# PROPOSAL FOR PRELIMINARY EXPLORATION (G-3)

# OF GRAPHITE IN CHORMUNDA BLOCK (9.60 SQ. KM AREA)

# DISTRICT- BALANGIR & NUAPARA, ODISHA

**COMMODITY: GRAPHITE**

**BY**

**MINERAL EXPLORATION AND CONSULTANCY LIMITED**

**DR. BABASAHAB AMBEDKAR BHAWAN**

**SEMINARY HILLS**

**NAGPUR (MH)**

**PLACE: NAGPUR**

**DATE: 15 May, 2024**

**Summary of the Block for Preliminary Exploration (G-3)**

| | Features | Details |
|---|---|---|
| | Block ID | **Chormunda Block** |
| | Exploration Agency | Mineral Exploration and Consultancy Limited (MECL) |
| | Commodity | **Graphite** |
| | Mineral Belt | Eastern Ghat Mobile Belt, Odisha |
| | Budget & Time schedule to complete the project | 2646.22 Lakhs & 13 months |
| | Objectives | The present exploration program (G3) has been formulated on the basis of the outcomes of previous work to fulfill the following objectives:<br>i. Geological mapping on 1:2000 scale to delineate graphite bands and other lithounits in the area.<br>ii. Topographical Contouring on 1:2000 scale, by means of surface contouring at 2 m interval.<br>iii. Delineation of the potential subsurface mineralized zones by Geophysical Surveys (Self Potential).<br>iv. Trenching will be carried out at suitable interval in the anomalous zone marked by geophysical survey to establish the continuity of the mineralization along strike direction, which is covered by soil.<br>v. After the positive outcomes of the above activities drilling will be carried out to intersect the graphite mineralization at 30m vertical depth with 400m strike interval.<br>vi. Assessment of quality and quantity of the resources (333) if any as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015. |
| | 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 | Work will be carried out by the proposed agency. |
| | Name/Number of Geoscientists | |
| | Expected Field days (Geology, Survey) | Geologist Party days: Field -150 days & HQ-45 days<br>Geophysicist Party days: Field -45 days & HQ-30 days |
| | | Survey Party days: 45 days (for Geophysical survey)<br>90 days (for Topographical survey) |
| | | Sampling Party days: 50 days |
| **1.** | **Location** | The proposed Chormunda Block lies in Patnagar and Nuapara Tehsil of Balangir and Nuapara District (Toposheet No: 64L/10), Odisha. Sulkimundi, Bhursipali, Babupaliand Chormunda villages fall in and around the proposed area. The State Highway-3 connecting Nuapara to |

<table>
<tr><td></td><td></td><td>Sohela passes about 7.0 km North of the block and the national highway 353 passes about 14 km east of the block. The district Headquarter Balangir and Bargarh is 90 km east and 135 km north-east of the block respectively. All the villages in the area are well connected to each other and to the highways by motorable roads and tracks. The nearest airport is at Raipur, which is about 155 km north-west of the block.</td></tr>
<tr><td></td><td>Latitude and Longitude</td><td>
<table>
<tr><th rowspan="2">POINT</th><th colspan="2">GCS (DMS)</th><th colspan="2">UTM Zone-44N (m)</th></tr>
<tr><th>LATITUDE</th><th>LONGITUDE</th><th>NORTHING</th><th>EASTING</th></tr>
<tr><td>A</td><td>20° 41' 46.33" N</td><td>82° 41' 56.549" E</td><td>2289453.49</td><td>676953.76</td></tr>
<tr><td>B</td><td>20° 41' 3.709" N</td><td>82° 42' 53.299" E</td><td>2288160.22</td><td>678609.78</td></tr>
<tr><td>C</td><td>20° 38' 33.03" N</td><td>82° 41' 59.887" E</td><td>2283510.40</td><td>677112.63</td></tr>
<tr><td>D</td><td>20° 38' 56.34" N</td><td>82° 41' 4.444" E</td><td>2284210.45</td><td>675500.29</td></tr>
</table>
</td></tr>
<tr><td></td><td>Villages</td><td>Sulkimundi, Bhursipali, Babupali and Chormunda villages</td></tr>
<tr><td></td><td>Tehsil/Taluk</td><td>Patnagar and Nuapara Tehsil</td></tr>
<tr><td></td><td>District</td><td>Balangir and Nuapara</td></tr>
<tr><td></td><td>State</td><td>Odisha</td></tr>
<tr><td>2.</td><td>Area (hectares/ square kilometres)</td><td></td></tr>
<tr><td></td><td>Block Area</td><td>9.60 sq.km</td></tr>
<tr><td></td><td>Forest Area</td><td>Mostly Non-Forest area.</td></tr>
<tr><td></td><td>Government Land Area (Bilanam)</td><td>Data not available</td></tr>
<tr><td></td><td>Charagaha</td><td>Data not available</td></tr>
<tr><td></td><td>Private Land Area</td><td>Data not available</td></tr>
<tr><td>3.</td><td>Accessibility</td><td></td></tr>
<tr><td></td><td>Nearest Rail Head</td><td>The nearest Railway Stations is at Nuapada (South Eastern Railway) which is 25 km west of the proposed block.</td></tr>
<tr><td></td><td>Road</td><td>The State Highway-3 connecting Nuapara to Sohela passes about 7.0 km North-west of the block and the national highway 353 passes about 14 km east of the block.</td></tr>
<tr><td></td><td>Airport</td><td>The nearest airport is at Raipur, which is about 155 km north-west of the block.</td></tr>
<tr><td>4.</td><td>Hydrography</td><td></td></tr>
<tr><td></td><td>Local Surface Drainage Pattern (Channels)</td><td>The area falls to the south western foothills of the Gandhamardan range and the adjacent pediplain of Bartia. There are several high points in the Gandhamardan range. The Ong River forms the main drainage fed by tributaries descending from the Gandhamardan range. The NW joints control the drainage pattern in this part. The northeastern part of the block comprises of ridges, having maximum elevation of 440 m. The average elevation of the block ranges between 320 m to 330 m.</td></tr>
<tr><td></td><td>Rivers/ Streams</td><td>Ong River and its tributaries</td></tr>
<tr><td>5.</td><td>Climate</td><td></td></tr>
<tr><td></td><td>Mean Annual</td><td>Average annual rainfall is 100 cm</td></tr>
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| | | |
|---|---|---|
| | Rainfall | |
| | Temperature | Minimum temperatures: 10°C (Dec-Feb),<br>Maximum temperatures: up to 46°C (March-June) |
| **6.** | **Topography** | |
| | Toposheet Number | 64L/10 |
| | Morphology of the Area | The area comprises of mostly gently undulating plane. The average elevation of the block is 330 m above MSL. Thick alluvium accumulated due to the network of drainage has helped the area to form cultivable land. |
| **7.** | **Availability of baseline geoscience data** | |
| | Geological Map (1:50K/25K) | Bhukosh Map (1:50000), Plate-II: Geological Map of area between Babupali-Khandijharan, GSI (1:63,360 scale) |
| | Geochemical Map | NGCM data available in Bhukosh |
| | Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps) | NGPM Gravity and Magnetic data available in Bhukosh,<br>Magnetic Anomaly Map in parts of Nuapada District, Odisha and Mahasamund and Gariabad District, Chattisgarh, F.S. 2015- 2016, GSI |
| **8.** | **Justification for taking up Preliminary Exploration** | i. Graphite occurrences in the Chormunda area have been established by GSI during the FS. 1979-80 and 1981-82, where a few small scale local mining has been observed within the block. The mineralizations to the strike extension of these quarries are unexplored. The present exploration will help to establish the lateral and vertical continuity of the mineralization.<br><br>ii. MECL has carried out preliminary field visit to the north of the block where graphite quarries were observed in the same geological setup. MECL collected few samples for graphite from the surface exposures which show 4.42% to 8.79% of FC. The proposed block falls in the southern extension of the area covered by MECL field visit having the same geological setup conducive for graphite mineralization.<br><br>iii. Based on the recommendations of 64thTCC NMET meeting the Proposal for Preliminary Exploration for graphite in Chormunda Block has been prepared. The committee members suggested that since GSI has carried out investigation for graphite in the block and a few local mining activities were also present, the block can be taken up for Preliminary Exploration. Based on the Block Geology Map and Regional Geology Map of the area, 64$^{th}$ TCC recommended extending the block further towards the north east and south west of the earlier Proposed Temrimal Block restricting the block area to khondalite/ migmatised khondalite, which is known to be potential for graphite mineralization. |

| | | |
|---|---|---|
| | | iv. During the field visit conducted by MECL the graphite mineralization observed on ground had a definite trend which was confirmed by the graphite quarries and few local mining activities located along the mineralized strike direction. The graphite occurrence on surface had been exhausted by mining and the graphite mineralization in the strike extension was covered by thick soil cover. Hence, exploration activities like geophysical survey and trenching will help to delineate the subsurface mineralized zone and augment the graphite resources in the proposed block.<br><br>v. GSI during the field season 1971-72 carried out detailed investigation of graphite deposit in Sargipalli-Bardhapalli Belt, Sambalpur and Bolangir District, Odisha.From the observations during the investigation and thick soil cover in the area, it was recommended that close spaced geophysical prospecting by SP and IP methods must be carried out to ascertain the strike extension of graphite deposits.<br><br>vi. GSI during the field season 1981-82 carried out investigation for graphite in Bolangir, Sambalpur and Kalahandi Districts of Odisha. A 25 km long zone between Temrimal and Khondajharan was recommended for detailed investigation as inspite of the low grade, the graphite bands are likely to be continuous over long strike extensions. Exploratory trenching, sampling, etc were suggested to establish the strike length.In soil covered areas to prove the depth extension of the geophysical survey followed by drilling was also recommended. This zone as described earlier holds promise for its strike continuity. The Geological Map of area between Babupali and Khandijharan (Plate-III, Source-GSI)as mapped by S.D. Mohanty F.S.1981-82, GSI shows the Graphite mineralized zone and the proposed block falls in the area which is potential for graphite mineraliation.<br><br>vii. At present graphite is a critical mineral for the nation. The previous exploration in the surrounding area has established occurrences of graphite. Hence, the Preliminary Exploration (G-3) will help to establish the vertical and lateral extension of graphite in the current block, which will definitely augment the graphite resource and make the block feasible for auction. |

# PROPOSAL FOR PRELIMINARY EXPLORATION (G-3)
# OF GRAPHITE IN CHORMUNDA BLOCK (9.60 SQ. KM AREA)
# DISTRICT- BARGARH AND NUAPARA, ODISHA

## 1.0.0 INTRODUCTION

1.1.0 Worldwide demand for graphite is expected to rise with the development of non-carbon energy applications such as batteries used in electric vehicles, electric devices and energy storage devices that use graphite. Such emerging & high growth applications of graphite are certainly causing noticeable impacts on the demand & consumption patterns within the country & globally as well. Demand for graphite in lithium-ion batteries for application in electric/hybrid vehicles, laptops, smart phones, home/business applications and traditional uses for expanded graphite foils, are the potential areas that are expected to be major drivers in the market. It represents 23% of global flake graphite demand.

1.2.0 The world resources of graphite are believed to exceed 800 million tonnes of recoverable graphite. However, world reserves of graphite have been placed at 320 million tonnes of which Turkey accounts for 28% followed by China (23%), Brazil (22%), Madagascar & Mozambique (8% each), Tanzania 5%, India &Uzbekisthan (2% each) and Mexico & Dem. P. R. of Korea ( 1% each). (IBM, Mineral Year Book-2021).

1.3.0 World graphite production has fluctuated slightly in recent years. In 2022, the total worldwide production of graphite amounted to 1.3 million metric tons, an increase from the 1.13 million metric tons produced in the previous year. In the past decade, China has consistently been the leading global graphite producer. In 2022, China produced an estimated 850,000 metric tons of graphite. Following China, was Mozambique in a distant second place, with a production volume estimated at 170,000 metric tons that year. India ranks 10th position in the top graphite producing countries.

1.4.0 Graphite occurrences are reported from various States but the deposits of economic importance are located in Arunachal Pradesh, Chhattisgarh, Jharkhand, Odisha and Tamil Nadu. Arunachal Pradesh accounts for 36% of the total resources which is followed by Jammu & Kashmir (29%), Jharkhand (9%) Madhya Pradesh (5%) Odisha (9%), and Tamil Nadu (4%). However, in terms of reserves, Tamil Nadu has the leading share of about 36% followed by Jharkhand (30%) and Odisha (33%) of the total reserves (Mineral Year Book-2021). The graphite reserves having +40% Fixed Carbon is rather limited in the country. In view of this, detailed exploration of graphite deposits in Odisha, Jharkhand, Jammu & Kashmir and Kerala should be carried out.

1.5.0 The Mininstry of Mines has recently listed out 30 critical minerals that are essential for economic development and national security, graphite is one of them. The use of

digital technologies depends on minerals such as lithium, graphite, cobalt, titanium and rare earth elements. Graphite is mainly required in clean technology industries having major application in Batteries, Lubricants, fuel cells for EVs, Electric Vehicle. Based on the Report on Critical minerals for India, June 2023 India has 9 million tones of graphite reserve (Production reported from 12 mines). The net import reliance for graphite in India is 60% which is mostly imported from China, Madagascar, Mozambique, Vietnam and Tanzania. Graphite has been categorized as a mineral having high economic importance and well as high supply risk. To meet the demand new area suitable for graphite mineralization needs to be explored. The proposed block is an attempt for the search of graphite.

**1.2.0 BACKGROUND**

1.2.1 In view of the enactment of the MMDR Amendment Act, 2015 and Mineral Auction Rule, 2015 by the Govt. of India, the State administration of Odisha desired that some mineral prospects of the State be explored on priority basis through National Mineral Exploration Trust (NMET) fund so that those could be auctioned and thereby earn revenue for the state along with the augmentation of reserve and resource of the country. Graphite occurrences in Balangir district in Odisha are among them.

1.2.2 The proposed block is a cluster of 10A 2(b) leases/ taken over leases selected for further exploration by the State Technical Committee (JWG) on 06.02.2023. State government allotted the blocks to MECL for necessary actions. MECL has carried out preliminary field visit to the north of the block where graphite quarries were observed. MECL collected few samples for graphite from the surface exposures which show 4.42% to 8.79% FC. The proposed block falls in the southern extension of the area covered by MECL field visit having the same geological setup conducive for graphite mineralization.

1.2.3 The proposal for Temrimal Block at Reconnaissance Survey over an extent of 57.30 sq km was discussed in 64$^{th}$TCC NMET meeting held on 29$^{th}$ April 2024.The committee members suggested that since GSI has carried out investigation for graphite in the block and previous mining leases were also present, the block can be taken up for Preliminary Exploration. It was also suggested that since GSI has carried out Geophysical survey in the area, the same map can be obtained from GSI Data Repository and incorporated in the proposal. However, only magnetic survey data in 500 to 1 km grid interval has been received from GSI. Based on the Block Geology Map and Regional Geology Map of the area, TCC also recommended extending the block further towards the north east and south west of the earlier Proposed Temrimal Block and restricting the block area to khondalite / migmatised khondalite, which is known to be potential for graphite mineralization.

1.2.4 In light of preliminary field visit and TCC NMET suggestions, the Proposal for Preliminary Exploration for graphite in Chormunda Block over an extent of 9.60 sq km is prepared and submitted for discussion. The details of the proposal are described in the following paragraphs.

**2.1.0 LOCATION AND ACCESSIBILITY**

2.1.1 The proposed Chormunda Block comprises of 9.60sq km area and lies in Patnagar and Nuapara Tehsil of Balangir and Nuapara District (Toposheet No: 64L/10), Odisha. Sulkimundi, Bhursipali, Babupali and Chormunda villages fall within the proposed area. The State Highway-3 connecting Nuapara to Sohela passes about 7.0 km North-west of the block and the national highway 353 passes about 14 km east of the block. The district Headquarter Balangir and Nuapara is 90 km east and 20 km north-east of the block respectively. All the villages in the area are well connected to each other and to the highways by motorable roads and tracks. The nearest Railway Stations is at Nuapada (South Eastern Railway) which is 25 km west of the proposed block. The nearest airport is at Raipur, which is about 155 km north-west of the block.The block proposed is bounded by latitude 20° 38' 33" N to 20° 41' 47" N and longitude 82° 41' 4" E to 82° 42' 53" E (Plate No I).

**Table 2.1**

**Coordinates of Corner Points of Proposed Chormunda Block, Balangir and Nuapara District, Odisha**

| POINT | GCS (DMS) | | UTM Zone-44N (m) | |
|---|---|---|---|---|
| | LATITUDE | LONGITUDE | NORTHING | EASTING |
| A | 20° 41' 46.33" N | 82° 41' 56.549" E | 2289453.49 | 676953.76 |
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| D | 20° 38' 56.34" N | 82° 41' 4.444" E | 2284210.45 | 675500.29 |

**2.2.0 PHYSIOGRAPHY AND DRAINAGE**

2.2.1 The area falls to the south western foothills of the Gandhamardan range and the adjacent pediplain of Bartia. There are several high points in the Gandhamardan range. The Ong River forms the main drainage fed by tributaries descending from the Gandhamardan range. The NW joints control the drainage pattern in this part.The northwestern part of the block comprises of ridges, having maximum elevation of 450 m. The average elevation of the block ranges between 320 m to 330 m.

**2.3.0 CLIMATE**

2.3.1 The area has a sub-tropical climate with torrential rainfall between June and September. The temperature ranges between $10^0$ C in winter and $46^0$ C in summer season and the average annual rainfall is around 100 cm. This part of Odisha is very

hot in summer with occasional extreme hotness in comparison to other parts of the state.

**2.4.0 FLORA AND FAUNA**

2.4.1 The areas under exploration are sparse to densely vegetate. The floral assemblage includes Sal (Shorearobusta), Shishu (Dalbergialatifolia), Neem (Nekuaindica), Tamarind (Tamarindusindica), Jackfruit (Autocarpusintergrifolia), Kendu (Diaspyrosmelanxylon), Mango, Amla, Harida, Bahada, Boula, Simili, Berries and Bel etc. Wild animals are scarcely observed in this area. The faunal assemblages include bears, rabbits, snakes, wild boars, jackals, peacocks, wild hens and host of birds.

**3.1.0 REGIONAL GEOLOGY**

3.1.1 The exploration area lies in the northern part of the Eastern Ghat Super Group of rocks belonging to the meta-sedimentary sequence of Precambrian khondalite. The sequence of para-metamorphic is made up of pelitic, psammitic and calcareous formations, which are represented by khondalite, quartzite and calc-silicate rocks. These have been intruded by granites. All the hill ranges in this area are composed of either khondalite or garnetiferous quartzite or both. Calc-silicate bands adjoining to the ore horizons form denudational hillocks or mounds and are 1 to 2m thick. Granite gneiss occupies the valleys. The whole sequence has been metamorphosed to granulite facies. Structurally the area exhibits a complex picture.

3.1.2 On the basis of contact relationship, presence of xenoliths/caught up patches of one particular unit within the other & structural and stratigraphical relationship, the tentative stratigraphic succession of the area (After GSI)may be given as follows:

**Table: 3.1**

**Regional Stratigraphic succession (After GSI)**

| Age | Formation | Lithology |
|---|---|---|
| **Quaternary** | - | Alluvium, soil and latsol |
| **Tertiary** | - | Laterite |
| **Precambrian (Eastern GhatSupergroup)** | - | Aplite, Pegmatite and Quartz veins |
| | **Granitoids** | Equigranular, non-garnetiferous granite gneiss, garneti-ferous granite gneiss and granulite, |
| | **Charnockite Suite** | Hypersthene bearing gneisses and granulites (mostly acid to intermediate charnockitic type) |
| | **Khondalite Suite** | Pyroxene granulite, quartzite, Khondalite with manganiferous horizons |
| **Base Not Seen** | | |

### 3.2.0 GEOLOGY OF THE BLOCK

3.2.1 The proposed area is mainly covered by Granite Gneiss, Migmatite, Charnokites, Calc Granulite and Khondalite of Eastern Ghat Super Group. The details of lithologies present in the block are described in the successive paragraphs. The generalized stratigraphy of the proposed area (After GSI) is given in **Table No 3.2.**

**Table No 3.2**
**Geology of the Block (After GSI)**

| AGE | SUPERGROUP | FORMATION | LTHOLOGY |
|---|---|---|---|
| | | | Alluvium and soil<br>Pegmatite and quartz veins<br>Granite gneiss, Migmatites |
| **Archaean** | **Eastern GhatSupergroup** | Charnockite Formation | Charnockite |
| | | Khondalie Formation | Khondalite, calc-granulites<br>Garnetiferous quartzite |

3.2.1.1 **Khondalite:** Quartz-garnet-sillimanite gneisses and schists (with or without graphite), garnetiferous quartzite and calc-granulite constitute this formation.The quartz rich variants of the khondalites are resistant to erosion and stand out asconical hills, ridges with thick vegetation in the Gandhamardan Range.The schists and gneisses of the khondalite formation are grayish brownish in colour, medium grained and contains quartz, garnet, sillimanite with or without graphite and a little biotite.The sillimanite needles are arranged in a linear fashion imparting schistosity. Garnet is limonitised along cracks. Biotite forms after the garnet. Graphite flakes, when present, are normally arranged parallel or sub-parallel to schistosity.

3.2.1.2 **Calc-granulite:** It is a medium grained rock, greenish white in colour, The mineral assemblage are diopside, scapolite, quartz, calcitewith a little feldspar. In some cases presence of garnet is noted in minor amounts.

3.2.1.3 **Garnetiferous quartzite:**Quartzite is a medium grained greyish coloured rock and is mainly composed of quartz and garnet with a little biotite and graphite. Sometimes a few sillimanite needles are present.

3.2.1.3 **Charnokite:** The rock is mesocratic and contains quartz, feldspar and biotite. It is coarse grained granulitic rock consisting of hypersthene, orthoclase, microcline, granular quartz and a little biotite.

3.2.1.4 **Migmatite:** The khondalitic rocks are extensively migmatised. The migmatite is a leucocratic, medium grained rock showing stromatic type of structure displayed by alternating bands of palaeosomes and neosomes. The mineral constituents in the rock are quartz, feldspar, sillimanite, biotite, garnet and at places graphite.

3.2.1.5 **Granite gneiss:** The granite gneiss is of two types i.e. garnetiferous granite gneiss and porphyroblasticgarnetiferous granite gneiss. The nonporphyroblastic type is the older as evidenced by xenoliths of this rock found in porphyroblastic granite gneiss. Bands of this rocks are concordant with migmatisedkhondalite. The porphyroblasticgarnetiferous granite gneiss is the most predominant and occupies extensive areas. The rock is very coarse grained with porphyroblasts of feldspar in a groundmass of quartz, feldspar, garnet.

3.2.1.6 **Pegmatite and quartz veins:** Pegmatite and quartz veins are very common within the migmatite zone. Most of the veins are aligned parallel to the foliation of the migmatite host rock. Three combination of minerals are noted in the pegmatite i) quartz and feldspar, ii) quartz-feldspar-muscovite-biotite, iii) feldspar, quartz-biotite-tourmaline. Quartz veins of variable thickness occupy the joint planes. Sometimes it contains graphite flakes and clots.

3.2.2 **STRUCTURE**: Well developed foliation due to parallel arrangement of sillimanite needles, graphite and biotite flakes is displayed by the rocks of the khondalite formation. Banding displayed by concentration of garnet quartzo-feldspathic matters is prominent in the gneissic variety of the khondalites. In the non-porphyroblastic granite gneiss, flattened quartz and biotite rich bands impart the gneissosity. An indistinct gneissosity is observed in porphyroblastic granite gneiss by a rough alignment of feldspar porphyroblasts.

The strike of foliation is dominantly NE-SW to ENE-WSW with steep south easterly dips. The general steep dip (65° to 85°) of foliation is a common feature in the whole area.

3.2.3 **MINERALIZATION:** The graphite deposit of the area fall in the Sargipali graphite belt. Most of the deposits are under soil cover. Quarrying was started from the outcrops that were available. Graphite in a disseminated form is noted mostly in khondalite and less commonly in quartzite and granite gneisses in the areas. The graphite in khondalite constitutes 1 to 2% of the khondalite rocks and the parallel arrangement of the graphite flakes defines the foliation of khondalites. At places, the graphite concentration in migmatisedkhondalites increases sufficiently in bands which become economically exploitable. These bands might have long strike continuity (more than 100m) and low grade varying from 5% to 10% F.C. Other important form of graphite bodies are the lensoid and vein types. These bodies are smaller but the grade is normally higher (more than 30% F.C.). Generally, these bodies contain lumpy

graphite. Graphites of least significance occur as clots, pockets in pegmatite/quartz veins. The gangue minerals associated with graphite bodies are quartz, feldspar, garnet, sillimanite, biotite, calcite and sericite.

In Suklimuri, an outcrop of high grade graphite vein hosted by non-porphyroblastic granite gneiss containing kaolinised feldspar with migmatised khondalite on the hanging wall side was observed in a cultivated land. It was 16 cm thick with N40° E-S40°W strike and 45° dip. It was reported to have swelled to 65 cm thickness at a depth of 5m as noted in a nearby pit.

In the Bhursipalli village area trench exposed an 87 cm wide graphite band having a 7 cm high grade portion in the middle.

In the Babupali area, 3 small pits were observed where graphite mineralization was observed to be fracture filling veinlets and disseminated graphite flakes in pegmatites. Geophysical investigation in soil covered areas may be undertaken to delineate graphite bearing zones followed by drilling to prove depth extension of graphite mineraization.

**3.3.0 PREVIOUS WORK AND RECOMMENDATION**

3.3.1 Chakrabarti P. during the field season 1971-72 carried out detailed investigation of graphite deposit in Sargipalli-Bardhapalli Belt, Sambalpur and Bolangir District, Odisha. The major graphite deposits in the Sargipalli-Bardhapalli Graphite Belt were restricted to the narrow zones of leptynites. The economically workable graphite bodies were observed to be associated with pegmatites and appear to be hydrothermal in origin. The detailed surface mapping revealed that the local mining activities had exhausted almost all the surface shows of graphite, thus no new graphite deposits can be seen on surface. It was recommended to carry out close spaced geophysical prospecting by SP and IP methods along the leptinite zones and strike extension of graphite deposits.

3.3.2 Mohanty, S.D. and Joshi O.P. during the field season 1978-79 carried out investigation for graphite in Bolangir, Sambalpur and Kalahandi Districts, Odisha. 123 sq km area was mapped in 1:63,360 scale, out of which 33 sq km area was mapped in 1:15,840 scale, 11.25 cubic meter of test pitting was carried out and four quarries were examined. Graphite bands, veins and lenses were observed confined to linear zones within migmatised khondalite. In the Chormunda area, a 1.7m long graphite rich vein was exposed within the host rock migmatised khondalite having N25°E-S25°W strike and 65° easterly dip which becomes 35°at depth. The graphite produced from the quarry was mainly of lumpy type. In the southern extension of the quarry, graphite clots were observed in the soil, the apparent continuity of the graphite was estimated to be another 50m without any sign of narrowings along the strike. About 0.3km away from the Chormunda quarry, a 25 m thick graphite vein was exposed in a water channel dug by the villagers. About 400m east of Suklimuri, a

quarry was reported to have existed in the past. All these-indicate that this zone is likely to have potential deposits below the soil cover. Flaky to lumpy graphite with average FC between 7% with 24600 tonnes of graphite was estimated in 4 quarries in the entire area. Thick soil cover was observed in the graphite bearing areas, thus geophysical methods to probe concealed bodies in probable graphite bearing zones were recommended. Regional evaluation of the graphite resources, detailed geological mapping, exploratory excavation and sampling in selected zones to assess additional resource was recommended.

3.3.3 Mohanty S.D. during the field season 1981-82 carried out investigation for graphite in Bolangir, Sambalpur and Kalahandi Districts, Odisha.Reconnaissance study of 665 sq km area, 56.65 cubic meter pitting and trenching and collection of 28 channel samples were carried out. Graphite bands, veins and lenses occur mostly parallel to the foliation within the migmatisedkhondalite. The graphite bands have lower fixed carbon content but considerable depth and strike extension. A reserve of 57415 tonnes in possible category with 5.93% to 7.25% FC was estimated. In the Babupali-Chormunda area graphite mineralization was traced over 5 km in NE-SW direction to the strike continuity of Temrimal possibly separated by soil cover. In Suklimuri, an outcrop of high grade graphite vein hosted by non-porphyroblastic granite gneiss containing kaolinised feldspar with migmatised khondalite on the hanging wall side was observed in a cultivated land. It was 16 cm thick with N40° E-S40°W strike and 45° dip. It was reported to have swelled to 65 cm thickness at a depth of 5m as noted in a nearby pit. In the Bhursipalli village area trench exposed an 87 cm wide graphite band having a 7 cm high grade portion in the middle. In the Babupali area, 3 small pits were observed where graphite mineralization was observed to be fracture filling veinlets and disseminated graphite flakes in pegmatites. Geophysical investigation in soil covered areas may be undertaken to delineate graphite bearing zones followed by drilling to prove depth extension of graphite mineraization.

3.3.4 Satapathy U.N. during the field season 1987-88 carried out Photogeological Studies on the assessment of graphite resources in Titlagarh- Sargipalli Belts in parts of Bolangir and Sambalpur Districts, Odisha. An area of 2100 sq km was covered with the aid of aerial photographs on 1:60,000 (approx) scale. It was observed that the structure and migmatisation majorly controls the graphite localization. Three graphite bearing zones were demarcated in the area by the photo geological studies. The proposed block falls in southern part of Zone-1. The zone-1 is a 28 km. long and 6km. wide area between Rengali in the southwest and Thutibhata in the northeast which seems to be promising with a number of graphite mines. Further geological and geophysical survey was recommended to be carried out in the area. The proposed Chormunda Block falls 8 km south west of Zone-1.

3.3.5 Kameswara Rao G., Kapoor K.N., Kundu H.K., during the field season 1987-88 carried out geophysical investigation for regional assessment of graphite resources in parts of Bolangir, Sambalpur and Kalahandi Districts, Odisha. Integrated geophysical surveys employing SP, EM and resistivity methods over the anomalous zones indicate that the mineralisation is of sporadic nature and hence are not of much economic importance for exploration. The SP survey helped to delineate 9 SP anomaly centers varying between -50 to -220 mV in the area. Out of these 9 anomaly zones, 2 zones around the Gandhamardan hill range were suggested for test drilling to study the mature of the causative body. The SP survey Maps of the area are not available with GSI.

3.3.6 Mukherjee R., Roy S.K., Agarwal R. during the field season 2015- 2016 carried out geophysical mapping in parts of Nuapada District, Odisha and Mahasamund and Gariabad District, Chattisgarh. The work was carried out in toposheet no 64L/05, 06, 10 and 64K/12 to delineate the subsurface structure and the geology of the area using the Gravity and Magnetic methods maintaining grid interval of 2.5 sq km. Several litho contacts, structural features and intrusions were identified. It was recommended that detailed gravity and magnetic mapping of the areas marked by rectangles should be taken up to delineate of high gravity and magnetic zones.

## 4.0.0 OBJECTIVE OF THE PROPOSED PRELIMINARY EXPLORATION (G-3 STAGE):

4.1.0 The present exploration program (G3) has been formulated on the basis of the outcomes of previous work to fulfill the following objectives:

i. Geological mapping on 1:2000 scale to delineate graphite bands and other lithounits in the area.
ii. Topographical Contouring on 1:2000 scale, by means of surface contouring at 2 m interval.
iii. Delineation of the potential subsurface mineralized zones by Geophysical Surveys (Self Potential).
iv. Trenching will be carried out at suitable interval in the anomalous zone marked by geophysical survey to establish the continuity of the mineralization along strike direction, which is covered by soil.
v. After the positive outcomes of the above activities drilling will be carried out to intersect the graphite mineralization at 30m vertical depth with 400m strike interval.
vi. Assessment of quality and quantity of the resources (333) if any as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.

## 5.0.0 PLANNED METHODOLOGY

5.0.1 In accordance to the objective set for Preliminary Exploration (G-3) of the block, the exploration programme is proposed. The Exploration shall be carried out as per Minerals (Evidence of Mineral Contents) Rule-2015. Accordingly, the following scheme of exploration is formulated in order to achieve the objectives. The details of different activities to be carried out are presented in subsequent paragraphs.

## 5.1.0 GEOLOGICAL MAPPING

5.1.1 Geological mapping will be carried out in the 9.60 sq.km area on 1:2,000 scale. Rock types, their contact, structural features will be mapped. Surface manifestations of the graphite mineralisation along with their surface disposition will be marked on map. 10 numbers of surface samples of various lithounits will be studied for petrology and minerography.

## 5.2.0 GROUND GEOPHYSICAL SURVEY:

5.3.1 Ground Geophysical Self Potential Survey would be carried out in the proposed block to delineate the target mineralization. The survey will be planned in a grid pattern of 100m traverse interval across the trend of mineralization. A total of tentative 30 Line Km SP survey is planned to delineate the subsurface mineralized graphite zones. The tentative geophysical plan attached below is prepared based on the graphite mineralization observed during field visit and possible mineralized graphite zones marked by GSI. The area which is already mined out for graphite has not been included in the Self Potential Survey Plan. Therefore a total of 3.5 sq km is proposed for Self Potential geophysical survey out of 9.60 sq km area.

## 5.4.0 TRENCHING

5.4.1 13 trenches (400 cubic m) have been proposed in the area to ascertain the continuity of graphite mineralization identified during the geophysical survey. A mineralized length of maximum 10 m, is estimated to be intersected in the trenches. The maximum numbers of samples collected from each trench is 15 including the mineralized zone, hanging wall and footwall. A total of 195 Nos of primary would be collected from 10 trenches & 10% of Primary samples i.e. 19 samples will be sent to NABL External Labs for proximate analysis of graphite (i.e. Fixed Carbon (FC), Ash (A), Moisture (M) and Volatile Matter (VM)).

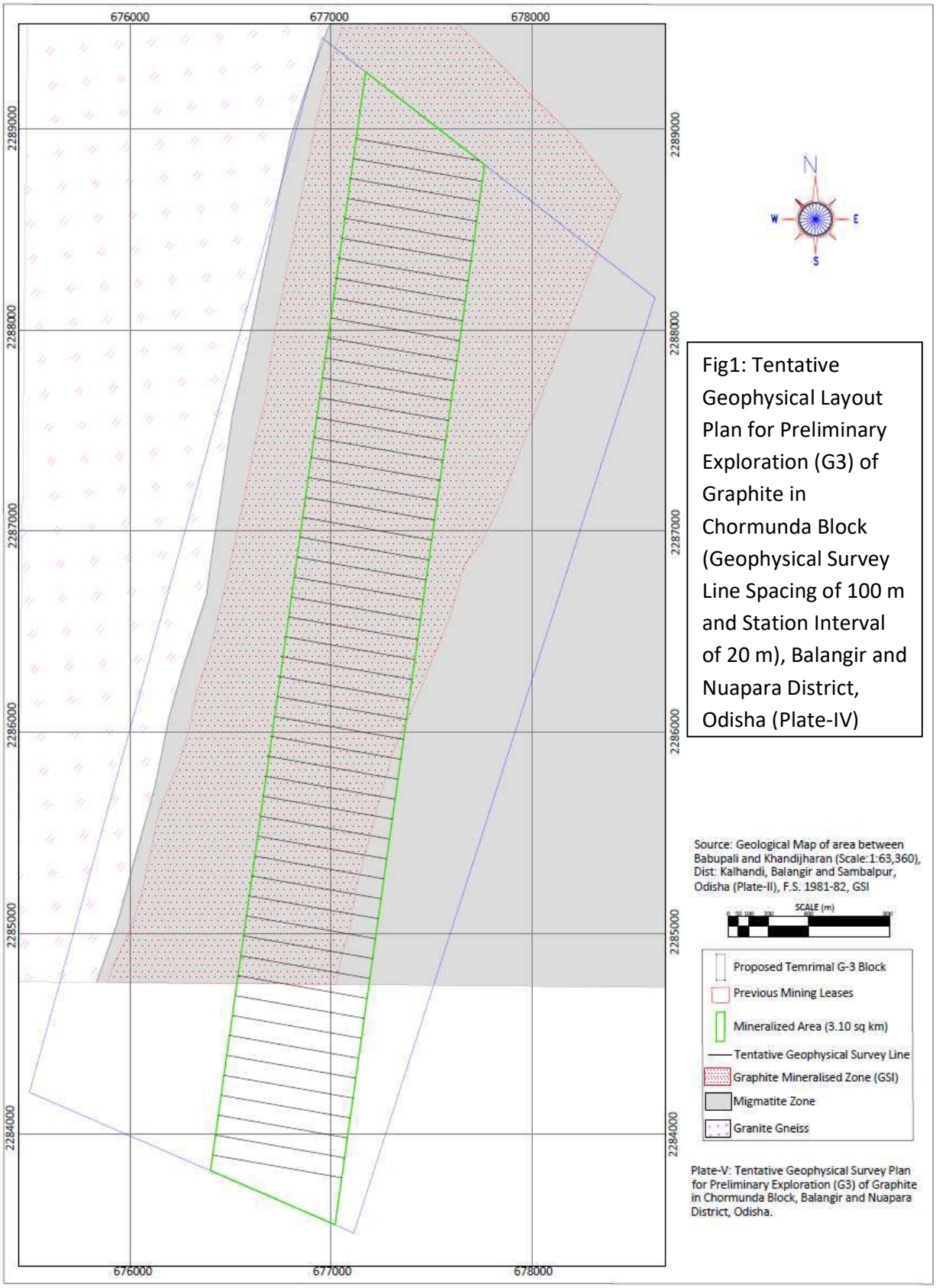



Fig1: Tentative Geophysical Layout Plan for Preliminary Exploration (G3) of Graphite in Chormunda Block (Geophysical Survey Line Spacing of 100 m and Station Interval of 20 m), Balangir and Nuapara District, Odisha (Plate-IV)

Plate-V: Tentative Geophysical Survey Plan for Preliminary Exploration (G3) of Graphite in Chormunda Block, Balangir and Nuapara District, Odisha.

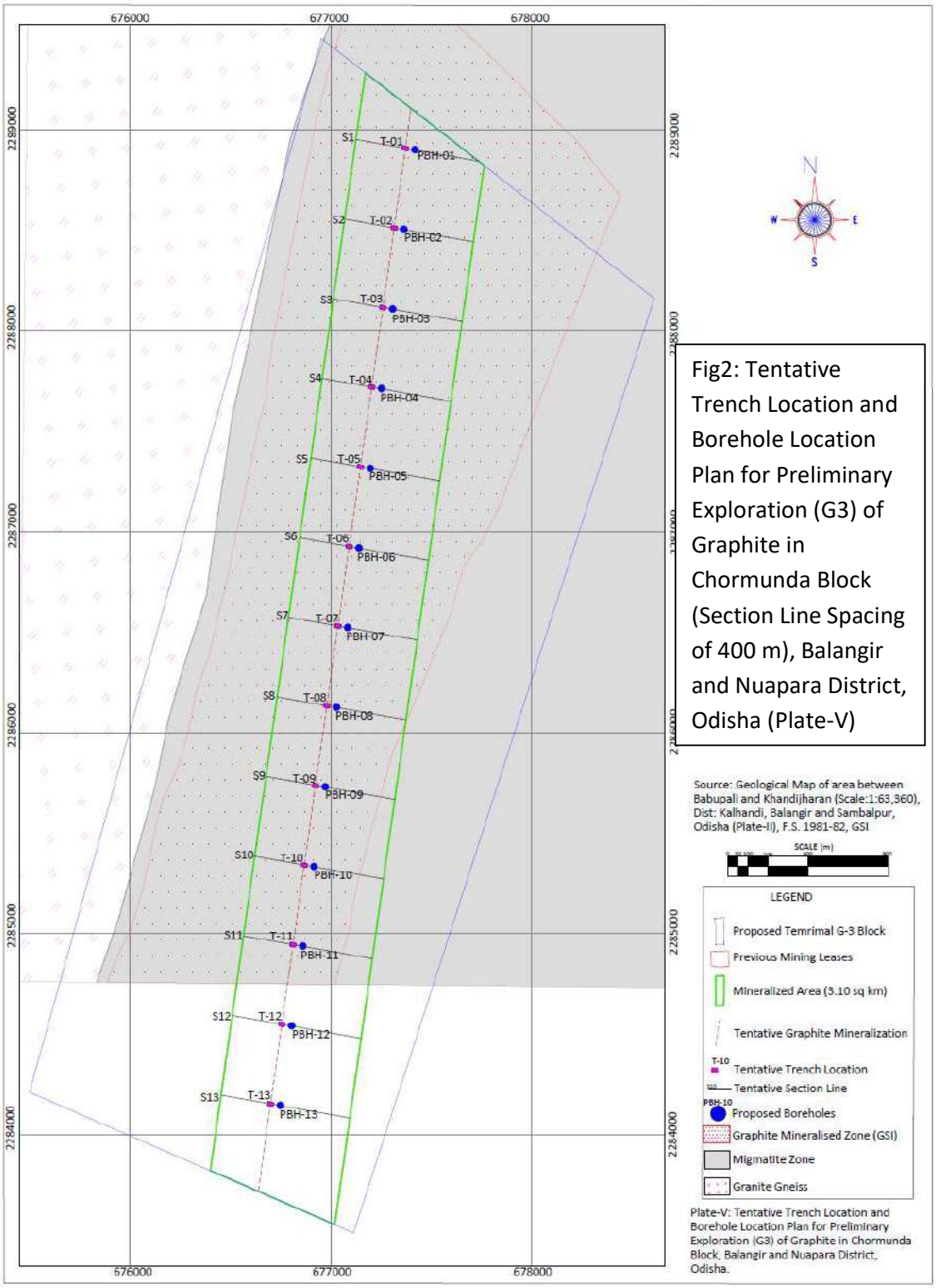
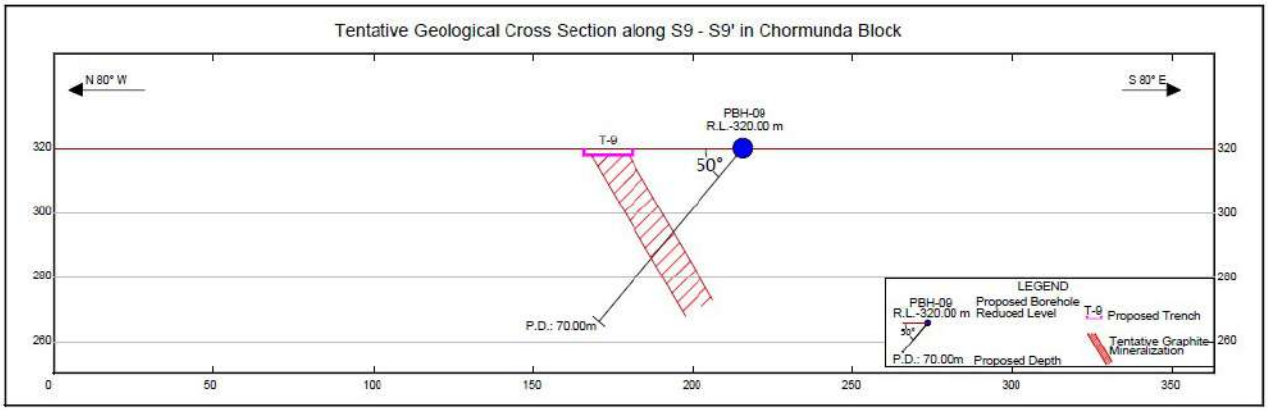



Fig2: Tentative Trench Location and Borehole Location Plan for Preliminary Exploration (G3) of Graphite in Chormunda Block (Section Line Spacing of 400 m), Balangir and Nuapara District, Odisha (Plate-V)

## 5.5.0 EXPLORATORY DRILLING

5.5.1 Based on the positive outcomes of geophysical survey and trenching, boreholes will be planned to establish subsurface continuity of mineralization. 13 nos of boreholes have been planned at 400 m strike interval to intersect the graphite mineralization at 30 m vertical depth from the surface. The total depth of each borehole is estimated to be 60 m approx and the estimated mineralization to be intersected in each borehole is 10 m. 15 nos of samples from each borehole (mineralized zone, hanging wall and footwall) will be collected for primary sampling. 910.00 m of scout drilling will be carried out to explore the total strike length of mineralization for 1$^{st}$ level intersection.




## 5.6.0 CORE LOGGING

5.6.1 The borehole cores would be logged systematically. Viz. details of the litho units, colour, structural feature, texture, mineralization, besides the recovery, rock quality designation (RQD) and graphite ore type would be recorded.

## 5.7.0 CORE SAMPLING

5.7.1 The mineralized graphite along with hanging wall and foot wall of drill core will be sampled as Primary sample. The length of each sample will be kept 1.00 m within the ore zone depending upon the thickness of particular type of graphite zone and its physical character. The primary core samples for graphite mineralisation will be analysed for Fixed Carbon (FC: Non-carbonate), Ash, Moisture and Volatile Matter (VM) (Proximate Analysis for 4 parameters). The cores of rocks 3 m immediate on footwall and 3 m immediate on hanging wall of mineralized zones would be sampled at 1.0 m interval, depending upon the intensity of mineralization, change in lithology and core recovery etc.

15 nos of samples from each borehole (mineralized zone, hanging wall and footwall) will be generated as primary samples. A total 195 numbers of primary core samples will be analyzed for graphite mineralization (FC: Non-carbonate, Ash,

Moisture and VM). Around 10% of Primary samples i.e. 19 numbers of sample for Graphite will be sent to NABL External Labs for analysis of graphite mineralization (FC: Non-carbonate, Ash, Moisture and VM) as external check samples.

5 samples are kept for Raman Spectroscopy is proposed to assess the physical properties of graphite.

**5.8.0 WHOLE ROCK ANALYSIS:**

5.8.1 Whole Rock analysis will be carried out on 5 Nos of samples to check the rock types, their variation in chemical composition.

**5.9.0 PETROLOGICAL AND MINERAGRAPHIC STUDIES**

5.9.1 Thin and polished section studies on drill cores samples would be done for ascertaining the petrographic and mineragraphic characteristics. These samples would be drawn from ore zones and host rocks. A provision of 10 specimens for petrographic and 10 specimens for mineragraphic studies has been kept in the block.

**5.10.0 BULK DENSITY**

5.10.1 A provision of 5 samples for bulk density determination has been kept.5 nos of pits throughout the area will be carried out in suitable graphite exposures to determine bulk density of graphite.

**6.1.0 QUANTUM OF WORK:**

6.1.1 The quantum of work proposed by MECL in Chormunda Block (G-3 Stage of Exploration) is given in Table 6.1.

**Table: 6.1**
**Proposed Quantum of Exploratory Work in Chormunda Block, District- Balangir and Nuapara, Odisha.**

| Sl. No. | Item of Work | Unit | Proposed Quantum of work |
|---|---|---|---|
| 1 | Geological Mapping (1:2000) | sq. km | 9.60 |
| | Topography Survey (1:2000) | sq. km | 9.60 |
| 3 | Geophysical Survey (SP Survey) | Line Km | 30 |
| 4 | Trenching (1m x 2m x15m) x 13 trenches | Cu. m | 400 |
| 5 | Exploratory Drilling | m. | 910 |

| Sl. No. | Item of Work | Unit | Proposed Quantum of work |
|---|---|---|---|
| 6 | Sample Preparation & Chemical Analysis | | |
| | i) Proximate Analysis of Primary samples for Graphite for 4 parameters i.e. Fixed Carbon (FC), Ash (A), Moisture (M) and Volatile Matter (VM) (195 Trench + 195 Borehole) | Nos. | 390 |
| | iii) External Check sample (10 % of Primary samples) for Graphite for 4 parameters (19 Trench + 20 Borehole) | Nos. | 39 |
| 7 | Whole rock analysis | Nos. | 5 |
| 8 | Raman Spectroscopy | Nos. | 5 |
| 9 | Petrographic Studies | Nos | 10 |
| 10 | Mineragraphic Studies | Nos | 10 |
| 11 | Bulk Density studies | Nos | 5 |
| 12 | Report Preparation (Digital format) | Nos. | 1 |

### 6.2.0 MANPOWER DEPLOYMENT

6.2.1 Manpower deployment List may be provided later.

### 6.3.0 TIMELINE AND BREAK-UP OF EXPENDITURE

6.3.1 The proposed exploration programme is planned for Preliminary Exploration (G-3). The work activities like camp setting, geological work, geophysical survey, drilling & laboratory work, report writing will be completed within 13 months' time. The bar chart showing activities wise time schedule is placed at **Table-6.2.**

**Table-6.2.**

| Estimated time schedule for Preliminary Exploration (G-3) for Graphite in Chormunda Block, Districts: Balangir & Nuapara, State: Odisha [Block area- 9.60 sq. km; Schedule timeline- 13 months] | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Particulars** | **Months** | **1** | **2** | **3** | **4** | **5** | **6** | | **7** | **8** | **9** | **10** | **11** | **12** | **13** |
| 1 | Camp Setting/ mobilization | Months | | | | | | | | | | | | | | |
| 2 | Geologist days | days | | | | | | | | | | | | | | |
| 3 | Geophysist days | days | | | | | | | | | | | | | | |
| 4 | Survey Days (2 party) | days | | | | | | | | | | | | | | |
| 5 | Trenching | days | | | | | | | | | | | | | | |
| 6 | Drilling (2 rig) | m | | | | | | | | | | | | | | |
| 7 | Sampling days | days | | | | | | | | | | | | | | |
| 8 | Camp winding | Months | | | | | | | | | | | | | | |
| 9 | Laboratory Studies | days | | | | | | | | | | | | | | |
| 10 | Geologist days, HQ | days | | | | | | | | | | | | | | |
| 11 | Report Writing with Peer Review | days | | | | | | | | | | | | | | |

REVIEW

6.3.2 Tentative cost has been estimated based on Schedule of Charges (SoC) of projects funded by National Mineral Exploration Trust (NMET) w.e.f. 01/04/2020 and the total estimated cost is **Rs. 246.22 Lakh.** The summary of tentative cost estimates for Preliminary Exploration is given in **Table No.- 6.3** and details of tentative cost estimates are given as Annexure-I.

**Table No.- 6.3**

**Summary of Tentative cost estimates for Preliminary Exploration in Chormunda Block**

| Sl. No. | Item | Total |
|---|---|---|
| 1 | Geological Work | 3,832,320 |
| 2 | Geophysical Work | 2,120,460 |
| 3 | Trenching | 1,332,000 |
| 4 | Drilling | 10,956,380 |
| 5 | Laboratory Studies | 1,450,905 |
| | **Sub total** | **19,692,065** |
| 6 | Report | 750,000 |
| 7 | Peer Review | 30,000 |
| 8 | Proposal Prepration | 393,841.30 |
| | **Total** | **20,865,906** |
| 9 | GST (18%) | 3,755,863.13 |
| **Total cost including 18% GST** | | **24,621,769** |
| **SAY, in Lakhs** | | **246.22** |

## 7.0.0 JUSTIFICATION

**7.1.0** Graphite occurrences in the Chormunda area have been established by GSI during the FS. 1979-80 and 1981-82, where a few small scale local mining has been observed within the block. The mineralizations to the strike extension of these quarries are unexplored. The present exploration will help to establish the lateral and vertical continuity of the mineralization.

**7.2.0** MECL has carried out preliminary field visit to the north of the block where graphite quarries were observed in the same geological setup. MECL collected few samples for graphite from the surface exposures which show 4.42% to 8.79% of FC. The proposed block falls in the southern extension of the area covered by MECL field visit having the same geological setup conducive for graphite mineralization.

**7.3.0** Based on the recommendations of 64thTCC NMET meeting the Proposal for Preliminary Exploration for graphite in Chormunda Block has been prepared. The committee members suggested that since GSI has carried out investigation for graphite in the block and a few local mining activities were also present, the block can be taken up for Preliminary Exploration. Based on the Block Geology Map and Regional Geology Map of the area, 64$^{th}$ TCC recommended extending the block further towards the north east and south west of the earlier Proposed Temrimal Block restricting the block area to khondalite/ migmatised khondalite, which is known to be potential for graphite mineralization.

**7.4.0** During the field visit conducted by MECL the graphite mineralization observed on ground had a definite trend which was confirmed by the graphite quarries and few local mining activities located along the mineralized strike direction. The graphite occurrence on surface had been exhausted by mining and the graphite mineralization in the strike extension was covered by thick soil cover. Hence, exploration activities like geophysical survey and trenching will help to delineate the subsurface mineralized zone and augment the graphite resources in the proposed block.

**7.5.0** GSI during the field season 1971-72 carried out detailed investigation of graphite deposit in Sargipalli-Bardhapalli Belt, Sambalpur and Bolangir District, Odisha.From the observations during the investigation and thick soil cover in the area, it was recommended that close spaced geophysical prospecting by SP and IP methods must be carried out to ascertain the strike extension of graphite deposits.

**7.6.0** GSI during the field season 1981-82 carried out investigation for graphite in Bolangir, Sambalpur and Kalahandi Districts of Odisha. A 25 km long zone between Temrimal and Khondajharan was recommended for detailed investigation as inspite of the low grade, the graphite bands are likely to be continuous over long strike extensions. Exploratory trenching, sampling, etc were suggested to establish the strike length.In soil covered areas to prove the depth extension of the geophysical survey followed by drilling was also recommended. This zone as described earlier holds promise for its strike continuity. The Geological Map of area between Babupali and Khandijharan (Plate-III, Source-GSI)as mapped by S.D. Mohanty F.S.1981-82, GSI shows the Graphite mineralized zone and the proposed block falls in the area which is potential for graphite mineralization.

**7.7.0** At present graphite is a critical mineral for the nation. The previous exploration in the surrounding area has established occurrences of graphite. Hence, the Preliminary Exploration (G-3) will help to establish the vertical and lateral extension of graphite in the current block, which will definitely augment the graphite resource and make the block feasible for auction.

## 8.0.0 References:


- Chakrabarti P., F.S. 1971-72, GSI, Detailed investigation of graphite deposit in Sargipalli-Bardhapalli Belt, Sambalpur and Bolangir District, Odisha.
- Mohanty, S.D. and Joshi O.P., F.S. 1978-79, GSI, Report on investigation for graphite in Bolangir, Sambalpur and Kalahandi Districts, Odisha.
- Mohanty S.D., F.S. 1981-82, GSI, Report on investigation for graphite in Bolangir, Sambalpur and Kalahandi Districts, Odisha.
- Satapathy U.N. F.S. 1987-88, GSI, Photogeological Studies on the assessment of graphite resources in Titlagarh- Sargipalli Belts in parts of Bolangir and Sambalpur Districts, Odisha.
- Kameswara Rao G., Kapoor K.N., Kundu H.K., F.S. 1987-88, GSIReport on geophysical investigation for regional assessment of graphite resources in parts of Bolangir, Sambalpur and Kalahandi Districts, Odisha.
- Mukherjee R., Roy S.K., Agarwal R.,F.S. 2015- 2016, GSI, A report on geophysical mapping in parts of Nuapada District, Odisha and Mahasamund and Gariabad District, Chattisgarh.

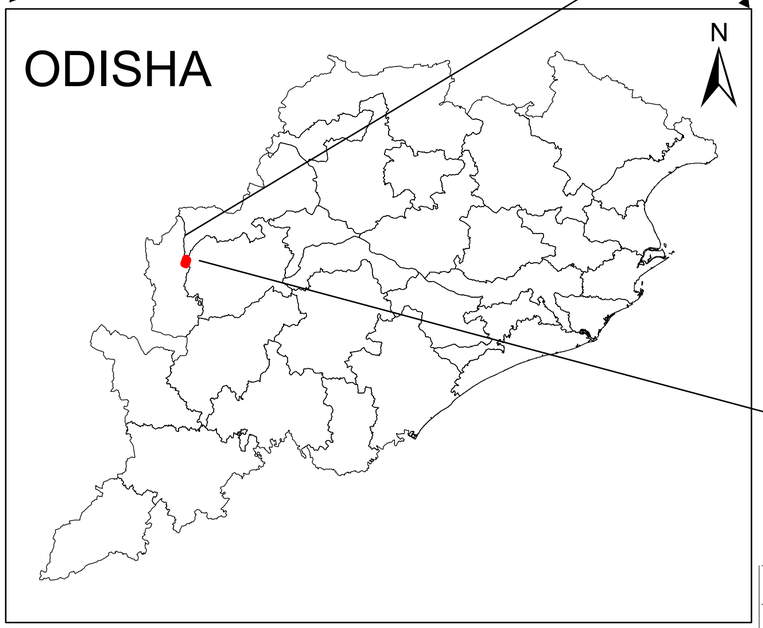

## 9.0.0 List of Plates:

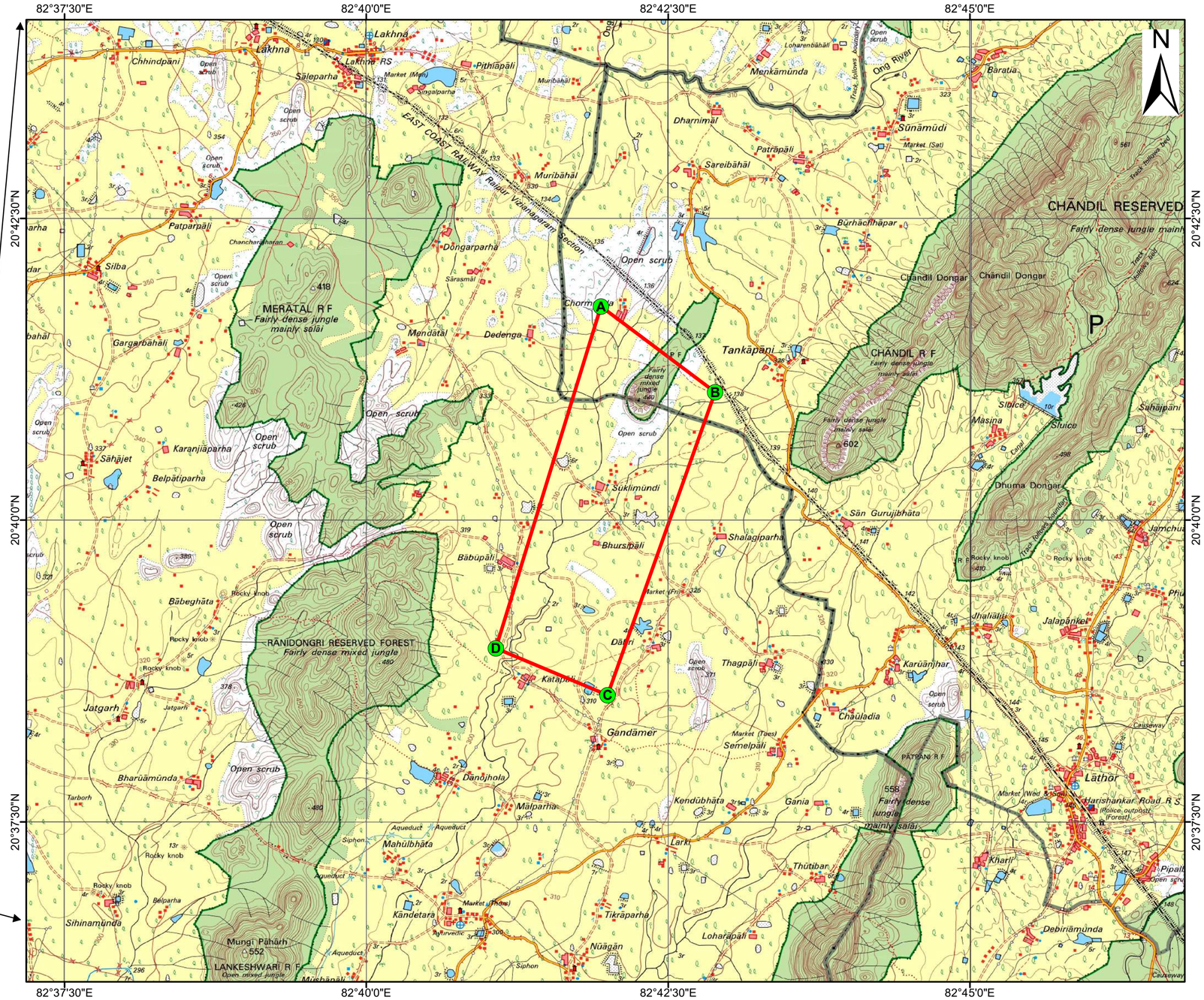
i. Plate-I: Location Map of Chormunda Block in Toposheet no. 64L/10, Balangir and Nuapara District, Odisha.
ii. Plate-II: Regional Geological Map showing Chormunda Block (Source: Bhukosh, GSI).
iii. Plate-III: Geological map of Chormunda Block (Scale 1:63,360, F.S. 1981-82, GSI).
iv. Plate-IV: Tentative Geophysical Layout Plan for Preliminary Exploration (G3) of Graphite in Chormunda Block (Geophysical Survey Line Spacing of 100 m and Station Interval of 20 m), Balangir and Nuapara District, Odisha
v. Plate-V: Tentative Trench Location and Borehole Location Plan for Preliminary Exploration (G3) of Graphite in Chormunda Block (Section Line Spacing of 400 m), Balangir and Nuapara District, Odisha
vi. Plate-VI: Tentative Geological Cross Section along Section Line S9 – S9' in Chormunda Block, Balangir and Nuapara District, Odisha

## 10.0.0 List of Annexures:

- Estimated Time Schedule and Details of Tenative Cost for Preliminary Exploration (G-3) for Graphite in Chormunda Block (Area- 9.60 sq. Km), Districts: Balangir & Nuapara, State: Odisha

# Location Map of Proposed Chormunda G-3 Block (9.60 sq km), District: Balangir and Nuapara, Odisha


0 0.5 1 2 3 4 Kilometers

## Legend

- Proposed Chormunda G-3 Corner Points
- Proposed Chormunda G-3 Block

Part of Survey of India
Toposheet No: 64L/10

**Coordinates of Corner Points of Chormunda Block (9.60 sq km)**

| SL NO | POINT | GCS (DMS) | | UTM Zone-44N (m) | |
|---|---|---|---|---|---|
| | | LATITUDE | LONGITUDE | NORTHING | EASTING |
| 1 | A | 20° 41' 46.326" N | 82° 41' 56.549" E | 2289453.49 | 676953.76 |
| 2 | B | 20° 41' 3.709" N | 82° 42' 53.299" E | 2288160.22 | 678609.78 |
| 3 | C | 20° 38' 33.032" N | 82° 41' 59.887" E | 2283510.40 | 677112.63 |
| 4 | D | 20° 38' 56.340" N | 82° 41' 4.444" E | 2284210.45 | 675500.29 |

# Regional Geology showing Proposed Chormunda Graphite Block, District: Balangir and Baragarh, Odisha

N

82°37'30"E 82°40'0"E 82°42'30"E 82°45'0"E 82°47'30"E 82°50'0"E 82°52'30"E 82°55'0"E

20°55'0"N 20°52'30"N 20°50'0"N 20°47'30"N 20°45'0"N 20°42'30"N 20°40'0"N 20°37'30"N

Source: Bhukosh, GSI

1:100,000

0 1 2 4 6 8

Kilometers

## Legend

- PROPOSED CHORMUNDA G-3 BLOCK
- DONGARGARH GRANITE
- BENGPAL
- BENGPAL GNEISS
- CHARNOCKITE
- KHONDALITE
- MIGMATITE
- PAIRI
- SINGHORA
- CLEAVAGE/FOLIATION/SCHISTOSITY (S1)
- JOINT

# GEOLOGICAL MAP OF AREA BETWEEN BABUPALI - KHANDIJHARAN, DISTRICTS KALAHANDI, BALANGIR, AND SAMBALPUR, ORISSA

SCALE 1:63,360

0 1 2Km

(Parts of Toposheet Nos. 64L/10, 11 & 13)

82° 45' | 82° 50' | 20° 55'N | 20° 52'30"N | 20° 50'0"N | 20° 47'30"N | 20° 45'0"N | 20° 42'30"N | 20° 40'0"N

Palkmal 1·5Km

Palkmal

Deogarh

Durgapali

Nursinghanath

Nawapara

Kudhariphasa

Manbhang

Patrapali

Mutipali

Marjadapali

Brahm antal

Kharamal

Dudkijharia

Temrimal

Menkamunda

Chormunda

Suklimuri

Bhersipali

Boroupali

ONG R

Nawapara 24Km

Raipur 34Km

Vizianagram 324Km

20° 50'

20° 45'

82° 50'

82° 45'

## LOCATION MAP

SCALE

20 0 20Km

82° 00' | 83° 00' | 21° 00' | 20° 00'

SAMBALPUR

Raipur

Padmapur

Khariar Rd

Lathor

Harishankar Rd

Belpara

Komna

Kantabanji

Vizianagram

M.P

KALAHANDI

BALANGIR

Khariar

Area covered during 1981-82
PLATE II & III

## INDEX

| | |
|---|---|
| 7 Laterite | Strike and dip of foliation |
| 6 Granite gneiss | Litho unit boundary inferred / actual |
| 5 Migmatite zone | Graphite occurrence |
| 4 Basic granulite | Graphite quarry working / abandoned |
| 3 Calc-granulite | Graphite mineralised zone |
| 2 Quartzite | Proposed Chormunda G-3 Block |
| 1 Khondalite | |

Mapped by S.C. CHAKRABARTI, F.S 1948-49

Migmatised zone and graphite occurrences plotted by S.D. MOHANTY, GEOLOGIST. F.S 1981-82

G.S.I, Op. Orissa D.O No. 26/86.

Plate-III: Geology Map showing Proposed Chormunda Block
(Source: GSI, F.S. 1981-82)

676000
677000
678000
2289000
2288000
2287000
2286000
2285000
2284000

N
W
E
S

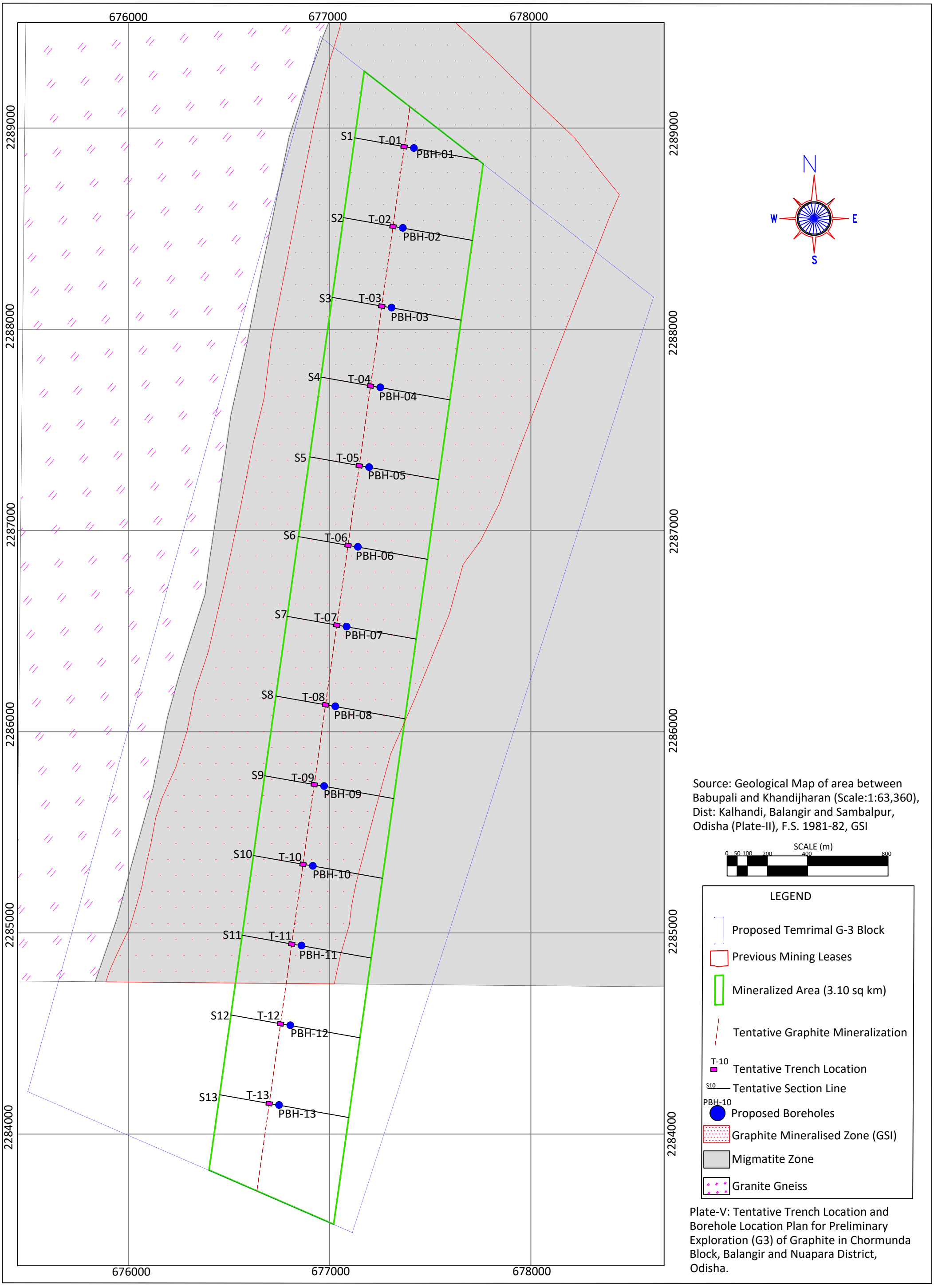
Source: Geological Map of area between Babupali and Khandijharan (Scale:1:63,360), Dist: Kalhandi, Balangir and Sambalpur, Odisha (Plate-II), F.S. 1981-82, GSI

SCALE (m)

0 50 100 200 400 800

- Proposed Temrimal G-3 Block
- Previous Mining Leases
- Mineralized Area (3.10 sq km)
- Tentative Geophysical Survey Line
- Graphite Mineralised Zone (GSI)
- Migmatite Zone
- Granite Gneiss

Plate-V: Tentative Geophysical Survey Plan for Preliminary Exploration (G3) of Graphite in Chormunda Block, Balangir and Nuapara District, Odisha.




Source: Geological Map of area between Babupali and Khandijharan (Scale:1:63,360), Dist: Kalhandi, Balangir and Sambalpur, Odisha (Plate-II), F.S. 1981-82, GSI

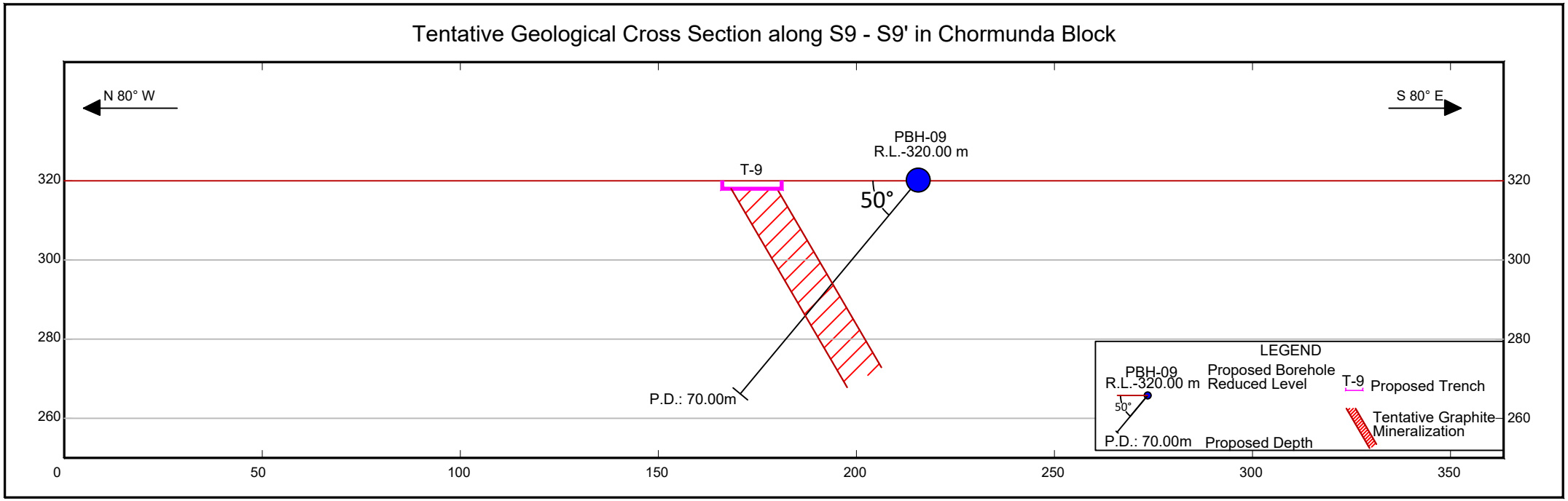
SCALE (m)

0 50 100 200 400 800

LEGEND

- Proposed Temrimal G-3 Block
- Previous Mining Leases
- Mineralized Area (3.10 sq km)
- Tentative Graphite Mineralization
- T-10 Tentative Trench Location
- S10 Tentative Section Line
- PBH-10 Proposed Boreholes
- Graphite Mineralised Zone (GSI)
- Migmatite Zone
- Granite Gneiss

Plate-V: Tentative Trench Location and Borehole Location Plan for Preliminary Exploration (G3) of Graphite in Chormunda Block, Balangir and Nuapara District, Odisha.


Tentative Geological Cross Section along S9 - S9' in Chormunda Block
N 80° W
S 80° E
PBH-09
R.L.-320.00 m
T-9
50°
P.D.: 70.00m
320
300
280
260
0
50
100
150
200
250
300
350
LEGEND
PBH-09
R.L.-320.00 m
Proposed Borehole
Reduced Level
T-9
Proposed Trench
50°
P.D.: 70.00m
Proposed Depth
Tentative Graphite
Mineralization

| Estimated cost for Preliminary Exploration (G-3) for Graphite in Chormunda block, District: Balangir & Nuapara, Odisha. [Block area- 9.60 sq. km; Nos. of Borehole- 13; Borehole depth range: 60-70m; Schedule timeline- 13 months] | | | | | | | |
|---|---|---|---|---|---|---|---|
| S. No. | Item of Work | Unit | Rates as per NMET SoC 2020-21 | | Estimated Cost of the Proposal | | Remarks |
| | | | SoC-Item -Sl No. | Rates as per SoC | Qty. | Amount (Rs) | |
| A | **GEOLOGICAL WORK** | | | | | | |
| 1 | **Geological Mapping (1:12500), Borehole logging, sampling & Report writing** | | | | | | |
| i | Charges for one Geologist- Field | day | 1.2 | 11,000 | 150 | 16,50,000 | |
| ii | Charges for one Geologist - HQ | day | 1.2 | 9,000 | 45 | 4,05,000 | |
| iii | 2 labours/ party (Rs 522/day/labour) (As per rates of Central Labour Commissioner) | day | 5.7 | 522 | 300 | 1,56,600 | Amount will be reimbursed as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher |
| iv | Core Sampling -1 Samplers<br>Labour charge not included | day | 1.5.2 | 5,100 | 50 | 2,55,000 | |
| v | 4 labours/ party (Rs 522/day/labour) (As per rates of Central Labour Commissioner) | day | 5.7 | 522 | 200 | 1,04,400 | Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher |
| 2 | **Survey** | | | | | | |
| i | Topographical Survey | day | 1.6.1a | 8300 | 90 | 747000 | Topographical Survey on 1:2000 (2 m contour interval) |
| ii | 4 labours/ party (Rs 522/day/labour) (As per rates of Central Labour Commissioner) | day | 5.7 | 522 | 360 | 1,87,920 | |
| iii | Bore Hole Fixation and determination of co-ordinates & Reduced Level of the boreholes by DGPS and boundary coordinates | Per Point of observation | 1.6.2 | 19,200 | 17 | 3,26,400 | 13 BHs and 4 boundary coordinates |
| | | | | | **Sub Total- A** | **38,32,320** | |
| B | **GEOPHYSICAL SURVEY** | | | | | | |
| i | Self Potential and Magnetic (30 Line Km depending on graphite mineralized zone) | Line Km | 3.3a | 29600 | 30 | 8,88,000 | Tentative 3.2 sq km area for Geophysical Survey at 100 m traverse interval i.e. 30Line Km. |
| ii | Charges for one Geophysicist- Field | day | 3.18 | 11000 | 45 | 4,95,000 | |
| iii | Charges for one Geophysicist - HQ | day | 3.18 | 9000 | 30 | 2,70,000 | |
| iv | Surveyor Work | day | 1.6.1a | 8300 | 45 | 3,73,500 | |
| v | 4 labours/ party (Rs 522/day/labour) (As per rates of Central Labour Commissioner) | day | 5.7 | 522 | 180 | 93,960 | |
| | | | | | **Sub Total- B** | **21,20,460** | |
| C | **TRENCHING** | | | | | | |
| | Trenching (1m x 2m x15m): 10 trenches | Cu. M. | 2.1.1 | 3330 | 400 | 13,32,000 | |
| | | | | | **Sub Total- C** | **13,32,000** | |
| D | **DRILLING** | | | | | | |
| i | Drilling upto 300m (Hard Rock) (1 rig ) | m | 2.2.1.4a | 11,500 | 780 | 89,70,000 | |
| ii | Land / Crop Compansation | per BH | 5.6 | 20,000 | 13 | 2,60,000 | Amount will be reimburse as per actuals or max. Rs. 20000 per BH with certification from local authorities |
| iii | Construction of concrete Pillar (12"x12"x30") | per borehole | 2.2.7a | 2,000 | 13 | 26,000 | |
| iv | Transportation of Drill Rig & Truck associated per drill | Km | 2.2.8 | 36 | 1,800 | 64,800 | Certification in this regard is required to be provided |
| v | Monthly Accomodation Charges for drilling Camp (up to 2 Rigs) | month | 2.2.9 | 50,000 | 3 | 1,50,000 | Rig1: 3 months, Rig2: 2 months, |
| vi | Drilling Camp Setting Cost | Nos | 2.2.9a | 2,50,000 | 2 | 5,00,000 | |
| vii | Drilling Camp Winding up Cost | Nos | 2.2.9b | 2,50,000 | 2 | 5,00,000 | |
| viii | Approach Road Making (Flat Terrain) | Km | 2.2.10a | 22,020 | 4 | 88,080 | Road Making will be considered as per the requirement and Road Making Charges will be reimbursed later |
| ix | Core Preservation: One complete borehole plus mineralised cores of all the remaining Bhs | m | 5.3 | 1,590 | 250 | 3,97,500 | This amount will be reimbursed after successful delivery of the cores to concerned libraries/authorities |
| | | | | | **Sub Total- D** | **1,09,56,380** | |
| E | **LABORATORY STUDIES** | | | | | | |
| 1 | **Chemical Analysis** | | | | | | |
| i | **Primary & Check samples for Graphite** | | | | | | |
| | a. Primary Samples for Proximate Analysis of Graphite: Fixed Carbon (FC), Ash (A), Moisture (M) and Volatile Matter (VM) | Nos | 4.1.16 | 3,000 | 390 | 11,70,000 | Trench-195, BH-195 |
| | b-External(10%) Check samples from NABL Lab for Proximate Analysis of Graphite: Fixed Carbon (FC), Ash (A), Moisture (M) and Volatile Matter (VM) | Nos | 4.1.16 | 3,000 | 39 | 1,17,000 | Trench-19, BH-20 |
| 2 | **Physical & Petrological Stusies** | | | | | | |
| i | Preparation of thin section | Nos | 4.3.1 | 2,353 | 10 | 23,530 | |
| ii | Complete petrographic study report | Nos | 4.3.4 | 4,232 | 10 | 42,320 | |
| iii | Preparation of polished section | Nos | 4.3.2 | 1,549 | 10 | 15,490 | |
| iv | Complete mineragraphic study report | Nos | 4.3.4 | 4,232 | 10 | 42,320 | |
| v | Digital Photographs | Nos | 4.3.7 | 280 | 10 | 2,800 | |
| vi | Bulk Density studies | Nos | 4.8.1 | 1,605 | 5 | 8,025 | |
| vii | Whole Rock Analysis ($SiO_2$, $Fe_2O_3$, $MnO_2$, $Al_2O_3$, MgO, CaO, BaO, $K_2O$, $P_2O_5$, $TiO_2$, $V_2O_5$, LOI, S, V) | Nos | 4.1.15a & b | 5,884 | 5 | 29,420 | |
| ix | Raman Spectroscopy | Nos | | 5,000 | 10 | 50,000 | Price not available in SoC, NMET. Will be reimbursed as per actual cost through outsourcing. |
| | | | | | **Sub Total- E** | **14,50,905** | |
| D | | | | | **Total A to E** | **1,96,92,065** | |
| E | **Geological Report Preparation** | | **5.2** | For the projects having cost exceeding Rs. 150 lakhs and less than Rs. 300 lakhs - A minimum of Rs. 7.5 lakhs or 3% of the value of work whichever is more | | **7,50,000** | Reimbursement will be made after submission of the final Geological Report in Hard Copies (5 Nos) and the soft copy to NMET. |
| F | **Peer review Charges** | | **As per EC decision** | | | **30,000** | |

| S. No. | Item of Work | Unit | Rates as per NMET SoC 2020-21 | | Estimated Cost of the Proposal | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | SoC-Item -Sl No. | Rates as per SoC | Qty. | Amount (Rs) | |
| **G** | **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 | | **3,93,841** | EA has to submit the Hard Copies and the soft copy of the final proposal along with Maps and Plan as suggested by the TCC-NMET in its meeting while clearing the proposal. |
| **H** | **Total Estimated Cost without GST** | | | | | **2,08,65,906** | |
| **I** | **Provision for GST (18% of I)** | | | | | **37,55,863** | GST will be reimburse as per actual and as per notified prescribed rate |
| **J** | **Total Estimated Cost with GST** | | | | | **2,46,21,769** | ***or Say Rs. 246.22 Lakh*** |
| **Note:** | | | | | | | |
| 1 | If any part of the project is outsourced, the amount will be reimbursed as per the Paragraph 3 of NMET SoC and Item no. 6 of NMET SoC. In case of execusion of the project by NEA on its own, a Certifiate regarding non outsourcing of any component/project is required. | | | | | | |