PROPOSAL FOR RECONNAISSANCE SURVEY (G-4)

OF GRAPHITE, VANADIUM AND ASSOCIATED MINERALS IN BHALUANI KALAN BLOCK (32.70 SQ. KM AREA)

DISTRICT- PALAMU, JHARKHAND

COMMODITY: GRAPHITE, VANADIUM & ASSOCIATED MINERALS

BY

MINERAL EXPLORATION AND CONSULTANCY LIMITED

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SEMINARY HILLS

NAGPUR (MH)

PLACE: NAGPUR

DATE: 17th & 18th November, 2025

Summary of the Block for Reconnaissance Survey (G-4)

	Features	Details
	Block ID	**Bhaluani Kalan**
	Exploration Agency	Mineral Exploration and Consultancy Limited (MECL)
	Commodity	**Graphite, Vanadium & Associated Minerals**
	Mineral Belt	Chhotanagpur Granite Gneiss Complex (CGGC)
	Budget & Time schedule to complete the project	**461.83 Lakhs& 10 months**
	Objectives	The present exploration program (G4) has been formulated on the basis of the outcomes of previous work and recent field traverses to fulfill the following objectives in phase wise manner: i. Geological mapping on 1:12,500 scale to delineate graphite bands and other lithounits in the area. ii. To undertake surface sampling comprising bedrock, chip, and stream sediment specimens—for geochemical analysis of Graphite and Associated mineralization aimed at guiding the next phase of the exploration program. iii. Delineation of the potential subsurface graphite and associated mineralized zones by integrating multiple ground geophysical methods like Gamma Ray Spectrometric, Magnetic, Induced Polarization (IP) cum Resistivity and Self-Potential (SP) Surveys. iv. Trenching will be carried out at suitable interval in the anomalous zone marked by surface geophysical survey to establish the continuity of the graphite and associated mineralization disseminated along strike direction, which is covered by soil. v. After the positive outcomes of the above activities scout drilling will be planned out to intersect the potential zones at 50 m vertical depth. vi. Assessment of quality and quantity of the resources (334) if any as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015 (Amended 2021).
	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-60 days Geophysicist Party days: HQ-30 days
		Sampling Party days: 60 days

1.	**Location**	The proposed Bhaluani Kalan Block comprises of 32.70sq km area and lies in Palamu District (Toposheet No: 63P/16), Jharkhand. Bhaluani Kalan, Sankha, Kamt, Harhepa, Keshiar, Bandua, Gulali villages are present in the proposed area.

	Latitude and Longitude	**Corner Points**	**WGS 1984 (DMS)**		
			Latitude	**Longitude**	
		A	83°54'59.13"E	24°14'48.99"N	
		B	83°56'50.37"E	24°14'49.43"N	
		C	83°56'52.39"E	24°14'32.69"N	
		D	83°57'27.05"E	24°14'32.96"N	
		E	83°57'28.04"E	24°14'49.70"N	
		F	83°59'60.00"E	24°14'51.02"N	
		G	83°59'60.00"E	24°12'35.39"N	
		H	83°55'30.74"E	24°12'36.20"N	
	Villages	Bhaluani Kalan, Sankha, Kamt, Harhepa, Keshiar, Bandua, Gulali villages			
	Tehsil/Taluk	Bishrampur			
	District	Palamu			
	State	Jharkhand			
2.	**Area (hectares/ square kilometres)**				
	Block Area	32.70sq.km			
	Forest Area	Hatai Khas Protected Forest (Open Jungle mainly Sal)			
	Government Land Area (Bilanam)	Data not available			
	Charagaha	Data not available			
	Private Land Area	Data not available			
3.	**Accessibility**				
	Nearest Rail Head	The nearest Railway Stations is at Garhwa Road which is 11 km south-west of the proposed block.			
	Road	The Rajhara-Garhwa Road connecting Rajhara to Garhwa passes through the south west corner of the block which merges onto Aurangabad-Rajhara-Daltonganj Road (NH139). The district headquarter Daltonganj is 55.00 km north-east of the block. All the villages in the area are well connected to each other and to the highways by motorable roads and tracks.			
	Airport	The nearest airport is Chainki Airport at Rerma, which is about 45 km north east of the block.			
4.	**Hydrography**				
	Local Surface Drainage Pattern (Channels)	The major part of the block falls in Hatai Khas Protected Forest. There are several high points in the forest area. The tributaries of Sojhghatiya Nala forms the main drainage fed by tributaries descending from the Hatai Khas Protected Forest and also from the surrounding plane.			
	Rivers/ Streams	Tributaries of Sojhghatiya Nala which drains into North Koel River.			
5.	**Climate**				
	Mean Annual Rainfall	Average Annual Rainfall:1044–1220 mm			
	Temperature	Minimum temperatures: 8-12°C (Dec-Feb), Maximum temperatures: up to 43°C (March-May)			
6.	**Topography**				
	Toposheet Number	63P16			

	Morphology of the Area	The southwestern part of the block has maximum elevation of 550 m. The elevation of the block ranges between 220 m to 550 m. The area comprises of mostly gently undulating plane. The average elevation of the block is 300 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)	Geological Map (1:50000), NGDR Portal
	Geochemical Map	NGCM data available in NGDR Portal
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	NGPM only Gravity data available in NGDR Portal
8.	**Justification for taking up Reconnaissance Survey**	The proposed block has been carved out on the basis of different ML Graphite blocks in the vicinity of Bhaluani Kalan Block. The blocks namely, Rewaratu, Dulsulma, Lesliganj &Ponchi Graphite blocks (Palamu district) G2 level exploration has been done by DGM Jharkhand. All the blocks lie around 37 km SE of the proposed block. There are other prospective Graphite blocks in district Palamu, Jharkhand where DMG Jharkhand is doing exploration at various stages namely Punardih Block (37 Ha, G2), Chanpi Block (110 Ha, G2), Chanpi-II Block (100 Ha, G3), Bhang Parasia Block (75 Ha, G3), Sokra Block (100 Ha, G3) and Ghutuwa Block (35 Ha, G3).The said blocks will be in due course put up for auction by the Govt. of India. Reconnaissance survey of Graphite, Vanadium and associated minerals in Tulbula-Arapur of Palamu districts, Jharkhand (G4 Stage) currently taken up by GSI (2024-25) in 100 sq km in adjacent area of the proposed MECL block. Also, an abandoned graphite mining lease in the name of Pachgurha Khurd, Palamu district, Jharkhand in an area of 3.40 Ha lying in the northern side of the proposed block. During MECL's initial field visit, the presence of graphite mineralization on the surface was validated by some exposures in the area. In the strike extension area however, the mineralization was concealed beneath a thick soil cover. Therefore, exploration methods such as geophysical surveys and trenching will be helpful to identify the subsurface mineralized zones and enhance the graphite resource within the proposed block. A total of seven graphite surface samples were collected from the area, and the analytical results of the bedrock samples are presented below:

Sl. No.	Sample No.	Moisture%	Ash%	VM%	FC%
1	SG-01	1.20	78.80	5.60	14.40
2	SG-02	1.80	75.40	7.50	15.30
3	SG-05	0.70	86.20	2.50	10.70
4	SG-06	1.40	78.00	14.00	6.60
5	SG-07	0.50	87.80	3.10	8.60
6	SG-08	0.30	90.70	1.90	7.10
7	SG-09	0.30	90.20	2.90	6.60

The given surface samples as above were also subjected to analysis for 34 elements through ICP-MS and anomalies were found out in Vanadium (V), Zirconium (Zr), Strontium (Sr), Rubidium (Rb) and ∑REE+Sc+Y as given below:

Sl.No.	**Sample No.**	**Vanadium (V) ppm**	**Zirconium (Zr) ppm**	**Strontium (Sr) ppm**	**Rubidium (Rb) ppm**	**∑REE+Sc+Y**
1	SG-01	483.39	274.47	151.24	187.65	329.44
2	SG-02	459.49	113.51	136.80	171.69	315.85
3	SG-05	161.64	145.46	117.37	91.99	294.42
4	SG-06	196.69	107.99	182.16	77.18	295.38
5	SG-07	62.42	256.20	74.93	136.80	259.27
6	SG-08	665.85	280.08	84.42	201.79	189.99
7	SG-09	913.90	268.81	99.25	207.89	249.69

The above anomalous values are corroborating well with the NGCM values (stream sediments samples) downloaded from NGDR portal as depicted in the anomaly map shown in the plates enclosed (Plate VIII, IX, X, XI & XII). The ∑REE+Sc+Y in and around the proposed block shows values ranging from 189.99 to 945.00ppm showing average value of 666.27ppm. The Rb values ranging from 77.18ppm to 244.00ppm showing average value of 133.31ppm. The V values ranging from 62.42 to 913.90ppm showing average value of 303.61ppm. The values of Zr 107.99ppm to 1985.00ppm showing average value of 667.42ppm and the values of Sr ranging from 38.00ppm to 305.00ppm showing average value of 123.22ppm.

At present graphite is a critical mineral for the nation. Hence, the proposed Reconnaissance Survey (G-4) will help to establish the vertical and lateral extension of Graphite and Associated mineralization in the current block, which will definitely augment the Graphite resource (334) along with other elements if any in the proposed Bhaluani Kalan Block.

PROPOSAL FOR RECONNAISSANCE SURVEY (G-4)

OF GRAPHITE VANADIUM & ASSOCIATED MINERALS IN BHALUANI KALAN

(32.70 SQ. KM AREA)

DISTRICT- PALAMU, JHARKHAND

1.0.0 INTRODUCTION

1.1.0 Worldwide demand for graphite is expected to raise with the development of non-carbon energy applications such as batteries used in electric vehicles, electric devices and energy storage devices. 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. Graphites are also used in crucibles, foundries, pencils and sophisticated applications of graphite are in refractories that are used in the manufacture of steel, cement and glass, expanded graphite-based sealing gaskets, graphitised grease, braid, brushes, brake lining, etc. It is also used for specialty applications, such as, in the nuclear industry, soil conditioners and graphite foils, which is used for sealing in the chemical and petrochemical industries as well as in the energy, engineering and automotive industries. It is also used in minor amounts as a vital additive for producing foundry coatings to prevent fusion of liquid metal with sand at the mould or core face. Such coatings are either applied by spraying or painting in the form of suspension or by dusting or by rubbing as dry powders. Graphite used for coating is of high quality which.

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 330 million tonnes of which Turkey accounts for 27% followed by Brazil (22%), China (15%), Madagascar & Mozambique (7% each), Tanzania (5%), Russia (4%), India & Uzbekistan (2% each) and Mexico (0.9%). World production of graphite was 1.40 million tonnes in 2022 as compared to 1.3 million tonnes in 2021. China was the leading producer, with a share of about 61% which is followed by Mozambique (11%), Madagascar (0.083%), India (0.06%) and Brazil (0.05%) (*IBM, Mineral Year Book-2023).*

1.3.0 As per NMI database, based on the UNFC system, the total reserves/ resources of graphite as on 1.4.2020 have been placed at about 211.62 million tonnes, out of which 8.56 million tonnes are in the Reserves category and 203.6 million tonnes are placed under Remaining Resources category. Resources containing +40% fixed carbon constitute about 2.91 million tonnes and resources analysing 10–40% fixed carbon constitute 43.98 million tonnes. The balance 164.73 million tonnes fall under ‘Beneficiable’, 'Others', 'Unclassified' and 'Not-known' grades. Arunachal Pradesh accounts for 36% of the total resources which is followed by Jammu & Kashmir (29%), Jharkhand (9%), Odisha (9%), Madhya Pradesh (5%) and Tamil Nadu (4%). However, in terms of reserves, Tamil Nadu has the leading share of about 36% followed by Odisha (33%) and Jharkhand (30%) of the total reserves.

1.4.0 Graphite mines, except a few underground mines, are mostly small and opencast. Palamu and Garhwa districts are the principal graphite producers in Jharkhand, with localities like

Satbarwa, Mansoti, Bishrampur, and others marked for graphite mineralization; Nawapara & Balangir districts in Odisha; and Madurai & Sivagangai districts in Tamil Nadu. Most graphite deposits in Palamu are of low grade, but some localities show concentrations of floatable flaky graphite with fixed carbon content ranging from 5-20%. Overall reserves in Palamu are among the highest in Jharkhand.

1.5.0 The Ministry 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, lubricant sand fuel cells for EVs (Electric Vehicle). Based on the Report on Critical minerals for India, June 2023 India has 9 million tonnes of graphite reserve (Production reported from 12 mines). 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.

1.6.0 BACKGROUND

1.6.1 In view of the enactment of the MMDR Amendment Act, 2015 (Amended 2015, 2020, 2021, 2025) and Mineral Auction Rule, 2015 (Amended 2021) by the Govt. of India, the State administration of Jharkhand 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 Palamu district in Jharkhand are among them.

1.6.2 The Ministry of Mines, Govt. of India is actively auctioning critical mineral blocks to boost domestic production and reduce reliance on imports. The Ministry of Mines has launched several tranches of auctions, with the sixth tranche offering blocks of minerals like Graphite, Vanadium, REE & RM, Cobalt, Manganese, Tin, Glauconite, Potash & Halite, Bauxite & Aluminous Laterite, Titanium, Rock Phosphate, Tungsten and Lithium. Among the graphite blocks explored by MECL, Babja, Biarpalli, and Salepali blocks have been successfully auctioned, while three others- Larambha, Kanaital and Bharatbahal in Balangir district Orissa are currently listed on the auction platform for VIth tranche.

1.6.3 GSI, DGM Jharkhand and other agencies carried out exploration in and around the proposed Bhaluani Kalan block for Graphite and associated minerals from 1945 to 2022 as shown in Plate-V. The exploration is still continuing in the Palamu district by DGM Jharkhand for Graphite commodity as extended programme at G2 an G3 levels in the State of Jharkhand.

1.6.4 MECL after discussion with DGM Jharkhand send letter no MECL/EXPL/File/DMG JH. /2025-26/50 dated 17.04.2025, requesting to accord consent to take up Reconnaissance Survey (G4) for Graphite, Vanadium and Associated Minerals in Bhalauni Kalan Block, District-Daltonganj (Palamu), Jharkhand.

1.6.5 In light of the above proposal for Reconnaissance Survey for graphite, vanadium and associated minerals in Bhaluani Kalan over an extent of 32.70 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 Bhaluani Kalan Block comprises of 32.70sq km area and lies in Bishrampur Taluka of Palamu District (Toposheet No: 63P16), Jharkhand. Bhaluani Kalan, Sankha, Kamt, Harhepa, Keshiar, Bandua, Gulali villages fall within the proposed area.

The Rajhara-Garhwa Road connecting Rajhara to Garhwa passes through the south-west corner of the block which merges onto Aurangabad-Rajhara-Daltonganj Road (NH139). The district headquarter Daltonganj is 55.00 km north-east of the block. The nearest Railway Stations is at Garhwa Road which is 11 km south-west of the proposed block. 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 Chainki Airport at Rerma, which is about 45 km north east of the block. The block proposed is bounded by latitude 24°12'35.39"N to 24°14'49.70"N and longitude 83°54'59.13"Eto 83°59'60.00"E (Plate No I).

Table 2.1

Coordinates of Corner Points of Proposed Bhaluani Kalan, Bishrampur Taluka, Palamu District, Jharkhand

Corner Points	WGS 1984 (DMS)		Area (sq km)
	Latitude	Longitude	
A	83°54'59.13"E	24°14'48.99"N	32.70
B	83°56'50.37"E	24°14'49.43"N	
C	83°56'52.39"E	24°14'32.69"N	
D	83°57'27.05"E	24°14'32.96"N	
E	83°57'28.04"E	24°14'49.70"N	
F	83°59'60.00"E	24°14'51.02"N	
G	83°59'60.00"E	24°12'35.39"N	
H	83°55'30.74"E	24°12'36.20"N	

2.2.0 PHYSIOGRAPHY AND DRAINAGE

2.2.1 The major part of the block falls in Hatai Khas Protected Forest. There are several high points in the forest area. The tributaries of Sojhghatiya Nala forms the main drainage fed by tributaries descending from the Hatai Khas Protected Forest and also from the surrounding plane. Tributaries of Sojhghatiya Nala which drains into North Koel River. The southwestern part of the block has maximum elevation of 550 m. The elevation of the block ranges between 220 m to 550 m. The area comprises of mostly gently undulating plane. The average elevation of the block is 300 m above MSL. Thick alluvium accumulated due to the network of drainage has helped the area to form cultivable land.

2.3.0 CLIMATE

2.3.1 The region experiences a subtropical climate marked by clear seasonal shifts. Summers, spanning March to May, are typically hot and dry, with temperatures ranging from 30°C to 42°C, and the highest heat occurring in May. The monsoon season, from June to September, brings intense rainfall, particularly in July and August, when precipitation often exceeds 300mm per month. This period is characterized by high humidity and frequent

thunderstorms. Winters, from December to February, are cool and dry, with temperatures between 10°C and 20°C, and occasional foggy mornings adding a crispness to the air.

2.4.0 FLORA AND FAUNA

2.4.1 The area under exploration is situated within a region renowned for its dry deciduous forests, riverine habitats, and seasonal biodiversity. The surrounding vegetation reflects a semi-arid, subtropical climate, supporting a variety of plant species. Dominant tree species include Sal (Shorea robusta), Mahua (Madhuca indica), Palash (Butea monosperma), Neem (Azadirachta indica), and Bamboo. The undergrowth features Lantana camara, Vetiver grass, and a vibrant display of seasonal wildflowers during the monsoon.

Proximity to the Palamu Tiger Reserve enriches the region's wildlife diversity. Among the mammals, one can find Spotted deer (Chital), Sambar deer, Wild boar, Indian fox, and jackals, with occasional sightings of leopards and sloth bears in denser forest zones. The avian population includes peacocks, parakeets, drongos, and kingfishers, along with migratory birds that arrive during the winter. Notably, the Indian roller, Jharkhand's state bird, is a frequent sight.

The area also hosts a range of reptiles and amphibians, such as monitor lizards, various snake species (both venomous and non-venomous), and frogs and toads that thrive during the rainy season. A rich variety of insects, including butterflies, beetles, and pollinators, adds to the ecological vibrancy, with seasonal swarms of dragonflies and fireflies enhancing the monsoon spectacle.

This diverse blend of flora and fauna plays a vital role in supporting local livelihoods, traditional medicinal practices, and agricultural activities.

3.1.0 REGIONAL GEOLOGY

3.1.1 The major part of the area under review is almost wholly composed of the gneissic and granitic rocks of the Chhotanagpur Granite Gneiss Complex (CGGC) of the Precambrian age. The older metamorphites include pelitic schist, quartzite, amphibolite, calcsilicate rocks and metabasics occurring as bands and inclusions within the gneissic rocks. Pegmatite and quartz veins are ubiquitous in nature. Basic and ultrabasic rocks representing younger intrusive have also affected the gneissic rocks at some places.

3.1.2 The younger sedimentaries are represented by Lower Gondwana sandstone, shale and boulder bed and unconformably overlie the Precambrian rocks. Based on the field relationship, a generalised geological succession of the area (After GSI) is given as follows:

Table: 3.1: Regional Geological succession (After GSI)

Age	Formation	Lithology
Permocarboniferous	Lower Gondwana	sandstone, shale &boulder bed
----------UNCONFORMITY----------		
Precambrian		Pegmatite & quartz veins Basic & Ultrabasic intrusives Granites, migmatites and Granite gneisses
		Amphibolite &metabasics Calc-silicaterock& Crystalline Dolomitic Limestone Quartzite Quartz-mica-tremolite schist and Biotite schist Quartz- sillimanite-graphite schist

3.2.0 GEOLOGY OF THE BLOCK

3.2.1 The proposed area is mainly covered by Granite Gneiss. Graphite mineralization is mainly found in Precambrain metamorphic terrains, especially in schistose rocks, granite gneiss, sillimanite-bearing schists, and quartzites. Flaky and crystalline graphite forms within feldspathic quartz-graphite-mica schists, granite gneiss, and sometimes in quartz veins or associated with pegmatite intrusions. The details of lithologies present in the block are described in the successive paragraphs.

3.2.1.1 **Quartz – Graphite-Mica Schist:** This is the main host rock for graphite mineralisation in the area. It occurs as bands, lenses and inclusions of varying dimensions within the gneissic rocks. The rocks are characterized by various components which are arranged in parallel bands exhibiting a schistose fabric. The foliation trend of the rocks varies from NW-SE to ENE-WSW with steep (60^{o} to 80°) southerly or northerly dips. Megascopically, the rocks are grey to black in colour medium to coarse-grained, soft but compact and consist chiefly of quartz, mica, feldspar and graphite in varying proportions. Quartz occurs in the form of small grains arranged in layers. Mica is found to occur as thin sheets which are transparent to translucent. Graphite is generally dispersed in the rock as minute grains and flakes. The rocks are feldspathised to varying degrees.

3.2.1.2 **Quartzite:** The quartzites are more common in the granite gneisses as bands, lenses and inclusions.

3.2.1.3 **Granite gneiss:** Granite gneiss is the most dominant rock type covering about 80% of the total area and is a part of the enormous body known as the Chhotanagpur Granite Gneiss. These occupy generally the low grounds in the area. The field relationship of the granite gneisses with the older metamorphites described above is quite clear from the presence of several inclusions of the older rocks within the former. The granite gneisses show wide variation from distinct to strongly gneissic types exhibited by alternating quartzo-feldspathic and mafic-rich bands attaining several centimeters in width. Sometimes the gneissic bands show contortions. The trend of the gneissic foliation varies from ENE-WSW to NW-SE with northerly or southerly dips. Megascopically, these are grey colored coarse to medium-grained rocks consisting of quartz and mostly grey feldspars with biotite as the chief mafic constituents. Field evidences suggest medium to high grade metamorphic facies for these rocks.

3.2.1.4 **Pegmatite and quartz veins:** Almost all the rock formations mentioned above have been intruded along foliation and joints by veins of pegmatite and quartz. The majority of the pegmatite veins in the area contain, apart from quartz, pink feldspars with occasional biotite. Quartz veins of varying sizes are quite common in the area. They are mostly emplaced along the foliation planes of the gneisses and schists. In the quartz -graphite mica schists, the quartz veins are closely associated with graphite. In general, the quartz veins of the area are milky white in colour.

3.2.2 **STRUCTURE**: The most important structural element noted in the area is the foliation, which is best display by the gneisses and the schists. Graphite occurs in well-defined bands or lenses, often along foliation planes or in zones affected by folding, shearing, or fracturing.

3.2.3 MINERALIZATION:

3.2.3.1 The area has experienced a high-grade regional metamorphism, in response to which, argillaceous, arenaceous, and calcareous rocks together with basic and ultrabasic rocks have undergone changes. The effects of regional metamorphism of these older rocks associated with the great masses of the granite gneiss are manifested in the form of complete recrystallisation and textural readjustment. Schistosity and gneissosity are predominantly developed in the metasediments and are often accompanied by concentration of alternating lamellae of quartzo-feldspathic and micaceous minerals.

3.2.3.2 Graphite mineralization is found as disseminated grains and flakes in well-defined zones or bands within granite gneiss and metamorphosed schistose rocks. The mode of occurrence and mineral association indicate graphite formation was at least partly syngenetic, formed during the regional metamorphism of its host rocks. The association of graphite with minerals like mica, garnet, and biotite in strongly metamorphosed schistose rocks highlights the importance of high-temperature and pressure processes.

3.2.3.3 During the recent preliminary field visit by MECL, 07 (seven) graphite-bearing surface samples were collected. The locations of these samples are detailed in Plate-IV.

3.3.0 PREVIOUS WORK AND RECOMMENDATION

3.3.1 Systematic geological mapping of the area (toposheet no. 73 A/2) was first carried out by Mukti Nath during the field season 1945-46. He also mapped the adjoining area in toposheet no. 73 A/5 during the field season 1951-52 and 1952-53. He recorded most of the graphite occurrences in these areas.

Later Modak undertook preliminary appraisal of the graphite occurrences of the district during the field season 1957-58 and submitted a list of graphite occurrences with short notes on important ores.

During the field season 1967-68 and 1968-69, S. Prasad carried out detailed investigation of the graphite occurrences falling in parts of toposheet nos. 73 A/1 and 73 A/5 including these occurrences encountered during the course of the present work. He indicated an inferred reserve of graphite to the order of 97,447.00 tonnes in the freehold areas.

The graphite bearing areas of Palamu district have also been studied by the officers of the State Department of Mines and Geology, Bihar from time to time. Based on the work done by the State Department of Mines and Geology, Bihar and the Geological Survey of India, the reserves of graphite in Palamu district have been tentatively calculated to 2.25 million tonnes upto a depth of 20 meters with average graphite content of 15% in the rocks (S.R. Rai, 1975).

3.3.2 In pursuance of the Field Programme of the Geological Survey of India for the year 1969-70 investigation for graphite in a part of Palamu district, Bihar from 1st April 1970 to the 10th of June, 1970. The report deals with the investigation for some of the reported occurrences of graphite in the Palamu district, Bihar. The investigation includes detailed geological mapping covering an area of 65 sq.km on a scale of 1:31,680, lying between latitudes N 23°55'00" and 24°00'00" and longitudes E 84°00'00" and 84°09'00" in Topo Sheet No.73 A/1.

Detailed mapping of the area around Temrain, Ajlatua and Chando revealed that graphite rich schist bands and lenses as well as veins of lumpy graphite occur in Ajlatua, Kui, and Parsakhar areas. Poor dissemination is found in Chando area but no graphitic bands are found in other areas. At Ajlatua, graphite occurs as veins and disseminations whereas in Kui-Parsakhar area it occurs as segregations and disseminations in felspathised quarts mica schists, granite-gneisses and calc-silicate rocks.

The graphite veins contain lumpy or massive graphite and occur either within the lenses of graphite bearing mica schist and gneisses or in their close proximity. Vein graphite is associated with quartz, feldspar, mica, and sometimes calc-silicate minerals and occurs as lumpy mass of flaky or acicular graphite. Disseminated flaky graphite is fairly evenly distributed in the schist and might have originated due to regional metamorphism of the carbonate minerals in the original sediments.

The formation of vein deposits is attributed to re-mobilization of the graphite contained in the metamorphosed schists at a later stage and its concentration and deposition at favorable

localities. The graphite veins found near Ajlatua, Kui and Parsakhar are of fairly large dimensions and of good grade and can be worked economically on a small scale. The deposits at Ajlatua and Parsakhar are being worked by private parties. It is difficult to find out the exact dimensions and extents of the individual veins without detailed pitting which will be profitable only with actual mining. However, probable extents of the veins have been indicated. Geophysical prospecting and limited drilling can also help in finding the extent of the known graphite bands and veins and may be tried by the parties.

However, the graphite rich schist bands in these areas can also be worked and beneficiated as they contain 20 - 25 per cent graphite flakes. A tentative reserve of about 28,000 tonnes of graphite is estimated in the deposits examined during the season. Detailed mapping and combing of the other remaining areas in Palamu district may be taken up to locate other workable graphite rich bands and veins.

3.3.3 In pursuance of progress report for the field seasons 1968-69 & 1970-71(part) Geological Mapping of Daltonganj Coalfield (main basin) Palamu District, Bihar on scale 1: 31,680.

The coal bearing rocks occur north of, Daltonganj town (24°02': 84°04') as an ovate patch covering about 75 sq. km. in area, roughly bounded by latitudes 24°01'30" and 24°13'30"N and longitudes 83°52'30" and 84°14'30"E and forms part of Survey of India Topo Sheet Nos.72 D/4 and 63P/16.

Daltonganj coals are normally of the high moisture and high volatile type and contain a variable percentage of ash. They fall under High Moisture Class I to Class III category as per Indian Standard Procedure classification. The coals are mostly dull, the predominant petrological constituents being durain and fusain with minor vitrain bands. In the Singra-Meral sub-basin all the coal seams have high moisture (5.9 to 11.2%) and medium to high volatile matter (25.6 to 35.9%) content.

Gari-Kathautia areas in the northern part of the coalfield. In the Rajhara area, an elongate zone of high rank semi-anthracitic coal is present within the workings of the Rajhara seam which is normally sub-bituminous in nature. Here a regular areal variation from low to high rank coal accompanied by a decrease in moisture content from over 10% to less than 1% has been recorded.

The Daltonganj Coalfield is a shallow basin, the coal seams being mostly thin and the coal is of high in moisture content though some are low in ash.

3.3.4 In pursuance of the Item No. NM/63 P, 64 M, 72 D, 73A/ ER/BHR/77/3 of the Field Season Programme of the Bihar (West) Circle, Geological Survey of India, for the Field Season 1981-82, geological studies on the re-appraisal of a part of Palamu district falling in parts of toposheet nos. 72 D/4, 73 A/1 and A/5 were carried out in the area of known graphite occurrences. The present work included large-scale geological mapping on 1:31,630 scale and collection of samples for analytical results.

On the basis of the present studies, the authors have been able to delineate the various lithounits including the granitoid complex, whose field relationships and lithology have been brought in greater details. Within the granitoids, the various units delineated are granite

gneiss, porphyroblastic gneiss and migmatites as four distinct varieties of massive to weakly foliated granites.

The graphite-bearing rocks are mostly concentrated in the eastern part of the area, where sillimanite zone of regional metamorphism has developed in the metapelites. On the other hand, graphite bearing rocks are scanty or absent in the western part.

The present study has revealed that graphite is not confined to one litho-unit. It is seen as a predominant constituent in the quartz-sillimanite-graphite schist occurring as disseminated grains and minute flakes, as disseminations/concentrations in the E-W trending quartzites, and as lumpy or crystalline variety in the pegmatoid veins. The pegmatoid veins carrying segregation of graphite are localised within the feldspathised quartz-sillimanite-graphite schist. Graphite appears to have been segregated along fractures within the pegmatites due to mobility from the adjacent graphitic schist.

The most favourable host rock for graphite in the area is quartz-sillimanite schist, which occurs as enclaves. These occurrences are closely associated with quartzites which form prominent E-W trending ridges in this area. Graphite schist bands are located mostly along the margins of these quartzite ridges. Two occurrences of graphitic schists are found about 2Nkm northeast of Dhabadih, Other smaller occurrences of graphite are found within the granite gneiss in this area.

The quartz-sillimanite schists carrying graphite vary in trend from E-W to NW-SE and show steep dips (70º -80°) due south. The foliation trend is conformable with the bedding traces in the quartzites. The bands of quartz-sillimanite-graphite schist vary in length from 30-600 km and in width from 20-100 m. The prominent bands are exposed in the area southeast of Murma east of Dulsulma, southeast of Dhabadih and northwest of Satbarwa. In some cases, close association of graphitic schist with calc-silicate rocks is observed. The area is rather free from effects of wide spread feldspathisation except locally as seen in the area SE of Dhabadih, here, graphite occurs mostly as disseminated grains and minute flakes. Graphite content in the rocks varies from 8-15% (V.E.). Most of the occurrences are leased out and mining activities are underway in respect of some occurrences having larger dimensions.

Besides the above mentioned three blocks of graphite occurrences in the eastern part of the area, only one occurrence of graphite bearing quartz-sillimanite schist has been noted in the western part of the area. The lensoidal band occurring within granite gneiss measures 0.5km in length having a maximum width of 150m. The strike of the foliation in the rock varies from NNW-SSE to NW-SE with 70°-75° westerly dips. Graphite content in the rock varies from 10-15% in the granite gneiss country. These metapelites are mostly concentrated in the eastern part of the area. Graphite is also seen occurring as lenses or bands at the margins of E-W trending quart, in Dulsulma-Dhabadih area. In some cases, graphite concentrated is locally seen within the quartzites. Field evidences suggest that graphite occurrences are closely associated with calc-silicate rocks.

From the analytical results of the samples, it is so that the graphite ores of the area are generally of poor grade. The fixed carbon content in the graphite samples varies from 7.65-

26.68%. As such, beneficiation would be required for upgrading the ores for commercial utilization.

3.3.5 In pursuance of final report on specialized thematic mapping of chhotanagpur gneissic complex (CGC) in the rajakhar-pinarahi sector for delineation of different CGC components and search of economic mineral deposit in parts of palamu district, jharkhand by GSI. Specialised Thematic Mapping (STM) on 1:25,000 scale was carried out during FS: 2018-19 over 350 sq. km. area bounded by laltitude: 24°17'05" N - 24°25'00" N and longitude: 84°00'42" E - 84°15'00" E in Toposheet no. 72D/3 in Palamu district of Jharkhand to delineate the different components of Chhotanagpur Gneissic Complex (CGC). w.r.t their stratigraphic relations, deformation and metamorphism, the stratigraphic position of different granitoids and older enclaves in CGC and search for economic mineral deposit.

The area suffered four phases of deformations (D**1** to D**4**) which is coeval with three metamorphic events (M**1**to M**3**). The general trend of gneissic foliation varies from EW to ENE-WSW. S2 is the most prominent schistosity, which trends EW to ENE-WSW, dipping moderately towards south. The first time reported "Ekta Pahari Shear Zone" is associated with D3 deformation.

Pyrite, chalcopyrite and pyrrhotite mineralisation observed within hornblende biotite granite (younger granitoid of CGGC) and peridotite may be targeted for base metal exploration. Enrichment of REE from 635 ppm to 1290 ppm are found in younger granite from Bairiadih and south west of Karma kalan, porphyritic granite from Ekta, migmatitic gneiss from Karma kalan and granite gneiss from north of Tenudih. One sample of gabbro shows encouraging value of 2.40 ppm of Ag from the west of Maradag and a granite gneiss sample shows 2.10 ppm of Ag from Lohrahi area.

The younger granite, porphyritic granite, migmatites from in and around Ekta, Bairiadih, south west of Karma Kalan and north of Tenudih are to be studied for REE mineralisation. The gabbro from Murumdag area has to searched for Ag mineralisation.

3.3.6 In pursuance of FS 2019-2020, AMD: Reconnaissance radiometric survey and geological mapping (1:25,000) along Untariroad-Rahla-Bishrampur-Chhipadohartract, Garhwa and Palamu district, Jharkhand (T.S. No. 63 P/15, P/16, 72 D/3 & D/4) with latitude & Assignment no. 3.1 (Code - 3019301): Reconnaitory core drilling to explore the sub- surface continuity of migmatite-hosted uranium mineralization, Karke area, Garhwa district, Jharkhand has been studied by officers of Atomic Mineral Division.

In view of encouraging results obtained in Karke–Chundi block;areas lying northeast of Karke-Chundi block along Untari road-Rahla-Bishrampur-Chhipadohar tract, has been taken up for locating possible continuity of radioactive pegmatoid leucosomes as well granite/pegmatite hosted uranium mineralisation by reconnaissance radiometric survey and geological mapping. Gneissic foliation is major structural fabric having general strike E-W to ESE-WNW with dip 40-85^{o} due south.

Reconnaissance radiometric survey and geological mapping over an area of 130sq.km. along Untari-Chhipadohar-Rahla-Bishrampur area, lying north-east of Karke-Chundi uranium mineralization, has led to the identification of several mixed U & Th (0.083% U3O8and 0.64% ThO2) to thoriferous anomaly (upto 0.038% ThO2) in biotite granite, granite-pegmatite, pegmatite which are found intrusive within granite-gneiss and migmatite of study area. Results obtained by radiometric survey work and laboratory studies are not so encouraging in context of Uranium mineralization. Therefore, future detailed work in this area is not recommended for migmatite and granite-pegmatite hosted uranium mineralization.

3.3.7 In pursuance of FS 2021-22, Reconnaissance survey for REE and Rare metals in and around Bangasi - Chhotahasa area, Palamu District, Jharkhand. (G4) was carried out vide FSP Id: M2ASMIF-MEP/NC/ER/SU-JH/2021/36529. The objectives of the geological investigation were “to search for REE & RM mineralization”.

During the fieldwork, large scale mapping on 1:12,500 scale was carried out in 100 sq. km area in part of toposheet No. 63P/16 in and around Chhotahasa-Bangasi areas. The mapped area of CGGC is a collage of litho-tectonic assemblages that has undergone polyphase deformation, metamorphism and magmatism. The lithology of the study area has been classified into three major subdivisions viz. (a) Unclassified Metamorphics (b) Chhotanagpur Granite Gneiss Complex components and (c) Younger Intrusives.

The large-scale mapping suggests that study area is exposed with variants of granitoids which contains small (few centimeters to large enclaves) of metasedimentary and mafic rocks, pegmatite, syenite and quartz veins. The lithounits belonging to unclassified Metamorphics occurs as enclaves within the gneissic country rock of CGGC. The unclassified Metamorphics unit is comprised of garnet-sillimanite schist, amphibolite, mica schist, grunerite-cummingtonite schist, felsic granulite, anorthosite and calc-silicate. These rocks are confined in the Central, Eastern and Southern part of the study area. The granite gneissic unit of Chhotanagpur Granite Gneiss Complex components covers around 75-80% of the mapped area. The gneissic components of CGGC encompasses migmatite gneiss, granite gneiss and hornblende-biotite granite gneisses. The trend of gneissic foliation of the granitic gneiss varies from WNW-ESE to NE-SW with a moderate to steeply dip towards north.

The granite gneiss has intruded the Unclassified Metamorphics and later migmatised. The migmatization is co-eval with deformational event. Since, migmatite shows layered structure of leucosome and its subsequent folding which the melt was present. The thickness of stromatic leucosome is more in the hinge portion. The pegmatite veins are mostly occurring as concordant or discordant veins and are sporadically present in the northern part of the study area but shows its absence in southern part of mapped area. Syenite unit is exposed in the southern area. Two variants of pegmatite have been deciphered based on field observation

Pegmatite-I: Trending northeast-southwest: This pegmatite unit has been intruded along S3 foliation. The width of the unit is less as compared to Pegmatite-II.

Pegmatite-II: Trending northwest-southeast. REE mineralization is expected in pegmatite-II-unit trending N55°W-S55°E. The unit is rich in potash feldspar. The concentration of allanite

has been observed in the central part of unit around Sukri PF. This unit is rich in K-feldspar. Pegmatite unit trending in N40°W-S40°E displays with angular graphic texture. The concentration of biotite was also noticed in the core part of the body.

The older metamorphic unit is highly associated with allanite. It is well observed in outcrop as well as petrographic studies. In petrographic studies, radiating features with hollow around grain boundary has been observed.

The study area has suffered three phases of deformation. The first episode was marked by tight isoclinal folding (F1) along NW–SE axial planes with the development of S1 foliation in unclassified Metamorphics. S2 Foliation have been developed in variants of granite gneiss by D2 deformational episodes. The last stage of deformation D3 has led to development of F3 folding.

The strong peraluminous nature (Shand, 1943) of the pegmatites and host rocks suggest it's protoliths as metasediment. Both the pegmatites and gneisses were derived from the partial melting of sedimentary rocks within the crust.

The analytical results of total REE content are not encouraging. The average ratios of K/Rb, K/Cs, Mg/Li and Al/Ga in the pegmatites samples doesn't fall under the fertile pegmatite ratios data, therefore the pegmatites are non-mineralized in REE and RM. The LREE rich allanite are present in host rocks such as anorthosite, felsic granulite but these REE bearing elements are not found in pegmatite unit. In initial stage, due to the presence of lower concentration of REE in the primary system, all the REE has been consumed in the crystal lattice of REE minerals like allanite during the later phase. Therefore, lower concentration of REE has been observed in the non-fertile pegmatites of late hydrothermal system in the study area.

The total REE content in the BRS samples are highly variable in nature. It ranges from 9.77ppm to 861.5ppm. The values of Rb ranges upto 1226ppm. The high amount of Rb in the studied pegmatites suggest the differentiated nature of granites. It may also be deduced that the different pegmatites may have evolved from variety of granitic rocks originate from the same magma. The concentration of LREE in BRS samples ranges from 4.71ppm to 619ppm and HREE ranges from 0.56ppm to 90.72ppm.

The concentration of total REE in stream sediment samples ranges from 28.03ppm to 1431.24. A total of four stream sediment samples from Talapara, Rabda and Karakath P.F. shows total REE values from 800ppm to 1400ppm. The concentration of LREE ranges from 17.30ppm to 1257ppm and HREE ranges from 2.73ppm to 72.88ppm.

The total REE content ranges in Regolith and C-horizon samples ranges from 131 ppm to 879 ppm. The concentration of LREE in samples ranges from 100ppm to 808.85ppm whereas the HREE ranges from 18.19ppm to 74.34ppm. The samples have also been categorized based on Regolith and C-horizon. The LREE in Regolith samples ranges from 119ppm to 594ppm whereas the HREE ranges from 19.76ppm to 65.46ppm. The total REE concentration in Regolith samples ranges from 141ppm to 659ppm. The concentration of LREE in C-horizon

samples ranges from 100ppm to 809ppm, whereas the concentration of HREE ranges from 19.88ppm to 74.34ppm.

3.3.8 In pursuance of the Geological report on exploration of graphite in Rewaratu block, Satbarwa, district-Palamu, Jharkhand by Directorate of Mines & Geology (DMG), Government of Jharkhand. The total block area is 27.78 Ha. The area falls under toposheet no. 73 A/5. The block is situated around 37 km south-east of proposed Bhaluani Kalan block. The trend (Strike & Dip) of mineralization zone of the area is NW- SE dipping 24^{o} to 60^{o} towards SW directions and NE-SW dipping 25º to 42º towards SE direction.

A total of 1846.50 meters of drilling was carried out in the area in 39 boreholes. The analytical result reveals that, fixed carbon content ranges between 2.00% to 20.23%. The total calculated G2 level (332) flaky graphite resources are 0.718 MT. Result shows that qualitatively the area is potential and good deposit of graphite is present in the area. The Rewaratu Graphite block had been auctioned under ML category by Govt of Jharkhand.

3.3.9 In pursuance of the Geological report on exploration of graphite in Lesliganj graphite block, district-Palamu, Jharkhand by Geological survey of India (GSI) & Directorate of Geology, Bihar/Jharkhand. The block has been situated around 31 km towards SE part of proposed Bhaluani kalan block. The area falls under toposheet no. 72 D/04. The total block area is 94.521 Ha. The trend (Strike & Dip) of mineralization zone of the area is NS & NW- SE with dips varying from 55º to 84º SE.

A total of 622.05 meters of drilling was carried out in the area in 16 bore holes. The analytical result reveals that, fixed carbon content ranges between 2.197% to 29.153%. The total calculated G2 level (332) graphite resources are 0.669 MT. The Lesliganj Graphite block had been auctioned under ML category by Govt. of Jharkhand on 01.08.2018 at final bid of 75.00%.

3.3.10 In pursuance of the Geological report on exploration of graphite in Dulsulma graphite block, Satbarwa, district-Palamu, Jharkhand by Directorate of Mines and Geology, Govt. of Jharkhand. The area falls under toposheet no. F45A5 part & G2 level of exploration has been carried out in 36.29 Ha area. The block is around 41km away from proposed Bhaluani kalan block in SE direction. The trend (Strike & Dip) of mineralization zone of the area is Strike – SW – NE & NW – SE, Dip – 26° - 85° towards SE & Dip – 72°-83° towards SW.

A total of 1004.50 meters of drilling was carried out in the area in 23 bore holes. The analytical result reveals that, average fixed carbon content is 7.78 %. The total calculated G2 level (332) graphite resources are 1.48 MT. The Dulsulma Graphite block had been auctioned under ML category by Govt. of Jharkhand on 01.03.2019 at final bid of 149.20%.

3.3.11 In pursuance of the Geological report on exploration of Graphite in Ponchi block, Satbarwa, district-Palamu, Jharkhand by Directorate of Mines & Geology (DMG), Government of Jharkhand, field session 2015-16 & 2016-17, geological exploration work has been assigned for the exploration of graphite. The block is situated around 37 km south-east of proposed Bhaluani Kalan block. The area falls in toposheet number 73 A/1. Geological Mapping work has been done in the year 2000-01. Later this area was taken up for making the Mineral

Block for Auction. Altogether 0.10 sq km area has been mapped on 1:2000 scale and total 100 samples were collected from the area. Out of which, 33 graphite schist samples were collected from the surface, trenches, pits and old abandoned pits. Rest 67 samples are core samples. 2 trenches and 2 pits were excavated in the area. The trend (Strike & Dip) of mineralization zone of the area, Strike - N40^{o} – N166^{o}, Dip – 60^{o} - 76^{o} towards NE to SE Graphite is present as vein deposit in Sillimanite-Biotite-Graphite schist in this area.

Drilling work has been carried out in the area during field season 2016-17. A total of 270.00 meters of drilling was carried out in the area on 5 bore holes. As per the Geological Report, the analytical result of surface samples reveals that, fixed carbon content ranges between 3.55% to 46.28% and in core samples it ranges between 2.03% to 10.51%. Result shows that qualitatively the area holds potential for good graphite deposit.

Total resource of flaky graphite of 0.2429 million tonnes has been estimated under G2 level (332) of exploration with an average grade of fixed carbon 6.83. The Ponchi Graphite block (Area-10 Ha) was auctioned under ML category by MoM, Govt of India on 22.10.2024 at a final bid of 752.05%.

3.3.12 There are other prospective Graphite blocks in district Palamu, Jharkhand where DMG Jharkhand is doing exploration at various stages namely Punardih Block (37 Ha, G2), Chanpi Block (110 Ha, G2), Chanpi-II Block (100 Ha, G3), Bhang Parasia Block (75 Ha, G3), Sokra Block (100 Ha, G3), Ghutuwa Block (35 Ha, G3) and Sikat Block (100 Ha, G3). The said blocks will be in due course put up for auction by the Govt. of India.

4.0.0 OBJECTIVE OF THE PROPOSED RECONNAISSANCE SURVEY (G-4 STAGE)

4.1.0 The present exploration program (G4) has been formulated on the basis of the outcomes of previous work and recent field traverses to fulfill the following objectives:

i. Geological mapping on 1:12,500 scale to delineate graphite bands and other lithounits in the area.
ii. Delineation of the potential subsurface mineralized zones by Geophysical Gamma Ray Spectrometric, Magnetic, Induced Polarization (IP) cum Resistivity and Self-Potential (SP) Surveys.
iii. 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.
iv. After the positive outcomes of the above activities scout drilling will be carried out to intersect the graphite and associated mineralization at 50m vertical depth.
v. Assessment of quality and quantity of the resources (334) if any as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015 (Amended 2021).

5.0.0 PLANNED METHODOLOGY

5.0.1 In accordance to the objective set for Reconnaissance Survey (G-4) of the block, the following exploration programme is proposed. The exploration shall be carried out as per Minerals (Evidence of Mineral Contents) Rule-2015 (Amended 2021). 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

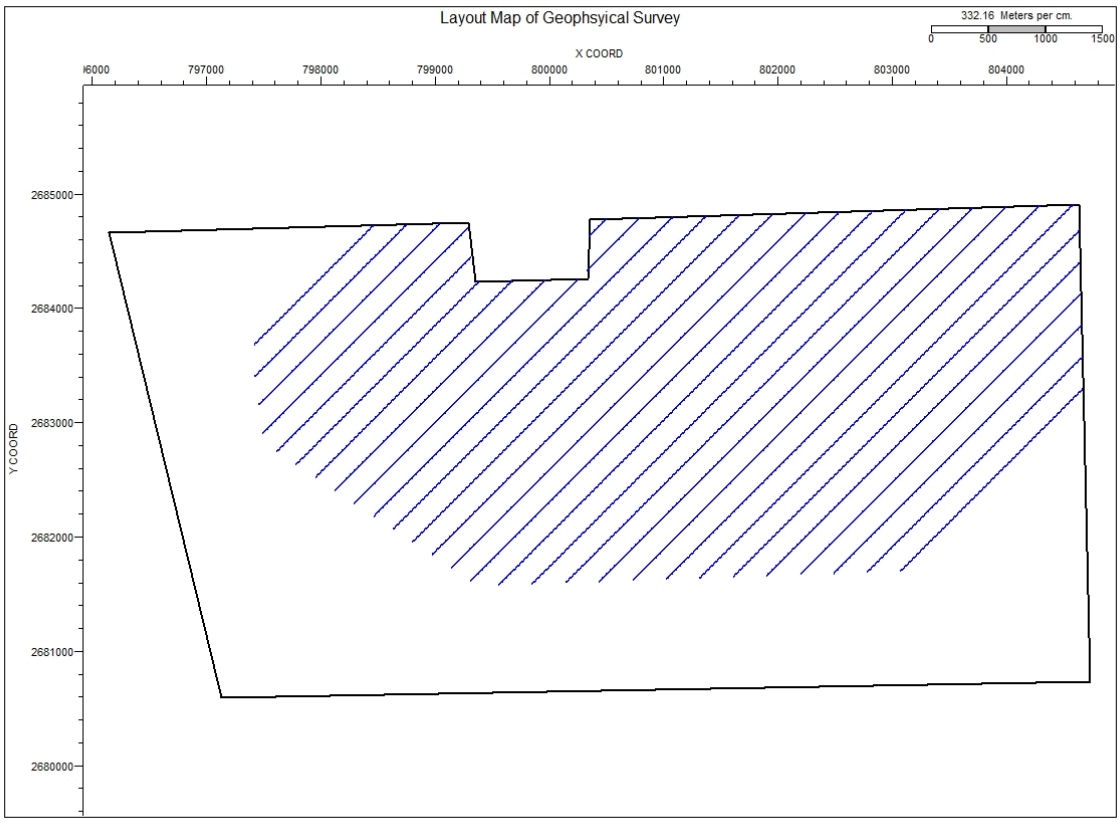
5.1.1 Geological mapping will be carried out in the 32.70 sq.km area on 1:12,500 scale. Rock types, their contact, structural features will be mapped. Surface manifestations of the graphite and associated mineralisation along with their surface disposition will be marked on map. 50 nos. of bedrock samples will be collected from surface exposure of graphite for proximate analysis of graphite (i.e. Fixed Carbon (FC), Ash (A), Moisture (M) and Volatile Matter (VM)) and 05 nos of samples for XRF analysis of major oxides (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, PbO, SO_3, MnO, P_2O_5, V_2O_5, LOI). Around 10% of Primary samples i.e. 05 numbers of sample for Graphite 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)). 10 numbers of surface samples of various lithounits will be studied for petrography and minerography.

5.2.0 GROUND GEOPHYSICAL SURVEY:

5.2.1 The primary objective of the geophysical investigation is to delineate graphite-bearing zones, estimate their spatial extent, and provide detailed subsurface geological interpretations by integrating multiple geophysical methods. Graphite mineralization generally occurs in graphitic schists, gneisses, and carbonaceous rocks, which display distinctive physical

properties compared to the surrounding host rocks. Graphite-bearing schists are typically associated with bands of quartzite, calc-granulite, meta-gabbro, and amphibolites, all enclosed within a gneissic country rock. Based on the general occurrence of graphite and local geology, an integrated geophysical approach involving I.P Cum Resistivity, S.P and Magnetic and Gamma ray Spectrometric survey methods is proposed to effectively investigate the area.

Gamma Ray Spectrometric survey will help to identify the felspathic rock zones in which the Graphite, REE's, RM's and associated mineralization are associated. Further the alteration zones can be easily identified with Gamma ray Spectrometric survey which in turn will help to identify the most promising area suitable for mineralization zones in complex geology. The Geophysical Survey target area is approximately 10 sq km identified after detailed geological mapping in the proposed 32.70 sq km. The surface geophysical survey design will involve Line Interval of 100 m, Station Interval of 10 m, Gamma ray Spectrometric for 5000 stations and Magnetic, Resistivity, IP, SP Surveys for 100 Line Kilometers (Lkm).



5.2.2 Based on Gravity and Magnetic data available on the NDGR Portal, it was observed that the data were acquired at approximately 1.5 km station intervals. Within the block, only about four gravity stations and five magnetic stations are present, and their locations do not coincide. The data density is therefore insufficient for a reliable interpretation, even at a regional scale within the proposed block area.

However, an attempt was made to extract preliminary information from the available dataset. Both gravity and magnetic data indicate the presence of a possible geological contact or lithological variation trending in the NW–SE direction. The northeastern part of the block exhibits relatively high gravity and moderate to high magnetic anomalies, suggesting a possible change in lithology and potential mineralization zones.

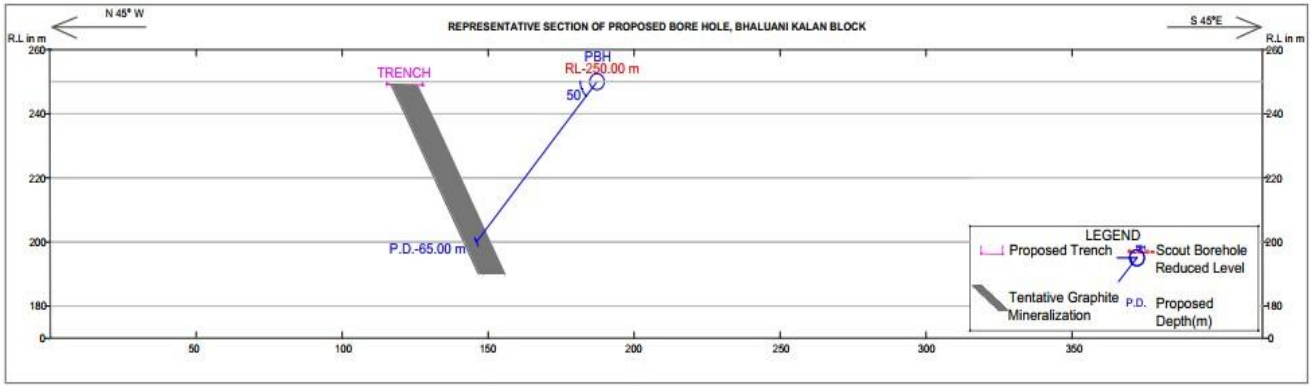
Hence, a detailed geophysical investigation with closer station spacing is recommended within the block to achieve a more accurate subsurface interpretation.

5.3.0 TRENCHING

5.3.1 10 trenches (200 cum) have been proposed in the area to ascertain the continuity of graphite and associated mineralization identified during the surface geophysical survey. A mineralized length of maximum 10m is estimated to be intersected in the trenches. The maximum numbers of samples collected from each trench is 10 including the mineralized zone, hanging wall and footwall. A total of 100 Nos of primary samples would be collected from 10 trenches & 10% of Primary samples i.e. 10 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)).

5.4.0 EXPLORATORY DRILLING

5.4.1 Based on the positive outcomes of geological mapping, sampling, geophysical survey and trenching, boreholes will be planned to establish subsurface continuity of mineralization. A total 500m scout drilling will be carried out in the graphite and associated mineralized zones identified by geological mapping, geophysical survey and trenching. The boreholes will be planned to intersect at 50 m vertical depth from the surface. The total estimated mineralization to be intersected in each borehole is 10 m. 10 nos of samples from each borehole (mineralized zone, hanging wall and footwall) will be collected for primary sampling.



5.6.0 CORE LOGGING

5.6.1 The borehole cores would be logged systematically viz. details of the lithounits, color, 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 and associated mineralisation will be analysed for Fixed Carbon (FC: Non-carbonate), Ash, Moisture and Volatile Matter (VM) (Proximate Analysis for 4 parameters) and major oxide concentration (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, PbO, SO_3, MnO, P_2O_5, V_2O_5, LOI) 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.

10 nos of samples from each borehole (mineralized zone, hanging wall and footwall) will be generated as primary samples. A total 200 numbers of primary core samples will be analyzed for graphite mineralization (FC: Non-carbonate, Ash, Moisture and VM) and 20 samples for oxide concentration (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, PbO, SO_3, MnO, P_2O_5, V_2O_5, LOI). Around 10% of Primary samples i.e. 20 numbers of sample for Graphite will be sent to NABL External Labs for analysis of graphite mineralization (FC: Non-carbonate, Ash, Moisture and VM) and 2 samples for major oxide concentration (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, PbO, SO_3, MnO, P_2O_5, V_2O_5, LOI) as external check samples.

5.8.0 RAMAN SPECTROSCOPY

5.8.1 05 samples are kept for Raman Spectroscopy is proposed to assess the physical properties of graphite in 04 hrs of sample study.

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 DENSITY

5.10.1 A provision of 5 samples for density determination has been kept.

6.1.0 QUANTUM OF WORK:

6.1.1 The quantum of work proposed by MECL in Bhaluani kalan Area (G-4 Stage of Exploration) is given in Table 6.1.

Table: 6.1

Proposed Quantum of Exploratory Work in Bhaluani Kalan Block, District-Palamu, Jharkhand.

Sl. No.	Item of Work	Unit	Proposed Quantum of work
1	Geological Mapping (1:12500)	sq. km	32.70
2	Geophysical Survey		
i)	Gamma ray Spectrometric survey	Stations	5000
ii)	Magnetic, IP, Resistivity & SP Surveys	Line km	100
3	Trenching (2m x 1m x10m) x 10 trenches	Cu. m	200
4	Scout Drilling	m.	500
5	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) (50 Bedrock + 100 Trench + 100 Borehole)	Nos.	200
ii)	Primary Samples for Vanadium element (25 Bedrock + 50 Trench + 50 Borehole)	Nos.	125
iii)	External Check sample (10 % of Primary samples) for Graphite for 4 parameters (5 Bedrock + 10 Trench + 10 Borehole)	Nos.	25
vi)	External (10%) Check samples from NABL Lab for primary sample analysis of Vanadium element (3 Bedrock + 5 Trench + 5 Borehole)	Nos.	13
iv)	XRF analysis for major oxides (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, PbO, SO_3, MnO, P_2O_5, V_2O_5, LOI) (5 Bedrock + 15 Borehole)	Nos.	20
v)	External (10%) Check samples from NABL Lab for XRF analysis for major oxides (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, PbO, SO_3, MnO, P_2O_5, V_2O_5, LOI)	Nos.	2
vii)	ICP-MS (sequential technique) for 34 elements (Li, Sc, Ti, V, Co, Ni, Ga, Rb, Sr, Y, Zr, Nb, Ge, Cr, Sn, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ta, W, Hf, Zn)	Nos.	25
6	Raman Spectroscopy	Hrs.	4
7	Petrographic Studies	Nos	10
8	Mineragraphic Studies	Nos	10
9	Density	Nos	5
10	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 Reconnaissance Survey (G-4). The work activities like camp setting, geological work, geophysical survey, drilling & laboratory work, report writing will be completed within 10 months' time. The bar chart showing activities wise time schedule is placed at **Table-6.2.**

Table-6.2.

Sl.	Particulars	Months	1	2	3	4	5		6	7	8	9	10
1	Camp Setting/ mobilization	Months											
2	Geologist days	days											
3	Geophysicist days	days											
4	Trenching	days											
5	Drilling	m											
6	Sampling days	days											
7	Camp winding	Months											
8	Laboratory Studies	days											
9	Geophysicist days	days											
10	Geologist days, HQ	days											
11	Report Writing with Peer Review	days											
NOTE:													
1	**Commencement of project may be reckoned from the day the exploration acreage is available along with all statutory clearances.**												
2	**Time loss on account of monsoon/agricultural activity/forest clearance/local law & order problem/ lockdown etc. will be additional to above time line.**												

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. 461.83 Lakhs.** 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 Reconnaissance Survey (G-4) in Bhaluani Kalan Block

Sl. No.	Item	Total
1	Geological Work	35,60,940
2	Geophysical Work	2,47,56,930
3	Trenching	6,66,000
4	Drilling	68,29,500
5	Laboratory Studies	16,70,341
	Sub total	**3,74,83,711**
6	Report	11,24,511
7	Peer Review	30,000
8	Proposal Prepration	5,00,000.00
	Total	**3,91,38,223**
9	GST (18%)	70,44,880.06
Total cost including 18% GST		**4,61,83,103**
SAY, in Lakhs		**461.83**

7.0.0 JUSTIFICATION

7.1.0 The proposed block has been carved out on the basis of different ML Graphite blocks in the vicinity of Bhaluani Kalan Block. The blocks namely, Rewaratu, Dulsulma, Lesliganj &Ponchi Graphite blocks (Palamu district) G2 level exploration has been done by DGM Jharkhand. All the blocks lie around 37 km SE of the proposed block.

7.2.0 There are other prospective Graphite blocks in district Palamu, Jharkhand where DMG Jharkhand is doing exploration at various stages namely Punardih Block (37 Ha, G2), Chanpi Block (110 Ha, G2), Chanpi-II Block (100 Ha, G3), Bhang Parasia Block (75 Ha, G3), Sokra Block (100 Ha, G3) and Ghutuwa Block (35 Ha, G3).The said blocks will be in due course put up for auction by the Govt. of India.

7.3.0 Reconnaissance survey of Graphite, Vanadium and associated minerals in Tulbula-Arapur of Palamu districts, Jharkhand (G4 Stage) currently taken up by GSI (2024-25) in 100 sq km in adjacent area of the proposed MECL block. Also, an abandoned graphite mining lease in the name of Pachgurha Khurd, Palamu district, Jharkhand in an area of 3.40 Ha lying in the northern side of the proposed block.

7.4.0 During MECL's initial field visit, the presence of graphite mineralization on the surface was validated by some exposures in the area. In the strike extension area however, the mineralization was concealed beneath a thick soil cover. Therefore, exploration methods such as geophysical surveys and trenching will be helpful to identify the subsurface mineralized zones and enhance the graphite resource within the proposed block. A total of seven graphite surface samples were collected from the area, and the analytical results of the bedrock samples are presented below:

Sl. No.	Sample No.	Moisture%	Ash%	VM%	FC%
1	SG-01	1.20	78.80	5.60	14.40
2	SG-02	1.80	75.40	7.50	15.30
3	SG-05	0.70	86.20	2.50	10.70
4	SG-06	1.40	78.00	14.00	6.60
5	SG-07	0.50	87.80	3.10	8.60
6	SG-08	0.30	90.70	1.90	7.10
7	SG-09	0.30	90.20	2.90	6.60

The given surface samples as above were also subjected to analysis for 34 elements through ICP-MS and anomalies were found out in Vanadium (V), Zirconium (Zr), Strontium (Sr), Rubidium (Rb) and ∑REE+Sc+Y as given below:

Sl.No.	Sample No.	Vanadium (V) ppm	Zirconium (Zr) ppm	Strontium (Sr) ppm	Rubidium (Rb) ppm	∑REE+Sc+Y
1	SG-01	483.39	274.47	151.24	187.65	329.44
2	SG-02	459.49	113.51	136.80	171.69	315.85
3	SG-05	161.64	145.46	117.37	91.99	294.42
4	SG-06	196.69	107.99	182.16	77.18	295.38
5	SG-07	62.42	256.20	74.93	136.80	259.27
6	SG-08	665.85	280.08	84.42	201.79	189.99
7	SG-09	913.90	268.81	99.25	207.89	249.69

The above anomalous values are corroborating well with the NGCM values (stream sediments samples) downloaded from NGDR portal as depicted in the anomaly map shown in the plates enclosed (Plate VIII,IX,X,XI & XII). The ∑REE+Sc+Y in and around the proposed block shows values ranging from 189.99 to 945.00ppm showing average value of 666.27ppm. The Rb values ranging from 77.18ppm to 244.00ppm showing average value of 133.31ppm. The V values ranging from 62.42 to 913.90ppm showing average value of 303.61ppm. The values of Zr 107.99ppm to 1985.00ppm showing average value of 667.42ppm and the values of Sr ranging from 38.00ppm to 305.00ppm showing average value of 123.22ppm.

7.6.0 At present graphite is a critical mineral for the nation. Hence, the proposed Reconnaissance Survey (G-4) will help to establish the vertical and lateral extension of Graphite and Associated mineralization in the current block, which will definitely augment the Graphite resource (334) along with other elements if any in the proposed Bhaluani Kalan Block.

8.0.0 References:

- Report on the Graphite Investigation in the Palamau District, Bihar. Progress Report for the (Field Season 1969-70) by Shashidhar PrasadGeological Survey of India Bihar Circle Patna. (April,197l)
- A Report on the Geological Re-Appraisal of a Part of Palamau District, Bihar, in connection with Graphite Investigation (Progress Report on the Field Season 1981-82) P.K. Sinha (P.T.) N. Dayal, Geologists (Jr.) And S.K. Ghosh, Asstt. Geologist Geological Survey of India Erstwhile Bihar (West) Circle Patna (1986)
- Reconnaissance Survey for REE and Rare Metals in and around Bangasi-Chhotahasa Area, Palamu District, Jharkhand. (Stage: G-4) Final Report for Field Season 2021-22 by Gladson Bage, Senior Geologist Biswajit Bharali, Geologist Geological Survey of India Mission-II State Unit: Jharkhand, Ranchi Eastern Region Ranchi November, 2022
- Reconnaissance Survey of Graphite, Vanadium and Associated Minerals in Tulbula-Arapur Area of Palamu Districts, (Field Season 2024-25), Geological Survey of India Mission-II State Unit: Jharkhand, Ranchi Eastern Region Ranchi (Ongoing).
- Annual report of Untari-rahla-bishrampur-chhipadohar area, Garhwa & Palamu district, Jharkhand CGGC investigations, AssignmentCode:3019301/3019302 field season: 2019-20. Atomic Mineral Division, Nikhil Porwal, SO/D, N.R.R.Ecka,SO/F
- A report on the investigation for coal by drilling in Daltonganj coalfield Bihar, field seasons 1968-69 & 1970-71(part), Geological Survey of India, by S. K. Chakraborti, Geologist (sr.) And Amit b. Dutt, Geologist.
- Final report on specialized thematic mapping of Chhotanagpur gneissic complex in the rajakhar-pinarahi sector for delineation of different CGC components and search of economic mineral deposit (if any) in parts of Palamu district, Jharkhand. By, Rana Shil, Sr.Geologist & Biswajit Bharali, Geologist.
- Mineral Block Summary of ML Graphite Blocks in Palamu district,Jharkhand.

9.0.0 List of Plates:

001 Plate-I: Location Map showing Bhaluani Kalan Block in Toposheet no. 63P/16, Palamu District, Jharkhand.

002 Plate-II: Regional Geological Map with BRS samples Fixed Carbon (FC) values showing Bhaluani Kalan Block (Source: NGDR, GSI).

003 Plate-III: Google Earth Map showing Bhaluani Kalan Block with BRS Sample Location, Palamu District, Jharkhand.

004 Plate-IV: ML Graphite blocks wrt proposed Bhaluani Kalan Block

005 Plate-V: Other Exploration Blocks wrt Proposed Bhaluani Kalan Block

006 Plate-VI: Gravity & Magnetic NGPM Data (Source: NGDR, GSI).

007 Plate-VII: Proposed Geophysical Layout Map in Bhaluani Kalan Block

008 Plate-VIII: Rubidium Anamoly Map (Source: NGDR, GSI).

009 Plate IX: Strontium Anamoly Map (Source: NGDR, GSI).

010 Plate X: €TREE+Sc+Y Anamoly Map (Source: NGDR, GSI).

011 Plate XI: Vanadium Anamoly Map (Source: NGDR, GSI).

012 Plate XII: Zirconium Anamoly Map (Source: NGDR, GSI).

10.0.0 List of Annexures:

i) Estimated Details of Tentative Cost for Reconnaissance Survey (G-4) for Graphite, Vanadium and Associated Minerals in Bhaluani Kalan Block (Area- 32.70 sq. Km), Palamu District, Jharkhand