



**PROPOSAL FOR G3 STAGE MINERAL EXPLORATION OF
GRAPHITE AND ASSOCIATED MINERALS AROUND
MAHADEVBERA VILLAGE IN SERAIKELA-KHARSAWAN
DISTRICT, JHARKHAND**

(Graphite and Associated Minerals)

**By
Natural Resources Division, Tata Steel Limited**

Place: Jamshedpur, Jharkhand



**Summary of the Block for G3 Stage Exploration
GENERAL INFORMATION ABOUT THE BLOCK**

	Features	Details
	Block ID	Mahadevbera
	Exploration Agency	Natural Resources Division-Tata Steel Limited
	Commodity	Graphite
	Mineral Belt	North Singhbhum Mobile Belt (NSMB)
	Completion Period with entire time schedule to complete the project	12 months
	Objectives	<p>1. Carryout topographical survey, geological mapping, bed rock & channel sampling, trenching, and sampling followed by chemical analysis to identify potential zones of graphite.</p> <p>2. Conduct Geophysical Survey (S.P.).</p> <p>3. Undertake exploratory drilling over the identified mineralized area, perform drill core sampling and analysis to understand depth of mineralization, extend of ore zone and hence quantify resource (333) and grades.</p>
	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	Field geological activities including mapping, collection of samples and preparation, chemical analysis, survey, database preparation, review, interpretations, report writing etc., shall be conducted by inhouse team and facilities. Some of the other jobs such as, geophysical survey, mineragraphic study, exploratory drilling shall be conducted thorough outsourced agencies.
	Name/ Number of Geoscientists	<p>4 to 6 geoscientists shall be deployed in the project.</p> <ol style="list-style-type: none"> 1. Shakil Hassain, Sr. Geologist 2. Shramana Rudra Roy, Geologist 3. Shreenivas Mishra, Geologist 4. Agrodeep Kundu, Geologist 5. Swastik Dhar, Asst. Geologist
	Expected Field days (Geology) Geological Party Days	<p>Geology = 180 days</p> <p>Geological Party = 150 days</p>
1.	Location	

	Coordinates	Corner Points	LATITUDE	LONGITUDE
		A	22° 57' 48.0960" N	85° 52' 26.7960" E
		B	22° 57' 20.6568" N	85° 53' 43.8864" E
		C	22° 56' 42.0684" N	85° 53' 27.7116" E
		D	22° 57' 09.4140" N	85° 52' 10.3944" E
	Villages	Mahadevbera, Urmal, Ghagri		
	State	Jharkhand		
2.	Area (hectares/ square kilometers)			
	Block Area	3.0 Sq. Km. / 300 Ha		
	Forest Area	-		
	Government Land Area	-		
	Private Land Area	-		
3.	Accessibility			
	Nearest Rail Head	Chandil of SE railways is situated at 30 km from the block		
	Road	The block can be approached by village road of 2.0 km from Ranchi-Baharagora highway (NH-33) and from Jamshedpur covering a distance of 60 km.		
	Airport	Nearest airport at Ranchi (80 km from the block)		
4.	Hydrography			
	Local Surface Drainage Pattern (Channels)	dendritic to radial pattern		
	Rivers/ Streams	Subarnarekha Nadi		
5.	Climate			
	Mean Annual Rainfall	700 to 1200 mm		
	Temperatures (December) (Minimum)	6°- 20°C		
	Temperatures (June) (Maximum)	32°- 44°C		
6.	Topography			
	Toposheet Number	73F/13		
	Morphology of the Area	The northern and southern part of the block consists of flat plains with agricultural land and human settlements, while the western, central and the eastern part of the terrain consists of hills and hillocks. The area is rugged in nature, with numerous ridges and narrow valleys. The highest elevation of the area is 473m above MSL near the Ranka hill and the lowest elevation is 281m above MSL noted east of Urmal village.		
	Availability of baseline geoscience data	Source: NDGR portal		

	Geological Map (1:50K/ 25K) Geochemical Map	Available in 1:50000, 1:25000, 1:12500 scale
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	Available (Geophysical – Magnetic and Gravity anomaly data at Regional Scale)
	Justification for taking up Preliminary Exploration	<p>The proposed exploration block area falls in the eastern side of Kubasal-Jagro-Serengdih Gold Block (G4) which was explored in detail by GSI during 2019 (Report reference: ERO-15853-2018). GSI explored this block of 110 Sq. Km. area with 1:12,5000 scale mapping.</p> <p>The proposed block falls within Ghagri Asangibera Gold Block (G4) which was explored in detail by GSI during 2016-17 for 100 Sq. Km. area with 1:12,5000 scale mapping. The proposed block shares common boundary in the north with Sindauri-Urmal Gold Block (G4) which was explored by GSI in 2007-2009.</p> <p>GSI primarily focused its exploration efforts on gold mineralization in the blocks. However, the report for the Kubasal-Jagro-Serengdih Gold Block (G4) also highlighted the presence of graphite mineralization.</p> <p>The GSI report indicates graphite mineralization in the Papirda-Jopno–Kubasai Graphite Block (G4), characterized by two bands of carbon phyllite. An area of 100 square kilometers was systematically mapped at a scale of 1:12,500. The general trend of the carbonaceous phyllite varies from E-W to N80°W-S80°E. The northern carbon phyllite exhibits ferruginous and micaceous properties, includes chlorite, and features thin quartzite bands. In contrast, the southern carbonaceous phyllite is noted for its tuffaceous and pyritiferous nature, with a lighter density that tends to soil easily. Graphitization is also noticed in the carbonaceous phyllite near Vijayagiri dam. Analytical results revealed fixed carbon values exceeding 2% in 40 samples, with the highest recorded value at 6.1% and the lowest at 0.1%. The information regarding graphite mineralization can be found in the report for the Kubasal-Jagro-Serengdih Gold Block (G4), while the report for the Papirda-Jopno-Kubasai Graphite Block (G4) is currently not available in the NGDR database.</p> <p>On thorough review of past work by GSI, the geologists of Tata Steel Limited have carried out field</p>

		<p>work in this graphite bearing potential areas. Two significant graphite bands, trending east-west could be identified within the carbon phyllite in the eastern and western sections of the Vijayagiri Ridge. A total of 48 samples were collected from various lithological types in the area. The analytical results from 42 of these samples revealed an average fixed carbon (FC) content of approximately 2%, which is right around the threshold value. Of the analyzed samples, 19 (about 45%) demonstrated FC values exceeding 2%, with an average FC of 3.19%, with maximum of 7.43%, and a minimum of 2.12%.</p> <p>More traverses were undertaken in the northern band which was covered by GSI during G4 investigation for graphite. The field work and subsequent analysis of BRS could identify four major graphite mineralized zones in which average fixed carbon (FC) in the samples has been 4.3% at 2% FC cut-off where the highest value reaching 6.99%.</p> <p>Based on the findings of the past G4 stage exploration by GSI, considering geological suitability and accounting review and analysis of base data collected from NGDR, field observations, prepared updated maps supplemented with proximate analysis of collected samples, a G3 stage exploration is henceforth proposed over 3.00 Sq. Km. area targeting potential graphite mineralization.</p>
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DETAILED DESCRIPTION ABOUT THE BLOCK

1. Block Summary

1.1 Location and Accessibility

The proposed graphite block for G3 exploration is located south of Urmal village and includes Mahadevbera village and falls within SOI toposheet no. 73F/13 of Seraikela-Kharsawan District, Jharkhand. Hence the proposed block is named as “**Mahadevbera Graphite Block**”. The block is bounded by Latitude 22° 56' 42.07" N to 22° 57' 48.10" N and Longitude 85° 52' 10.40" E to 85° 53' 43.89" E. This block covers an area of about 3.0 Sq. Km. The area covered includes forest clad hills and hillocks and plain agricultural lands. Almost 80% of the area is forest covered and rest 20% is habitat and agricultural land. The proposed block seems to be a freehold area. The block under investigation is 80 km from Ranchi in the west and 60 km from Jamshedpur in the east. The area is well connected by Ranchi-Baharagora highway (NH-33). Chandil is the nearest town, and a railway junction is about 30 km from the area. Chandil is well connected with other part of state Jharkhand.

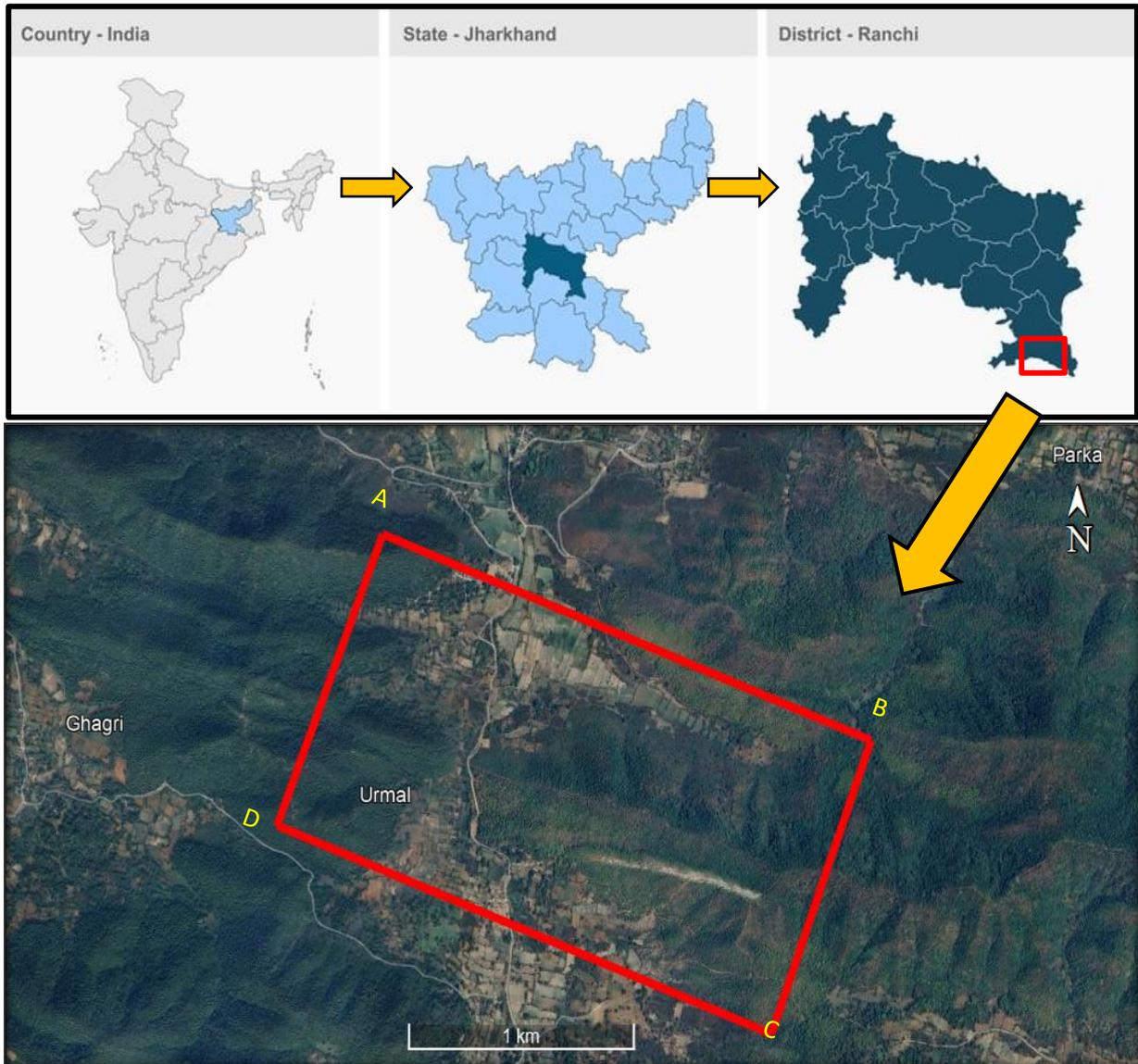
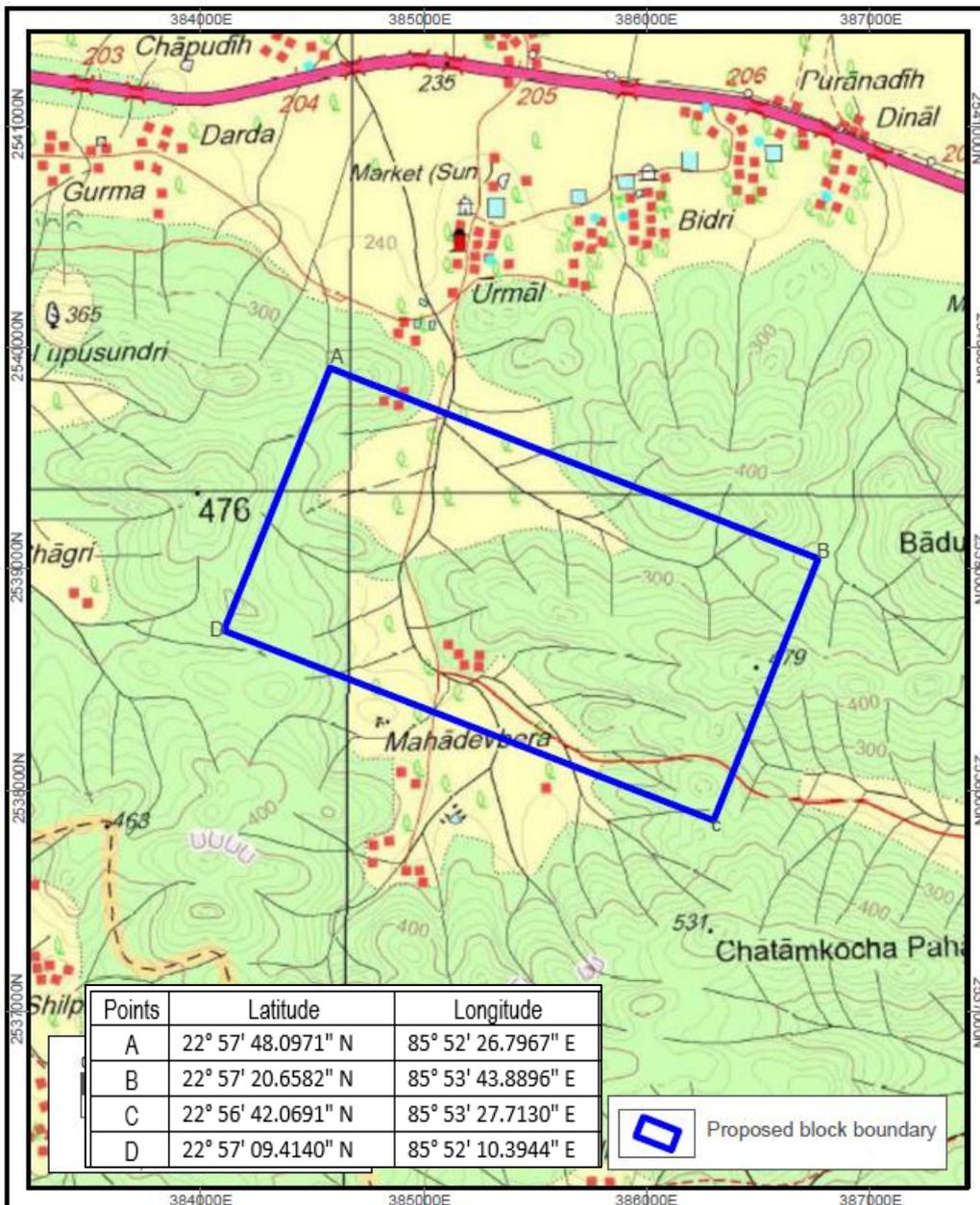


Figure 1: Index map showing location of the proposed Mahadevbera Block over google image.

1.2 Physiography:

The blocks form a part of Dalma hill range and exhibit a hilly and rugged topography. The northern and southern part of the block consists of flat plains with agricultural land and human settlements, while the western, central and the eastern part of the terrain consists of hills and hillocks. The area is rugged in nature, with numerous ridges and narrow valleys. Overall, the area is characterized by hillocks, mounts and is covered by forest. The highest elevation of the area is 473m above MSL near the Ranka hill and the lowest elevation is 281m above MSL noted east of Urmal village. The drainage pattern in area varies from dendritic to radial pattern. Subarnarekha is the major river in the nearby area, which is flowing in north to south direction, located 12 km east of the proposed block. The area experiences a temperature ranging from 32° - 44°C during summer months and 10° - 15°C during winter months. Average annual rainfall in the area ranges from 700 to 1200 mm.

Proposed Graphite Block



Map-1: Location of the proposed exploration block over toposheet

1.3 Background Geology (Regional Geology, Geology of the Block):

Regionally the block forms a part of North Singhbhum Mobile Belt (NSMB) which comprise rocks of volcano-sedimentary sequence of Paleo-Proterozoic to Meso-Proterozoic age. The Dalma volcanics and Dalma volcano-sedimentary sequence falls under NSMB. Dalma Group is made up of three pyroclastic sequences, a phyllite/ carbonaceous-phyllite unit, and a lava flow sequence. The ultramafic-mafic lava flows occupy the youngest stratigraphic level. The phyllite sequence is represented by grey pale/phyllite with intercalations of carbonaceous phyllite and ferruginous phyllite (Sharan, 2000).

The carbonaceous phyllite is the marker horizon and basal unit of Lower Dalma Formation. The northern litho package of Dalma volcanics has more abundance of tuff, chert, carbonaceous shale, mafic-ultramafic bodies and acid volcanic compared to its southern counterpart (Gupta and Basu, 1977). The proposed area was first studied by Dunn and Dey (1942). The carbonaceous phyllite exposed as an east west trending high standing linear ridges from Papirda to the west to Kubasai to the east. It is fine grained, dark grey to black in colour, light weight. It is pyritiferous and soils finger due to the presence of carbon particles. Gupta and Basu (1977) and Gupta et. al., (1980) opined that carbonaceous phyllite of Dalma volcanics is graphitic schist and contain graphite.

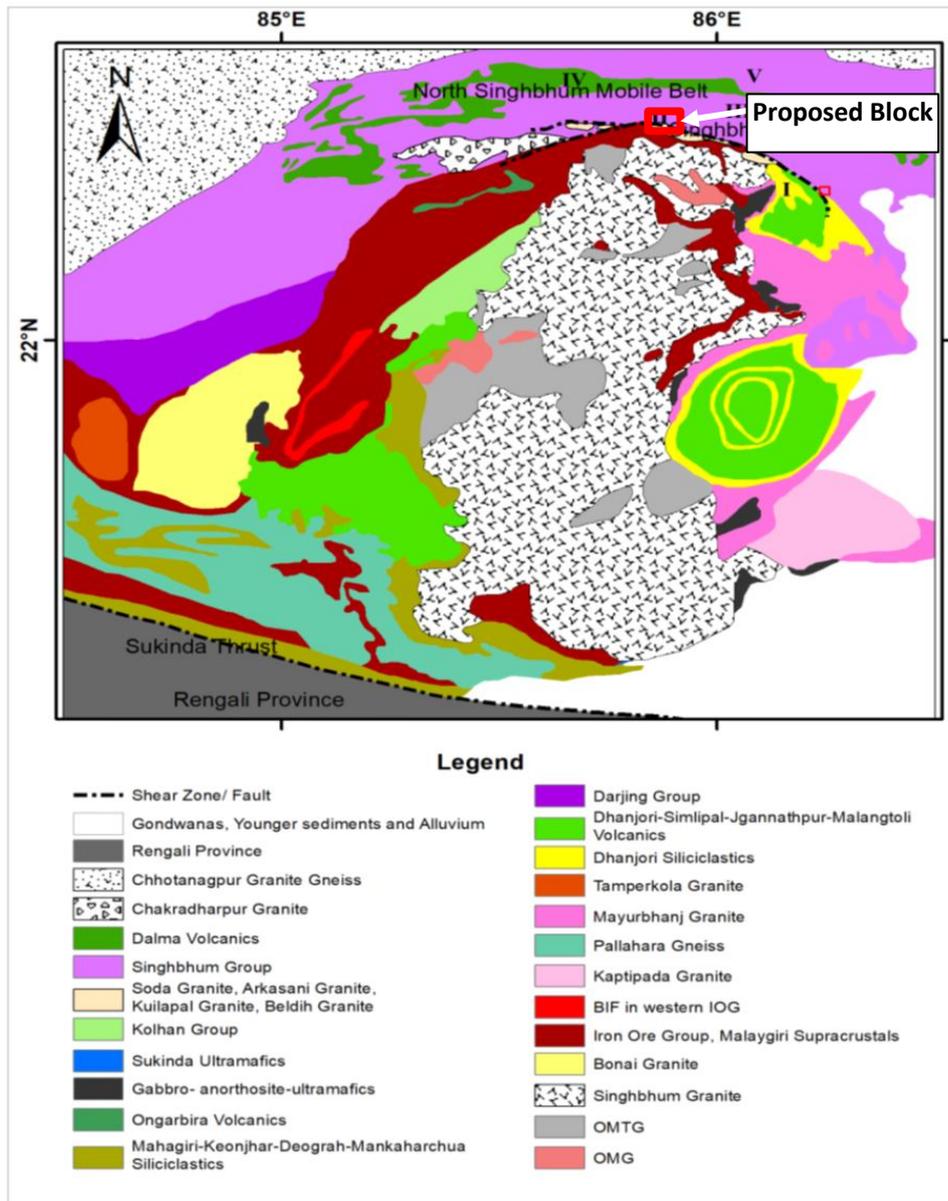
There are two varieties of carbonaceous phyllite observed regionally. The northern most unit shows fissile nature and shows well developed slaty cleavages. The northernmost carbon phyllite is ferruginous, micaceous, consists of chlorite and associated with thin quartzite bands. The broken surface of the rock is feeling like needle. At places it shows some bleaching spot on the surface. Alternating band of lighter and darker is seen frequently. The southernmost carbonaceous phyllite is more tuffaceous and pyritiferous and comparatively lighter in density often soil finger more. It is well exposed near Papirda along a nala section. It is fine grained, dark grey to black in color, light weight. It is pyritiferous and soil finger due to the presence of carbon particles. In thin section the rock is fine grained, exhibit schistose texture and consists of an assemblage of quartz, sericite, biotite and some dusty carbonaceous matter. The schistosity is mainly defined by elongated quartz ribbon and micas. The local villager mixed the powder part of this carbonaceous unit into coal and used into the fire of brick production.

1.4 Regional Stratigraphy

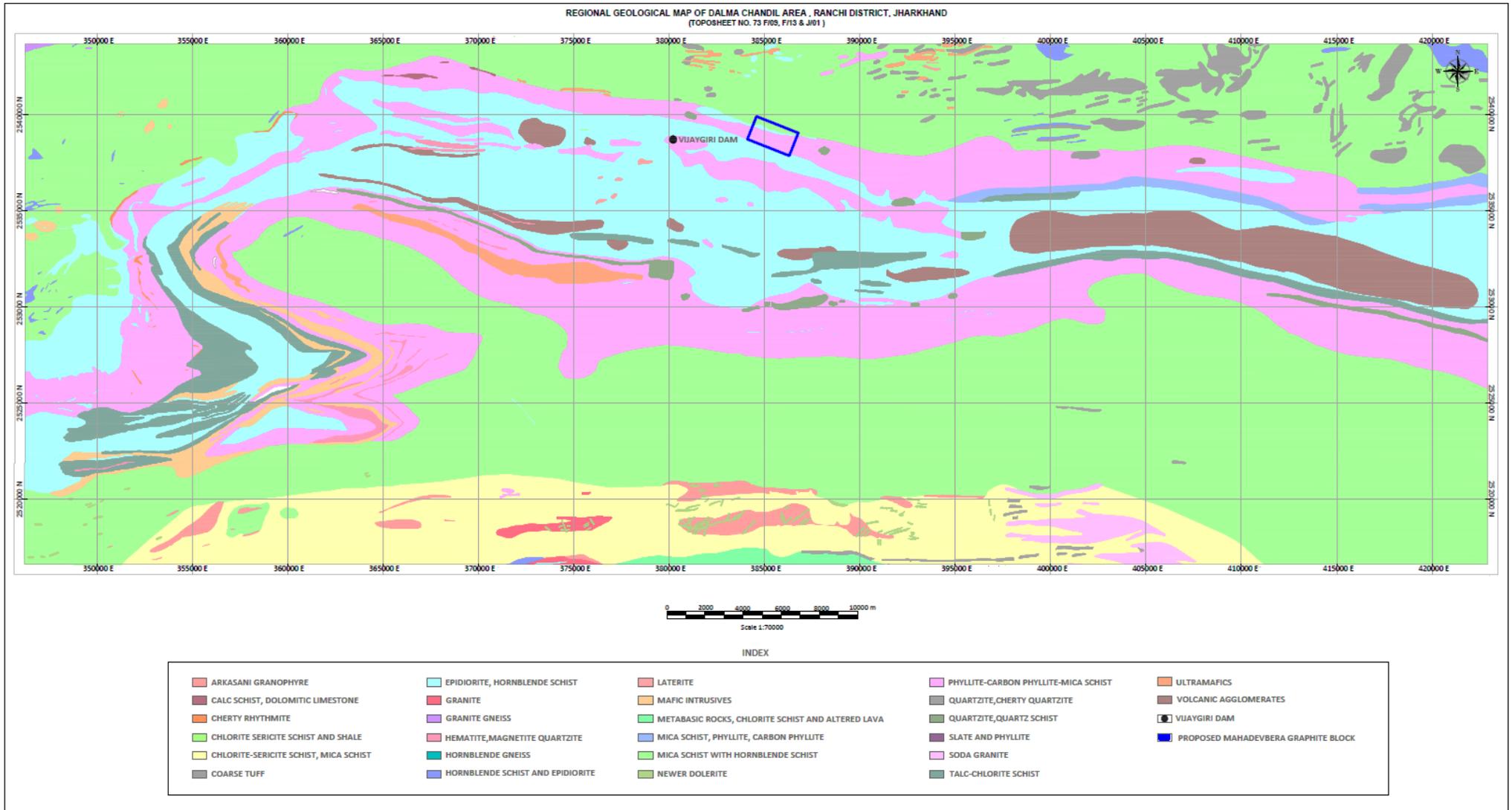
Gupta et. al., (1977) and Gupta and Basu (1984) established the stratigraphy and tectonics of Pre-Cambrians in and around Sonapet valley. In the recent times, the regional stratigraphy of the area after Gupta et. al. (1980) is shown in Table-1.

Table 1: Regional Stratigraphy of Mahadevbera Block after Gupta et. al. (1980)

North Singhbhum Mobile Belt (Paleoproterozoic to Mesoproterozoic)	Dalma Group (Volcanics)	Upper Dalma Formation	Gabbro –intrusive Volcanic agglomerate, Pillow meta basalt.
		Lower Dalma Formation	Brecciated quartz vein, Ultramafic suite tuffaceous tremolite schist, Carbonaceous Phyllite
	Singhbhum Group	Dhalbhum Formation (Upper Singhbhum Formation)	Tuffaceous phyllite Micaceous quartzite, Chloro-phyllite
		Chaibasa Formation (Lower Singhbhum Formation)	Ultramafic /mafic dyke Quartzite Quartz mica schist



Map-2: Regional Geological Map of Singhbhum Craton (Source: After Saha, 1994 and modified from other sources)



MAP 3: Regional Geological Map (1:50000 scale) showing the Proposed G3 block on toposheet nos. 73F/9 ,73F/13 and 73J/01 (source: NDGR)

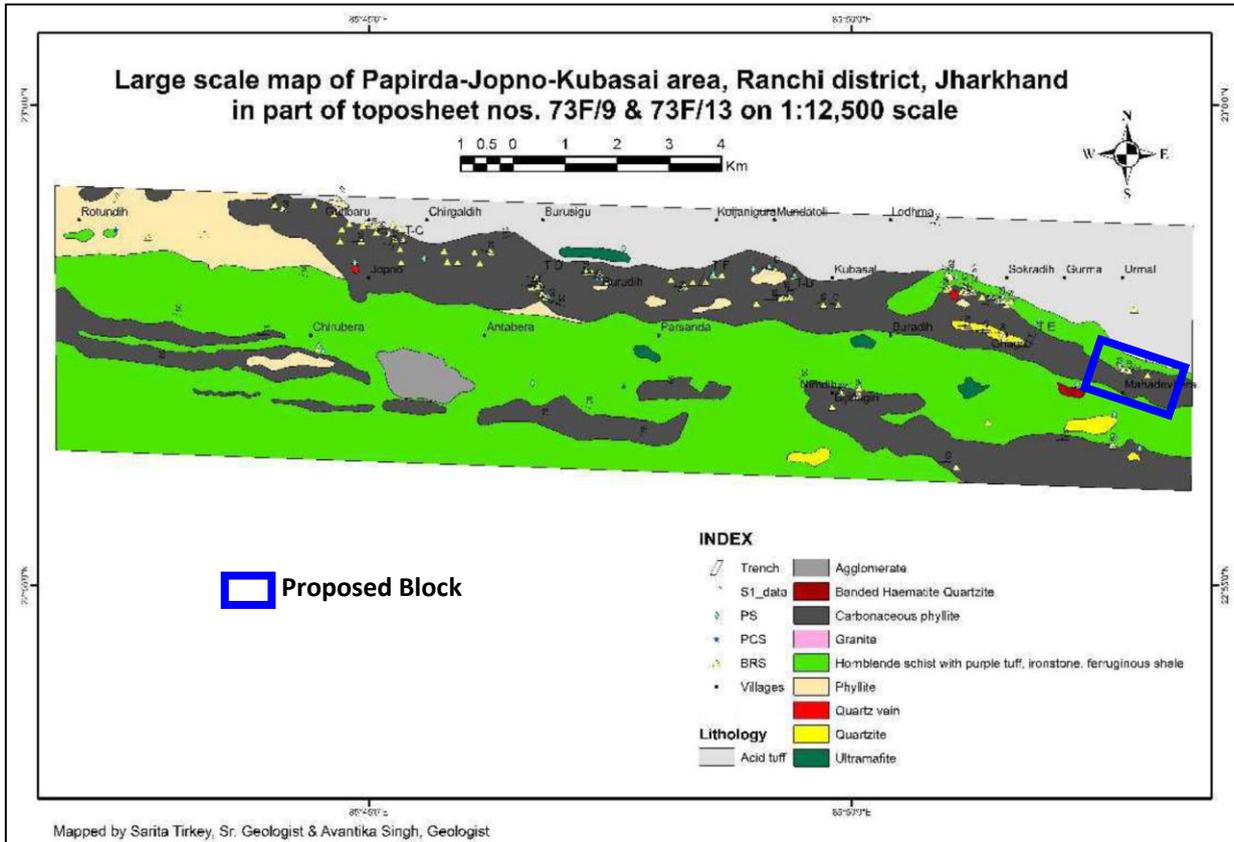


1.5 Section of the block for exploration

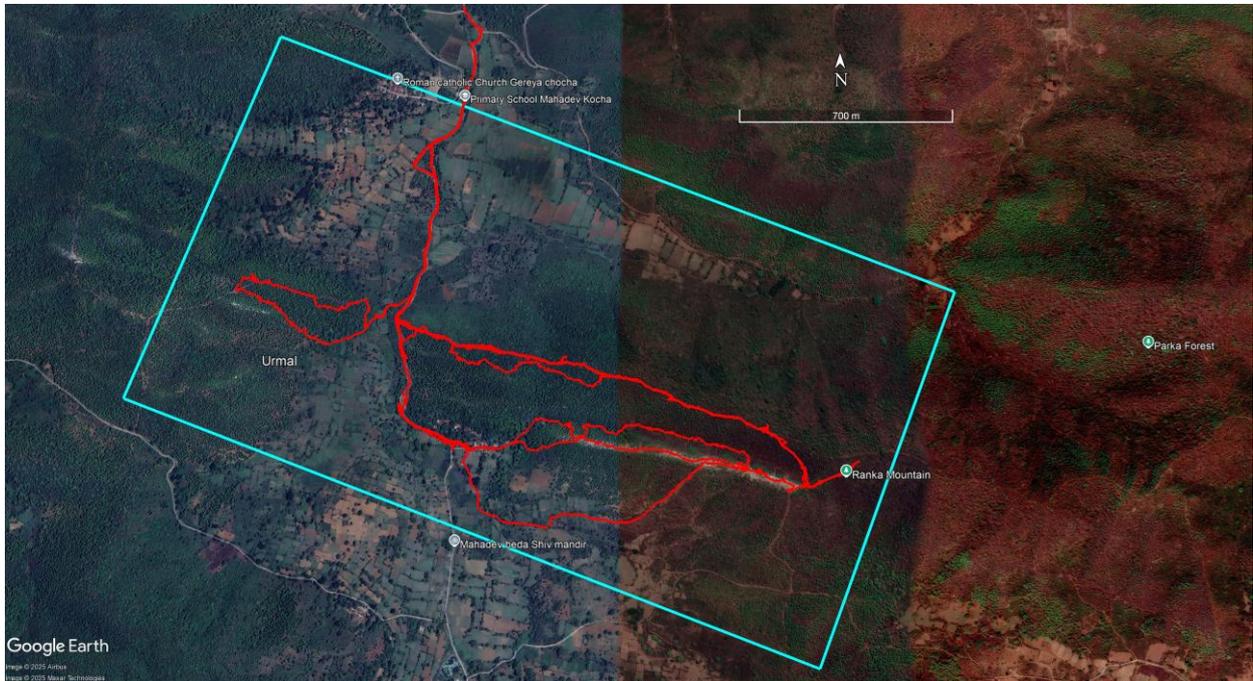
The past work of GSI in and around the area are referred and consulted in detail while selecting the potential target area for further exploration. The proposed exploration block area falls in the eastern side of Kubasal-Jagro-Serengdih Gold Block (G4) which was explored in detail by GSI during 2019 (Report reference: ERO-15853-2018). The proposed graphite block falls within Ghagri Asangibera Gold Block (G4) which was explored in detail by GSI during 2016-17. The proposed block shares common boundary in the north with Sindauri-Urmal Gold Block (G4) which was explored by GSI in 2007-2009. GSI primarily focused its exploration efforts on gold mineralization in the blocks. However, the report for the Kubasal-Jagro-Serengdih Gold Block (G4) also highlighted the presence of graphite mineralization.

The GSI report of Kubasal-Jagro-Serengdih indicates graphite mineralization in the Papirda-Jopno–Kubasai Graphite Block (G4), characterized by two bands of carbon phyllite (Map-4). An area of 100 square kilometers was systematically mapped at a scale of 1:12,500. The general trend of the carbonaceous phyllite varies from E-W to N80°W-S80°E. The northern carbon phyllite exhibits ferruginous and micaceous properties, includes chlorite, and features thin quartzite bands. In contrast, the southern carbonaceous phyllite is noted for its tuffaceous and pyritiferous nature, with a lighter density that tends to soil easily. Graphitization is also noticed in the carbonaceous phyllite near Vijayagiri dam. Analytical results revealed fixed carbon values exceeding 2% in 40 samples, with the highest recorded value at 6.1% and the lowest at 0.1%. The information regarding graphite mineralization can be found in the report for the Kubasal-Jagro-Serengdih Gold Block (G4), while the report for the Papirda-Jopno-Kubasai Graphite Block (G4) is currently not available in the NGDR database.

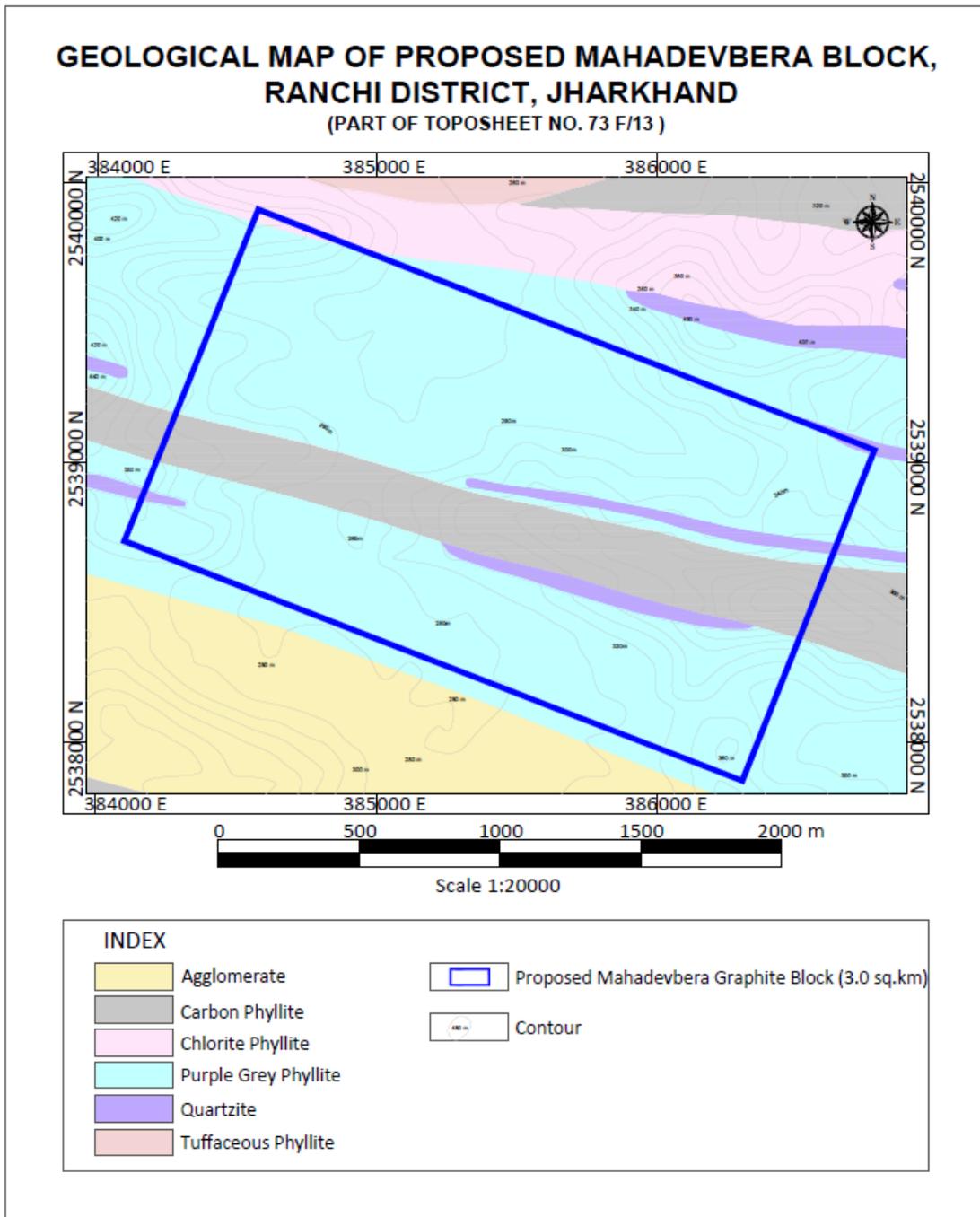
Based on review of studies of GSI, traverses (Map-5) are undertaken by the Geologists of Natural Resources Division-Tata Steel Limited in June and in July 2025 which confirmed occurrence of potential zones of graphite. Samples collected from the area confirmed fixed carbon values in the samples. With all these considerations, an area of 3.0 Sq. Km. is selected and proposed for carrying our Preliminary Exploration (G3) for graphite and associated minerals.



MAP 4. Large Scale map of Papirda-Jopno-Kubasal area, Ranchi district, Jharkhand in part of toposheet nos. 73F/9 & 73F/13 on 1:12,500 scale. (Source- Report reference: ERO-15853-2018)



MAP 5. GPS tracks of Tata Steel Geologists plotted over google map falling within the proposed graphite exploration block



MAP 5: GSI Geological Map (1:25,000 scale) of proposed Mahadevbera Graphite Block

1.6 Geology of the Block

Large scale mapping (1:25,000) explored area of GSI sourced from NDGR in the area revealed occurrences of carbon phyllite, chlorite phyllite, volcanic agglomerate, purple phyllite, tuffaceous phyllite and quartzite. The area is majorly covered by phyllite along with quartzite and chlorite schist at few areas.

The field traverse conducted by geologists from Tata Steel Limited's Natural Resources Division in the proposed area revealed a geological composition primarily of graphite-bearing carbon phyllite, cherty and banded quartzite, talc tremolite schists, and metasomatically altered



albitized and chloritized rocks, alongside rocks exhibiting clay mineralization. The area's structural trend was generally E-W to N70°W-S70°E, with rock beds typically dipping 60° north; however, localized south-dipping strata suggest the presence of structural complexities like folding. Graphite occurrences were noted within the carbonaceous phyllite, where fracture and joint planes showed amorphous textures that soiled fingers, with graphite mineralization predominantly found in these carbon phyllite bands. The carbon phyllite rocks were observed to be very fine-grained, well foliated, and exhibited a dark grey coloration, when scratched they produced a blackish streak that stained the fingers upon contact, indicating a high graphite content within the carbon phyllites. Carbon phyllite in this area occur in association with banded cherty quartzite which was identified by its conchoidal fracture and vitreous luster, while Talc-Tremolite-Schist characterized by a light grey to brown coloration, very fine grain size, well developed foliation planes, white streak, and distinctly soapy when touched. The talc-tremolite schist bands were trending in an east-west direction and dipping steeply at angles ranging from 60° to 70° towards 10° North and were present at the foot wall side of carbon phyllite band.

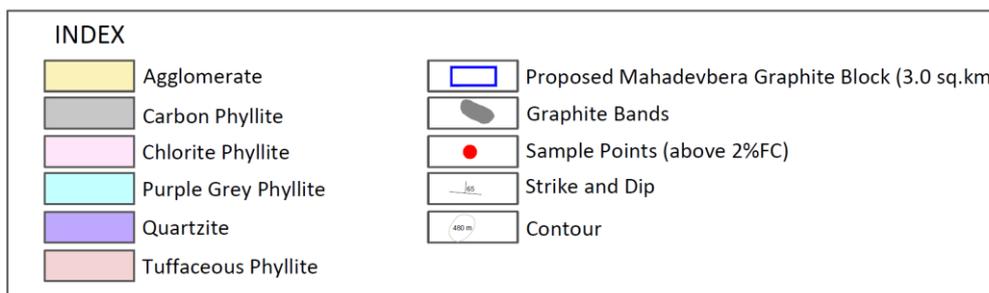
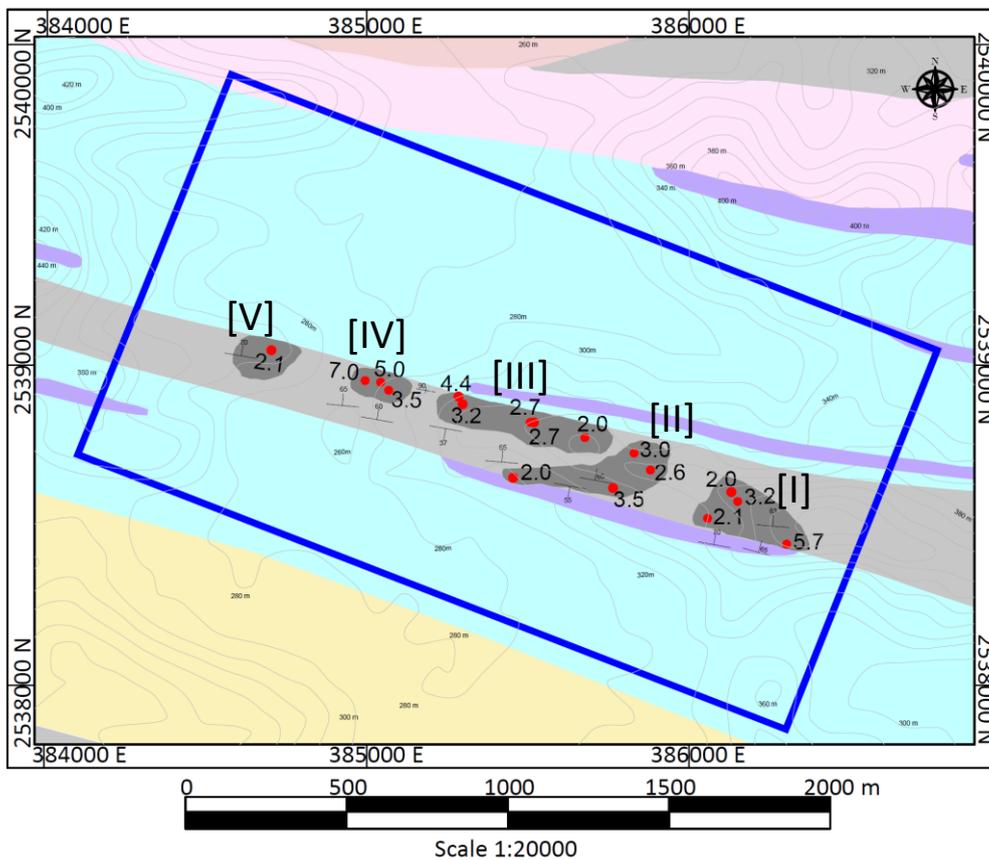
The carbon phyllite band was traced along its strike up to the eastern as well as on the western end of the ridges. Out of 57 samples collected, 17 samples (30%) showed FC value >2% with an average grade of 3.33% FC having maximum value of 6.99% FC and minimum value of 2.02% FC. Carbon phyllites present in the eastern side of the ridge showed promising results with 16 samples (> 2% FC). While, in the western side of the ridge, the graphite concentration appeared to be relatively low, as the rocks did not stain the hand upon scratching and analytical values showed only one sample having FC >2%.

1.6.1 Chemical analysis of collected samples from the area by Geologists of Natural Resources Division-Tata Steel Limited

Sl. no	Sample ID	FC% Air Dry Basis
1	MB-M-01	6.99
2	MB-M-02	4.89
3	MB-M-03	3.56
4	MB-M-07	4.36
5	MB-M-14	2.65
6	MB-M-15	3.20
7	MB-M-21	2.04
8	MB-M-23	3.55
9	MB-M-25	2.13
10	MB-M-35	2.11
11	MB-M-47	2.04
12	MB-M-49	2.61
13	MB-M-51	3.17
14	MB-M-54	2.66
15	MB-M-55	2.02
16	MB-M-58	5.69
17	MB-M-60	3.00

A total of 17 samples collected from the carbon phyllite in the area have resulted good values of FC% while other samples are well within the permissible limit to consider for economic use as Graphite. Based on the field observations and analysis of 17 samples with FC value above 2%, five (I to V) potential graphite mineralization zones are demarcated within the carbon phyllite (Map-6). Overall, the area seems to be promising to host Graphite mineralization of economic importance.

Zone	Surface Area (Ha) of Mineralized Zone	Avg. Grade (FC%)
I	4.58	3.3
II	4.65	2.8
III	5.06	3.0
IV	1.48	5.1
V	2.08	2.1



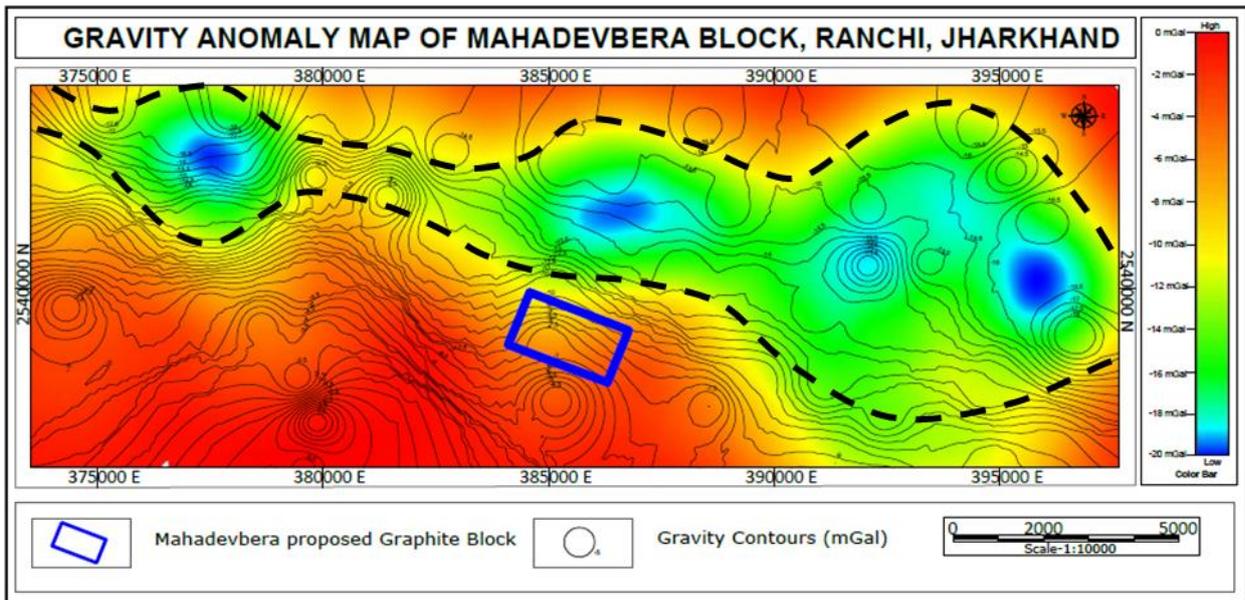
MAP 6: Updated Geological Map (1:25,000 scale) of proposed Mahadevbera Graphite Block after GSI

1.7 Mineral potentiality based on Geology and Geophysics

1:25K Geological Map and NGPM data sourced from NGDR for toposheet nos. 73F/13, are plotted and analysed. Based on the data a detail investigation of the graphite mineralization in the block was carried out.

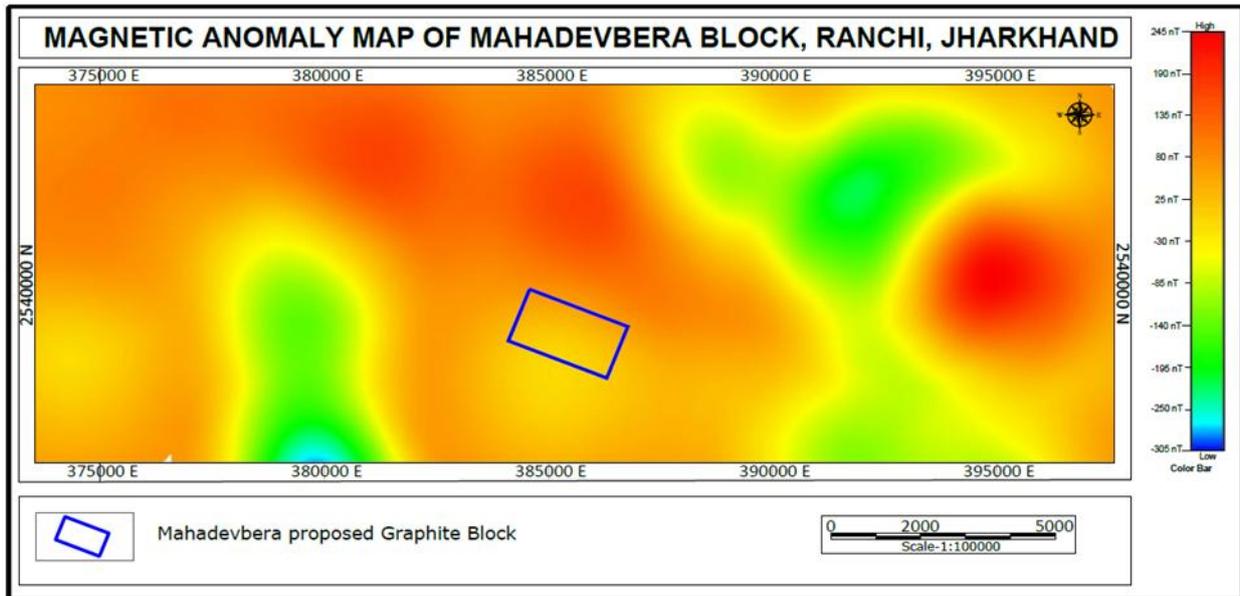
As per 1:25K Geological Map three to four significant carbon phyllite bands were mapped by GSI. These bands were dipping majorly in the north with few bands dipping to the south. The central band was identified as graphite bearing carbon phyllite based on analysis of 17 samples which showed four major graphite mineralized zones where the average fixed carbon (FC) in the samples has been 3.33% at 2% FC cut-off where the highest value reaching 6.99%.

The gravity data contours from the NGPM have been generated utilizing the available data points within the designated area. Bouguer anomaly contours generated at 0.5 mGal intervals using the Gravity point data indicate lower anomaly in the northern part of the proposed block. The observed low gravity zone in the northern part of the block may have attributed by the presence of a northerly dipping graphite bearing carbon phyllites. The resulting heat map (Map 7) illustrates a low gravity anomaly in the northern sector of the block.



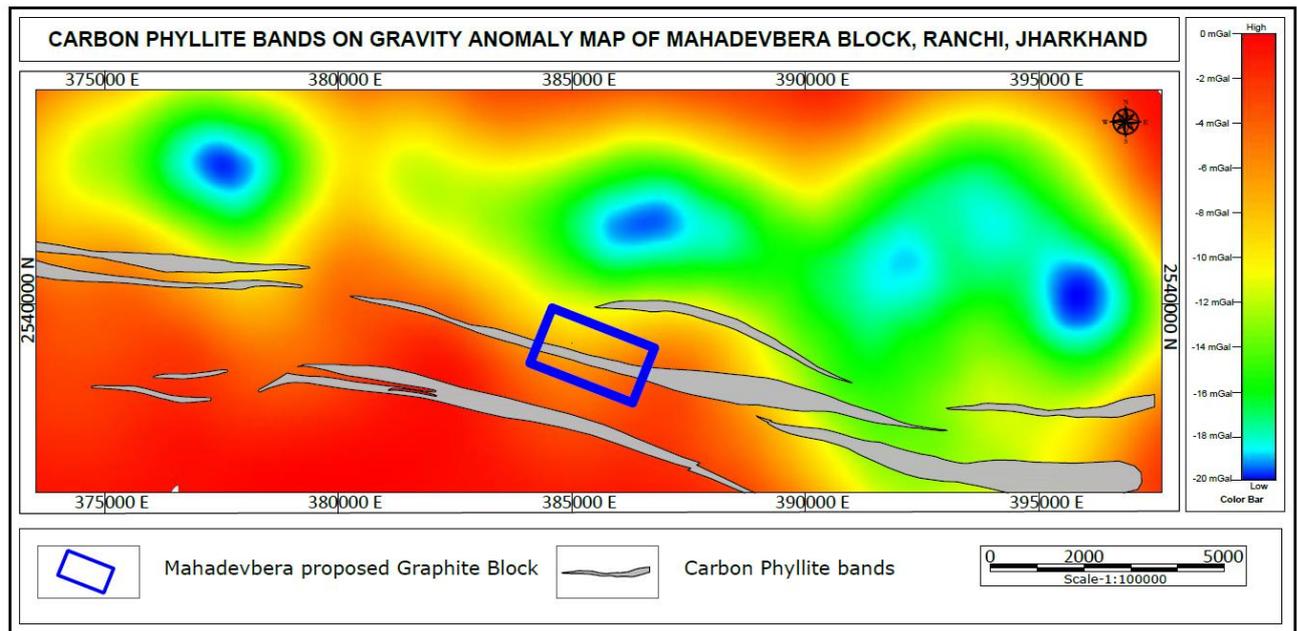
MAP 7: Geophysical Anomaly Map of Proposed Mahadevbera Graphite Block

Magnetic anomaly Heat map is generated using the Magnetic point data indicate high anomaly (Map 8) in pocketed areas near the northern part of the block. The analysis of NGPM magnetic data indicates a moderately high magnetic anomaly within and around the proposed block, contrasted by a higher magnetic anomaly in the northern region, which is predominantly composed of volcanic agglomerates and sericite magnetite phyllite.



MAP 8: Magnetic Anomaly Map of Proposed Mahadevbera Graphite Block

A geological overlay map (Map 9) has been generated by superimposing carbon phyllite bands onto gravity anomaly maps. This revealed that the carbon phyllite bands exhibit a WNW-ESE trend with a northerly dip, a trend that closely correlates with the low gravity anomaly zone, suggesting that these low gravity areas may indicate carbon phyllite with elevated graphite content.



MAP 9: Geological Overlay Map with gravity anomaly heat map of Proposed Mahadevbera Graphite Block



1.7 Scope for proposed exploration

On review of existing baseline and past exploration reports, data therein from areas within and around this proposed block and field data collected recently by geologists of Tata Steel Limited, it is planned that initially topographical survey (using drone and DGPS survey) shall be carried out followed by geological mapping (1:4000 scale) with bed rock, channel sampling, chemical analysis to delineate outcrops, surface geology and potential zones of graphite mineralization. Further in the potential areas, geophysical survey (SP survey) shall be carried out to locate potential subsurface graphite ore bodies/ zones. After synthesizing all acquired data till this stage, exploratory core drilling is proposed to be carried out in two levels (at 200m & 400m spacing) to understand lateral extend and for proving depth of mineralization for graphite with chemical analysis. Few samples shall also be analysed for associated critical minerals. All borehole collars and boundary pillar of the block shall be surveyed by DGPS. Finally, all acquired data shall be collated to estimate resources in G3 category guided by MEMC Rule. Petrological studies along with thin section to be prepared. Complete mineral study report to be submitted after the completion of work.

The scope of the proposed exploration has been formulated based on the findings of G-4 level of exploration done by Geological Survey of India (GSI). Details are given below:

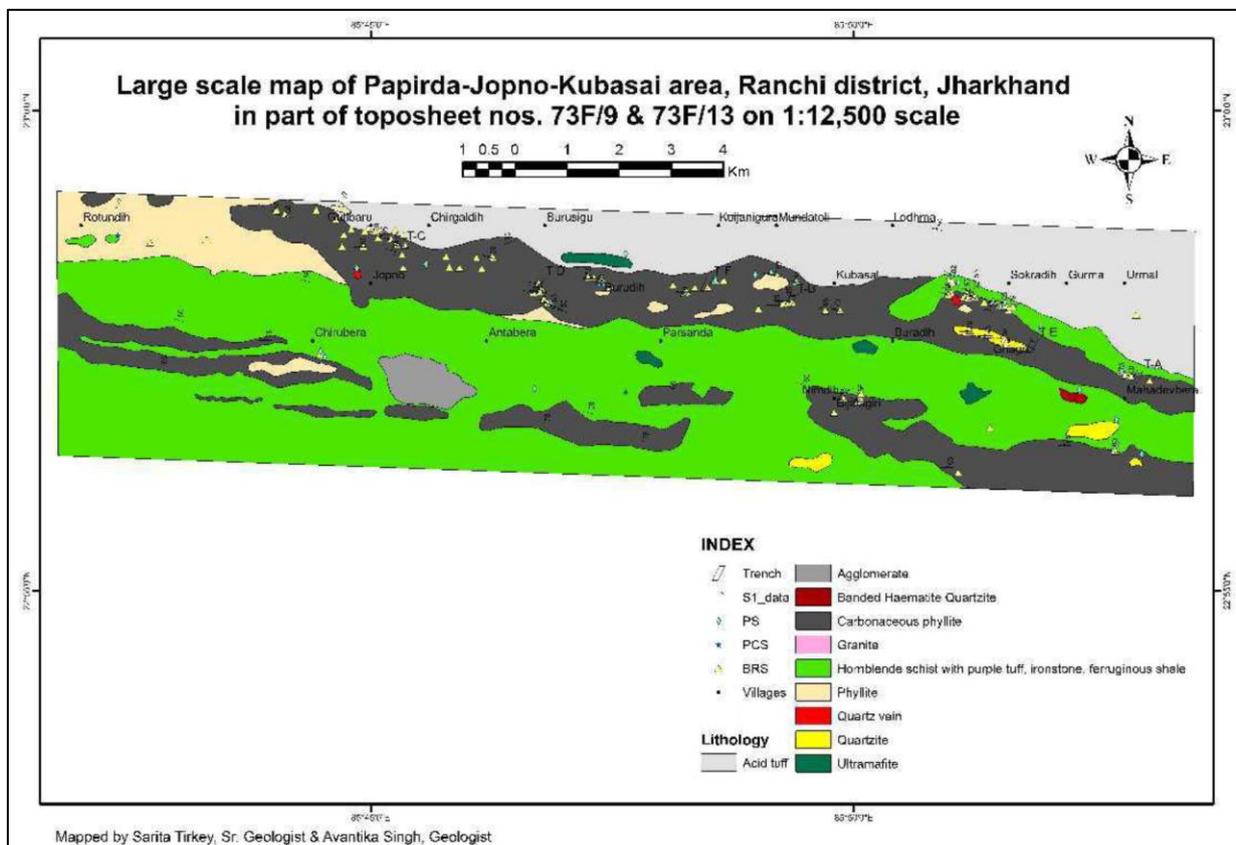
1. **Detailed Geological Mapping (1:4000 scale):** 300 Ha
2. **Drone based Topographical Survey:** 300 Ha and fixation of boreholes and boundary points.
3. **Geophysical Survey (SP):** 30 Line km.
4. **Trenching:** 10 Nos (300 CuM).
5. **Core Drilling:** Total 13 BHs (3200 m); 8 boreholes (1700m) at 200m spacing interval. 1st level of exploration (up to depth of ~80m) and 5 boreholes (1500m) at 400m spacing 2nd level of exploration (up to depth of ~140m).
6. **Sampling & analysis:** BRS-60, channel-40, trench-40 and core samples-700).
7. **Analysis by ICP-MS for 34 radicals and REE:** 10 nos.
8. **Mineragraphic study:** 10 samples.
9. **Bulk density study:** 5 samples.
10. **GR Writing & Resource Estimation:** To estimate Graphite Resources (333) in the block as per UNFC norms & Minerals (Evidence of Mineral. Contents) Rules-2021.

1.8 Recommendations of Mineral Exploration Report

The proposed graphite block falls within Kubasal-Jagro-Serengdih G4 block explored by GSI during 2016-17 (Report reference: ERO-15853-2018) this report indicates graphite mineralization in the

Papirda-Jopno-Kubasai Graphite Block (G4) also explored by GSI. The report outlines a para and large-scale map of the G4 block:

“In pursuance of annual field season programme (FSP) of Geological Survey of India, ER, for the year 2017-18, the investigation entitled “Reconnaissance survey for graphite mineralization in carbonaceous phyllite around Papirda – Jopno –Kubasai areas, Ranchi District, Jharkhand (SOI toposheet: 73F/9, F/13) (G4)” (Section 11) was taken up vide FSP code. ME/ER/JH/2017/003 by Tirkey, S and Singh, A. The main objective of the investigation was to assess potentiality of graphite mineralization in carbonaceous phyllite around Papirda-Jopno-Kubasai area, Ranchi District, Jharkhand. An area of 100 sq. km was mapped on 1:12,500 scale, besides collection of 100 nos. of bed rock samples, 100 nos. of pitting trenching samples, 25 nos. of petrological samples, 10 nos. of petrochemical samples and 10 nos. of samples for EPMA study from representative stratigraphic and mineralizing unit for analysis. Analytical results show more than 2% fixed carbon value in 40 nos. of BRS samples with highest value of 6.1% and the lowest value of 0.1%.”



MAP 8. Large Scale map of Papirda-Jopno-Kubasai area, Ranchi district, Jharkhand in part of toposheet nos. 73F/9 & 73F/13 on 1:12,500 scale.

Based on the findings of GSI’s G4 report and encouraging results of the graphite sampled from Papirda-Jopno-Kubasai area, a portion of 3.0 sq. km area was demarcated and selected to carry out further preliminary investigation for graphite.

1.9 Objectives

The exploration programme is to systematically explore the block and establish graphite resource under UNFC-333 code and prepare a comprehensive geological report complying to guidelines of MEMC Rule.



2. Previous Work

2.1 Previous Exploration within adjoining area by GSI

2.1.1 PROSPECTING FOR GOLD IN VOLCANO-SEDIMENTARY SEQUENCE EAST OF SINDAURI TO URMAL AREA, RANCHI AND SARAIKELA-KHARSAWAN DISTRICTS, JHARKHAND (ERO-14071-2007)

During the Field Seasons 2007–08 and 2008–09, GSI carried out large-scale geological mapping (100 sq. km at 1:12,500 scale), geochemical sampling (250 bedrock and soil samples), stream sediment sampling (50 samples) and pit trench sample (100 at 100 cu. m) in the Sindauri–Urmal area.

The mapped area primarily features metamorphosed argillaceous and arenaceous sediments as its oldest and most widespread rock types. These include tuffaceous phyllite, phyllite, and carbon phyllite, with quartzite representing the metamorphosed arenaceous component. The region also contains basic intrusive rocks such as amphibolite, metagabbro, and meta dolerite, alongside acidic intrusive like pegmatite, quartz veins, and quartz tourmaline veins.

The sulphide mineralization in the form of Pyrite, Arsenopyrite and Gold is noted within carbon phyllite. Mineralization is seen both in vein and rock matrix. It may be speculated that shear zones have facilitated mylonitization of the rocks which have subsequently affected by hydrothermal fluids bringing about mineralization.

Bedrock samples from the Asangibera area have shown gold values ranging from 110 ppb to 173 ppb and silver values up to 2.2 ppm. Similarly, two pyritiferous quartzite samples from Hutup area, which are ferruginized and limonitized, yielded gold values of 128 ppb and 140 ppb, with silver at 2.2 ppm and 2 ppm respectively. Further south of Burudih, ferruginized and limonitized quartzite samples showed gold values between 148 ppb and 200 ppb. The Urmal area presented gold values of 110 ppb, 137 ppb, 139 ppb, and 151 ppb, with this ferruginous quartzite extending eastward. Notably, two channel samples from 2 km southwest of Urmal (near Asangibera) assayed significantly higher gold values of 600 ppb and 800 ppb, associated with quartzo-feldspathic veinlets found within carbon phyllite.

The area exhibits intense shearing, brecciation, and hydrothermal alteration, suggesting the potential for structurally controlled gold mineralization. Significantly, widespread, and structurally controlled graphite-bearing carbonaceous phyllite, highly sheared, brecciated, and mylonitized, indicates favorable conditions for graphite mineralization, further supported by the presence of sulphide minerals like pyrite and arsenopyrite.

2.1.2 REPORT ON RECONNOITORY SURVEY FOR GOLD IN GHAGRI-ASANGIBERA-DUBRAJPUR-JURGU AREAS, RANCHI & SARAIKELA-KHARSAWAN DISTRICTS, JHARKHAND (FS 2016–17)

GSI has conducted FSP 2016-17 in parts of Ranchi and Saraikela-Kharsawan districts of Jharkhand (toposheet 73F/13), mapped 100 sq. km at 1:12,500 scale to assess gold potential within the North Singhbhum Mobile Belt (NSMB).

Geologically, the area is part of a Palaeo-Meso Proterozoic volcano-sedimentary sequence, bounded by the Tamar Porapahar shear zone to the north (with Chotanagpur Gneissic Complex)



and the Singhbhum Shear Zone to the south (with Singhbhum Granite). The area lies within the North Singhbhum Mobile Belt and hosts brecciated quartzite, carbonaceous phyllite, purple tuff, and acid volcanics.

Lithologies include acid volcanics, various phyllites (tuffaceous, carbonaceous, chloritic, purple, khaki green, talc-tremolite), magnetite-bearing quartz-sericite schist, ultramafics, meta-greywacke, carbonates, and brecciated quartzite, comprising units of the Chandil, Lower Dalma, and Upper Dalma Formations.

Sulphide mineralization (pyrite, bornite, arsenopyrite) was observed in brecciated quartzite and quartz veins. The area is traversed by multiple shear zones and shows signs of hydrothermal alteration, gossan development, and boxwork structures, indicating high gold potential.

GSI has collected 100 bedrock samples, 100 PTS, 100 cu. m of trenching, and 25 petrological samples. In terms of Au mineralization, one bed rock sample show anomalous value of 2.4 ppm collected from brecciated quartzite unit. Other BRS samples shows value of 150 ppb, 410 ppb and 340 ppb respectively which are distributed randomly but occur in brecciated quartzite. 10 stream sediment samples are collected all over the area out of which 06 samples yielded positive Au values. The maximum Au value is 17.45 ppm collected from a stream draining Acid volcanics. One pit sample show value of 110 ppb in acid volcanics. All the surficial indication as well as the chemical analysis value of the samples collected, point to the Ghagri area. One bed rock sample show a value of 410 ppb sampled from brecciated quartzite unit. Stream draining the ridge east of Ghagri show value of 0.83 ppm. Two stream sediments from Ghagri yielded visible gold specks. Trench samples from Ghagri show Au values of 210 ppb and 180 ppb respectively.

In this investigation, GSI has identified multiple graphite-rich carbonaceous phyllite zones interbedded with brecciated quartzite and purple tuff. The carbonaceous phyllite was noted for its graphitic sheen, soiling of fingers, and intercalation with quartz veins, all of which are indicative of graphite enrichment.

The report also documented intense shearing and hydrothermal alteration, which are key geological processes associated with the mobilization and concentration of graphite. The presence of tourmalinization and silicification in the vicinity of the Mahadevbera block further supports the potential for economic graphite deposits.

2.1.3 REPORT ON “RECONNAISSANCE SURVEY FOR GOLD AND ASSOCIATED MINERALS IN AND AROUND KUBASAL, JARGO, SERENGDH AREAS, RANCHI DISTRICT, JHARKHAND” (ERO-15853-2018)

Large scale mapping on 1:12, 500 scale for 110 sq.km was carried out for investigation of Gold around Kubasal-Jargo-Serengdih areas, Ranchi & Saraikela-Kharsawan districts, Jharkhand; in parts of toposheet no. 73F/9 & 73F/13 in field session 2018-19.

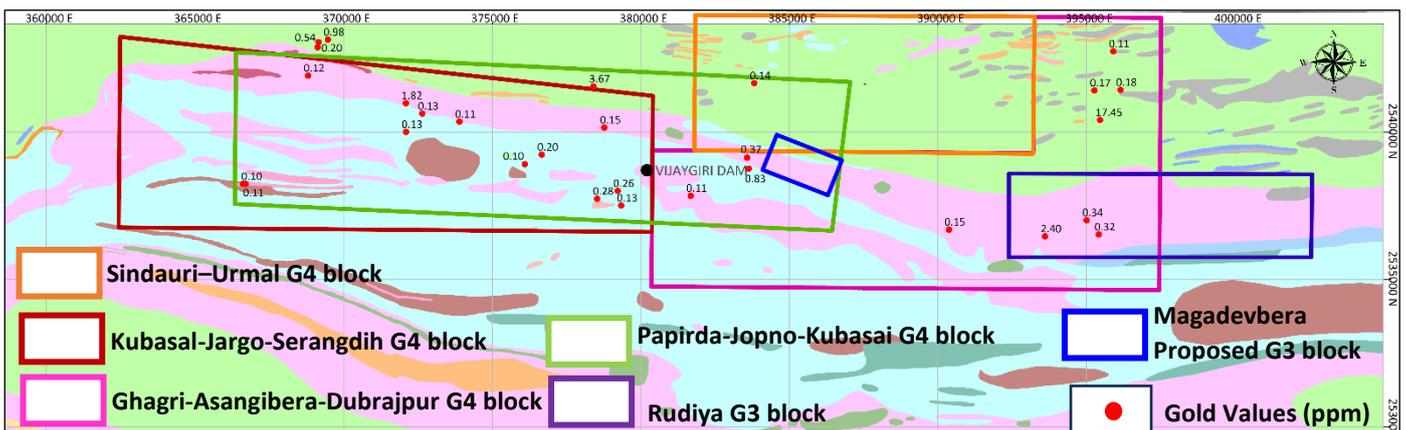
The area forms a part of the North Singhbhum Mobile Belt (NSMB) which is represented by lithounits like tuffaceous phyllite and acid volcanics of Chandil Formation. The Dalma Formation is further subdivided into the Lower Dalma Formation, composed of carbonaceous phyllite, meta-greywacke, purple and white tuffs/phyllites, chlorite phyllite, and brecciated

quartzite/quartz reefs, and the Upper Dalma Formation, consisting mainly of metabasalt, volcanic agglomerate, and pillowed metabasalt. Overall, the area's lithology includes brecciated quartzite, carbonaceous phyllite, acid volcanics, and ultramafics, with notable sulphide mineralization (pyrite, chalcopyrite, and arsenopyrite) observed in brecciated quartzite and quartz veins, indicating promising targets for gold mineralization.

The area is structurally controlled by multiple shear zones and shows intense brecciation, ferruginization, and gossan development, supporting further exploration. The report highlighted zones of intense mylonitization and brecciation, which are known to host graphite mineralization in the Singhbhum region. The presence of graphite flakes in hand specimens and the association with quartz-tourmaline veins further validate the mineral potential of the area.

During the field session, 102 bedrock samples, 100 PTS (100 cu.m), 50 stream sediment samples and 25 petrological samples were collected. Bedrock samples from brecciated quartzite yielded Au values of 85 ppb, 115 ppb, 120 ppb, and 260 ppb. Stream sediment samples showed visible gold flakes and Au values up to 3.67 ppm. Pit samples from acid volcanics yielded Au values up to 200 ppb.

The gold values of the GSI explored blocks around the proposed block are shown in MAP 9.



MAP 9: Gold Values around Proposed Mahadevbera Graphite Block

3. Block description

The proposed exploration block covers an area of 3.0 Sq. Km. area with 4 corner points. Coordinates of these points in degree decimal is given in the below table.

Table 1: Block boundaries coordinates of the proposed Mahadevbera Graphite Block.

Points	LATITUDE	LONGITUDE	Northing	Easting
A	22° 57' 48.0960" N	85° 52' 26.7960" E	2539906.205	384580.752
B	22° 57' 20.6568" N	85° 53' 43.8864" E	2539045.673	386769.828
C	22° 56' 42.0684" N	85° 53' 27.7116" E	2537862.405	386300.211
D	22° 57' 09.4140" N	85° 52' 10.3944" E	2538720.169	384104.501

4. Planned Methodology

It is planned to carryout following activities to explore the area adequately at G3 stage.

1. Topographical Survey (1:4000 scale)
2. Geological mapping (1:4000 scale)
3. Bed rock, channel sampling and analysis.
4. Geophysical survey by SP method.
5. Trenching to expose bed rock, sampling, and analysis.
6. Exploratory drilling: Core drilling, sampling, analysis to prove, extent, depth of mineralised zone.
7. Borehole collar survey and fixing of boundary pillars.
8. Bulk Density determination with core samples.
9. Petrological and Mineragraphic Studies.
10. Chemical analysis of selected samples for REE and critical minerals.
11. Mineragraphic study
12. Data synthesis and preparation of Geological report (grade & resource estimates)

5. Nature, Quantum, and Target

5.1 Survey, Geological Mapping, Trenching & Geochemical Sampling:

Topographical survey shall be carried out using drone and DGPS to generate orthomosaic map of the area. The DEM thus generated shall be used to extract contours at 10m or smaller interval. Geological mapping in 1:4000 scale shall be conducted over the entire area while simultaneously bed rock, channel sampling and analysis shall be carried out.

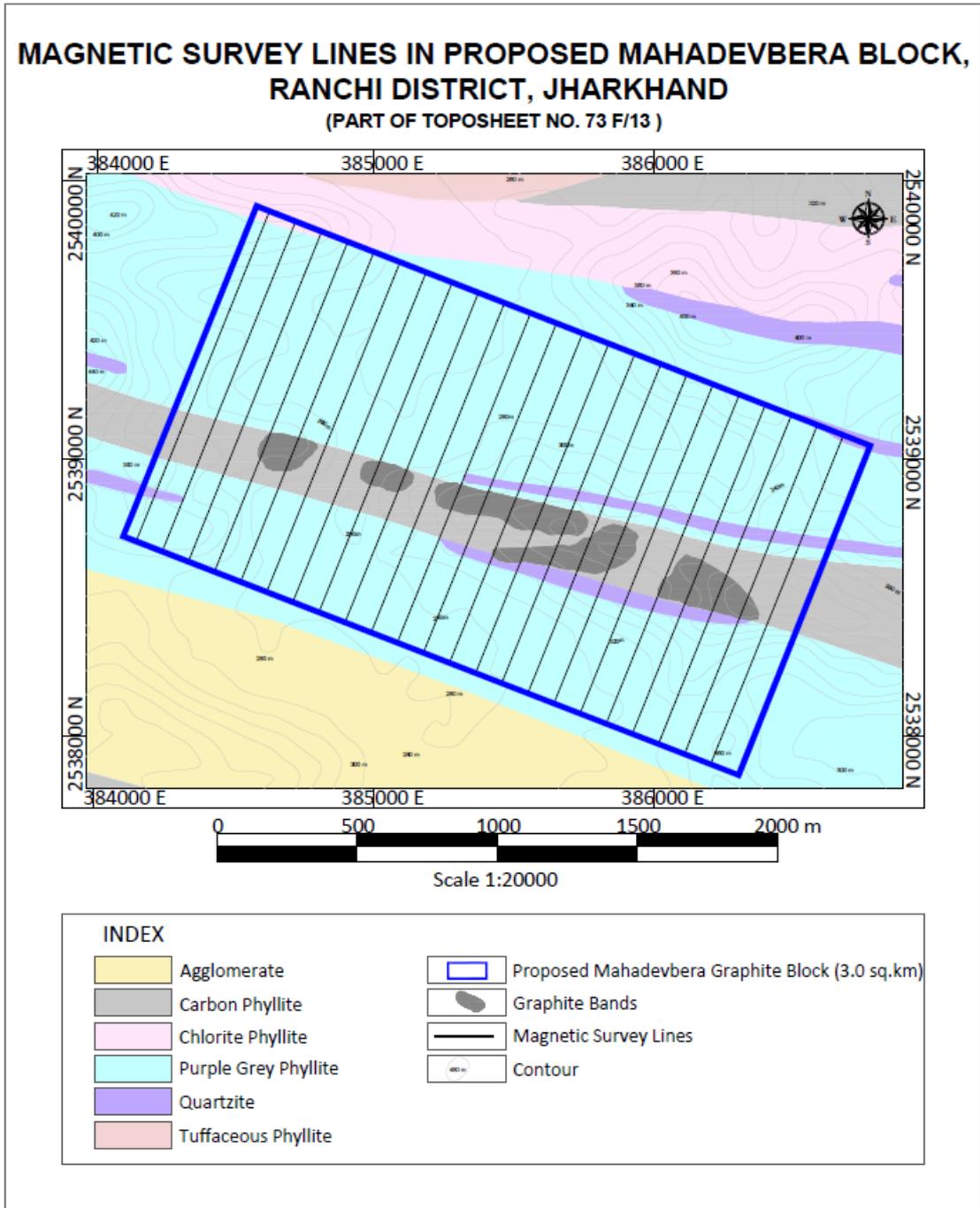
During bed rock sampling, rock chips shall be collected from three or more locations of about equal proportion over the same lithology to avoid biasness. Channel samples shall be collected across the ore zone for >1.0m section (as applicable).

Channel sampling shall be done for cutting channels across the strike of the graphite bearing schist for a length of 1.0 mto 2.0m in length.

Trenches of shall be made across the ore zone to understand near surface lithological variations and quality of ore.

5.2 Geophysical Survey:

Self-potential survey is proposed to be carried out across the block spaced at 100m intervals for 30-line km so to delineate the extent of the ore zones laterally and vertically ore mineralization and plan for drill proving.



5.3 Exploratory Drilling:

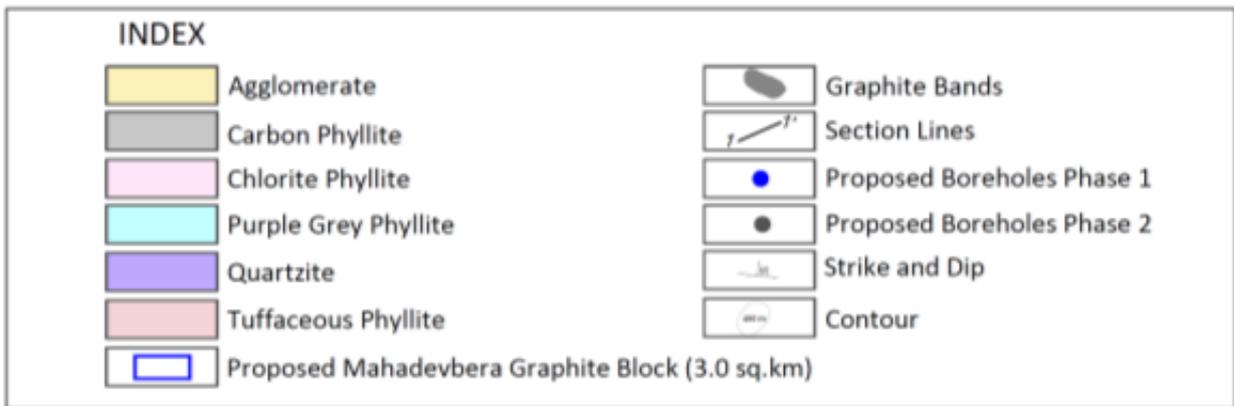
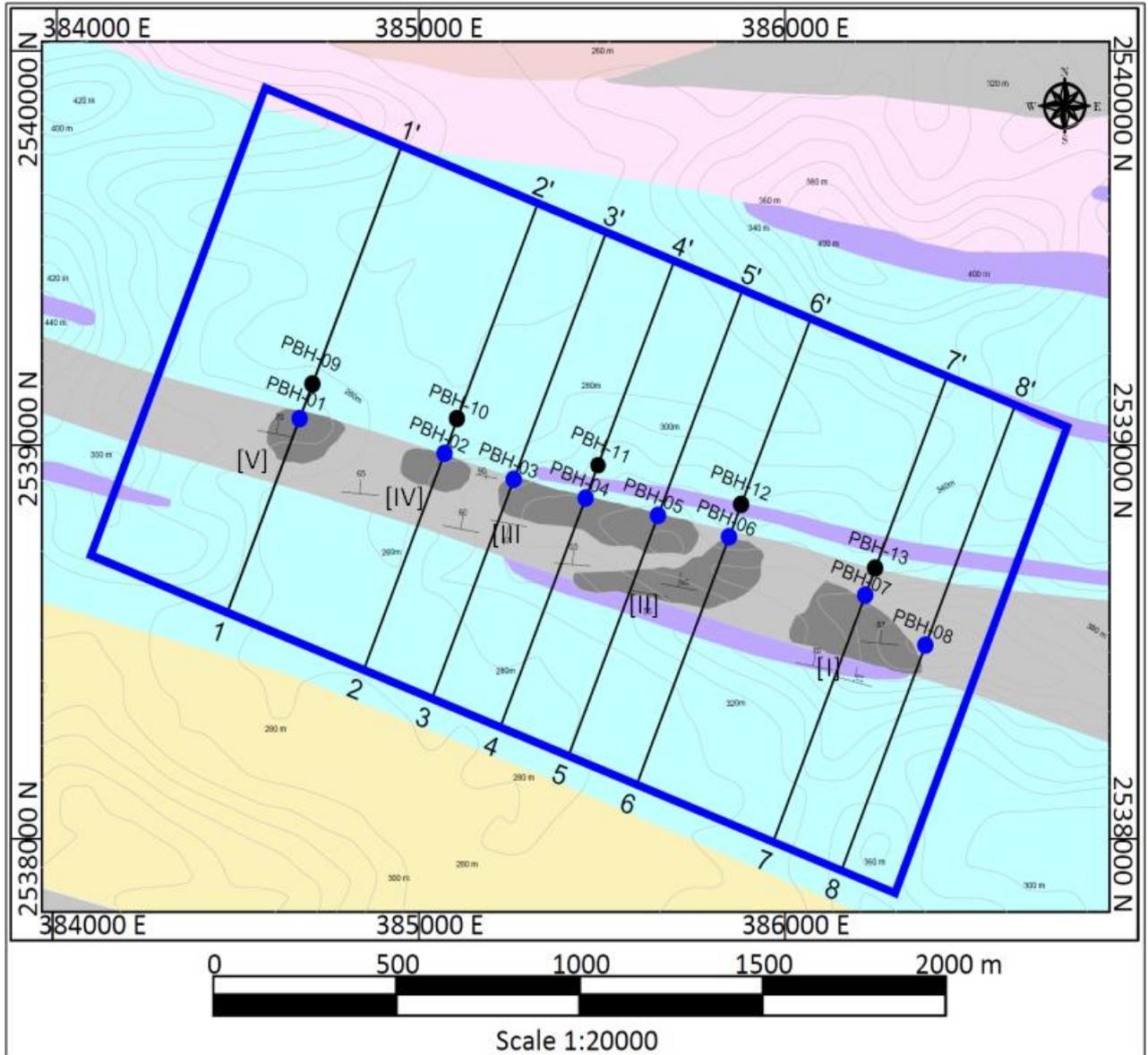
The guideline of MoEF & CC dated 29th Dec, 2023, issued in Van (Sanrakshan Evam Samvardhan) Adhinyam, 1980 and Van (Sanrakshan Evam Samvardhan) Rules, 2023 which guide us that “Surveys in the forest lands for mining purposes which involve breaking of forest land by way of drilling the bore holes and digging the trenches, such as for mining, shall not be treated a non-forest purpose as long as such surveys involve felling of up to hundred trees in the entire areas proposed for survey and drilling of up to 62 holes of four inch diameter in a block”. Complying to this guideline, only 13 boreholes are planned to be drilled in the area.



Core drilling (NQ size) is specifically planned for the most promising target zones to gain insights into subsurface geology and the extent of mineralization, with all boreholes being inclined. Based on geological mapping, analytical results, and the known mineralization in the adjacent Ghagri-Asangibera and Kubasal blocks, it is proposed to explore the block at a G-3 level. This will involve drilling at a 200m x 400m grid interval across the entire anomalous zone to understand the depth persistency, geometry, and control of mineralization, as well as to conduct a preliminary assessment of inferred category resources and graphite grade. Given the disposition of graphite-bearing host rocks, 13 inclined boreholes at a 60° angle to the horizontal, totalling 3200m of exploratory drilling (Diamond core drilling), are planned to intercept the ore body at minimum vertical depths of ~80m and ~140m. Initially, 8 of these boreholes (~1700 m) will be drilled at first phase to examine graphite incidence, with subsequent boreholes to be drilled to a vertical depth of 80m over the anomalous zone, subject to extension based on findings and future planning. Details of the projected BHs are given in Table No - 2 and proposed BHs with projected sections showing anticipated graphite bands are shown on the MAP-10 and Fig 2. The depth of projected BHs has been calculated as per the surface topography and intersection of known graphite bands for PBH – 1 to PBH – 13.

Therefore, total meterage of drilling shall be 3200 (avg. 200 m for graphite). Samples shall be collected and analysed for sample length of 1.0 m in the ore zone and one sample in both top and bottom of the ore zone are planned to be analysed.

With all generated data, G3 (UNFC-333) category resources shall be established complying latest guidelines of MEMC Rule and any other guidelines made thereafter. During estimation of resource threshold value of 2% FC shall be considered for graphite.



MAP 10: Proposed Planned Boreholes in Proposed Mahadevbera Graphite Block

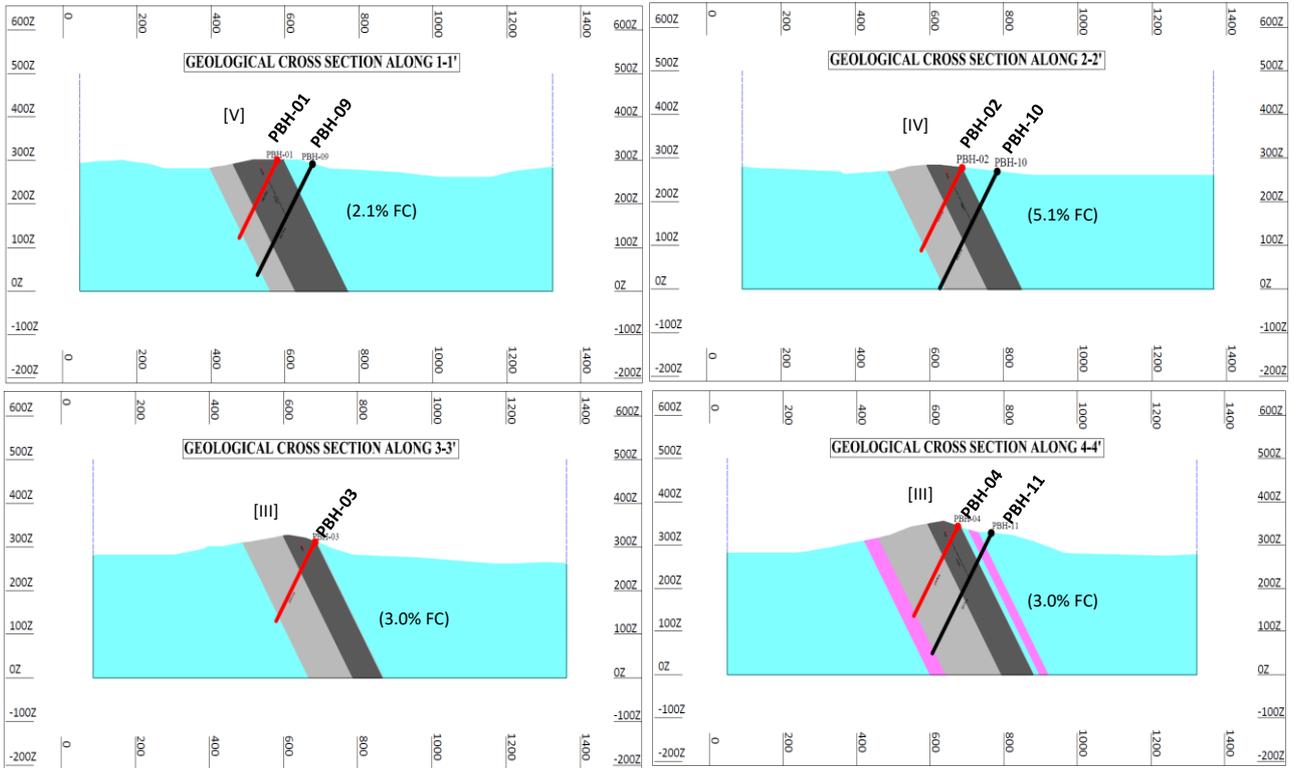


Figure 2: Conceptual Sections of Proposed Mahadevbera Graphite Block

Table 2: Tentative depth of Proposed Boreholes

Phase 1 BH	Drilling Metre
PBH-01	210
PBH-02	220
PBH-03	220
PBH-04	240
PBH-05	270
PBH-06	225
PBH-07	190
PBH-08	120
Total	1695 m

Phase 2 BH	Drilling Metre
PBH-09	300
PBH-10	310
PBH-11	330
PBH-12	300
PBH-13	250
Total	1490 m

5.4 Broad Quantum of Work (NQT)

Components

Phase-I

Topographical Survey

Quantum

1. 3.0 Sq. Km. area of Drone and DGPS based topographical Survey.

Lithological Mapping, sampling and analysis

2. 3.0 Sq. Km area (1:4000 scale)
3. Bed rock, channel sampling = 100 nos.
4. QAQC samples (10%) = 10 nos.

Trenching, sampling, and analysis

1. 10 Nos. (1m x 2m x15m)
2. Sampling and analysis = 40 samples
3. QAQC samples = 4 Nos.

Petrographic and mineragraphic studies

1. Thin polished sections = 10 Nos.
2. Complete petrographic/ ore microscopic/ mineragraphic study= 10 Nos.
3. ICP-MS (34 rad) = 10 Nos.

Phase-II

Geophysical Survey

1. Self-potential Survey
2. 30 Line Km

Exploratory Drilling

1. No. of holes = 13 nos.; Meterage = 3200m
2. Borehole collar survey = 13 nos. (final with DGPS)
3. Sample analysis = 700 nos.
4. QAQC samples (10%) = 70 nos.
5. Determination of insitu bulk density = 5 samples.

Synthesis of all available data

1. Peer Review.
2. Geological Report writing and submission with recommendations

Activity Timeline for the Project

Sl. No.	Particulars	Months	1	2	3	4		5	6	7	8		9	10	11	12		
1	Pre-field Activities	Months	■				Review					Review						
2	Geological Mapping & Allied activities	Months	■	■	■			■		■	■			■				
3	Topographical Survey	Months		■						■	■							
4	Geophysical Survey	Months		■	■													
5	Trenching	Months			■			■										
6	Sampling & Analysis	Months				■												
7	Drilling	Months								■	■				■			
8	Core Sampling & analysis	Months							■		■				■	■		
9	Laboratory studies	Months													■			
10	Interpretation, Planning & Review (HQ)	Months														■		
11	Report Writing with Peer Review	Months																■

References

- Prospecting for Gold in Volcano-Sedimentary Sequence East of Sindauri to Urmal Area in Ranchi and Saraikela–Kharsawan Districts, Jharkhand (ERO-14071-2007); Field Seasons 2007–08 and 2008–09. Geological Survey of India, Eastern Region.
- Reconnaissance Survey for Gold in and around Ghagri–Asangibera–Dubrajpur–Jurgu Areas, Ranchi & Saraikela–Kharsawan Districts, Jharkhand (FS 2016–17); FSP Code: ME/ER/JH/2016/001. Geological Survey of India, Eastern Region.
- Reconnaissance Survey for Gold and Associated Minerals in and around Kubasal, Jargo, Serengdih Areas, Ranchi District, Jharkhand (ERO-15853-2018); Field Season 2018–19. Geological Survey of India, Eastern Region.

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