DETAILED PROJECT REPORT (DPR)

PRELIMINARY EXPLORATION FOR ALUMINOUS LATERITE, TITANIUM, VANADIUM AND ASSOCIATED MINERALS IN MUDBIVADI BLOCK, BIDAR DISTRICT, KARNATAKA

(G3-STAGE & 3 SQ.KM)

COMMODITY: VANADIUM AND ASSOCIATED CRITICAL MINERALS

By

GMMCO TECHNOLOGY SERVICES LTD (GTS)

HYDERABAD, TELANGANA

CKA Birla Group GTS

FOR SUBMITTINGPROPOSALFORUNDERTAKING PRELIMNARYEXPLORATION

From:	To:
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Rangareddy District, Hyderabad - 500089	New Delhi - 110011.

1) Name and address of the Applicant		
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2) Details of Accreditation as Private Exploration Agencies and Notification under the Provision to Section 4(1) of the MMDR Act.		
(a)	Date of accreditation granted by QCI-NABET	20th May - 2024
(b)	Date of expiry of accreditation	15th May - 2027
(c)	Date of Notification under the provision to Section 4(1) of the MMDR Act.	13th Sept - 2024
(d)	Date of expiry of notification	12th Sept - 2027
(e)	Category of the Exploration agency (Category A or B) under Notification	Category - A

3) Location details of the area proposed		
(a)	State	Karnataka
(b)	District(s)	Bidar District
(c)	Nearby village(s)	Mudbi and Chiknagaonwadi
(d)	Survey of India (SOI) Toposheet No(s)	56C/14
(e)	Area in Sq. Km	3

(f)	Boundary co-ordinates of the Proposed Block (in Decimal Degree)	Corner points	Latitude (DD)	Longitude (DD)
		A	17.703486	76.928052
		B	17.714225	76.916022
		C	17.718392	76.920233
		D	17.712894	76.929458
		E	17.721750	76.938233
		F	17.714780	76.948303

4) Mineral Potential of the area		
(a)	Name of Mineral(s) identified/expected in the area/block	Vanadium and Associated Critical Minerals
(b)	Title of the Project	Mudbiwadi Block
(c)	Stage of Exploration	G-3
(d)	Basis on which mineral potential of the area has been identified	Please refer enclosed “Summary proposal”

5) Documents enclosed with the application	
(i)	Location of the proposed block demarcated on Survey of India (SOI) Toposheet No.56C/14
(ii)	Documents mentioned in item 4(d) above.

Signature of the applicant

Dr. Akkala Surendra Babu
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Place: Hyderabad

Date: 06.08.2026

Summary of the Block

Preliminary Exploration for Aluminous Laterite, Titanium, Vanadium and Associated Minerals in Mudbivadi Block, Bidar District, Karnataka (G3-Stage & 3 Sq.Km)

<table>
<tr><th>S.No</th><th>Features</th><th colspan="3">Details</th></tr>
<tr><td></td><td>Block ID</td><td colspan="3">Mudbivadi Block</td></tr>
<tr><td></td><td>Exploration Agency</td><td colspan="3">M/s GMMCO Technology Services Limited Hyderabad, India.</td></tr>
<tr><td></td><td>Commodity</td><td colspan="3">Vanadium and associated Critical Minerals</td></tr>
<tr><td></td><td>Mineral Belt</td><td colspan="3">Deccan trap volcanism</td></tr>
<tr><td></td><td>Completion Period with entire Time schedule to complete the project</td><td colspan="3">Ten (10) months</td></tr>
<tr><td></td><td>Objectives</td><td colspan="3">1. Detailed geological mapping (1:4,000 scale) to delineate Aluminous Laterite mineralization.
2. Surface sampling (BRS/channel) and trenching to establish continuity and grade variation.
3. Exploratory drilling at 400 m spacing up to 30 m depth to prove lateral and vertical continuity.
4. Estimation of Inferred Resources (UNFC 333) for Aluminous Laterite, TiO_2, V, Sc and associated minerals as per UNFC and MEMC Rules, 2015.</td></tr>
<tr><td></td><td>Whether the work will be carried out by the proposed agency</td><td colspan="3">M/s GMMCO Technology Services Limited Hyderabad, India</td></tr>
<tr><td></td><td>Name/Number of Geoscientists</td><td colspan="3">Two Senior Geologists</td></tr>
<tr><td></td><td>Expected Field days(Geology)Geological Party Days</td><td colspan="3">Two Senior Geologists: 200 days (2x100 days)</td></tr>
<tr><td>1.</td><td>Location</td><td colspan="3"></td></tr>
<tr><td></td><td>Latitude and Longitude</td><td colspan="3"><table>
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	Villages	Mudbi and Chiknagaonwadi
	Tehsil /Taluk	Basavakalyan
	District	Bidar
	State	Karnataka
2.	**Area (hectares/square kilometers)**	
	Block Area (Sq.Km)	3
	Forest Area	Nil
	Government Land Area	Data not available
	Private Land Area	Data not available
3.	**Accessibility**	
	Nearest Rail Head	Bidar Railway station
	Road	Mudbi is a Village in Basavakalyan Taluk in Bidar District of Karnataka State, India. It belongs to Gulbarga Division. It is located 76 KM towards west from District headquarters Bidar. 11 KM from Basavakalyan. 623 KM from State capital Bangalore
	Airport	The nearest airport is Bidar, Karnataka
4.	**Hydrography**	
	Local Surface Drainage Pattern (Channels)	The proposed area represents a plateau geomorphic setting characterized by an undulating terrain, with a moderately to highly dissected upper plateau developed in the north-western part of Toposheet No. 56C/14.
	Rivers/Streams	1st order Nalas present in proposed area
5.	**Climate**	
	Mean Annual Rainfall	Bidar experiences an average annual rainfall of approximately 847 mm to 937 mm
	Temperatures (December) Minimum Temperatures (June) (Maximum)	Tropical climate with hot summers, mild winters, and southwest monsoon rainfall.
6.	**Topography**	
	Toposheet Number	56C/14
	Morphology of the Area	The proposed area is gentle undulations and low-lying areas
7	**Availability of baseline geosciences data**	
	Geological Map (1:50K/25K)	1:12,500 (LSM map, G4 stage, Mudbi block, GSI, 2025) 1: 50,000 (Bhukosh)
	Geochemical Map	NGCM data available
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well also Local scale GP maps)	NGDR

8.	**Justification for taking up Reconnaissance Survey / Regional Exploration**	In the proposed block, Geological Survey of India (GSI, 2025) carried out Critical Mineral Assessment Programme (CMAP) on 1: 12,500 scale in the Mudbi block and delineated four potential zones within aluminous laterite, recommending the area for detailed investigation. Analytical results from BRS, channel indicate appreciable enrichment of Al_2O_3(11.72 to 32.05%), TiO_2 (0.96 to 4.94%), V (233 to 3047 ppm), Sc (14 to 209 ppm). The multi-element association suggests favourable potential for establishing critical and strategic mineral resources in the proposed G3 block. The elevated values reflect intense lateralization and residual concentration processes. The mineralization is genetically related to deep weathering of Deccan Traps basalts, resulting in residual enrichment of alumina and iron along with concomitant concentration of vanadium, titanium and scandium Considering the promising analytical results, identified potential zones, and favourable genetic model, the block warrants systematic G3 stage exploration to establish Inferred Resources and assess its economic viability. Analytical Results of Proposed G3 Block - Aluminous Laterite (GSI, CMAP, 2025) (Plate:3) Al_2O_3: 14.36%- 30.48%, Vanadium: 223-2056 ppm, Scandium: 4 -200 ppm, TiO_2: 1.7%-4.51%.

Detailed Block Summary of the Mudbivadi Block

Contents

Block Summary

1. Introduction

Critical minerals such as Vanadium (V), Cobalt (Co) and Scandium (Sc) are of strategic importance due to their applications in advanced alloys, energy storage systems and high-technology industries. Identification and assessment of indigenous resources of these minerals have been prioritized, including their occurrence in secondary and unconventional geological environments. Laterites, developed through prolonged chemical weathering under low erosion conditions, are recognized as significant secondary repositories of critical minerals due to residual enrichment processes (Schulz, 2017; Jones and Vasyukova, 2018; Wang et al., 2021).

The proposed area is situated in the Deccan Plateau and is underlain by Deccan Trap basaltic flows with widespread laterite cover. The basaltic flows exhibit weathered vesicular and zeolitic zones at flow contacts, commonly associated with red bole and intertrappean horizons. These horizons provide favourable geological conditions for the concentration and retention of critical minerals during lateritization.

In the proposed block, Geological Survey of India (GSI, 2025) carried out Critical Mineral Assessment Programm (CMAP) on 1: 12,500 scale in the Mudbi block and delineated four potential zones within aluminous laterite, recommending the area for detailed investigation. Analytical results from BRS, channel indicate appreciable enrichment of Al_2O_3 (11.72 to 32.05%), TiO_2 (0.96 to 4.94%), V (233 to 3047 ppm), Sc (14 to 209 ppm). The multi-element association suggests favourable potential for establishing critical and strategic mineral resources in the proposed G3 block.

Geochemical mapping carried out by GSI in the adjoining area by Pawar and Nirmalkumar (2023) reported anomalous concentrations of V (239-1183 ppm), Co (1-128 ppm) and Sc (25-56 ppm) from laterite zones. Further, a Critical Mineral Assessment Programme conducted by Deepu T.R. et al. (2025) over a limited area reported enrichment of V (89 - 4280 ppm; average ~898 ppm) and Sc (4-104 ppm; average ~43 ppm) from surface and borehole samples. Subsurface information is, however, limited to two boreholes, and the sampling density is inadequate to establish lateral continuity, thickness variation and grade consistency of mineralized laterite horizons (Plate-3, 4 & 5).

In view of the favourable geological setting and considering the promising analytical results, identified potential zones, and favourable genetic model, the block warrants systematic G3 stage exploration to establish Inferred Resources and assess its economic viability.

Location and details of the area

The proposed block falls in the survey of India toposheet No. 56C/14 in the administrative jurisdiction of Bidar District, Karnataka (Plate-1). The area forms part of Gulbarga division, where laterite is exposed. It is located 76 KM towards west

from District headquarters Bidar. 11 KM from Basavakalyan. 623 KM from State capital Bangalore.

Physiography

Toposheet No. 56C/14 is characterised by a plateau-dominated physiography with gently to moderately undulating terrain, developed as part of the Deccan plateau region. The area comprises laterite-capped uplands, intervening shallow valleys, and locally dissected plateau remnants, reflecting prolonged subaerial exposure and tropical weathering.

Elevation varies moderately across the toposheet, with higher ground forming subdued plateaus and lower elevations marked by seasonal nalas and minor drainage channels. The drainage pattern is predominantly dendritic to sub dendritic, controlled by regional slope and structural weaknesses, and exhibits a moderate to high degree of dissection in places. The combined influence of physiography, drainage, and tropical climatic conditions has favoured intense lateritisation and residual concentration of alumina and associated elements, making the area conducive for aluminous laterite bauxite and allied critical mineral occurrences.

Regional Geological setup

The proposed block, situated in the southeastern part of the Deccan Plateau within toposheet 56C/14 is predominantly characterized by basaltic flows of the Deccan Trapsand lateritic outcrops. These flows are of Upper Cretaceous to Paleogene age and regionally correlated to flows 9 to 13. Individual flows are differentiated by the presence of inter-trappean chert and/or red bole horizon. These flows are under the Ambaneli Formation of the Sahyadri Group. The oldest flows, no.9 and 10, are dark to grey, fine-grained and very sparsely porphyritic with plagioclase of 5 mm size. The base of the flow is not in the area. A thin bed of red bole separates this flow from the overlying flow.

The second flow (No. 11 and 12) is exposed between 580+/-2 m and 630+/-2 m above msl. The flow is dark grey, very fine-grained at places and porphyritic in texture. This shows light and dark coloured horizontal bands, which may be either due to compositional change or stretching of the vesicles. In the weathered portions, some horizontal grooves are seen, which might have been developed due to differential weathering.

It contains vesicles of 1 mm to 5 mm in size, which are partly to filled with zeolite, calcite, secondary silica and glass. The intertrappean horizon overlying the second flow and is greenish, cream, white to brown, un-fossiliferous siliceous chert. The third flow (No.13) is exposed above 630+/- 2 m and is the youngest flow in this area. It is greenish-grey, fine to coarse-grained and sparsely to moderately glomeroporphyritic in texture (T.P. Gururaja and A.S. Khan FS 1978-79. A.S. Khan FS 1979-80, B Chakrabarti FS 1980-81).

Laterite covers about half of the area on the eastern side and a few scattered mounds in the remaining area, which form plateaus of various sizes having irregular outlines, linear ridges, and conical and flat-topped blocks of small size. Laterite is yellowish to reddish brown, limonitic and highly porous with vermicular openings. The contact between the underlying flow and laterite is gradational.

Table 1: Generalized stratigraphy of the Area

(Source: Compiled 50 K Geological Map, GSI)

Age	Super group	Group	Formation	Lithology
Cenozoic				Laterite
Upper Cretaceous to Palaeocene	Deccan Trap	Sahyadri	Ambaneli	Basalt flow 13
				Basalt flow 11, 12
				Intertrappean
				Basalt flow 10
				Basalt flow 9

In the local geological context, the lateritic profiles exhibit a systematic upward increase in degree of weathering, marked by development of saprolite, core-stone horizons, mottled zones, and ferruginous/aluminous duricrust caps, with fresh basalt encountered at depths exceeding 30- 40 m. Such well-developed lateritisation has facilitated residual concentration of alumina, iron, titanium, vanadium and allied elements, making the Deccan Trap hosted laterites of the area favourable targets for aluminous laterite bauxite and critical mineral exploration. The geological setting thus provides a strong rationale for undertaking G-3 stage investigations in the proposed block under UNFC and MEMC Rules.

Geology of the Block

The proposed block is underlain by Cenozoic laterite formations developed over Late Cretaceous-Palaeocene basaltic flows of the Deccan Traps (Sahyadri Group), along with associated intertrappean beds comprising chert and chert with marl. The laterites represent the products of intense chemical weathering of basalt under tropical climatic conditions, leading to residual enrichment of iron, alumina, and associated elements. Consequently, the lithological assemblage within Toposheet No. 56C/14 is dominated by Deccan Trap basalts, intertrappean sediments, and lateritic caps (Plat-3).

Four younger basalt flows, designated Flows 9,10,11,12 & 13 (Table 1), are recognised in the area. These flows are sub-horizontal to horizontal, laterally extensive, and exhibit typical 'Aa' type basaltic characteristics, including thick massive cores, locally developed columnar jointing, rough and rubbly upper surfaces, and highly vesicular flow tops. Vesicles, ranging in size from 1 mm to 10 mm, are commonly infilled with secondary minerals such as calcite, zeolite, drusy quartz, and chalcedony. Individual flows are distinguished on the basis of their fragmental and vesicular flow tops, weathering characteristics, joint patterns, and intervening intertrappean horizons. Laterite occurs both as isolated cappings and as extensive blanket deposits over the trap flows, with profile thickness varying from 1 m to 30 m. Parts of Flows II and III have undergone advanced lateritisation, producing vermicular, hard, massive, and concretionary laterite. The laterite exhibits colour variations from brick red and reddish-brown to dark greyish-red, reflecting differences in degree of weathering and iron enrichment.

Scope for proposed exploration

The proposed exploration programme aims to undertake G-3 stage preliminary exploration to assess the aluminous laterite bauxite potential and associated critical minerals (V, Ti, and Ga) within the block. The scope includes systematic geological and structural mapping to delineate laterite cover, basalt flows, intertrappean horizons, and favourable geomorphic domains controlling lateritisation and mineral enrichment.

Detailed geological mapping (1:4,000 scale) to delineate Aluminous Laterite, TiO_2, Vanadium (V), Scandium (Sc) and associated critical mineralisation. Surface sampling (BRS/channel) and trenching to establish continuity and grade variation of Al_2O_3, TiO_2, V, Sc and associated minerals. Exploratory drilling at 400 m spacing up to 40 m depth to prove lateral and vertical continuity of mineralisation. Estimation of Inferred Resources (UNFC 333) for Aluminous Laterite, TiO_2, Vanadium, Scandium and associated minerals as per UNFC and MEMC Rules, 2015.

Mineral Potentiality based on Geology

Mineralisation within the proposed block is closely associated with intense lateritisation of Deccan Trap basalts, which has resulted in the residual concentration of aluminium and iron, along with enrichment of vanadium, Scandium, titanium, and gallium. During prolonged tropical weathering, silica and alkalis were leached, while relatively immobile elements such as Al, Fe, Ti, Sc, REE and V became progressively concentrated within the lateritic profile. Vanadium is preferentially enriched through adsorption and substitution within iron oxides and hydroxides, whereas titanium occurs largely as resistant Ti-bearing phases and as lattice-bound components within the weathered basalt. Gallium, owing to its geochemical affinity with aluminium, is commonly incorporated within aluminous laterite and bauxite horizons. The development of thick, mature lateritic profiles, particularly over Flows II and III, thus provides favourable conditions for the formation of Al-V-Sc-Ti-Ga bearing laterite and bauxite, warranting systematic G-3 stage preliminary exploration.

2. Previous Work

Systematic geological investigations in and around the proposed block have been carried out by the Geological Survey of India (GSI) from time to time. Early regional geological mapping established the presence of Deccan Trap basaltic flows, intertrappean sediments and lateritic caps, and delineated the broad stratigraphic framework of the area. These studies documented extensive lateritisation of basaltic flows, particularly over plateau surfaces, indicating favourable conditions for the development of laterite and associated secondary mineral enrichment.

Anjali Upadhyay (2025) was investigated the Mudbi Block, Bidar District, Karnataka, under the Critical Mineral Assessment Programme (CMAP) to assess the potential of Vanadium (V), Scandium (Sc), Titanium (Ti) and associated critical minerals in lateritic profiles developed over Deccan Trap basalts. Geological mapping, geochemical sampling, scout drilling and mineralogical studies revealed significant enrichment of V (233-3047 ppm), Sc (14-209 ppm), Al_2O_3 (11.72-32.05%) and TiO_2 (0.96-4.94%) within the laterite and saprolite horizons. Mineralogical studies indicate that Vanadium is primarily hosted in Fe-Ti oxide minerals such as magnetite, ilmenite, hematite and goethite. The study concluded that lateritization of Deccan Trap basalts has resulted in substantial enrichment of critical minerals, making the area favourable for further exploration.

Sinha et al. (1980) carried out geological mapping on 1:50,000 scale in toposheets 56F/4, 56G/5 and 56G/6. The area was reported to be largely covered by tholeiitic Deccan Trap basalts of Cretaceous to Eocene age, resting disconformably over Bhima Group limestones of Precambrian age. The Deccan Trap basalts are capped by laterite at places, with a gradational contact between basalt and laterite. The Bhima limestone are described as grey to buff coloured, banded, thin-bedded and laminated, generally horizontal with local warping. The contact between Bhima limestone and Deccan Traps is marked by the presence of clayey red bole horizons of 10-30 cm thickness.

Geochemical mapping carried out by Pawar and Nirmalkumar (2023) in toposheets 56G/01 and 56G/05 reported anomalous concentrations of Vanadium (239 -1183 ppm), Cobalt (1-128 ppm) and Scandium (25 - 56 ppm) from seven GCM samples collected from laterite zones, particularly in and around SindolTanda village (toposheet 56G/05).

Subsequently, Deepu T.R. et al. (2025) carried out a Critical Mineral Assessment Programme over an area of 25 sq. km on 1: 25,000 scale. The study reported Fe_2O_3 values ranging from 14.16 to 59.88% (average 38.38%), Al_2O_3 from 10.22 to 26.90% (average 18.51%) and TiO_2 from 0.97 to 5.78% (average 2.03%), along with notable enrichment of Vanadium (89-4280 ppm; average 897.81 ppm) and Scandium (4-104 ppm; average 42.90 ppm) from bedrock samples. Two boreholes (KBST-1: 21.5 m and KBST-3: 35.1 m) intersected well-developed lateritic profiles comprising duricrust, ferruginous laterite and saprolite over basalt. KBST-1 recorded maximum V (1035 ppm) and Sc (77 ppm) within the upper 6 m, while KBST-3 showed higher concentrations of V (2209 ppm over 1.25 m), Sc (average 157.5 ppm) and ΣREE (1138 ppm over 4.2 m) within the ferruginous saprolite zone.

3. Block description

The following coordinates are proposed for systematic execution of the G-3 stage exploration programme in the Mudbiwadi block:

Table-2. Boundary coordinates of the proposed block

Corner points	Latitude (DD)	Longitude (DD)
A	17.703486	76.928052
B	17.714225	76.916022
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Field Evidence and In-situ Geochemical Analysis (Mudbiwadi Block) (Source: GSI-G4 CMAP Report)

The geochemical data and field observations from the Mudbi Block indicate the development of a well-preserved lateritic profile over Deccan Trap basalts under prolonged tropical weathering conditions. The laterites are characterized by moderate to high Al_2O_3 (11.72-32.05%), elevated Fe_2O_3 (13.77-59.36%), and appreciable TiO_2 (0.96-4.94%), reflecting intense desilication and residual enrichment during lateritization. The lateritic profile comprises laterite, ferruginous laterite, saprolite, clay-rich saprolite and weathered basalt, indicating distinct vertical geochemical zonation.

Vanadium concentrations range from 233 to 3047 ppm, with the highest values generally associated with Fe-rich laterites, suggesting a close affinity of vanadium with iron oxide phases. Scandium values range from 14 to 209 ppm and show significant enrichment within the laterite-saprolite profile relative to the parent basalt. The relatively stable TiO_2 content indicates its immobile behaviour during weathering and consequent residual concentration within the lateritic horizons. Mineralogical investigations reveal that vanadium is mainly hosted in Fe-Ti oxide minerals such as magnetite, ilmenite, hematite and goethite.

Profile-4 located at the central portion of the proposed block shows 1043ppm V and 109ppm Sc in duricrust, up to 1124ppm V and 110ppm Sc in mottled zone. The major oxides SiO2, Al2O3, and TiO2 show decreasing trend from saprolite to lower mottled zone while Fe2O3 increases up to this point after which the trend is reversed within the clay rich upper mottled zone (Fig. 3).

The pronounced enrichment of Vanadium, Scandium, Titanium and associated critical minerals within the laterite and saprolite horizons demonstrates the favourable role of lateritization in upgrading metal concentrations. These geochemical and mineralogical characteristics indicate good potential for critical mineral mineralisation and justify further exploration to establish the thickness, continuity and grade variation of the mineralized lateritic profile.

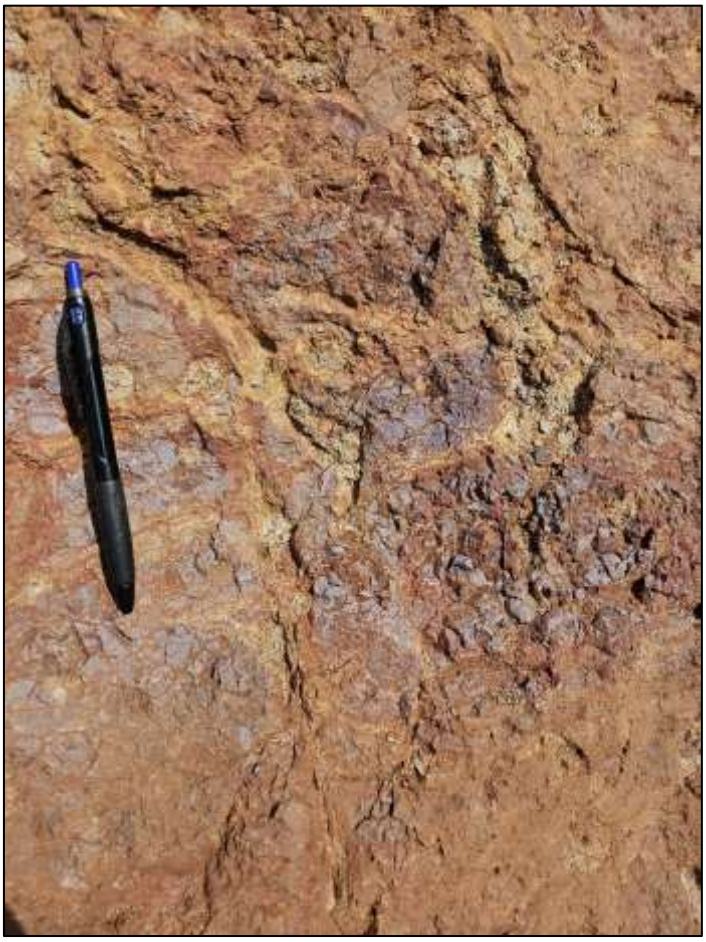

Figure 1. Field Photograph of saprolite showing large basalt relicts within clayey groundmass, south of Mudbiwadi (GSI, 2025)

Figure 2. Field Photograph of laterite duricrust, west of Mudbiwadi (GSI, 2025)

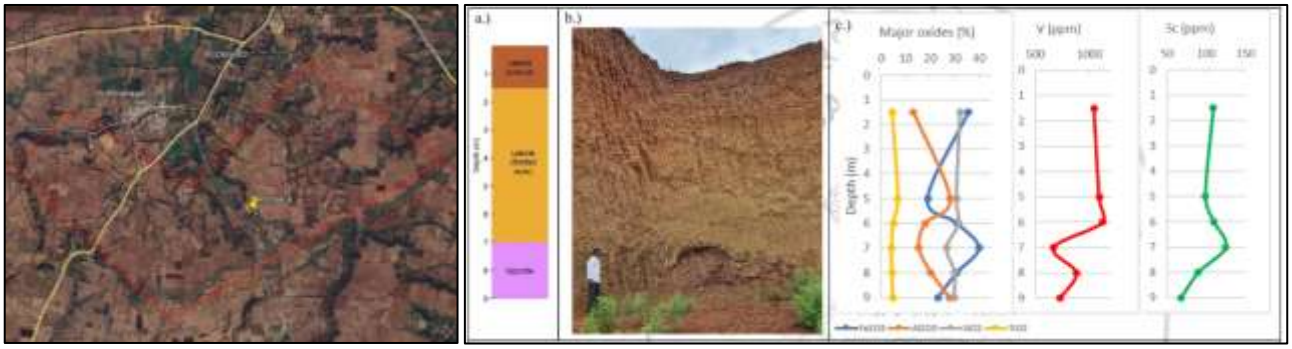

Figure 3. a) Schematic diagram of profile-4 b) Field photograph showing profile-4 c) Graph showing Fe2O3, Al2O3, SiO2, TiO2, V and Sc values along the profile (GSI, 2025)

4. Planned Methodology

The proposed G3-stage investigation is aimed at evaluating the lateral and vertical distribution of critical mineral enrichment within laterite profiles developed over the Deccan Trap terrain and assessing their preliminary resource potential. The exploration programme will comprise integrated geological, geochemical, mineralogical, and subsurface investigations to establish the grade, continuity, and thickness of mineralized horizons.

4.1 Geological Mapping

Large-scale geological mapping on 1:5,000 scale will be carried out over the entire study area to delineate lithological units, geomorphic features, structural elements, and the spatial extent of lateritization. Detailed mapping will focus on the identification of basalt flow contacts, vesicular and amygdaloidal zones, red bole horizons, intertrappean beds, and variations in laterite profiles comprising duricrust, ferruginous laterite, bauxitic laterite, and saprolite horizons. Information on profile development, weathering characteristics, and geomorphological controls on mineralization will be systematically documented.

4.2 Geochemical Investigation

A systematic geochemical sampling programme will be undertaken from laterite, ferruginous, bauxitic, and saprolitic horizons following an appropriate grid pattern. Representative samples will be analyzed for critical minerals and associated elements including Vanadium (V), Scandium (Sc), Cobalt (Co), Gallium (Ga), Titanium (Ti), Rare Earth Elements (REE), and major oxides such as Fe_2O_3, Al_2O_3, SiO_2, TiO_2, and LOI. The analytical programme will be supported by stringent QA/QC measures through the incorporation of field duplicates, blanks, and certified reference standards to ensure analytical accuracy and precision.

4.3 Geophysical Investigation

Geophysical surveys will be carried out to delineate the thickness, lateral continuity, and subsurface geometry of laterite horizons and to identify variations in weathering profiles associated with critical mineral enrichment. The investigation will include Electrical Resistivity Tomography (ERT)/Resistivity Imaging and Resistivity Profiling with Twin-Electrode Configuration along selected traverses across the study area. Resistivity data will be acquired at a station interval of up to 10 m along profiles strategically planned based on geological and geomorphological considerations. The surveys will be aimed at differentiating lateritic duricrust, ferruginous and bauxitic horizons, saprolite zones, and underlying basaltic bedrock based on their contrasting electrical resistivity characteristics.

4.4 Subsurface Exploration

Subsurface investigations will be carried out through a combination of pitting, trenching, and exploratory drilling. A total of 10 boreholes are proposed to assess the thickness, grade variation, lateral continuity, and vertical distribution of mineralized laterite horizons. Detailed lithological logging, core recovery measurements, geotechnical observations, and systematic sampling of drill cores and trench sections will be undertaken. The drilling programme will provide critical information on profile architecture, bedrock configuration, and controls on mineral enrichment.

4.5 Mineralogical and Laboratory Studies

Selected samples representing various horizons of the laterite profile will be subjected to mineralogical investigations, including XRD, petrographic, and SEM-EDS studies, wherever required, to determine the mode of occurrence and host phases of critical elements. These studies will aid in understanding enrichment processes and mineralogical controls on critical mineral distribution.

4.6 Data Integration, Resource Assessment and Target Delineation

All geological, geochemical, drilling, and mineralogical data will be integrated in a GIS environment to generate thematic layers and spatial distribution models. Statistical and geospatial analyses will be undertaken to delineate anomalous zones and evaluate their continuity. Based on the integrated interpretation, potential mineralized blocks will be identified and preliminary resources estimated in accordance with UNFC guidelines applicable to G3-stage exploration. The outcome of the investigation will establish the prospectivity of aluminous laterite-bauxite and associated V-Ti-Ga-Sc-REE mineralization and provide a scientific basis for planning subsequent detailed exploration and resource evaluation.

5. Nature Quantum and Target

The following work components are proposed for the reconnaissance (G- 3) stage exploration programme in the Mudbivadi block:

Table .2 Proposed works in Mudbivadi Block

S. No	Activities	Unit	Target
1	**Geological Mapping & Other work**		
	Detailed Geological Mapping (on 1:4000 Scale)	Sq. Km	3
2	**Survey**		
	i) Topographic Survey (on 1:4,000 Scale)	Sq. Km	3
	ii) DGPS survey for Block Boundary and Boreholes	Nos.	11
3	**Pitting / Trenching**		
	Pitting	Cu m	50
4	**Drilling**		
	i) Drilling (In-house)	m	150
	ii) Core Logging	Nos.	150
5	**Sampling**		
	i) Bed Rock Samples (BRS)	Nos.	20
	ii) Core samples	Nos.	150
	iii) Pitting/Trenching samples (PTS)	Nos.	50
6	**Laboratory Studies**		
	i)Chemical analysis	Nos.	270
	ii) Petrographic studies	Nos.	10
7	**Geological Report Preparation**		

6. Manpower deployment

The following manpower is proposed for systematic execution of the G-3 stage exploration programme in the Mudbivadi block:

Table-5. Details of manpower deployment

S.No	Category	Number	Role / Responsibility
1	Senior Geologists	2	Overall supervision, planning and execution of geological mapping, structural studies, and data integration
	Field Labour	4	Collection, labeling, preparation, and dispatch of bedrock, trench and pit
3	Sampler	1	Collection, labeling, preparation, and dispatch of bedrock, trench, pit, and core samples.
4	Supporting Labour for core Sampling	2	Assist sampler in sample collection, handling, and processing.
5	Surveyor	1	DGPS Survey for BH fixation & RL determination

7. Time Schedule for Reconnaissance Survey (G-3 stage)

The proposed G-3 stage exploration programme in the Mudbivadi block is planned to be completed within a period of 10 months.

Table-6. Exploration time schedule

S. No	Activity	Unit	Months											
			1	2	3	4		5	6	7	8		9	10
1	Camp Establishment	Months					Review-1					Review-2		
2	Geological mapping	Months												
3	Sampling (BRS, Pitting)	Months												
4	Sampling analysis (BRS, Pitting)	Months												
5	Survey (Boundary points and Drill collars)	Months												
6	Scout Drilling	Months												
7	Core logging & sampling	Months												
8	Sampling analysis (Drill core samples)	Months												
9	Laboratory analysis	Months												
10	Camp winding	Months												
11	Report preparation and submission	Months												

8. Break-up of expenditure

Table-8. Detailed break-up of expenditure

Cost Estimate - Preliminary Exploration (G3) for Aluminous Laterite, Titanium, Vanadium and Associated Critical Minerals in Mudbiwadi Block, Bidar District, Karnataka. Area - 3 sq. km, Drilling: 150m; BHs: 08; Timeline: Ten (10) months		
S. No.	**Item of Work ***	**Estimated Cost of the Total Amount (Rs.)**
A	Geological Mapping & Other works	25,55,634
B	Survey work	6,45,720
C	Pitting/Trenching	2,36,250
D	Drilling	13,60,500
E	Laboratory Studies	12,41,600
F	Geological Report Preparation	2,50,000
G	Peer review	30,000
H	Preparation of Exploration Proposal	1,21,399
I	**Total Estimated Cost without GST**	**60,39,704**
J	Provision for GST (18% of I)	11,59,290
K	**Total Estimated Cost with GST**	**75,99,788**
Say Rs. in Lakhs		**76.00**

Detailed break-up of expenditure

Cost Estimate - Preliminary Exploration (G3-stage) For Aluminous Laterite, Titanium, Vanadium and Associated Critical Minerals In Mudbiwadi Block, Bidar District, Karnataka. Total Block Area- 3 sq.km, Completion time- 10 months, Review after 4 & 8 months; Drilling 150 m in 5 BHs (30 m each) **Implementing Agency: GMMCO Technology Services Limited**						
S. No.	**Item of Work ***	**Unit ***	**Rates as per NMET SoC 2025**		**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**					
i	Geological mapping, (1:4000 scale)	Sq.km	1.1	18300	3	54,900
ii	Charges for Geologist per day (Field) for geological mapping & trenching work	Day	1.2.1a	14500	120	17,40,000
iii	Charges for Geologist per day (HQ)	Day	1.2.1a	10500	30	3,15,000
iv	Labours Charges for field work	Day	5.8	556	240	1,33,440
v	Charges for one Sampler per day (1 Party)	Day	1.2.1b	7850	31	2,43,350
v	Labours (Field) for (Total 4 Nos i.e 2 workers per one Geologist)	Per day	5.8	556	124	68,944
					Sub Total-A	**25,55,634**
B	**Survey Work**					
i	DGPS Survey and for BH fixation & RL determination (5 BH + 6 Boundary points)	Per Point	1.3.2	24000	11	2,64,000
ii	Charges of one qualified surveyor with Total Station for carrying out topographical survey in different RF and surface contouring at different interval, fixation of borehole and determination of co-ordinates & Reduced Level (RL) of the boreholes with total station etc.	Per day	1.3.1	10,500	30	3,15,000
iii	Labour Charges for sampler (4)	Day	5.8	556	120	66,720
					Sub Total- B	**6,45,720**
C	**Pitting/Trenching**					
i	Trenching	per cu.m	2.1.2	4725	50	2,36,250
					Sub Total- C	**2,36,250**
D	**Drilling**					

i	Drilling (In-house)	per m	2.2.1.1c	5,500	150	8,25,000
ii	Land / Crop Compensation (in case the BH falls in agricultural Land)	per BH	5.6	30,000	5	1,50,000
iii	Construction of concrete Pillar (12"x12"x30")	Per BH	2.2.7	2,000	5	10,000
iv	Borehole plugging by cement	Per BH	2.2.8	10,000	5	50,000
v	Miscellaneous Charges (Transportation of Drilling Rig, Accommodation for Drill Camp, Camp setting and winding, construction of Approach road)	Drilling cost	2.2.9	0.25		2,06,250
vi	Core preservation	M	5.3	1590	75	1,19,250
					Sub Total- D	**13,60,500**
E	**LABORATORY STUDIES**					
1	**Chemical Analysis**					
i	Major oxides (WD XRF)-(oxides + traces -24 elements)	Per Sample	4.1.17a	4,200	220	9,24,000
ii	External Check (10%)	Per Sample	4.1.17a	4,200	22	92,400
iii	Analysis of one rock/ soil sample for quantitative analysis of 14 REE elements + 9 trace element (U, Ta, Ge, Be, Sn, As, Rb, Th, Ga) by ICP-MS (sequential technique)	Per Sample	4.1.15	7,400	25	1,85,000
iv	External Check (10%)	Per Sample	4.1.15	7,400	3	22,200
2	**Physical & Petrological Studies**					
i	Preparation of polished thin section of rock/ water	Per Sample	4.3.1	800	5	4,000
ii	Study of polished thin section	Per Sample	4.3.1	2800	5	14,000
	Sub Total D					**12,41,600**
E	**Total A to D**					**60,39,704**
F	Geological Report Preparation	One time	5.2		LS	2,50,000
G	Peer review Charges	As per EC decision				30,000
H	Preparation of Exploration Proposal	One time	5.1	2% of the Cost or Rs. 5.0 Lakhs whichever is less		1,20,794
I	**Total Estimated Cost without GST**					**64,40,498**
J	**Provision for GST (18% of I)**					**11,59,290**
K	**Total Estimated Cost with GST**					**75,99,788**
	Say Rs. In Lakhs					**76.00**

Note	
1	Strict adherence to the Ministry of Finance's and GFR guidelines is mandatory. Every transaction must adhere to GFR rule 21.
2	In case of delay/non- performance, the appropriate action will be taken by competent authority against delinquent agency as per prevailing Govt. of India rules/guidelines on procurement.
3	If any part of the project is outsourced, the amount will be reimbursed as per the Item no. 6 of NMEDT SoC. In case of execution of the project by NEA on its own, a Certificate regarding non outsourcing of any component/project is required.
4	Necessary efforts should be made to minimize any adverse impact on the environment during exploration activities.
5	Any item of work not mentioned above shall be added as per SoC.
6	All the Geological Reports and data are to be uploaded on NGDR as per MERT template by the agency.

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Anjali Upadhyay, Geological Survey of India (GSI) (2025). Unpublished Report On Critical Mineral Assessment Programme For Vanadium And Associated Critical Minerals In Lateritic Rocks OfMudbi Block, Bidar District, Karnataka of Toposheet No. 56C/14.

Deepu, T.R et.al (2025). Critical Mineral Assessment Programme in laterite-basalt terrain of Deccan Plateau, Karnataka, Geological Survey of India, Unpublished Progress Report, GSIJones, M.T. and Vasyukova, O.V. (2018). Critical metals in lateritic profiles: Controls on distribution and enrichment. Ore Geology Reviews, 95, pp. 849-865.

Pawar, S.S. and Nirmalkumar, (2023). Geochemical mapping in parts of toposheets 56G/01 and 56G/05, Karnataka, Geological Survey of India, Unpublished Report, GSI, Hyderabad.

Sinha, R.K et.al (1980). Geological mapping in parts of Gulbarga District, Karnataka (Toposheets 56F/4, 56G/5 and 56G/6), Geological Survey of India, Unpublished Report.

Plates

Plate -1: Location map of the proposed block (Karnataka state)

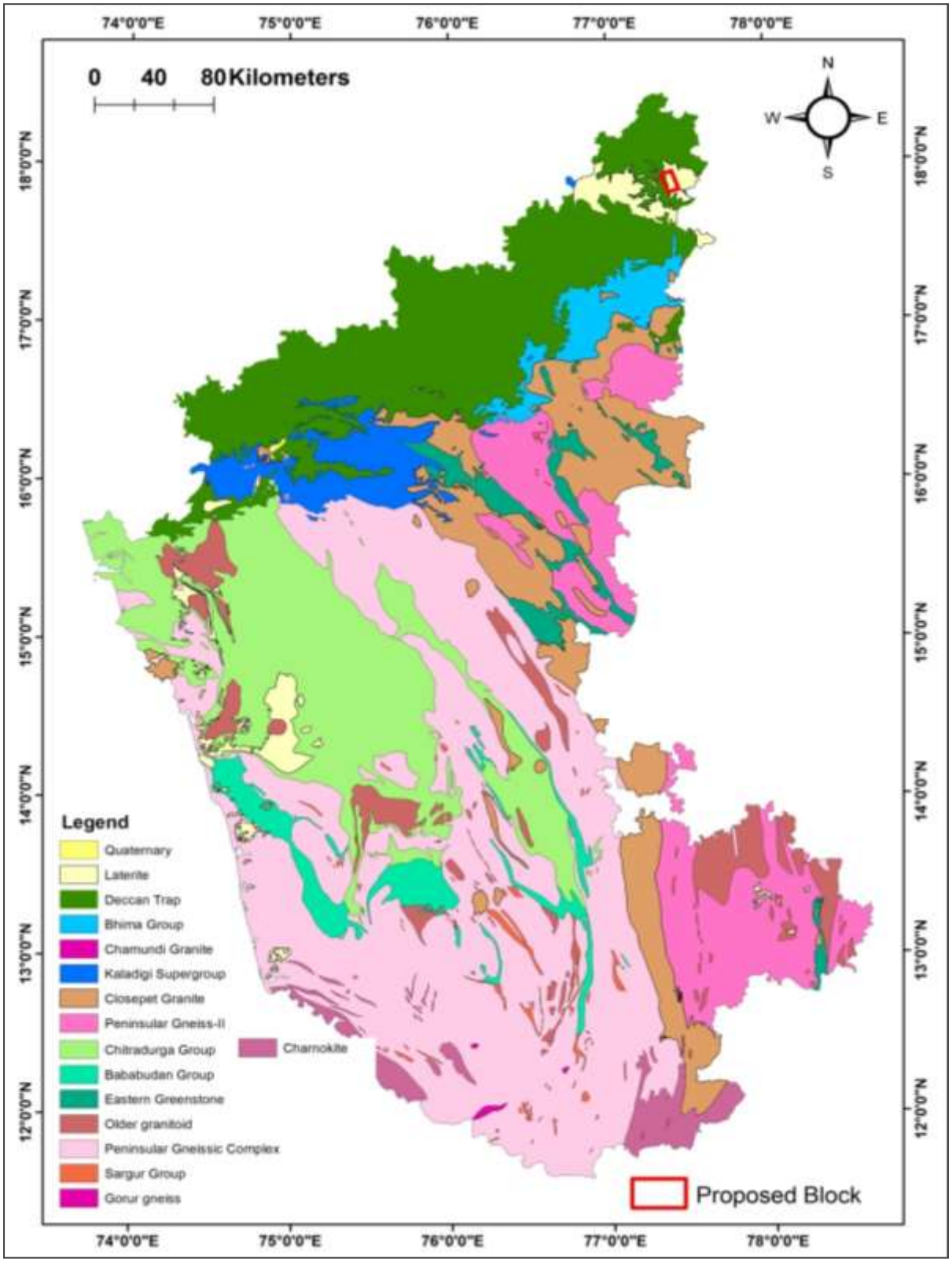

Plate-2: Geological map of toposheet no.56C/14 (1:50,000 scale) (Source. GSI, NGDR)

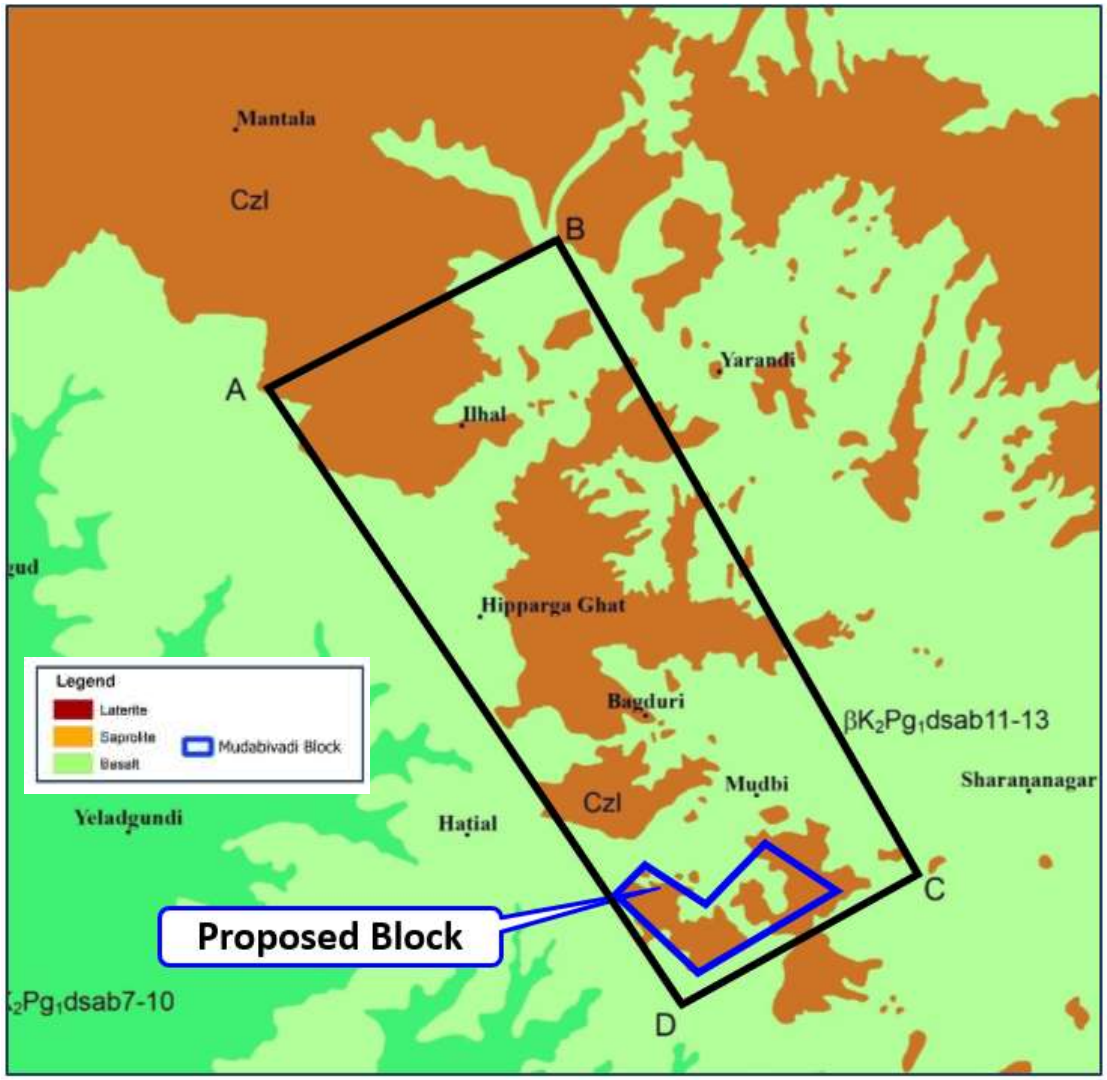

Plate-3: Survey of India toposheet no.56C/14 with proposed block

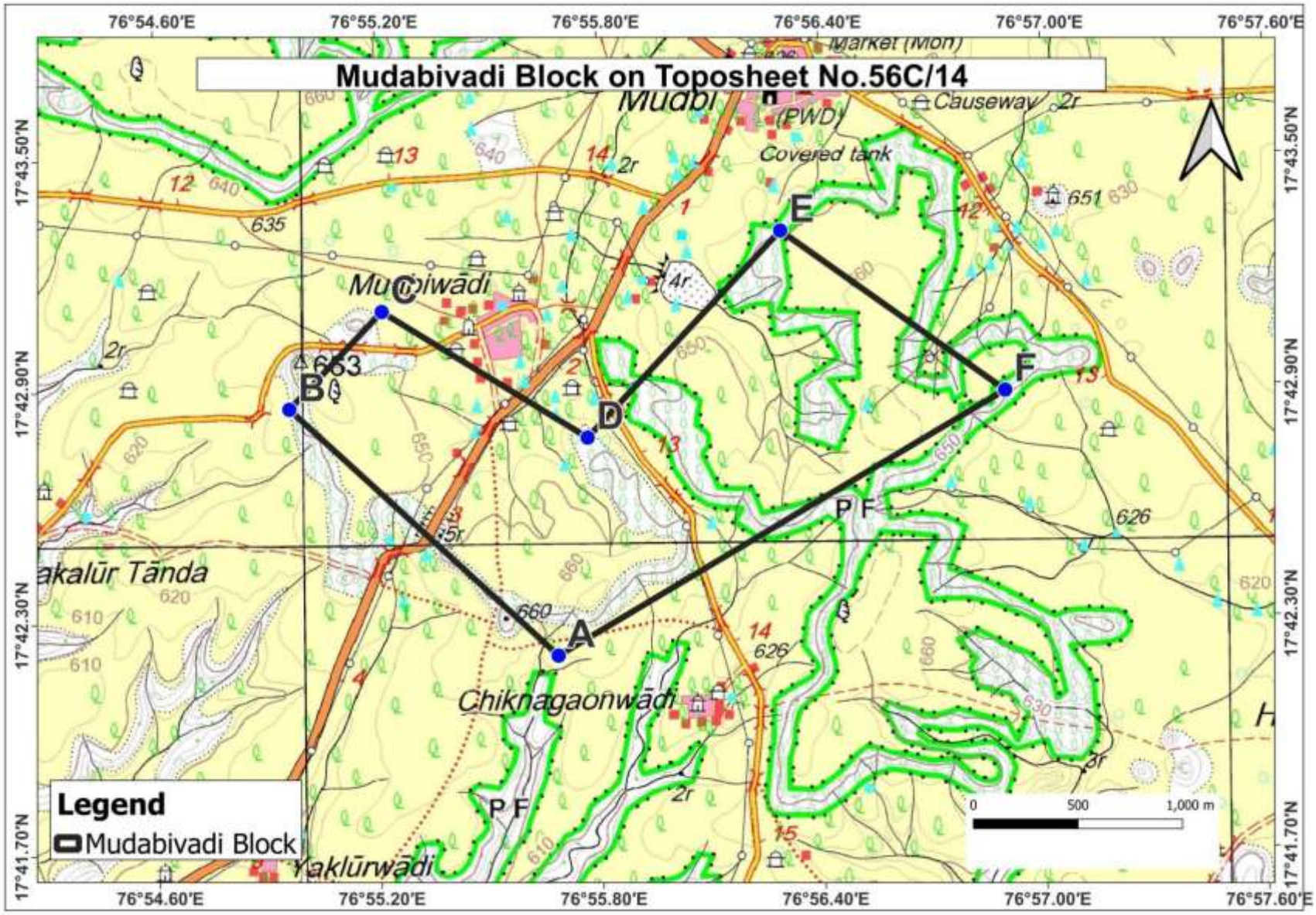

Plate-4: Al_2O_3distribution map of the proposed block (Source. GSI-G4 CMAP Report)

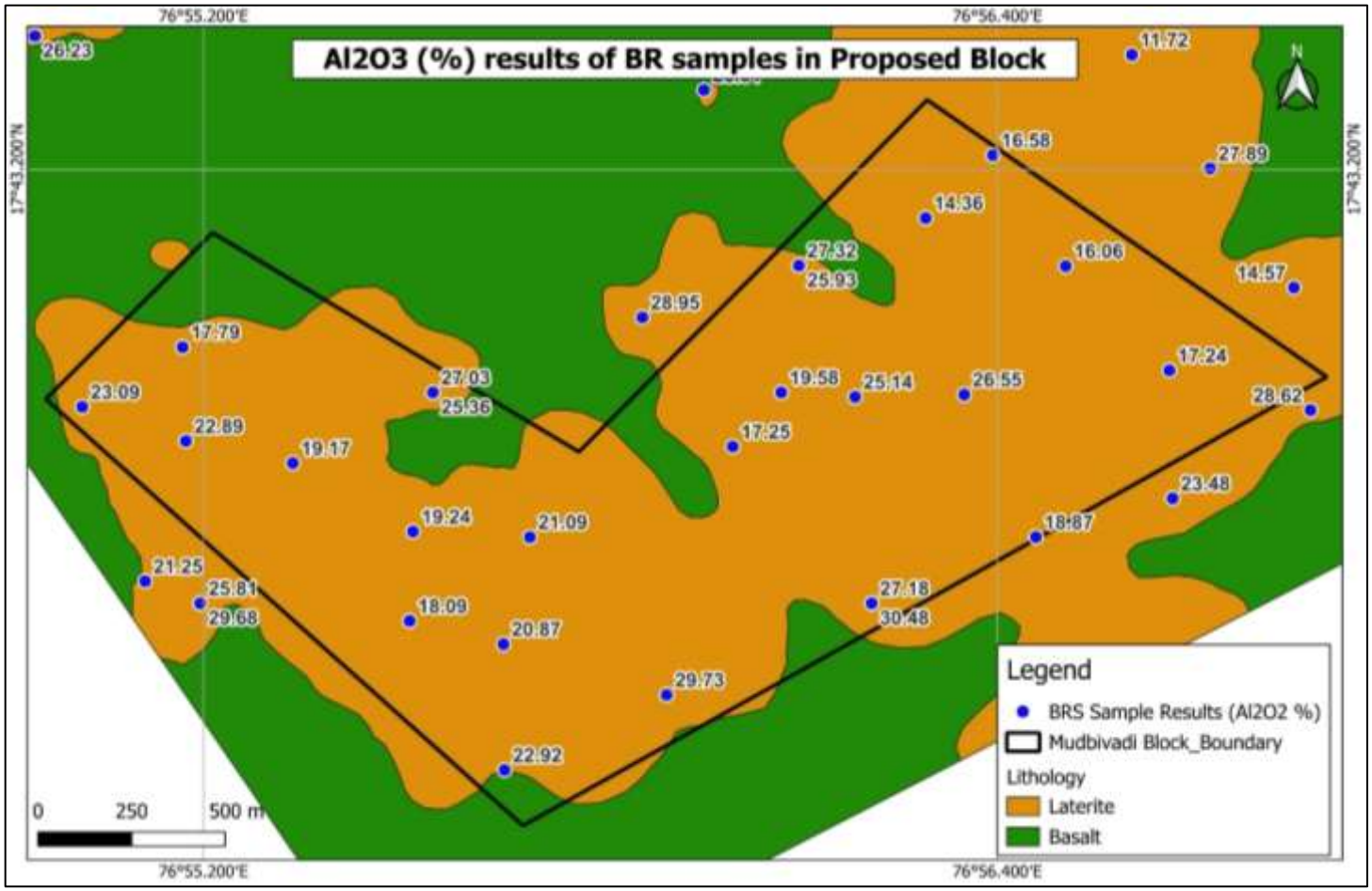

Plate-5: Vanadium distribution map of Proposed block

(Source. GSI-G4 CMAP Report)

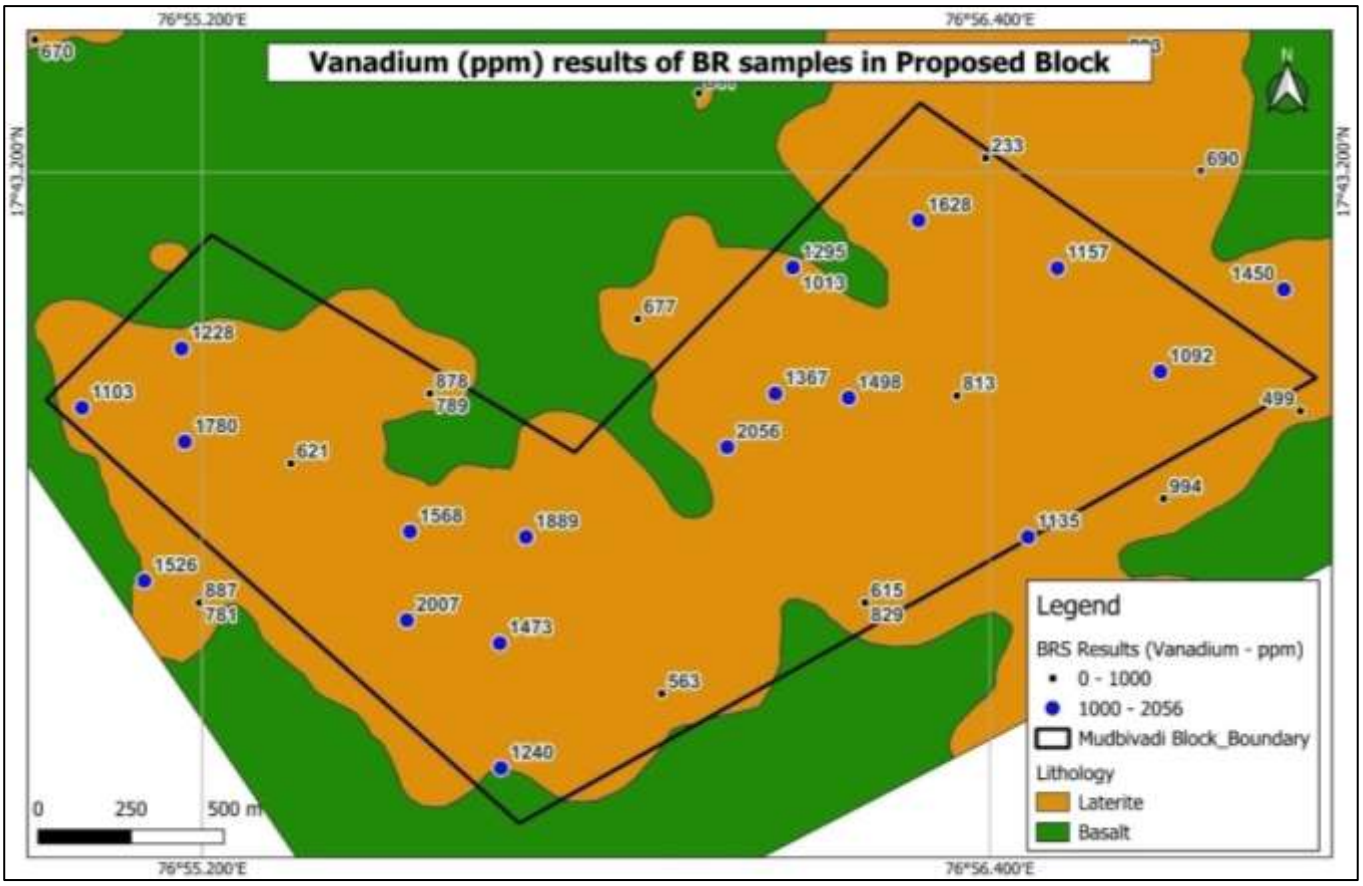

Plate-6: TiO_2 distribution map of Proposed block (Source. GSI-G4 CMAP Report)

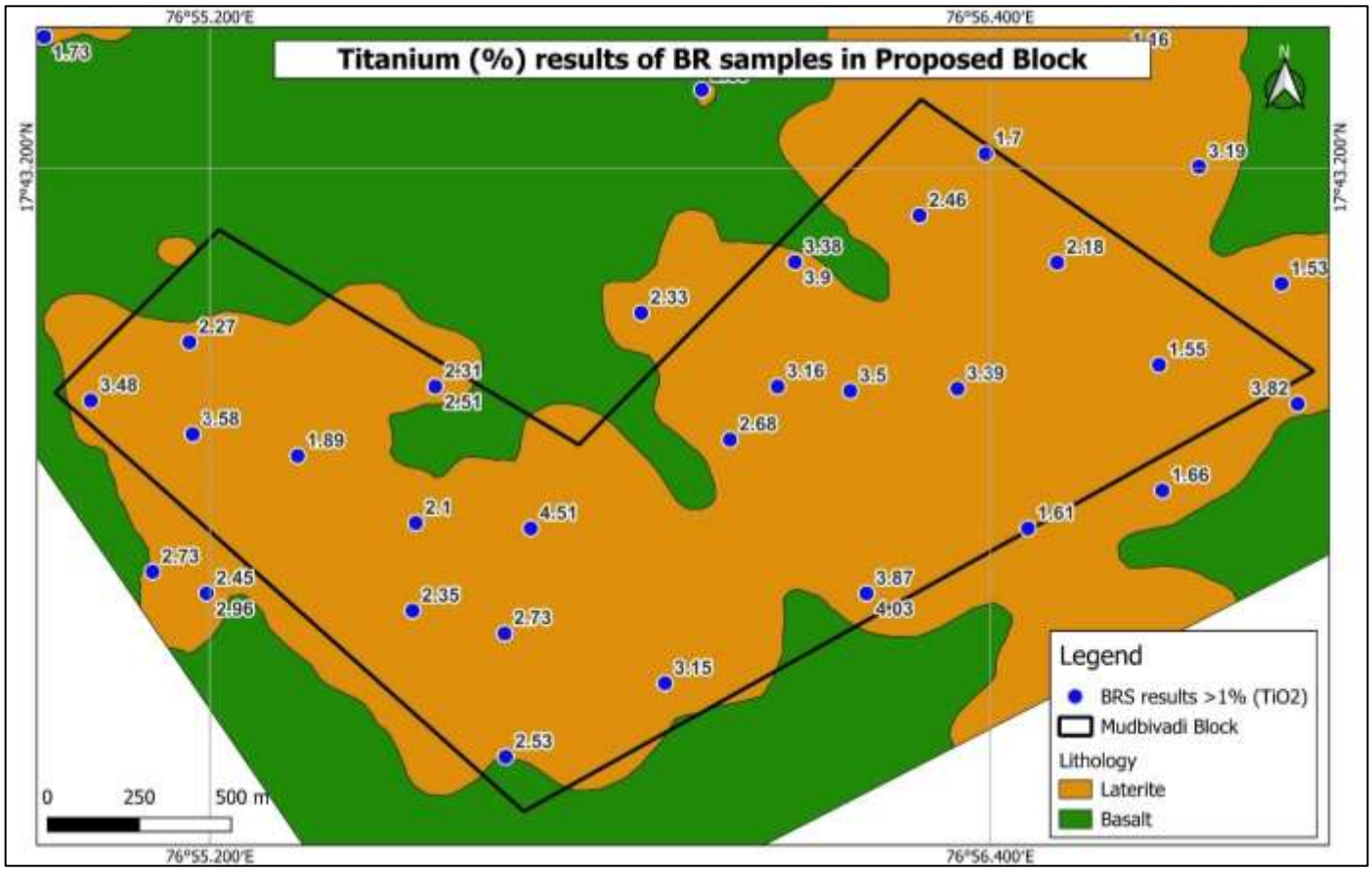

Plate-7: Proposed block (Red colour) and GSI-G4 CMAP (Yellow Colour) blocks on Google earth image

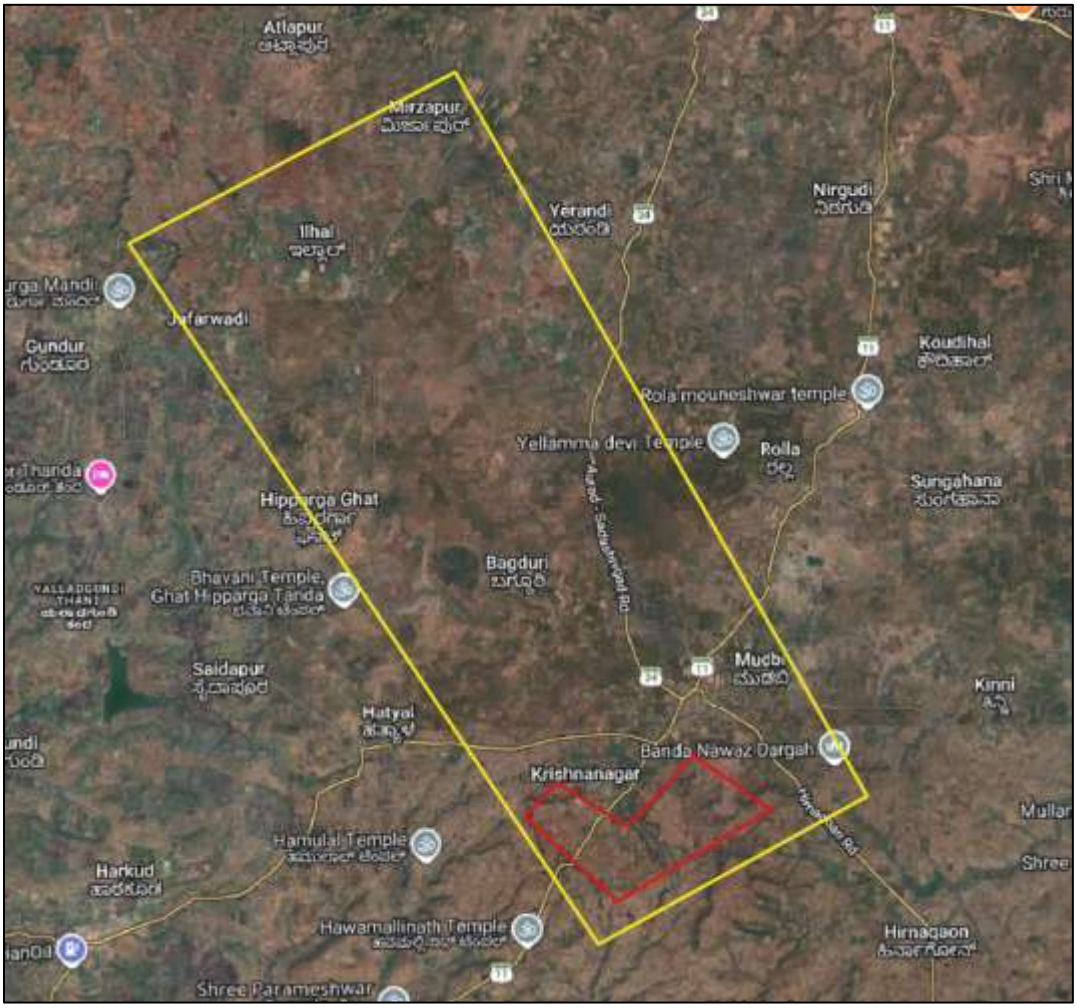

Plate-8: Tentative proposed borehole location map of proposed block