

**PROPOSAL  
FOR  
RECONNAISSANCE SURVEY (G4), OF VANADIUM SCANDIUM  
AND ASSOCIATED MINERALS HOSTED IN ALUMINOUS  
LATERITE IN NIVALI AREA RATNAGIRI DISTRICT  
MAHARASHTRA  
UNDER NMEDT**

**COMMODITY: STRATEGIC & CRITICAL-  
VANADIUM SCANDIUM AND ASSOCIATED  
MINERALS**

**By**

**M/s. MMPL Private Limited  
(formerly Maheshwari Mining Pvt. Ltd.)**

**Place: Kolkata**

**Date: 6<sup>TH</sup> 2026**

## Detailed description on the following titles to be made in the proposal

### 1. Block Summary

	Features	Details
1	Block ID	NIVALI
2	Exploration Agency	MMPL Private Limited
3	Commodity	Vanadium, Scandium and associated minerals (Gallium Titanium) hosted in Aluminous Laterite
4	Mineral Belt	Deccan Traps
5	Completion Period of the project	12 months
6	Objectives	<ol style="list-style-type: none"> <li>1. To conduct geological <b>mapping</b> on 1:12k to delineate the lithology especially aluminous laterite, and surface mineralization hosting the target minerals (V, Ga, Sc, and Ti).</li> <li>2. To collect a <b>bedrock sample</b> from rocks which host the <b>mineralization</b> for first-hand information and geochemical analysis.</li> <li>3. To conduct pitting for expose thickness of laterite and collect sampling for geochemical analysis.</li> <li>4. To measure laterite profiles and conduct <b>section measurements</b> to understand the vertical distribution and thickness of the mineralized horizons.</li> <li>5. To utilize <b>drilling</b> (scout) to assess the subsurface continuity and depth extension of the laterite and know content of Critical Minerals body.</li> <li>6. To conduct <b>20 line-kilometres</b> of Electrical Resistivity Tomography (ERT) using the <b>Profiling with double separation</b> method to delineates the high-resistivity <b>aluminous laterite/bauxite horizons</b> and maps the interface with the underlying basaltic bedrock.</li> <li>7. To integrate all collected geophysical, geological, and geochemical data to establish preliminary mineral resources as per international norms.</li> </ol>

77	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	All components will be executed by MMPL Pvt. Ltd. only.															
8	Name/ Number of Geoscientists	2															
9	Expected Field days (Geology) Geological Party Days	180															
<b>1.</b>	<b>Location</b>																
	<table border="1"> <thead> <tr> <th>Point ID</th> <th>Latitude</th> <th>Longitude</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>17.061</td> <td>73.392</td> </tr> <tr> <td>B</td> <td>17.061</td> <td>73.593</td> </tr> <tr> <td>C</td> <td>17.011</td> <td>73.593</td> </tr> <tr> <td>D</td> <td>17.011</td> <td>73.392</td> </tr> </tbody> </table>	Point ID	Latitude	Longitude	A	17.061	73.392	B	17.061	73.593	C	17.011	73.593	D	17.011	73.392	
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A	17.061	73.392															
B	17.061	73.593															
C	17.011	73.593															
D	17.011	73.392															
	Villages	Nivali , Hathakhambe, Charveliwadi															
	Tehsil/ Taluk	Ratnagiri															
	District	Ratnagiri															
	State	Maharashtra															
<b>2.</b>	<b>Area (hectares/ square kilometres)</b>																
	Block Area	118.4 sq km															
	Forest Area																
	Government Land Area																
	Private Land Area																
<b>3.</b>	<b>Accessibility</b>																
	Nearest Rail Head	The nearest Railway station is <a href="#">Ratnagiri Railway Station</a> (around 14-20 km away), which has excellent connectivity with most cities across India.															
	Road	NH66 passes through the area															
	Airport	<b>Ratnagiri Airport (RN)</b> is a domestic airport connecting flights to certain cities in Maharashtra, and is the closest by road. <a href="#">Chhatrapati Shivaji International Airport (BOM)</a> in Mumbai is the major international airport, located about 240 km from Ratnagiri city.															
<b>4.</b>	<b>Hydrography</b>																

	Local Surface Drainage Pattern (Channels)	The area is closed to the Western Ghats is highly dissected with the deep valley. The river system is young and due to heavy rainfall, there is tremendous head ward erosion. It exhibits dendritic and sub parallel drainage pattern
	Rivers/ Streams	Area drained by Bav River , flowing towards north west and join Shashtri River and ultimately merge in Arabian Sea.
<b>5.</b>	<b>Climate</b>	The climate of the study area is typical of the Konkan area and is hot and humid in the summers and mild in winters. In general, the day is hot, at times humid while the nights are pleasant. Heavy rains occur during monsoon period spread between mid-May to mid-September.
	Mean Annual Rainfall	Annual rainfall in the area varies between 300-350cm
	Temperature	The maximum and minimum temperatures recorded are 40 and 10 degrees Celsius respectively
<b>6.</b>	<b>Topography</b>	
	Toposheet Number	47G/8, 47G/12
	Morphology of the Area	Morphology of highly dissected topography with N S and NW-SE trending hill ranges of Western Ghats.
<b>7</b>	<b>Availability of baseline geoscience data</b>	
	Geological Map (1:50K)	<b>Available</b>
	Geochemical Map (1:50K)	<b>Available</b>
	PGRS Study	<b>NA</b>
	Geophysical Map	<b>NA</b>
<b>8.</b>	<b>Justification for taking up Reconnaissance Survey</b>	<ol style="list-style-type: none"> <li>1. The proposal for G4 reconnaissance survey is strongly justified by the convergence presence of extensive lateritic cover in the proposed block area and significant geochemical anomalies identified in NGCM and MMPL itself carried out analysis of few Bed Rock Samples.</li> <li>2. The proposed block is northern extension of Ratnagiri Block proposed for Bauxite and associated minerals exploration in <b>GSI work on Regional Assessment of Lateritic Profiles (FS 2022-24)</b>, in these lateritic profiles study across the region, one profile that is Zarewadi is 1 km south of the block and in this profiles Geological and Geochemical study explicitly indicated the presence of aluminous laterite, bauxite horizons over the Deccan Traps in area and elevated values of Vanadium up to 1177 ppm, Gallium 65 ppm, and Titanium up to 3 % , Al<sub>2</sub>O<sub>3</sub> up to 38 % , hosted in the laterite horizons.</li> <li>3. This potential is substantiated by <b>National Geochemical Mapping (NGCM)</b> data, where stream sediments recorded anomalous concentrations of critical metals, with <b>Vanadium (V)</b> up to 766 ppm, Titanium Dioxide (TiO<sub>2</sub>) from 2% to 4%,</li> </ol>

		<p>Scandium (Sc) up to 49 ppm, Gallium (Ga) up to 41 ppm, and Alumina (<math>Al_2O_3</math>) from 19% to 25%.</p> <p>4. To validate these secondary dispersion patterns, <b>due diligence sampling of 05 bedrock samples</b> was conducted by MMPL which confirmed mineralization in the profile. The bedrock analysis yielded <b><math>Al_2O_3</math> values of 24%–49%</b> and <b><math>TiO_2</math> of 2-3%</b>, alongside enriched trace elements including <b>V (728-840 ppm)</b>, <b>Ga (41-51ppm)</b>, and <b>Sc (35 ppm)</b>, Zirconium up to 300 ppm.</p> <p>5. The consistent enrichment of V-Ti-Sc-Ga from stream sediments to bedrock and presence of laterite profiles highlights a robust mineralized system, warranting a systematic G4 exploration to delineate the extent and resource potential of these critical minerals.</p>
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## Physiography

The Block and adjoining area form a part of Western Ghats and adjoining high dissected hilly region to the west. The highest peaks towards east on the 'Continental Divide' and Vishalgarh fort ( $\Delta 800\text{m}$ ) Machkawdu Dongar ( $\Delta 775\text{m}$  and  $\Delta 799\text{m}$  hill 1.5 km south of Gavdi. West and south-west part of the area comprises many dissected flat topped, low hills which rise to a height of 200m to 350m above MSL. These plateaux show a gradual slope towards west. Bav river which is tributary of Shashtri river entered in block from east and flows northward while exits block.

## Background Geology

**Regional geology:** One of the interesting aspects in the study area is that different varieties of rock types starting from Precambrian to Quaternary are present. The area exposes gneisses of Peninsular Gneissic Complex (PGC); acidic, metabasic and ultramafic intrusives of Archaean to Paleoproterozoic age, metasedimentary of Dharwar Supergroup; sedimentaries of Kaladgi Supergroup, basalts of Diveghat, Purandargarh and Mahabaleshwar formations belonging to Sahyadri Group of Deccan Trap Supergroup; carbonaceous clay of Miocene to Pliocene; and laterites of Cenozoic and alluvium of Quaternary age. The laterites have developed over the Deccan basalts of Upper Cretaceous to Palaeogene, shales of Kaladgi Supergroup of Neo Proterozoic and gneisses & granite of Archaean to Palaeo Proterozoic age. In southern part, peneplanation has exhumed the sedimentaries of Kaladgi Supergroup and metasedimentaries of Dharwar Supergroup. Very thin carbonaceous clay occurs in valley near Ratnagiri.

Table 2.1: Stratigraphic succession of the degree sheet 47 H (as per 2<sup>nd</sup> Edition GQM)

	Alluvium
	Laterite
	Carbonaceous clay
	Dolerite dykes
Deccan Trap Supergroup	Basaltic Flows
-----Unconformity-----	
Kaladgi Supergroup	Conglomerate, Sandstone, Shale
-----Unconformity-----	
Acidic intrusives	Granite, pegmatite and quartz veins
Metabasic and ultramafic intrusives	Metaultramafite, Metapyroxenite, Metagabbro
Dharwar Supergroup	Conglomerate, BIF, Phyllite, Quartzite, Quartz mica schist, Hornblende schist, Talc schist, Actinolite tremolite schist, staurolite kyanite schist
Peninsular Gneissic Complex	Granite Gneiss

Figure 1 . Modified after Tare, M., Basha, S. N. H., Simi, T. S., & Ghosh, U. (2017).

### Geological of the present proposed area:

Local geological description is based on geological mapping in adjacent area by Reddy in 1982 on 1: 63 k scale, largely exhibits a single time work unit, viz. the Deccan Traps, comprising basaltic lava flows. In a cumulative thickness of 725m, between elevations 37m and 76m above MSL 25 basaltic flows have been identified. The thin of individual flow ranges from 15m to 58m. All the flows of aa type except one Flow (No.6) which depicts pahoehoe character. Apart from this, intrusives in the form of basic dykes occur at two places, viz, at Gadi nala 0.40 miles SW of Jadhavwadi, and another east of Kochhri. Laterite occurs 152m above MSL. Amongst recent deposits alluvial material is noticed on the banks of Machkandi River and Kajvi nala.

### Description of basaltic flows:

General description of the various flows occurring in the area is given below:

#### Flow No. 1:

Outcrops of Flow No. 1 are seen in Kajvi nala section immediately south of Ghativle village and top contact is exposed on either bank. However, base of this flow is not exposed in the area mapped.

The flow comprises, massive, weathered, medium grained, columnar as well wide, spaces sheet jointed basalt of a type. It is highly porphyritic with feldspars of white colour of 2 mm size. It contains specks of reddish mineral viz. olivine magnetite. At places, it is vesicular, vesicles being filled with break sooty glass.

**Flow No. 2:**

Overlying Flow No. 1, outcrops of this flow is seen 1.5 km SW of Borivla, in river section near Bhavani Temple around Pillawadi etc. The contact of the flow is marked by a 10 cm wide red bole zone near second milestone on Dhabola-V unmetalled road. The flow comprises, massive, at places weathered basal of aa type represent by a medium grained, porphyritic rock with high distribution of white feldspars of 0.4 to 0.8. At places, it is vesicular, vesicles being filled with dark black glass and zeolites.

**Flow No. 3:**

It overlies Flow No. 2 and is traceable throughout the area in the lower reaches of the hills e.g. around Sakha Dhahola, Shiposhi, Borivla and Purya villages. It thickness considerably in Purya-1319 hill section. It is massive, exfoliated widely jointed, fine grained aa flow and is highly porphyritic in texture.

**Flow No. 4:**

Overlying Flow No. 3 outcrops of this flow are seen along Sakharpa Devrukh road, Dhabola ghat, Maslamanwadi village, Gosaviwadi and Ganeshwadi villages and in the upper reaches of Kajni nala. It thickness down along Machkandi River section at the crossing of Dhabola-Vatol road but thins down considerably in Nagarpara (.939 hill) section. The basalt flow is massive, though, at places weathered, wide spaced columnar jointed in lower portions however display close spaced columnar jointing in top portions. It comprises fine grained rock with high incidence of honey yellow feldspars (0.4 mm to 0.6 mm) At places, it is vesicular, vesicles being most empty but rarely filled with dark pitch glass.

**Flow No. 5:**

Outcrops of this flow are well exposed in Sakharpa, Dhabola ghat section, around Dhangarwadi, near Maskanwadi, around Shiposhi Borivla and in the upper reaches of Machkandi River near Khorninko and Guraowadi villages. The best section is seen along the Dhabola-Dhangawadi road. It is a massive, light grey, close spaced columnar jointed, medium grained aa flow. It is highly porphyritic in texture with white feldspars of 0.3 mm to 0.6 mm in size. At places, it exhibits glomeroporphyritic textures and contains specks of magnetite and olivine.

**Flow No. 6:**

The best sections of the flow are exposed on Dhabola ghat section, Borivla to .1015 hill section and Kolvda village. It is weathered exfoliated and highly lateritized simple pahoehoe flow in most of the sections. However, pipe amygdule, ropy structures are recorded in this flow in Borivla to .1015 hill section. It thins down in the south-western parts of the area.

**Flow No. 7:**

Overlying Flow No. 6, outcrops of this flow are seen on Sakharpa-Devrukh road, Dhabola ghat, immediately south Karjari, 2 km north of Shrimbavli, around Vikli in .1014 hills to .913 hills etc. The flow represents a massive dark grey, jointed, coarse grained aa flow which is in contact laterite at 1512m in western parts of the area. It is a nonporphyritic in texture.

**Flow No. 8:**

Outcrops Flow No. 8 are seen in the lower reaches of the hills e.g. around Dhatakacha Dongar, .1150 hill, .1204 hill etc. It thins down considerably on KirbetVishalgarh section. It is massive, weathered highly, columnar jointed in upper portion, medium grained flow of aa type. It is sparsely porphyritic to non-porphyritic in texture.

**Flow No. 9:**

Overlying Flow No. 8, outcrops of this flow are seen in the lower reaches of the hills e.g. Dhabacha Dongar, .925 hill, 1164 hill etc. Those forming plateaus tops are massive dark grey, fine grained aa flow, non-porphyritic in character. Rare incidence of honey yellow feldspars is however noticed at places.

**Flow No. 10:**

The outcrops of Flow No. 10 are seen in the eastern parts of the area at Dhabacha Dongar, .1311 hills and around .1624 hills. It considerably thickens down in .1624 hill section and thins down in Vishalgarh section From Kirbet side. It is a massive, weathered, and highly columnar jointed in upper portions, medium grained aa flow and forms extensive plateaus in the area. It is nonporphyritic.

**Flow No. 11:**

Overlying Flow No. 10, outcrops of Flow No. 11 are continuously seen in the middle sections of the hills in the eastern parts of the area, the best section exposed being in Khanniako (.2348) hill section. It thins out in Kochhri-Mach-Kanda section. The flow represents a massive light grey, crudely columnar jointed medium grained aa flow which is essentially non-porphyrific to sparsely porphyritic in character.

***Laterite and laterite profiles***

This is the target stratigraphic unit of the block. The lateritic capping over the Deccan Volcanic Province have been traditionally classified into 'Highland laterite and 'Lowland' laterite. refer to two distinct events of lateralisation in Tertiary and Quaternary times respectively. The Lowland lateritic profiles (*in-situ*) in the region are developed over basalts are common in the study area. There are numbers of laterite quarries found in the study area and are being quarried for laterite bricks used as building stones.

Local Stratigraphic Sequence			
(Modified after Reddy 1982)			
Flow Number	Formation	Thickness	Age
	Soil and alluvium		Recent
	Laterite		Pleistocene
	Basic intrusive		Post-Trappean
	<b>Group-II</b>		
11	Medium grained, dark, grey, massive non-porphyrific aa flow	25m	
10	Medium grained, grey, vesicular, non-porphyrific aa flow	58m	
9	Medium grained, grey, massive, non-porphyrific aa flow with elongated vesicles	46m	
8	Medium grained massive, grey, non-porphyrific aa flow with crude columnar jointing	41m	
7	Dark grey, fine grained, massive, non-porphyrific aa flow with crude columnar jointing	31m	
6	<b>MARKER FLOW</b> : Vesicular and partly lateralized pahoehoe flow showing exfoliation	15m	
	<b>Group-I</b>		
5	Fine to medium grained, massive, light grey, columnar jointed aa flow	39m	
4	Medium grained, massive, light grey, highly porphyritic aa flow	34m	
3	Fine grained, massive highly porphyritic aa flow	32m	
2	Grey, massive, aa flow-highly porphyritic	37m	
1	Massive grey, highly porphyritic aa flow	10m	

## Mineral potentiality based on geology, geophysics, ground geochemistry:

The mineral potentiality of the proposed block for Vanadium (V), Scandium (Sc), Gallium (Ga), Titanium (Ti), and associated critical minerals is thoroughly established across geological, geophysical, and geochemical domains, leveraging specific data generated by MMPL and collected from GSI reports up to 2025.

### Geological Potentiality

The geology is characterized by numerous **lava flows** and extensive in-situ "Lowland" lateritic capping, which covers approximately **70% of the proposed block area**. These lateritic profiles range from **10 to 20 meters thick**, consisting primarily of aluminous laterite and bauxite. This highly favorable lateritization process is validated by the detailed GSI profiles in adjacent areas like Zarewadi area. Following the NMEP 2016 policy and GSI's FS 2018-19 review, the area has been officially designated as an **Obvious Geological Potential (OGP)** zone for bauxite.

### Ground Geochemistry Potentiality

The geochemical evidence is robust, drawing from detailed analyses of stream sediments (FS 2021-22 data), MMPL's BRS, GSI's BRS from adjacent areas (Zarewadi), and general core samples (CS) from the region (FS 2022-24 data). The consistent enrichment of V-Ti-Sc-Ga across all sampling types highlights a robust, warrantable mineralized system.

- **Vanadium (V):** Concentrations are exceptional. MMPL's 8 BRS samples yielded values up to **840 ppm**, while regional BRS peak at an impressive **2,543 ppm** (0.25% V). Subsurface 27 core samples consistently yield high values up to **1,407 ppm**, confirming mineralization at depth. Stream sediments (81 samples across 38 profiles) provide background anomalies of **316 to 696 ppm** (ranging from 316-696 ppm).
- **Scandium (Sc) and Gallium (Ga):** These high-value critical metals are highly enriched. Scandium (Sc) reaches **51 ppm** in MMPL BRS, with regional core samples showing up to **52 ppm** and GSI BRS around Zarewadi **17–30 ppm**. Stream sediment values range from **28 to 68 ppm**. Gallium (Ga) is uniformly high, with BRS values up to **49 ppm**, and core samples of regional study reaching a peak of **88 ppm**.
- **Alumina and Titanium:** The primary host rock has significant potential for bauxite production, with  $Al_2O_3$  values in aluminous laterite in MMPL BRS ranging from **19.11% to 49%** and in regional study core samples showing similar ranges (**30.26% to 48.14%**). Titanium ( $TiO_2$ ) is also highly concentrated, reaching **10.05%** in BRS of regional study and **7.20%** in regional core sample and up to 4 percent in Stream sediments.
- **Associated Elements:** Other significant trace element enrichments include **Chromium (Cr)** up to 1,621 ppm, **Nickel (Ni)** up to 181 ppm, **Zirconium (Zr)** up to 1,551 ppm, and total REE average of 387 ppm, in regional study.

**Lithological Continuity:** The block is in direct continuity with the **Zarewadi** (south ) proposed by GSI for Bauxite and critical mineral g4 exploration . Successful G4 investigations by the GSI in these adjacent areas (FS 2026-27) provide high confidence for similar success in the Pali block.

The Nivali Block represents one of the promising **Critical Mineral** targets in the laterite belt, with the potential to host a significant multi-element resource (V-Sc Ga-Ti-Al) within a 20-meter vertical thickness.

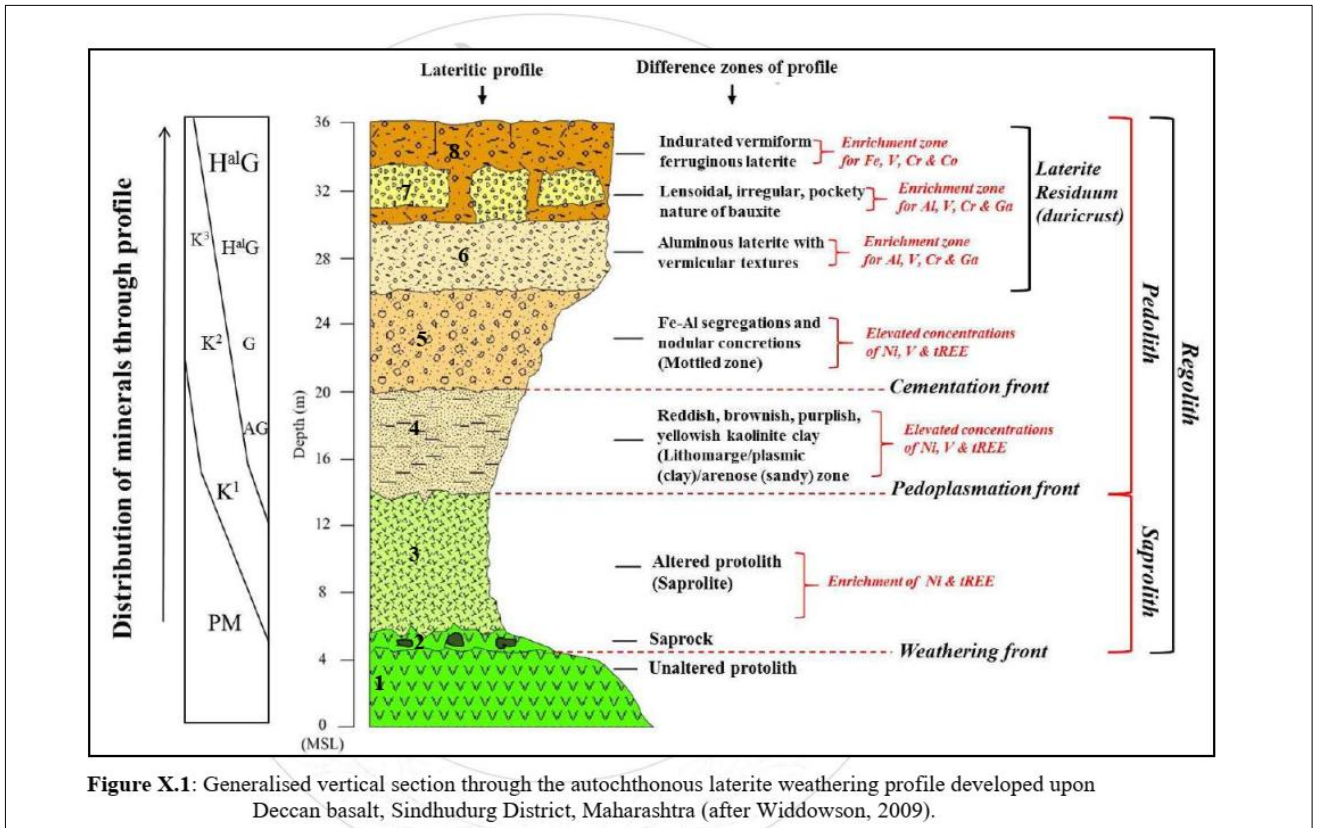


Figure 2 Profile showing potential of various critical minerals in Laterite developed over Deccan Trap basalt. (Bhaise, M. S., & Dixit, A. R. (2024))

### Scope for proposed exploration.

Scope of work						
Sr	Nature of Work	Proposed Work				
1	Large Scale Mapping	118.414 sq. km				
2	Pitting	200 cubic meters, with 200 pit samples.				
3	Bed Rock Samples	165 BRS (150 primary + 15 External Check) these samples include close spaced sampling of laterite profiles.				
4	Major Oxides( $Al_2O_3$ , $TiO_2$ , $SiO_2$ etc.) by XRF and Trace REE and Minor elements (Ga, Sc, V, Zr, Ni, Cr etc.) by ICPMS	Sample Category	Primary Samples	External Check Samples	Total Samples	Method
		Bedrock Samples (BRS)	150	15	165	ICPMS and XRF
		Pitting Samples	200	20	220	ICPMS and XRF
		Borehole Core Samples	180	18	198	ICPMS and XRF
		<b>Total</b>	<b>530</b>	<b>53</b>	<b>583</b>	<b>ICPMS and</b>



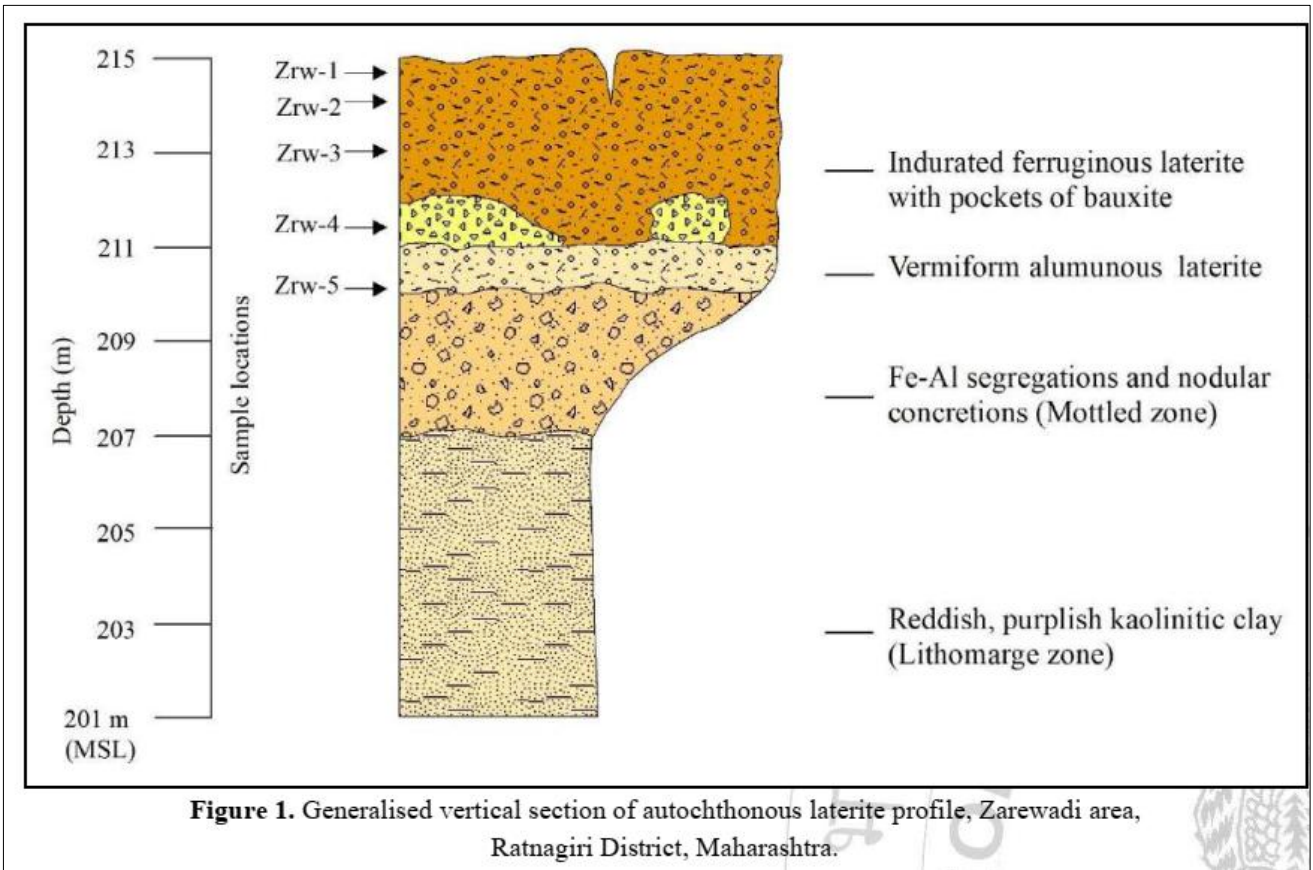


Figure 3 From GSI in FS 22-24 carried out regional assessment of lateritic profiles. (Bhaise, M. S., & Dixit, A. R. (2024))

**Table 1.** Major/minor oxides and trace elements of bed rock samples collected from different zones of laterite profile, Zarewadi area, Ratnagiri District, Maharashtra

Sample No.	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	CaO	MgO	MnO	Na <sub>2</sub> O	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	LOI	Co	Cr	Cu	Ga	Ni	Rb	Sc	Sr	V	W	Su	Li	Cs	Ag	Litho-unit	Diff. zones of laterite profile
	(ppm)																										
Zrw-1	5.84	27.61	49.23	2.95	0.01	0.02	0.06	0.01	0.08	0.10	15.20	230	622	33	60	181	<20	18	20	1177	2.07	5.90	5.05	0.17	2	Ferruginous laterite	Laterite residuum
Zrw-2	5.88	28.84	46.57	1.50	0.02	0.08	0.05	0.03	0.46	0.15	16.41	238	947	31	52	190	<20	17	35	840	1.99	5.02	8.14	1.10	3		
Zrw-3	10.95	32.31	36.11	3.04	0.03	0.19	0.03	0.03	0.30	0.22	16.67	118	432	96	59	67	<20	20	34	666	3.11	6.14	13.39	1.46	3	Bauxite	
Zrw-4	4.51	38.31	34.30	2.44	0.03	0.10	0.04	0.03	0.22	0.15	20.90	89	665	51	65	40	<20	20	36	735	3.10	4.99	<5	0.59	3	Aluminous laterite	
Zrw-5	15.90	33.20	33.13	2.82	0.17	0.29	0.06	0.03	0.30	0.61	11.40	107	394	77	52	72	<20	23	268	530	2.27	5.19	11.33	1.26	2		

**Table 1.1.** REE & trace elements results of bed rock samples collected from different zones of laterite profile, Zarewadi area, Ratnagiri District, Maharashtra

Sample No.	As	Y	Zr	Nb	La	Ce	Pr	Nd	Eu	Sm	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	U	Total REE	Litho-unit	Diff. zones of laterite profile
	(ppm)																							
Zrw-1	52.70	4.56	257	14.11	5.95	13.13	1.14	4.64	0.17	0.96	0.72	0.14	0.76	0.18	0.55	0.11	0.72	0.11	4.76	0.72	2.94	52.70	Ferruginous laterite	Laterite residuum
Zrw-2	90.27	16.37	240	20.93	20.33	34.30	3.92	15.04	0.57	2.85	2.06	0.43	2.97	0.59	2.01	0.34	2.40	0.38	6.28	1.17	6.34	90.27		
Zrw-3	58.71	11.67	288	23.38	22.07	38.35	3.79	12.92	0.55	2.39	1.85	0.39	2.02	0.44	1.50	0.29	1.62	0.28	9.02	1.23	5.13	58.71	Bauxite	
Zrw-4	78.26	15.63	268	24.81	21.19	39.33	4.05	14.20	0.50	2.38	2.05	0.45	2.69	0.55	1.92	0.37	2.38	0.36	7.79	1.46	6.12	78.26	Aluminous laterite	
Zrw-5	46.33	22.06	268	22.13	84.86	160.03	20.03	76.11	2.86	13.4	10.46	1.46	6.79	0.99	2.96	0.39	2.40	0.33	7.76	1.30	5.98	46.33		

Figure 4 From GSI in FS 22-24 carried out regional assessment of lateritic profiles. (Bhaise, M. S., & Dixit, A. R. (2024))

Regional assessment of aluminous laterite unit which is dominant in proposed block, developed over Deccan basalt of Ratnagiri and Sindhudurg district the following results are reported.

Parameter	Bed Rock Samples (BRS)	Core Samples (CS)
<b>Total Samples</b>	81 samples (38 profiles)	27 samples (9 boreholes)
<b>Major Oxides (%)</b>		
SiO <sub>2</sub>	7.79 – 29.23	7.40 – 23.31
Al <sub>2</sub> O <sub>3</sub>	26.63 – 50.50	30.26 – 48.14
Fe <sub>2</sub> O <sub>3</sub>	2.70 – 37.03	8.93 – 34.20
TiO <sub>2</sub>	1.24 – 10.05	1.61 – 7.20
CaO	0.01 – 0.22	0.01 – 0.33
MgO	0.01 – 0.50	0.01 – 0.28
MnO	0.02 – 0.30	0.02 – 0.12
Na <sub>2</sub> O	0.01 – 0.10	0.01 – 0.04
K <sub>2</sub> O	0.03 – 0.84	0.01 – 0.87
P <sub>2</sub> O <sub>5</sub>	0.03 – 0.72	0.05 – 0.29
LOI	11.40 – 25.09	13.20 – 23.00
<b>Trace Elements (ppm)</b>		
Co	5 – 131	22 – 126
Cr	106 – 1621	159 – 915
Cu	5 – 309	31 – 277
Ga	38 – 79	46 – 88
Ni	34 – 154	27 – 91
Rb	5 – 37	20 – 46
Sc	17 – 75	19 – 52
Sr	11 – 268	22 – 54
V	137 – 2543	355 – 1407
Zr	161.92 – 1551	285 – 832
Li	<5 – 46.42	<5
Ag	1 – 4	2 – 6

Geochemical Characterization of different lithologies of the region is given below.

Table X.1: Average chemical compositions of major/minor oxides, few trace elements and tREE for lateritic profiles developed over basalts Ratnagiri & Sindhudurg districts, Maharashtra

Litho unit	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	CaO	MgO	MnO	Na <sub>2</sub> O	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	Co	Cr	Cu	Ga	Ni	Rb	Sc	Sr	V	tREE
Ferruginous Laterite	11.18	29.53	40.55	2.96	0.03	0.09	0.15	0.02	0.19	0.23	148	657	114	60	88	7	30	41	948	101
Aluminous Laterite	14.72	37.11	26.38	3.65	0.04	0.10	0.06	0.02	0.21	0.13	71	447	93	62	73	7	31	49	709	135
Bauxite	5.08	41.98	26.78	4.03	0.01	0.04	0.05	0.01	0.06	0.16	70	662	70	72	41	1	30	57	774	144
Fe rich layer/band	8.75	12.33	68.49	1.91	0.03	0.05	0.07	0.01	0.06	0.33	325	256	196	31	139	1	17	51	777	150
Clayey laterite (Mottled zone)	27.88	28.11	26.28	2.85	0.09	0.28	0.08	0.03	0.42	0.16	90	301	190	48	127	26	41	35	663	139
Aluminous clay (Lithomarge zone)	35.73	28.56	19.53	3.27	0.12	0.28	0.09	0.03	0.38	0.13	61	229	207	44	118	23	43	39	582	155
Weathered basalt (Saprolite)	43.51	24.52	14.12	2.91	3.07	1.50	0.13	0.70	0.42	0.32	57	166	276	32	159	19	47	113	472	387
Basalt (Protolith)	48.70	15.40	13.64	2.05	8.63	4.39	0.18	2.18	0.30	0.35	50	73	218	21	80	5	35	222	350	119

Figure 4 From GSI in FS 22-24 carried out regional assessment of lateritic profiles. (Bhaise, M. S., & Dixit, A. R. (2024))

Based on above study GSI recommended blocks for Bauxite and associated critical minerals, in below figure position of proposed blocks and block recommended by GSI is given;

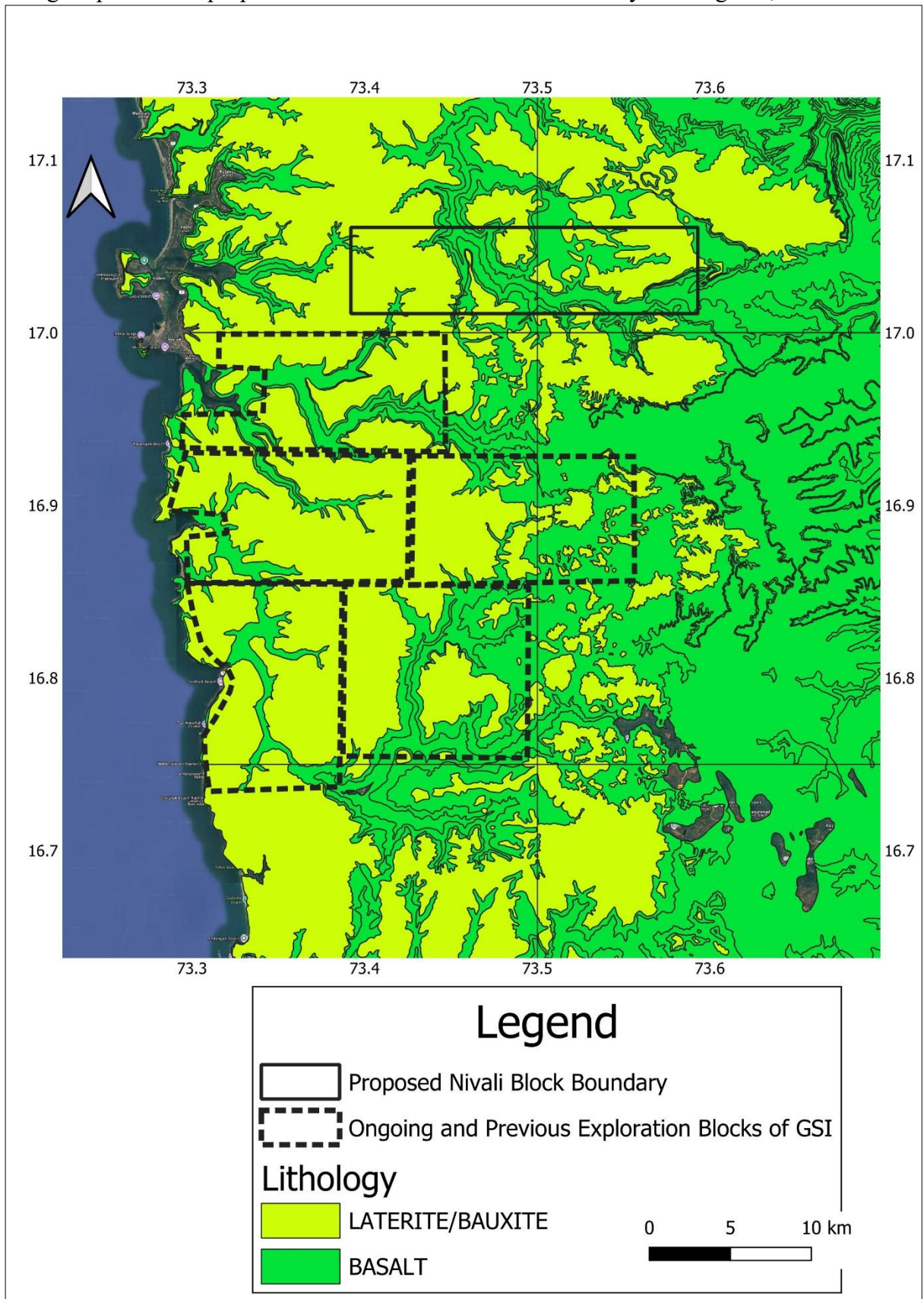


Figure 5 From GSI in FS 22-24 carried out regional assessment of lateritic profiles. (Bhaise, M. S., & Dixit, A. R. (2024))

## Previous Work

A comprehensive study titled "Mineral Prognostication of Laterite Belt, Maharashtra, through Perspective Maps to Find out New Target Areas for Bauxite, Gold, Chromite, Nickel and Associated Minerals" was undertaken by the Geological Survey of India, detailed in a final report (Item No.: DI/CR/MH/2015/055; Field Season 2015-16 & 2016-17). The study area, primarily within degree sheet 47H, covered the laterite belt of Western Maharashtra, spanning three geomorphic domains: the Deccan Plateau (900-1000m ASL), the Konkan Lowland (60-120m ASL), and the Konkan Coastal Belt (<20m elevation).

The investigation focused on areas exposing **basalts** of the Diveghat, Purandargarh, and Mahabaleshwar formations belonging to the **Sahyadri Group of the Deccan Trap Supergroup**, along with Miocene/Pliocene carbonaceous clay and Cenozoic laterites. The study utilized advanced GIS platforms and probabilistic data analysis techniques (knowledge-driven mineral prospectivity modeling and Fuzzy Logic methods) to integrate geological, geochemical, remote sensing, and geophysical datasets. This approach generated mineral prospectivity maps by applying knowledge of empirical spatial associations between existing mineral deposits and indicative geological features.

The outcome validated the presence and potential of bauxite and lateritic occurrences within and surrounding the broader study area (including parts of Ratnagiri District). Favourability maps for various commodities were prepared, confirming the regional potential for economically important elements associated with these lateritic profiles developed over basaltic parent material. The generated outputs are specifically recommended for formulating future G-4 stage investigation programs. This foundational work successfully identified and mapped areas with high potential for bauxite, aluminous laterite, and associated critical minerals, providing critical baseline data that supports the rationale for the proposed focused investigation in the Pali area for Vanadium and Scandium.

The Geological Survey of India (GSI) conducted a project during the Field Season (FS) 2018-19, aligned with the National Mineral Exploration Policy (NMEP) 2016, to revise and update the Obvious Geological Potential (OGP) areas across the Central Region (Madhya Pradesh, Maharashtra, and Chhattisgarh). The primary objective was to revisit existing OGP boundaries by incorporating current geoscientific data and expanding the scope to include a wider range of mineral commodities, particularly those with increasing demand due to new technologies (e.g., selenium, indium, rare earths).

The work involved a comprehensive review and compilation of data from over 1,800 GSI mission reports and reports from other agencies (DGM, MECL, WCL) into a GIS platform. This process generated commodity-wise maps and identified new potential areas for various minerals.

Key commodities considered during the revision included gold, diamond, base metals (copper, lead, zinc), tin, tungsten, Rare Earth Elements (REE), chromite, nickel, cobalt, manganese, iron, bauxite, graphite, molybdenum, phosphorite, and coal.

The revision process successfully delineated new or extended OGP areas for these commodities. Notably, **the project specifically added the area around the user's current proposed block as an Obvious Geological Potential area for bauxite.**

This study provides essential regional context and confirmation of the potential for bauxite and associated critical minerals in the lateritic belts of Maharashtra, directly supporting the rationale for the proposed G4 stage reconnaissance survey in the Pali area for Vanadium and Scandium.

The recent investigation conducted by the Geological Survey of India (GSI) under FSP IDs M2ARP/NC/CR/SU-MH-PUN/2022/42451, M2ARP/NC/CR/SU-MH-PUN/2022/48438, and

M2ARP/NC/CR/SU-MH-PUN/2024/52858 focused on the "Regional Assessment of Lateritic Profiles developed over the Western Dharwar Sequences and Deccan Traps in parts of Sindhudurg, Ratnagiri and Kolhapur districts, Maharashtra." The primary objectives were to classify lateritic rocks based on field and geochemical signatures, assess elemental enrichment patterns in 2D and 3D models, and identify prolific enrichment zones for future exploration planning.

The project covered reconnaissance mapping over 2400 sq km, including 321.15 m of drilling across 14 boreholes and the measurement of 93 lateritic profiles. A total of 250 core samples and 700 bedrock samples were collected and subjected to detailed geochemical, petrographic, ore microscopic, SEM-EDX, and XRD analyses.

The study area encompasses various lithologies, notably **basalts of the Purandargarh Formation** belonging to the **Sahyadri Group of the Deccan Trap Supergroup**, along with sedimentary rocks (Kaladgi Supergroup, Tertiary shales), Precambrian rocks, and extensive lateritic cover. The research focused on autochthonous lateritic profiles and core samples developed over these parent lithologies.

Profiles were consistently subdivided into six zones from bottom to top: Unaltered protolith, Altered protolith, Saprolite zone, Lithomarge/plasmic zone, Mottled zone, and Laterite residuum (duricrust), with the residuum further classified into ferruginous laterite, **aluminous laterite**, and bauxite.

Crucially for the current proposal, significant enrichment zones were identified for several critical elements regardless of the parent rock (including basalt). Prolific average enrichment was noted for Fe<sub>2</sub>O<sub>3</sub> (43%), Al<sub>2</sub>O<sub>3</sub> (45%), Ga (74 ppm), Cr (767 ppm), Co (161 ppm), V (983 ppm), Ni (118 ppm), and tREE (387 ppm) within different zones of the lateritic profiles. Ore microscopic and XRD studies confirmed goethite, hematite, ilmenite, and anatase as primary iron oxides, with gibbsite as the dominant ore mineral in bauxite.

As an outcome of this regional assessment, 16 blocks (**fig.5**) were demarcated for future exploration in the Ratnagiri and Sindhudurg districts. Specifically, 5 blocks were proposed for G4 stage investigation for bauxite, **aluminous laterite**, and associated critical minerals/elements (including **Vanadium** and **Scandium**) for Field Season (FS) 2025-26. One block was initiated under FS 2024-25, and the remaining 8 G-4 stage blocks were recommended for assessment of critical elements within bauxite/laterite for FS 2026-27. This prior work provides the foundational data and identified targets for the proposed G4 stage reconnaissance survey in the Navili area, which is in just 1km vicinity of proposed GSI block.

## Block description

Point ID	Latitude	Longitude
A	17.061	73.392
B	17.061	73.593
C	17.011	73.593
D	17.011	73.392

## Planned Methodology

**Reconnaissance Survey (G4)** of Vanadium, Scandium, and associated minerals in the Pali Area, Ratnagiri, follows these specific steps:

- **Geological Mapping:** Large-scale mapping at 1:12.5k scale will be carried out across the entire 118.141 sq. km area to delineate lithology and locate profile sections of the lateritic horizon for detailed study.

- **Detailed Profile Study:** Exposed lateritic profiles will be studied in detail, including close-space sampling and chemical analysis to understand mineral distribution.
- **Bedrock Sampling (BRS):** 150 BRS (including profile samples) will be collected from lithologies of interest. All samples will be analysed by ICP-MS for REE, Ga, V, Sc, and other trace elements, and by XRF for major oxides.
- **Pitting:** 100 pits will be excavated to expose the profile of the laterite, involving a total of 200 cubic meters of pitting and 200 samples analysis by ICPMS and XRF.
- **Resistivity Profiling/Imaging (ERT):** A ground geophysical survey using double spacing Electrical Resistivity Tomography (ERT) will be conducted as a key component of the G4 reconnaissance program. The proposed quantum of work for this activity is **20 line-kilometres**. The specific methodology will utilize "Profiling with single separation or Resistivity imaging (station interval up to 10m.)" This technique is selected to effectively delineate the distinct vertical zonation (e.g., highly resistive bauxite duricrust versus conductive clay zones) and lateral continuity of the primary aluminous laterite horizon across the most prospective targets within the block area, providing a robust 2D/3D subsurface model to guide further drilling.
- **Scout Borehole Drilling:** 10 core boreholes will be drilled to a depth of approximately 25m each (250m total) at targeted lithologies to define depth continuity after surface analysis.
- **Petrographic Study:** 5 thin-section microscopy and 5 polished-section microscopy studies will be conducted on borehole and surface samples to identify mineral assemblages, textures, and alteration states.
- **Bulk Density Analysis:** 5 samples will undergo analysis for tonnage calculation purposes.
- **Data Interpretation & Reporting:** The final phase involves data interpretation, resource estimation & Geological Report writing.

## Proposed Nature Quantum and Target

<b>EASTIMATED COST OF RECONNAISSANCE SURVEY (G4), OF VANADIUM SCANDIUM AND ASSOCIATED MINERALS HOSTED IN ALUMINOUS LATERITE IN NIVALI AREA RATNGIRI DISTRICT MAHARASHTRA</b>							
<b>Geological Mapping 118.414 sq km , Drilling 250m , pitting 200, BRS 150, Core Samples 180</b>							
				<b>Rates as per NMET SoC 2025</b>		<b>Total Amount (Rs)</b>	
Sl no.	Item of Work	Unit	SoC-Item Sl. No	Rate	Qty.		Remarks
A	<b>Geological Mapping Other Geological Work</b>						
1	Large scale (LSM) Geological mapping/Trenching.	Sq. Km		18300	118.414	2166976.2	LSM of Previous G4 will be utilized and modified
1.1	Geologist man days (1 No) for Large Scale (LSM) Geological mapping / Pitting/Sampling	days	1.2.1b	14500	160	2320000	
1.2	Labour (field) for (Total 4 Nos i.e. 2 workers per one geologist)	per worker	5.8	541	320	173120	Amount will be reimbursed as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher.
1.3	Geologist Man Days (HQ)	Per day	1.2.1a	10500	60	630000	
	<b>Sub Total A</b>					<b>5290096.2</b>	
B	<b>Survey Work</b>						
	DGPS Survey for BH fixation & RL determination	Per Point of observation	1.3.2	24000	14	336000	4 boundary points and 10 BH points

	Labour Charges for survey work;	Day	5.8	541	112	60592	0 4 labours per day
	<b>Sub Total B</b>					<b>396592</b>	
C	Profiling with twin separation or Resistivity imaging (station interval up to 10m.)	line km	3.6b	300000	20	6000000	
	<b>Sub Total C</b>					<b>6000000</b>	
D	<b>Pitting work</b>						
1.4	Pitting work	cum	2.1.2	4725	200	945000	
	<b>Sub Total D</b>					<b>945000</b>	
E	<b>DRILLING</b>						
1	Drilling up to 250m (soft rock)	m	2.2.1.1 c	5,500	250	1375000	
2	Land / Crop Compensation (in case the BH falls in agricultural Land)	per BH	5.6	30000	10	300000	As per actuals as certified by local authorities subject to a maximum of 30,000 per bore hole
3	Construction of concrete Pillar (12"x12"x30")	per borehole	2.2.7	2000	10	20000	
4	Borehole plugging by cement	Lum sum per borehole	2.2.8	10000	10	100000	
5	Miscellaneous Charges (Transportation of Drilling Rig, Accommodation for Drill Camp, Camp setting and winding, construction of Approach Road and Drill core preservation)	Drilling cost	2.2.9	0.25			1. For Drilling cost less than 50 Lakhs: 25% of the Drilling Cost
10 a	Charges for one Sampler per day (1 Party)	one sampler per day	1.1.1b	7850	130	1020500	

10 b	Labours (4 Nos)	day	5.8	541	480	259680	Amount will be reimbursed as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher.
	<b>Total E</b>					<b>3075180</b>	
<b>F</b>	<b>Laboratory Studies</b>						
1	Chemical Analysis						
i)	Geochemical Sampling-Surface samples (Bedrock/Channel /Soil/Stream sediment)						
	a. Major oxides (WD XRF)- (oxides+ traces - 24 elements)	Per sample	4.1.17 a	4200	150	6,30,000	
	b. analysis of Minor, Trace RM and REE elements by ICPMS	Per sample	4.1.15	7400	150	1110000	
ii)	Surface Check samples (10% External)						
	a. Analysis of major oxides samples by XRF	Per sample	4.1.17 a	4200	15	63000	
	b. analysis of Minor, Trace RM and REE elements by ICPMS	Per sample	4.1.15	7400	15	111000	
iii	Pits sample analysis						
	a. Major oxides (WD XRF)- (oxides+ traces - 24 elements)	Per sample	4.1.17 a	4200	200	840000	

	b. analysis of Minor, Trace RM and REE elements by ICPMS	Per sample	4.1.15	7400	200	1480000	
	Pits External Check (10%)						
	a. Analysis of major oxides samples by XRF	Per sample	4.1.17 a	4200	20	84000	
	b. analysis of Minor, Trace RM and REE elements by ICPMS	Per sample	4.1.15	7400	20	148000	
iv	Borehole Sample Chemical analysis						
	a. Major oxides (WD XRF)- (oxides+ traces - 24 elements)	Per sample	4.1.17 a	4200	180	756000	
	b. analysis of Minor, Trace RM and REE elements by ICPMS	Per sample	4.1.15	7400	180	1332000	
	Borehole External Check (10%)						
	a. Analysis of major oxides samples by XRF	Per sample	4.1.17 a	4200	18	75600	
	b. analysis of Minor, Trace RM and REE elements by ICPMS	Per sample	4.1.15	7400	18	133200	
2	Physical and Petrological studies					0	
i.	Preparation of thin section	Per sample	4.3.1	500	5	2500	
ii	Study of thin section	Per sample	4.3.4	2800	5	14000	
iii	Preparation of polish section	Per sample	4.3.2	800	5	4000	
iv	Study of polish section	Per sample	4.3.4	2800	5	14000	
vi	Bulk density analysis	Per sample	4.8.3	2500	5	12500	
	<b>Sub Total F</b>					<b>68,09,800</b>	

<b>G</b>	<b>Total A-F</b>					2,25,16,668	
H	Preparation of Exploration Proposal	One time	5.1	2% of approved cost of proposal		4,50,333	
I	Geological Report Preparation	One time	5.2	250000	lump sum	750000	
J	Total estimate Cost Without GST					23717001.2	
K	18 %GST					42,69,060	
L	<b>Total cost with GST</b>					<b>27986061.2</b>	
M	<b>In lakh</b>					<b>279.86</b>	

**BREAK-UP OF EXPENDITURE RECONNAISSANCE SURVEY (G4), OF VANADIUM SCANDIUM AND ASSOCIATED MINERALS HOSTED IN ALUMINOUS LATERITE IN NIVALI AREA RATNGIRI DISTRICT MAHARASHTRA**

<b>EASTIMATED COST SHEET OF RECONNAISSANCE SURVEY (G4), OF VANADIUM SCANDIUM AND ASSOCIATED MINERALS HOSTED IN ALLUMINOUS LATERITE IN NIVALI AREA RATNGIRI DISTRICT MAHARASHTRA</b>		
	Quantum	Amount in INR
A	Geological Mapping Other Geological Work	5290096
B	Survey Work	396592
C	Resistivity Survey	6000000
D	Pitting work	945000
E	DRILLING	3075180
F	Laboratory Studies	6809800
G	<b>Total A-E</b>	<b>22516668</b>
H	Preparation of Exploration Proposal	4,50,333
I	Geological Report Preparation	750000
J	Total estimate Cost Without GST	23717001
K	18 %GST	42,69,060
L	<b>Total cost with GST</b>	<b>27986061</b>



## References:

1. **Bhaise, M. S., & Dixit, A. R. (2024).** *Final report on regional assessment of lateritic profiles developed over the Western Dharwar sequences and Deccan Traps in parts of Sindhudurg, Ratnagiri and Kolhapur Districts, Maharashtra (Field Season 2022-24)* (Report No. M2ARP/NC/CR/SU-MH-PUN/2022/42451). Geological Survey of India, State Unit: Maharashtra, Pune.
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### Plates

1. Plate I- Location Map of the Proposed Block
2. Plate II- Location of Proposed Block on Toposheet no 47G/8 & 47 G/12
3. Plate III- Geological Map of the proposed Block
4. Plate IV-NGCM geochemical map of selected elements
5. Plate V -Geochemical map of BRS samples analysis carried out by MMPL

Plate I- Location Map of the Proposed Block

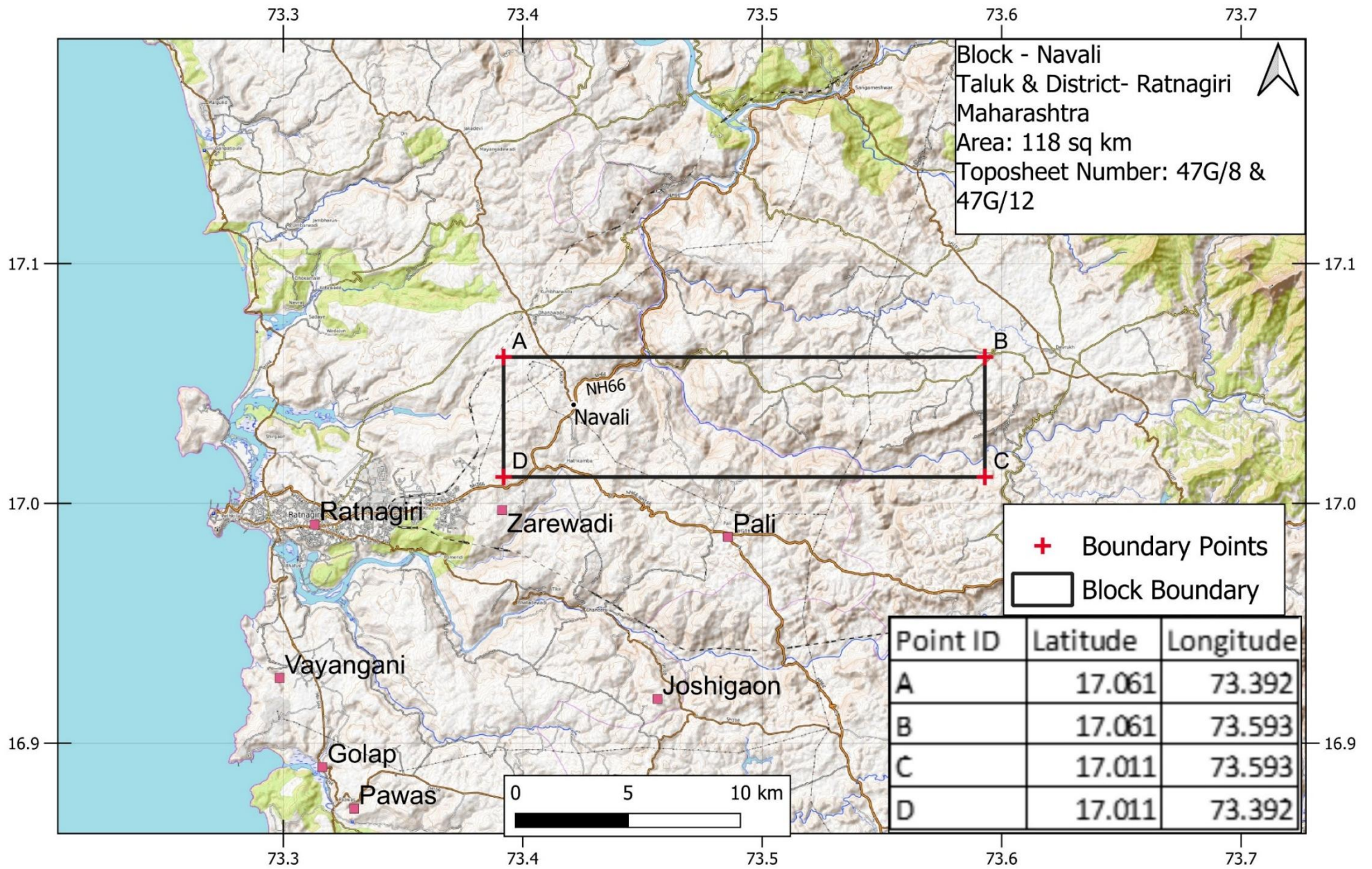
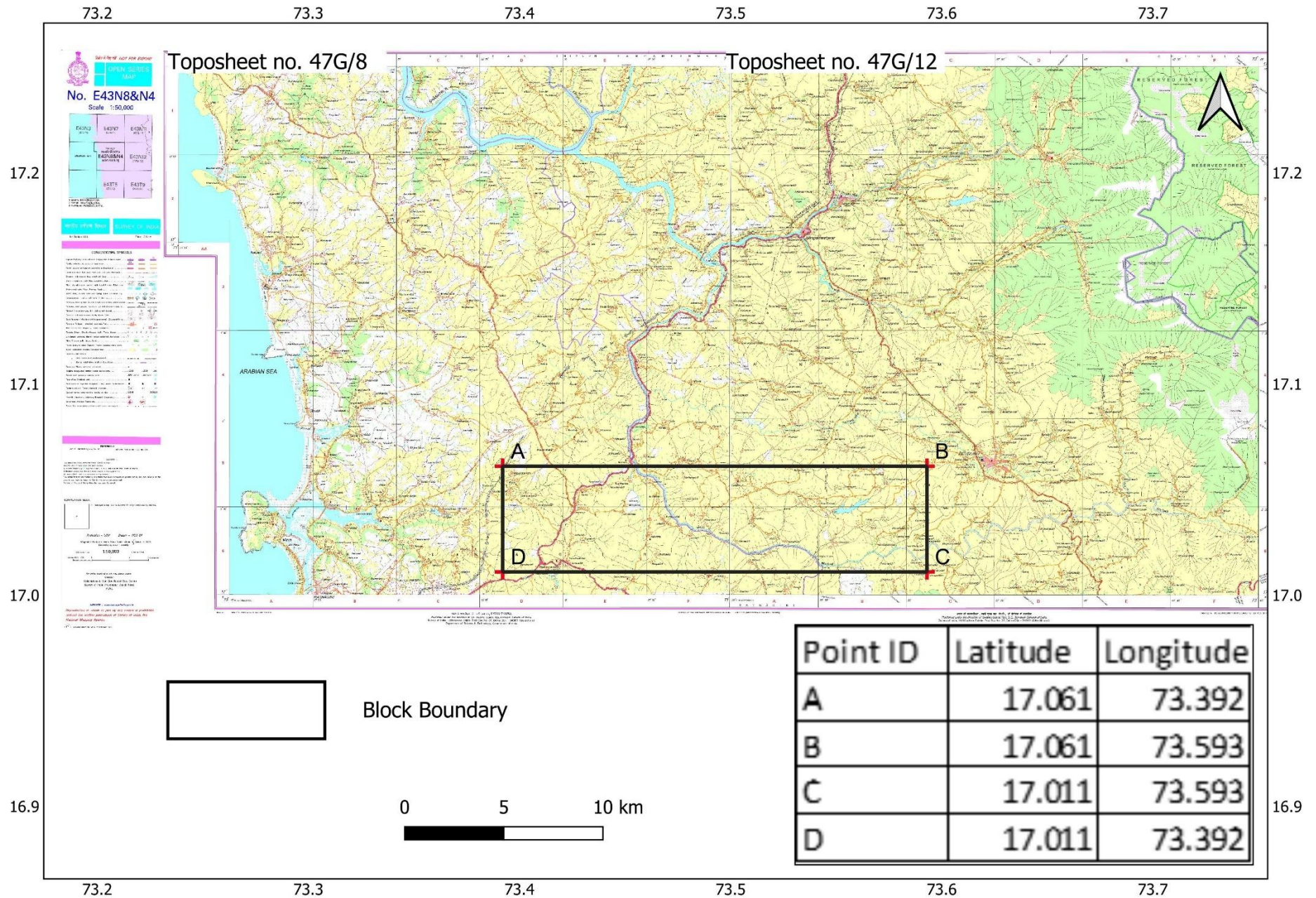


Plate II- Location of Proposed Block on Toposheet no 47G/8 & 47 G/12



73.4

73.5

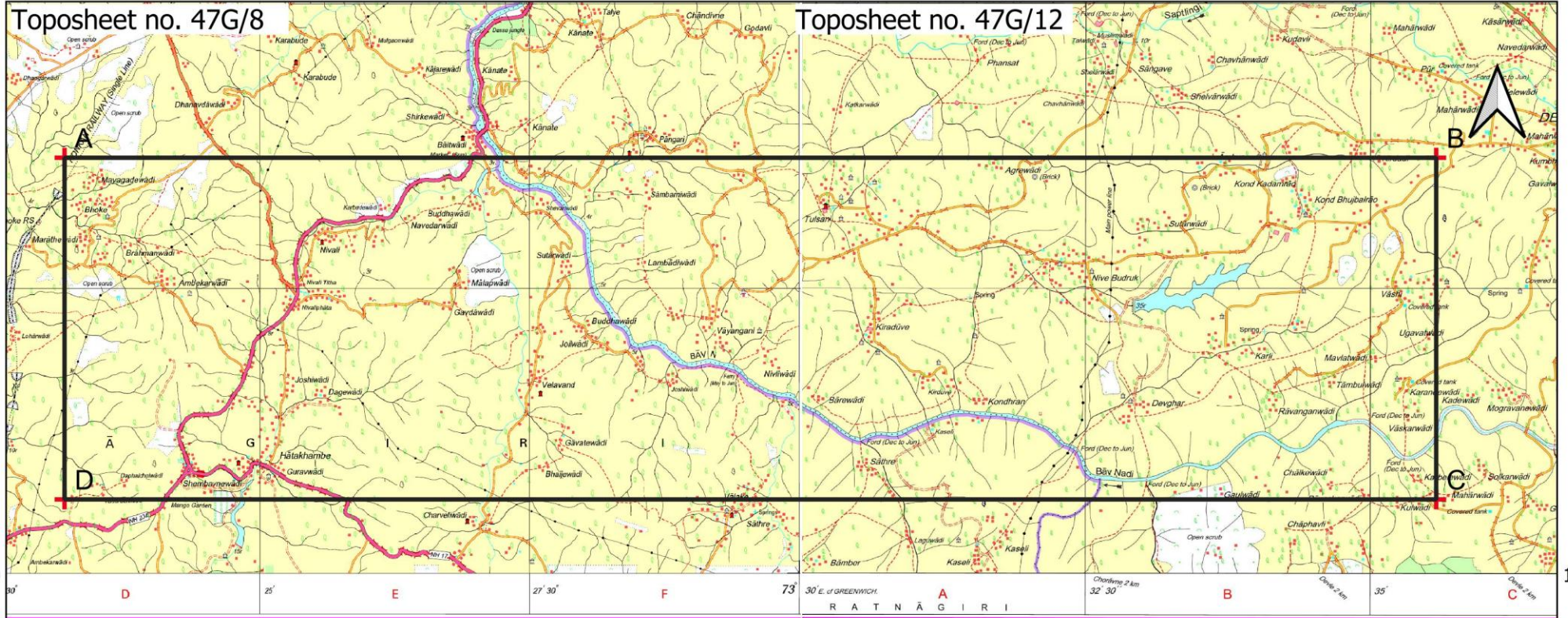
73.6

Toposheet no. 47G/8

Toposheet no. 47G/12

17.0

17.0



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Block Boundary



Point ID	Latitude	Longitude
A	17.061	73.392
B	17.061	73.593
C	17.011	73.593
D	17.011	73.392

73.4

73.5

73.6

Plate III- Geological Map of the proposed Block

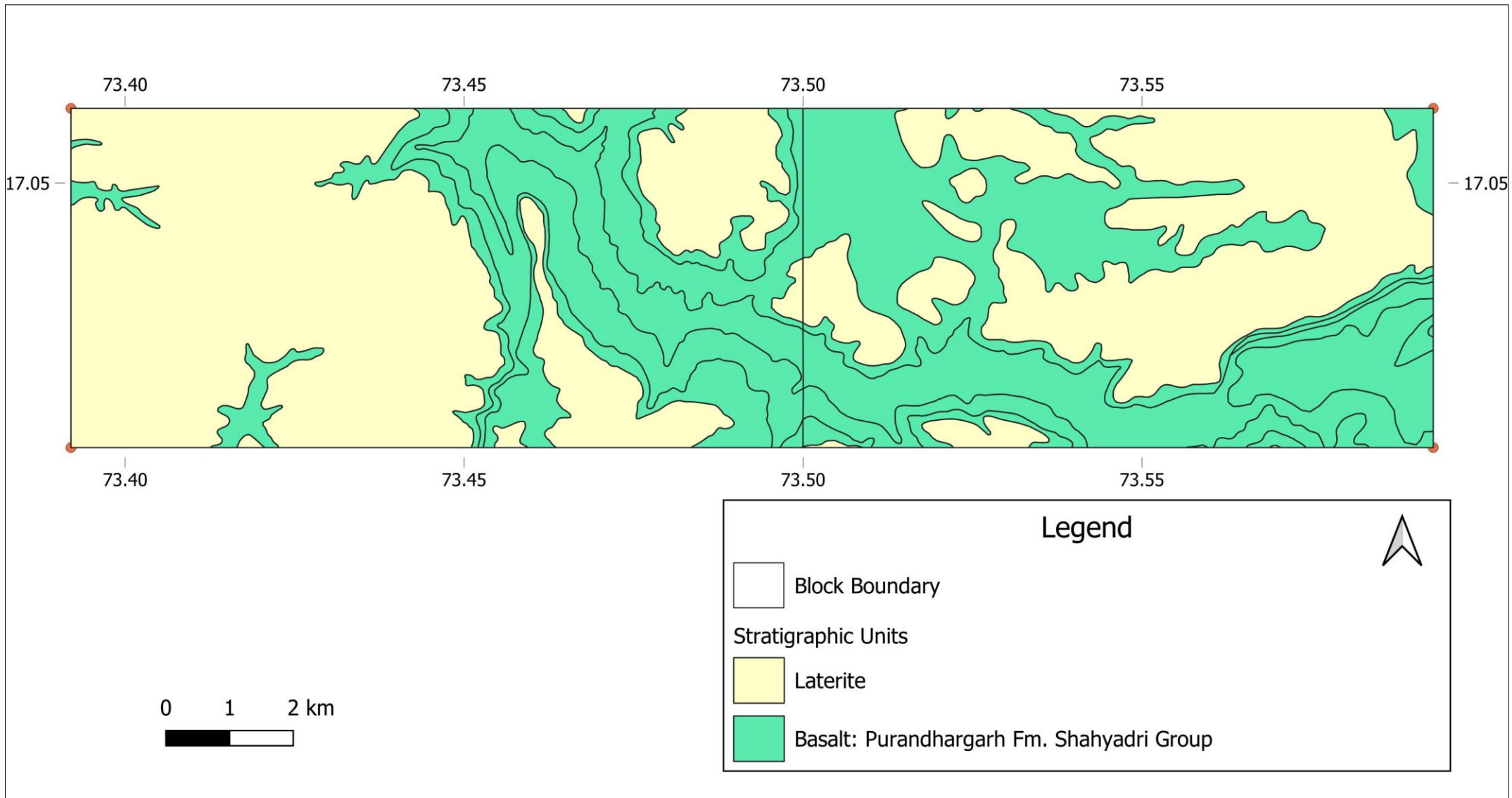


Plate IV-NGCM geochemical map of selected elements

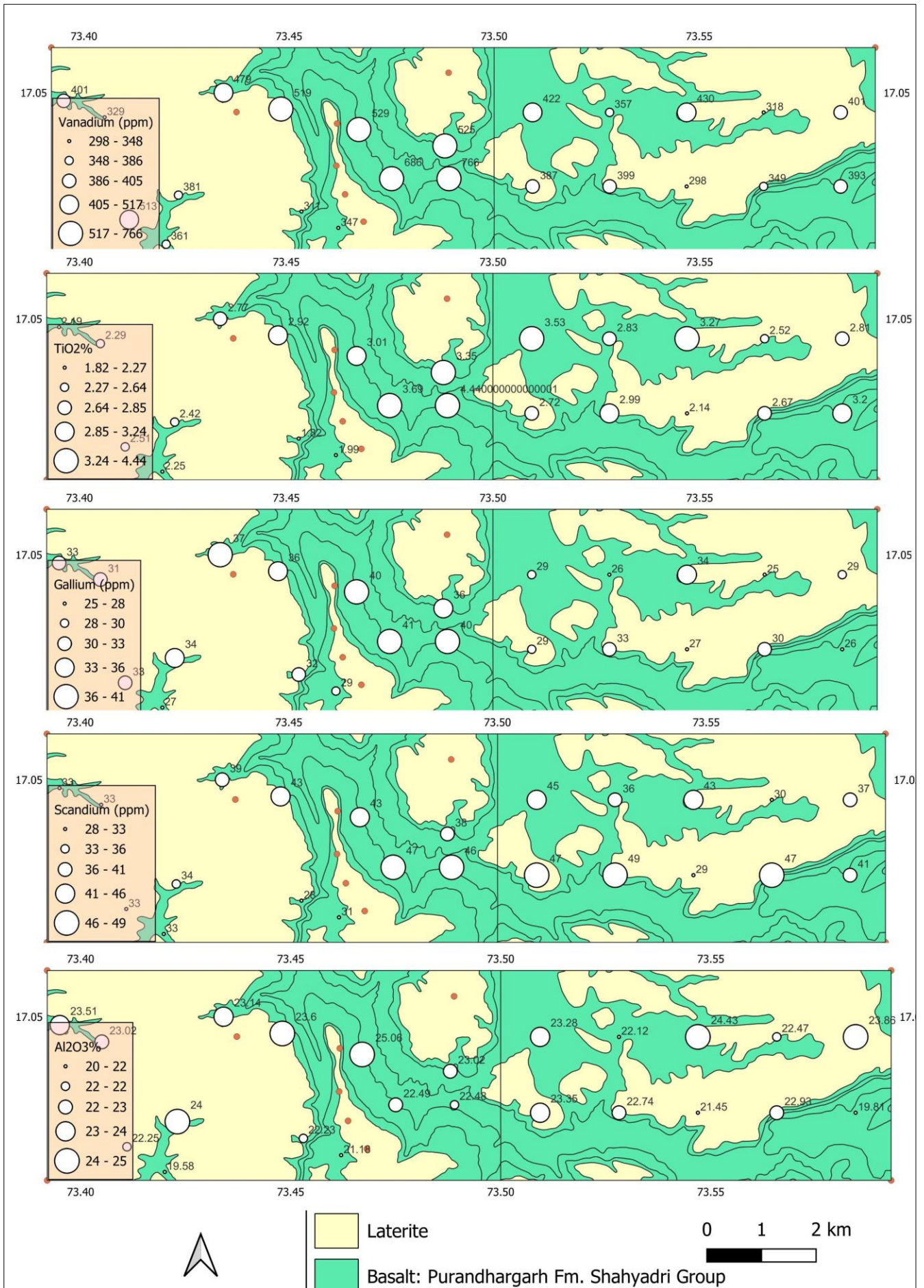


Plate V -Geochemical map of BRS samples analysis carried out by MMPL

