PROPOSAL FOR PRELIMINARY INVESTIGATION (G-4 STAGE) FOR GRAPHITE AND AS SOCIATED MINERALS AROUND SONAGHATI, AMDOL, JHAREGAON & BHAYAWARI DISTRICT BETUL, M.P.

(7.34 Sq.Km Area)

COMMODITY: GRAPHITE

To

NATIONAL MINERAL EXPLORATION TRUST (NMET)
(Through DEPT. OF MINES & GEOLOGY,
GOVT OF MADHYA PRADESH)

Submitted by

GeoExpOre Pvt.Ltd

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September 2023

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(AS PER NMET FORMAT)

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SUMMARY OF THE BLOCK FOR PRELIMINARY INVESTIGATION FOR GRAPHITE AROUND SONAGHATI, AMDOL, JHAREGAON & BHAYAWARI VILLAGES, DIST. BETUL, M.P (G-4 STAGE)

GENERAL INFORMATION ABOUT THE BLOCK

	Features	**Details**
	Block ID	CR-023185:1.2013-14-Item Code:040/ME/GR/CR/MP/2013/029 2.2015-16-tem Code:068/ME/GR/CR/MP/2015/ 048
	Exploration Agency	GeoExpOre Private Limited
	Commodity	Graphite and associated minerals
	Mineral Belt	Betul belt, Madhya Pradesh
	Completion Period with entire Time schedule to complete the project	12 months.
	Objectives	Based on the evaluation of previous work and Geological data, the present proposed Preliminary Investigation (G4) has been formulated to fulfil the following objectives: ❖ To carry out Geological & structural mapping on 1:12,500 scale for demarcation of Graphite and associated mineral bearing formations (host rock) with the structural features to identify the surface manifestations and lateral disposition of the mineralized zones. ❖ To collect surface (Grab/Bedrock/soil/stream sediment) samples & proximate analysis for Graphite and decide further course of Exploration program. ❖ To carry out Ground geophysical survey Vertical Electro Magnetic (VES) Sounding, Electrical Resistivity imaging, SP and Magnetic to demarcate concealed Graphite mineralisation and associated mineral bearing formations. ❖ To carry out trenching for targeted areas to expose Graphite bearing formation concealed under soil.

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		❖ To carry out channel and trench samples collected from Graphite bearing formation to demarcate mineralised zones. ❖ To drill 10 scout boreholes up to 60m vertical depth to prove the strike and depth persistence of ore bearing formation mapped in the area which in turn will decide the future course of Exploration program at G-3 category of UNFC. ❖ To estimate reconnaissance of Graphite resources along with accessory elements as per UNFC norms and Minerals (Evidence of Mineral Contents) Rules-2015 at G-4 level
	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	The Geological Mapping, core logging and report writing will be carried out by GeoExpore Private Limited. Survey, Geophysical investigation and Drilling will be through outsourcing agencies, which are empanelled by NMET through GeoExpOre Pvt Ltd Surveying: Mr. Shri Saila, Sandur Drilling: GEO TECH EXPLORATION 51, Panchdeep Nagar, Wardha Road, Nagpur - 440024 Lab Tests: PSY PSN MY# Analytical & Quality Services Pvt Ltd , Vizag. Govt labs will used whenever required (HGML , IBM, NGRI, IIMT (CSIR) & GSI
	Name/ Number of Geoscientists	02 Geologists 01 Geophysicist 01 Hydrogeologist
	Expected Field days (Geology) Geological Party Days	Geologist Party days: 210 days Survey Party days: 90 days
1	**Location**	Sonaghati, Amdol, Jharegaon & Bhayawari villages, Betul District, Madhya Pradesh

<table>
<tr><td></td><td>Latitude & Longitude</td><td>
<table>
<tr><td rowspan="2">PROPOSED AREA BOUNDARY</td><td colspan="2">WGS 84</td></tr>
<tr><td>LATITUDE</td><td>LONGITUDE</td></tr>
<tr><td>A</td><td>N21^0 53′ 30.2 ″</td><td>E77^0 49′ 49.4″</td></tr>
<tr><td>B</td><td>N21^0 54′ 18.0 ″</td><td>E77^0 49′ 44.6 ″</td></tr>
<tr><td>C</td><td>N21^0 54′ 21.3 ″</td><td>E77^0 49′ 49.6 ″</td></tr>
<tr><td>D</td><td>N21^0 55′ 15.7″</td><td>E77^0 49′ 40.4 ″</td></tr>
<tr><td>E</td><td>N21^0 55′ 28.7 ″</td><td>E77^0 50′ 00.3″</td></tr>
<tr><td>F</td><td>N21^0 55′ 10.7 ″</td><td>E77^0 51′ 16.3″</td></tr>
<tr><td>G</td><td>N21^0 55′ 26.5 ″</td><td>E77^0 51′ 49.0″</td></tr>
<tr><td>H</td><td>N21^0 54′ 59.5 ″</td><td>E77^0 52′ 05.7″</td></tr>
<tr><td>I</td><td>N21^0 54′ 30.7″</td><td>E77 ^{0}50′ 56.9″</td></tr>
<tr><td>J</td><td>N21^0 54′ 07.7″</td><td>E77^0 50′ 28.3″</td></tr>
<tr><td>K</td><td>N21^0 53′ 35.6″</td><td>E77^0 50′ 15.5″</td></tr>
<tr><td>L</td><td>N21^0 53′ 34.8″</td><td>E77^0 49′ 55.2″</td></tr>
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</td></tr>
<tr><td></td><td>Villages</td><td>Sonaghati, Amdol, Jharegaon & Bhayawari villages,</td></tr>
<tr><td></td><td>Tehsil/ Taluk</td><td>Bethul</td></tr>
<tr><td></td><td>District</td><td>Betul district</td></tr>
<tr><td></td><td>State</td><td>Madhya Pradesh</td></tr>
<tr><td>2</td><td>Area (hectares/ square kilometres)</td><td>7.34 Sq.Km</td></tr>
<tr><td></td><td>Block Area</td><td>7.34 Sq.Km</td></tr>
<tr><td></td><td>Forest Area</td><td>~ 20% of the area under open mix Jungle</td></tr>
<tr><td></td><td>Government Land Area</td><td>Nil</td></tr>
<tr><td></td><td>Private Land Area</td><td>~80 % Agricultural Land</td></tr>
<tr><td>3</td><td>Accessibility</td><td>The area is about 5 km. NW of Betul town. The</td></tr>
</table>

.		National Highway NH46 is running to the East of proposed area
	Nearest Rail Head	Sonaghati (2 Km)
	Road	Jharegaon and Amdol villages are connected by motorable road which in turn connected to National Highway 46 and connected to Sonagati town
	Airport	Nagpur Airport Located at 180 km
4.	**Hydrography**	The surface water in the proposed area occurs in local ponds, reservoirs, Machna River which flows almost E-W around the proposed area
	Local Surface Drainage Pattern (Channels)	The drainage is mostly dendritic
	Rivers/ Streams	Machna river flowing EW located around 3-4 km in the South of the proposed area, which is tributary to Narmada River
5.	**Climate**	The area experiences a dry and temperate climate except during the south-west monsoon which sets in June and continues up to September.
	Mean Annual Rainfall	The annual Rail Fall recorded between 1085 mm
	Temperature (December) (Min) Temperature (June)(Max)	Minimum temperatures 11^0C Maximum temperatures 41^0 C
6	**Topography**	
	Toposheet Number	55G/13
	Morphology of the Area	The proposed area is generally flat with few hillocks in the NW part and SE part,the elevation vary from 655 m to 685 m
7	**Availability of baseline geoscience data**	
	Geological Map (1:50K/ 25K)	Geological map on 1:50,000 scale (Source: GSI Bhukosh)

	Geochemical Map	**Not Available**
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	**Not Available**
8.	**Justification for taking up Reconnaissance Survey / Regional Exploration**	a) The old workings for graphite from the area north of Betul, Tikari – Gauthana and Chiklar were first reported by J. Narayanmurthy (1958). The occurrence of graphite schist is confined within a narrow belt of muscovite-quartz schist, which is about 2 miles (3.2 km) x 100 ft (30 to 35 m). During FS 2012-13 prospecting for graphite was carried out in Tikari – Gauthana, and Chiklar areas and it was found that the graphite mineralisation is exposed discontinuously in the form of 3 lenticular bands disposed in en-echelon pattern over a strike length of more than 3.5 km trending ENE- WSW to NNE-SSW (Lenka. B & Ahmad. S A,2012-13) b) During FS 2012-13, Lenka B and Ahmad S.A(GSI), have carried out large scale mapping followed by detailed mapping in parts of Chiklar, Gauthana and Tikari areas. Delineated the graphite bands for a cumulative strike length of 3.5 km and the bands were divided into three segments viz, the southern (1450 m strike length), the central (550 m strike length) and the northern band (1350 m strike length). Further, Lenka B (FS 2013-14) has carried out exploration by drilling in the above said area by means of 07 boreholes in the area covering parts of the southern and central graphite bands, proving the 1.25 km strike length and estimated graphite resource of 4.73 MT (333) c) Based on the recommendation of investigation carried out during 2013-14, GSI during the FS-2015-16, carried out general exploration (G2) for graphite by close spaced drilling with deeper intersection was carried out in Tikari- Gauthana- Chiklar areas covering parts of toposheet no. 55G/13 in Betul district of Madhya Pradesh,over a strike length of 1.25 km. Also carried out detailed Geological Mapping in an area of 0.30 Sq.km on 1:2000 Scale and exploratory drilling approximately at 200 m

		interval for 2nd level of intersection, besides, the infillings of boreholes where ever possible for the first level of intersection. Thus, a total of 670 m strike length on the southern band and 530 m on the central graphite band was explored up to a vertical depth of 135m d) GSI investigations have indicated that , metasedimentories like quartz-mica schist and quartzite occur as linear ridges of variable dimensions within the gneissic complex in Sonaghati and Golighat areas. The quartz mica schist is the host rock for graphite mineralisation in the area. On the basis of occurrence of similar geological formation along the strike line, an area of 7.34 sq.km to the SW of GSI investigated blocks has been identified for the present preliminary Investigation program at G-4 level. Proposed exploration activities includes Geological Mapping & surface sampling combined with Ground geophysical survey Vertical Electro Magnetic(VES) Sounding, Electrical Resistivity imaging, SP and Magnetic in anomalous areas in conjunction with scout drilling will be helpful in assessing the disposition of the Graphite mineralized zones, structural features like shears and faults if any. 1. The Exploration will be helpful in delineation of Graphite and associated minerals and reconnaissance resources in the area. 2. The Reconnaissance Survey will help in planning of further detailed exploration programme in G-3 level.

Detailed description

1.0 Block Summary

1.1.0 Physiography

Geomorphologically, the area in the vicinity of the proposed area represents a generally flat (agricultural lands) with isolated hillocks in NW and SE portion of the proposed area occupied by linear ridges of gneissic complex flanked on both sides by low lying areas with quartz-mica schist, amphibolites and gneisses

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

1.2.1 Brief regional geology and structural framework

1.2.2 Regional Geology

Tikari-Gauthana-Chiklar area is located in the western part of Betul-Chhindwara belt, which extends from Chhindwara in the east to Chicholi in the west in the ENE-WSW direction. The Betul belt forms a part of the Central Indian Tectonic Zone (CITZ), and represents a Proterozoic mobile belt (Roy and Prasad, 2001). The Betul belt is of late Archean to NeoProterozoic age which is bounded by fault / ductile shear zones-the Son Narmada South Fault (SNSF) in the north and Goviligarh Tan Shear Zone in the south. The ENE-WSW trending Betul supracrustal belt forms a conspicuous litho-tectonic unit lying between Mahakoshal belt in the north and Sausar supracrustal belt in the south, extends for a length of about 135 km with an average width of 15 km from Chhindwara town in the east to Chicholi village in Betul district in the west and is composed of volcano-sedimentary rocks, intruded by mafic-ultramafic and granitic suite of rocks in that order (Srivastava and Chellani, 1995). The Betul belt is surrounded by younger Gondwana sediments and Deccan Trap from three directions and through a narrow NW-SE trending corridor along Kanha. The gneissic complex of Betul belt shows tectonic contact with the gneisses of Sausar Belt of Chhindwara district.

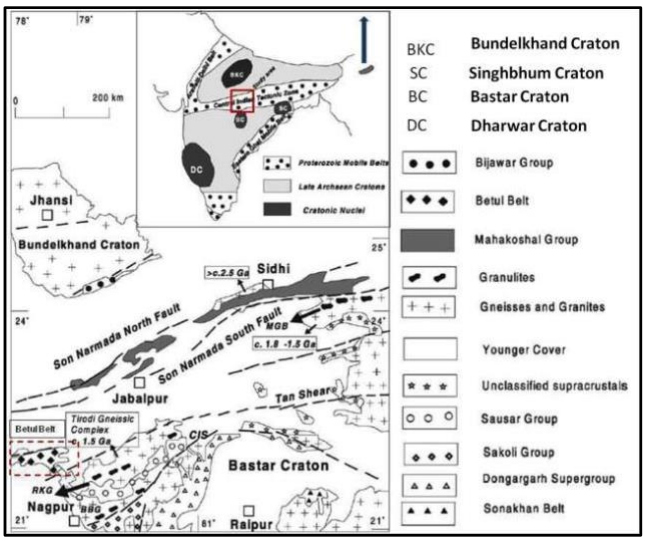

Figure:1-Geological map showing different components of CITZ. Bundelkhand and Bastar Craton and geological setup within and near CITZ, Data from various published geological maps, after Roy et al. 2002.

The litho-assemblage of the Betul belt comprises three distinct suites of rocks which are shown in Figure 2. The belt is traversed by a number of ENE-WSW ductile shear zones having sub vertical to steep dips towards north which were developed during deformation and shows low to medium grade metamorphism.

1) Supracrustal rocks, which include quartzites, metapelite, bimodal volcanics (basalt rhyolite) metaexalhites, calc-silicates and BIF which show evidence for shallow water sedimentation

2) Ultramafic- mafic suite, represented by pyroxenite – hornblende, pyroxenite – gabbro – diorite - quartz diorite association

3) Syn to post tectonic granitic suites

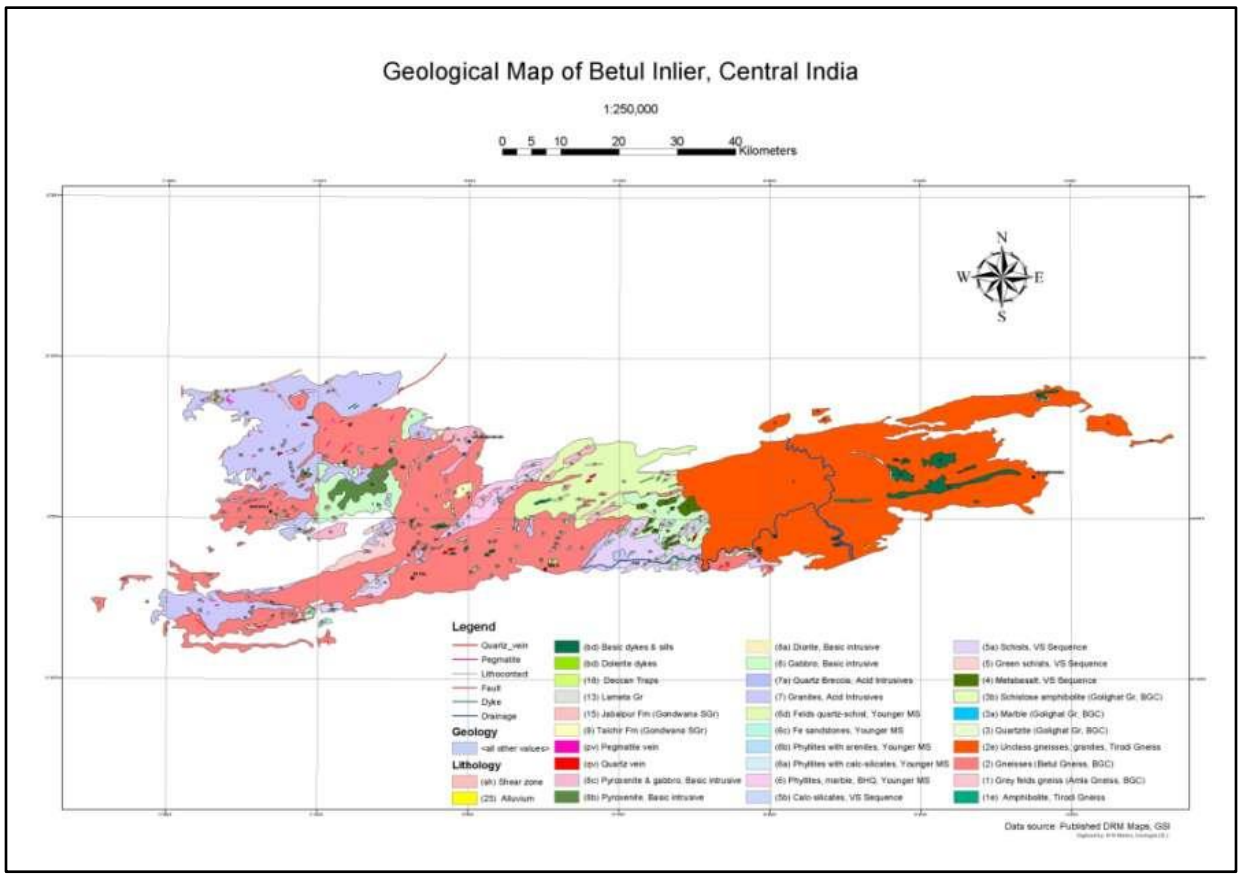

Figure:2-Litho-assemblage three distinct suite of rock of the Betul belt comprises (Ref. Chakraborty and Essakkimuthu (2006))

The Palaeo- Proterozoic older metasediments/supracrustals comprising graphite schist, marble, calc- silicates, tremolite- actinolite schist and quartzite are seen only in the western and north-western part of the belt around Sonaghati and Chicholi forming high ridges. These rocks are very well foliated and occur as enclaves within older granite gneisses. Mafic and ultramafic suite of rocks of possible Neo- Proterozoic age occurs in the western part of Betul Belt around Padhar which comprises gabbro, pyroxenite, dunite, peridotite, serpentinite etc. The lower to middle Proterozoic metasediments have developed on a sparse scale in the area and are represented by quartzites and schist. The meta sedimentary include quartzites, calcareous quartzites, quartz mica schist, graphite schist, carbon phyllite and marble and are continuous litho-units in the northern and western part of the Sonaghati ridge.

In recent past, workers like Parihar and Chellani (1992), Raut and Mehrotra (1992), Ramteke and Patel (1993), Srivastava and Patel (1994), Ramteke and Jadia (1994) and Srivastava and Chellani (1995), Mahakhud (1993) and *Mahakhud et.al.,(2001 a)* have brought out different characteristic features of the belt. *Mahakhud (1993)* provides a generalised stratigraphic succession of Betul belt is given in Table -1 below. (Ref;-*GSI-Report on Exploration for Graphite in Gauthana Block and*

Surrounding Areas, Betul district, M.P(G-3 stage) and A Report on General Exploration of Graphite in Tikri - Gauthana- Chiklar and Surround Areas, Betul District, M.P (G-2 stage)

Table:1-Generalised Stratigraphic succession of Betul belt (after Mahakud et al., 2000)(Source GSI)

	Formation	Lithology
Cretaceous	Deccan Traps	Basaltic flows
Late Proterozoic	Basic intrusive/Ultrabasic	Hornbiendite/gabbro/pyroxenite
	Acid intrusives	Granites/aplite/pegmatite/quartz vein
Middle Proterozoic	Younger meta sediments	Phyllites/quartz-mica schist, ferruginous quartzite/BHQ
	Volcano sedimentary sequence	Acid volcanics, meta rhyolite, tuff with intercalation of meta sediments like anthophyllite schist, calc silicate etc.
		Basic volcanics, pillowed and non pillowed meta basalt
Early Proterozoic	Granitoid complex	Granite gneiss, porphyritic gneiss, pillowed meta basalt
	Older meta sediments	Graphite schist, marble, calc silicate, tremolite-actinolite schist and quartzite
	Basement not seen	

The older meta sedimentary are confined to the western part of the belt around Betul Town, while granite gneiss is exposed to the west of Betul town around Amla and Morkha and the volcano sedimentary sequence comprising bimodal volcanics and intercalations of impersistent metasediments are mainly found in Kherli Bazar-Bargaon-Banskhapa areas in central and eastern parts of the Betul belt. Deccan Traps are exposed towards south and east, while Gondwanas border the Precambrian inliers towards west and north. On the basis of the litho assemblage Chaturvedi (2001) proposed a tectno-lithostratigraphic succession of Betul belt, which is given in Table-2 below.

Table:2-Tectano-lithostratigraphy of Betul belt (after Chaturvedi 2001)(Source GSI)

DECCAN TRAPS	Basaltic lava flows and dolerite dykes
GONDWANA SUPERGROUP	Mainly sandstone, shale and conglomerates with coal seams in some areas.

DECCAN TRAPS	Basaltic lava flows and dolerite dykes
Tectonic /Unconformable	
INTRUSIVES	Quartz veins, quartzo-felspathic veins, Pegmatite veins. Aplitic veins pink and grey granite
PADHAR MAFIC COMPLEX	Pyroxenite, gabbro and metabasics
BHOPALI GROUP	Dolomitic limestone, Phyllitic/calc-phyllites Ferruginous quartzite
INTRUSIVES	Crudely foliated granitePorphyroblastic/augen gneiss
BARGAON GROUP	Pillowed lava, basalt/apillitic/Komatite Chert rhyolite and associated volcano-clastics
GOLIGHAT GROUP	Kosmi Formation-quartz mica schist, actinolite-tremolite-chlorite schist, garnetiferous mica schist and linear bands of graphite schist Temni Formation-Lenses of calc-silicate, marble and carbonates Sonaghati Formation- quartz calcareous quartzite, micaceous quartzite
BETUL GNEISSIC COMPLEX	Amla gneiss with interbands of schists and amphibolites representing basement

Chakraborthy et al (2009) modified the tectono-stratigraphic succession of Betul belt and the same is given in Table-3

Table:3-tectono-stratigraphic succession of Betul belt (Chakraborthy et al 2009)(Source GSI)

DECCAN TRAPS	Basaltic lava flows and dolerite dykes
Intrusive contact / Disconformity	
GONDWANA SUPERGROUP	Conglomerate, sandstones, and shales
Unconformable / Tectonic Contact	

BETUL GROUP	INTRUSIVES	Basic dykes, pegmatites, quartz veins, homophanous amphibole-mica granite, porphyritic granite
	Intrusive / Tectonic contact	
	PADHAR MAFIC – ULTRAMAFIC SUITE	Diorite, epidiorite, gabbro, norite, pyroxenite, hornblendite, websterite, harzburgite, anorthosite, diorite, talc – serpentinite rock, quartz – epidote rock
	Intrusive / Tectonic contact	
	SONAGHATI FORMATION	Intercalated sequence of quartzite, quartz-mica schist and graphite schist
	Conformable / Tectonic contact	
	BARGAON FORMATION	Meta-sediments (mica schists), meta-rhyolite and felsic metatuff, metabasalt and amphibole – chlorite schist
	Conformable / Tectonic contact	
	RANIPUR FORMATION	Phyllite, banded hematite / magnetite quartzite, BIF, granulite, meta-basalt, amphibolites, carbonaceous phyllites, calcareous quartzite, calc-silicates, marble
Un-conformable / Tectonic contact		
AMLA GNEISS	BASEMENT ROCK	Banded migmatite gneiss,quartzofeldspathic mica schist /gneiss

(Ref;*-GSI-Report on Exploration for Graphite in Gauthana Block and Surrounding Areas, Betul district, M.P(G-3 stage) and A Report on General Exploration of Graphite in Tikri -Gauthana- Chiklar and Surround Areas, Betul District, M.P (G-2 stage)*

1.2.3 Geology of the area

Geologically, the area exposes graphite bearing quartz – muscovite-biotite-sericite chlorite schist, flanked on the east by discontinuously exposed quartzite and amphibolites whereas the western contact is defined by continuous occurrence of granite gneiss. In the southern part, the western contact of quartz- sericite- muscovite schist and granite gneisses are marked by discontinuously

exposed various small and large pegmatite bodies. Besides, a number of silicified zones are found within the quartz- sericite- muscovite schist

1.2.3.1 Granite gneisses

Granite gneisses occur as a major litho unit along the western contact of quartz – sericite-muscovite schist. The variants include pink porphyroblastic gneisses, homophanous pink biotite gneisses and quartzo feldspathic gneisses. The rocks are medium to coarse grained, grey, whitish grey, pinkish grey and well foliated which is defined by parallel arrangement of feldspars and flakes of biotite. At places, the gneissosity is highly obliterated due to the effect of shearing otherwise showing development of strong foliation. The foliation in the rocks is NE-SW with 50^{o} to sub vertical dips due NW or SE.

Figure:3 Foliation is defined by parallel arrangement of layers of quartz and feldspars and flakes of biotite exposed near south west of 787 peak near SE of Chiklar village(Source GSI)

1.2.3.2 Quartz- sericite- muscovite- biotite-chlorite schist

Quartz- sericite- muscovite- biotite-chlorite schist is a prominent unit among the older metasediments and occurs as a continuous band in the mapped area for the entire strike length. Quartz-mica-schist, the host lithology for graphite rests over the gneisses roughly aligned in ENE-WSW, with dips varying in amount and direction due to intense folding in the area. The western contact of quartz sericite- muscovite- biotite schist is largely defined by discontinuously exposed small and large pegmatite bodies.The contact between schist and gneisses is largely defined by intrusion of pegmatite.

Figure:4 Folding in quartz-muscovite-biotite schist, north of Gauthana village(Source GSI)

1.2.3.3 Graphite schist

Graphite schist occur within the quartz - sericite- muscovite- biotite schist in the form of 3 lenticular bodies disposed in en-echelon pattern over a strike length of 3.5 km. The width of the graphite bearing zone varies from 5 m to 135 m as depicted in the detailed map of the southern graphite band. The graphite schist mainly comprises of small flakes of steel grey graphite mixed intimately with muscovite flakes and ash grey powdery material. The foliation planes are well defined by compactly packed flakes of mica and graphite. Prominent concordant veinlets of quartzo-felspathic material and siliceous partings are well recorded in graphite-schist. The graphite bodies are mostly sub vertical to vertical, however shallower dips are also observed in the area of folding.

Figure:5 Graphite exposed in an old working (GSI Report)

1.2.3.4 Quartzite

Quartzite helps in building the structural history of the metasedimentaries, primary and secondary structures are well preserved within the quartzites. In the northeastern part, at places the sheared quartzite occurs as caught up patch within schists. This sheared quartzite band is exposed as a discontinuous lithounit in the southern band and as more or less continuous lithounit in the central band with an exposed width of less than 5 m to a maximum of 20 m. Thick bedded quartzite is particularly the characteristic of the top linear part of the entire Sonaghati ridge.

1.2.3.5 Amphibolite

Amphibolite occurs as thin linear bodies almost throughout the area and disposed parallel or sub parallel to regional foliation assuming concordant relationship with the rocks, exposed over a length of nearly 3.5 km with width varying from 80-120 m in NE SW direction. In general, these amphibolites are greenish to dark green in colour, medium grained and show development of foliation parallel to the foliation of the host rock. Two sets of foliation are prominent in amphibolites, one ENE- WSW and another in NE-SW direction, with varying dips both towards NW & SE.

1.2.3.6 Quartz veins

Quartz veins of various generations are emplaced in NNE-SSW direction.These veins are emplaced parallel to S1 as well as S2 foliations and also cutting across these two. The thinner quartz veins are emplaced parallel to the foliations, and the thicker quartz veins are confined to a very well defined zone.

1.2.3.7 Pegmatites

Pegmatites are composed of quartz, feldspar, muscovite and biotite books with little development of garnet in the pegmatite within the schist.Numerous large and small pegmatite bodies have been emplaced in the southwestern part of the area, mainly in the mica schists and granite gneisses with sharp contacts. The pegmatite veins/bodies occur more or less parallel to the regional strike of the rocks in NE-SW direction with a concordant relationship with the granitic and schistose rocks.

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1.2.4 Metamorphism and structural fabric in the area

Polyphase deformation in the Betul supracrustal rocks has been accompanied by corresponding metamorphism in order to make adjustment of mineral assemblages with changed temperature and pressure conditions. Metasedimentary rocks of the area represent the western part of the Betul inlier, which is highly deformed and regionally metamorphosed. Presence of various mineral assemblages suggest that the rocks have experienced regional metamorphism which is syntectonic to F1 deformation and is confined to upper green schist facies except in marginal areas, where calcareous metasediments close to granitoid /shear zones are thermally metamorphosed to calc silicate hornfelses. Widespread occurrence of Quartz + Orthoclase + Microcline + Muscovite + Biotite + Plagioclase + Perthite + Apatite + Zircon in the basement banded migmatite gneisses, Quartz + Plagioclase +Muscovite+Sericite+Chlorite+Feldspar+Calcite + Diopside + Epidote + Garnet + Sphene + Apatite Tremolite +Wollastonite + Opaques and Carbonate in the metasedimetaries of the Ranipur Formation and Quartz + Muscovite + Sericite + Opaques + Feldspar + Garnet+ Calcite+ Graphite in the metasedimentaries of the Sonaghati Formations is an indicative of a regional metamorphism of upper green schist facies to amphibolite facies

Betul belt in Central India is located between Son-Narmada and Tapti lineaments which trend roughly ENE-WSW. Primary structures in the area are well preserved by quartzites and are represented by colour banding defined by alternate pink, grey and greyish white bands and compositional banding defined by alternate siliceous and ferruginous bands. Bedding is preserved at few places but schistosity (S1) is prominent in quartz-mica schist, where S1 is defined by the parallel alignment of the mica flakes, developed due to tight, isoclinal folding of the first generation (F1). The rocks of the area show NNE-SSW strike and dips towards WNW in the northern part and ESE in the southern part. The predominant dip direction is northerly except in the southern part, which is probably due to development of a regional antiformal structure. The supracrustal of Betul belt show evidences of polyphase deformation producing folds of at least three generations (F1, F2 & F3) with contemporaneous shearing of gradually decreasing intensity accompanied by a gradual shift in the direction of compressive strain from ENE-WSW to N-S.On the basis of the attitude F1 folds can be categorised as moderately plunging, vertical to steeply inclined and upright folds (Parihar, et.al 1992). In macroscopic scale the Sonaghati ridge actually comprises two coalesced limbs of an almost upright synformal structure of this generation. In mesoscopic scale F1 folds are observed on either limb of this macroscopic fold in quartz-mica-schist. The second generation (F2) folds are not common in this area and are developed locally. They are observed only on mesoscopic scale with folding up to S2 foliation. The F2 folds are tight isoclinals and chevron hinged. The axial plane of these folds shows variation in trend from NE SW to NW-SE. Large numbers of shear zones, ranging in magnitude from few meters to several km long and few cms to about 200 m wide have been observed in the area. These shear zones are

strike parallel to regional schistocity / gneissocity and are related to more than one episode of deformation i.e related to progressive stages of deformations.

1.2.5 Mineral potentiality based on geology, geophysics

The Betul belt is a known geological milieu for its volcanic hosted massive sulphides, to the geological community. Due to its complex tectono lithostratigraphy, structure and potentiality for mineralization related to acid magmatism in the western part, tungsten mineralization and molybdenum, niobium and tantalum anomalous values have been reported whereas in the northern part Padhar mafic-ultramfic and in the eastern part Mordongri ultramafic complex show promise for PGE, Ni, Co, Cr and Cu mineralization as there are reports of occurrence of the mineralization by various workers in this suite of rocks.

The occurrence of Graphite dated back to 1958 but no subsequent prospecting/exploration was ever planned till shri Lenka B and S A Ahmad carried out prospecting for Graphite in Chiklar-Gauthana-Tikari areas, Betul district, M.P. The prospecting work has revealed the presence of significant mineralisation of Graphite contained in the supra crustal rocks of proterozoic age. P.K Raut and Meherotra (FS 1991-92) has reported the presence of graphite in the supracrustal of Betul belt in Golighat and Junewani area. Based on the reported occurrence, Lenka while carrying out the G2 stage investigation for graphite has carried out recconoitery traverse in Golighat and Junewani area for generation of G4 stage proposal. The surface manifestations of graphite mineralization in the area are in the form of few old pits and mine dumps. It has also been observed that graphite being hosted within the quartz mica schist has a contrast in the appearance of soil colour than the surrounding areas. In Golighat area, the surface manifestation occurs only in the form of few insect burrowings with limited surface exposures and blackening of the surface soil.(Ref;*-GSI-Report on Exploration for Graphite in Gauthana Block and Surrounding Areas, Betul district, M.P(G-3 stage) and A Report on General Exploration of Graphite in Tikri -Gauthana- Chiklar and Surround Areas, Betul District, M.P (G-2 stage)*

1.2.6 Geophysical Exploration

Geophysical mapping on 1:50,000 scale in toposheet no. 55 G/13, have been carried out by Prasad, K.N.et.al during FS 2013-14. Elliptical shaped gravity high aligned in the NE SW direction has been observed. This moderate gravity indicates presence of medium density bodies and two elliptical shape gravity lows has been observed on either side of moderate gravity values. These may be due to felsic intrusion of granitic rock within the Betul group of rocks.

GSI during 2015-16 carried out integrated geophysical surveys employing SP, magnetic (VF) and IP cum resistivity methods in Tikari-Gauthana-Chiklar area, Betul district, MP for delineation of

graphite mineralization in the area and to indicate the continuity and to provide an initial estimate of size, shape, structure in the area. Geophysical surveys are carried out for the southern and central graphite band and the geological, geophysical corners and borehole points were covered by DGPS survey by the geophysicist. Traverses were laid on the baseline which was at an angle of N55^{o}E at 200 m interval.

SP surveys have brought out low variation which may be attributed to formational / compositional changes/near surface exposure of graphite. High SP values are seen in the southern side which may be due to exposed pegmatites / gneisses. Magnetic survey has delineated structural / lithological contacts which are significant to understand lithological disposition and sub-surface structures in the study area. The southern zone shows a bipolar body which indicates a lithological contact (amphibolites/pegmatite) and the prominent magnetic low on eastern side may be due to shallow causative body. Magnetic survey has delineated structural / lithological contacts which are significant to understand lithological disposition and sub-surface structures in the study area. The southern zone shows a bipolar body which indicate a lithological contact (amphibolites/pegmatite) and the prominent magnetic low on eastern side may be due to shallow causative body. While, IP / resistivity surveys has delineated host rock and graphite on the basis of resistivity and chargeability and
well corroborated with magnetic contour patterns.(Ref;*-GSI-Report on Exploration for Graphite in Gauthana Block and Surrounding Areas, Betul district, M.P(G-3 stage) and A Report on General Exploration of Graphite in Tikri -Gauthana- Chiklar and Surround Areas, Betul District, M.P (G-2 stage)*

1.3.0 Scope for proposed exploration.

The Reconnaissance survey at G-4 stage proposed exploration program comprises of Geological mapping of 7.34 Sq.Km area on 1:12,500 scale, Surface/ Geochemical sampling (Bedrock, soil, stream sediment), Pitting /Trenching, Geophysical survey (Magnetic, Vertical electromagnetic sounding, Electrical Resistivity, SP), drilling of 10 Nos of scout boreholes involving about 1000m drilling to drilling associated survey, chemical analysis, Petrological analysis and estimation of resources under G4 category and Report preparation.

1.4.0 Objectives of Exploration

- Carry out Geological & structural mapping on 1:12,500 scale for demarcation of Graphite and associated mineral bearing formations (host rock) with the structural features to identify the surface manifestations and lateral disposition of the mineralized zones.

- ❖ To collect surface (Grab/Bedrock/soil/stream sediment) samples & analyse for Graphite and decide further course of Exploration program.

- ❖ Carry out Ground geophysical survey with Vertical Electro Magnetic Sounding (VES) Electrical Resistivity imaging, SP, and Magnetic and to demarcate concealed demarcation of Graphite and associated mineral bearing formations.

- ❖ To carry out channel and trench samples collected from Graphite bearing formation to demarcate mineralised zones.

- ❖ To drill 10 scout boreholes up to 60m vertical depth to prove the strike and depth persistence of ore bearing formation mapped in the area which in turn will decide the future course of Exploration program at G-3 category of UNFC.

- ❖ To estimate reconnaissance Graphite l resources along with accessory elements as per UNFC norms and Minerals (Evidence of Mineral Contents) Rules-2015 at G-4 level

1.5.0 Observation and Recommendations of previous work.

1.5.1 Observations GSI investigation 2013-14 & 2015-16

- The Palaeo- Proterozoic older metasediments/supracrustals comprising graphite schist,marble, calc- silicates, tremolite- actinolite schist and quartzite are seen in the western and north- western part of the belt around Sonaghati and Chicholi forming high ridges.

- The lower to middle Proterozoic metasediments have developed on a sparse scale in the area and are represented quartzites,calcareous quartzites, quartz mica schist, graphite schist, carbon phyllite and marble. These metasedimentaries occur as enclaves within the granite gneisses and are continuous litho units in the northern and western part of the Sonaghati ridge.

- Sonaghati Formation representing linear ENE-WSW trending arenaceous rocks which passes through Sonaghati.

- The source of graphite in the present study area belongs to syngenetic category as it is mostly confined to the quartz mica schist formed through the metamorphic evolution of carbonaceous matter dispersed in the sediments (Lenka. B & Ahmad, S A, GSI, Unpublished report, 2013).

- Graphite occurs as an essential constituent of graphite schist in the area which extends from Tikari (1.5 km South east of Maramjhiri railway station) in the southwest to Chiklar in the NE over a strike length of more than 3.5 km. The graphite bodies exhibit a

discontinuous lensoid disposition, more or less in strike continuity with a slight dextral shift at Chiklar village.

- The Graphite band type is largely confined to the quartz muscovite schist, but some pencil thick veins are also recorded from the amphibolites occurring in contact with the mica schist. The vein type of mineralization varies in thickness from 10 cm to 0.5 m. The vein type mineralisation generally occurs along the foliation and joints while pockets and clots are associated with pegmatite. In the area graphite observed that the flaky variety is comparatively soft with visible flakes of graphite and mostly muscovites whereas the amorphous variety is extremely fine grained and is intimately associated with mostly quartz and mica

1.5.2 Recommendations

1. GSI during 2013-14 & 2015-16 carried out Exploration for Graphite In Gauthana Block nd Surrounding Areas, Betul Disrict, M.P (G-3 Stage). Further, GSI during 2015-16 carried out G-2 Stage) General Exploration Of Graphite In Tikari-Gauthana- Chiklar and Surrounding Areas, Betul Disrict, M.P. Geological Survey of India (2016), in its well-documented report has made four recommendations for further exploration of graphite and associated mineralisation in this area

2. In view of the sizable strike length of graphite schist bands accompanied by encouraging analytical results, the graphite mineralisation in Betul district, M.P. recommended for Detailed exploration including drilling in the remaining strike length on the part of the southern, and the northern graphite band.

3. Exploration towards the south western extension of the Southern Graphite Band by means of deeper trenches. The part is falling outside the forest area and is of thick soil cover. Trenches should be done looking at the swerving nature of the band.

4. Geophysical survey beyond N2400 to check the extension of this graphite schist in NE direction in the Northern graphite band, which remains totally unexplored. Besides this the major contacts (structural and lithological) which have been delineated by geophysical surveys need to explore further for better understanding of the geological setup of the graphite mineralization in the area

5. With respect to the above findings, a G4 stage investigation for graphite has been proposed in an area of 7.34 sq.km for establishing graphite bearing zone's in the western extension.

2.0 Previous Work

a) Raut and Mehrotra (1991) and Parihar and Chellani (1991), while carrying out second generation mapping in toposheet nos. 55G/9 and 55G/13 reported granite gneisses, pink foliated granite, porphyroblastic gneiss, pinkish grey granite, pegmatoid gneiss, metasediments, tremolite-actinolite-quartz schist, marble bands, calc-silicates, hornfels, graphite schist, and skarn rocks, intruded by aplite veins, quartzofeldspathic veins, and basic dykes. Shrivastava and Mehrotra (1992) and Ramteke and Patel (1992) have also carried out second generation mapping of T.S No.55G/13 on the 1:25,000 scale in different parts of Betul district and made an attempt to bring out different phases of granites, variation in granite gneisses, delineation of the enclaves of metasediments and differentiation pattern within intrusive, mafic suites with a perspective to have a detailed account of the geology of the Precambrian rocks of the area and their mineral potential.

b) GSI during FS 2000 to 2002, Specialised thematic mapping on 1:25,000 scales have been carried out in parts of the T. S No. 55F/16, G/13 and J/04 by Chakraborty,et.al. They have given a lithostratigraphic succession of the Betul belt which is based mainly on the physical continuity of different lithounits and its broad lithologic similarity. The Betul Supracrustal rocks in the area are mainly exposed in three spatially distinct geomorphic domains viz. 1) along prominent and linear ENE-WSW trending sub parallel ridges from near Sonaghati (i.e. north of Betul) in the west, 2) along NNE-SSW trending ridge from east of Padhar towards NNE in the east and 3) as undulatory hilly terrain around Muariya and Kherli Bazar in the central part

c) During FS 2012-13, (Lenka B and Ahmad S.A), carried out large scale mapping followed by detailed mapping in parts of Chiklar, Gauthana and Tikari areas. They delineated the graphite bands for a cumulative strike length of 3.5 km and the bands were divided into three segments viz, the southern (1450 m strike length), the central (550 m strike length) and the northern band (1350 m strike length). Furtner, Lenka B (FS 2013-14) has carried out exploration by drilling in the above said area by means of 07 boreholes in the area covering parts of the southern and central graphite bands, proving the 1.25 km strike length and estimated an inferred resource of 4.73 MT (333).(Ref;-*GSI-Report on Exploration for Graphite in Gauthana Block and Surrounding Areas, Betul district, M.P(G-3 stage) and A Report on General Exploration of Graphite in Tikri -Gauthana- Chiklar and Surround Areas, Betul District, M.P (G-2 stage)*

3.0 Block description

3.1.0 The corner points coordinates of GSI (G3 & G2) area in 1.00 Sq,Km (0.70 + 0.30) is given in Table-4 below

SL. NO	BH.NO.	DGPS COORDINATES	
		LATITUDE	LONGITUDE
1	G-01	21° 55' 52.75501" N	77° 53' 15.39208" E
2	G-02	21° 56' 02.73424" N	77° 53' 09.61221" E
3	G-03	21° 56' 15.8920" N	77° 53' 24.9632" E
4	G-04	21° 56' 11.83626" N	77° 53' 31.96804" E
5	G-05	21° 56' 16.85440" N	77° 53' 47.51314" E
6	G-06	21° 56' 18.30112" N	77° 53' 44.81658" E
7	G-07	21° 56' 25.08392" N	77° 53' 59.79402" E
8	G-08	21° 56' 23.46944" N	77° 54' 02.64561" E
9	G-09	21° 56' 15.38067" N	77° 54' 03.58792" E
10	G-10	21° 56' 08.25752" N	77° 53' 59.86163" E
11	G-11	21° 56' 04.45641" N	77° 53' 49.73083" E
12	G-12	21° 56' 07.49334" N	77° 53' 46.78897" E
13	G-13	21° 56' 00.79773" N	77° 53' 39.04175" E
14	G-14	21° 55' 57.01017" N	77° 53' 23.38022" E
15	G-15	21° 55' 56.41175" N	77° 53' 20.88844" E
16	G-16	21° 55' 55.41722" N	77° 53' 19.83870" E
17	G-17	21° 56' 16.77117" N	77° 54' 06.08902" E
18	G-18	21° 56' 27.30655" N	77° 54' 01.37076" E
19	G-19	21° 56' 38.92858" N	77° 54' 27.77179" E
20	G-20	21° 56' 26.93867" N	77° 54' 32.53313" E

3.1.1 Proposed G4 Investigation area

The area falls in Survey of India Toposheet No. 55G/13 and covers an area of about 7.34 sq.km. The villages in the area are Sonaghati,Amdol,Jharegaon & Bhayawari villages, Betul District, Madhya Pradesh. The Coordinates of the corner points of the block is given in Table-5 below.

PROPOSED AREA BOUNDARY	WGS 84	
	LATITUDE	LONGITUDE
A	N21^0 53′ 30.0 ″	E77^0 49′ 49.4″
B	N21^0 54′ 18.0 ″	E77^0 49′ 44.6 ″
C	N21^0 54′ 21.3 ″	E77^0 49′ 49.6 ″
D	N21^0 55′ 15.7″	E77^0 49′ 40.4 ″
E	N21^0 55′ 28.7 ″	E77^0 50′ 00.3″
F	N21^0 55′ 10.7 ″	E77^0 51′ 16.3″
G	N21^0 55′ 26.5 ″	E77^0 51′ 49.0″
H	N21^0 54′ 59.5 ″	E77^0 52′ 05.7″
I	N21^0 54′ 30.7″	E77 ^{0}50′ 56.9″
J	N21^0 54′ 07.7″	E77^0 50′ 28.3″
K	N21^0 53′ 35.6″	E77^0 50′ 15.5″
L	N21^0 53′ 34.8″	E77^0 49′ 55.2″

4.0 Planned Methodology

The exploration program has been proposed in accordance with the objective set for reconnaissance survey (G-4) of the block. The Exploration shall be carried out as per Minerals (Evidence of Mineral Contents) Rule-2015 and Minerals (Evidence of Mineral Contents) Amendment Rules-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.

4.1.0 Geological Mapping (1:12,500 Scale)

Geological Mapping will be done in the entire 7.34 Sq.Km area on 1:12,500 scale. Rock types, their contact, demarcation of mineral deposit and associated mineralization bearing formations (host rock) with the structural features to identify the surface manifestations and lateral dispositions of the mineralized zones.

4.2.0 Geochemical Sampling (Surface sampling/BedRock /Stream sediment)

During the course of Geochemical Sampling the bedrock samples shall be collected from the outcrops along with soil and stream sediment samples. A total of 80-100 nos. of primary samples from bedrock/soil/stream sediment (from ultramafic rocks) will be collected and analysed for assay of Graphite and associated mineralization in the area . Around 15 no of check samples (20%) will also be analysed for assay of Graphite and associated mineralisation.

4.3.0 Surveying

The block boundary will be surveyed by DGPS and total station in WGS-84 datum for demarcation of proposed area boundary points. Survey party will also carry out surface features, contouring in the proposed area and associated with Geological activities for taking up locations of outcrop, Pitting/ Trenching, channel sample collection for taking up the location of sample points and plotting it on the map for proper interpretation of the sample data. Further, during the drilling programme, the survey party will carry out borehole fixation and determination of reduced level and co-ordinates of the boreholes.

4.4.0 Geophysical Survey

The area of the block is 7.34 sq.km and in general is plain land with some undulations and majority of the area is under cultivation with few hillocks. It is proposed to carry out Ground geophysical survey which includes Vertical Electro Magnetic(VES) Sounding, Electrical Resistivity imaging, SP and Magnetic. The survey has been planned in a grid pattern of 200m x 200m for Electrical Resistivity imaging & Magnetic and planned for Vertical Electromagnetic sounding(VES). A total of 8-10 line km of Self Potential(SP), 100 stations of Magnetic, 50 stations for Soundings / profiling of Electromagnetic and 25 Line km Electrical Resistivity imaging have been planned. The Approximate time period to conduct the survey will be around 3 months (2 months for acquiring data and 1 month for processing and interpretation).

4.5.0 Pitting/Trenching

Shallow trenching (Excavation) shall be carried out in the Graphite in anomaly zones identified based on the results of geological mapping, geochemical sampling and Geophysical Studies. A total of 10 Pits & 5 Trenches have been planned in 120 CuM. Trenching will be carried out on surface up to a depth of maximum 2 m depth from surface after removal of soil/weathered column in the area. A provision of 60-80 Nos.of primary & around 15 no of check (20%) trench/channel samples are kept for analysis of Ash, FC, VM & Moisture. The trench walls will be mapped on 1:200 scale.

4.6.0 Core Drilling

Based on the results of surface exploration such as geological mapping, geophysical & geochemical survey and pitting/ trenching in an area of 7.34 Sq.km., scout boreholes shall be drilled in targeted mineralized zone to find out the continuity of mineralized zones in strike & dip direction and to assess the attitude of the subsurface disposition of the Graphite bodies. To find out the continuity of mineralized zones in strike & dip direction, Ten (10 nos.) vertical boreholes shall be drilled over the mineralised zone in a grid pattern of 200m X 200m along the strike and dip direction to prove the mineralization if any. Total drilling meterage of 600m, taking the average depth of borehole as 60m. The drilling will be carried out for the upper (first) level of intersection of mineralized zones. The azimuth and angle of inclination of the proposed boreholes will be decided once the attitude (strike & dip) of mineralized zones (host rock) is deciphered after geological mapping

4.7.0 Drill Core Logging

The borehole core will be systematically logged for rock types, structural features, textures, intersection of ore zones, types of mineralization and occurrence of various ore minerals. The logging for determination of Rock Quality Designation/determination (RQD) will also be carried out.

4.8.0 Drill Core Sampling

During geological logging of drill cores, mineralized zones will be marked on the basis concentration of ore minerals and lithology. Total of 300 no of primary and 60 no of check (20%) samples will be analysed for Graphite (Moisture, FC, VM, Ash etc). Total of 10 samples shall be subjected to ICP/MS studies for determination of 34 trace elements

4.9.0 Whole Rock Analysis

Whole Rock analysis for SiO_2, Al_2O_3, Fe_2O_3, TiO_2, MnO, CaO, Na_2O, K_2O+H_2O, MgO, P_2O_5, CO_2, & S radicals will be carried out on 20 Nos samples to check the rock types, their variation in chemical composition.

4.10.0 Petrological & Mineralogical Studies

During the course of Geochemical sampling and core logging 30 samples from various litho units from surface and in borehole cores will be studied for petrography in thin section and 30 samples from mineralized zones will be studied for the minerography (ore mineral assemblages and their distribution, alteration, enrichment etc.) in polished sections. Ore-microscopy and Geochemistry of samples will also be studied.

4.11.0 Specific Gravity Determination

The specific gravity will be determined for 10 samples from the mineralized zones intersected in the boreholes.

4.12.0 Bulk Density Determination

The Bulk Density will be determined for 5 samples from the mineralized zones intersected in the boreholes.

4.13.0 ICP-MS studies (34 Trace elements)

A total of 10. Nos of samples shall be subjected for the study of trace elements (34 elements) by ICP-AES/ICP-MS method. All samples will be sent to NABL accredited laboratories and QA / QC samples will be inserted appropriately.

4.14.0 XRD Studies

A total 20 nos. of samples shall be subjected for XRD studies.

4.15.0 To estimate resources as per UNFC norms and Minerals Evidence & Mineral Contents(MEMC) Rule- 2015 at G-4 level and meet the NMET objectives.

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4.16.0 Submission of reports and recommendations compliant with G4 level as per MEMC 2021 and suggestions for follow up work to upgrade the project, if deemed necessary.

5. Nature Quantum and Target

Nature and quantum of proposed work is given in Table-6

Details of Quantum of Work Proposed													
Time Schedule (in Months) for Preliminary Investigation (G-4 STAGE) for Graphite & Associated Mineralization around Sonaghati,Amdol,Jharegaon & Bhayawari,District Betul, M.P.													
Item of Work	**1**	**2**	**3**	**4**	**5**	**6**		**7**	**8**	**9**	**10**	**11**	**12**
Camp Setting & Ground Geophysical studies							**REVIEW**						
Geologist (1 Party) for Geological Mapping, Pitting/Trenching/Drilling & Sampling - (7.34Sq.Km.) (1:12,500 SCALE)													
Pitting/Trenching -Bed Rock													
Stream Sediment & Soil Samplings													
Sample Preparation(1Party)- includes crushing, powdering, packing & Labelling													
Analyses of Pit/Trench, BRS & Geochemical Samples													
Survey work- boundary survey, surface features Contouring & BH fixation, determination of coordinates and Reduced level													
Drilling (2 Drill Operation)(600 Mtrs.)													
Core Sampling - core splitting, crushing, powdering, coning and quartering													
Analysis of Drilling Core Samples(Nos.)													
Camp Winding													
Geological Report Writing with Peer Review and submission													

5.1 Nature and Quantum of work proposed

The details of the particular, quantum and the targets are tabulated below in Table -7

Table : 7 Envisaged Quantum of proposed work for Graphite around Sonaghati, Amdol, Jharegaon and Bhayawari (G4 Area)

Cost Estimate for Preliminary Investigation (G-4 STAGE) for Graphite & Associated Mineralization around Sonaghati, Amdol, Jharegaon & Bhayawari District Betul, M.P.			
Total Area 7.34 Sq.Km - Mapping 1:12,500 Scale			
Sl.No	**Item of work**	**Unit**	**Qty**
A	**GEOLOGICAL WORK**		
i	Geologist Party days H Q	Days	90
ii	Geologist Party days (1) -Field (7month)	Days	210
iii	Labourers (4 Nos.) (Rs 477/day/labour)	Days	240
iv	Sampler Party days (1party)	Days	60
v	Labour for Sampling (2 Nos.)	Days	60
B	**GROUND GEOPHYSICAL SURVEY**		
i	a. Magnetic Survey (10-30 LineKm) (200m interval in 100 stations)	No of Station	100
ii	b. Vertical Electro Magnetic Sounding (50 stations)	Sounding	50
iii	c. Electrical Resistivity imaging (Line Km)(200m interval in 25 Line km)	Line Km	25
iv	Self -Potential (8-20 Line km)	Line Km	10
vii	Expert Charges for Geophysicist (HQ)	Per Day	30
viii	Geophysicist-Monitoring of Geophysical Investigation (Field)	Per Day	30
ix	Labourers (Rs 477/day/labour) Geophysical Survey(4Nos)	Days	240
C	**SURVEY**		
i	Survey Party Days (1 party)	Days	90

	DGPS Survey- Demarcation of boundary, Fixation of Boreholes, determination of coordinates & Reduced Level (Including Labourer		10
ii	Labourers (Rs 477/day/labour) for Survey Party (4 Nos)	Days	360
	Sub Total A+B+C		
D	**PITTING & TRENCHING**		
i	**Pitting -(1m x 1 mx 2 m) -10 Pit s**	Per Cu.M	20
ii	**Trenching(1m x 2mx 10 m) (5 Nos)**	Per Cu.M	100
	Sub Total D		
E	**DRILLING**		
	Surface Drilling (2 Rigs) (60 m depth) 10bhs	mts.	600
	Drill core preservation charges- "One complete borehole plus mineralised cores of all the BHs of the Block, all cost included "60m for one borehole, 30m mineralised zone for remaining 9 Bhs, "	per Mts.	330
	Approach Road making for Flat terrain	per Km.	10
	Land Compensation	Per Borehole	10
	Construction of concrete Pillar (12'' x12''x30'')	Per Borehole	10
	Sub Total E		
F	**LABORATORY STUDIES**		
	a. Chemical analyses	Nos	
	(i)Proximate Analysis of Trench/Pit for graphite-VM,FC, Moisture & Ash	Nos	140
	Whole Rock Analyses-Major Oxides by XRF technique	Nos	10
	ii) Check Samples (Bed rock/ soil/ stream) (20%)	Nos	25
	Primary + Check Sample		
	a)Proximate Analysis (Ash, Moisture, V.M. and F.C.)	Nos	300
	(b)Check Samples-(Ash, Moisture, V.M. and F.C.)20%)	Nos	60

	c) Total Sulphur (S)	Nos	10
	b.Petrography studies		
	a) X-RD Studies	Nos	20
	b)ICP -MS studies (34 trace elements)	Nos	10
	c) Preparation of thin sections	Nos	30
	c)Complete petrographic /ore microscopic study/Mineragraphic studies	Nos	30
	d)Preparation of Polished Sections	Nos	30
	e) Rock Powdering	Nos	200
	Sub Total F		
G	**GEOTECHNICAL STUDIES**		
	a)Specific Gravity Determination	Nos	10
	b)Bulk density	Nos	5
	Sub Total G		
	Total A+B+C+D+E+F+G		
H	**PREPARATION OF EXPLORATION PROPOSAL (5+1 Soft Copy)**	Per Project	1
I	**PEER REVIEW**	As per EC committee	
J	**GEOLOGICAL REPORT PREPARATION 5+5 HARD COPIES + 2 SOFT COPY (@3%)**	Per Project	1

6. Manpower deployment

Manpower requirement for initial Geological activity includes 2 Geologists, 1 Surveyor, 2 sampling technicians, 1 Geophysicist, 1 Geochemist, 1 Hydrogeologist and 4 labourers each for different activities. Followed by ground Geophysical (Geophysical survey will be outsourced.) & Geochemical Exploration and Exploratory Diamond Core Drilling Activities.

7. Break-up of expenditure

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. **301.83** Lakhs. The details of tentative cost estimates are given in Table No. 8 below

Cost Estimate for Preliminary Investigation (G-4 STAGE) for Graphite & Associated Mineralization Around Sonaghati,Amdol,Jharegaon & Bhayawari District Betul, M.P.						
Total Area 7.34 Sq.Km - Mapping 1:12,500 Scale						
Sl.No	**Item of work**	**Unit**	**NMET SoC-Item -Sl No.**	**NMET Rates (2020)**	**Qty**	**Amount INR**
A	**GEOLOGICAL WORK**					
i	Geologist Party days H Q	Days	1.3	9000	90	810000
ii	Geologist Party days (1) -Field (7month)	Days	1.3	11000	210	2310000
iii	Labourers (4 Nos.) (Rs 477/day/labour)	Days	5.7	477	240	114480
iv	Sampler Party days (1party)	Days	1.5.2	5100	60	306000
v	Labour for Sampling (2 Nos.)	Days	5.7	477	60	28620
B	**GROUND GEOPHYSICAL SURVEY**					
i	a.Magnetic Survey (10-30 LineKm) (200m interval in 100 stations)	No of Station	3.2a	1800	100	180000
ii	b. Vertical Electro Magnetic Sounding (50 stations)	Sounding	3.7a	21197	50	1059850
iii	c. Electrical Resistivity imaging (Line Km)(200m interval in 25 Line km)	Line Km	3.6c	300000	25	7500000
iv	Self -Potential (8-20 Line km)	Line Km	3.3a	29600	10	296000
vii	Expert Charges for Geophysicist (HQ)	Per Day	3.18	9000	30	270000
viii	Geophysicist-Monitoring of Geophysical Investigation (Field)	Per Day	3.19	11000	30	330000

ix	Labourers (Rs 477/day/labour) Geophysical Survey(4Nos)	Days	5.7	477	240	114480
C	**SURVEY**					
i	Survey Party Days (1 party)	Days	1.6.1a	8300	90	747000
	DGPS Survey- Demarcation of boundary, Fixation of Boreholes,determination of coordinates & Reduced Level (Including Labourer		1.6.2	19200	10	192000
ii	Labourers (Rs 477/day/labour) for Survey Party (4 Nos)	Days	5.7	477	360	171720
	SubTotal A+B+C					**14430150**
D	**PITTING & TRENCHING**					
i	**Pitting -(1m x 1 mx 2 m) -10 Pits**	Per Cu.M	2.1.2	3800	20	76000
ii	**Trenching(1m x 2mx 10 m) (5 Nos)**	Per Cu.M	2.1.1	3330	100	333000
	SubTotal D					**409000**
E	**DRILLING**					
	Surface Drilling (2 Rigs) (60 m depth) 10bhs	mts.	2.2.1.3a	10100	600	6060000
	Drill core preservation charges- "One complete borehole plus mineralised cores of all the BHs of the Block, all cost included "60m for one borehole, 30m mineralised zone for remaining 9 Bhs, "	per Mts.	5.3	1590	330	524700
	Approach Road making for Flat terrain	per Km.	2.2.10a	22020	10	220200
	Land Compensation	Per Borehole	5.6	20000	10	200000
	Construction of concrete Pillar (12'' x12''x30'')	Per Borehole	2.2.7a	2000	10	20000
	SubTotal E					**7024900**
F	**LABORATORY STUDIES**					
	a.Chemical analyses	Nos				

	(i)Proximate Analysis of Trench/Pit for graphite-VM,FC, Moisture & Ash	Per sample	4.1.16	3000	140	420000
	Whole Rock Analyses-Major Oxides by XRF technique	Per sample	4.1.15a	4200	10	42000
	ii) Check Samples (Bed rock/ soil/ stream) (20%)	Per sample	4.1.16	3000	25	75000
	Primary + Check Sample					
	a)Proximate Analysis (Ash, Moisture, V.M. and F.C.)	Per sample	4.1.16	3000	300	900000
	(b)Check Samples-(Ash, Moisture, V.M. and F.C.)20%)	Per sample	4.1.16	3000	60	180000
	c) Total Sulphur (S)	Per sample	4.2.14	1900	10	19000
	b. Petrography studies					
	a) X-RD Studies	Per sample	4.5.1	4000	20	80000
	b)ICP -MS studies (34 trace elements)	Per sample	4.1.14	7731	10	77310
	c) Preparation of thin sections	Per sample	4.3.1	2353	30	70590
	c)Complete petrographic /ore microscopic study/Mineragraphic studies	Per sample	4.3.4	4232	30	126960
	d)Preparation of Polished Sections	Per sample	4.3.2	1549	30	46470
	e) Rock Powdering	Per sample	4.3.12	2520	200	504000
	Sub Total F					**2541330**
G	**GEOTECHNICAL STUDIES**					
	a)Specific Gravity Determination	Per Sample	4.8.1	1605	10	16050
	b)Bulk density	Per Sample	'4.10	3540	5	17700
	Sub Total G					**33750**
	Total A+B+C+D+E+F+G					**24439130**

H	**PREPARATION OF EXPLORATION PROPOSAL (5+1 Softcopy)**	Per Project	5.1		1	**380000**
I	**PEER REVIEW**	As per EC committee				**10000**
J	**GEOLOGICAL REPORT PREPARATION 5+5 HARD COPIES + 2 SOFTCOPY (@3%)**	Per Project	5.2		1	**750000**
	TOTAL A to I					**25579130**
	GST 18%					**4604243**
	Total with GST 18% (Say 301.83lakhs)					**30183373**

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