.01
41	BRS-41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	23.34	3.04	4.67	72.57
42	BRS-42	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	17.10	3.06	4.08	53.06
43	BRS-43	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	29.16	2.08	3.08	39.69
44	BRS-44	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	30.01	2.22	2.37	49.72
45	BRS-45	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11.77	2.43	4.99	15.01
46	BRS-46	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	24.23	1.93	7.18	36.04
47	BRS-47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	21.77	2.36	3.55	39.61
48	BRS-48	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15.99	2.26	2.91	24.12
49	BRS-49	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	18.34	2.04	1.21	35.85
50	BRS-50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12.54	2.14	4.95	30.79
51	BRS-51	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25.87	2.67	4.89	49.59
52	BRS-52	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	21.52	2.28	5.97	57.65
53	BRS-53	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.98	2.17	2.09	20.40

54	BRS-54	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.75	3.50	2.27	10.52
55	BRS-55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	20.12	3.17	1.35	28.18
56	BRS-56	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	20.33	2.74	0.71	30.17
57	BRS-57	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.32	2.37	2.25	14.83
58	BRS-58	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.72	2.30	2.76	12.10
59	BRS-59	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	14.47	3.19	1.92	19.38
60	BRS-60	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	21.36	3.33	1.44	27.43
61	BRS-61	37	67	155	34	197	8	78	37	123	594	728	16.81	3.49	6.50	34.40
62	BRS-62	33	54	662	43	238	1	74	66	53	303	7168	27.55	3.32	1.64	199.59
63	BRS-63	29	65	141	24	177	4	71	43	53	194	996	11.75	2.09	0.66	94.24
64	BRS-64	34	67	178	20	185	2	72	46	84	227	1777	15.66	1.89	0.78	108.59
65	BRS-65	30	57	143	14	183	1	65	36	65	233	1019	10.90	2.06	2.95	100.70
66	BRS-66	23	72	232	28	220	6	64	43	71	278	1980	21.20	2.32	3.29	74.75
67	BRS-67	28	62	207	42	252	1	71	37	45	279	2759	21.97	2.18	2.16	66.77
68	BRS-68	28	52	222	30	207	2	68	41	76	329	2016	19.72	2.35	2.11	69.10
69	BRS-69	28	61	207	29	238	5	68	41	46	246	1860	19.29	2.22	1.33	78.29
70	BRS-70	19	69	189	20	272	2	59	37	32	267	1813	18.23	1.86	1.46	83.05

Sl. No.	Sample No.	Cu	Ga	Nb	Pb	Rb	Sc	Sr	Th	V	Zn	Zr	Be	Ge	Mo	Sn
71	BRS-71	23	57	100	16	211	10	126	39	38	143	1005	8.99	1.65	1.61	43.93
72	BRS-72	27	61	149	20	201	1	66	39	42	199	1776	10.60	2.37	8.51	49.26
73	BRS-73	22	71	241	50	256	1	62	43	47	322	2753	20.62	1.95	2.54	66.40
74	BRS-74	25	64	144	26	181	3	64	39	56	190	1553	9.69	2.01	2.40	64.01
75	BRS-75	24	63	131	32	186	6	73	39	47	201	966	12.37	1.95	1.58	52.69
76	BRS-76	25	59	144	26	170	2	73	36	56	214	1239	11.90	1.95	2.09	64.09
77	BRS-77	29	53	192	19	160	3	67	38	107	213	1288	13.70	3.53	4.71	74.02
78	BRS-78	23	65	235	43	227	3	76	48	46	317	2975	22.51	2.36	1.72	43.18
79	BRS-79	28	64	239	32	203	4	68	42	117	242	2418	22.37	2.01	3.88	30.19
80	BRS-80	41	82	295	28	122	7	69	53	178	413	2379	22.19	2.68	2.83	27.25
81	BRS-81	36	67	258	27	165	2	61	45	131	332	2141	24.41	2.73	2.46	27.72
82	BRS-82	36	54	395	53	225	2	66	42	88	352	5136	37.25	3.14	1.24	73.02
83	BRS-83	24	63	175	31	204	2	68	36	50	195	1400	15.75	2.66	1.24	23.71
84	BRS-84	29	64	508	54	257	1	69	64	79	343	4529	15.40	4.77	2.31	66.87
85	BRS-85	36	63	267	51	225	1	62	46	58	312	2476	21.81	2.63	3.37	37.55
86	BRS-86	42	57	558	69	198	5	75	77	119	444	4681	31.87	3.20	3.42	57.25
87	BRS-87	32	60	361	49	341	1	76	53	54	413	5509	42.48	4.94	3.64	59.78
88	BRS-88	28	60	228	42	219	3	70	38	74	298	2785	21.55	2.39	4.53	32.01
89	BRS-89	36	68	176	19	162	4	66	41	102	252	1559	12.92	1.69	2.93	17.21
90	BRS-90	31	60	184	21	169	7	67	42	119	245	1418	13.99	2.43	7.32	18.31
91	BRS-91	37	67	268	33	225	1	69	40	67	346	3403	24.83	2.70	3.51	41.08
92	BRS-92	27	66	253	25	216	4	69	42	80	310	2696	16.58	2.12	2.28	36.32
93	BRS-93	30	57	289	37	201	6	69	46	96	323	2854	22.48	2.65	5.36	59.54
94	BRS-94	31	69	202	29	210	4	58	36	91	261	2006	22.92	2.94	4.36	52.49
95	BRS-95	30	62	343	31	254	3	66	38	120	297	3860	22.59	2.87	4.63	59.96
96	BRS-96	27	58	333	52	245	2	65	44	73	376	3263	27.90	2.73	3.69	61.87
97	BRS-97	24	59	216	28	208	2	63	39	62	246	2292	23.69	2.33	2.44	43.60
98	BRS-98	34	59	418	43	215	2	67	45	164	397	3697	28.38	3.73	4.08	76.57
99	BRS-99	35	55	252	31	220	4	64	38	86	321	2445	22.23	2.77	3.65	48.06
100	BRS-100	31	74	262	28	220	1	62	43	87	303	2514	24.78	2.75	5.04	52.12
101	BRS-101	25	60	274	32	221	3	62	47	74	316	2447	22.544	3.118	4.382	36.91
102	BRS-102	34	56	241	29	205	4	63	41	127	278	2699	17.502	3.382	3.473	39.534
103	BRS-103	31	61	302	40	237	9	65	47	82	368	3010	24.897	3.548	2.398	44.32
104	BRS-104	32	56	179	14	194	7	64	41	87	261	1779	16.346	1.692	1.997	21.693
105	BRS-105	36	72	216	47	150	10	62	38	112	256	1867	13.337	2.54	2.158	19.766

Sl. No.	Sample No.	Cu	Ga	Nb	Pb	Rb	Sc	Sr	Th	V	Zn	Zr	Be	Ge	Mo	Sn
106	BRS-106	32	56	294	32	157	2	70	38	78	256	3195	18.952	3.447	2.017	38.436
107	BRS-107	32	53	258	40	218	4	63	44	69	260	2921	18.499	2.504	2.432	39.14
108	BRS-108	31	63	204	16	221	2	58	44	66	227	2094	18.57	2.635	2.659	27.805
109	BRS-109	21	65	204	24	213	2	62	42	65	210	2270	17.805	2.615	2.152	27.841
110	BRS-110	60	61	453	79	263	2	81	59	104	920	2553	37.077	2.822	4.562	37.422
111	BRS-111	29	59	236	20	236	5	65	42	63	301	3666	20.124	2.703	2.334	32.462
112	BRS-112	38	56	382	45	255	3	70	43	61	408	5990	30.93	3.53	2.464	78.851
113	BRS-113	22	26	136	55	192	4	62	16	25	258	1687	11.281	1.352	1.627	21.54
114	BRS-114	32	67	423	72	294	2	68	36	78	328	3357	28.85	2.779	5.849	61.622
115	BRS-115	27	69	240	41	252	3	67	39	55	334	2337	26.023	2.858	3.588	29.236
116	BRS-116	27	57	141	17	199	9	63	40	53	198	1357	12.708	1.782	6.938	15.91
117	BRS-117	28	54	700	64	200	4	86	68	81	727	7507	64.58	4.464	4.026	61.23
118	BRS-118	32	56	320	35	233	2	65	42	64	466	3324	30.443	4.227	3.13	48.675
119	BRS-119	34	58	328	52	204	4	73	44	65	411	3306	28.926	3.144	2.449	42.754
120	BRS-120	37	58	490	81	250	3	70	47	65	817	4192	39.178	3.354	2.273	90.032
121	BRS-121	41	54	570	64	296	3	76	46	67	493	6840	38.583	4.135	3.703	84.982
122	BRS-122	32	68	184	22	205	7	57	41	58	235	1637	17.866	2.779	2.959	43.353
123	BRS-123	39	58	194	23	127	4	61	44	134	233	1577	12.674	2.995	2.169	70.672
124	BRS-124	43	68	223	28	156	5	61	42	113	255	1992	13.99	3.294	2.49	50.037
125	BRS-125	25	69	217	20	208	7	62	42	79	289	1799	22.214	2.855	1.96	79.503
126	BRS-126	36	71	257	27	170	3	62	41	143	259	2269	26.003	1.898	1.531	87.072
127	BRS-127	42	69	150	19	125	9	81	42	188	215	799	7.451	2.005	1.779	65.153
128	BRS-128	38	53	523	51	177	2	80	54	73	723	5315	29.999	2.263	2.771	76.12
129	BRS-129	32	47	253	21	182	6	68	44	98	265	2795	26.789	2.257	0.544	47.353
130	BRS-130	30	62	261	33	196	8	64	44	116	270	2665	21.871	3.348	1.604	49.782
131	BRS-131	44	70	251	25	178	5	75	46	134	271	2431	26.317	3.06	1.556	44.42
132	BRS-132	45	76	285	19	150	7	75	50	182	326	2354	22.049	2.018	0.981	41.702
133	BRS-133	32	62	176	19	147	9	69	43	115	236	1365	14.752	1.404	1.197	39.515
134	BRS-134	47	65	381	32	187	4	92	45	187	396	3267	58.1	3.125	9.898	79.809
135	BRS-135	32	43	347	30	239	8	76	46	112	331	3631	31.943	2.056	1.6	83.367
136	BRS-136	60	50	432	52	160	3	84	49	206	515	3170	51.762	1.854	4.793	25.109
137	BRS-137	29	42	329	32	169	8	87	51	107	532	3281	16.666	1.754	32.676	65.21
138	BRS-138	75	34	100	13	68	31	185	47	473	136	202	2.539	1.335	1.213	28.525
139	BRS-139	55	54	219	16	139	6	135	46	153	78	1659	14.551	1.472	5.415	21.951
140	BRS-140	38	65	288	19	210	4	73	56	115	172	3125	81.568	2.31	15.149	46.509

Sl. No.	Sample No.	Cu	Ga	Nb	Pb	Rb	Sc	Sr	Th	V	Zn	Zr	Be	Ge	Mo	Sn
141	BRS-141	39	61	312	22	174	7	78	59	119	131	3423	18.399	1.926	<0.5	40.777
142	BRS-142	31	65	281	26	224	9	73	44	99	343	3211	25.992	2.958	1.742	50.807
143	BRS-143	30	53	292	21	211	4	76	52	114	97	3133	26.897	1.985	1.481	43.425
144	BRS-144	38	58	320	22	195	3	77	52	140	91	3168	22.126	2.08	2.889	48.209
145	BRS-145	39	53	281	31	186	2	85	53	109	90	3164	23.608	1.853	2.634	43.234
146	BRS-146	39	54	368	39	199	4	73	43	121	91	3667	25.825	1.852	1.123	51.31
147	BRS-147	35	52	374	29	156	4	79	55	151	86	3592	14.868	1.682	0.713	49.525
148	BRS-148	48	49	276	19	176	16	90	51	134	75	2611	20.423	1.213	10.714	36.271
149	BRS-149	35	60	326	26	206	4	77	53	119	97	3185	35.03	2.395	1.784	42.967
150	BRS-150	38	56	278	19	213	4	78	47	110	452	3206	33.653	2.214	5.695	46.049
151	BRS-151	31	75	325	21	206	4	84	50	127	89	3340	22.756	1.958	2.347	46.095
152	BRS-152	46	64	305	23	143	6	118	51	140	87	3200	33.575	1.881	5.015	58.618
153	BRS-153	40	70	320	28	188	4	74	49	124	75	3252	15.476	1.53	1.658	42.936
154	BRS-154	32	39	310	25	160	5	92	53	93	76	3343	15.724	1.732	37.516	59.098
155	BRS-155	37	45	298	23	177	5	74	40	89	58	3463	7.319	1.356	6.427	38.767
156	BRS-156	40	68	392	25	188	2	75	53	116	75	4055	21.699	1.999	1.827	51.601
157	BRS-157	31	61	345	29	191	4	75	58	111	56	3958	33.176	1.649	0.569	49.97
158	BRS-158	45	52	150	11	132	6	133	49	117	66	1109	9.812	1.403	2.953	23.695
159	BRS-159	29	49	142	14	116	11	104	49	122	74	990	13.065	1.203	1.318	11.902

160	BRS-160	39	40	335	30	195	2	74	52	99	51	3970	48.016	1.547	1.701	54.391
161	BRS-161	43	58	321	18	195	4	127	49	162	265	2821	32.037	2.055	3.58	37.522
162	BRS-162	37	61	303	22	235	7	77	53	119	86	3188	110.61	1.913	14.805	44.83
163	BRS-163	33	51	149	13	139	13	114	46	117	65	1165	7.277	1.125	0.501	12.023
164	BRS-164	53	57	440	30	140	2	71	46	206	59	3402	20.754	1.952	17.44	44.22
165	BRS-165	43	64	407	24	130	2	97	58	180	93	3759	21.191	2.648	27.175	52.605
166	BRS-166	38	50	365	33	146	3	82	54	109	69	3760	12.872	1.391	41.345	47.919
167	BRS-167	43	49	283	30	77	5	100	39	119	389	3265	31.955	2.12	16.059	34.91
168	BRS-168	34	37	369	28	169	2	93	58	119	97	3830	14.471	1.97	18.442	51.517
169	BRS-169	36	57	389	32	185	2	72	49	132	110	3767	34.156	2.266	3.454	55.299
170	BRS-170	37	54	294	18	221	5	72	43	148	144	2722	24.29	3.623	1.201	43.296
171	BRS-171	36	71	225	19	167	7	67	42	114	281	2103	13.74	1.952	<0.5	28.362
172	BRS-172	28	59	130	15	138	11	81	45	116	176	867	8.108	1.76	<0.5	9.472
173	BRS-173	32	57	270	28	172	6	63	43	52	215	2558	29.128	2.207	0.701	45.814
174	BRS-174	29	51	156	24	201	16	106	43	107	230	1418	13.054	2.12	<0.5	18.324
175	BRS-175	41	30	853	146	146	3	92	66	60	747	9369	84.148	5.525	2.038	59.39

Sl. No.	Sample No.	Cu	Ga	Nb	Pb	Rb	Sc	Sr	Th	V	Zn	Zr	Be	Ge	Mo	Sn
176	BRS-176	49	47	677	86	268	2	78	63	61	579	8014	61.667	5.342	1.617	62.923
177	BRS-177	30	68	264	28	214	4	66	42	90	364	2597	28.105	2.975	0.644	51.556
178	BRS-178	29	69	214	55	454	6	67	35	36	279	1727	28.163	2.493	1.659	94.839
179	BRS-179	13	55	222	57	567	27	135	55	20	349	4300	42.716	2.04	1.051	98.722
180	BRS-180	31	76	436	56	308	2	88	61	53	416	2455	67.07	3.62	1.26	63.396
181	BRS-181	30	57	616	52	306	2	104	58	51	443	5257	78.926	4.729	1.712	109.272
182	BRS-182	31	64	394	69	327	3	87	56	61	401	3392	36.472	3.423	1.53	91.016
183	BRS-183	22	62	327	54	314	3	84	54	43	383	2058	37.162	3.601	1.658	52.21
184	BRS-184	33	35	137	44	181	8	177	50	49	147	1159	10.836	1.723	1.314	38.931
185	BRS-185	42	27	173	53	177	10	150	54	83	307	1162	19.369	2.315	1.492	54.511
186	BRS-186	32	66	709	101	419	5	99	63	69	435	4528	70.249	4.286	2.212	78.292
187	BRS-187	32	67	269	58	264	6	77	44	61	335	2276	29.581	2.921	1.14	66.894
188	BRS-188	29	63	268	76	246	6	83	46	85	368	2340	26.932	3.316	2.594	41.818
189	BRS-189	29	65	282	43	264	5	76	53	67	345	2472	26.074	2.626	2.341	47.526
190	BRS-190	23	48	170	43	359	2	73	45	22	171	1758	29.18	1.784	3.511	38.09
191	BRS-191	30	70	228	66	252	4	78	37	52	304	2110	25.376	2.728	2.368	37.169
192	BRS-192	26	60	288	36	295	6	73	39	59	343	2307	33.239	3.114	2.304	46.196
193	BRS-193	24	73	172	25	262	2	69	36	36	254	1654	20.258	2.098	2.031	25.371
194	BRS-194	29	70	513	47	250	3	79	58	96	443	2881	45.774	4.564	0.982	80.567
195	BRS-195	31	71	475	130	375	5	80	47	76	669	6910	37.581	3.575	3.099	69.392
196	BRS-196	35	76	570	77	271	5	81	67	60	646	6310	43.873	5.028	1.796	28.315
197	BRS-197	34	81	162	22	235	8	95	47	116	188	1519	9.694	3.474	0.537	25.555
198	BRS-198	30	46	221	23	218	10	87	41	76	305	2284	15.701	4.282	1.48	35.415
199	BRS-199	40	53	552	55	336	4	74	60	71	438	6405	42.172	4.232	1.573	88.423
200	BRS-200	35	56	446	39	349	6	77	56	68	429	6205	34.239	4.813	1.242	89.296
201	BRS-201	24	72	188	21	265	7	74	40	51	239	1531	20.264	2.62	4.018	39.105
202	BRS-202	29	67	159	21	263	4	65	39	42	207	1592	18.004	2.389	1.796	47.681
203	BRS-203	39	69	229	23	259	3	65	47	55	134	2419	32.744	2.561	3.666	87.478
204	BRS-204	31	69	287	47	277	2	69	52	56	260	2332	35.165	3.639	1.997	88.791
205	BRS-205	30	63	159	41	257	10	74	47	43	187	1550	17.918	2.81	1.226	75.128
206	BRS-206	34	57	213	36	290	5	71	43	61	263	2510	24.908	2.381	4.916	19.484
207	BRS-207	31	39	159	35	240	6	79	44	43	190	1349	17.111	2.308	3.85	50.927
208	BRS-208	26	65	200	41	289	8	74	43	47	253	2237	26.393	2.961	3.876	37.797
209	BRS-209	33	68	174	26	259	3	63	31	93	290	1952	21.064	3.05	3.6	43.529
210	BRS-210	23	59	141	20	224	6	62	29	42	161	1597	14.816	2.154	6.206	17.04

Sl. No.	Sample No.	Cu	Ga	Nb	Pb	Rb	Sc	Sr	Th	V	Zn	Zr	Be	Ge	Mo	Sn
211	BRS-211	28	64	239	32	219	5	75	41	78	299	1845	26.89	2.78	3.176	26.685
212	BRS-212	25	62	142	21	226	8	76	36	47	226	1104	16.419	1.996	3.437	21.755
213	BRS-213	38	59	155	14	147	16	63	34	154	172	1176	25.505	2.209	6.481	40.438
214	BRS-214	33	65	359	63	207	6	63	36	65	299	2116	11.297	2.312	6.637	14.791
215	BRS-215	32	38	223	39	272	5	83	41	63	273	1884	24.732	2.968	4.804	12.907
216	BRS-216	32	60	317	60	267	2	86	40	84	472	3141	31.223	3.283	3.63	42.631
217	BRS-217	30	60	223	33	280	3	65	36	51	291	1848	24.595	2.581	2.328	80.179
218	BRS-218	27	63	270	75	283	6	72	37	68	289	2381	25.113	2.936	3.356	10.509
219	BRS-219	34	65	204	42	242	4	64	39	55	264	2041	20.638	2.58	10.05	79.659
220	BRS-220	30	66	301	48	263	5	81	43	61	334	2310	29.445	3.212	4.085	78.582
221	BRS-221	28	37	165	37	223	5	81	40	42	222	1365	16.754	2.225	5.664	63.859
222	BRS-222	29	42	242	46	266	5	76	45	55	293	2337	24.869	2.721	2.56	75.566
223	BRS-223	37	58	441	47	328	3	74	52	75	493	5400	47.587	3.552	4.261	53.823
224	BRS-224	31	64	217	25	256	6	71	41	50	278	1816	24.429	2.647	2.158	31.226
225	BRS-225	30	64	295	42	374	8	69	40	32	276	2412	38.143	2.701	3.014	51.449
226	BRS-226	26	38	261	92	226	2	94	18	32	400	2118	30.486	1.762	2.387	36.198
227	BRS-227	30	73	250	35	423	5	64	43	27	340	2071	36.12	2.263	0.869	40.975
228	BRS-228	27	73	452	107	372	3	80	57	44	535	3264	56.908	3.634	0.985	92.863
229	BRS-229	37	48	123	7	115	11	76	37	135	161	902	5.03	2.003	1.172	31.466
230	BRS-230	29	56	214	18	156	7	72	36	105	101	2258	14.422	2.891	<0.5	31.3
231	BRS-231	23	58	202	21	233	2	69	41	49	250	1854	20.705	2.893	5.311	39.684
232	BRS-232	32	64	228	59	194	9	79	39	159	337	1921	17.65	3.68	7.082	37.537
233	BRS-233	25	60	302	50	289	4	86	41	61	320	2014	38.15	3.482	3.269	34.738
234	BRS-234	31	68	220	35	281	4	75	43	54	302	1981	22.701	2.721	5.239	34.595
235	BRS-235	27	53	223	43	253	7	73	44	59	287	1909	22.718	2.696	4.346	37.548
236	BRS-236	35	55	197	24	123	8	79	45	159	217	1192	9.265	2.179	2.227	14.152
237	BRS-237	30	70	243	20	132	4	89	42	169	266	1917	15.156	2.237	<0.5	21.198
238	BRS-238	32	65	185	20	118	11	77	45	166	273	1242	7.997	2.745	2.834	12.701
239	BRS-239	39	62	241	27	186	7	74	49	103	239	2344	17.521	2.764	1.667	61.043
240	BRS-240	37	57	294	34	180	2	68	49	124	310	2678	26.189	3.15	4.679	40.084
241	BRS-241	37	62	274	25	192	7	72	45	115	318	2643	30.198	3.209	1.772	41.191
242	BRS-242	37	57	287	30	203	2	68	44	117	257	2801	21.515	2.731	2.078	42.018
243	BRS-243	39	62	213	29	139	8	70	43	149	278	1725	14.904	2.974	3.576	29.78
244	BRS-244	42	58	221	30	147	11	81	40	145	261	1741	16.792	3.658	2.151	25.112
245	BRS-245	34	54	396	23	180	2	73	47	80	69	3745	27.421	1.804	5.847	70.058

Sl. No.	Sample No.	Cu	Ga	Nb	Pb	Rb	Sc	Sr	Th	V	Zn	Zr	Be	Ge	Mo	Sn
246	BRS-246	31	35	92	11	179	7	100	47	53	46	510	7.037	0.984	2.287	29.825
247	BRS-247	28	33	84	11	184	7	95	45	50	49	504	6.953	0.936	2.653	29.984
248	BRS-248	29	43	209	36	186	7	68	37	74	274	1672	15.468	2.436	7.71	48.209
249	BRS-249	24	42	370	109	195	8	82	54	84	345	3305	23.97	3.277	7.47	72.609
250	BRS-250	27	52	184	36	212	2	73	42	59	261	1868	16.623	2.529	7.396	39.453
251	BRS-251	31	61	192	24	169	8	65	35	105	266	1264	13.575	3.137	4.966	21.134
252	BRS-252	27	58	242	40	251	3	75	42	68	277	5742	15.227	2.455	3.855	39.839
253	BRS-253	43	54	363	62	229	9	88	40	80	336	9576	13.047	3.584	4.334	56.974
254	BRS-254	33	66	152	23	166	6	71	37	66	229	1190	11.241	2.104	4.671	14.617
255	BRS-255	30	53	385	38	230	5	76	51	82	296	4815	19.501	2.79	2.993	55.286
256	BRS-256	30	64	253	39	238	4	60	37	73	331	2011	19.211	2.267	4.257	28.132
257	BRS-257	31	62	236	29	212	7	65	41	73	279	2386	17.401	2.537	3.835	26.543
258	BRS-258	34	57	252	34	293	6	67	50	54	290	2719	20.728	2.147	3.115	36.751
259	BRS-259	24	51	190	31	283	5	71	54	55	228	1776	17.832	1.865	4.407	29.046
260	BRS-260	28	41	176	33	289	9	72	54	48	204	1440	16.826	1.804	4.25	25.237
261	BRS-261	34	50	270	60	307	3	78	65	53	317	2248	32.669	2.664	3.928	45.865
262	BRS-262	29	47	149	18	166	2	71	46	70	95	1005	8.318	1.778	9.047	12.63
263	BRS-263	30	48	137	20	178	2	62	38	57	179	1130	11.025	1.897	2.809	13.913
264	BRS-264	34	37	204	35	165	6	79	47	100	252	1679	12.56	2.298	5.34	20.949
265	BRS-265	27	56	133	25	178	4	66	40	41	165	1128	10.595	2.057	3.952	11.804

266	BRS-266	29	54	327	68	194	2	77	42	74	309	6996	13.101	3.214	7.506	43.75
267	BRS-267	34	50	377	78	190	2	80	43	79	326	8896	14.582	3.657	10.09	48.971
268	BRS-268	30	48	316	191	206	2	75	31	53	257	10173	19.923	3.677	5.935	32.307
269	BRS-269	42	63	202	38	153	7	72	40	132	234	1819	13.081	2.815	4.315	20.035
270	BRS-270	41	56	166	17	170	3	65	33	81	266	1629	12.05	2.177	5.993	27.867
271	BRS-271	32	52	199	29	153	5	77	39	138	222	1661	11.999	2.765	6.118	15.59
272	BRS-272	35	51	153	21	166	7	69	35	57	204	1329	11.548	1.894	5.163	14.233
273	BRS-273	34	55	201	25	180	3	72	51	75	170	1577	11.397	1.707	4.478	17.299
274	BRS-274	34	44	137	22	158	8	105	38	80	195	1061	9.096	2.056	4.084	13.676
275	BRS-275	28	41	165	30	169	6	78	44	84	208	1192	11.975	2.33	6.47	15.235
276	BRS-276	26	61	482	263	317	6	92	30	51	278	7586	32.428	3.404	8.53	92.457
277	BRS-277	42	54	248	44	257	6	62	36	97	401	3517	19.233	2.926	4.002	81.427
278	BRS-278	42	45	309	57	191	9	117	55	112	369	2294	19.601	2.645	3.585	35.553
279	BRS-279	33	66	305	25	307	4	66	40	80	345	1658	33.636	2.938	4.04	27.214
280	BRS-280	30	36	364	42	243	2	84	71	82	523	1815	35.982	3.876	4.471	38.278

Sl. No.	Sample No.	Cu	Ga	Nb	Pb	Rb	Sc	Sr	Th	V	Zn	Zr	Be	Ge	Mo	Sn
281	BRS-281	33	43	171	35	253	6	71	41	51	251	1690	13.562	2.37	4.433	27.688
282	BRS-282	34	42	171	56	268	5	80	42	47	356	1594	19.545	2.285	17.75	27.34
283	BRS-283	29	45	178	32	279	2	77	43	47	230	1849	19.95	3.262	12.71	33.333
284	BRS-284	27	39	189	35	158	10	106	53	109	218	1426	10.928	2.482	1.914	18.285
285	BRS-285	27	49	240	47	180	6	71	46	62	312	1869	21.002	2.278	5.315	25.45
286	BRS-286	43	52	177	15	108	9	77	40	175	189	1226	14.154	2.461	4.056	33.144
287	BRS-287	43	34	211	29	113	10	90	50	244	196	1326	9.207	2.14	4.111	39.454
288	BRS-288	51	45	298	53	161	4	61	38	107	215	1827	15.712	3.452	5.397	79.554
289	BRS-289	30	22	119	47	225	26	180	58	45	220	1540	7.535	1.335	3.843	14.985
290	BRS-290	23	63	216	23	205	8	64	42	103	300	2048	18.825	2.435	2.927	42
291	BRS-291	30	51	229	33	197	6	70	44	117	257	1858	14.352	1.928	5.22	45.423
292	BRS-292	26	44	208	28	213	12	70	45	98	246	1980	13.123	3.004	1.926	48.405
293	BRS-293	32	54	350	52	253	8	83	55	100	375	3714	24.826	3.665	5.884	85.238
294	BRS-294	31	41	386	58	268	6	100	60	99	439	3546	31.366	3.541	7.029	56.504
295	BRS-295	32	59	372	144	273	2	83	41	81	407	2360	27.101	3.325	7.383	90.913
296	BRS-296	25	50	208	71	258	2	84	40	58	295	2197	21.702	3.206	4.743	68.954
297	BRS-297	32	47	215	35	179	9	91	44	98	255	2094	14.747	2.315	4.178	70.382
298	BRS-298	37	56	239	18	226	6	72	39	83	281	1881	18.626	2.537	2.436	78.223
299	BRS-299	21	53	182	32	183	6	73	44	59	174	1762	11.372	2.989	1.802	63.92
300	BRS-300	37	63	180	28	161	9	80	44	108	237	1513	10.604	2.538	1.333	55.256

Annexure-V: Details of chemical analysis results of channel samples from Indrana – Siwana area

Sl. No.	Sample No.	Y ppm	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Hf ppm	Ta ppm	W ppm	U ppm	ΣREE+Y ppm
1	SM-II/VVK/CH-1/1/21-22	340.35	144.00	392.06	39.66	172.88	39.05	3.92	37.76	8.27	51.79	10.29	32.16	5.23	34.89	5.30	59.03	3.24	<0.50	4.77	1317.60
2	SM-II/VVK/CH-1/2/21-22	916.65	208.40	494.16	60.05	274.70	70.31	7.13	73.73	18.93	134.90	29.25	96.27	16.24	104.71	14.70	288.15	14.58	3.25	14.61	2520.14
3	SM-II/VVK/CH-1/3/21-22	277.74	57.52	203.41	18.87	83.28	21.08	2.16	22.25	5.82	41.04	8.70	29.07	5.07	35.05	5.56	102.88	2.80	4.20	6.36	816.61
4	SM-II/VVK/CH-1/4/21-22	690.43	145.05	471.10	49.48	220.71	55.38	5.40	54.12	14.28	103.90	21.99	71.67	12.17	78.24	11.53	229.12	11.56	5.95	11.85	2005.45
5	SM-II/VVK/CH-1/5/21-22	563.03	311.21	616.04	81.36	348.61	72.29	6.81	65.76	13.24	81.50	15.71	48.47	7.63	47.22	6.48	77.46	5.78	2.87	12.67	2285.34
6	SM-II/VVK/CH-1/6/21-22	757.15	148.52	498.72	50.76	230.03	59.68	6.00	60.12	16.26	116.63	24.64	78.75	13.39	86.62	12.44	234.59	11.30	<0.50	12.88	2159.70
7	SM-II/VVK/CH-1/7/21-22	533.03	57.49	251.49	19.98	90.12	23.89	2.47	25.11	7.83	68.31	17.33	66.46	12.19	80.60	11.76	175.36	4.83	<0.50	10.58	1268.05
8	SM-II/VVK/CH-1/8/21-22	565.29	44.11	276.31	17.31	81.80	26.14	3.10	31.25	9.86	79.21	18.57	66.89	12.23	82.47	11.89	197.99	13.77	4.76	11.40	1326.44
9	SM-II/VVK/CH-1/9/21-22	218.15	94.27	295.88	26.21	113.48	25.19	2.55	24.09	5.23	33.04	6.50	20.24	3.32	21.88	3.32	50.41	3.40	2.85	4.95	893.34
10	SM-II/VVK/CH-1/10/21-22	275.44	134.51	357.83	40.90	180.96	39.02	3.67	35.26	7.30	44.99	8.68	26.54	4.21	27.01	4.02	56.00	3.00	3.73	4.93	1190.35
11	SM-II/VVK/CH-1/11/21-22	304.88	148.78	445.01	44.67	196.54	42.14	4.06	38.75	8.18	50.13	9.71	29.45	4.62	29.32	4.38	52.10	3.19	2.14	5.31	1360.62
12	SM-II/VVK/CH-1/12/21-22	247.66	150.47	378.09	40.73	177.07	37.02	3.53	34.31	6.90	40.33	7.76	23.76	3.70	24.35	3.68	44.51	3.02	<0.50	4.63	1179.36
13	SM-II/VVK/CH-1/13/21-22	230.62	147.23	382.12	41.18	180.00	37.53	3.53	33.09	6.71	40.08	7.55	23.12	3.63	23.43	3.57	34.13	3.29	<0.50	4.07	1163.37
14	SM-II/VVK/CH-1/14/21-22	257.69	142.38	410.51	42.56	189.42	42.02	3.96	38.03	7.57	44.66	8.48	25.61	3.94	25.01	3.64	40.91	4.10	<0.50	4.79	1245.46
15	SM-II/VVK/CH-1/15/21-22	274.38	159.75	502.42	41.64	182.01	39.34	3.86	38.10	7.71	46.72	8.73	26.05	4.15	26.99	4.05	45.31	2.52	<0.50	5.08	1365.89
16	SM-II/VVK/CH-1/16/21-22	283.11	160.59	551.97	45.25	197.52	43.47	4.25	41.49	8.30	48.07	9.08	26.94	4.23	27.20	4.06	43.12	7.06	1.54	4.36	1455.53
17	SM-II/VVK/CH-1/17/21-22	282.43	181.11	431.20	51.17	224.54	46.65	4.29	40.91	7.98	46.60	8.92	27.13	4.25	27.75	4.25	43.92	4.65	<0.50	4.81	1389.18
18	SM-II/VVK/CH-1/18/21-22	347.59	231.43	534.89	62.98	279.14	59.05	5.49	53.89	10.27	58.78	11.05	33.16	5.08	32.73	4.86	47.00	1.08	<0.50	4.92	1730.37
19	SM-II/VVK/CH-1/19/21-22	306.55	170.51	407.92	46.50	200.68	41.89	4.05	38.89	7.93	48.53	9.20	28.38	4.41	28.03	4.24	42.82	5.67	<0.50	4.99	1347.69
20	SM-II/VVK/CH-1/20/21-22	294.85	155.37	387.07	44.67	200.55	42.84	4.20	40.09	8.14	49.13	9.36	28.16	4.36	27.72	4.06	44.70	2.22	1.33	4.50	1300.58
21	SM-II/VVK/CH-1/21/21-22	235.11	138.81	333.24	38.17	167.01	34.60	3.31	30.93	6.34	38.27	7.43	23.18	3.75	24.49	3.77	41.15	3.63	<0.50	3.92	1088.40
22	SM-II/VVK/CH-1/22/21-22	290.59	200.31	422.80	52.07	228.49	46.46	4.30	40.68	7.92	46.95	8.91	27.01	4.23	27.53	4.17	49.28	3.02	0.79	5.54	1412.42
23	SM-II/VVK/CH-1/23/21-22	293.15	192.84	404.46	56.74	244.27	49.24	4.65	44.33	8.89	51.91	10.66	30.86	4.80	31.20	4.44	53.39	3.47	9.18	7.53	1432.43
24	SM-II/VVK/CH-1/24/21-22	354.16	187.86	415.84	57.12	253.92	54.94	5.29	49.31	10.39	61.75	12.20	37.23	5.72	37.04	5.30	59.09	3.52	9.26	7.47	1548.04
25	SM-II/VVK/CH-1/25/21-22	216.52	111.40	251.26	33.37	150.42	32.06	3.18	29.23	6.31	38.76	7.62	23.73	3.69	24.27	3.59	35.97	2.14	5.66	4.52	935.42

Sl. No.	Sample No.	Y ppm	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Hf ppm	Ta ppm	W ppm	U ppm	ΣREE+Y ppm
26	SM-II/VVK/CH-1/26/21-22	297.01	193.43	427.50	56.82	252.23	52.49	4.99	46.06	9.33	55.23	10.39	32.06	4.86	32.06	4.62	47.11	3.34	5.37	5.96	1479.08
27	SM-II/VVK/CH-1/27/21-22	295.56	194.62	444.22	55.80	241.77	50.47	4.79	44.49	8.88	52.71	9.95	30.89	4.82	31.80	4.77	55.00	2.31	5.24	5.92	1475.54
28	SM-II/VVK/CH-1/28/21-22	182.12	111.47	254.32	32.10	141.19	29.86	2.89	26.13	5.47	32.21	6.19	18.98	2.94	19.95	2.96	34.35	1.50	6.03	3.79	868.78
29	SM-II/VVK/CH-1/29/21-22	253.78	175.34	374.15	49.59	217.91	44.85	4.23	39.16	7.82	45.68	8.64	26.55	4.11	27.35	4.12	48.79	2.82	2.43	5.24	1283.28
30	SM-II/VVK/CH-1/30/21-22	247.21	173.76	380.75	48.71	214.56	43.60	4.15	38.10	7.60	43.45	8.34	25.56	3.94	26.16	3.89	49.43	2.84	4.66	5.77	1269.77
31	SM-II/VVK/CH-1/31/21-22	281.87	193.65	439.86	56.79	248.93	50.93	4.77	44.32	8.66	50.15	9.48	28.47	4.39	28.45	4.28	51.49	2.60	3.85	5.92	1454.99
32	SM-II/VVK/CH-1/32/21-22	278.32	199.70	427.76	55.68	245.33	50.49	4.83	44.70	8.72	49.47	9.44	28.17	4.33	29.12	4.37	50.75	2.70	7.21	5.10	1440.42
33	SM-II/VVK/CH-1/33/21-22	239.97	158.54	350.21	47.14	210.13	44.04	4.15	38.39	7.71	44.76	8.53	25.56	3.93	25.72	3.79	41.22	1.69	5.83	4.85	1212.57
34	SM-II/VVK/CH-1/34/21-22	224.29	133.95	307.15	39.84	177.65	37.81	3.64	33.52	6.90	41.65	7.92	24.21	3.81	24.73	3.64	48.37	2.40	9.46	4.73	1070.69
35	SM-II/VVK/CH-1/35/21-22	226.83	132.85	327.56	40.87	179.80	34.18	3.35	31.72	6.38	38.61	8.56	21.68	3.36	22.70	3.49	41.68	2.70	5.08	4.48	1081.93
36	SM-II/VVK/CH-1/36/21-22	294.31	174.32	409.43	48.21	209.79	44.18	4.40	40.75	8.07	48.04	9.05	27.76	4.32	28.88	4.35	45.55	2.47	0.74	4.53	1355.85
37	SM-II/VVK/CH-1/37/21-22	271.55	135.75	354.55	39.44	174.46	37.82	3.70	33.85	7.06	43.22	8.24	25.61	4.01	25.95	3.93	46.26	2.23	4.28	4.66	1169.14
38	SM-II/VVK/CH-1/38/21-22	213.57	87.66	343.80	26.02	115.38	26.40	2.76	25.29	5.23	32.78	6.16	19.08	3.04	20.29	3.06	39.09	1.21	5.39	5.10	930.54
39	SM-II/VVK/CH-1/39/21-22	199.51	114.36	287.56	32.03	141.17	29.87	2.94	27.00	5.27	31.03	5.81	18.05	2.88	19.17	2.95	30.87	2.85	3.26	3.52	919.58
40	SM-II/VVK/CH-1/40/21-22	215.32	94.83	309.93	28.59	126.98	28.69	2.87	26.84	5.53	34.39	6.50	20.27	3.20	21.95	3.39	36.54	2.35	4.58	3.51	929.29
41	SM-II/VVK/CH-1/41/21-22	208.50	87.98	286.54	27.55	123.09	27.77	2.85	25.79	5.31	32.86	6.10	18.94	2.96	20.04	3.13	32.09	3.43	1.57	4.47	879.41
42	SM-II/VVK/CH-1/42/21-22	605.29	83.03	549.19	20.82	90.55	22.85	2.72	28.13	7.98	66.58	15.25	54.19	9.43	61.88	9.19	107.31	4.82	2.51	4.97	1627.06
43	SM-II/VVK/CH-1/43/21-22	484.63	113.73	577.97	31.06	129.86	28.02	2.94	27.14	6.17	40.66	7.86	24.71	3.83	25.27	3.78	43.77	4.06	4.76	4.99	1507.63
44	SM-II/VVK/CH-1/44/21-22	277.24	171.65	380.85	45.45	200.54	42.89	4.15	37.76	7.51	45.38	8.57	26.29	4.09	27.09	4.04	43.74	4.69	0.86	4.73	1283.49
45	SM-II/VVK/CH-1/45/21-22	289.10	145.38	352.66	45.48	205.37	44.77	4.38	40.04	8.08	49.57	9.32	28.40	4.54	29.87	4.50	46.46	3.24	7.03	5.34	1261.48
46	SM-II/VVK/CH-1/46/21-22	226.87	154.14	318.78	44.31	195.41	40.97	3.98	35.60	6.75	39.09	7.20	21.94	3.51	23.74	3.69	38.21	3.57	1.47	5.11	1125.98
47	SM-II/VVK/CH-1/47/21-22	183.15	140.81	291.87	35.80	153.04	31.13	3.05	27.57	5.28	31.42	5.86	18.24	2.93	19.74	3.08	35.71	2.87	5.49	5.50	952.96
48	SM-II/VVK/CH-1/48/21-22	246.57	146.57	342.99	40.34	173.91	35.49	3.57	32.21	6.43	40.57	7.79	24.33	3.91	26.35	4.02	41.90	4.52	0.16	5.05	1135.06
49	SM-II/VVK/CH-1/49/21-22	230.16	127.54	303.33	34.80	143.18	30.67	3.08	28.28	6.39	40.84	7.87	24.42	3.98	24.93	3.80	40.43	7.94	1.23	4.83	1013.27
50	SM-II/VVK/CH-1/50/21-22	252.63	134.10	314.40	33.86	144.60	29.64	3.07	28.41	6.04	39.71	7.67	24.60	3.99	26.52	3.92	39.44	5.67	3.98	5.19	1053.15

Sl. No.	Sample No.	Y ppm	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Hf ppm	Ta ppm	W ppm	U ppm	ΣREE+Y ppm
51	SM-II/VVK/CH-1/51/21-22	772.55	72.73	465.00	25.31	119.35	36.48	4.22	45.92	14.71	121.45	27.23	92.79	15.68	101.35	14.33	239.00	15.58	8.07	9.79	1929.09
52	SM-II/VVK/CH-1/52/21-22	319.47	52.44	210.31	17.53	79.27	21.20	2.18	23.18	6.39	49.18	10.86	37.14	6.53	45.84	7.21	206.05	5.76	3.57	8.77	888.72
53	SM-II/VVK/CH-1/53/21-22	306.91	156.75	412.80	43.92	190.82	41.05	4.03	38.12	8.10	51.48	9.97	31.23	4.91	32.46	4.89	48.81	5.18	5.09	5.53	1337.43
54	SM-II/VVK/CH-2/1/21-22	161.10	91.82	192.08	27.98	125.57	28.91	4.93	25.28	5.11	31.18	5.96	18.75	3.01	19.83	3.04	38.48	2.27	2.57	3.01	744.53
55	SM-II/VVK/CH-2/2/21-22	1424.05	688.83	1522.80	191.82	822.87	176.20	18.24	172.01	36.05	228.29	45.01	140.07	21.46	136.00	19.11	319.52	21.57	4.07	30.83	5642.78
56	SM-II/VVK/CH-2/3/21-22	794.65	490.53	1045.23	128.47	536.41	109.84	10.53	103.38	21.20	131.62	25.59	80.06	12.33	78.22	10.83	162.59	12.46	3.47	15.56	3578.89
57	SM-II/VVK/CH-2/4/21-22	715.68	462.53	1037.57	125.43	529.54	107.12	10.21	97.50	19.53	122.73	23.72	74.44	11.57	72.58	10.30	157.24	6.40	8.01	15.24	3420.45
58	SM-II/VVK/CH-2/5/21-22	992.69	522.62	1151.06	144.83	599.52	128.25	12.84	121.40	25.73	164.13	31.90	98.59	15.22	96.11	13.31	203.19	17.92	4.09	20.16	4118.19
59	SM-II/VVK/CH-2/6/21-22	151.49	78.41	196.48	24.62	112.69	25.41	4.39	23.20	4.50	26.59	5.13	16.32	2.67	18.26	2.81	35.91	3.48	7.50	3.35	692.98
60	SM-II/VVK/CH-3/1/21-22	146.01	84.94	189.77	25.52	115.39	25.72	4.71	23.33	4.63	27.38	5.11	15.59	2.48	16.27	2.50	31.04	3.28	9.97	2.97	689.33
61	SM-II/VVK/CH-3/2/21-22	943.06	448.65	986.97	124.86	540.29	117.77	11.92	111.98	23.44	147.68	28.33	89.47	13.66	86.24	12.43	181.15	17.08	4.90	17.27	3686.74
62	SM-II/VVK/CH-3/3/21-22	126.08	92.13	209.73	26.98	118.53	26.22	4.38	22.84	4.38	25.02	4.58	14.21	2.29	15.38	2.42	30.26	3.09	6.03	2.87	695.17
63	SM-II/VVK/CH-3/4/21-22	153.08	95.55	195.90	27.50	123.55	28.72	4.76	25.48	5.21	30.78	5.62	17.34	2.78	18.31	2.80	34.04	4.29	5.79	3.69	737.38
64	SM-II/VVK/CH-3/5/21-22	132.17	114.25	232.05	30.53	133.65	27.33	4.65	23.68	4.61	26.85	4.90	15.27	2.37	15.99	2.49	29.42	2.88	6.13	3.03	770.77
65	SM-II/VVK/CH-3/6/21-22	1508.82	855.28	1897.54	236.68	995.26	205.01	20.64	194.11	39.50	244.14	46.96	145.99	22.36	140.92	19.57	315.20	32.48	3.06	31.74	6572.76
66	SM-II/VVK/CH-3/7/21-22	132.35	111.75	247.48	30.24	130.06	26.14	4.16	22.56	4.08	23.94	4.64	15.38	2.55	17.30	2.66	33.28	3.69	2.84	3.53	775.28
67	SM-II/VVK/CH-4/1/21-22	216.91	97.16	238.71	30.60	136.72	31.70	4.35	29.26	6.16	38.78	7.32	23.02	3.59	23.16	3.52	50.53	3.39	0.98	4.13	890.93
68	SM-II/VVK/CH-4/2/21-22	624.51	390.83	858.90	101.81	422.00	85.06	5.97	76.69	16.56	99.26	19.17	60.23	9.31	58.41	8.40	143.66	8.10	1.10	11.90	2837.12
69	SM-II/VVK/CH-4/3/21-22	603.77	375.59	801.60	97.70	404.83	82.91	5.77	74.47	16.12	96.28	18.63	58.18	9.00	56.53	8.14	136.82	9.11	3.06	11.84	2709.52
70	SM-II/VVK/CH-4/4/21-22	164.06	88.22	223.47	27.70	126.96	28.00	5.14	24.13	5.09	30.11	5.73	17.42	2.68	17.34	2.65	34.55	2.22	<0.50	2.22	768.69
71	SM-II/VVK/CH-5/1/21-22	255.84	108.62	268.03	76.43	338.21	35.37	6.15	47.30	10.50	54.66	23.83	24.95	3.75	23.47	3.56	45.19	1.90	2.09	3.62	1280.65
72	SM-II/VVK/CH-5/2/21-22	1913.54	1094.07	2337.47	309.02	1331.55	289.70	28.60	266.15	55.64	329.28	64.45	193.41	28.30	183.48	24.13	407.15	53.83	4.56	39.41	8448.79
73	SM-II/VVK/CH-5/3/21-22	2005.14	1161.18	2462.38	312.16	1313.47	256.94	24.25	233.76	50.06	304.11	58.87	181.07	27.40	168.64	23.56	371.14	36.64	5.29	34.68	8582.98
74	SM-II/VVK/CH-5/4/21-22	292.44	163.99	391.07	46.03	201.07	41.47	5.98	35.85	7.72	47.51	9.25	29.52	4.65	28.53	4.16	57.95	3.37	5.09	4.90	1309.24
75	SM-II/VVK/CH-6/1/21-22	407.71	191.67	542.11	57.25	255.57	60.13	5.68	56.08	11.88	78.51	15.45	47.28	7.64	46.87	7.05	112.50	13.69	1.13	10.04	1790.86

Sl. No.	Sample No.	Y ppm	La ppm	Ce ppm	Pr ppm	Nd ppm	Sm ppm	Eu ppm	Gd ppm	Tb ppm	Dy ppm	Ho ppm	Er ppm	Tm ppm	Yb ppm	Lu ppm	Hf ppm	Ta ppm	W ppm	U ppm	ΣREE+Y ppm
76	SM-II/VVK/CH-6/2/21-22	103.47	59.18	124.15	17.25	75.14	15.91	1.37	13.32	2.95	18.70	3.86	13.43	2.61	20.97	3.94	39.15	2.01	6.09	1.65	476.25
77	SM-II/VVK/CH-6/3/21-22	242.02	155.29	368.02	44.64	188.79	37.06	3.55	32.34	6.79	39.83	7.56	24.25	3.95	26.55	4.28	70.38	3.90	5.29	5.35	1184.94
78	SM-II/VVK/CH-6/4/21-22	447.18	255.29	563.59	70.63	307.80	61.95	5.73	55.50	11.88	69.04	13.55	42.48	6.89	44.96	7.10	147.80	3.62	9.87	9.88	1963.56
79	SM-II/VVK/CH-6/5/21-22	555.87	275.26	757.76	84.80	381.04	86.27	8.77	74.91	15.44	90.40	16.93	52.56	8.37	53.69	8.09	159.25	8.52	3.58	11.06	2470.16
80	SM-II/VVK/CH-6/6/21-22	393.29	153.52	446.35	43.48	195.97	46.76	4.44	43.71	10.00	61.92	12.14	38.51	6.24	40.70	6.28	95.09	3.65	11.64	8.39	1503.30
81	SM-II/VVK/CH-7/1/21-22	378.85	259.82	571.70	71.89	305.36	60.37	5.62	52.40	10.85	62.64	12.11	36.30	5.55	35.67	5.22	55.89	3.70	9.78	7.53	1874.32
82	SM-II/VVK/CH-7/2/21-22	1353.87	276.99	1017.94	98.01	471.56	133.53	13.40	131.40	33.02	211.35	41.37	129.92	20.30	126.67	18.30	267.01	12.99	4.29	25.80	4077.63
83	SM-II/VVK/CH-7/3/21-22	1208.53	356.52	1098.16	120.30	553.19	131.93	12.70	125.26	29.28	182.82	35.83	112.19	17.78	111.19	15.82	213.64	20.22	6.18	21.34	4111.49
84	SM-II/VVK/CH-7/4/21-22	409.54	310.50	660.21	77.19	319.35	62.28	5.67	53.96	11.44	69.37	13.46	43.50	6.95	44.24	6.73	82.16	3.97	3.84	9.41	2094.38
85	SM-II/VVK/CH-8/1/21-22	337.68	405.70	703.01	77.89	303.24	54.85	5.11	49.43	9.47	54.12	10.15	31.62	4.86	30.73	4.50	60.14	3.75	4.08	8.57	2082.34
86	SM-II/VVK/CH-8/2/21-22	1448.17	758.23	1840.90	219.88	936.42	195.22	17.49	175.60	38.44	234.45	44.95	139.61	21.10	128.30	17.98	220.16	16.17	3.82	23.53	6216.72
87	SM-II/VVK/CH-8/3/21-22	391.95	512.45	1006.13	106.51	410.58	65.63	5.71	58.90	10.88	62.16	12.02	38.65	6.11	39.13	5.89	80.30	4.05	6.03	11.25	2732.70
88	SM-II/VVK/CH-9/1/21-22	1036.69	1049.96	1783.10	264.58	1034.22	164.35	12.77	138.42	27.79	164.43	31.70	101.28	15.77	100.56	14.51	159.74	11.34	3.42	20.45	5940.13
89	SM-II/VVK/CH-9/2/21-22	1531.85	637.69	1187.78	216.31	969.34	207.22	18.29	175.95	39.15	237.52	46.73	147.02	22.63	142.71	20.12	301.52	19.11	7.09	30.13	5600.32
90	SM-II/VVK/CH-9/3/21-22	944.59	534.49	1220.04	150.54	624.75	133.85	11.59	118.63	25.69	152.57	28.69	88.48	13.62	85.03	12.08	214.75	14.64	5.49	23.36	4144.63
91	SM-II/VVK/CH-10/1/21-22	451.99	230.47	497.17	62.36	269.38	58.71	5.53	52.28	11.72	71.35	13.89	45.10	7.34	48.35	7.34	128.18	4.44	3.19	9.69	1832.98
92	SM-II/VVK/CH-10/2/21-22	1264.37	242.68	939.21	90.66	433.08	119.06	11.44	118.19	31.07	210.60	43.88	142.61	22.97	145.28	21.20	355.55	18.22	2.47	15.09	3836.30
93	SM-II/VVK/CH-10/3/21-22	1154.09	252.30	784.35	89.43	445.01	118.89	10.96	114.54	28.68	186.26	37.25	120.18	19.18	117.83	17.27	338.49	19.14	5.03	18.60	3496.22
94	SM-II/VVK/CH-10/4/21-22	433.30	337.37	681.24	91.64	395.72	79.63	7.07	64.49	13.49	77.54	14.71	47.06	7.66	50.74	7.62	90.28	6.13	8.11	9.10	2309.29
95	SM-II/VVK/CH-11/1/21-22	1023.99	467.63	1248.51	116.78	513.07	120.73	11.04	113.22	26.27	164.99	31.72	99.57	15.63	97.78	13.92	138.48	12.92	8.94	14.88	4064.83
96	SM-II/VVK/CH-11/2/21-22	1386.08	580.06	1315.99	172.17	735.53	174.58	16.09	155.66	35.31	218.98	42.34	133.75	21.04	134.06	19.26	272.76	22.24	7.96	26.37	5140.89
97	SM-II/VVK/CH-11/3/21-22	887.54	481.08	1128.96	132.37	552.29	116.80	10.38	106.12	23.03	139.46	26.94	84.54	12.94	80.74	11.87	186.74	10.87	7.06	17.50	3795.06
98	SM-II/VVK/CH-11/4/21-22	1471.14	757.79	1669.68	219.23	948.28	196.89	17.37	175.13	38.10	235.93	45.47	141.14	22.38	138.42	19.80	278.76	22.45	10.74	26.70	6096.73
99	SM-II/VVK/CH-11/5/21-22	1382.25	684.60	1546.15	198.97	847.77	180.78	15.68	160.53	35.36	214.33	41.31	129.01	19.85	125.53	18.04	264.33	21.71	9.56	25.17	5600.17
100	SM-II/VVK/CH-11/6/21-22	1679.22	934.22	1999.76	265.93	1134.83	220.75	19.96	202.14	43.73	265.22	51.63	156.61	23.89	141.11	19.64	220.48	18.16	6.33	22.91	7158.63

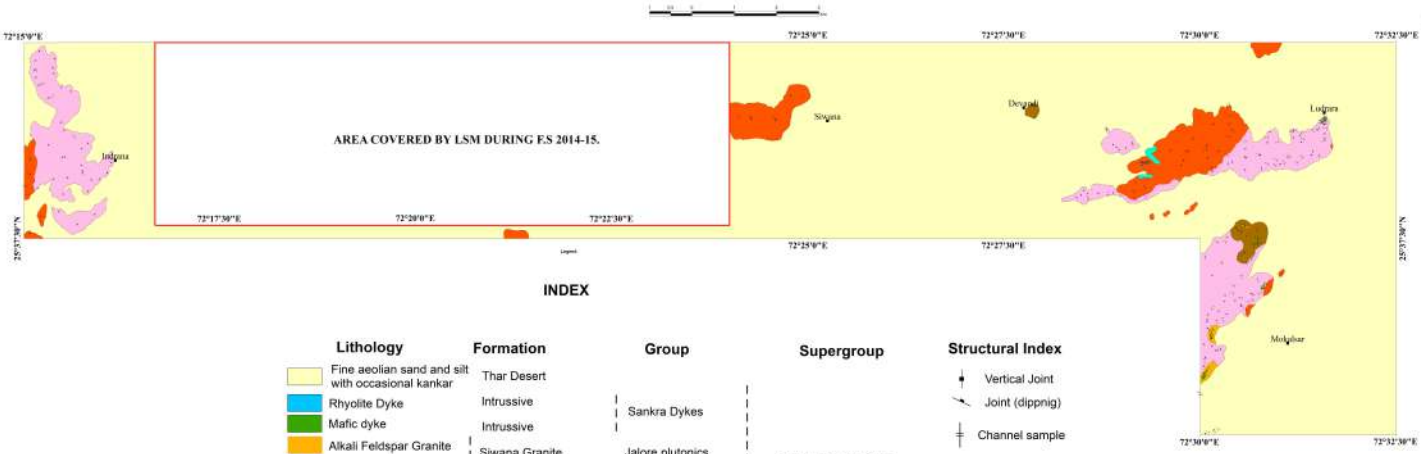
Annexure-VI: Details of chemical analysis results of petrochemical samples from the study area

Sl. No.	Sample No	SiO2 %	Al2O3 %	Fe2O3 %	MnO %	MgO %	CaO %	Na2O %	K2O %	TiO2 %	P2O5 %	Ba ppm	Co ppm	Cr ppm	Cu ppm	Ga ppm	Nb ppm	Pb ppm	Rb ppm	Sc ppm	Sr ppm	Th ppm	V ppm	Zn ppm	Zr ppm	Ni ppm
1	PCS-1	69.70	10.38	6.23	0.14	0.03	0.50	4.60	4.78	0.45	0.04	336	4	107	30	44	171	37	171	2	71	43	54	280	1564	29
2	PCS-2	69.64	9.12	8.27	0.15	0.15	0.28	4.54	3.58	0.44	0.03	389	6	50	31	28	189	51	183	5	91	56	74	256	863	27
3	PCS-3	69.75	8.98	8.33	0.14	0.40	0.32	4.12	4.55	0.44	0.04	646	6	112	48	49	300	38	218	2	70	44	79	353	3578	29
4	PCS-4	64.12	10.76	9.70	0.15	1.20	0.73	4.83	4.60	0.56	0.11	602	4	102	31	70	268	20	202	5	68	49	98	256	2716	33
5	PCS-5	69.60	5.54	11.29	0.21	1.58	0.26	4.12	1.72	0.19	0.08	1343	14	91	29	33	784	143	128	2	86	73	61	746	9421	37
6	PCS-6	70.51	7.33	9.12	0.10	0.52	0.45	3.25	4.48	0.31	0.05	915	7	66	27	65	564	74	429	2	88	56	65	400	3113	34
7	PCS-7	74.21	9.71	3.72	0.06	0.19	0.24	3.25	4.74	0.27	0.03	119	7	52	21	68	168	30	314	1	62	42	28	216	1547	24
8	PCS-8	56.24	14.77	10.66	0.08	0.19	0.95	4.49	6.97	0.82	0.11	695	3	47	36	58	171	14	179	7	72	51	138	154	1431	28
9	PCS-9	58.84	14.32	9.92	0.14	0.71	2.01	5.09	4.98	0.82	0.26	759	9	47	34	51	121	8	114	11	80	39	136	158	799	27
10	PCS-10	53.88	15.74	12.28	0.22	0.94	1.30	5.47	5.09	1.10	0.24	1001	8	58	51	55	129	10	117	15	110	42	202	141	715	31
11	PCS-11	60.91	11.97	11.65	0.34	0.97	0.40	4.26	4.63	0.78	0.15	495	13	61	43	68	181	15	126	4	80	41	156	232	1250	33
12	PCS-12	68.09	11.51	7.00	0.08	0.79	0.38	1.86	5.17	0.52	0.06	577	3	43	38	56	210	13	219	3	73	45	72	89	1933	24
13	PCS-13	66.93	11.59	5.81	0.12	0.19	0.63	4.61	4.72	0.49	0.08	501	6	44	27	61	223	38	281	3	70	59	56	228	2262	26
14	PCS-14	69.46	10.85	6.49	0.20	0.24	0.15	3.41	4.78	0.59	0.07	607	8	63	32	76	142	15	165	4	60	38	69	168	1217	27
15	PCS-15	72.10	7.83	8.29	0.16	0.13	0.15	3.43	3.83	0.21	0.05	434	11	56	34	54	307	207	212	5	77	34	46	259	10121	29
16	PCS-16	68.97	10.48	5.81	0.13	0.18	0.46	4.49	4.65	0.48	0.06	371	3	55	20	61	143	26	173	3	64	39	59	192	1301	19
17	PCS-17	66.74	8.33	10.77	0.14	0.76	0.33	3.14	5.27	0.33	0.25	425	10	64	38	70	295	29	249	2	60	37	84	507	2190	31
18	PCS-18	71.00	9.78	5.32	0.08	0.24	0.27	4.00	4.06	0.41	0.05	406	4	53	25	59	173	29	246	4	66	48	47	514	2178	22
19	PCS-19	66.61	5.76	14.71	0.15	0.09	0.24	4.05	3.46	0.23	0.06	645	20	77	48	47	262	43	151	1	61	38	85	164	2162	33
20	PCS-20	67.08	9.32	11.70	0.07	0.62	0.50	0.15	4.76	0.63	0.07	832	4	74	36	57	360	32	204	4	80	53	128	324	3887	30

Plate-1

Large scale geological map of the Indrana-Siwana area,Siwana Ring Complex (SRC), Barmer District, Rajasthan.

(in parts of toposheet no. 45C/06 and 45C/10)



INDEX

Lithology	Formation	Group	Supergroup
Fine aeolian sand and silt with occasional kankar	Thar Desert		
Rhyolite Dyke	Intrussive	Sankra Dykes	
Mafic dyke	Intrussive		
Alkali Feldspar Granite	Siwana Granite	Jalore plutonics	Malani Igneous Suite
Granite			
Pyroclastic Flow			
Rhyolite	Kailana Felsic Volcanics	Jhodhpur Volcanics	
Porphyritic Rhyolite			

Structural Index

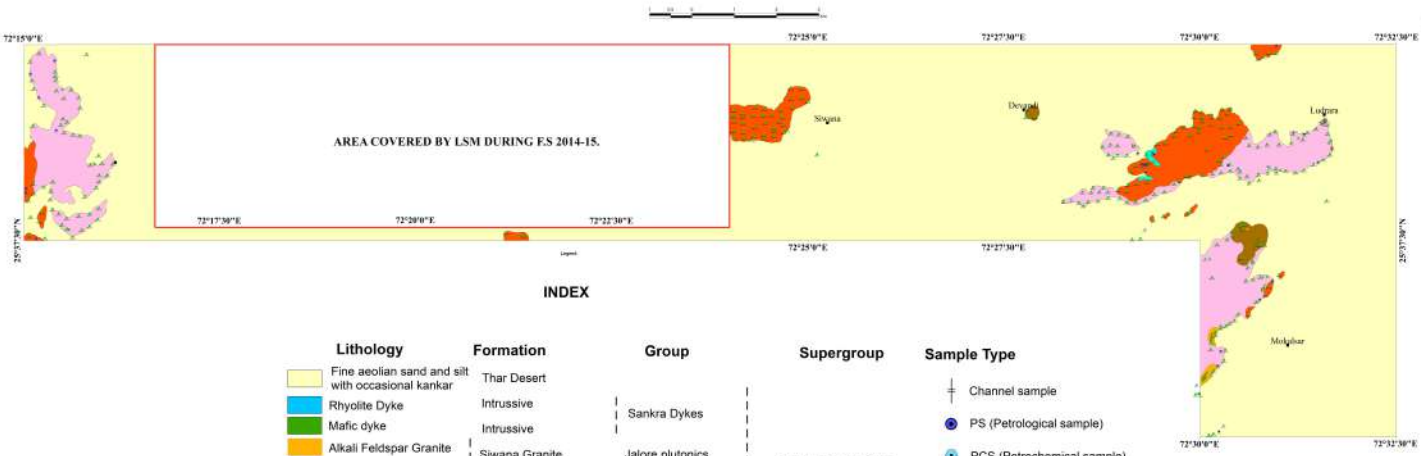
- Vertical Joint
- Joint (dippnig)
- Channel sample

Mapped by,
VIVEK V.KUMAR, Sr.Geologist
Dr. Kiran Jyoti Mishra, Sr.Geologist
Project SM-II Division,F.S 2021-22.

Plate-2

Large scale geological map of the Indrana-Siwana area,Siwana Ring Complex (SRC) showing sample locations.

(in parts of toposheet no. 45C/06 and 45C/10)



INDEX

Lithology	Formation	Group	Supergroup
Fine aeolian sand and silt with occasional kankar	Thar Desert		
Rhyolite Dyke	Intrussive	Sankra Dykes	
Mafic dyke	Intrussive		
Alkali Feldspar Granite	Siwana Granite	Jalore plutonics	Malani Igneous Suite
Granite			
Pyroclastic Flow			
Rhyolite	Kailana Felsic Volcanics	Jhodhpur Volcanics	
Porphyritic Rhyolite			

Sample Type

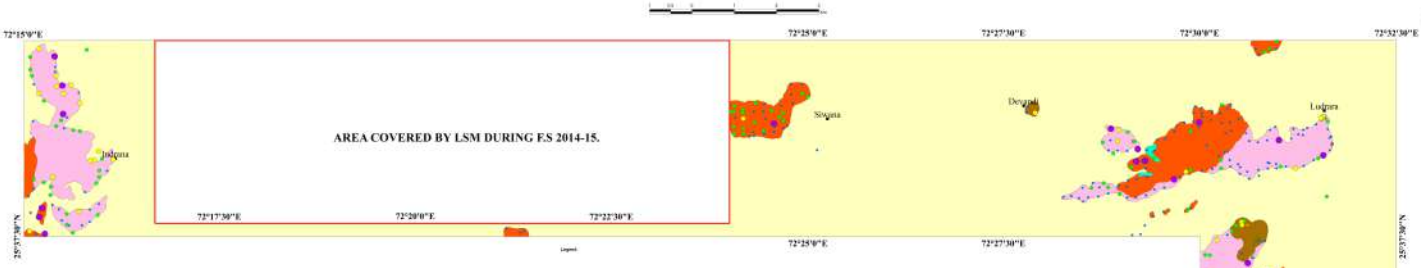
- Channel sample
- PS (Petrological sample)
- PCS (Petrochemical sample)
- BRS (Bed rock sample)

Mapped by,
VIVEK V.KUMAR, Sr.Geologist
Dr. Kiran Jyoti Mishra, Sr.Geologist
Project SM-II Division,F.S 2021-22.

Plate-3

Large scale geological map of the Indrana-Siwana area,Siwana Ring Complex (SRC) with point anomaly distribution of Σ REE+Y values.

(in parts of toposheet no. 45C/06 and 45C/10)



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Lithology	Formation	Group	Supergroup
Fine aeolian sand and silt with occasional kankar	Thar Desert		
Rhyolite Dyke	Intrussive	Sankra Dykes	
Mafic dyke	Intrussive		
Alkali Feldspar Granite	Siwana Granite	Jalore plutonics	Malani Igneous Suite
Granite			
Pyroclastic Flow			
Rhyolite	Kailana Felsic Volcanics	Jhodhpur Volcanics	
Porphyritic Rhyolite			

Index

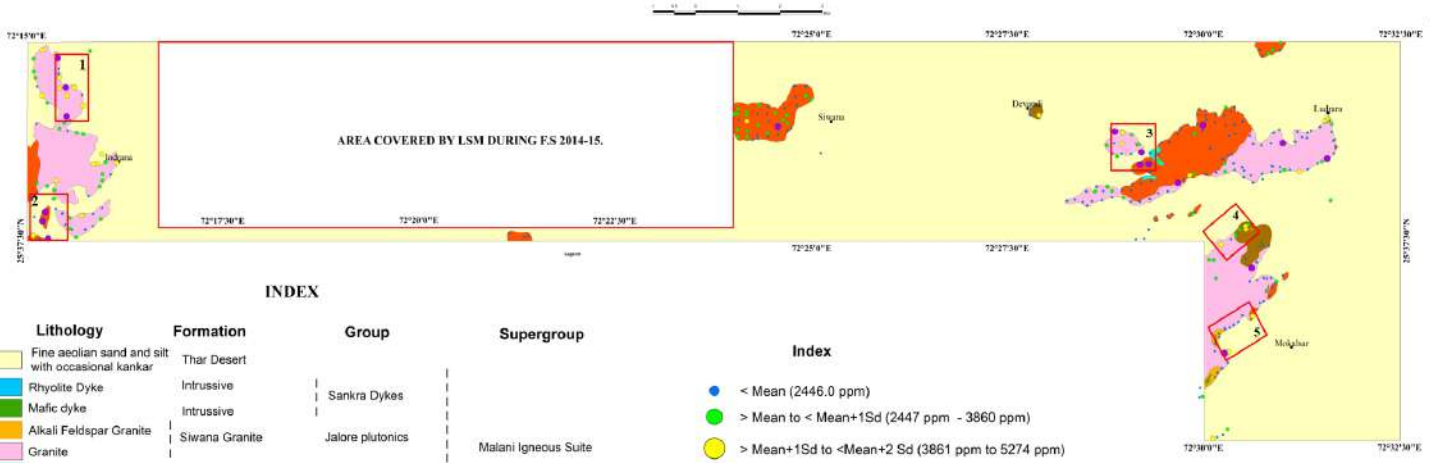
- < Mean (2446.0 ppm)
- > Mean to < Mean+1Sd (2447 ppm - 3860 ppm)
- > Mean+1Sd to <Mean+2 Sd (3861 ppm to 5274 ppm)
- > Mean+2Sd (5275 ppm to 8985 ppm)

Mapped by,
VIVEK V.KUMAR, Sr.Geologist
Dr. Kiran Jyoti Mishra, Sr.Geologist
Project SM-II Division,F.S 2021-22.

Plate- 4

Large scale geological map of the Indrana-Siwana area,Siwana Ring Complex (SRC) with point anomaly distribution of Σ REE+Y values.

(in parts of toposheet no. 45C/06 and 45C/10)



INDEX

Lithology	Formation	Group	Supergroup
Fine aeolian sand and silt with occasional kankar	Thar Desert		
Rhyolite Dyke	Intrussive	Sankra Dykes	
Mafic dyke	Intrussive		
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Rhyolite	Kailana Felsic Volcanics	Jhodhpur Volcanics	
Porphyritic Rhyolite			

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- < Mean (2446.0 ppm)
- > Mean to < Mean+1Sd (2447 ppm - 3860 ppm)
- > Mean+1Sd to <Mean+2 Sd (3861 ppm to 5274 ppm)
- > Mean+2Sd (5275 ppm to 8985 ppm)

1 **Indrana North Block** 3 **Ludrara – Arjiyana Block**

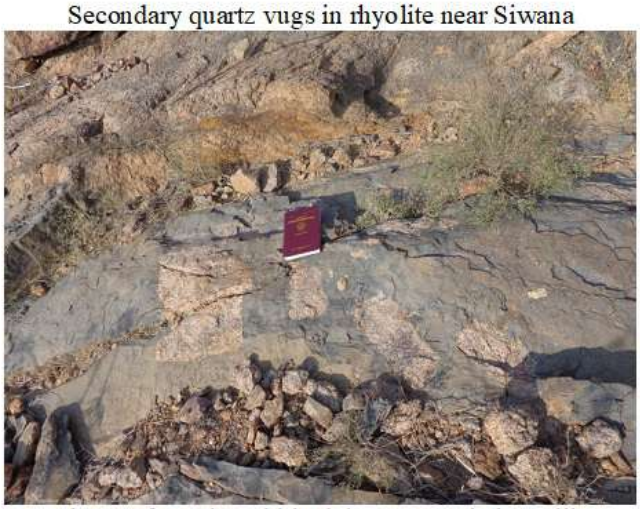
2 **Indrana South Block** 4 **Mokalsar North Block** 5 **Mokalsar South Block**

Mapped by,
VIVEK V.K/UMAR, Sr.Geologist
Dr. Kiran Jyoti Mishra, Sr.Geologist
Project SM-II Division,F.S 2021-22.

Secondary quartz vugs in rhyolite near Siwana

Secondary quartz vugs in rhyolite near Siwana

Epidote formed in rhyolite near Mokalsar village



Enclaves of granite within dyke near Mokalsar village

Iron oxide staining in rhyolite near Arjiyana village

Cluster of aegirine needles near Mailawas village

Columnar structure in rhyolite near Siwana

Columnar structure in rhyolite near Siwana fort

Pegmatite with aegirine needles observed near Mokalsar village

Flow banding in dyke observed near Ludrara viilage