

**DETAILED PROPOSAL FOR RECONNAISSANCE SURVEY (G4 STAGE) OF  
GRAPHITE IN MAJHIGUDA BLOCK, RAYAGADA DISTRICT, ODISHA  
UNDER NMEDT**

**Commodity: Graphite**

**BY**



**Maheshwari**  
Global Technologies. Ecological Mining.

**MMPL PRIVATE LIMITED  
FR 07 SHILPANGAN, PLOT NO – LB 1,  
SECTOR III, SALT LAKE, KOLKATA-700091**

**Place: Kolkata**

**Date: 23.03.2026**

## Summary of the Block in G4 Stage Exploration

Sl.no	Features	Details
A.	Block ID	Majhiguda Block
B.	Current Exploration Agency	MMPL Private Limited (Formerly Maheshwari Mining Private Limited)
C.	G4 stage Geological Report (Previous stage Geological Report)	Report On Investigation of Graphite Around Majhiguda, Rayagada district, Orissa (T.S.No. 65M/7). Field season: 1996-97
D.	Commodity	Graphite
E.	Mineral Belt	Eastern Ghats Mobile Belt (EGMB)
F.	Completion Period with entire Time schedule to complete the project	12 Months
G.	Objectives	<p>The present exploration program (G4) has been formulated on the basis of the outcome of previous work as well as sampling data to fulfil the following objectives:</p> <ul style="list-style-type: none"> <li>• Geological mapping on 1:12,500 scale to delineate graphite bands and other lithological units in the area.</li> <li>• Delineation of the potential subsurface mineralized zones by Geophysical Surveys (SP survey).</li> <li>• Trenching will be carried out to expose the graphite bands.</li> <li>• Scout drilling for 30 m vertical depth of intersection.</li> <li>• Assessment of the resources in class 334 as per UNFC norms &amp; Minerals (Evidence of Mineral Contents) Rules- 2015.</li> </ul>
H.	Whether the work will be carried out by the proposed agency or through out- sourcing and details thereof. Components to be outsourced and name of the out-sourced agency	The work will be carried out by proposed agency.
I.	Name/Number of Geoscientists	Field Geologist: Two numbers HQ Geologist: Two numbers
J.	Expected Field days (Geology) Geological Party Days	180

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1.	Location	<table border="1"> <thead> <tr> <th>Cardinal points</th> <th>longitude</th> <th>latitude</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>83.2500</td> <td>19.4583</td> </tr> <tr> <td>B</td> <td>83.4167</td> <td>19.4583</td> </tr> <tr> <td>C</td> <td>83.4169</td> <td>19.3983</td> </tr> <tr> <td>D</td> <td>83.3711</td> <td>19.3990</td> </tr> <tr> <td>E</td> <td>83.3709</td> <td>19.3901</td> </tr> <tr> <td>F</td> <td>83.2500</td> <td>19.3908</td> </tr> </tbody> </table>	Cardinal points	longitude	latitude	A	83.2500	19.4583	B	83.4167	19.4583	C	83.4169	19.3983	D	83.3711	19.3990	E	83.3709	19.3901	F	83.2500	19.3908
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Villages	Majhiguda, Murkakona																						
Tehsil	--																						
District	Rayagada district																						
State	Odisha																						
2.	<b>Area (hectares/square kilometres)</b>																						
	Block Area	127.11 sq km																					
	Forest Area																						
	Government Land Area																						
	Private Land Area																						
3.	<b>Accessibility</b>																						
	Nearest Rail Head	Sikarpai Railway station																					
	Road	NH-45																					
	Airport	Jharsuguda																					
4.	<b>Hydrography</b>																						
	Local Surface Drainage Pattern (Channels)	Dendritic pattern																					
	Rivers/Streams																						
5.	<b>Climate</b>																						
	Mean Annual Rainfall	1,340.30 mm																					
	Temperatures (December)(Minimum )	15°C (59°F)																					
	Temperatures (June)(Maximum)	32.6°C (90.7°F)																					
6.	<b>Topography</b>																						
	Toposheet Number	65M/7																					
	Morphology of the Area	<p>The area is predominantly rugged with an average elevation of 400 meters and hills that rise up to 900 meters above sea level. Most of the area is covered by a chain of hills and mounds. The drainage pattern follows a dendritic layout with two perennial nala-the Pedda Nala, flowing from northwest to south and the Balandeli Nala, flowing from north to south.</p> <p>The general slope, as indicated by the drainage pattern, is from the northern to the southern side of the region. The alignment of the hill ranges and the drainage system is primarily influenced by the underlying lithology and structure. The higher elevations are dominated by khondalite, while other lithological units are found at lower altitudes.</p>																					
7.	<b>Availability of base line geoscience data</b>																						
	Geological Map (1:50000/1:25000)	Available																					

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8.	Justification taking up Reconnaissance Survey/ Regional Exploration	<p>Justification for taking up the investigation in G4 stage:</p> <ul style="list-style-type: none"> <li>In course of investigation, 9 graphite occurrences have been encountered around Majhiguda area. The graphite is occurring as disseminations and flakes and is generally associated with migmatized khondalite and rarely calc granulite as in the west of Bhitarsaja. The trend of the foliation of the migmatized khondalite varies from N10°W-S10°E to N15°E-S15°W dipping 60° Easterly &amp; Westerly. Chemical analysis results of graphite samples by DMG, Orissa are given below:</li> </ul> <table border="1"> <thead> <tr> <th>Sl No.</th> <th>Location</th> <th>Moist%</th> <th>VM%</th> <th>Ash%</th> <th>FC%</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>NW of Deulabadi</td> <td>0.40</td> <td>2.70</td> <td>87.60</td> <td><b>9.30</b></td> </tr> <tr> <td>2</td> <td>WSW of Budagurha</td> <td>0.30</td> <td>1.90</td> <td>93.20</td> <td><b>4.60</b></td> </tr> <tr> <td>3</td> <td>NNW of Budagurha</td> <td>0.45</td> <td>6.10</td> <td>88.00</td> <td><b>5.45</b></td> </tr> <tr> <td>4</td> <td>S of Bhitarsaja</td> <td>0.30</td> <td>2.10</td> <td>88.80</td> <td><b>8.80</b></td> </tr> <tr> <td>5</td> <td>S of Ajayagarh</td> <td>0.30</td> <td>0.80</td> <td>88.70</td> <td><b>10.20</b></td> </tr> <tr> <td>6</td> <td>East of 667</td> <td>0.20</td> <td>1.00</td> <td>92.60</td> <td><b>6.20</b></td> </tr> <tr> <td>7</td> <td>NW of 667</td> <td>1.05</td> <td>10.95</td> <td>84.30</td> <td><b>3.70</b></td> </tr> <tr> <td>8</td> <td>East of Pipiligurha</td> <td>0.30</td> <td>2.90</td> <td>91.10</td> <td><b>5.70</b></td> </tr> <tr> <td>9</td> <td>South of Bhitarsaja</td> <td>0.80</td> <td>6.60</td> <td>88.60</td> <td><b>4.00</b></td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>During this investigation, 7 numbers of crystalline limestone are encountered. The limestone is occurring as lenticular bands associated with calc-granulite. The trend of the foliation of crystalline limestone varies from N-S to N35°E-S35°W, dipping 55° to 70° due East and south easterly. The details of the occurrence is given below:</li> </ul> <table border="1"> <thead> <tr> <th>Sl No.</th> <th>Location</th> <th>CaO%</th> <th>MgO%</th> <th>SiO2%</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>NNW of Talasaja</td> <td>53.80</td> <td>0.55</td> <td>1.89</td> </tr> <tr> <td>2</td> <td>NNW of Talasaja</td> <td>53.70</td> <td>0.42</td> <td>6.50</td> </tr> <tr> <td>3</td> <td>NE of Salimi</td> <td>44.80</td> <td>0.32</td> <td>25.46</td> </tr> <tr> <td>4</td> <td>NE of Salimi</td> <td>38.50</td> <td>0.59</td> <td>35.72</td> </tr> <tr> <td>5</td> <td>SW of Sikarpai</td> <td>41.86</td> <td>0.63</td> <td>27.68</td> </tr> <tr> <td>6</td> <td>SW of Sikarpai</td> <td>44.45</td> <td>0.41</td> <td>47.34</td> </tr> <tr> <td>7</td> <td>SW of Sikarpai</td> <td>40.05</td> <td>0.25</td> <td>33.38</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>Based on the results, MMPL proposes a block of 127.11 sq. km area for G4 stage of investigation.</li> </ul>	Sl No.	Location	Moist%	VM%	Ash%	FC%	1	NW of Deulabadi	0.40	2.70	87.60	<b>9.30</b>	2	WSW of Budagurha	0.30	1.90	93.20	<b>4.60</b>	3	NNW of Budagurha	0.45	6.10	88.00	<b>5.45</b>	4	S of Bhitarsaja	0.30	2.10	88.80	<b>8.80</b>	5	S of Ajayagarh	0.30	0.80	88.70	<b>10.20</b>	6	East of 667	0.20	1.00	92.60	<b>6.20</b>	7	NW of 667	1.05	10.95	84.30	<b>3.70</b>	8	East of Pipiligurha	0.30	2.90	91.10	<b>5.70</b>	9	South of Bhitarsaja	0.80	6.60	88.60	<b>4.00</b>	Sl No.	Location	CaO%	MgO%	SiO2%	1	NNW of Talasaja	53.80	0.55	1.89	2	NNW of Talasaja	53.70	0.42	6.50	3	NE of Salimi	44.80	0.32	25.46	4	NE of Salimi	38.50	0.59	35.72	5	SW of Sikarpai	41.86	0.63	27.68	6	SW of Sikarpai	44.45	0.41	47.34	7	SW of Sikarpai	40.05	0.25	33.38
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## Detailed description of the following proposal.

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### 1 Block Summary

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

#### 1.1 Physiography

The area is predominantly rugged with an average elevation of 400 meters. Most of the area is covered by a chain of hills and mounds. The drainage pattern follows a dendritic layout with two perennial nala-the Pedda Nala, flowing from northwest to south and the Balandeli Nala, flowing from north to south.

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#### 1.2 Background Geology

##### 1.2.1 Regional Geology

The rugged country with discontinuous hill ranges occurring along the coast of the Bay of Bengal is known as the Eastern Ghats. The average altitude is 610 m and the tallest peak Mahendragiri is 1501 m high. The highly deformed rocks that experienced ultrahigh-temperature granulite facies metamorphism and several generations of magmas of varied compositional types are recognized as the **Eastern Ghats Mobile Belt (EGMB)** which is extending from Brahmani River in Odisha to Ongole in south-eastern Andhra Pradesh. The 1000-km-long terrain is nearly 300 km wide in the northern part (Mahalik 1996), but tapers to merely 30 km in the south, the average width being 100 km. The Gondwana in two Phanerozoic rift valleys, the Mahanadi Graben in the north and the Godavari Graben in the south, break the continuity. It is a Mesoproterozoic terrain that has a very long history of tectono-thermal evolution including migmatization and charnockitization of supra-crustal rocks.

The EGMB was referred to as a convergent orogeny that evolved under NW–SE-directed sub horizontal compression resulting from oblique collision of continental plates (Chetty and Murthy 1994; Ramakrishnan et al. 1998; Bhattacharya 2002). Gravity modelling constrained by seismic information suggests that the eastward-inclined 38 to 40km-thick column of cratonic crust lies 35 km below this mobile belt (Kumar et al. 2004). It will be apparent that the EGMB displays high-gravity anomaly compared to the cratons, implying denser rocks underlying it (Subramanyam and Verma 1986). Building the bulk of the EGMB, the exposed charnockite–khondalite succession represents the thrust-

up lower crustal material. The basement archaean rocks are seen nowhere, but the material forming them occurs in the framework of the mobile belt in a drastically remobilized and reconstituted forms.

Four lithological zones were recognized in the EGMB on the basis of ages of protoliths and constituent minerals (Ramakrishnan et al. 1998). The fifth unit is the zone of transition. The brief descriptions are as follow-

The **Western Charnockite Zone** comprises dominant charnockites and enderbites with lenses of basic and ultrabasic rocks and minor intercalations of metapelite (khondalite) and basic granulites. There are several generations of charnockites, the oldest being deformed and gneissose, garnet bearing and concordant in disposition with the khondalite.

The **Western Khondalite Zone** is dominated by metapelitic khondalite with intercalations of quartzite, calc silicate gneiss, marble and minor though very significant high Mg–Al granulite characterized by sapphirine. Intrusive bodies of charnockites and massif-type anorthosite, as seen at Bolangir, Turrkel and Jugsaipatna are also present. Metamorphosed basic sills and lava flows are represented by concordant bodies of basic granulites within the khondalite succession. In many cases, there are plutonic intrusives.

The **Central Migmatite Zone** is made up of dominant migmatites, garnet-bearing diatexites with leptynites, high Mg–Al granulite and calc silicate rock intruded by charnockites and porphyritic granites. There are bodies of massif-type anorthosite within the zone. The migmatites owe their origin to high-grade metamorphism with differential melting of siliceous granulites, like the khondalite. The charnockites also show a composition that reveals affinity to tholeiitic to calc-alkaline basalts of the protoliths (Rao et al. 1995). There are patches of charnockite developed incipiently on the granulitic gneisses and migmatites. They were supposed to have formed as a result of activity of CO<sub>2</sub>-rich fluids and/or through a process of charnockitization of metasediments of appropriate bulk composition (Nanda and Pati 1989; Paul et al. 1990; Rajesham et al. 1992; Mohan et al. 2003).

The **Eastern Khondalite Zone** consists of a lithology not different from that of the Western Khondalite Zone, but is devoid of anorthosite bodies. The leptynites that are interlayered with khondalites in the Chilka Lake area represent the granitoids produced by dehydration melting in the metapelites of different composition (Sen and Bhattacharya 1997). The presence of sillimanite trails within garnets suggests that the khondalites were indeed subjected to partial melting. In the Rengali domain in the northern part of the EGMB, the multiple shear zones seem to have not only served as places for intrusion of alkaline rocks but also provided pathways to fluids that brought about charnockitization and migmatization of granulitic rocks (Mahalik 1994). Understandably, the ultrabasic intrusives occur as boundinaged bodies in the highly deformed masses of khondalites of

shear zones. Closely associated in space, the co-magmatic anorthosite occurs as metamorphosed and tectonized layers in the EGMB.

**Transition Zone** is present on the western and south-western margins of the EGMB. It consists of a mixture of litho-types belonging to the craton and the Western Charnockite Zone. The granulites show retrogression to amphibolite facies of metamorphism along the shear zone.

On the basis of different geological investigation and evidences tentative stratigraphic column (Table 1) was proposed by Ramakrishnan et al., (1994).

<b>Table 1: Stratigraphic Sequence of Eastern Ghats [Ramakrishnan et al., (1994)]</b>	
<b>Age</b>	<b>Lithological Units</b>
800-900 Ma	Alkaline rocks, granitoids
1000-1100 Ma	-----Eastern Ghats orogeny-----
	Development of eastern Ghats front of upgraded cratonic rocks.
	Incipient and massive charnockite and garnetiferous gneiss with biotite and sillimanite
1300-1400 Ma	Emplacement of alkaline rocks (Feldspathoid gneiss and anorthosite)
Khondalite Group (WKZ, CMZ, EKZ)	Garnet-sillimanite-Quartzo-feldspathic graphite gneiss
	Cordierite-sapphirine-spinel rocks
	Calc silicate rocks and rare marbles
	Quartzite rich in garnet
1600-1800 Ma (WCZ)	Evolution of purana basin
2600-2800 Ma	Charnockite with enclaves of basic granulite, high grade schists including BIF and layered basic complexes, representing original cratonic basement (?) in migmatitic amphibolite facies
3000 Ma	Vestigial events (?)

### 1.2.2 Geology of the area at G4 stage of investigation

The outcrop map of the proposed area consists of mappable lithological units of acid to intermediate charnockite, granite gneiss, calc granulite, pyroxene granulite, quartz-garnet-sillimanite graphite schist/gneiss, leptynite and calc-silicate gneiss. The khondalite occurs along the higher altitude where as other lithological units are restricted to the hill slopes and valley portions.

## **Description of the lithological units**

### **Charnockite**

This is the dominant lithology of the area. Large continuous dome shaped exposures of charnockite are well exposed in central, eastern and south western parts; small outcrops of charnockite are also encountered in the north western and western part of the area.

Charnockite is a medium to coarse grained greasy looking rock that is typically greenish grey to dark grey in color. It is composed of plagioclase, quartz, prismatic pyroxene and occasionally garnet. The rock is very hard, compact and massive in nature. In some locations charnockite suffer some sort of migmatization evidenced by formation of well-developed flow folding.

### **Granite gneiss**

Granite gneiss is extensively exposed in the northwestern, western, and southeastern parts of the study area. This rock is characterized by pinkish white color and is primarily composed of quartz, feldspar, biotite and garnet. The gneissosity is well-developed with distinct layering: light-colored bands rich in quartz and feldspar, alternate with darker layers dominated by biotite. In certain areas, larger augen-shaped porphyroblasts of quartz and feldspar are observed. The granite gneiss is foliated in nature, with a general trend NW-SE dipping towards southwest. Small graphite flakes occur in granite gneiss scattered in a disseminated form, aligned parallel to the foliation plane.

### **Khondalite**

Khondalite in the area is hard, highly weathered, foliated, and migmatized, occurring predominantly at high elevations in the northeastern, southern and western parts of the region. The khondalite exhibits gradational boundaries with the surrounding granite gneiss. The rock is leucocratic, ranging in color from reddish-brown to buff-red and is medium to coarse-grained consisting primarily of garnet, quartz, feldspar, and sillimanite with or without graphite. Some of the khondalite units display coarse garnet grains. The general strike of the lithounit ranges from N50°W to N30°W, with dips between 40° and 60° towards southwest.

### **Leptynite**

Leptynite occurs as small bodies within khondalite in areas near Palupai, Barhisola, Dhepagurha and Kalingaguda villages. The lithological units are light-colored and consist primarily of quartz, feldspar, staurolite, and garnet. A distinctive feature of the unit is the presence of well-developed quartz blades, which are oriented parallel to the foliation plane.

### **Calc granulite**

Calc granulite has limited distribution and occurs within the granite gneiss in the area. Calc-silicate granulite bodies are encountered in the southern part of Tenupulisi village and northwestern part of Rangamati village. The rock is fine grained, greenish white in colour composed of wollastonite, diopside, plagioclase and quartz; shows ridge and furrow structure due to differential weathering of alternate compositional banding.

### **Quartzite**

A narrow band of quartzite is located in the southwestern part of Palupai village, where it is associated with khondalite. The quartzite is brownish-white in colour, medium to fine grained, hard and compact composed predominantly of quartz with small proportions of garnet.

### **Basic Granulite**

Basic granulite occurs as narrow bands within the granite gneiss near Bankili village. Patches of basic granulite occur within granite gneiss and leptynite in the northern part of chakrigurha village.

## **1.3 Geology of the proposed block area**

### **Garnetiferous Granite gneiss**

It is exposed around Guha and west of Kadalichuan areas. It is leucocratic medium grained rock. It megascopically found to contain varying amounts of quartz, feldspar, garnet and other mafics. The trend of the foliation varies from N-S to N10°E-S10°W dipping 60° to 65° due east and south easternly.

### **Charnockite**

It is exposed around villages Gartali and west of Pandarapara area only. The foliation in charnockite is vertical to sub-vertical having a trend that varies from N20°W-S20°E to N40°W-S40°E.

### **Quartzo-feldspathic graphite gneiss**

Exposure of this unit confined to the north of Gopalpur and south of Bhitarsaja area. It is leucocratic medium grained and is composed of quartz feldspar and mafics.

### **Quartzite**

The lithounit occurs as ridges and lenticular band and mounds in association with khondalite and porphyritic granite gneiss. They are exposed around Minajhola, SW of Sirkarpai, Deulabadi, West of Kotlapara, Salimi, Kandakora etc. The trend of the foliation of the quartzite varies from N15°W-S15°E to N20°W-S20°W dipping at an angle of 60° to 65° North easternly and south easternly.

#### 1.4 Mineral potentiality based on geology, geophysics, ground geochemistry etc.

9 No of graphite samples have been drawn from outcrops around Majhiguda. Samples have been collected to make preliminary assessment. Graphite occurrences have been located near Deulabadi, Alanda, Bhitarsaja, Bhitarsaja, Ajayagarh, East of 667, Pipiligurha and Bhitarsaja. The value of FC% for the samples by DMG, Orissa are given below:

SI No.	Location	Moist%	VM%	Ash%	FC%
1	NW of Deulabadi	0.40	2.70	87.60	9.30
2	WSW of Budagurha	0.30	1.90	93.20	4.60
3	NNW of Budagurha	0.45	6.10	88.00	5.45
4	S of Bhitarsaja	0.30	2.10	88.80	8.80
5	S of Ajayagarh	0.30	0.80	88.70	10.20
6	East of 667	0.20	1.00	92.60	6.20
7	NW of 667	1.05	10.95	84.30	3.70
8	East of Pipiligurha	0.30	2.90	91.10	5.70
9	South of Bhitarsaja	0.80	6.60	88.60	4.00

During this investigation, 7 numbers of crystalline limestone are encountered. The limestone is occurring as lenticular bands associated with calc-granulite. The trend of the foliation of crystalline limestone varies from N-S to N35°E-S35°W, dipping 55° to 70° due East and south easternly. The details of the occurrence by DMG, Orissa given below:

SI No.	Location	CaO%	MgO%	SiO2%
1	NNW of Talasaja	53.80	0.55	1.89
2	NNW of Talasaja	53.70	0.42	6.50
3	NE of Salimi	44.80	0.32	25.46
4	NE of Salimi	38.50	0.59	35.72
5	SW of Sikarpai	41.86	0.63	27.68
6	SW of Sikarpai	44.45	0.41	47.34
7	SW of Sikarpai	40.05	0.25	33.38

Based on the surface evidences, a total nine number of graphite bearing samples were collected by MMPL within the block area. The value of FC% for the samples are given below:

SL. NO.	SAMPLE ID	(%) MOISTURE (ARB)	(%) VM (DB)	(%) ASH (DB)	(%) S (DB)	(%) FC (DB)
1	MM-01	1.66	2.98	87.80	0.27	8.95
2	MM-02	1.60	2.83	87.67	0.26	9.24

SL. NO.	SAMPLE ID	(%) MOISTURE (ARB)	(%) VM (DB)	(%) ASH (DB)	(%) S (DB)	(%) FC (DB)
3	MM-03	1.62	2.87	87.65	0.27	9.21
4	MM-04	1.62	2.84	87.55	0.23	9.38
5	MP-01	0.78	5.61	90.64	0.19	3.56
6	MP-02	0.76	5.12	86.51	0.24	8.13
7	MP-03	0.82	5.18	87.34	0.21	7.27
8	MD-01	0.90	5.88	92.40	0.21	1.51
9	MD-02	0.87	5.99	92.47	0.18	1.36

Whether we should incorporate Mg and Cao% or not?

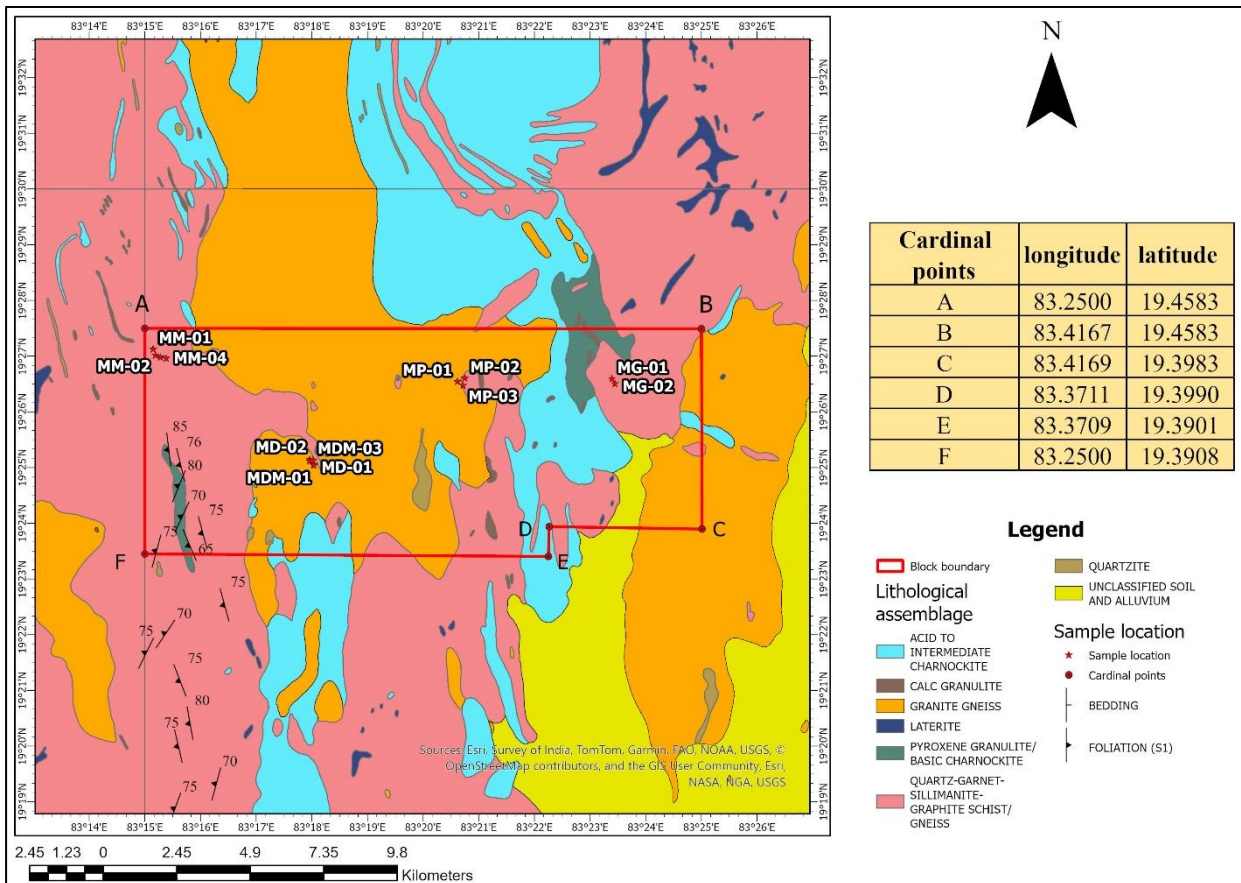


Figure 1: Location of sample collected from the proposed area

## 1.5 Recommendations of previous G4 stage mineral exploration report

The recommendations of previous G4 stage mineral exploration report are as follow-

- Out of the nine identified graphite occurrences, the fixed carbon values range from 3.70% to 10.20%. Resource estimation has been carried out for two areas, considering their aerial extent and a depth factor of 10 m. A specific gravity of 2.20 and a recovery factor of 40% have been applied. Based on these parameters, the estimated resource is as follows:
  - i) Ajayagarh (100m x 50m) = 44,000 tonnes (FC: 10.20%)
  - ii) Bhitarsaja (300m X 30m) =79,200 tonnes (FC: 8.80%)
- Based on the following parameters, an attempt has been made to estimate the probable reserves of four limestone occurrences: (i) exposed areal extent, (ii) mineable depth up to 30 m, (iii) specific gravity of 2.7, and (iv) ore recovery of 60%. Based on these parameters, the estimated resource is as follows:
  - i) NNW of Talasaja: 0.48600 MT (CaO: 47.32 - 50.79%)
  - ii) NE of Salimi: 0.510300 MT (CaO: 29.73 - 36.12%)
  - iii) N of Gumigurha: 0.364500 MT (CaO: 29.97 – 48.87%)
  - iv) SW of Sikarpai: 0.364500 MT (CaO: 28.32 – 39.55%)

## 1.6 Objectives

The present exploration program (G4) has been formulated on the basis of the outcome of previous work as well as sampling data to fulfil the following objectives:

- Geological mapping on 1:12,500 scale to delineate graphite bands and other lithological units in the area.
- Delineation of the potential subsurface mineralized zones by Geophysical Surveys (SP survey).
- Trenching will be carried out to expose the graphite bands.
- Scout drilling for 30m vertical depth of intersection.
- Assessment of the resources in class 334 as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.

## 2 Previous Work in adjoining area:

Directorate of Mining & Geology, Odisha has carried out investigation in G4 stage “**Report on investigation of graphite around majhiguda, Rayagada district, Orissa (T.S. No. 65M/7), Field season: 1996-97 by P.K. Panigrahi, Geologist and P.Tirkey, Asst. Geologist**”

### 3 Block description

The detailed co-ordinate of the proposed block is given below-

Table 2: Co-ordinates of corner points		
Cardinal points	latitude	longitude
A	19.4583	83.2500
B	19.4583	83.4167
C	19.3983	83.4169
D	19.3990	83.3711
E	19.3901	83.3709
F	19.3908	83.2500

### 4 Planned Methodology

Reconnaissance survey (G4 Stage) of Graphite in Majhiguda Block, Rayagada District, Odisha geological mapping in 1:12,500 scale, trenching, geophysical SP survey, scout drilling, chemical analysis of the samples (BRS, PT and core samples), petrological and mineralogical studies are proposed in the block. The exploration will be carried out as per Minerals (Evidence of Mineral contents) Rules-Amended in 2021. Accordingly, the details of different activities to be carried out are presented in subsequent columns.

#### 4.1 Geological Mapping

Large scale geological mapping on 1:12,500 scale in the area (127.11 Sq. Km) will be carried out by taking geological traverses. The contacts of different lithologies, structural features, etc. will be noted in detail. The large-scale geological map on 1:12,500 scale will be generated as an outcome.

#### 4.2 Core Drilling

##### 4.2.1 Borehole plan:

Scout boreholes will be planned to investigate the depth persistence of graphite mineralization (lenticular body) up to 30 m vertical depths of intersection.

##### 4.2.2 Core Logging

The drill cores would be logged systematically viz. details of litho-units, colour, structural feature, texture, mineralization, besides the recovery, rock quality designation and type of ore deposit would be recorded.

### 4.2.3 Core Sampling

The drill core will be split into two equal halves and one part would be preserved in the core box. The other half will be powdered to 70 micron (200 mesh size) and the same would be divided into four parts (250 g each) through coning and quartering. One part of the sample will be sent to chemical laboratory for proximate analysis, second part to be preserved in the camp as duplicate sample, third part to be sent for chemical analysis of minor and trace elements by ICPMS and the fourth part would keep as either check sample or sample to be used for any other specific purpose.

The length of each sample will be kept 0.50 m-1.0 m depending upon the width of the graphite zone. 44 nos. would be analysed by ICPMS to ascertain the presence of other trace elements.

### 4.3 Petrographic and petrochemical Studies

Thin and polished section studies of the outcrop samples and the core samples will be studied for detailed petrographic and mineralogical characteristics. These samples will be collected from ore zones and associated rocks. A provision of 20 nos. specimens for both petrographic and petrochemical studies will be kept for the proposed area.

### 4.4 Bulk Density Determination

In addition, bulk density determination of 5 nos. samples will be carried out for the proposed block.

## 5 Nature Quantum and Target for G4 stage

<b>Table no. 3: Nature and quantum of work for Reconnaissance survey (G4 Stage) of Graphite in Majhiguda Block, Rayagada District, Odisha</b>			
<b>Sl. no</b>	<b>Item of work</b>	<b>Unit</b>	<b>Quantum</b>
1	Detailed Geological mapping (on 1:12,500)	Sq. Km	127.11
2	SP survey	L.km	10
3	Trenching	Cubic meter	300
4	Drilling (number of borehole = 8, 800 m)	Meter	800
5	Proximate analysis for graphite (BRS=50; PT samples =200; core samples = 450)	Nos.	700
6	Proximate analysis for graphite 10% external check	Nos.	70

**Table no. 3: Nature and quantum of work for Reconnaissance survey (G4 Stage) of Graphite in Majhiguda Block, Rayagada District, Odisha**

Sl. no	Item of work	Unit	Quantum
7	Analysis for 34 elements by ICP-AES / ICPMS (34 elements along with Cu, Pb, Zn, Fe, Ni, Co, Cr, Al, S, Bi etc)	Nos.	44
8	Petrographic studies	Nos.	20
9	Preparation of thin sections	Nos.	20
10	Study of thin section	Nos.	20
11	Bulk density/ specific gravity determination	Nos.	5
12	Drill core preservation	Meter	500

## 6 Manpower deployment

Two geologists, two geophysicists, one surveyor with required labourers and two drilling rigs with drilling crew will be deployed as per the requirement of the time schedule chart (Table: 4).



## 7 BREAK UP OF EXPENDITURE

The breakup of expenditure is given in table 5.

Estimated Cost for Reconnaissance survey (G4 Stage) of Graphite in Majhiguda Block, Rayagada District, Odisha under NMEDT							
Total area - 127.11 Sq.km; Borehole - 8; Meterage - 800 m, Period of completion - 12 months, Review - After 6 months (after mapping, trenching and SP survey)							
SL.No	Item Of Work*	Unit*	Rate As Per NMEDT SOC 2025		Estimated Cost of the Proposal		Remarks
			SOC. Item No	Rate As Per revised SOC* (a)	Qty. (b)	Total Amount (Rs) (a*b)	
<b>A</b>	<b>Large Scale Geological Mapping and Other Geological Work &amp; Surveying</b>						
i	Geological mapping (1:12,500), Trenching & Drilling work	Per Sq. km	1.1	₹ 18,300.00	127.11	₹ 23,26,113.00	
ii	Charges for 2 Geologist per day (Field) for Geological mapping & Trenching work, drilling activity (without labour)	day	1.2.1a	₹ 14,500.00	120	₹ 17,40,000.00	
iii	Labours charges; Base rate (for 2 labours per geologists)	day	5.8	₹ 541.00	240	₹ 1,29,840.00	Amount will be reimbursed as per the notified rates by the Central Labour Commissioner or

Estimated Cost for Reconnaissance survey (G4 Stage) of Graphite in Majhiguda Block, Rayagada District, Odisha under NMEDT							
Total area - 127.11 Sq.km; Borehole - 8; Meterage - 800 m, Period of completion - 12 months, Review - After 6 months (after mapping, trenching and SP survey)							
SL.No	Item Of Work*	Unit*	Rate As Per NMEDT SOC 2025		Estimated Cost of the Proposal		Remarks
			SOC. Item No	Rate As Per revised SOC* (a)	Qty. (b)	Total Amount (Rs) (a*b)	
							respective State Govt. whichever is higher.
iv	Charges for Geologist per day (HQ)	day	1.2.1a	₹ 10,500.00	30	₹ 3,15,000.00	
	<b>Sub Total- A</b>					<b>₹ 45,10,953.00</b>	
<b>B</b>	<b>Trenching/Pitting</b>						
i	Trenching	per cu.m	2.1.1	₹ 4,125.00	300	₹ 12,37,500.00	
	<b>Sub Total- B</b>					<b>₹ 12,37,500.00</b>	
<b>C</b>	<b>Survey work</b>						
i	DGPS Survey for BH fixation & RL determination	Per Point of observation of observation	1.3.2	₹ 24,000.00	14	₹ 3,36,000.00	
ii	Labours Charges for survey work; Base rate	day	5.8	₹ 541.00	30	₹ 16,230.00	
	<b>Sub Total- C</b>					<b>₹ 3,52,230.00</b>	
<b>D</b>	<b>Ground Geophysical Survey (in- house)</b>						

Estimated Cost for Reconnaissance survey (G4 Stage) of Graphite in Majhiguda Block, Rayagada District, Odisha under NMEDT							
Total area - 127.11 Sq.km; Borehole - 8; Meterage - 800 m, Period of completion - 12 months, Review - After 6 months (after mapping, trenching and SP survey)							
SL.No	Item Of Work*	Unit*	Rate As Per NMEDT SOC 2025		Estimated Cost of the Proposal		Remarks
			SOC. Item No	Rate As Per revised SOC* (a)	Qty. (b)	Total Amount (Rs) (a*b)	
i	Charge for SP survey	Line km	3.3a	₹ 62,140.00	10	₹ 6,21,400.00	
ii	Charges for Geophysicist per day (HQ)	day	3.18	₹ 10,500.00	30	₹ 3,15,000.00	
<b>Sub Total- D</b>						<b>₹ 9,36,400.00</b>	
<b>E</b>	<b>Drilling (after review) (in-house)</b>						
i	Scout Drilling (Hard rock) (HQ) in first Level	per m	2.2.1.1d	₹ 10,000.00	800	₹ 80,00,000.00	
ii	Borehole deviation by multi shot camera	per m	2.2.5	₹ 330.00	133	₹ 44,000.00	Interval 6 m
iii	Land / Crop Compansation (in case the BH falls in agricultural Land)	per borehole	5.6	₹ 30,000.00	8	₹ 2,40,000.00	
iv	Construction of concrete Pillar (12"x12"x30")	per borehole	2.2.7	₹ 2,000.00	8	₹ 16,000.00	

Estimated Cost for Reconnaissance survey (G4 Stage) of Graphite in Majhiguda Block, Rayagada District, Odisha under NMEDT							
Total area - 127.11 Sq.km; Borehole - 8; Meterage - 800 m, Period of completion - 12 months, Review - After 6 months (after mapping, trenching and SP survey)							
SL.No	Item Of Work*	Unit*	Rate As Per NMEDT SOC 2025		Estimated Cost of the Proposal		Remarks
			SOC. Item No	Rate As Per revised SOC* (a)	Qty. (b)	Total Amount (Rs) (a*b)	
v	Miscellaneous charges (Transportation of drilling rigs, accomodation for drilling camp, camp setting and winding construction of approach road making and drill core preservation)	Lumpsum	2.2.9			₹ 15,00,000.00	For drilling cost more than 50 lakhs and less than 1 Cr, 20% of the drilling cost with a maximum ceiling of 15 lakhs
vi	Drill core preservation	per m	X	₹ 1,590.00	500	₹ 7,95,000.00	
vii	Charges for one Sampler per day (1 Party)	one sampler per day	1.2.1b	₹ 7,850.00	60	₹ 4,71,000.00	
viii	Charges for Labour	day	5.8	₹ 541.00	240	₹ 1,29,840.00	
<b>Sub Total- E</b>						<b>₹ 1,11,95,840.00</b>	

Estimated Cost for Reconnaissance survey (G4 Stage) of Graphite in Majhiguda Block, Rayagada District, Odisha under NMEDT							
Total area - 127.11 Sq.km; Borehole - 8; Meterage - 800 m, Period of completion - 12 months, Review - After 6 months (after mapping, trenching and SP survey)							
SL.No	Item Of Work*	Unit*	Rate As Per NMEDT SOC 2025		Estimated Cost of the Proposal		Remarks
			SOC. Item No	Rate As Per revised SOC* (a)	Qty. (b)	Total Amount (Rs) (a*b)	
<b>F</b>	<b>Laboratory Studies</b>						
<b>1</b>	<b>Chemical Analysis</b>						
<b>i)</b>	<b>Surface Samples+ Trench samples+ BH Core samples</b>						
a	Proximate analysis for graphite	Nos	4.1.18	₹ 3,614.00	700	₹ 25,29,800.00	BRS=50, Trench sample=200, BH Core sample=450
b	Proximate analysis for graphite (10% external check)	Nos	4.1.18	₹ 3,614.00	70	₹ 2,52,980.00	
c	Analysis of one rock/ soil sample for quantitative analysis of 14 REE elements+9 Trace elements (U, Ta, Ge, Be, Hf, Sn, As, Rb, Th) by ICP-MS (sequential technique)	Nos	4.1.15	₹ 7,400.00	40	₹ 2,96,000.00	Trench=20, BH Core sample=20
d	Analysis of one rock/ soil sample for quantitative analysis of 14 REE elements+9 Trace elements (U, Ta, Ge, Be, Hf, Sn,	Nos	4.1.15	₹ 7,400.00	4	₹ 29,600.00	

Estimated Cost for Reconnaissance survey (G4 Stage) of Graphite in Majhiguda Block, Rayagada District, Odisha under NMEDT							
Total area - 127.11 Sq.km; Borehole - 8; Meterage - 800 m, Period of completion - 12 months, Review - After 6 months (after mapping, trenching and SP survey)							
SL.No	Item Of Work*	Unit*	Rate As Per NMEDT SOC 2025		Estimated Cost of the Proposal		Remarks
			SOC. Item No	Rate As Per revised SOC* (a)	Qty. (b)	Total Amount (Rs) (a*b)	
	As, Rb, Th) by ICP-MS (10% external check)						
<b>2</b>	<b>Physical &amp; Petrological Studies</b>						
i	Preparation of polished thin section of rock	Nos	4.3.2	₹ 800.00	20	₹ 16,000.00	
ii	Complete petrographic/ ore microscopic study/ mineragraphic report of rock sample (along with 5 nos. digital photo micrograph)	Nos	4.3.4	₹ 2,800.00	20	₹ 56,000.00	
iii	Major oxides (WD XRF)- (oxides+traces-24 elements)	Nos	4.1.17a	₹ 4,200.00	20	₹ 84,000.00	
iv	Bulk density analysis	Nos	4.8.3	₹ 2,500.00	5	₹ 12,500.00	
v	Raman Spectroscopy	per hour	4.5.1	₹ 2,700.00	24	₹ 64,800.00	
	<b>Sub Total- F</b>					<b>₹ 33,41,680.00</b>	
<b>G</b>	<b>Total A to G</b>					<b>₹ 2,15,74,603.00</b>	

Estimated Cost for Reconnaissance survey (G4 Stage) of Graphite in Majhiguda Block, Rayagada District, Odisha under NMEDT							
Total area - 127.11 Sq.km; Borehole - 8; Meterage - 800 m, Period of completion - 12 months, Review - After 6 months (after mapping, trenching and SP survey)							
SL.No	Item Of Work*	Unit*	Rate As Per NMEDT SOC 2025		Estimated Cost of the Proposal		Remarks
			SOC. Item No	Rate As Per revised SOC* (a)	Qty. (b)	Total Amount (Rs) (a*b)	
H	Geological Report Preparation	5 Hard copies with soft copy	5.2		total cost of project exceeding 150 lakh	₹ 7,50,000.00	Reimbursement will be made after submission of the Final Geological Report in Hard Copies (5 Nos) and the soft copy to NMEDT.
I	Peer review Charges	As per EC decision		₹ 30,000.00	1	₹ 30,000.00	
J	Preparation of Exploration Proposal (5 Hard copies with a soft copy)	5 Hard copies with a soft copy	5.1	2% of the Cost or Rs. 5 Lakhs whichever is lower		₹ 5,00,000.00	EA will be reimbursed after submission of the Hard Copies and the soft copy of the final proposal along with Maps and Plan as suggested by the TCC-NMEDT in its meeting while clearing the proposal.

Estimated Cost for Reconnaissance survey (G4 Stage) of Graphite in Majhiguda Block, Rayagada District, Odisha under NMEDT							
Total area - 127.11 Sq.km; Borehole - 8; Meterage - 800 m, Period of completion - 12 months, Review - After 6 months (after mapping, trenching and SP survey)							
SL.No	Item Of Work*	Unit*	Rate As Per NMEDT SOC 2025		Estimated Cost of the Proposal		Remarks
			SOC. Item No	Rate As Per revised SOC* (a)	Qty. (b)	Total Amount (Rs) (a*b)	
K	3D Ore body modeling using compatible software	As per actual/ implementing agency to put the cost based on the market survey	5.4			₹ 8,00,000.00	
L	Total Estimated Cost without GST					₹ 2,36,54,603.00	
M	Provision for GST (18% of L)					₹ 42,57,828.54	GST will be reimbursed as per actual and as per notified prescribed rate
N	<b>Total Estimated Cost with GST</b>					<b>₹ 2,79,12,431.54</b>	
						<b>Rs. In Lakhs</b>	<b>₹ 279.12</b>

**8 List of Plates**

<b>Sl. No</b>	<b>Description</b>
I	Geological map of Majhiguda block on 1:50,000 scale
II	Geological map of Majhiguda block on 1:25,000 scale
III	Boundary of proposed block on toposheet number 65M/7

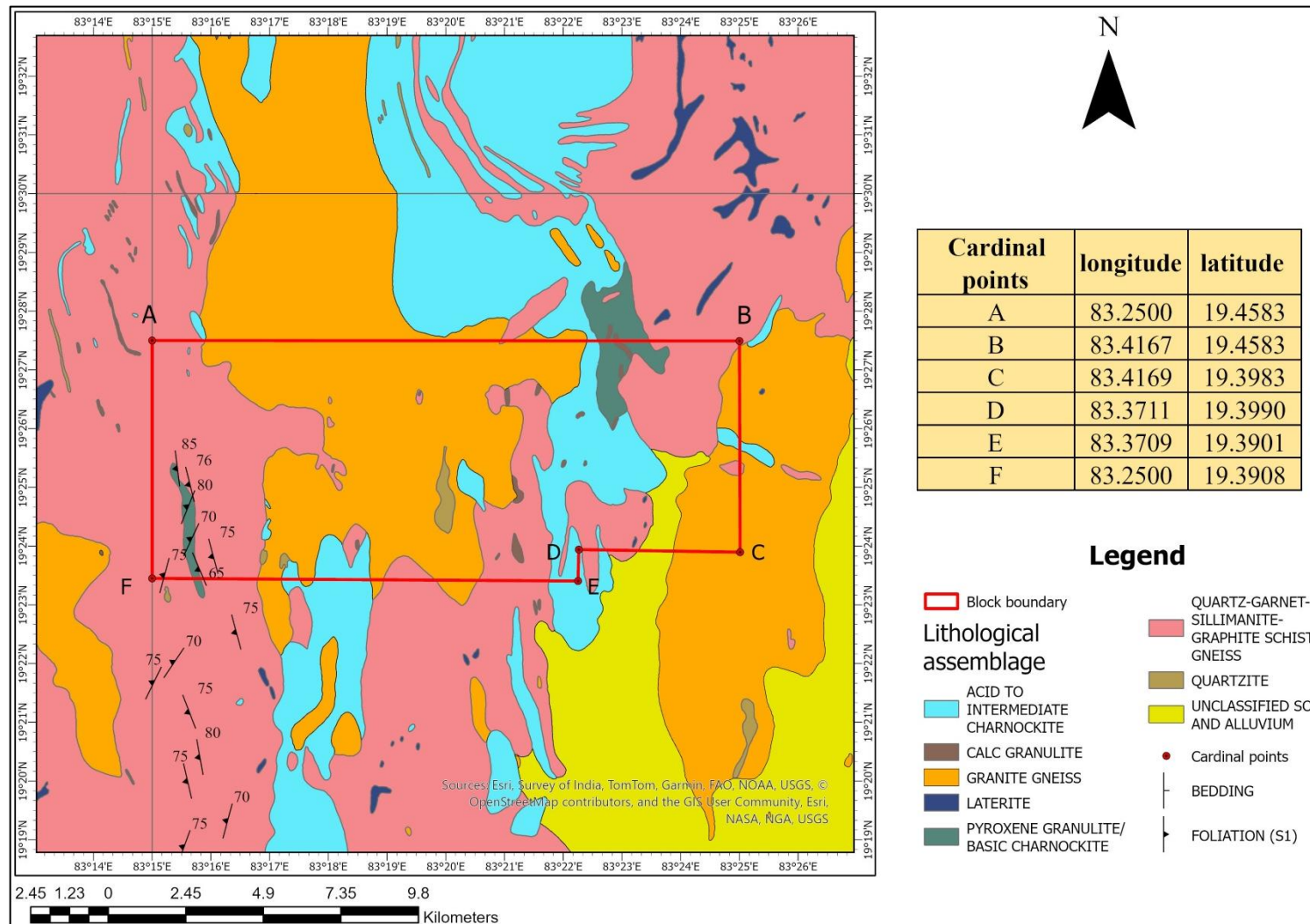
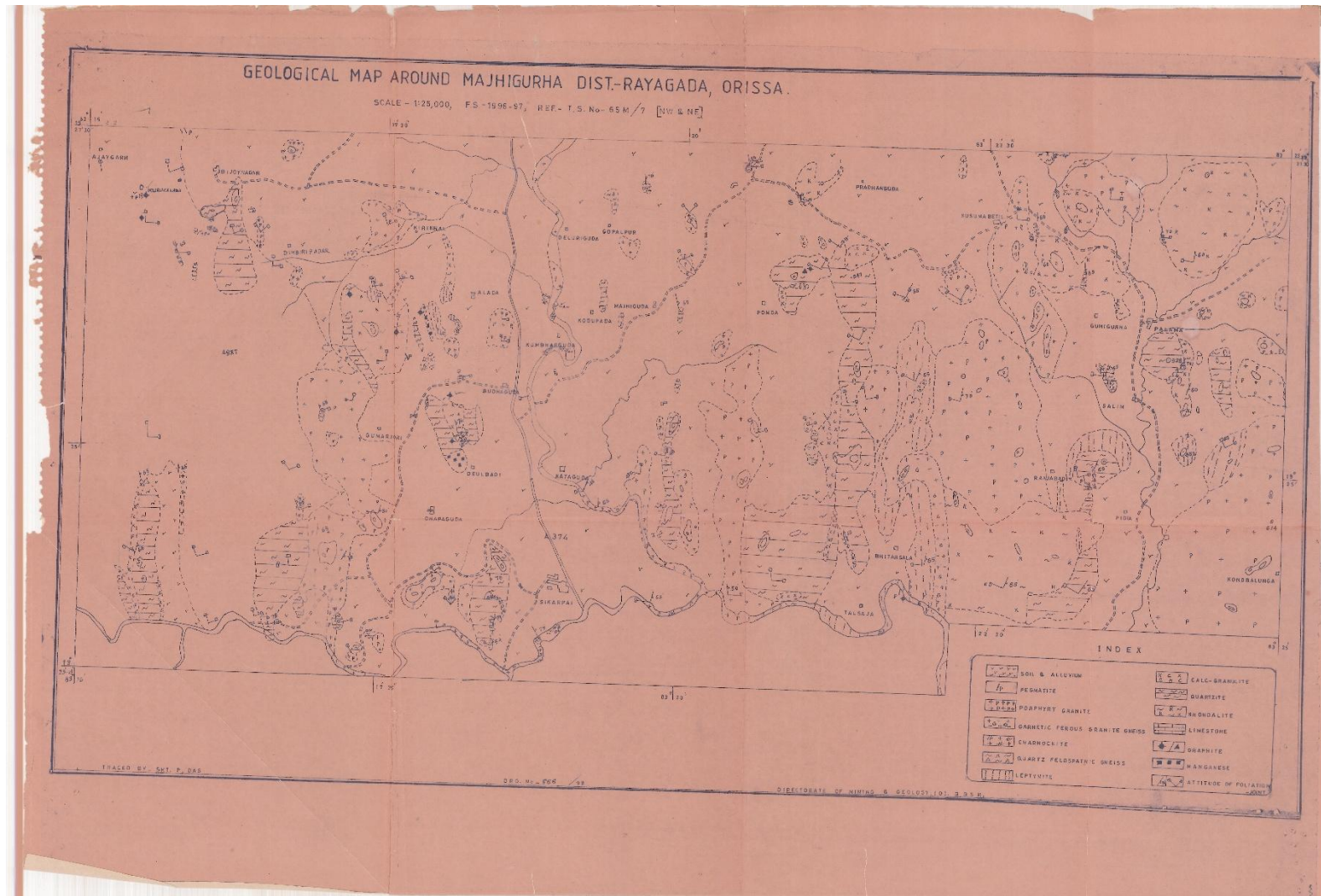


Fig 1: Geological map of Majhiguda block on 1:50,000 scale



**Fig 2: Geological map of Majhiguda block on 1:25,000 scale**

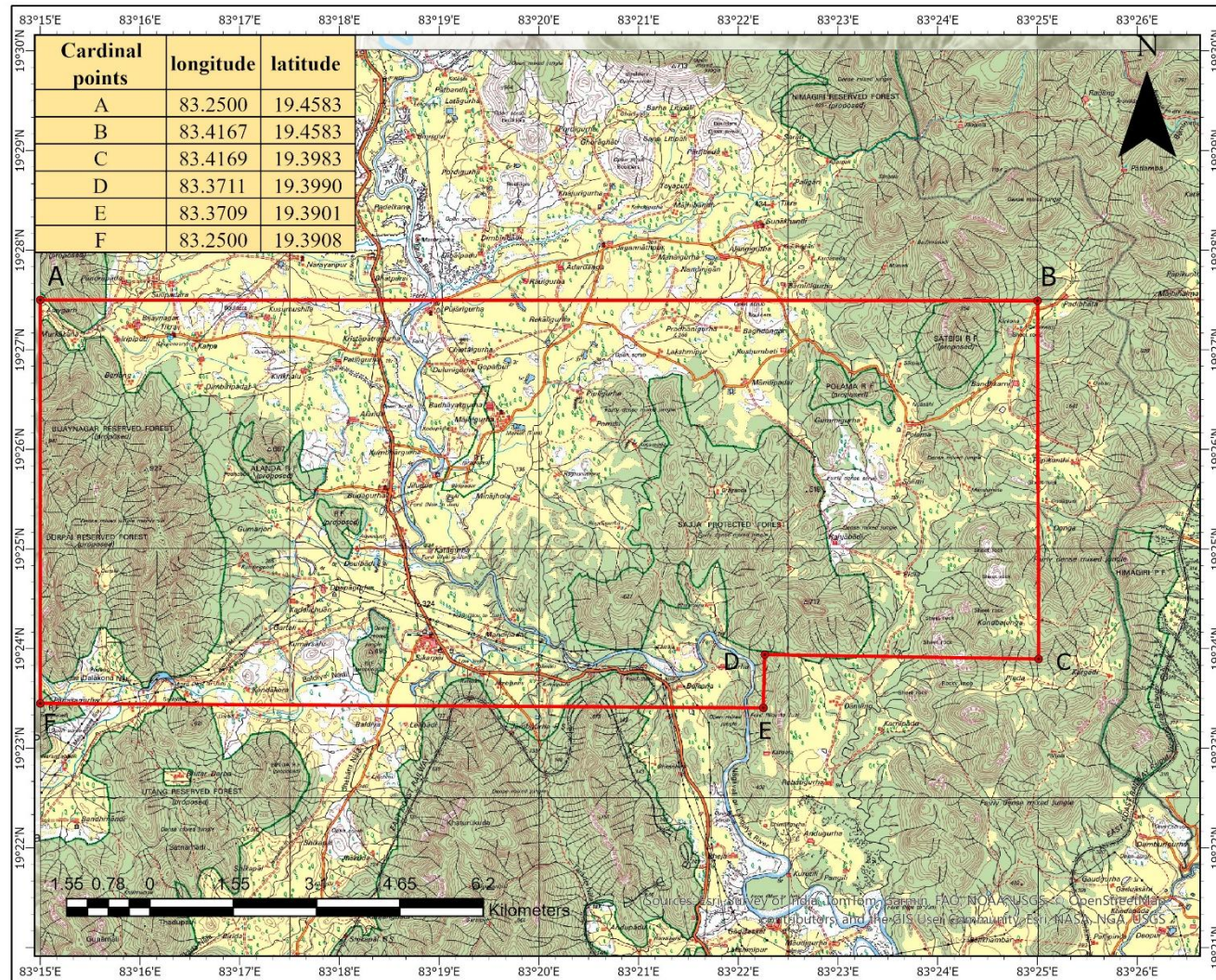


Fig 3: Boundary of the proposed block on SOI Toposheet No.:65M/7