



**GOVERNMENT OF ODISHA
DEPARTMENT OF STEEL AND MINES
DIRECTORATE OF MINES & GEOLOGY**

**GEOLOGICAL REPORT ON
PRELIMINARY EXPLORATION FOR GRAPHITE
AROUND NARINGPANGA (SOUTH), RAYAGADA DISTRICT,
ODISHA (G-3)**

**[Under section-8 of Minerals (Evidence of Mineral Contents)
Amendment Rules, 2021 Schedule-I (d), PART IV- A]
TOPOSHEET NO-E44F10**

NATIONAL MINERAL EXPLORATION TRUST

BY

**Ramesh Behera, Geologist & EIC
Ananta Kumar Das, Geologist
M.K. Oram, DDG & TSO
Dr. P. C. Mishra, JDG**

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**PRELIMINARY INVESTIGATION (G-3) FOR GRAPHITE IN
NARINGPANGA (SOUTH) BLOCK, DISTRICT: RAYAGADA,
STATE: ODISHA**

CHAPTER-1

सारांश

1.1 खनिज ब्लॉक सारांश

भाग A – खनिज ब्लॉक के बारे में सामान्य जानकारी

(ई-नीलामी प्लेटफॉर्म की वेबसाइट पर उपलब्ध कराया जाएगा)

	विशेषता	विवरण
1.	स्थान	
	खनिज ब्लॉक	नारींगपंगा (दक्षिण) ग्रेफाइट ब्लॉक
	अक्षांश (Latitude)	
	1	19°43'28.79616" N
	2	19°43'33.03300" N
	3	19°43'28.77816" N
	4	19°43'31.61568" N
	5	19°43'22.03716" N
	6	19°43'15.12624" N
	7	19°43'28.35480" N
	8	19°43'26.98248" N
	देशांतर (Longitude)	
	1	83°33'12.89664" E
	2	83°33'18.40104" E
	3	83°33'22.53888" E
	4	83°33'25.87356" E
	5	83°33'33.40656" E
	6	83°33'25.23672" E
	7	83°33'16.44804" E
	8	83°33'14.31180" E
	गाँव	नारींगपंगा
	तहसील/तालुका	मुनिगुड़ा
2.	जिला	रायगढ़ा
	राज्य	ओडिशा
	क्षेत्रफल (हेक्टेयर/वर्ग किमी)	
	कुल क्षेत्रफल	0.143 वर्ग किमी

	खनिजीकृत क्षेत्र	0.078 वर्ग किमी				
	गैर-खनिजीकृत क्षेत्र	0.065 वर्ग किमी				
3.	अन्वेषण					
	स्थिति (G2/G3/G4 आदि)	G3 (प्रारंभिक अन्वेषण)।				
	अन्वेषण एजेंसी	खान एवं भूविज्ञान निदेशालय, ओडिशा				
	कुल बोरहोल संख्या व मीटरज	6 बोरहोल, कुल 398 मीटर				
	बोरहोल दूरी (घनत्व)	6 BHs, 0.143 वर्ग किमी में				
4.	खनिज की मात्रा (ग्रेड अनुसार)					
	खनिज	ग्रेफाइट (1)				
	कुल भूवैज्ञानिक संसाधन	F.C 2% से कम से 5% तक				
		कुल अनुमानित संसाधन	0.413 मिलियन टन			
	खनिज क्षेत्रों की संख्या	01 (एक)				
	प्रवृत्ति (स्ट्राइक और डिप)	स्ट्राइक: N40° -60° W-S40° -60° E, डिप: 55° - 70° दक्षिण-पश्चिमी दिशा में				
5.	ग्रेड		F.C (%)	SiO ₂ (%)	Al ₂ O ₃ (%)	LOI (%)
		F.C content 2% to < 5%	3.01	66.23	12.77	8.70
	खनिज	1. ग्रेफाइट (F.C -3.01%)				
6.	पहुंच					
	निकटतम रेलवे स्टेशन	मुनिगुड़ा (पूर्वी तट रेलवे पर), नारींगपंगा से 22 किमी				
	सड़क	जिला मुख्यालय रायगढ़ा से दूरी लगभग 64 किमी				
	हवाई अड्डा	जेयपोर (210 किमी), निकटतम बंदरगाह: विशाखापत्तनम (260 किमी)				
7.	जलग्रहण क्षेत्र					
	सतही जल निकासी पैटर्न	सतही जल निकासी पैटर्न बारहा नाला द्वारा नियंत्रित, NW से SE दिशा में बहती है।				
	नदियाँ/नाले	बारहा नाला				
8.	जलवायु					
	औसत वार्षिक वर्षा	1288 मिमी				
	तापमान (दिसंबर)	14 ⁰ -18 ⁰ C				
	तापमान (मई)	27 ⁰ -46 ⁰ C				
9.	स्थलाकृति					
	टोपोशीट नंबर	E44F10 (65M/10).				
	स्थलाकृति विवरण	समतल क्षेत्र जिसमें पूर्वी और पश्चिमी किनारों पर छोटे-छोटे पहाड़ियाँ हैं				

SUMMARY

1.1 MINERAL BLOCK SUMMARY

[To be made available on the website of e - auction platform]

PART A – GENERAL INFORMATION ABOUT MINERAL BLOCK

	Features	Details
1.	Location	
	Mineral Block	Naringpanga (South) Graphite Block
	Latitude	
	1	19 ⁰ 43'28.79616" N
	2	19 ⁰ 43'33.03300" N
	3	19 ⁰ 43'28.77816" N
	4	19 ⁰ 43'31.61568" N
	5	19 ⁰ 43'22.03716" N
	6	19 ⁰ 43'15.12624" N
	7	19 ⁰ 43'28.35480" N
	8	19 ⁰ 43'26.98248" N
	Longitude	
	1	83 ⁰ 33'12.89664" E
	2	83 ⁰ 33'18.40104" E
	3	83 ⁰ 33'22.53888" E
	4	83 ⁰ 33'25.87356" E
	5	83 ⁰ 33'33.40656" E
	6	83 ⁰ 33'25.23672" E
	7	83 ⁰ 33'16.44804" E
	8	83 ⁰ 33'14.31180" E
	Village	Naringpanga
	Tahasil/Taluka	Muniguda
	District	Rayagada
	State	Odisha
2.	Area (Hectares/square km)	
	Total area	0.143 Sq. km
	Mineralised area	0.078 Sq. km
	Non-mineralised area	0.065 Sq. km
3.	Exploration	
	Status (G2/G3/G4 etc.)	G 3 (Preliminary Exploration)
	Exploration Agency	Directorate of Mines & Geology, Odisha
	Total No. of BHs with meterage	6 boreholes, 398 m
	Borehole spacing	6 BHs in 0.143 sq. km

	(Density)					
4.	Quantity of Minerals (Grade wise)					
	Mineral	Graphite (1)				
	Total Geological Resources (Resource)	F.C content 2% to < 5%	0.413 mt			
		Grand Total Inferred Geological Resource	0.413 mt			
	Number of mineral zones	01(one)				
	Trend (Dip and strike)	Strike: N40° -60° W-S40° -60° E dipping at 55 ⁰ to 70 ⁰ south westerly				
5.	Grade		F.C (%)	SiO ₂ (%)	Al ₂ O ₃ (%)	LOI (%)
		F.C content 2% to < 5%	3.01	66.23	12.77	8.70
	Mineral	1. Graphite (F.C -3.01%)				
6.	Accessibility					
	Nearest Rail head	Muniguda which is on East Coast Railway 22 km from Naringpanga.				
	Road	The distance from the district headquarter Rayagada is about 64km.				
	Airport	Jeypore 210, Visakhapatnam is the nearest port is at 260 km.				
7.	Hydrography					
	Local Surface Drainage Pattern (Channels)	The drainage system of the area is controlled by Barha Nala flowing from the NW to SE with large meanders and it ephemeral streamlets.				
	River/Streams	Barha Nala				
8.	Climate					
	Mean Annual Rainfall	1288 mm				
	Temperature (December)	14 ⁰ -18 ⁰ C				
	Temperature (May)	27 ⁰ -46 ⁰ C				
9.	Topography					
	Topo Sheet Number	E44F10 (65M/10).				
	Morphology of the area	The area in general represents a plain country with minor undulations. The eastern and western parts of the terrain are occupied by small hillocks.				

कार्यकारी सारांश

ग्रेफाइट का अन्वेषण G-3 स्तर पर खान एवं भूविज्ञान निदेशालय (Directorate of Mines & Geology) द्वारा NMET की स्वीकृति के अनुसार किया गया, जैसा कि पत्र क्रमांक NMET/302 दिनांक 30.01.2023 में उल्लेखित है। इसके अनुसार, निदेशालय का 2023-24 का फील्ड सीजन कार्यक्रम (आदेश संख्या 13888/DoMG, दिनांक 18/11/2023) के अंतर्गत रायगड़ा जिले के नारिंगपंगा क्षेत्र में ग्रेफाइट का अन्वेषण शामिल किया गया था, जो 18 जनवरी 2024 को प्रारंभ होकर 18 अगस्त 2024 को पूरा हुआ।

यह अन्वेषण कार्य लिथोलॉजिकल इकाइयों और ग्रेफाइट खनिजीकरण की घटनाओं को सीमांकित करने और उनका आकलन करने के लिए किया गया, क्योंकि यह पहले से नीलाम किए गए एक ब्लॉक से सटा हुआ क्षेत्र है। G-3 स्तर के अन्वेषण के लिए स्वीकृत कार्यों में 1:2,000 स्केल पर 14.3 हेक्टेयर क्षेत्र में भूवैज्ञानिक मानचित्रण, स्थलाकृतिक सर्वेक्षण, सेल्फ-पोटेंशियल (SP) सर्वेक्षण, 6 बोरहोल की ड्रिलिंग (कुल 398 मीटर ड्रिलिंग मीटरज) और सैंपलिंग शामिल थे।

यह ब्लॉक भारत के सर्वेक्षण विभाग के टोपोशीट नंबर E44F10 (65M/10) में दर्शित है। अध्ययन क्षेत्र नारिंगपंगा गांव से 750 मीटर उत्तर-पूर्व में, मुनिगुड़ा ब्लॉक एवं तहसील मुख्यालय, रायगड़ा जिले में स्थित है। जिला मुख्यालय रायगड़ा, अध्ययन क्षेत्र से 64 किमी दूर स्थित है और राज्य राजमार्ग क्रमांक 5 के माध्यम से सुगम रूप से जुड़ा है। निकटतम रेलवे स्टेशन मुनीगुड़ा है, जो ईस्ट कोस्ट रेलवे पर स्थित है और अन्वेषण स्थल से लगभग 22 किमी दूर है।

अन्वेषण क्षेत्र पूर्वी घाट मोबाइल बेल्ट का हिस्सा है जिसमें मिश्रित खोंडालाइट, कार्बो-फेल्डस्पैथिक ग्राइस, लेप्टिनाइट, एपिडोट युक्त खोंडालाइट और मायलोनाइट शामिल हैं, जो मिट्टी एवं एलुवियम द्वारा आच्छादित हैं। लिथोइकाइयों में फोलिएशन की प्रवृत्ति $N40^{\circ}-60^{\circ}W$ से $S40^{\circ}-60^{\circ}E$ तक पाई जाती है, जो दक्षिण-पश्चिम दिशा में 55° से 75° तक डिप करती हैं।

उपग्रह चित्रों के विश्लेषण से ज्ञात हुआ कि अन्वेषण क्षेत्र प्रमुख शीयर ज़ोन के समीप स्थित है, जो ग्रेफाइट खनिजीकरण को प्रभावित करते हैं। यह क्षेत्र वंशधारा शीयर ज़ोन की उप-शीयर, टुमुडिबंधा शीयर ज़ोन से लगभग 12 किमी पश्चिम में स्थित है। इसके अतिरिक्त, एक सहानुभूतिशील शीयर ज़ोन भी क्षेत्र को पार करता है। इन प्रमुख और गौण शीयर ज़ोन की परस्पर क्रिया ने ग्रेफाइट के पुनः

संकेंद्रण की संभावनाओं को बढ़ाया है। ये संरचनात्मक विशेषताएँ—फोल्टिंग, फॉल्टिंग और शीयरिंग—खनिजीकरण के स्थानीयकरण, संचलन और संकेंद्रण को नियंत्रित करती हैं।

उच्च तापमान पर उत्पन्न खनिज संघटन, जैसे सिलिमेनाइट, गार्नेट, एपिडोट आदि, ग्रैनुलाइट फेशियल रूपांतरण को दर्शाते हैं, जबकि गार्नेट की दरारों में बायोटाइट का विकास और फेल्लस्पार का सौसेरिटाइजेशन प्रतिगामी रूपांतरण का संकेत देते हैं।

नारिंगपंगा ब्लॉक में संभावित ग्रेफाइट खनिजीकरण क्षेत्रों को चिह्नित करने हेतु एकीकृत अन्वेषण पद्धति अपनाई गई, जिसमें विस्तृत भूवैज्ञानिक मानचित्रण, स्थलाकृतिक सर्वेक्षण और SP सर्वेक्षण शामिल था। कुल 0.143 वर्ग किमी क्षेत्र में SP सर्वेक्षण 25m × 10m ग्रिड पर किया गया, जिससे 13.5 लाइन किलोमीटर में 1,335 मापन बिंदु प्राप्त हुए। नकारात्मक विसंगतियाँ -0.04 mV से -154.6 mV तक और सकारात्मक विसंगतियाँ 0.06 mV से 80.2 mV तक पाई गईं।

डेटा की व्याख्या आइसो-एनोमली नक्शों के माध्यम से की गई, जिससे केंद्रीय और पूर्वी क्षेत्र में संभावित खनिजीकरण संकेत मिले। SP मानचित्र में विसंगतियाँ NW-SE दिशा में पाई गईं, जो क्षेत्रीय भूगर्भीय प्रवृत्तियों के अनुरूप है।

ब्लॉक में ग्रेफाइट अयस्क बैंड, पॉकेट, लेन्स और बिखरे हुए रूप में मिगमैटाइट खोंडालाइट और कार्बो-फेल्लस्पैथिक ग्राइस में पाया गया है। यह खनिजीकरण संरचनात्मक रूप से नियंत्रित होता है, जो अक्सर फोलिएशन के अनुरूप संरेखित होता है। कुछ क्षेत्रों में होस्ट चट्टानों में मायलोनिटाइजेशन की प्रक्रिया पाई गई है।

SP विसंगतियों और सतही अनावरण के आधार पर, 45° झुकाव पर 6 बोरहोल ड्रिल किए गए, जिनकी कुल गहराई 398.00 मीटर थी। इनके अतिरिक्त, दक्षिणी भाग में 4 परीक्षण गड्ढों (100.5 क्यूबिक मीटर) की खुदाई की गई, जिनमें से दो में ग्रेफाइट खनिजीकरण पाया गया।

सभी 6 बोरहोल में ग्रेफाइट खनिजीकरण अवरोधित हुआ, जिसमें कुल 84.30 मीटर खनिजीकृत परत पाई गई। औसतन, खनिजीकृत परत की मोटाई लगभग 14.05 मीटर है। सबसे गहरे बोरहोल NPBH-5 की गहराई 78.80 मीटर (झुकाव सहित) थी, जिससे 5.50 मीटर ग्रेफाइट खनिजीकरण

अवरोधित हुआ। सबसे उथले बोरहोल NPBH-2 की गहराई 55.00 मीटर (झुकाव सहित) थी, जिससे 9.65 मीटर ग्रेफाइट खनिजीकृत परत मिली।

कुल 160 कोर सैंपल, 8 ग्रेब सैंपल, 14 पिट सैंपल और 11 मिश्रित सैंपल का विश्लेषण भूविज्ञान निदेशालय की लैब, भुवनेश्वर में वेट केमिकल पद्धति से किया गया। 20 आंतरिक और 10 बाहरी जांच सैंपल भी विश्लेषित किए गए। थोक घनत्व विश्लेषण 5 सैंपलों पर NABL अनुमोदित प्रयोगशाला में किया गया। खनिज विज्ञान और भू-रासायनिक विश्लेषण के तहत 14 XRD और 8 पेट्रोग्राफिक सैंपल DoMG में, जबकि 5 थिन सेक्शन और 20 ICP-MS सैंपल MECL, नागपुर में विश्लेषित किए गए।

160 कोर सैंपलों के रासायनिक विश्लेषण में ग्रेफाइट में फिक्स्ड कार्बन (FC) 2% से 10.03% तक पाया गया। क्रॉस सेक्शनल एरिया पद्धति से अनुमानित कुल भूवैज्ञानिक संसाधन 0.413 मिलियन टन (औसत FC 3.01%) आंका गया।

यह ब्लॉक संयुक्त राष्ट्र खनिज वर्गीकरण प्रणाली (UNFC) की 333 श्रेणी में आता है और खनिज (खनिज सामग्री के साक्ष्य) नियम, 2015 के अनुरूप है।

कुल 0.143 वर्ग किमी क्षेत्र की मैपिंग में 0.078 वर्ग किमी को खनिजीकृत और 0.065 वर्ग किमी को अखनिजीकृत पाया गया।

प्रारंभिक निष्कर्षों से ब्लॉक की संभाव्यता स्पष्ट होती है, जिसे संसाधन अनुमान को सुदृढ़ करने और खनिजीकरण को अधिक सटीक रूप से सीमांकित करने हेतु G-2 स्तर के विस्तृत अन्वेषण की आवश्यकता है।

EXECUTIVE SUMMARY

Exploration graphite was undertaken at G-3 stage by the Directorate of Mines & Geology as per approval of NMET, communicated vide L. No. NMET/302 Dt. 30.01.2023. Accordingly, the Field Season Programme of the Directorate of Mines & Geology, Odisha for 2023-24 (Order no. 13888/DoMG, Dt. 18/11/2023) included the exploration for Graphite around Naringpanga of Rayagada district which commenced on 18th January 2024 and field work was completed on 18th August 2024. The exploration was taken up to delineate the litho-assemblages and incidences of graphite mineralisation and assessment thereof, as it is the adjacent block of an already auctioned block. The approved components of exploration at G-3 stage included Geological mapping on scale 1:2,000 over 14.3 Ha area, topographic survey, Self-Potential (SP) Survey and drilling of 6 bore holes with a drilling meterage of 398 m and sampling.

The block is featured in Survey of India Toposheet No: E44F10 (65M/10). The study area lies 750m northeast of Naringpanga village in Muniguda Block & Tehsil Headquarters of Rayagada district. The district headquarters, Rayagada, is located 64 km from the study area and is accessible via State Highway No. 5. The nearest Railway Station is Muniguda, situated on the East Coast Railway, approximately 22 km away from the explored block.

The area of investigation forms a part of Eastern Ghats Mobile Belt comprising migmatized khondalite, quartzo-feldspathic gneiss, leptynite, epidote-bearing khondalite, and mylonite which are masked by soil & alluvium. The litho units exhibit foliation trends ranging from N40⁰-60⁰ W to S40⁰-60⁰ E, dipping from 55⁰ to 75⁰ in a south westerly direction. Satellite imagery analysis of the Naringpanga exploration area indicates its proximity to key shear zones that significantly influence the graphite mineralization. The area is located about 12 km west of the Tumudibandha Shear Zone, a sub shear of Vanshadhara shear zone (Fig. 5), which runs in a north-south direction. Additionally, a sympathetic shear zone, also north-south oriented, crosses through the area. The interaction of these shears with minor asymmetric shears from the Tel Shear (ENE-WSW) creates a favourable environment for the emplacement of granitic melts. This geological setting leads to the remobilization of graphite along structural weak planes, specifically the foliation in the rock mass, enhancing its potential for mineralization. The intersection of these

lineaments offers a structural avenue for the concentration and mobilisation of graphite. These structural features folding, faulting, and shearing play a critical role in controlling the localization, mobilization, and concentration of graphite mineralization. High-grade metamorphism coupled with intense deformation has redistributed graphite along zones of structural weakness, underscoring the structural control of mineralization in the region. High-temperature mineral assemblages of the involved litho-units with index minerals like sillimanite, garnet, epidotes etc. indicates a high temperature-pressure granulitic facies metamorphism while retrograde features like the occurrence of biotite within the fractures of garnet and saussuritization of feldspar attests retrogression.

To delineate the potential graphite mineralization zones in the Naringpanga block, an integrated exploration approach was undertaken, including detailed geological mapping, topographic survey, and Self-Potential (SP) survey over an area of 0.143 sq. km followed by drilling to ascertain the subsurface geometry. The objective of SP survey was to identify anomalous zones that could indicate the buried mineralised zones of graphite. The SP survey was conducted on a 25m X 10m grid pattern over a total area of 29.22 ha in the initial stage to identify a potential target zone, covering 13.5-line km, which resulted in 1,335 SP measurements. The SP data, with negative anomalies ranging from -0.04mV to -154.6mV and positive anomalies between 0.06mV and 80.2mV, were used to interpret possible graphite occurrences. The data interpretation was carried out using isoanomalous contour maps, revealing a significant range of anomalies, especially in the central and eastern sections of the survey area. The base point for the survey was located to the southwest of the project area, near a known graphite mineralization zone, which influenced the identification of potential graphite-bearing zones. These findings suggest that the area exhibits promising indications of graphite and possible sulphide ore bodies, with high negative SP anomalies correlating with potential mineralization.

The SP contour map further highlights a mineralization trend that follows a NW-SE direction, which aligns with the regional geological trend and the foliation trend of host rock. This alignment, along with the observed SP data, indicates that the central part of the survey area holds the highest potential for hosting significant graphite mineralization. This targeted exploration approach, utilizing the Self-Potential (SP) survey method, demonstrates its effectiveness in identifying potential graphite deposits.

Graphite ore bodies in the Naringpanga block occur as bands, pockets, lenses and disseminations within migmatized khondalite and quartzo-feldspathic gneiss. The mineralization is structurally controlled, often aligning with the foliation or layering of the host rocks. Khondalite, a high-grade metamorphic rock, and quartzo-feldspathic gneiss, metamorphosed granite, provide favourable loci for graphite enrichment synchronised with the bounding structural weak planes. In some areas, the host rocks have undergone mylonitization, where intense brecciation, shearing, and fracturing might have facilitated pathways for enrichment. The graphite in the region typically exhibits flaky nature, characteristic of metamorphic terrains. Its appearance is typically black to dark grey, often with a metallic sheen on fresh surfaces.

Based on surface exposures and self-potential (SP) anomalies, six inclined boreholes were drilled at a 45° inclination as per the approved borehole plan by TCC-NMET. These boreholes were located in the anomalous zones interpreted through SP Survey, covering a cumulative drilling depth of 398.00 meters. Besides, trial excavation to the tune of 100.5 cubic meters was done in 4 trial pits in the southern part of the prospect where there was no approval for additional boreholes by TCC. Out of the 4 pits, graphite has been encountered in two pits.

Graphite mineralization was intercepted in all six boreholes, with a cumulative thickness of 84.30 meters of ore-bearing formations intersected in the drill cores. The average thickness of the mineralized zones is approximately 14.05 meters. The deepest borehole, NPBH-5, reached an inclined depth of 78.80 meters, corresponding to a vertical depth of 55.72 meters, and revealed a graphite mineralized zone measuring 5.50 meters. The shallowest borehole, NPBH-2, achieved an inclined depth of 55.00 meters, corresponding to a vertical depth of 38.89 meters, and intercepted a 9.65-meter graphite mineralized zone.

A total of 160 core samples, 8 grab samples, 14 pit samples, and 11 composite samples were analysed at the Directorate of Mines and Geology (DoMG) Chemical Laboratory, Bhubaneswar by wet chemical analysis in dry state. Additionally, 20 internal check samples were analysed at DoMG, while 10 external check samples were processed at the New Green Pvt. Ltd. NABL-accredited Laboratory, Bhubaneswar. Bulk density determination was carried out for 5 samples in a NABL-accredited laboratory. Advanced mineralogical and geochemical studies included XRD analysis of 14 samples at the DoMG

XRD Laboratory and petrographic examination of 8 samples at DoMG, Bhubaneswar. At the MECL Laboratory, Nagpur, 5 thin sections and 5 petrographic samples were also analysed, while 20 samples have been subjected to geochemical analysis by ICP-MS in MECL laboratories.

The chemical analysis of 160 core samples from the exploration area reveals that the fixed carbon (FC) content in graphite ranges from 2% to 10.03%. Using the cross-sectional area method, the total geological resource of graphite has been estimated at 0.413 million tonnes with an average fixed carbon content of 3.01%.

These findings classify the block under the 333 category of the United Nations Framework Classification (UNFC) and as per the Minerals (Evidence of Mineral Contents) Rules, 2015 (MEMC 2015).

During the exploration of the Naringpanga area, a total of 0.143 sq. km was surveyed, of which 0.078 sq. km was identified as mineralized and 0.065 sq. km as non-mineralized.

The preliminary results highlight the potential of the block, meriting further detailed exploration at the G-2 level to refine resource estimates and delineate the mineralization more precisely.

CHAPTER – 2

INTRODUCTION

2.1 Details of the Project

Exploration graphite was undertaken at G-3 stage by the Directorate of Mines & Geology as per approval of NMET. The Project proposal was discussed in 48th TCC of NMET held on 22.12. 2022 and subsequently approved in the 27th Executive Committee (EC) meeting of NMET held on 10.01.2023. The approval was communicated vide L. No. NMET/302 Dt. 30.01.2023. Accordingly, the Field Season Programme of the Directorate of Mines & Geology, Odisha for fsp 2023-24 (Order no. 13888/DoMG, Dt. 18/11/2023) included the exploration for Graphite around Naringpanga (South) of Rayagada district which commenced on 18th January 2024 and field work was completed on 18th August 2024.

The exploration was taken up to delineate the litho-assemblages and incidences of graphite mineralisation and assessment thereof, as it is close to a block already auctioned. The approved components of exploration at G-3 stage included Geological mapping on scale 1:2,000 over 14.3 Ha area, topographic survey, Self-Potential (SP) Survey and drilling of 6 bore holes with a drilling meterage of 398 m and sampling.

The project area lies in the southern part of the Naringpanga Graphite Block. It is featured in Survey of India Toposheet No: E44F10 (65M/10). This block is situated approximately 750 m northeast of Naringpanga village in Muniguda Block, Rayagada. To delineate the potential graphite mineralization zones in the Naringpanga block, an integrated exploration approach was undertaken, including detailed geological mapping, topographic survey, and Self-Potential (SP) survey over an area of 0.143 sq. km followed by drilling to ascertain the subsurface geometry. Graphite ore bodies in the Naringpanga block occur as bands, pockets, lenses and disseminations within migmatized khondalite and quartzofeldspathic gneiss. During the exploration of the Naringpanga area, a total of 0.143 sq. km was surveyed, of which 0.078 sq. km was identified as mineralized and 0.065 sq. km as non-mineralized.

The preliminary results highlight the potential of the block, meriting further detailed exploration at higher level.

2.2 Investigating Agency

<i>a</i>	Name of the explorer/ Mining or prospecting rights holder:	Directorate of Mines & Geology, Odisha,
<i>b</i>	Address:	Directorate of Mines & Geology, Odisha Bhubaneswar, Odisha, 751001
<i>c</i>	Telephone No:	0674 2392374
<i>d</i>	E-Mail id:	dir.mines@orissaminerals.gov.in

2.3 Objectives & Scope of the Investigation

The objective of the present investigation was to assess the resource and grade of graphite occurrences of the block through topographic survey, detailed geological mapping of the block in 1:2000 scales, drilling, SP Survey and systematic sampling at 1m interval of the drilled core samples as per G3 stage of exploration of MEMC Rules-2015.

i. Geological Mapping:

- To conduct detailed geological mapping on a 1:2000 scale to delineate the litho-assemblages and incidences of graphite mineralisation.
- To record and analyze structural features such as foliations, lineations, shear fractures & shear criterias including structural controls influencing graphite mineralisation.
- To define the potential mineralised area from auction point of view for detailed assessment.

ii. Geophysical Survey:

- In order to decipher the potential graphite bearing anomalous zone in hostile para-metamorphites of pelitic & psammo- pelitic gneisses schists employing self-potential geophysical survey to detect and delineate concealed graphite ore bodies within the block.

iii. Trial Excavation:

- In order to expose the shallow level in-situ graphite bearing gneisses, excavations to the tune of 100 cu. m in trial pits/trenches in the areas of moderate to shallow soil cover.

iv. Exploratory Drilling:

- In order to delineate the sub-surface geometrical disposition of graphitic gneisses & schists by penetrating six inclined boreholes to establish the incidence of graphite ore bodies in geo-physically interpreted anomalous zones.

v. Laboratory studies:

- For characterisation of the lithological entities and ascertain the grade of the ore, various samples have been collected from bed rocks, drill cores, pit sections to ascertain the grade of graphite, petrography, mineralogy, trace elements, bulk density etc. and analysed.

vi. Resource & Grade Estimation:

- To Estimate preliminary graphite resources (category 333) following the UNFC (United Nations Framework Classification) standards and the guidelines of the Minerals (Evidence of Mineral Contents) Rules-2015.

2.4 Basis for Taking up Investigation

Occurrence of Graphite within pelitic schists and gneisses of EGMB is an established fact. The Naringpanga block is located in the Western Khondalite Zone of the Eastern Ghats. Historical records by DG (O), GSI, and others suggested the high grade granulitic terrains as potential for significant graphite occurrences. Five lithotectonic domains having distinct disposition patterns of mineralisation have been made. The area under exploration forms part of the Eastern Ghats Supergroup and comprises khondalite suite of rocks, charnockite, quartzo-feldspathic gneiss, and pegmatoids with associated

silica veinlets. The Khondalite group consists of garnet - sillimanite schist, Garnet-sillimanite-graphite gneisses, sillimanite - graphite gneiss, micaceous/ garnetiferous/ sillimanite bearing quartzites and garnet – sillimanite gneiss. S. N. Parida & D. N. Pani (1983-84) of DG (O) conducted geological mapping near Naringpanga block and reported seven occurrences of graphite in the region. Later, a detailed survey by the Directorate of Geology during F.S. 2016-17 over an area of 0.36 Sq. km in the adjacent northern part of the present block at G-2 level carved out an auctionable block which was successfully auctioned by Govt. The present study area shares geological continuity with the auctioned block. A part of the block was granted for PL in 2003 to M/s T. P. Minerals Pvt. Ltd. But, could not be executed as ML.

This block lies adjacent to a previously auctioned graphite block with established resource potentials. Thus, detailed exploration was warranted to assess the mineral potential.

2.5 Details and nature and quantum of work proposed vs achievement

SL. No.	Item of work	Approved Target	Achievement
1	Detailed Geological mapping (1:2000) and topographic survey (contouring at 2m intervals)	0.143 sq.km	0.143 sq. km
2	Drilling	400m	398 m (in 6 angle B.Hs)
3	Pitting	100 cum	100.5 Cu.m (4 PIT)
4	Self-Potential Survey	12-line km	13.5-line km
5	Sampling		Chemical Analysis
		Primary sample- 160	(B.H samples) - 160 Grab sample -8
		XRD-studies-10	XRD-studies-14
		Composite sample 10	Composite sample-11 Nos.
		Bulk density-5 Nos.	Bulk density-5 Nos.
		Preparation of Thin section study-5	Preparation of Thin section study-5
		Petrographic study-05.	Petrographic study-13 Nos.
		ICPMS (34 elements) –	ICPMS (34 elements) -20 Nos.

		20 Nos.	
		Internal check:	10% Internal Check sample- 20 Nos.
		External Check:	10% External Check sample- 10 Nos.

2.6 Personnel involved

(To be provided separately for all the qualified persons signing off the report)

A	Name:	<ol style="list-style-type: none"> Dr. P C Mishra, Joint Director Geology R. Behera, Geologist & Exploration In-Charge A. K. Das, Geologist
B	Address:	Directorate of Mines & Geology, Odisha, Bhubaneswar
C	Contact Mobile No:	0674 2392374
D	E-Mail id:	dir.mines@orissaminerals.gov.in
E	Qualification	Sl. 1: M.Sc. in Geology, Ph.D. Sl. 2 : M.Sc. in Geology Sl. 3: M.Sc. in Applied Geology
F	Experience	Sl. No. 1: 34 years of experience Sl. No. 2: 11 years of experience Sl. No. 3: 1 year of experience
G	Affiliation to any organization/ company, if yes, specify the name of the organisation or company:	Directorate of Mines & Geology, Government of Odisha.

ii Details of qualification and experience of persons associated with various aspects of exploration assessment of resources and reserves.

a	Name:	Dr. P.C. Mishra, Joint Director Geology	Ramesh Behera, Geologist and EIC	Ananta Kumar Das, Geologist
b	Address:	Directorate of Mines & Geology, Bhubaneswar, Odisha, 751001		
c	Contact Mobile No:	9861465695	7978513153	7008174291
d	E-Mail id:	pcmishra66@rediffmail.com	Rameshbehera8@gmail.com	ananta071994@gmail.com
e	Qualification:	M.Sc., PhD (Geology)	M.Sc., (Geology)	M.Sc. (Applied Geology)

f	Experience:	34 years	11 years	1 years
g	Affiliation to any organization, if yes, specify the name of the organization or company :	Directorate of Mines & Geology, Bhubaneswar, Odisha		

2.7 Mode of operation of different work components & associated agency:

The exploration components approved by TCC-NMET & EC was executed by efficient geo-scientists of the Directorate of Mines & Geology, Bhubaneswar, Odisha. The field officers from the Office of the Joint director of Geology, Koraput were deployed during the entire project period to execute the field components and Report preparation works. The drilling and Topographic survey components and geo-physical survey were outsourced. Besides, external check samples, ICPMS studies and bulk density determination studies were carried out in the NABL Laboratories.

CHAPTER-3

Property Description

3.1 Details of the area

- Village: Naringpanga
- Tahasil: Muniguda
- District: Rayagada
- State: Odisha
- **Toposheet No:** E44F10 (65M/10)
- DGPS and Global positioning System (GPS) coordinates of all corner points of the area. Handheld DGPS and GPS (GARMIN) were employed for fixation of Geo-Coordinates of corner points. The location map of the working area is shown in Fig.1.

CP	EASTING	NORTHING	LONGITUDE	LATITUDE
1	767648.325	2183027.174	83°33'12.89664" E	19°43'28.79616" N
2	767806.703	2183159.921	83°33'18.40104" E	19°43'33.03300" N
3	767929.205	2183030.846	83°33'22.53888" E	19°43'28.77816" N
4	768025.026	2183119.601	83°33'25.87356" E	19°43'31.61568" N
5	768248.905	2182828.258	83°33'33.40656" E	19°43'22.03716" N
6	768014.12	2182612.074	83°33'25.23672" E	19°43'15.12624" N
7	767751.977	2183015.153	83°33'16.44804" E	19°43'28.35480" N
8	767690.39	2182971.999	83°33'14.31180" E	19°43'26.98248" N

- Borehole points in latitude and longitude (Degree Minutes Second) format WGS-84 Datum

BH No	Northing	Easting	RL(m)	Longitude	Latitude
NPBH-01	767689.2503	2183040.786	331.40	83°33'14.310" E	19°43'29.218" N
NPBH-02	767778.4465	2183058.278	333.31	83°33'17.377" E	19°43'29.744" N
NPBH-03	767854.1705	2182910.55	331.02	83°33'19.901" E	19°43'24.906" N
NPBH-04	767887.8965	2182985.00	335.52	83°33'21.096" E	19°43'27.307" N
NPBH-05	767910.4273	2182829.996	329.86	83°33'21.791" E	19°43'22.260" N
NPBH-06	767975.6609	2182906.237	334.14	83°33'24.069" E	19°43'24.704" N

- **Cadastral details-** Cadastral details of the area with land use, area under forest with type of forest. In case the cadastral details are not available an indicative data of breakup of government, private and forest land.

Government Land/ Private land/ Forest land:

(To be inserted after receipt of authenticated Land schedule)

Total Area: 0.143 ha

Mineral(s) under investigation: **Graphite**

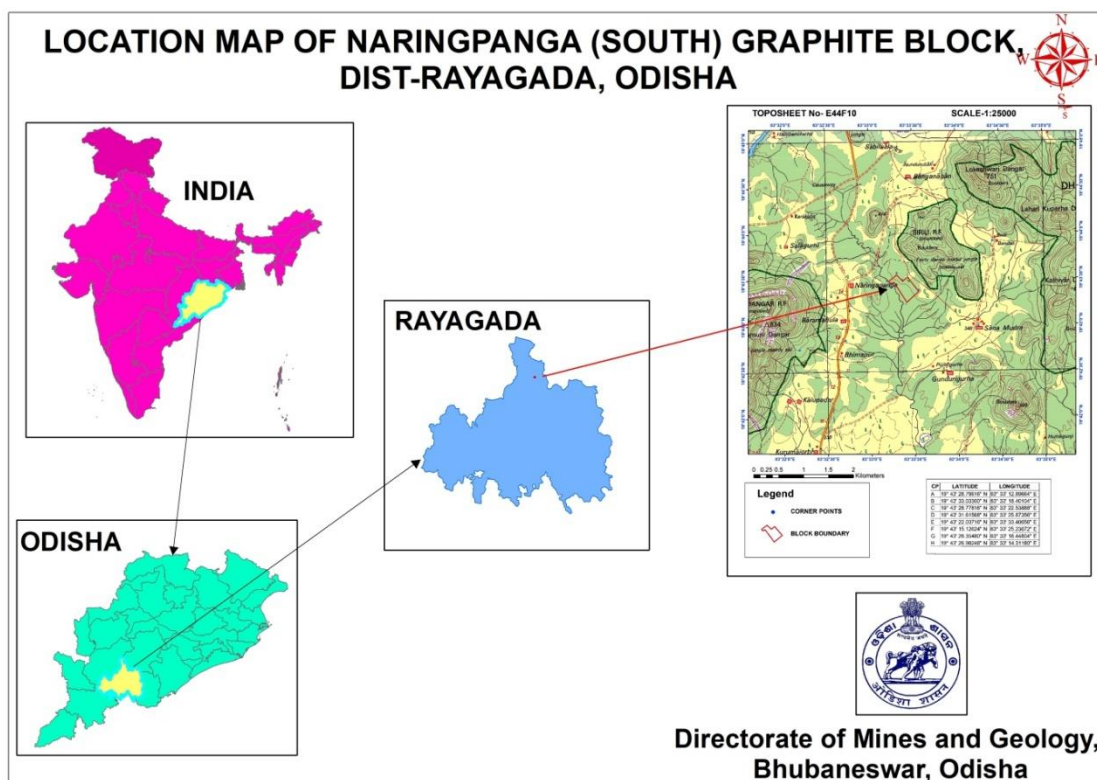


Fig. 1: Location Map of Naringpanga Graphite Block, Rayagada district, Odisha

3.2 Physiography and Environment

i. Relief of the area

Regionally, eastern and northern parts of the area consist of hill ranges and thick forests. The area exhibits a dendritic pattern of drainage. The general slope as indicated from the drainage is from northwest to southeast. Upper reaches of Vamsadhara River and its tributaries constitute the drainage system of the area. The hill ranges and the drainage in general have been controlled by the lithology and the structure of the formation. An analysis of the structural data has brought out that the long chain of hills represents synformal structures with intervening broad antiformal valleys indicative of attainment of geomorphological maturity of the terrain.

Locally, the area presents a predominantly plain landscape with minor undulations. The eastern and western region of the block is dotted with small hillocks. Elevation ranges from a minimum of 328 meters above mean sea level (MSL) in the central-west portion to a maximum of 352 meters msl in the northeastern corner of the block.

The Barha Nala, a tributary of River Vamshadhara, is a perennial Nala that dominates the drainage system of the area, is litho-structurally controlled and flows from northwest to southeast with pronounced meanders. This drainage is supported by smaller ephemeral streams and exhibits a sub-dendritic pattern influenced by the underlying lithological and structural framework. The water table in the region fluctuates between 2.00 and 11.70 meters.

ii. Accessibility:

Naringpanga is well connected by a metal road and is located approximately 20 km northeast of Muniguda, the Block & Tehsil Headquarters of Rayagada district. The study area lies 750 m northeast of Naringpanga village. The district headquarters, Rayagada, is located 64 km from the study area and is accessible via State Highway No. 5. The nearest railway station is Muniguda, situated on the East Coast Railway, approximately 22 km away. The nearest port is Vishakhapatnam, at a distance of 260 km. Healthcare infrastructure in the region includes a government CHC hospital in Muniguda block, a district hospital in Rayagada, and a sub-divisional hospital in Gunupur, along with several private healthcare facilities across the district. Financial services are well-represented, with 60 commercial bank branches and 24 rural bank branches. As far as the mining industry in the area is concerned. Industrial development is highlighted by the presence of Vedanta's alumina refinery at Lanjigarh. Hindalco's Utkal Alumina International Limited (UAIL) is already operating a 2.12 MTPA alumina refinery in the district. The study area falls under Muniguda Tehsil in Rayagada district.

iii. Host population (local tribes), Human settlements within and nearby the area

Naringpanga is a small village located in Muniguda Block of Rayagada district, Odisha. According to the 2011 Census, The village has a population of 233 people, among these, 107 are males and 126 are females, resulting in a sex ratio of 1,178 females per 1,000 males, which is significantly higher than the Odisha state average of 979. The village consists of 55 households, with most residents belonging to Scheduled Tribes (71.24%) and a smaller proportion to Scheduled Castes (19.74%).

iv. Socio Demographic profile of the area and nearby

Socio-demographic profile of Naringpanga village has been assessed as follows:

Particulars	Total	Male	Female
Total No. of Houses	55	-	-
Children (0 to 6)	27	12	15
Population	233	107	126
ST	166	75	91
SC	46	22	24
Literacy	24.76%	36.84%	14.41 %
Literate	51	35	16
Illiterate	182	72	110
Total worker	130	63	67
Main worker	3	-	-
Marginal worker	127	62	65

v. Historical sites and archaeological monuments, places of worship, public utilities etc. within or nearby

In the Muniguda block, some of the notable temples include the Jagannath Temple, which is significant within the region, and the Kumudabali Shiva Temple. Additionally, the Siva Temple at Chatikona is mentioned as an important place of worship. While no historical sites are specifically listed nearby Naringpanga itself, these temples contribute to the cultural and spiritual landscape of the area. The local schools also serve as key public infrastructure in the region.

vi. Forests, sanctuaries, national park and wildlife sanctuaries; grazing land and gochar land within or nearby the area with distance from periphery of the area explored.

No Wildlife Sanctuary is lying within a radial distance of 5 Km.

vii. Flora and Fauna within and nearby

Rayagada district spans a total geographical area of 7,073 square kilometers, of which 2,812.33 square kilometers amounting to 39.76% is covered by forest. The Naringpanga study area reflects this broader ecological profile, being sparsely vegetated with a mix of bushy forests and species such as Sal (*Shorea robusta*), Neem (*Azadirachta indica*), Mango, and Kendu (*Diospyros melanoxylon*). Occasional teak plantations are also observed. These forests play a significant ecological role and support both biodiversity and the livelihoods of local communities.

While the district is known to host wildlife like bears, jackals, and wild boars, the specific study area near Naringpanga lacks significant faunal presence. It is characterized by sub-tropical climatic conditions, which facilitate a rich floral composition but do not support large populations of wild animals. Additionally, there are no national parks, wildlife sanctuaries, or other protected areas in close proximity to the study site.

viii. *Water bodies:*

The area is situated in the eastern flanks of Bangei nala which is ephemeral. However, the area of investigation exhibits a plain land with small amplitude soil ridges manifested due to morpho-structures. The general slope of the terrain is from North to South. Seasonal rain cuts drain the area to Bangei nala, tributary of the Vansadhara River. Few deep rain cuts are also noticed in the western part of the area.

ix. *Climatic conditions:*

The district experiences a subtropical climate, with heavy monsoon rainfall concentrated between June and September, averaging around 1,288 mm annually. Summers are typically hot, with temperatures reaching up to 46°C, while winters are cool, with lows between 7°C and 8°C. This climatic variability supports the diverse vegetation and soil conditions found in the region, aligning with the physiographic and hydrological features of the Eastern Ghats.

x. *Any other physiographic, social and environmental factor having potential to affect the viability of the project and assessment of resource:*

Local resistance for viability of the project and assessment of resources cannot be ruled out.

3.3 Infrastructure

Local infrastructure with roads, railways, port facilities, electricity, water etc. With distance from the area	Roads	The block is accessible from the district Headquarters Rayagada covering 61 km SH-64.
	Railways	The nearest railway station / siding is at Muniguda Railway link of East-Coast Railway at a distance of 22 km from the block.
	Port Facilities	Visakhapatnam is the nearest port on the eastern coast of Andhra Pradesh located at 260 km from the block.
	Electricity	Available in the village Naringpanga
	Water	Ground water can be made available from the bore well put in the Block for drinking & domestic purposes.
	Airport	Jeypore, 210 km and Visakhapatnam 260 km from Muniguda.
Details of nearby industries in the area which may use the mineral commodity likely to be mined	Old graphite beneficiation plants are located in Rayagada district.	

CHAPTER – 4

PREVIOUS WORK

4.1 Previous exploration/previous history of mining in adjoining area:

1. Mohanty, B.C. & Vajani, P.C. (1982-83) of Directorate of Geology, Odisha, first reported occurrences of graphite around villages such as Sollagudi, Naringpanga, Kallupadar, Mudra, Bongna, Birli, and Sabinala in Rayagada district. Preliminary investigations revealed graphite occurrences with fixed carbon (F.C.) content ranging from 7% to 49%, highlighting variability in ore quality. Graphite mineralisation is hosted by migmatised khondalite and termed as stratiform in type and mostly foliation controlled.
2. S. N. Parida & D. N. Pani (1983-84) of DG (O) conducted geological mapping near Naringpanga block and reported seven occurrences of graphite in the region. Among these, the graphite deposit near Bandhamandi was noteworthy, although of low grade, with fixed carbon (F.C.) content ranging from 4.56% to 21.38% and is under active mining.
3. Pasayat, S.; Jena, B.K.; Adhikari, K.N. and Satpathy, U.N. of GSI mapped the area in 1985-86 and reported 4 Graphite occurs in form of four parallel, narrow, conformable bands rich in flaky and amorphous graphite within argillaceous members (UE 10547) of khondalite group of rocks. These bands are traceable discontinuously for over a strike length of about 500 m and has considerable depth persistence along dip direction.
4. Later, Nanda & Rauta of DG (O) carried out an investigation at G-4 level around Panchubai village Rayagada district in 2015-16 and estimated a reconnaissance resource of 0.032 million tonnes of graphite for 10 sporadic graphite pockets in the area. Among which, the Naringpanga occurrence was interpreted to be a potential area with graphite resource of 0.029 mt (G-4 level).
5. With the above backdrop, Officers of the then Directorate of Geology carried out detailed exploration around Naringpanga, Rayagada District, (Sahoo, & Rauta, (2016-17)), the block is subsequently auctioned by State Govt. successfully.

4.2 Details of previous exploration carried out by other agencies/parties

A part of the block was granted for PL in 2003 to M/s T. P. Minerals Pvt. Ltd. But could not be executed as ML. The PL holder also had not taken up any detailed exploration activities over the PL area. In 2021, with the recommendation of the Technical Committee, the block was taken over by the Government.

Delineation of graphite through detailed geological mapping in 1:2,000 scale was undertaken by the Directorate of Geology during F.S. 2016-17 over an area of 0.36 Sq. Km through a topographic survey. Out of which, an area of 0.0549 Sq. Km, the adjacent northern part of the present block was explored at G-2 level through drilling of 404.45 meters through 19 vertical boreholes, spaced at 50m x 50m grid intervals and meter-wise sampling. The maximum explored depth in the block was 26.15 meters. A total of 204 meter-wise core samples were collected from the boreholes, along with five grab BRS samples.

Out of the 19 boreholes, 13 BHs encountered graphite disseminations, while the remaining boreholes were barren.

The resource and grade of the block was estimated by cross sectional area method and borehole influence method. The total indicated geological resource of the Naringpanga graphite block is estimated to be 0.142 million tonnes with UNFC 332 which constitute 0.132 million tonnes of graphite with F.C. content ranging from 2 to < 5% and 0.01 million tonnes of graphite with more than 5% F.C. The average grade of the block with F.C. content 2 to < 5% is LOI- 9.617%, SiO₂-52.482 %, Al₂O₃- 17.355 % and F.C- 2.615% and for graphite with F.C. content ≥ 5% is LOI- 7.965%, SiO₂- 52.107%, Al₂O₃-18.495% and F.C.- 5.551% (Sahoo et. al. 2016-17). The block has been successfully auctioned at 7.65% to M/s Maa Kudargarhi Steel Pvt. Ltd. in the year 2022 by the State Government.

The present block shares the geological continuity with the auctioned block

CHAPTER -5

GEOLOGY OF THE AREA

5.1 Aerial Reconnaissance

The study area around naringpanga was interpreted with a buffer zone of about 30 km was interpreted from LISS II, band II & III satellite data over an area of 0.143 sq km to interpret the regional structure and local structural control of lithological geometry to decipher the possible control of mineralization. Satellite imagery interpretations of the Naringpanga area (fig.2) indicates its proximity to the Tumudibandha sub shear of Vanshadhara-Nagavalli shear zones that controls the geo-spatial distribution of the high grade granulites and might have facilitated the graphite mineralization in the sympathetic weak planes of host lithologies. The area is located about 12 km west of the Tumudibandha Shear, a sub shear of Vanshadhara Shear Zone (Fig. 2), which runs in a north-south direction. Additionally, a sympathetic shear zone, north-south oriented, passes through the area. The manifestations of these shears with minor asymmetric shears of the westerly lying Tel Shear (ENE-WSW) might have offered a favorable environment for the emplacement of granitic melts. The interpreted aerial maps have been subjected to ground truthing during field work.



Fig 2: Satellite image of the study area illustrating major shear fractures and folding patterns.

5.2 Regional Geological set up of the area with stratigraphy, structure & Metamorphism

5.2.1 Regional Geology

The area of exploration forms a part of Eastern Ghat Mobile Belt which skirts the eastern fringe of Dharwar and Bastar Cratons and the southern fringe of Singhbhum Craton. This belt has been sliced off along the eastern continental margin of India. In western and northern part, this belt has been thrust over the respective Cratons. The Eastern Ghats Mobile Belt is also cut across by Gondwana grabens of the Mahanadi and the Godavari. It consists of a typical litho-assemblages of charnockites, supracrustals of khondalite group (dominated by garnet-sillimanite gneiss with sub-ordinate quartzite, marble and calc-silicate), migmatized gneisses (leptynite and orthogneiss) and granitoids. All have been metamorphosed in upper amphibolite to granulite facies. Younger intrusions of anorthosites, alkaline rocks and granites are also conspicuous in this belt (Ramakrishnan et.al. 1998). Retrograde metamorphism has been reported in this belt (Sen et. al. 1995). In general, the Eastern Ghat Mobile Belt is tightly folded into isoclinal and recline folds, the axial plane of which plunges south-easterly due to strong forces of compression directed from south-east (Chetty et. al. 1998). Nanda (1995) divided the Eastern Ghat Mobile Belt into four longitudinal litho zones depending on the predominance of litho types. These are western Charnockite Zone (WCZ), Western Khondalite Zone (WKZ), Central Migmatite Zone (CMZ) and Eastern Khondalite Zone (EKZ). The present area of exploration lies in the Western Khondalite Zone.

Mahalik (1998) has divided Odisha into three geological sectors. Rocks of the region have been affected by two typical tectonic trends; the NE-SW trend, commonly known as the Eastern Ghats trend (oldest) and NW-SE trend, known as Nagavalli- Vansadhara trend. The NW-SE trend has been off-set by two major faults, the Eastern Ghats Boundary Fault and Tel River Shear. The NW-SE trend between Koraput and Bhawanipatna gets deflected to north-south orientation and continues up to Gandhamardan hill where it again deflected to NE-SW trend forming an arcuate belt. Faults and shear zones of south Odisha sector have genetically related either to the Eastern Ghats trend (NE-SW) or Nagavalli-Vansadhara trend (NW-SE). Khondalite and charnockite, part of the high-grade granulitic facies, show a predominant NE-SW trend, although local irregularities exist (Rao, A. T. 1977; Das, A. Sriram 1979). The folds in this area are mostly overturned, with the main axial plunge (F1)

directed to the NE, influenced by superimposed folding along the NW-SE axis (F2), which is associated with the emplacement of charnockite. Secondary folding, associated with shearing, led to the rotation of fold axes and the formation of isoclinal folds. The third deformation episode is marked by upright open folds with horizontal axes, a result of migmatization (Bhattacharya, 1994). The fourth phase is characterized by shearing and fracturing, with fault directions trending WNW and NNE (Sarkar et al., 1981).

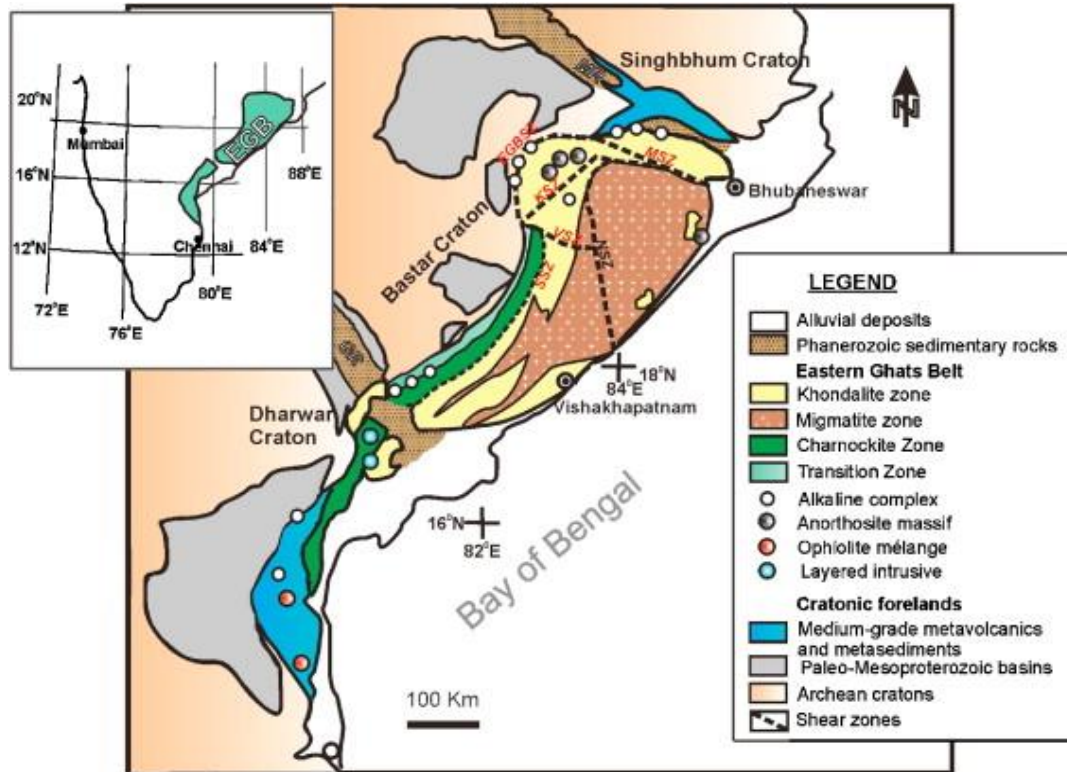


Fig. 3: Regional Geological map of Eastern Ghats Mobile Belt (Ramakrishnan et al. (1998).

Several tectonic models have been proposed by researchers to classify the Eastern Ghats Mobile Belt (EGMB) into various lithozones, provinces, and domains. These classifications are based on dominant lithology, tectonic fabric, and isotopic characteristics. Misra et al. (2015) provided a comprehensive review, discussing the merits and demerits of different classification schemes, offering insights into the complexity and diversity of the region. One of the notable classifications, as depicted in Fig. 3, is the litho-zonation proposed by Ramakrishnan et al. (1998). This model expanded the earlier divisions suggested by Nanda and Pati (1989), offering a refined understanding of the geological characteristics of the belt.

Ramakrishnan et al. (1998) identified four distinct longitudinal lithologic zones within the EGMB, arranged from west to east:

1. **Western Charnockite Zone (WCZ):** This zone predominantly consists of charnockitic rocks and represents the westernmost part of the EGMB.
2. **Western Khondalite Zone (WKZ):** Situated to the east of the WCZ, this zone is characterized by khondalite rocks, which include garnetiferous sillimanite gneisses, quartzites, and leptynites.
3. **Central Charnockite-Migmatite Zone (CMZ):** This zone is marked by a complex mix of charnockitic and migmatitic rocks, indicating extensive high-grade metamorphism and partial melting.
4. **Eastern Khondalite Zone (EKZ):** This is the easternmost zone, predominantly consisting of khondalite rocks, similar to the WKZ, but with variations in mineral assemblages and structural characteristics.

The merit of this classification is that it gives a clear understanding of the lithological distribution and variation across the belt.

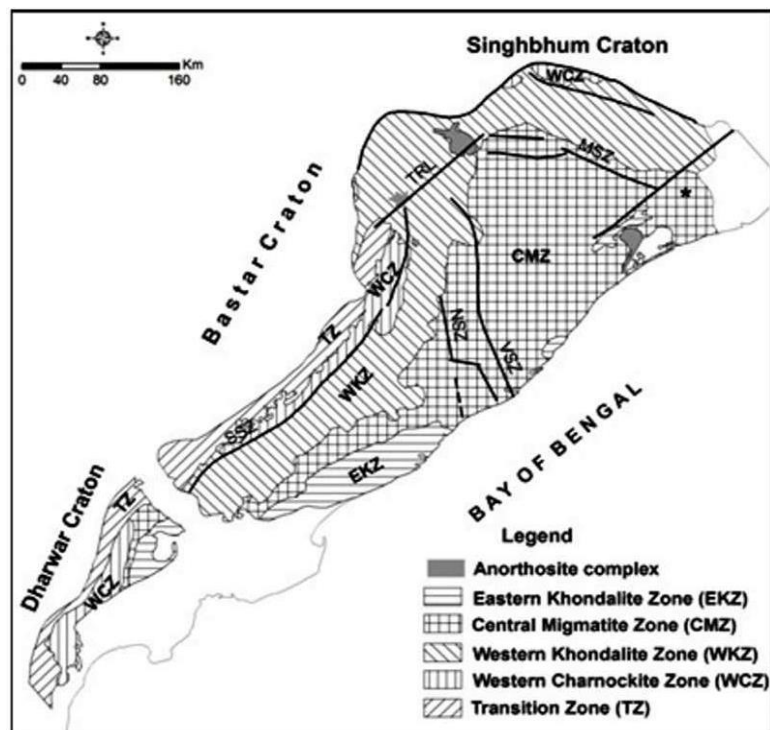
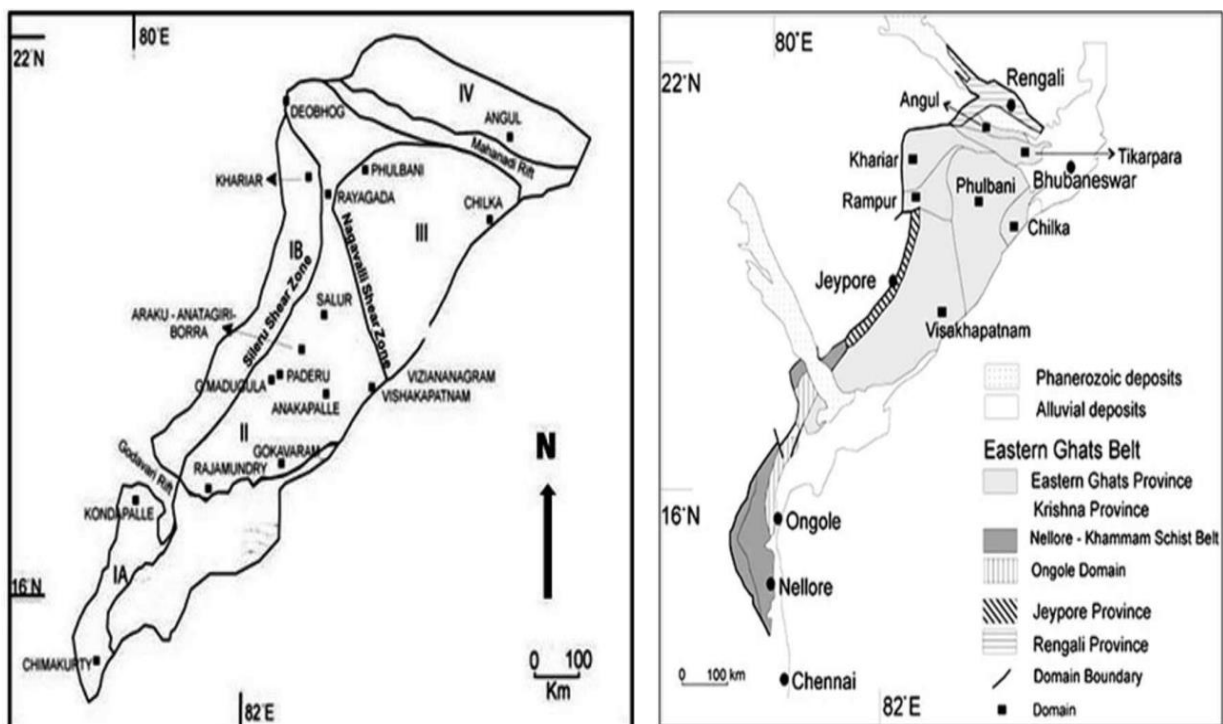


Fig. 4: Litho-zones of EGMB (Ramakrishna et. al. 1998)

Similar to the litho-zonation, Rickers et al. (2001) proposed a classification based on available isotopic data and divided the EGMB into four crustal domains as mentioned in figure 4 which can be compared to the lithological subdivisions proposed by Ramakrishnan et al. (1998) with additional inputs from the shear zones identified by Chetty and Murthy (1994) which serve as boundaries for these domains. Chetty (2001, 2010, 2014) and Chetty et al. (2003) based on the study of satellite images attempted to delineate different tectonic domains in the EGMB. Chetty (2001) divided the EGMB into at least nine distinct heterogeneously deformed terranes based on the presence of shear zones, different fold styles, and axial planes of early formed folds, distinct signatures of alkaline, anorthositic and granitic magmatism and tectonic interactions that have shaped the EGMB.

Fig.5: Domains of EGMB, Rickers, et.al. 2001 (left) & Provinces & Domains of EGMB in the EGMB, Dobmeier, & Raith (2003) (source; Nana et al. 2002)



However, accurately defining the boundaries and determining the exact nature of terrains can be challenging due to complexities in the geological record, insufficient detailed structural mapping in the granulite terrain and limited geochronological data on different domains. Figure 5 illustrates the classification by Dobmeier and Raith (2003), providing

insights into broader geological processes. In 2024, Behera & Mohakul et al., based on the contiguity of mineralised zones and their disruption due to structural discontinuities in EGMB, prepared a lithotectonic domain map with interpretation of prospective graphite mineralization provinces.

Five lithotectonic domains having distinct disposition patterns of mineralisation have been made which are (i) the southernmost, Vizianagaram - Rajahmahendravaram Domain bounded on its east by the N-S trending Nagavalli Shear Zone (NSZ), (ii) the Nagavalli - Vamsadhara Domain lying between NSZ and Vamsadhara Shear Zone (VSZ), (iii) the central Daspalla Phulbani Domain bounded by VSZ in the south and the Mahanadi Shear Zone (MSZ) in the north, (iv) the northernmost Angul Redhakhol Domain located north of the MSZ and (v) the western Balangir Domain between the eastern margin of the Bastar Craton and the Tel Shear Zone (TSZ) (Fig.6).

The broad stratigraphic framework of Eastern Ghats Super Group postulated by Ramakrishnan et al (1998) is as follows.

800-900 Ma	Alkaline rocks, granitoids
	-----Eastern Ghats Orogeny-----
1000-1100 Ma	Development of Eastern Ghats ‘Front’ of upgraded cratonic rocks Incipient and massive charnockite and garnet-hornblende-biotite gneisses and garnetiferous gneiss with biotite and sillimanite
1300-1400 Ma	Emplacements of alkaline rocks (feldspathoidal gneisses) and anorthosites
Khondalite Group (WKZ, CMZ & EKZ)	Garnet-sillimanite-graphite gneisses Cordierite-sapphirine-spinel rocks Calc-silicate rocks and rare marbles Quartzite rich in garnet (and some sillimanite) (The whole suite interleaved with charnockites)
1600-1800 Ma	Evolution of Purana basins
2600-2800Ma	Charnockites with enclaves of basic granulites, high grade (WCZ) schists including BIF, and layered basic complexes, representing original cratonic basement (?) in ‘migmatitic’ amphibolite facies
3000 Ma	Vestigial events (?)

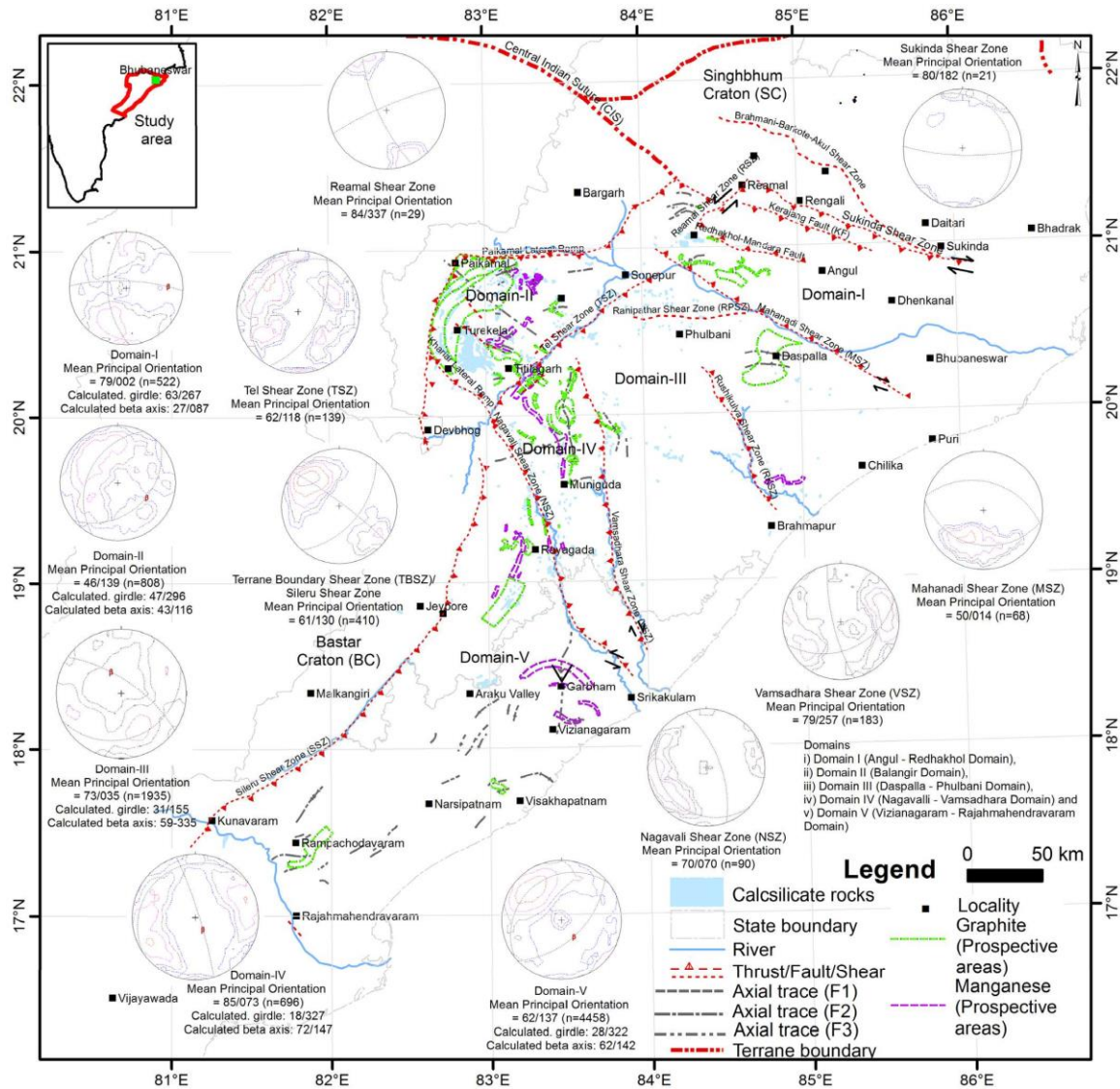


Fig.6: Regional Litho-tectonic domain map of EGMB after Behera & Mohakul, 2024

5.2.2 Local Geology and Stratigraphy:

The area under exploration forms part of the Eastern Ghats Supergroup and comprises khondalite, charnockite, quartzo-feldspathic gneiss, and pegmatoids with associated silica veinlets. These rock units are overlain by recent soil and alluvium. Pegmatoids occur as intrusive bodies within the migmatized khondalite, typically emplaced along the foliation planes (Plate-II).

Detail geological mapping over the area revealed that area is mostly soil covered with scanty exposures of the litho units like khondalite and its variants, quartzo-feldspathic gneiss, charnockite and pegmatite which are only exposed along the Barha Nala course

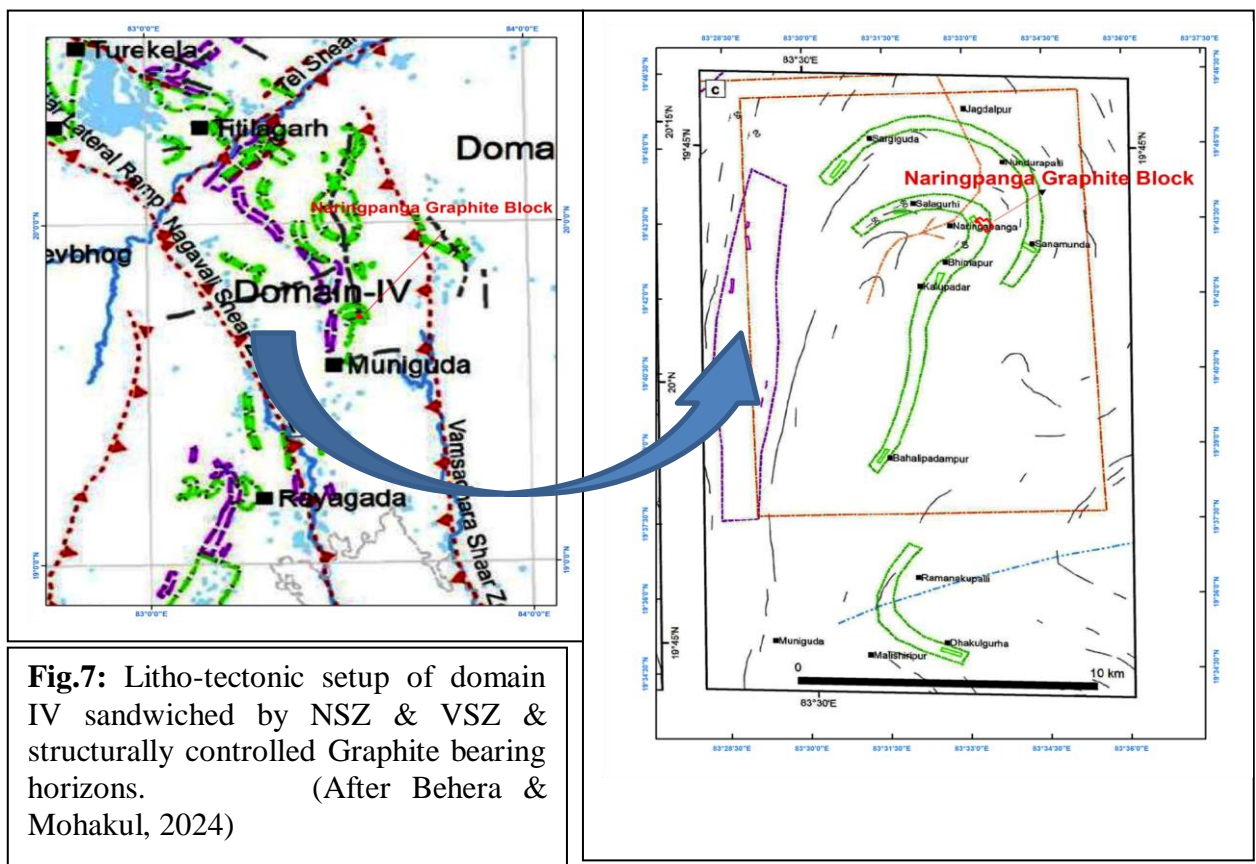
adjacent to the west of study area, The Khondalite group consists of garnet - sillimanite schist, sillimanite - graphite gneiss, micaceous/ garnetiferous/ sillimanite bearing quartzites and garnet – sillimanite gneiss. All these litho-units are migmatized and altered to variable extent. Except minor quartz and pegmatoid veins, the area is significantly devoid of any intrusive rocks. Members of Khondalite group namely quartz-garnet-sillimanite schist with or without graphite (Khondalite sensu-stricto), sillimanite-graphite schist and quartzites are interbanded with each other or exhibit variations along strike from argillaceous to arenaceous facies and vice versa. Similarly, khondalite grades along strike to migmatite from un-migmatized to thoroughly migmatized rock without any relict mineralogy of the parent rock. This type of gradation is essentially due to increasing abundance of quartzo-feldspathic material in the original rock. Arenaceous and argillaceous members of khondalite show strike ward gradation to quartzo-feldspathic gneiss as recorded in the borehole cuttings indicate that they are para-gneisses. On close examination, the interbedded arenaceous bands at some places within khondalite are seen to be leptynites in composition indicating them originally to represent arkoses in the sedimentary basin. Khondalite & quartzofeldspathic gneiss form more or less banded assemblage with variable degree of alteration. Based on their mutual field relation relationships, the following stratigraphic succession is suggested in order of their increasing antiquity.

Recent to sub recent	Soil/Alluvium
Intrusive	Pegmatoids & silica veinlets
	Quartzo-feldspathic gneiss (\pm Graphite & Garnet)
Archaean	Charnockite (migmatized)
	Khondalite (migmatized/kaolinised/ \pm graphite)

Regional Structure

The disposition of the mineralised zones is unique in each domain, primarily controlled by the second and third generation folding often modified by high strain zones. The study area lies within the Domain IV, of the litho-structural domain of EGMB (Behera & Mohakul, 2024) (Fig: 7). The Nagavalli-Vamsadhara domain is a narrow NNW-SSE trending belt bounded by Nagavalli Shear Zone (NSZ) in the west and VSZ in the east. It constitutes parts of WKZ and CMZ of Ramakrishnan et al. (1998). The shear zones (NSZ and VSZ) join the western boundary shear zone in the north and in the south, they merge

together to end abruptly against the east coast (Chetty, 2001). The authors proposed fold-thrust tectonics associated with westward thrusting in this domain. This domain trends at an angle (NNW-SSE) to the regional foliation (NE - SW) of the rocks of the EGMB. This domain becomes narrow towards the south. The domain constitutes tight folds with N-S axial traces (F2). The trend of the foliation near VSZ and NSZ are parallel to both shear zones. The foliation near VSZ steep westerly dip and is parallel to VSZ whereas the foliation in the vicinity of NSZ has steep easterly (Fig: 7). The steeply easterly dips of NSZ and merger with other westerly dipping shear zones at depth indicate the region's tectonic complexity. In this domain, the F2 folds are appressed with axial traces that are parallel to the NSZ and VSZ.



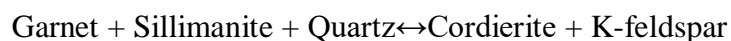
5.2.3 Metamorphism:

Regionally, the EGMB has undergone complex polyphase metamorphism, characterized by granulite facies metamorphic conditions. The metapelitic rocks, particularly khondalites, exhibit mineral assemblages such as garnet + sillimanite + quartz + K-feldspar + biotite \pm spinel, are suggestive of high-temperature and moderate-pressure

conditions. Metamorphic reactions in these rocks include the prograde transformation of muscovite and biotite into garnet and sillimanite, such as:



During peak metamorphism, dehydration melting reactions occurred, for instance:



Which produces granitic melts and migmatitic textures. In charnockitic rocks, orthopyroxene is a diagnostic mineral formed through the dehydration of biotite, via:



These reactions suggest the removal of water and stabilization of anhydrous minerals under high temperature conditions. In some areas, spinel + quartz + garnet assemblages are observed, indicating ultra high temperature metamorphism (>950°C).

Metamorphism in the EGMB is interpreted as a result of Proterozoic continent–continent collision, followed by prolonged crustal residence and exhumation. The mineral assemblages encountered in the study area suggest different metamorphic episodes based on the presence of specific minerals.

5.3 Surface indication of mineralization:

During geological mapping by the officers of DoMG, Odisha in F.S.P. 2016-17, around Naringpanga, exposures of graphite bearing quartzo-felspathic gneiss and migmatized graphite-sillimanite bearing gneisses of khondalite group of rocks were delineated along nala bed and walls of the Bengai Nala flowing in the western vicinity of the present target area (Fig.8). Here, disseminated flaky graphite is found to occur as lenses and pockets along the folial plane of the polytic gneisses and quartzo-felspathic gneisses with varying concentrations which shows sub vertical dip towards east with NNW-SSE foliation. Both quartzo-felspathic gneiss and migmatized graphite-sillimanite bearing gneisses exhibit more or less banded nature and conformable. The dip of litho units are extrapolable to the present area which led to intercept the graphite lodes in the boreholes given at 45° across the dip.



Fig. 8. Altered migmatised khondalite in the Bangei Nala bed & eastern wall section.

CHAPTER-6

GEOSCIENCE INVESTIGATION

6.1 Geological Mapping:

The exploration over the Naringpanga South Graphite block was taken up to assess the economic potentiality for graphite through detailed Geological mapping, SP survey, Pitting, Core drilling and Sampling followed by analysis to assess the inferred resource as per approval of exploration components of NMET. The achievements made under different components during exploration are given below.

Table 6.1: Exploration Components

SL. No.	Item of work	Approved Target	Achievement
1	Detailed Geological mapping (1:2000) and topographic survey (contouring at 2m intervals)	0.143 sq.km	0.143 sq. km
2	Drilling	400m	398 m (in 6 angle B.Hs)
3	Pitting	100 cum	100.5 Cu.m (4 PIT)
4	Self-Potential Survey	12-line km	13.5-line km
5	Sampling		Chemical Analysis
		Primary sample- 160	(B.H samples) - 160 Grab sample -8
		XRD-studies-10	XRD-studies-14
		Composite sample: 10	Composite sample-11 Nos.
		Bulk density-5 Nos.	Bulk density-5 Nos.
		Preparation of Thin section study-5	Preparation of Thin section study-5
		Petrographic study- 05.	Petrographic study- 13 Nos.
		ICPMS (34 elements) – 20 Nos.	ICPMS (34 elements) -20 Nos.
		Internal check:	10% Internal Check sample- 20 Nos.
		External Check:	10% External Check sample- 10 Nos.

6.1.1 Detailed Geological Mapping:

In order to facilitate geological mapping in 1:2000 scale, the entire area was surveyed using Total Station in 1:2000 scale by Total Station. A 550 m baseline was established in the N 40° W direction, aligning with the litho-unit trend, using a Topcon Total Station (Model IM-55). Offset lines were laid out in the west–east direction. Coordinates of the block's corner points and borehole (BH) locations were recorded using a DGPS Trimble R8 Internal GNSS Dual Frequency system. The reduced levels (RL) of topographic control points across the area were also recorded, and a topographic map was prepared with a 2 m contour interval (Plate-VI). Borehole locations were located as per SP anomalous zones and approved by NMET for exploration and collar height & coordinates are recorded.

The block has been surveyed using 2 - 4 DGPS points for accurate geo-referencing and ground control points. The DGPS points, established using the RTK (Real-Time Kinematic) method, ensured precise geo-referencing of the data. The survey data was extrapolated to the UTM grid system with the WGS-84 datum. The boundaries of the block were mapped using drone imagery, and critical points, such as borehole collar locations, were verified and fixed using DGPS. The ground control points and BH locations were recorded by Total station.

Detailed geological mapping over an area of 0.143 sq. km was conducted at a 1:2000 scale using a Brunton compass, Garmin GPS, and measuring tape to delineate litho-structural units. Traverses were spaced at 20 m intervals, and litho-structural elements were systematically recorded with respect to grid points and depicted in the geological map (Plate-II). The geometric disposition of litho-units beyond the study area was also recorded, as a significant portion of the working area is soil-covered, to aid in interpreting the spatial correlation of lithologies intersected in core samples. Based on surface and subsurface data, it is interpreted that 0.078 sq. km is mineralized, while 0.065 sq. km is non-mineralized. The study also included surface topographic mapping with contouring at 2 m intervals. Reduced Levels (RLs) of key points were recorded using a Total Station for precision. A separate topographic contour plan is provided in Plate-VI.

6.1.2 Description of different litho-units:

A brief note on the different litho-units of the area is discussed below:

(i) Khondalite:

Khondalite is the oldest rock unit occurring in the area which are migmatized and altered to variable extent. It is exposed in the Nala cuttings & wall sections only and also intercepted in boreholes. It forms a banded assemblage with the quartzo-feldspathic gneiss & often silicified. It is well foliated, shows compositional bending. The mineral present are quartz, feldspar, sillimanite, garnet, biotite and a few grains of graphite. In thin section it shows prisms and needles of sillimanite, porphyroblasts of garnet and recrystallised mosaic of quartz and feldspar. The accessory minerals are biotite, graphite and opaques. The rock shows well developed schistosity defined by the oriented needles of sillimanite, stretched grains of quartz and rod like forms of graphite. Because of close proximity to Bangei Nala, the lithounits have undergone higher degree of alteration and often places kaolinised. It is reddish brown to buff in colour, medium grained, and inequigranular consisting essentially of quartz, plagioclase, sillimanite, garnet and opaque minerals which are scattered throughout the rock mass. Quartz and orthoclase are abundant; plagioclase, sillimanite are common and garnet is noticed as an accessory. Secondary growth is noticed in most of the quartz grains. Under microscope plagioclases are highly saussuritised. Iron solution leached out from the garnet imparts a reddish look to the rock mass. Flakes of graphite occur as dissemination within the khondalite.



Fig. 9. (a) Altered migmatized khondalite in the Bangei Nala bed & eastern wall section.

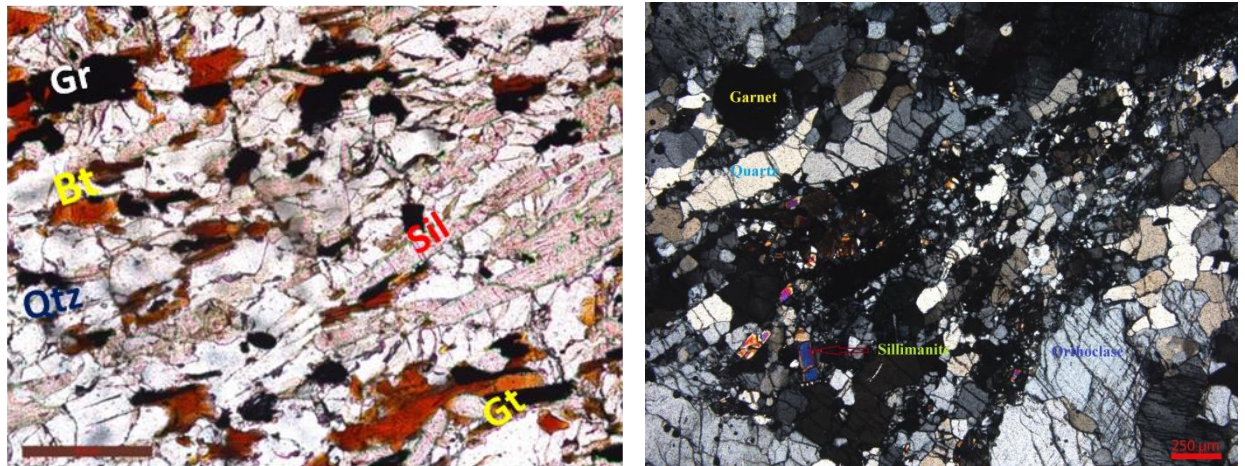


Fig . 9. (b) Micro-Photograph of graphite bearing migmatised khondalite. (Bt: Biotite, Gr Graphite, Gt: Garnet, Sil: Sillimanite, Qtz: Quartz)

The trend of foliation in khondalite varies from $N40^{\circ}-60^{\circ}W$ to $S40^{\circ}-S60^{\circ}E$ dipping 55° to 70° southwesterly. Intense weathering and alteration of the constituent minerals rendered the lithounits moderately fissile at places with kaolinisation of the plagioclase porphyroblasts. It is a medium to coarse grained rock predominantly composed of quartz and feldspar showing crude foliation characteristics. The quartz grains are often flattened along the plane of foliation. Sillimanites are found as slender crystals with transverse fracture. The quartz grains exhibit sutured boundaries and granulation indicating a strained condition. Secondary overgrowth in the shape of rims is noticed in some quartz grains. Orthoclases are perthitic in nature. Orthoclase feldspars are altered and impart a dusky appearance. The garnets are isotropic, and it is likely that iron has been leached from them, giving the rock a reddish colour.

XRD studies of khondalite core samples (fig.10) exhibits mineral peaks for quartz, orthoclase, microcline, almandine, sillimanite, graphite, biotite, kaolinite, montmorillonite, titanite and epidote of variable intensity.

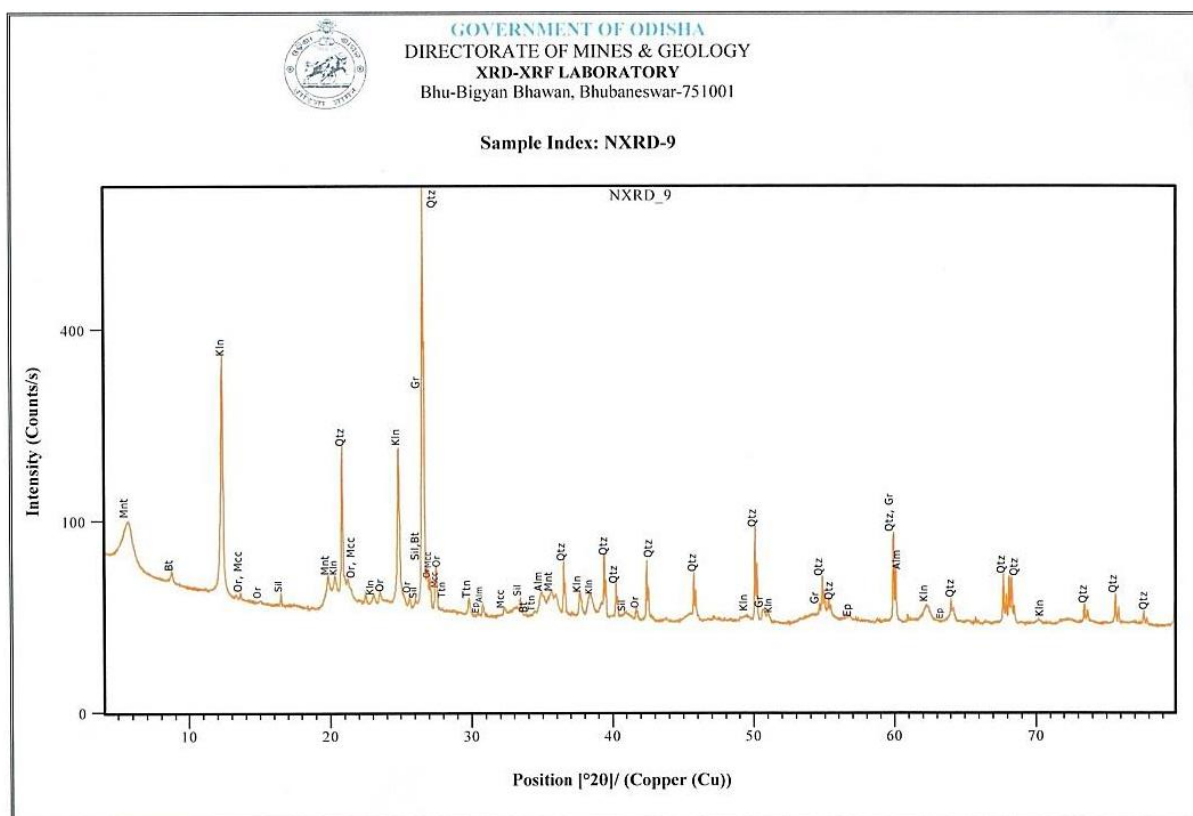


Fig. 10: XRD peaks of graphite bearing migmatized khondalite.

Hard and fresh khondalite are rare. Graphite flakes of variable dimensions are dimensionally oriented along the foliations defining gneissosity & schistosity of graphitized Khondalite.

(ii) Charnockite:

Charnockites, although not encountered within the block, are exposed as isolated patches in the western vicinity within the nala section, nevertheless, the dark coloured weathered & altered earthy mass encountered in shallow pit-4 (fig.11) is believed to be the altered product of charnockite. Megascopically, it is altered, earthy gray coloured, mesocratic and medium grained rock showing a relict gneissic trend and exfoliation weathering features. Crude gneissosity is developed due to dimensional orientation of quartz and feldspar along a definite direction. Granulated prisms of hypersthene and flakes of biotite constitute the melanocratic bands whereas felsic bands are represented by quartz and feldspar. Mineralogically, it is composed of plagioclase, orthoclase, hypersthene and quartz

as major and biotite are found as accessory minerals. Equidimensional quartz and feldspar form a mosaic texture. Under the microscope the rock shows inequigranular, xenomorphic, grano-blastic texture. The accessory constituents of the rock are apatite, zircon and opaques. K-feldspar which is the major constituent of the rock occurs as large plates and is mostly orthoclase. Microcline is rare, and occurs as small grains with irregular outline. Very often plagioclase replaces orthoclase in the margins as well as in central parts resulting in, myrmekite. Alteration from hypersthene to biotite and garnet is also seen along grain boundaries and cleavage planes.

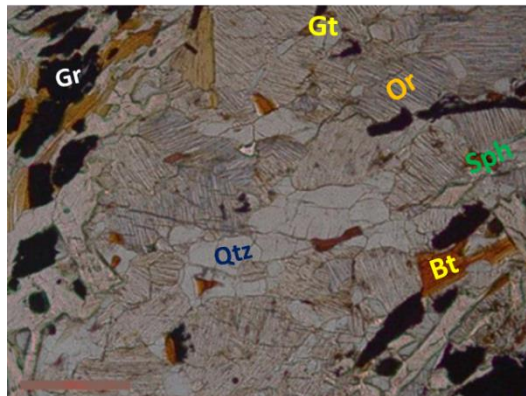


Fig. 11: Altered charnockite rock in the pit walls (Pit No.4).

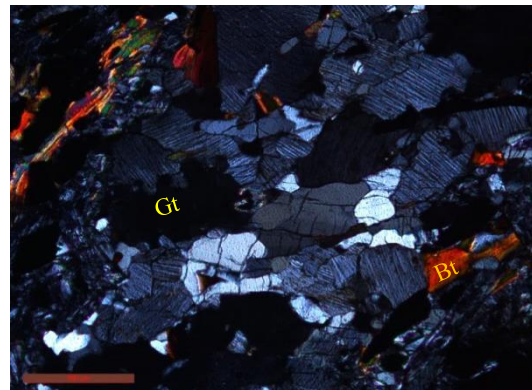
(iii) Quartzo-Feldspathic gneiss:

Quartzo-feldspathic gneiss is the second most predominant unit exposed in the Nala section and invariably forms a banded assemblage with the migmatized khondalite in the sub-surface. The rock is medium-grained and highly altered rock, (in the nala bed & walls beyond the working area) and closely associated and interbanded in the contact with migmatized khondalite exhibiting foliation and exfoliation weathering at places. It is a medium grained highly altered and migmatized rock showing a distinct gneissic trend and gradational contact with khondalite. It is essentially composed of quartz, orthoclase,

plagioclase and graphite and garnets are found as accessory minerals. Opaque are scattered throughout the rock mass. Graphite flakes occur as disseminations along the foliation of quartzo-feldspathic gneiss. Petrographic analysis of the both quartz and feldspar show dimensional orientation along the folial plane. Garnets are not uniform & highly altered with oxidation of ferromagnesian components. Secondary over-growth in most of the quartz grains indicates a sedimentary parentage. Graphite disseminations are also noticed in conformity to the folial plane defining gneissosity (fig. 12).



NPGS -2 PPL 5X



NPGS -2 XPL 5X

Fig. 12: Photo micrographs of quartzo-feldspathic gneiss (Gt: Garnet, Bt: Biotite, Qtz: quartz, Sph: Sphene, Or: Orthoclase).

Flaky or platy graphite & platy mineral biotites occur along the planes of foliation and parallel to the alignment of quartz grains. Darker bands called melanosomes are formed by the combination of garnet, biotite, and graphite, while lighter bands known as leucosomes are formed by quartz, plagioclase, and orthoclase, a characteristic feature of gneissosity. Orthoclase minerals are sericitized, and plagioclase minerals are saussuritized. Garnets are highly fractured, and some mineral grains exhibit signs of granulation and even mylonitised at depth. In certain areas, biotite and garnet occur close together, suggesting that biotite may have formed from the alteration of garnet.

XRD studies of quartzo-feldspathic gneiss core samples (fig.13) exhibits mineral peaks for quartz, orthoclase, microcline, andesine, almandine, graphite, biotite, kaolinite, titanite, pyrite and epidote of variable intensity.

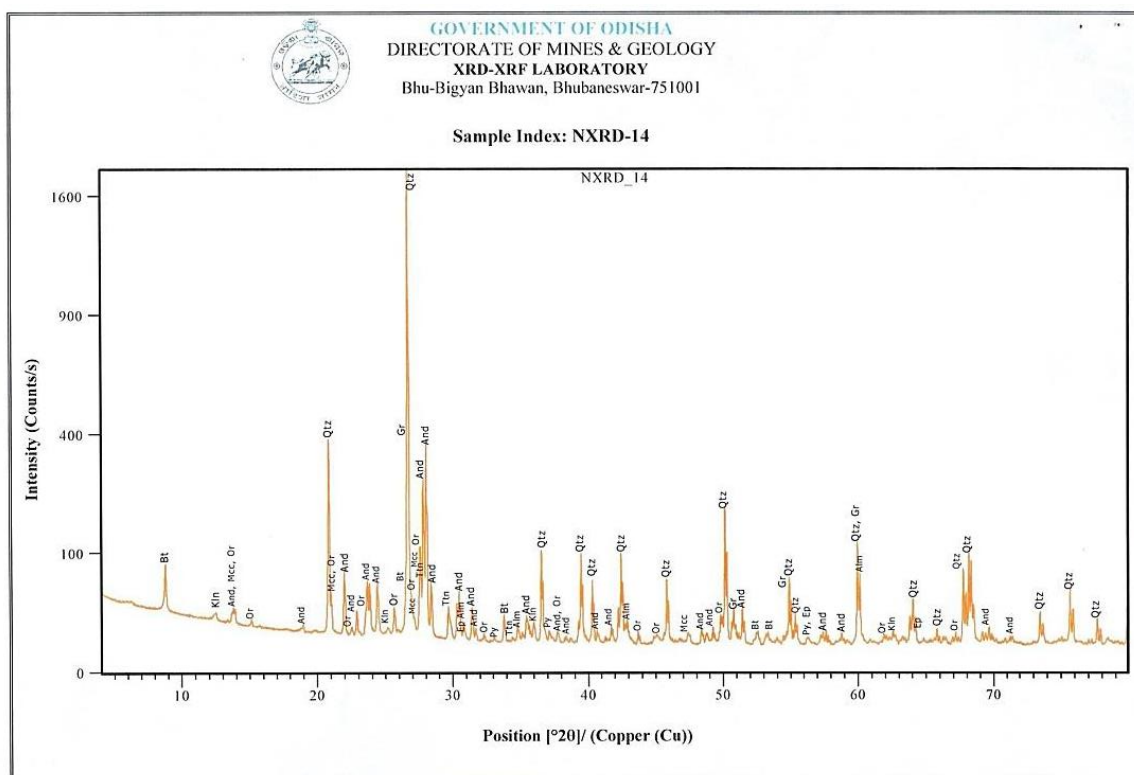


Fig. 13: XRD peaks of graphite bearing Quartzo-Feldspathic gneiss core samples.

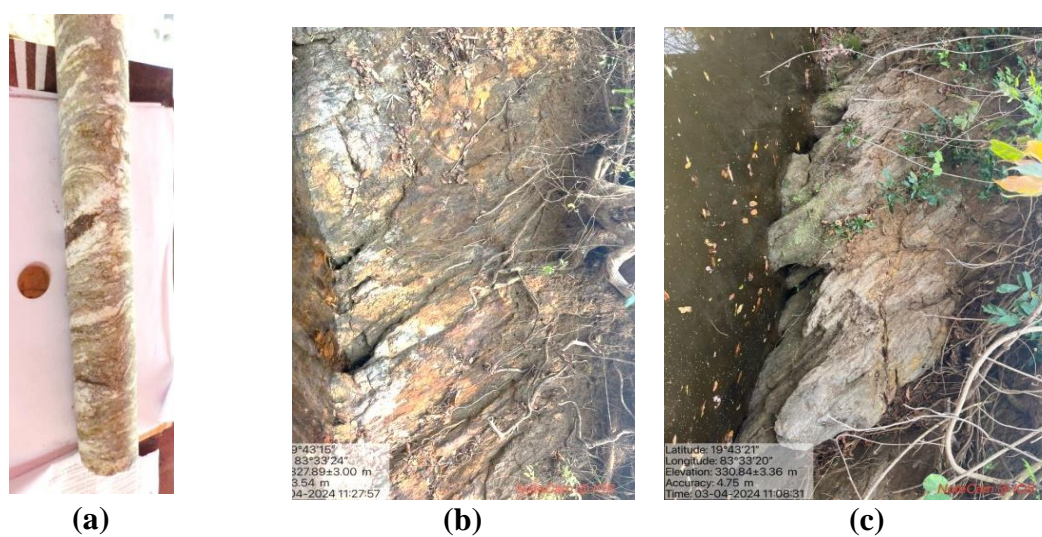


Fig. 14: a. Litho core of sheared migmatised quartzo-feldspathic gneiss with melanosomes & neosomes (BH No. 2) b. Migmatised quartzo-feldspathic gneiss in Bangei Nala section.

Figure 14, a & b depicts the sheared migmatized quartzofeldspathic gneiss (BH No. 2), featuring alternating dark melanosomes and light neosomes formed by partial melting and recrystallization. Shearing is evident in the deformed banding and aligned mineral grains, reflecting tectonic stresses.

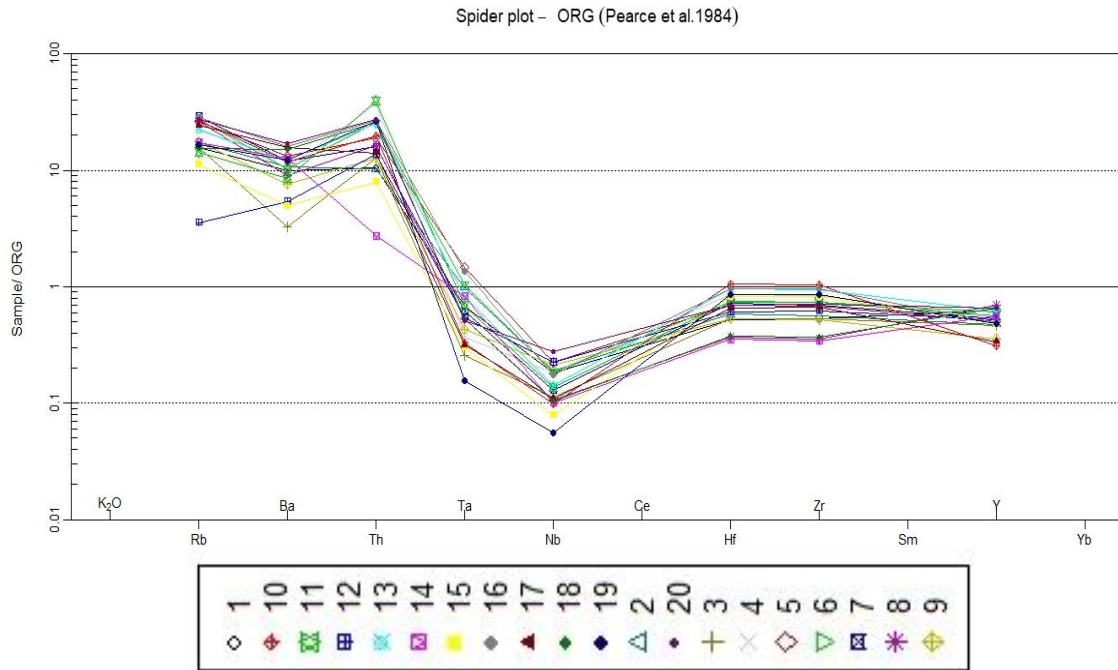


Fig. 15 (a): Spider plot of Trace elements.

Figure 15 represents (a) a spider plot and (b) tectonic discrimination plots (Pearce et al., 1984) to interpret the tectonic setting of the quartzo-feldspathic gneiss and its variants. The spider plot illustrates trace element dispersion patterns of 20 samples, showing enrichment in thorium, barium, and rubidium, along with depletion in niobium. These geochemical characteristics are indicative of granitic rocks formed in specific tectonic environments.

The tectonic discrimination plots (Fig. 15. b) utilize trace element ratios such as Y/Nb, Ta+Yb/Rb, Yb/Ta, and Y+Nb/Rb to classify granitic rocks into ocean ridge granites (ORG), volcanic arc granites (VAG), within-plate granites (WPG), and collision granites (COLG). The **Y+Nb vs. Rb plot** reveals most samples clustering in the WPG field, with minor extensions toward the syn-COLG field, suggesting a dominant within-plate tectonic setting. The **Y vs. Nb plot** similarly places most points in the WPG field, with a few near

the VAG and syn-COLG boundary, indicating mixed tectonic influences. The **Ta+Yb vs. Rb** and **Yb vs. Ta** plots consistently show a strong alignment within the WPG field, reinforcing the within-plate origin of these rocks. These geochemical patterns indicate a primarily within-plate granitic magma origin with minor volcanic arc contributions, reflecting a complex magmatic evolution. The spider and tectonic discrimination plots provide key insights into the tectonic setting and regional geological evolution of the quartzofeldspathic gneiss and its variants.

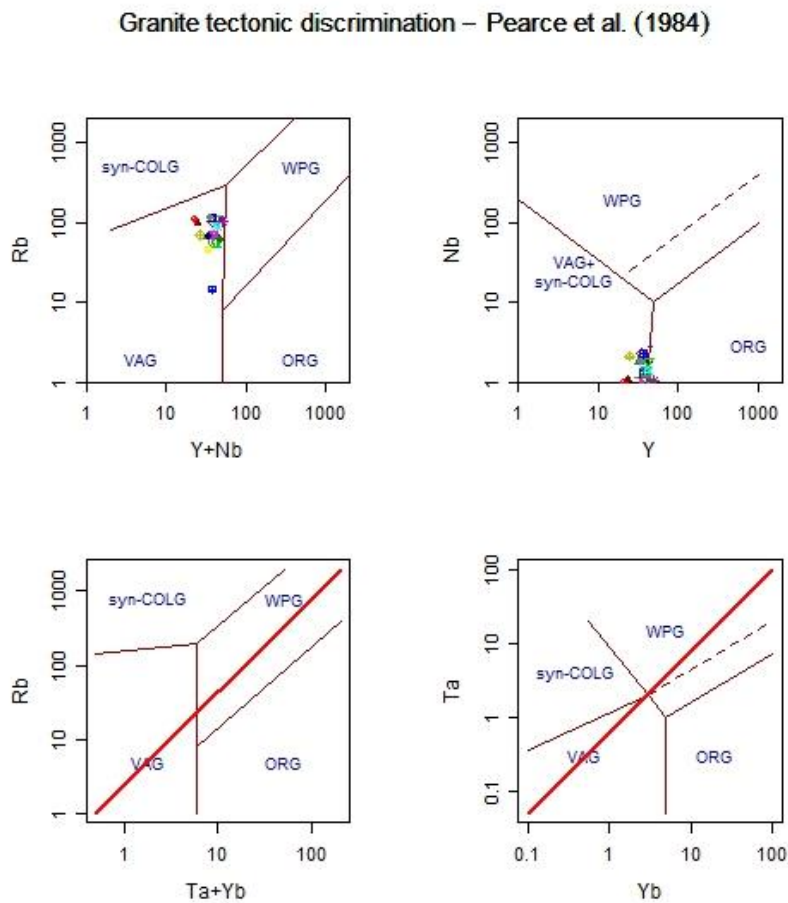


Fig. 15 (b): Discrimination plot of Y+Nb/Rb, Y/Nb, Ta+Yb/Rb, & Yb/Ta.

(iv) Pegmatite & vein quartz:

Small veinlets of pegmatoids/ silica within the host migmatites of khondalites & quartzofeldspathic gneiss are exposed on the Nala section both in northern and southern part of the area and also noticed in the borehole cuttings. These are mainly composed of

megacrysts of quartz and feldspar, where mica constitutes a very less percentage showing concordant relationship with the country rock. The permeations are mostly foliation guided.

(v) Soil and alluvium:

The entire part of the area is covered with soil and alluvium with average thickness of 4m. Residual soil is formed by weathering of the in-situ country rocks. The alluvium is encountered in the narrow tracts which support the vegetation and agriculture of the area. The soil is grayish in appearance and plastic. Thickness of soil cover varies from 2 to 6 m.

6.1.3 Detailed Structural Analysis

Structural details of the area:

Both diastrophic and non-diastrophic structures are found within the litho assemblages. The diastrophic structures include foliation, shears, folds and faults and non-diastrophic structures include joint and impersistent mineral lineation. As revealed from the surface and subsurface data, graphite mineralization is litho structurally controlled as it is confined to the foliation plane of quartzo-feldspathic gneiss and migmatized khondalite. The area is affected by granitic activity as a result of which meta-sediments are sheared. Drags and kinks are well marked in the migmatized khondalite. Secondary structural features are noticed in the litho units that include kinks and joints.

Satellite image interpretations of the area (fig. 2) decipher the structural complexities and controls of the litho-structural framework for the area where Vanshadhara-Nagavalli shear zones that merge with the Tumudibandh sub shear might have acted as a conduit to facilitate granitic invasion regionally which facilitated the graphite mineralization in the sympathetic weak planes of host lithologies in the domain. The area is located about 12 km west of the Tumudibandha Shear Zone, (Fig. 2) that runs in a north-south direction. Additionally, a sympathetic north-south oriented shear, passes through the present study area. The manifestations of these shears with minor asymmetric shears of the westerly lying Tel Shear (ENE-WSW) might have offered a favorable environment for the emplacement of granitic melts. This geological setting led to the remobilization of graphite along structural weak planes, specifically the foliation in the rock mass, enhancing its potential for mineralization. The intersection of these lineaments offers a structural avenue for the concentration and mobilisation of graphite, and distribution of the mineral in this region.

(i) Faults/Shear Zones

The study area, although masked by a rim of alluvium & soil but imprints of deformational signatures like brecciation, mylonitization, silicification, fracturing, and kaolinization are noticed in the drilled core cores (Fig.16) are noteworthy shear criterias. The presence of slickensides and mylonites within the involved lithounits attests to mobility & ductility of assemblages during faulting and shearing activity.

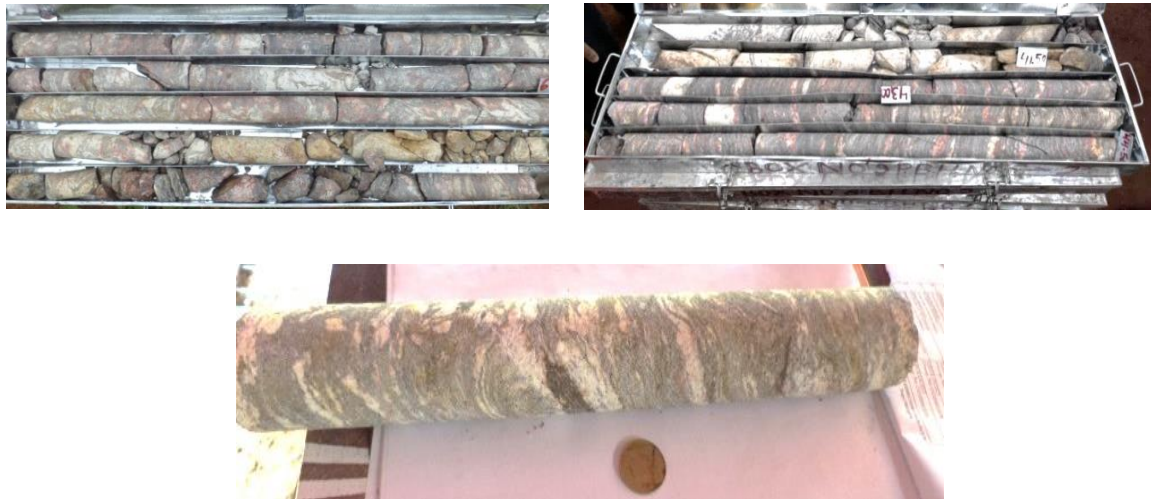


Fig. 16: Sheared migmatized khondalite & mylonitized quartzo-feldspathic gneiss in NPBH-2.

These structural features - folding, faulting, and shearing might be the controlling factors for the localization, mobilization, and concentration of graphite mineralization. High-grade metamorphism coupled with intense deformation has redistributed graphite along zones of favourable structural weak planes. These processes resulted in the pulverization of litho-units and might have offered secondary avenues for the redistribution of minerals. Mylonitisation has been observed in boreholes NPBH-3 and NPBH-5, at depths from 61.00m to 69.00m in NPBH-3 and from 60.50m to 65.00m in NPBH-5. Shearing served as conduits for migration, facilitating the emplacement of graphite along structural weak planes, particularly within fold hinges and foliations. The structural complexity of the area is further accentuated by the intersection of major lineaments, the Tumudibandha shear zone and the Tel shear and their sympathetic shears. These intersections might serve as loci for granitic melts and the remobilization of graphite, excited by intense tectonic forces.

(ii) Folding

The litho-units in the study area exhibit tight folds, kinks, and well-developed foliations, with structural trends ranging from N40°W–S40°E to N60°W–S60°E, dipping 50°–70° southwest and part of the regional F₁ fold system. The F₂ fold patterns (fig:13) are more or less isoclinal and reclined folds attributed to compressional forces and that played a role in localizing graphite mineralization, especially in the hinge zones of the folds, highlighting the structural control over the mineralization process. The F₃ deformational signatures includes drag folds, parasitic folds, kink folds, ‘Z’ & ‘M’ type folds and ptygmatic crenulations. Drag and parasitic folds reflect the localized strain within major fold systems, which likely influenced the mobility of mineralizing melts. Kink folds, characterized by sharp angles, and ptygmatic folds, with bulbous shapes, indicate the intense deformation and pressure conditions conducive to mineral concentration.

(iii) Foliation:

The foliation in the khondalite and quartzo-feldspathic gneiss units is well-developed in the exposed Lithounits encountered only in nala sections to the west of the block, with its general trend varying between N40°W-S40°E and N60°W-S60°E. The dip of the foliation ranges from 55° to 70° towards the southwest, reflecting its genetic correlation to the adjacent Tel shear in the west & VSZ to the east and Tumudibandha sub-shear that have shaped the region's geological structure. This foliation plane plays its role in facilitating the distribution of graphite mineralization along the structural planes.

(iv) Lineation:

Two distinct types of lineation are observed in the study area:

- i. Slickensides: These are prominently noted in quartzo-feldspathic gneiss and khondalite rocks, particularly in borehole cuttings. Slickensides are indicative of fault movements and represent striated, polished surfaces formed due to shearing.
- ii. Mineral Lineation: This is characterized by the alignment of minerals such as graphite, biotite, and garnet as streaks. The mineral lineation provides evidence of deformation and metamorphism, showcasing the directional movement and

alignment of mineral grains under tectonic forces and it makes a low to moderate plunge with foliation.

(v) Joints:

Two sets of joints are prominent in the khondalite and quartzo-feldspathic gneiss of the area in conformity to the foliation. The first set trends N45°E-S45°W with a dip of 74° northwestward, while the second set aligns parallel to the foliation trend.

6.1.4. Metamorphism:

a. (Quartz + Orthoclase + Plagioclase + Sillimanite+ Epidote + Garnet + Graphite)

This mineral assemblage indicates high-grade metamorphism. Sillimanite and garnet are characteristic minerals that form under high temperatures and pressures. Quartz, orthoclase, plagioclase, and graphite are also present. The presence of graphite suggests high-grade metamorphism.

b. (Quartz + Orthoclase + Plagioclase + Hypersthene + Garnet + Biotite)

This mineral assemblage suggests a medium to high-grade metamorphic episode. Hypersthene and biotite are minerals commonly found in metamorphic rocks. The presence of quartz, orthoclase, and plagioclase indicates the involvement of felsic minerals in the metamorphic process.

c. (Quartz + Orthoclase + Plagioclase + Garnet + Sillimanite +Graphite + Sphene)

This mineral assemblage suggests a high-grade metamorphic episode. Sillimanite & graphite are minerals commonly found in metamorphic rocks formed under high temperatures and pressures under granulitic facies conditions.

The given mineral assemblages indicate different degrees of metamorphism, ranging from high-grade to medium to high-grade. Each assemblage represents different combinations of minerals formed under specific temperature and pressure conditions. Based on the mineral assemblages and their textural characteristics, along with the occurrence of retrograde features, it seems that the metamorphic episodes in the area are indicative of the granulite facies of regional metamorphism. The granulite facies are associated with high-

temperature and high-pressure conditions, typically found in the deeper crust. The mineral assemblages include minerals like garnet, sillimanite, hypersthene, and orthoclase, are commonly associated with the granulite facies. Incidences like saussuritisation of plagioclases alteration of hypersthene to biotite and garnet & biotite and biotite in the fractures of garnet, suggest retrogression. Retrogression refers to the process in which a rock that has experienced high-grade metamorphism subsequently undergoes changes at lower temperatures and pressures, leading to the growth of minerals of lower grade. Additionally, the sausseritisation and kaolinisation of feldspar, which refers to the alteration of feldspar minerals into a fine-grained aggregate, is another retrograde feature. This process occurs due to the breakdown of feldspar minerals under lower temperature and pressure conditions.

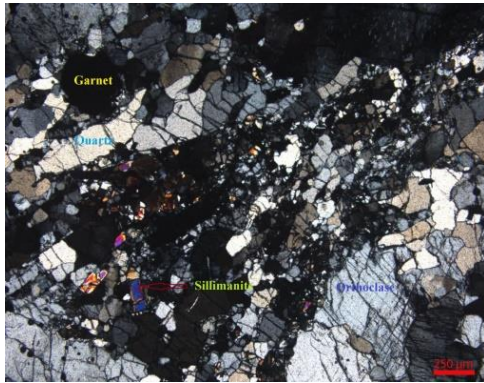
Therefore, the presence of high-temperature minerals and retrograde features like the occurrence of biotite and sausseritisation of feldspar supports the interpretation that the metamorphic episodes in the area are characteristic of the granulite facies of regional metamorphism.

6.1.5 Mineralogy of the ore zones and ore textures:

The integrated analytical studies of various studies of the host rocks and graphite bearing lito-units reveals the mineralogical characteristics of the ore zones in the study area. As discussed earlier, graphite occurs as flaky varieties mostly in disseminated form either as independent entities or tufts within the foliation plane of migmatized khondalites and quartzo-feldspathic gneisses occurring in the area.

The litho-units in the study area primarily comprise altered khondalite, graphite-bearing migmatized khondalite, and quartzo-feldspathic gneiss, which form a banded assemblage. These rocks are of meta-sedimentary origin and exhibit strong foliation. The lithology includes khondalite \pm graphite schists and gneisses, both of which have undergone high grade granulite facies metamorphism. Within this lithological framework, specific units contain graphite mineralization, particularly in the migmatized pelites, which are metamorphosed rocks made up of sand-sized psammite and fine-grained pelite minerals that have experienced partial melting and recrystallization. The quartzo-feldspathic invasions, which involve the intrusion of quartz and feldspar-rich materials, granitoids, are also present within these units. The graphite mineralization is concentrated along the foliation planes of migmatized khondalite, often exhibiting variations in concentration, with

swelling and pinching of the mineralised zones along the structural weaks. The mineralisation is concordant with the host rock and is concealed under thick alluvial soil cover. Graphite occurs as disseminations & micro veinlets or tufts, with individual flakes ranging from a few millimetres up to 5 millimetres in size. The graphite is primarily flaky and disseminated along the foliation planes of schists and gneisses, reflecting a structural control over its emplacement.



Mig. Khondalite with opaque (graphite flakes) as thin veinlets & fillings of micro fractures.

Other lithological units encountered in the area include migmatized khondalite, quartzo-feldspathic gneiss, leptynite, epidote - bearing khondalite, and mylonite. The mineralization appears to be governed by both the lithological characteristics and structural features of the rocks, indicating a litho-structural control on the distribution of graphite. In terms of structural features, joints observed in outcrops are sub-vertical, contributing to the permeability and mineralisation controls. Secondary mineralisation of pyrite, epidote, secondary quartz, zoisite, and garnet has been identified in the core samples, further adding to the complexity of the processes in the area.

However, mineralogical studies indicate that the graphite occurs as disseminated flakes and fibers along the foliation planes of migmatized khondalite and quartzo-feldspathic gneiss, with an erratic distribution. The deleterious elements present in these mineralised zones include quartz, plagioclase, orthoclase, and opaques. Quartz grains, exhibiting secondary overgrowths, appear as oval to lensoidal shapes with sutured outlines. Orthoclase is mostly perthitic and significantly altered to kaolin, while plagioclase occurs as platy crystals suffering from sausseritisation. The mineralization is believed to be a remobilized product of carbon during contact regional metamorphism, facilitated by the emplacement of quartzo-feldspathic gneiss.

6.1.6: Pitting and Trenching:

To ensure geometrical disposition graphite lode exposed in the nala bed, 4 pits are given in the hanging wall side. This approach provided crucial insights into the structural disposition and mineral potential of the graphite-bearing gneisses.

The pit locations are located in the southern part of the block, along the up-dip direction of the graphite gneisses exposed in the nala section.

- The selection of pit locations was guided by the fact that the southern part of the area was not covered by the geophysical survey, and devoid of any exposure.
- In order to intercept the lode at appropriate depths with respect to the exposed outcrops in the Nala section. The pit's location is chosen in the hanging wall sides, which proved to be useful to decipher the litho-structural disposition & delineate the mineralised zones.
- To overcome these limitations and ensure geometrical disposition of graphite lodes exposed in the nala bed, the pits are given in the hanging wall side in the up-dip direction.
- Out of the four pits, graphite was encountered only in the pit no. 2 while others exposed the thick alluvial cover and highly altered country rocks of khondalite & charnockite.

Table 6.2: Physical and Chemical Assay Data from Pit Samples, Naringpanga (S) Graphite Block.

Physical & Chemical Assay Log of Naringpanga Graphite Block, F.S.2023-24											
Pit No	01					Date of Commencement				27.06.2024	
Location (DD)	19.72455556			83.55719444		Date of Completion				27.06.2024	
(DMS)	19° 43' 28.4" N			83° 33' 25.9" E		Total Graphite Thickness				0 m	
Depth	4.00										
R.L	339										
Sl. NO	Sample ID	From	To	ASH %	M%	LOI%	SiO ₂	Al ₂ O ₃ %	F.C %	Length (in m)	Lithology
1		0.00	0.40							0.40	Soil
2	NGPT 1/1	0.40	1.40	90.38	3.13	9.62	60.34	11.36	0.62	1.00	Weathered Kh.
3	NGPT 1/2	1.40	2.40	91.34	2.96	8.66	59.24	17.66	0.50	1.00	
4	NGPT 1/3	2.40	3.40	89.70	3.71	10.30	55.66	16.44	0.59	1.00	
5	NGPT 1/4	3.40	4.00	93.04	2.29	6.96	60.48	22.68	0.55	0.60	
6	NGPT 1/5	Horizontal channel in the pit floor		90.92	2.70	9.08	54.74	20.12	0.82		

Physical & Chemical Assay Log of Naringpanga Graphite Block, F.S.2023-24											
PIT No	02					Date of Commencement		28.06.2024			
Location	19.72258333			83.55847222		Date of Completion		28.06.2024			
(DD)	19° 43' 21.3" N			83° 33' 30.5" E		Total Graphite Thickness		0.3m			
(DMS)	4.00 m										
Depth	336 m										
R.L	Sample ID	From	To	ASH %	M%	LOI%	SiO ₂	Al ₂ O ₃ %	F.C%	Length (in m)	Lithology
Sl. NO		0.00	0.70							0.70	Soil
1	NGPT 2/1	0.70	1.70	90.04	3.63	9.96	59.78	15.44	0.85	1.00	Weath. Kh.
2	NGPT 2/2	1.70	2.60	90.36	4.20	9.64	62.86	13.87	0.28	0.90	
		2.60	2.70							0.10	
3	NGPT 2/3	2.70	3.70	95.70	1.16	4.30	75.48	9.74	0.29	1.00	Graphite + Khondalite
4	NGPT 2/4	3.70	4.00	87.40	1.96	12.60	50.20	19.44	2.82	0.30	
5	NGPT 2/5	Horizontal channel in the pit floor		91.36	0.69	8.64	53.92	20.76	1.89		
6	NGPT 2C	Composite		90.90	1.56	9.10	59.20	15.34	1.81		Mig. Khond.
7	NGPT 1C	Composite		90.80	2.46	9.20	55.86	19.42	1.20		Mig. Kh.

Physical & Chemical Assay Log of Naringpanga Graphite Block, F.S.2023-24											
PIT No-	03					Date of Commencement		28.06.2024			
Location (DD)	19.72252778			83.55727778		Date of Completion		28.06.2024			
(DMS)	19° 43' 21.1" N			83° 33' 26.2" E		Total Graphite Thickness		0m			
Pit depth	4.25										
R.L	334										
Sl. NO	Sample ID	From	To	ASH %	M%	LOI %	SiO ₂ %	Al ₂ O ₃ %	F.C%	Length (in m)	Lithology
1		0.00	0.60							0.60	Soil
2		0.60	3.10							2.50	Weath. Kh.
3		3.10	4.25							1.15	
4	NGPT 3/5	Horizontal channel in		85.20	6.78	14.80	49.64	14.11	0.86		

		the pit floor								
--	--	---------------	--	--	--	--	--	--	--	--

Physical & Chemical Assay Log of Naringpanga Graphite Block,F.S.2023-24											
PIT No-	04					Date of Commencement				29.06.2024	
Location (DD)	19.72163889			83.55722222		Date of Completion				29.06.2024	
(DMS)	19° 43' 17.9" N			83° 33' 26.0" E		Total Graphite Thickness				0m	
Pit depth	4.50										
R.L	326										
Sl. NO	Sample ID	From	To	ASH %	M%	LOI%	SiO ₂	Al ₂ O ₃ %	F.C%	Length (in m)	Lithology
1		0.00	0.75							0.75	Soil
2		0.75	4.05							3.30	Weath. Kh.
3		4.05	4.50							0.45	
4	NGPT 4/5	Horizontal channel in the pit floor		89.48	4.30	10.52	60.60	12.98	0.94		

The graphite lode encountered in the pit-2 encompasses a distinct band in N-S direction and its extrapolation is done.

6.1.7 Sampling:

In order to ascertain the mineralogical composition and qualitative potential of graphite in the explored block, 160 core samples have been collected from the borehole cores at an appropriate length of 1 m or wherever there is abrupt change of the involved litho units. The graphite cores having longitudinal length of less than 0.5m were accounted for in the preceding samples. While the samples lengths of +0.5 to 1m were drawn as one sample when recorded. After extraction of core from core barrel, the drilled cores are spread systematically in the designated core boxes. The samples thus collected were reduced to desired quantity by coning and quartering were powdered to 200 mesh ASTM size. About 50 g of each sample was collected in duplicate by coning and quartering method and packed with proper leveling tags. All the core samples were analysed at the Research Laboratory Bhubaneswar, by wet chemical analysis method. In Naringpanga block, Al₂O₃, SiO₂, F.C, Ash and LOI has been analysed as per approval of NMET & the assaying and laboratory procedures adopted are as per the BIS standard.

Besides, 13 Nos. core samples have been analysed for petrographic, and 14 Nos. core samples are subjected to XRD studies each at Research Laboratory, Bhubaneswar. For

check sample analysis, the samples are tested at New Green Environmental Services Lab Ltd. (NABL accredited), Bhubaneswar. Further 20 Nos. of internal check samples are also analysed in wet chemical method in the Departmental Laboratory of DoMG (O) which shows positive correlation (Annexure-VI).

Another 20 samples have been analysed at MECL Laboratory, Nagpur for 34 trace REE elements (Method used- acid digestion followed by ICPMS) through Agilent make ICPMS Model- 7800 (Report annexed in Annexure -XIII).

Samples have been properly coded after preparation by indexing with references of the investigation area, borehole number and sample serial number and maintained in a register. The quality and appropriateness of the assaying and laboratory procedures used, and the technique are considered as total.

To ensure the accuracy of analytical results, the pulp duplicate of core samples were introduced as check samples, one in nearly every 10 samples. Out of 160 primary samples, 20 samples were chosen and considered as check samples.

Analysis of Samples

The assaying and laboratory procedures adopted are as per the BIS standards. After extraction of core from core barrel, the drilled cores are spread systematically in the designated core boxes. During sampling, meter wise longitudinal half of the core has splitted and was crushed manually by iron mortar and pestle and the other half is preserved for future reference. In case of sludge cores, samples were reduced by standard coning and quartering at -200 mesh size.

Samples have been properly coded after preparation by indexing with references of the investigation area, borehole number and sample serial number and maintained in a register. The quality and appropriateness of the assaying and laboratory procedures used, and the technique are considered as total. Utmost care is taken to avoid any contamination of the sample and following standard procedures for core collection from drill holes and core boxes, marked core length by using metal tags.

The sample sizes are based on the lithology and its homogeneity. Any contrast in the lithology etc. has been taken into consideration for sample size. However, in core drilling maximum one meter length is considered and final samples reduced and sieved to 200 mesh size for analysis.

The Naringpanga Graphite exploration Project was conducted at G3 level. The tonnage has been estimated as an in-situ body with natural moisture content. To ensure the accuracy of analytical results, the pulp duplicate of core samples were introduced as check samples, one in nearly every 10 samples. Out of 160 primary samples, 20 samples were chosen and considered as check samples. The analytical results of primary and check samples showed very good correlation.

Trace Elements Studies:

A total of 20 composite samples from graphite-mineralized zones were analysed using ICP-MS (Inductively Coupled Plasma Mass Spectrometry) at MECL laboratory. These analysis targeted minor and trace elements, covering 34 elements, including Li, Be, Sc, V, Cr, Co, Ni, Cu, U, Zn, Ga, As, Se, Rb, Sr, Y, Zr, Ge, Nb, Mo, Ag, Cd, In, Sn, Sb, Te, Cs, Ba, Hf, Ta, W, Pb, Bi, and Th at MECL Laboratory, Nagpur, the results of which are furnished in Annexure- XIII.

The ICP-MS studies show that Cr, V, Zn, Zr, Ba and Sr show good concentration. The ranges of trace elements detected are given below.

Table 6.3: Trace Element Concentration range (ppm).

Elements	Li	Be	Sc	V	Cr	Co	Ni	Cu	U
Min	2.81	0.61	3.69	30.83	42.37	4.68	15.99	32.22	0.35
Max	28.68	4.23	20.23	184.49	139.91	25.67	70.84	156.82	7.28
Elements	Zn	Ga	As	Se	Rb	Sr	Y	Zr	Ge
Min	31.54	7.72	32.94	0.30	14.20	53.39	21.59	116.23	0.65
Max	230.34	22.86	41.97	1.33	115.86	379.94	48.92	355.83	2.98
Elements	Nb	Mo	Ag	Cd	In	Sn	Sb	Te	
Min	0.56	0.82	0.13	0.24	0.10	0.89	0.97	0.12	
Max	2.78	5.99	0.58	0.57	0.10	6.31	1.63	0.40	
Elements	Cs	Ba	Hf	Ta	W	Pb	Bi	Th	
Min	0.19	164.14	3.17	0.11	0.16	10.82	0.19	2.19	
Max	3.09	853.62	9.43	1.02	1.33	31.49	0.58	31.59	

X-Ray Diffraction Studies:

A total 14 no of samples have been analysed by X-ray diffraction method at DOMG's Physical Laboratory to determine the proportions of major and minor constituents. The methodologies and results are given in Annexure-XVI(C).

The XRD studies identified the presence of the following constituent minerals: Quartz, Graphite, Biotite, Kaolinite, Orthoclase, Andesine, Almandine, Pyrite, Titanite, Montmorillonite, Sillimanite, Clinocllore, Microcline and Epidote are the constituent minerals which have been verified with the petrographic studies.

Chemical Analysis:

Laboratory Procedure: The chemical analysis of primary samples has been carried out in Chemical Research Laboratory Bhubaneswar for determining 8 radicals i.e Al_2O_3 , moisture, SiO_2 , FC, V.M, Ash, V_2O_5 and LOI.

Graphite Analysis:

Sample preparation: Crush and grind the sample to a fine powder.

Acid digestion: Digestion of the sample in a mixture of acids (e.g., sulfuric acid, nitric acid, and hydrofluoric acid) to break down the graphite.

Filtration: Filtration of the solution to separate the graphite from the acid-soluble impurities.

Ignition: Heating the graphite at high temperature (e.g., 1000°C) to remove volatile matter and moisture.

Gravimeter: Determination of the graphite content by weighing the residue.

The Wet Chemical Method is a traditional and reliable technique for analyzing the graphite, but it may be time-consuming and require specialized equipment and expertise.

Primary Sample Analysis: A total of 160 primary samples were analyzed at the Chemical Research Laboratory, Bhubaneswar, to determine eight radicals: Al_2O_3 , Moisture, SiO_2 , fixed carbon (FC), volatile matter (VM), ash, V_2O_5 , and loss on ignition (LOI). The data were processed based on the results of these analyses. Considering the low grade of graphite in the area, interpretation of graphite zones was carried out using a cut-off grade of 2% FC for flaky graphite. Based on the borehole analytical data, mineralized zones were delineated as per the aforementioned cut-off and are presented in Annexure-II. These zones are also plotted along the boreholes in all the cross-sections of the Naringpanga (G-3) blocks and are shown in Plates VIII to XII.

Check Sample Analysis: As per provision made in the proposal for QA/QC, chemical analysis of check samples and its comparison have been carried out in order to assess the bias and inaccuracies in assaying. A total of 20 Nos. (Around 10%) internal check samples and 10 Nos. (Around 10%) external check samples have been analysed in the Chemical

Laboratory of DOMG and New green environmental services (NABL accredited) respectively. The results and comparison of check sample analyses with primary sample analysis (External) are presented in Annexure-V and Annexure-VI respectively. During survey, cross verification was done after each day's DGPS/Total station. Again, the RL values are correlated with the S.I.T.S RL values. The sampling was done with utmost care meticulously. The core being soft and moderately hard are broken with a polythene covering and during crushing & sieving. Sieve covers are used to ensure zero contamination and loss of fines. Zipped polythene are also used to avoid breaking and contamination.

Composite Sample Analysis:

After delineation of mineralised zones of graphite at the required cut-off grade of graphite FC% i.e., 2.00 % FC (Threshold Value for flaky graphite) composite samples were prepared by mixing the primary samples from the graphite mineralized zones in length proportion. A total of 11 no of composite samples have been prepared from the boreholes and pit and analysed for nine radicals in the Chemical Laboratory of the DOMG. The results of the chemical analysis of composite samples are given in Annexure No-VII. The composite sample analysis results are furnished below.

Table 6.4: Analytical Results of Composite Samples from Boreholes

SI No.	Identity Mark	Lab No.	Ash%	M%	V.M%	F.C%	LOI%	SiO ₂ %	Al ₂ O ₃ %
1	NPC1/1C	865-P/24	91.66	2.06	3.32	2.96	8.34	69.93	11.29
2	NPC1/2C	866-P/24	93.34	1.69	3.08	1.89	6.66	67.99	12.93
	NPBH-1	Average	92.50	1.88	3.20	2.43	7.50	68.96	12.11
3	NPC2/1C	867-P/24	93.80	1.50	3.26	1.44	6.20	70.54	12.52
4	NPC2/2C	868-P/24	93.00	1.29	4.50	1.21	7.00	64.06	16.21
	NPBH-2	Average	93.40	1.40	3.88	1.33	6.60	67.30	14.37
5	NPC3/1C	869-P/24	93.56	1.33	3.20	1.91	6.44	65.70	15.86
6	NPC3/2C	870-P/24	93.16	1.00	3.25	2.59	6.84	67.90	14.09
	NPBH-3	Average	93.36	1.17	3.23	2.25	6.64	66.80	14.98
7	NPC4/1C	871-P/24	91.98	2.04	4.45	1.53	8.02	66.05	14.59
8	NPC4/2C	872-P/24	90.16	1.40	3.45	4.99	9.84	72.70	9.94
	NPBH-4	Average	91.07	1.72	3.95	3.26	8.93	69.37	12.26
9	NPC5/1C	873-P/24	95.26	1.03	2.35	1.36	4.74	69.76	14.19
10	NPC5/2C	874-P/24	94.96	1.06	2.51	1.47	5.04	70.20	12.97

	NPBH-5	Average	95.11	1.05	2.43	1.42	4.89	69.98	13.58
11	NPBH-6	875-P/24	87.14	2.82	4.65	5.39	12.86	63.66	16.12

6.1.8 Discussion:

The results of primary and check sample analysis show negligible variability and can be considered as valid and acceptable. The details of primary (internal) and external check samples are provided in Annexures VI and V, respectively, with a comparative analysis of Fe_2O_3 , SiO_2 , and Al_2O_3 (%) presented in Table 6.5. The scatter plots generated by plotting the primary and check sample data sets are presented in fig. 17 to 19.

Table 6.5: Comparative Analysis of F.C. %, SiO_2 %, and Al_2O_3 (%) in Primary and External Check Samples.

Sl. No	Sample code	PRIMARY			EXTERNAL		
		F.C. %	SiO_2 %	Al_2O_3 %	F.C. %	SiO_2 %	Al_2O_3 %
1	NPBH-1/1	7.84	80.78	2.58	7.79	40.91	0.21
2	NPBH-1/28	1.31	65.94	13.76	0.31	59.04	0.26
3	NPBH-2/12	2.39	64.76	13.94	1.06	40.28	0.15
4	NPBH-2/22	2.00	64.30	12.02	0.93	52.53	0.16
5	NPBH-3/3	3.93	55.06	14.32	1.72	44.54	0.26
6	NPBH-3/30	2.07	66.26	15.78	0.75	43.55	0.54
7	NPBH-4/26	10.03	78.62	3.00	9.03	40.67	0.11
8	NPBH-4/28	9.26	80.72	0.60	8.48	39.86	0.19
9	NPBH-5/20	2.50	66.12	12.56	1.68	41.26	0.62
10	NPBH-6/8	3.38	57.56	16.18	0.87	50.78	0.57

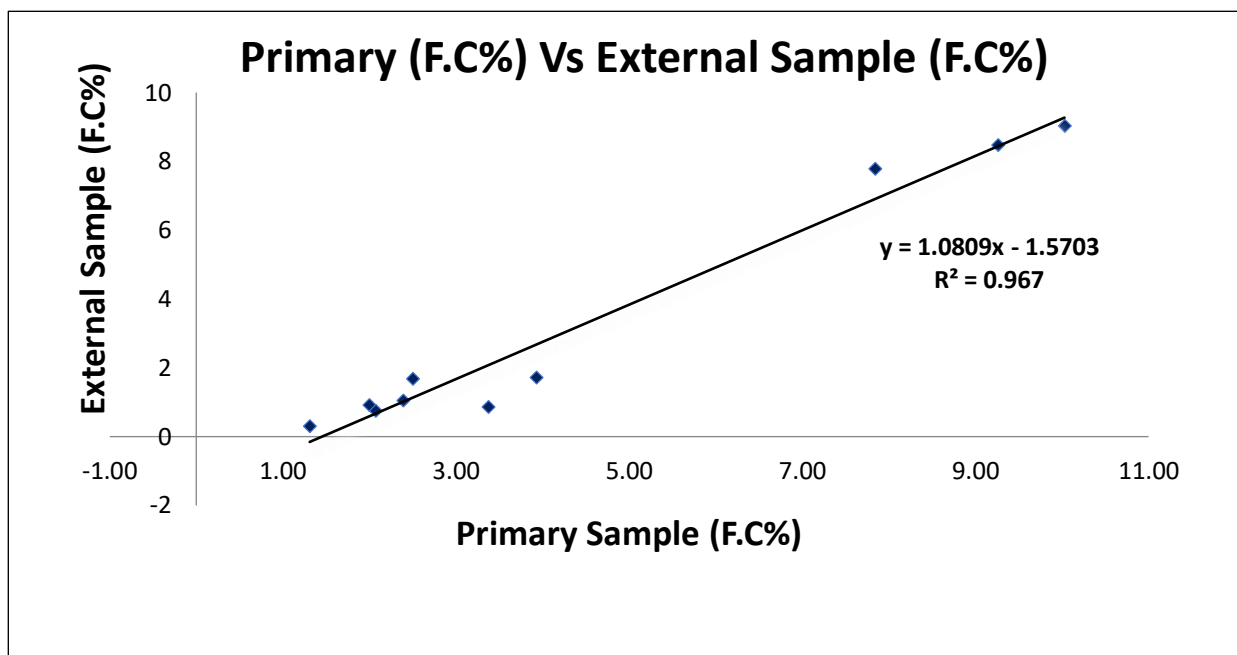


Fig. 17: Scatter plots showing the F.C. % comparison between the primary samples and external check samples.

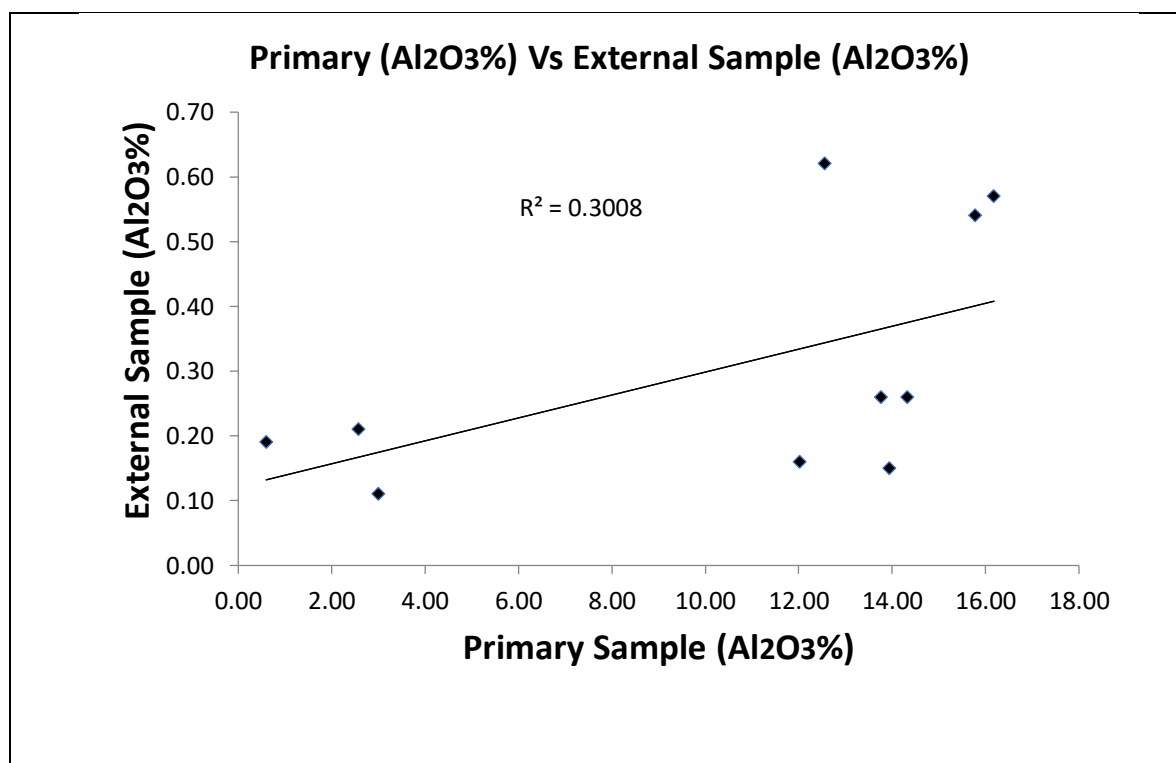


Fig. 18: Scatter Plot Showing Correlation Between Primary and External Al₂O₃% Samples

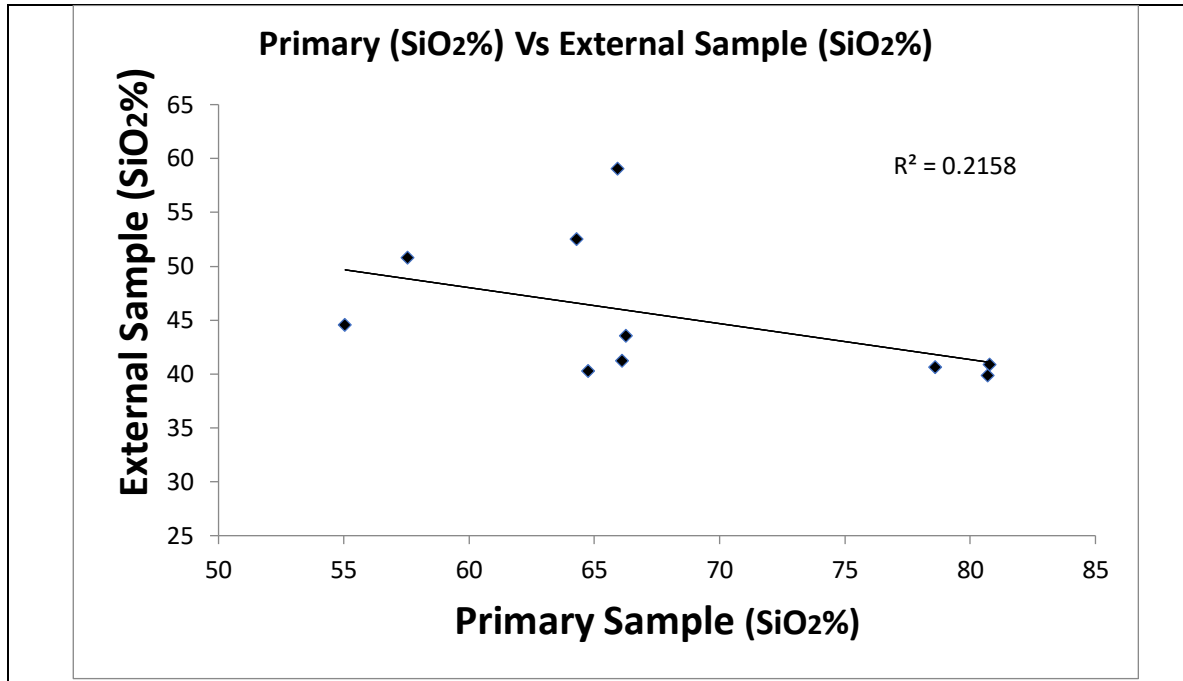


Fig. 19: Scatter Plot Depicting Correlation Between Primary SiO₂ % and External Check Sample SiO₂ %.

Mean, Mode Median, Standard deviation and variogram

Mean, mode, median, standard deviation, and variogram of Fixed Carbon percentage have been calculated from the chemical analysis data (160 samples)

Table 6.6: Statistical Summary (Mean, Median, Mode, Standard Deviation, and Variance) of 160 Borehole Samples.

Mean:	2.30
Median:	1.89
Mode:	1.26
Standard Deviation:	1.79
Variance	3.20

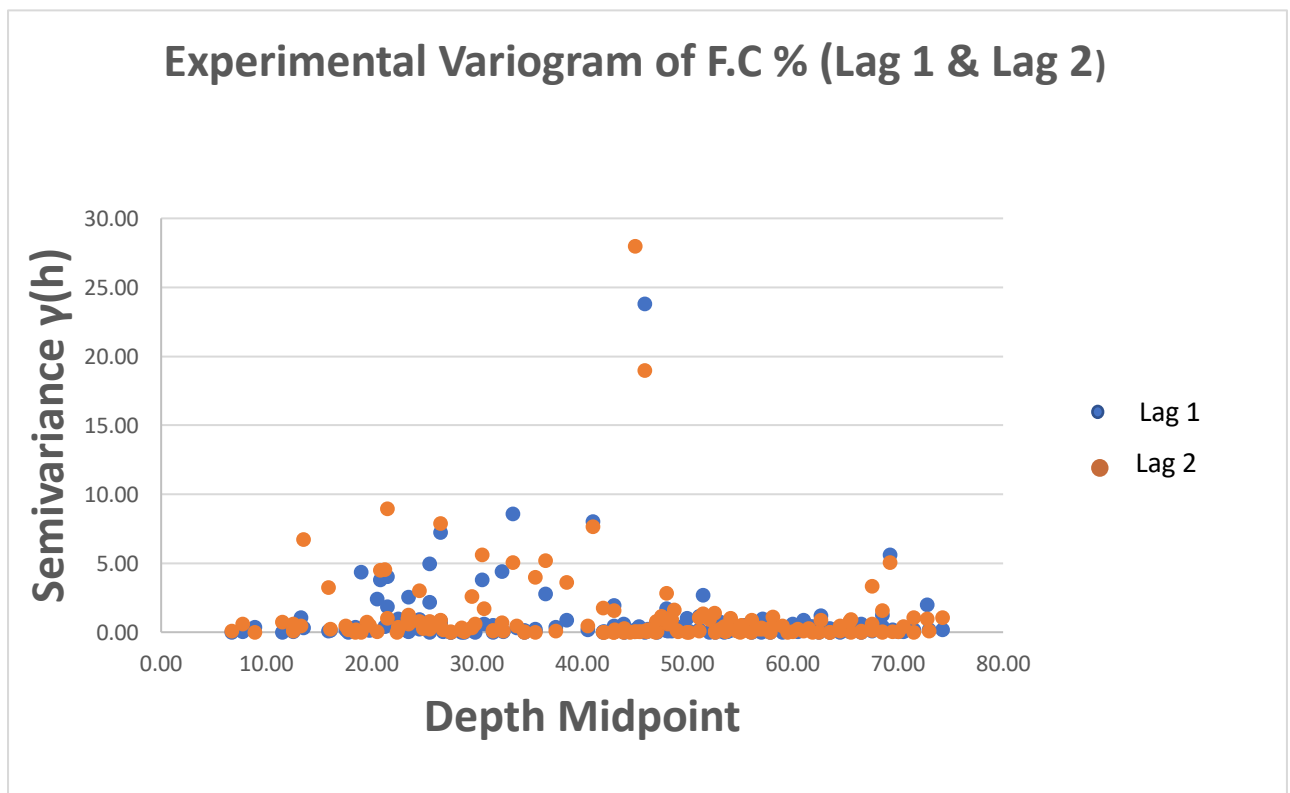
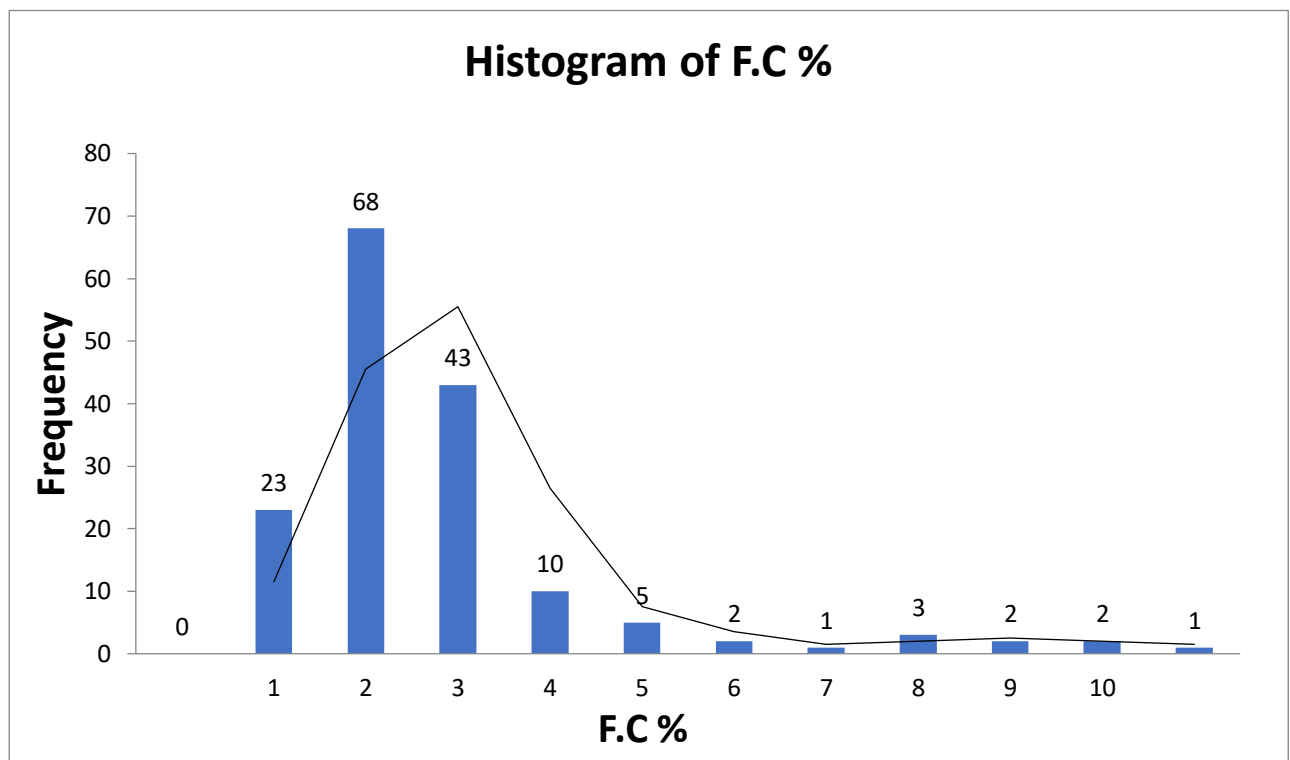


Fig.20: Histogram Showing the Distribution of Fixed Carbon (F.C. %) in 160 Borehole Samples.

6.1.9 Ore Zones:

The Naringpanga graphite block is explored by way of penetrating 6 boreholes in the northern part while the southern part was examined by 4 pits. Boreholes NPBH-1, NPBH-2, and NPBH-4 encountered mineral zones at shallow levels, with mineralized zones intercepted at depths of 6-7 meters below the surface. The deepest borehole in this study, NPBH-5, attained an inclined depth of 78.80m, (55.71m vertical depth) and intercepted graphite mineralization of 5.50m thickness. While the minimum inclined depth of 55.00m (38.88m vertical depth) was achieved in the borehole, NPBH-2, in which 9.65m of graphite mineralization has been intercepted. The overall thickness of the mineralization varies in response to the litho-structural control, but at least 3 levels of mineralized zones of variable thickness are evident in most boreholes. The average thickness of graphite mineralization intercepted in the boreholes is 9.93m.

The grade of graphite ranges from 2.0% to 10.03% FC. Borehole NPBH-1 exhibits the highest concentration of F.C (Fixed Carbon) values, recorded between 12.00m and 14.00m depth levels, conversely, the lowest F.C. value of 2.20% is found in NPBH-5. In terms of mineralization thickness, the highest graphite thickness was observed in NPBH-1, followed by NPBH-3 and NPBH-4. Besides, Pit 1 & 4 have also intercepted graphitised gneisses at about 2.5 m depth levels.

6.2 Geophysical Exploration

6.2.1: Geophysical Survey:

As per approval of 27th EC held on 10th January 2023, Self-Potential geophysical survey was undertaken in Total Area: 0.143 Sq. Km of Naringpanga block involving 13.5 line km surveys. Initially the target area was covered by SP survey over 14.3 Ha. But due to local resistance the initially proposed area could not be taken up for exploration. With due approval of TCC of NMET the co-ordinates of the block were revised to the further south of the earlier proposed area. Thus, a total of 29.22 Ha area was geophysically surveyed out of which geophysical interpretation was done in the present block over 14.3 Ha. The detailed Geophysical Report on Self Potential (641 stations out of 1335 stations) for graphite mineralisation in the Naringpanga block is given in Annexure-XIX.

Objective and Scope of Work:

The main objective of the geophysical survey was to delineate graphite ore zone and other associated minerals in Naringpanga block. The survey revealed significant self-potential (SP) anomalies characterized by negative SP high values. These anomalies are most likely associated with graphite mineralization, indicating the presence of subsurface graphite deposits.

Scope of the Survey

- A. Self-potential survey over 1335 data points in 13.5 line km grid pattern in the entire block.
- B. Preparation of a self-potential survey Report covering the above aspects.

6.2.2 Methodology

Exploration Parameters:

The coordinates of the corner points of the block boundary of the Naringpanga block are given in Chapter No. 3. The corner points of the block have been demarcated for Geophysical Survey in the field.

i) Instrument Details and theory:

The Self-Potential (SP) survey was performed using a Resistivity/SP Meter, Porous Pot Electrodes, and a Cable Reel. This method measures natural potential differences in the ground with a resolution in millivolts (mV). The SP survey detects subsurface electrical potentials caused by electrochemical, electro kinetic, and geothermal processes. These natural potentials arise from the movement of fluids, chemical reactions, or conductive materials such as graphite or sulphide minerals.

Due to the association of conductive materials like graphite with specific geological formations, SP surveys enable the delineation of mineralized zones, identification of groundwater pathways, and mapping of subsurface structures. This technique is particularly effective in locating structurally controlled deposits and understanding the subsurface conditions in areas with complex geology.

Data Acquisition:

The self-potential (SP) survey in the project area was conducted using a high-impedance potentiometer, two non-polarizing electrodes, and cables. The electrodes consisted of copper (Cu) metal immersed in a copper sulphate (CuSO_4) solution, housed in a porous pot. To ensure accuracy, a uniform batch of saturated salt solution was prepared, and the porous pots were filled accordingly. These were then short-circuited in a bath containing the same saturated salt solution and left overnight. Prior to commencing fieldwork, the potential difference between each pair of porous pots was measured, and only those with zero potential difference were selected for the survey.

At the end of each day, the porous pots and copper rods were thoroughly cleaned and recharged with fresh salt solution. They were then short-circuited in the same bath and kept overnight to prepare them for the following day's work. This rigorous process was consistently repeated throughout the duration of the survey to maintain the reliability and precision of the measurements.



Fig.21: Instruments used for Self-potential survey.

The self-potential (SP) data were measured at multiple survey stations along traverses laid in the area of interest, oriented perpendicular to the strike of the ore body or geological formations. A baseline was established along the NW-SE direction of the project area, and SP data were collected using a grid pattern of 25 m x 10 m spacing. This grid comprised 32 lines, all laid perpendicular to the baseline to ensure comprehensive coverage. A reference point was selected near the Nala section, located to the west of the project area. SP data collection began with respect to this primary reference point and continued to the

end of the wire. Upon completion of the initial wire, a secondary reference base was chosen, and subsequent SP data were collected relative to this secondary reference point. To ensure consistency and accuracy, all secondary base data were ultimately reduced and recalibrated with respect to the primary base point.

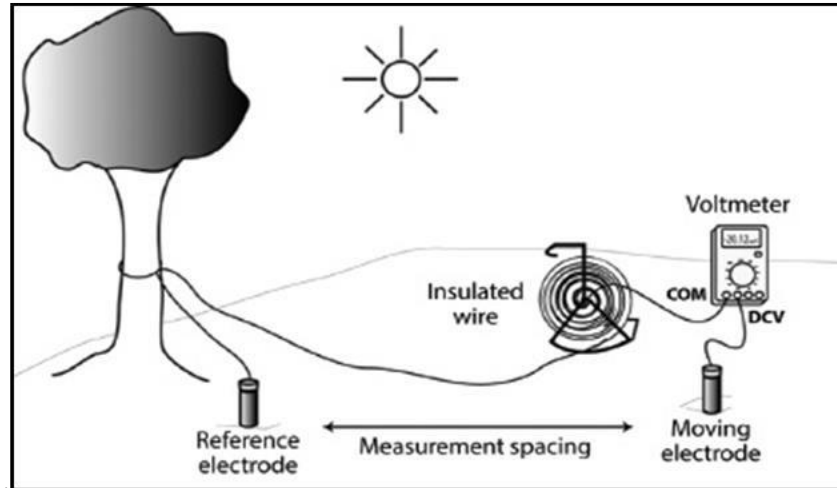


Fig.22: Self-potential data acquisition arrangement.

Data Processing:

The recorded SP data were systematically entered into a notebook computer in a structured format, which included the station number; UTM coordinates, and corrected SP values. This dataset served as the foundation for subsequent analysis and visualization. The data were processed and utilized in Surfer, a specialized software tool, to generate various graphical outputs and SP contour maps. These visual representations provided valuable insights into the spatial distribution of SP anomalies and their correlation with subsurface features.

1. Pot Correction:

The difference in pot readings arises from subtle discrepancies in construction, leading to varying levels of porosity between pots. This discrepancy usually remains constant and does not impede the Self-Potential (SP) survey. Nevertheless, an abrupt shift in pot readings may stem from factors such as cracks, contact between the porous pot and metal sulphides, or an under saturation of copper sulphate in one or both pots' solutions.

Ahead of the SP data acquisition, the pot difference was computed between two porous pots, and corresponding corrections have been applied to the SP data at each station point.

2. Reference Correction:

The readings for the last five station points were recorded in relation to the secondary reference station, employing the opposite terminal convention (where the stationary base pot connects to the positive terminal and the roving pot to the negative terminal of the potentiometer). These readings were then combined with their respective values measured in reference to the primary base. The average of these five combined readings served as the reference correction for subsequent measurements taken in reference to the secondary 9 reference point. This systematic approach was applied to reduce the entire Self-Potential (SP) dataset in relation to the primary reference point.

3. Drift Correction:

While measuring an SP line, the potential difference between the base pot and roving pot undergoes changes owing to fluctuations in chemical composition and temperature, leading to what is known as pot drift. To mitigate this drift, precautions were taken, such as placing the pots in the shade. Additionally, external factors like sunlight, magnetic storms, and high contact resistance can introduce further drift into the SP data acquisition process.

Following the reduction of SP data to the primary reference, corrections for drift were applied to the dataset. This correction process is essential to enhance the interpretability of SP variations, enabling a more accurate understanding of lithological variations, topographical influences, and the identification of mineralized zones of interest.

SP Data Interpretation:

Qualitative interpretation of self-potential (SP) data has been conducted through profile plots and contour maps. To enhance the correlation of local trends, lithological contacts, and historical workings, the geological map may be overlaid onto the SP contour map. While the SP anomaly minimum is generally assumed to coincide directly with the

anomalous body, adjustments are made for steep topography where the anomaly minimum might be displaced downhill.

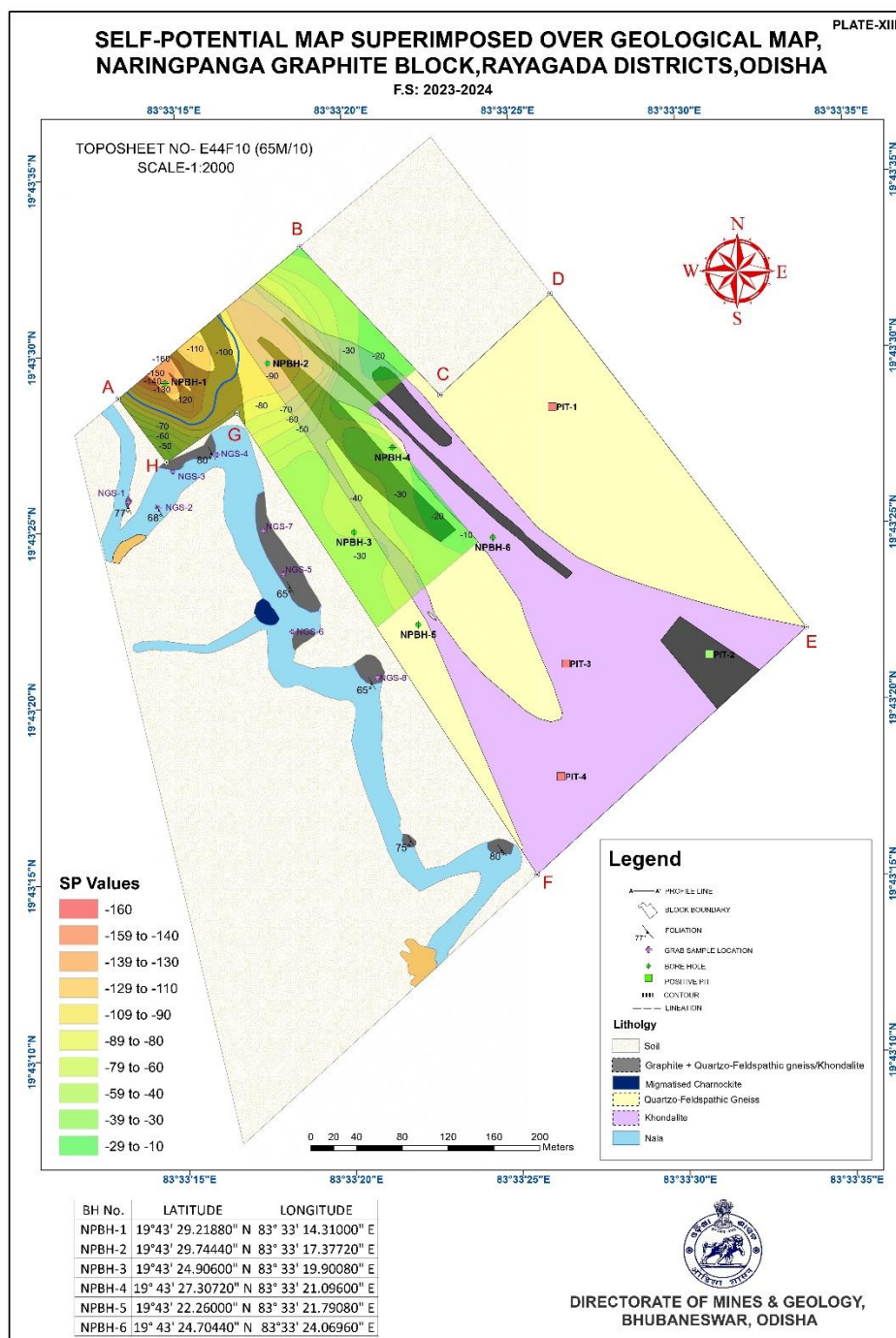


Fig.23: Integrated Geological and Geophysical map of Naringpanga Graphite Block, Rayagada district, Odisha

The isoanomaly contour provides a pictorial view of the mineralization zone. The elliptical form of the SP contours indicates that the major axis aligns with the direction of elongation of the poles. The contour map unveils an elliptical structure with a NW-SE orientation, consistent with the geological strike direction. Within the project area, SP values range from 80.2mV to -154.6mV. The anomalous zone, highlighted by a deep red coloration in the central region, extends beyond the project area, as suggested by the open contours on the map. Analysis reveals an up-dip orientation in the southwest and a down-dip orientation in the northeast of the anomalous zone. Consequently, the deep red-colored portion on the contour map is indicative of a probable graphite-bearing zone.

Profile lines reveal a consistent trend of decreasing SP values from the southwest (SW) to the central region and then gently increasing towards the northwest (NW). Notably, the primary anomalous zone identified in the central part of the project area along the profile lines L20, L21, L22, L23, and L24. Striking details emerge when connecting station points corresponding to peak positive and peak negative SP values, offering insights into the anomalous zone's strike directions.

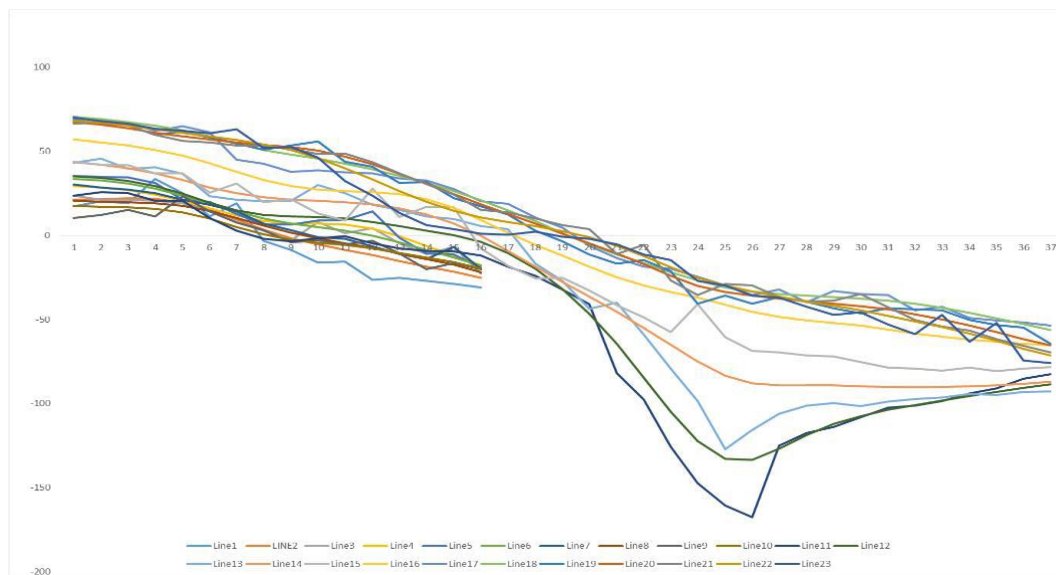


Fig.24: Composite Self-Potential (SP) Profile Plot across Multiple Survey Lines in the Naringpanga block.

**SP MAP SUPERIMPOSED OVER GEOLOGICAL MAP
NARINGPANGA (SOUTH) GRAPHITE EXPLORATION PROJECT, RAYAGADA**

TOPOSHEET NO- E44F10 (65M/10)

SCALE-1:2000

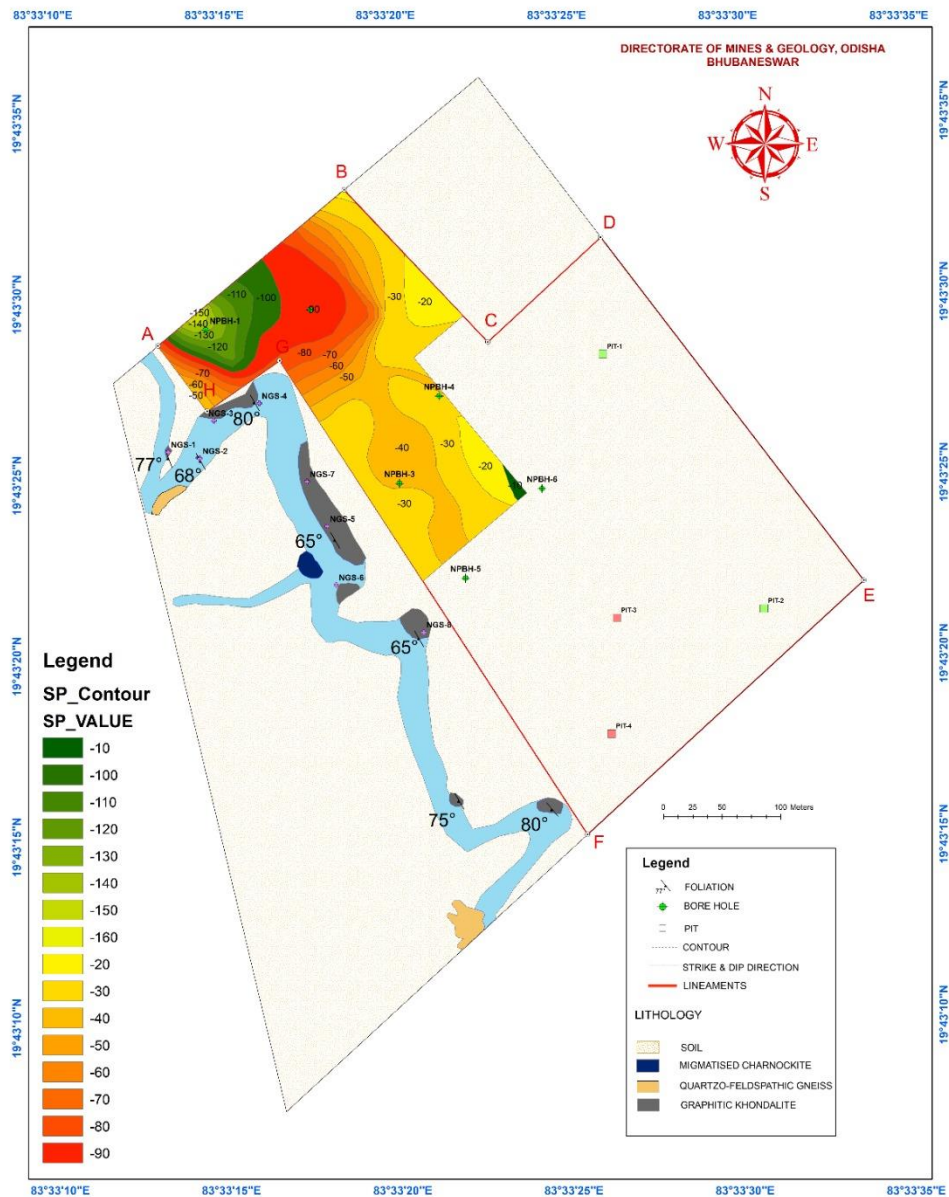


Fig. 25: Isopotential Map illustrating SP Anomaly Zones in the Naringpanga block.

Location of data points:

All borehole collars were placed and fixed based on SP anomalies and graphite exposures observed along the Nala section, rather than adhering to a uniform grid pattern.

Boreholes were inclined and drilled to a maximum depth of 78.80 m to intersect the mineralized zones. Additionally, four pits were excavated in the mineralized zones for resource estimation purposes.

The superimposed geological and geophysical map, along with borehole (BH) locations, is annexed as Plate No. XIII.

6.3 Geochemical Exploration:

REE & RM

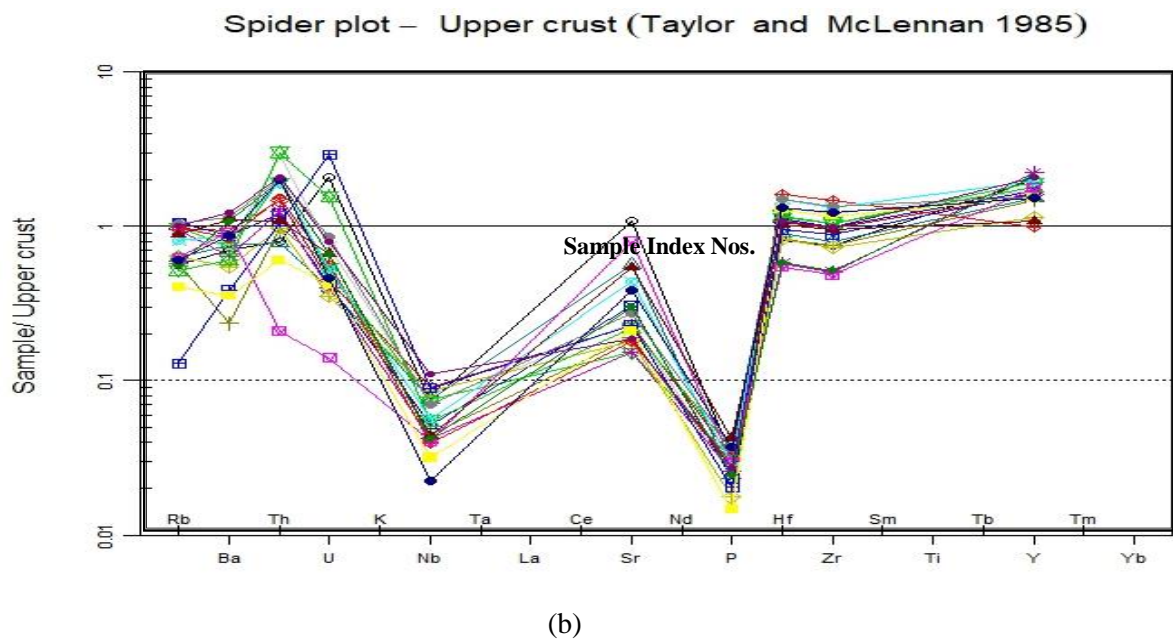
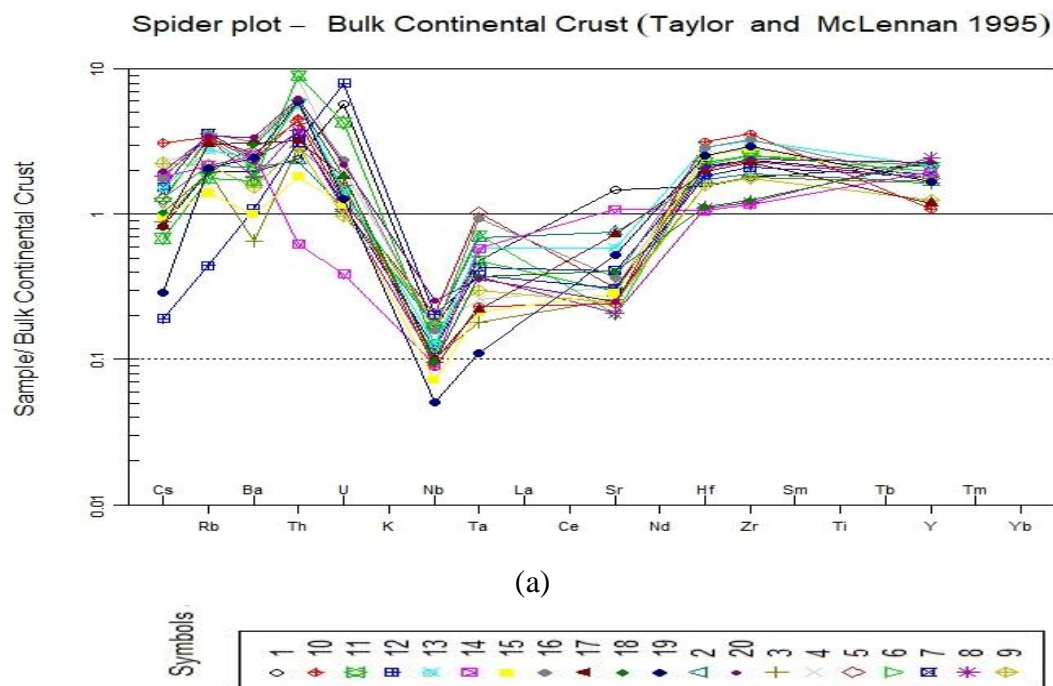
REEs (Rare Earth Elements) include light REEs (LREEs) such as scandium, lanthanum, cerium, praseodymium, neodymium, promethium, samarium, and europium, as well as heavy REEs (HREEs) such as gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, and yttrium. Based on REE and RM (Rare Metal) analyses of 34 major and minor elements, the chondrite-normalized REE plots (Taylor & Mcmilan, Pierce, et. al. 1984 indicates elevated concentrations of LREEs compared to their crustal abundance (Fig.26, a, b, c, d).

Table 6.7: Trace element abundance in migmatized khondalite & quartzo-feldspathic gneiss.

Elements	Li	Be	Sc	V	Cr	Co	Ni	Cu	U
Min	2.81	0.61	3.69	30.83	42.37	4.68	15.99	32.22	0.35
Max	28.68	4.23	20.23	184.49	139.91	25.67	70.84	156.82	7.28
Elements	Zn	Ga	As	Se	Rb	Sr	Y	Zr	Ge
Min	31.54	7.72	32.94	0.30	14.20	53.39	21.59	116.23	0.65
Max	230.34	22.86	41.97	1.33	115.86	379.94	48.92	355.83	2.98
Elements	Nb	Mo	Ag	Cd	In	Sn	Sb	Te	
Min	0.56	0.82	0.13	0.24	0.10	0.89	0.97	0.12	
Max	2.78	5.99	0.58	0.57	0.10	6.31	1.63	0.40	
Elements	Cs	Ba	Hf	Ta	W	Pb	Bi	Th	
Min	0.19	164.14	3.17	0.11	0.16	10.82	0.19	2.19	
Max	3.09	853.62	9.43	1.02	1.33	31.49	0.58	31.59	

The geochemical data from the study area provide insights into the elemental composition and its geological implications. The elemental data indicate that light rare earth elements (LREEs) such as lanthanum, cerium, along with heavy rare earth elements (HREEs) including scandium, and yttrium, are well-represented. Chondrite normalized REE

plots display higher concentrations of LREEs relative to their crustal abundance, suggesting enrichment processes by dynamo-thermal & regional contact metamorphism.



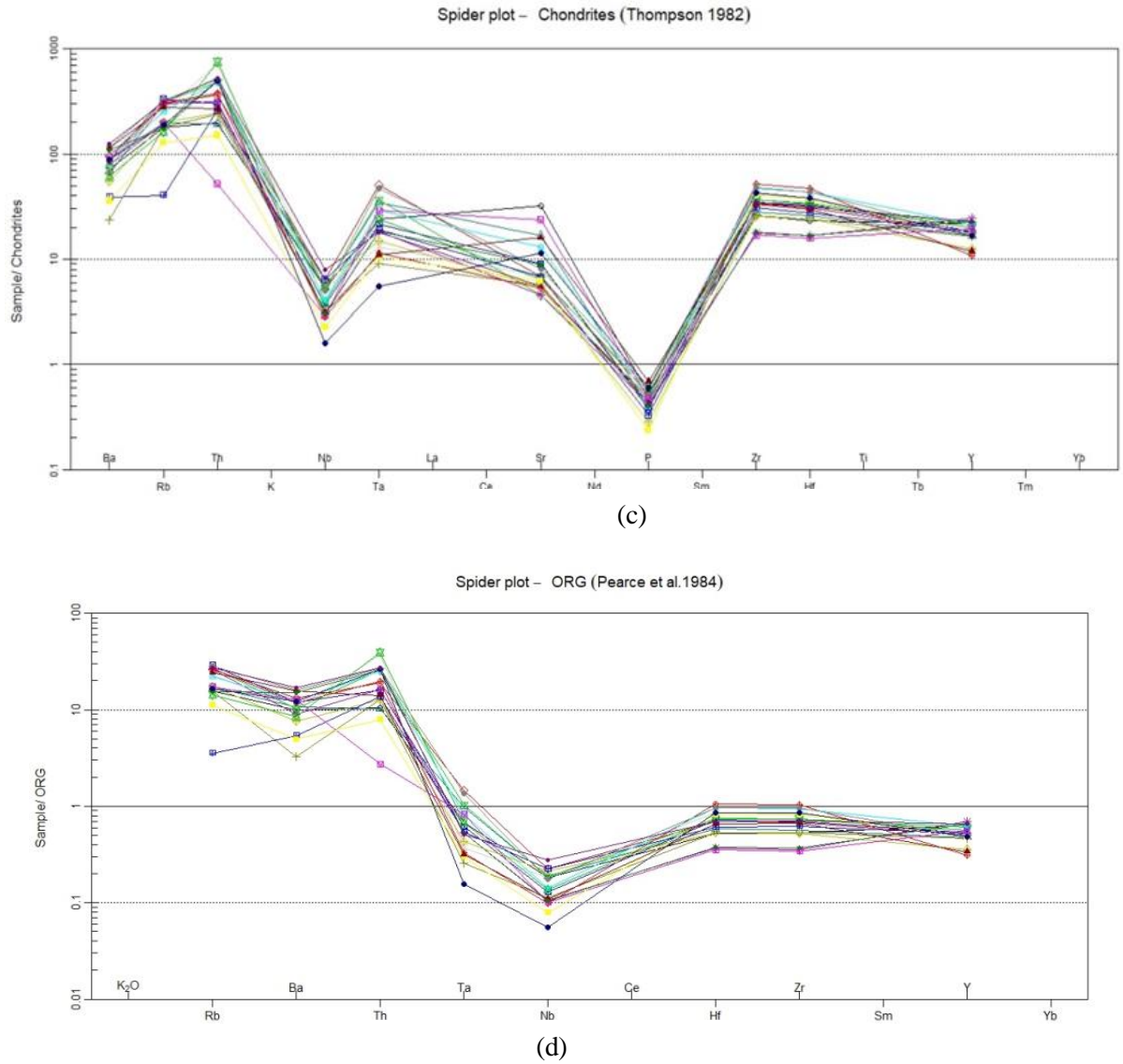


Fig. 26: Chondrite normalized plots of Migmatized Khondalite & Quartzofeldspathic Gneisses.

Additionally, the study highlights elevated concentrations of several elements like vanadium (V), strontium (Sr), zirconium (Zr), barium (Ba), and rubidium (Rb) are notable. These elements reflect distinct geochemical processes and the area's potential for mineral resources.

Vanadium exhibits a maximum concentration of 184.49 ppm, indicative of its association with mafic minerals or possible hydrothermal alteration. The presence of Sr (up

to 379.94 ppm) and Ba (up to 853.62 ppm) suggests their enrichment in feldspathic phases, pointing to a magmatic or metamorphic origin, potentially involving pegmatite or granitic processes. Similarly, Zr, with a maximum value of 355.83 ppm, highlights zircon enrichment, often linked to high-grade metamorphism or felsic magmatic activities. Transition metals such as chromium (Cr), cobalt (Co), nickel (Ni), and copper (Cu) exhibit moderate concentrations, reflecting the contribution of mafic-ultramafic components or fluid-mediated transport during tectono-metamorphic processes. Additionally, thorium (Th) and uranium (U), with respective maximum values of 31.59 ppm and 7.28 ppm, point toward a potential for radioactive mineralization, often associated with granitic and metamorphic terrains. Rare metals like hafnium (Hf) and tantalum (Ta) show moderate enrichment, suggesting their association with accessory minerals such as zircon or columbite in high-grade metamorphic rocks. Secondary processes like silicification and mylonitization may also play a role in redistributing these elements along structural features.

The overall geochemical signature underscores the influence of tectonic and metamorphic processes, including partial melting, recrystallization, and fluid mobilization, in shaping the elemental distribution.

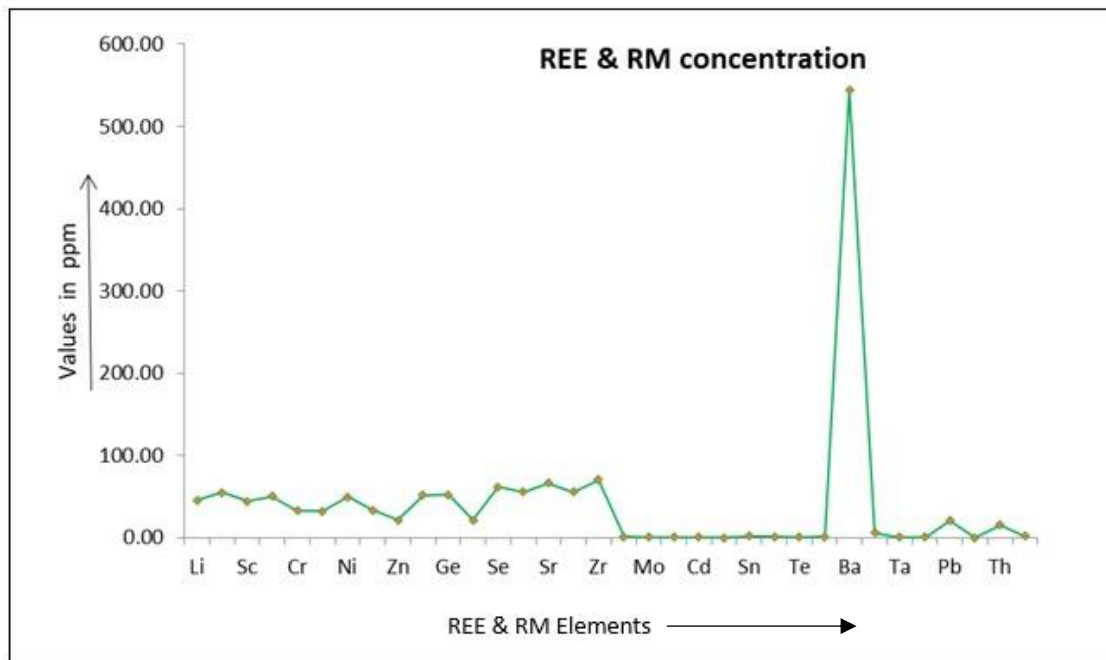


Fig.27: Histogram of REE concentrations across 34 parameters from 20 samples.

CHAPTER-7

INTEGRATION OF GEOLOGY, GEOPHYSICS AND GEOCHEMICAL EXPLORATION DATA & INTERPRETATION

The integration of the field geological data, outcrop disposition of graphitized lithologies in the vicinity of the study area and their extrapolation provided a guiding tool to fix the borehole target points to study the geo-spatial continuity of the ore bearing formations in the sub surface. The geological map has been superimposed over the self-potential (SP) contour map generated through mapping and SP survey in a GIS platform to interpret the potential target of mineralisation. Accordingly, the borehole points are fixed on anomalous zones in the up dip direction of the exposed graphitic gneisses and schists and borehole (BH) locations are presented as Plate No. XIII (Fig. 28). The map clearly demonstrates a spatial correlation between SP anomaly zones and geological formations. Boreholes were placed in low SP zones and extrapolated graphite-bearing outcrops based on geological reasoning. Notably, borehole NPBH-1, situated within an SP anomaly measuring -110 mV, confirmed the presence of graphite mineralization. Similar graphite intercepts were recorded in other boreholes located within low SP zones. This consistent alignment between SP anomalies and borehole results highlights a strong geophysical – geological correlation, underscoring the effectiveness of SP surveys in delineating subsurface graphite-rich zones.

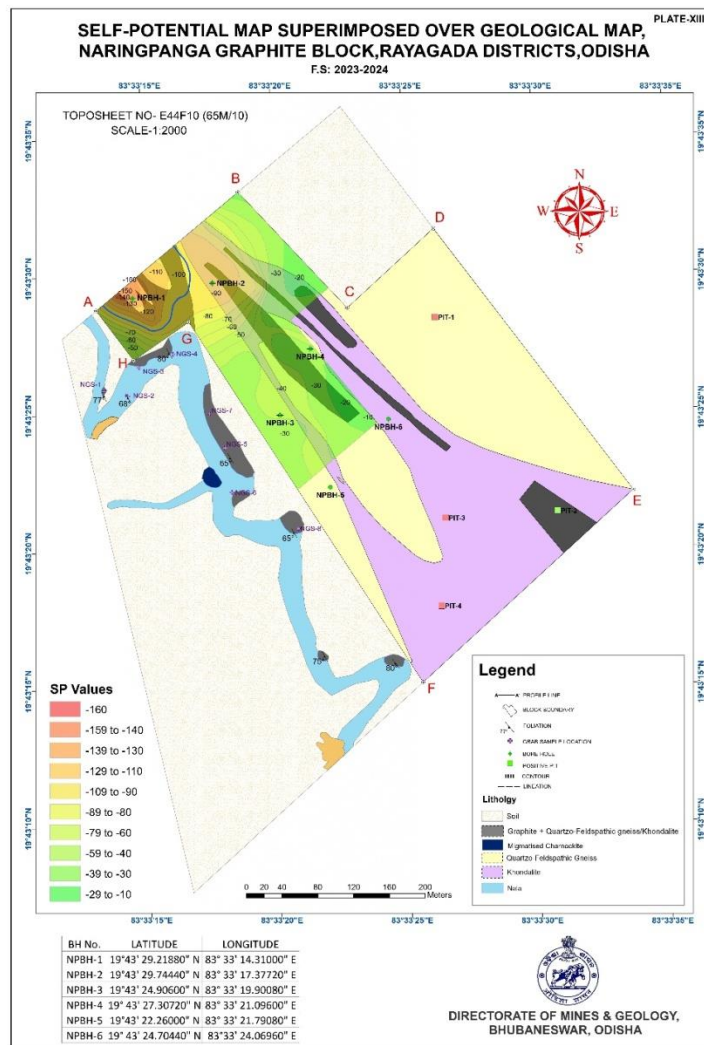


Fig.28: Overlay of Self-Potential (SP) Anomalies on the Geological Map of the Study area.

CHAPTER-8

MINERAL PROSPECT

8.1: Surface indication

During geological mapping, over 0.143 sq km, exposures of highly altered and kaolinised pelitic gneisses and schists and also altered to soil exposed in the deep gullies. However, isolated exposures of migmatised quartzo-feldspathic gneisses and migmatised khondalites are noticed in the nala bed and walls in which graphite occurs as disseminations beyond the mapped area.

8.2: Mode of occurrence

Here, disseminated flaky graphite is found to occur as small lenses and pockets. Varying concentrations of graphite occur as disseminated flakes within the pelitic gneisses and quartzo-feldspathic gneisses show NNW-SSE foliation and high angle dips towards west. Both quartzo-feldspathic gneiss and migmatised graphite-sillimanite bearing gneisses exhibit more or less banded nature and conformable. The dip of litho units are extrapolatable to the present area which led to intercept the graphite lodes in the bore holes given at 45° across the dip.



Fig. 29. Altered migmatised khondalite in the Bangei Nala bed & eastern wall section.

8.3: Strike length and width of anomalies

Geological mapping and trial exaction in the area coupled with ground geophysical reveals that the area is a potential area for graphite mineralisation. Integration of surface geological data and geophysical data indicate the possible extent of mineralised zones along the axial length of the block. It has been deciphered that the graphite bearing host rocks extends for a strike length of 550 m and average width of 142 meter cumulatively.

8.4: Alteration zones

The host rock of graphite in the study area has undergone intense weathering and alterations. Feldspars are mostly kaolinised and garnets are oxidized to variable extent. The weathering and alteration are so intense that insitu exposures have altered to soi to variable depth as observed in the nala walls. The pit walls also exposed the altered rocks with relict foliations (Fig.30)



Fig. 30. Altered migmatised khondalite in the pit wall wall section.

8.5: Genesis of mineralisation.

Graphite is a high grade mineral representing high temperature and pressure conditions. The litho-units in the study area primarily comprise altered khondalite, graphite-bearing migmatized khondalite, and quartzo-feldspathic gneiss, which form a

banded assemblage. These rocks are of meta-sedimentary origin and exhibit strong foliation. Mineralogical studies indicate that the graphite occurs as disseminated flakes and fibers along the foliation planes of migmatized khondalite and quartz-feldspathic gneiss, with an erratic distribution. The deleterious elements present in these mineralized zones include quartz, plagioclase, orthoclase, and opaques. The lithology includes khondalite \pm graphite schists and gneisses, both of which have undergone high grade granulite facies metamorphism. Within this lithological framework, specific units contain graphite mineralization, particularly in the migmatized pelites, which are metamorphosed rocks made up of sand-sized psammite and fine-grained pelite minerals that have experienced partial melting and recrystallization. The quartz-feldspathic invasions, which involve the intrusion of quartz and feldspar-rich materials, granitoids, are also present within these units. These geochemical patterns indicate a primarily within-plate granitic magma origin with minor volcanic arc contributions, reflecting a complex magmatic evolution. Secondary overgrowth in most of the quartz grains indicates a sedimentary parentage.

CHAPTER-9

EXPLORATION SYSTEMATIC DRILLING

9.1 Methodology of drilling with details of type of drilling

In order to ascertain the subsurface geometry, grade and resource of graphite in the block, 6 inclined boreholes are given to intercept the ore zones in the first level depth as approved by NMET. The boreholes were planned to reach depths of 30 m vertical levels and 60 m levels to explore the subsurface effectively and continued upto interception of a non-mineralised zone. Thus a cumulative drilling meterage of 398 m was achieved. The drilling work was outsourced to M/s Geo Environmental Services, Bhubaneswar. Diamond core drilling in six inclined boreholes were drilled at the borehole points interpreted from the SP anomalous zones, so as to intercept the graphite lode in the up-dip direction in compliance to the geological disposition of the ore body exposed in the nala section. The inclined BHs are given at an angle of 45^0 with respect to the horizontal as the litho-assemblages in the terrain exhibit dip angles varying from 25^0 - 70^0 .

The agency has deployed Volt-180 and Volt-90 rigs for the operation (Fig.31). The drilling employed a combination of dry and wet techniques. Dry drilling was conducted in soft formations and secured with HW casings up to inclined depth from 3 m to 6 m in length. For hard formations, wet drilling was carried out using a double-tube barrel system to ensure optimal core recovery. The cumulative drilling meterage achieved in 6 BHs is 398.00 m.



Fig. 31: Field photograph capturing drilling activities BH No. NPBH -1.

9.2 Borehole planning

Initially, the G3 stage exploration proposal included approximately 10 boreholes in a regular grid pattern. However, after a review by the TCC, it was advised to undertake only six boreholes with a total drilling meterage of 400m. Borehole locations were selected based on anomalous self-potential (SP) zones and extrapolated outcrop trends within the Nala section (Plate- XIII). Borehole NPBH-1 was placed over a high-potential anomaly zone, exhibiting an SP value of -110 mV. The BH loci are logically fixed with respect to exposure map & SP anomalous zone, without any bias. All borehole collars were placed and fixed based on SP anomalies and extrapolated graphite exposures observed along the Nala section, rather than adhering to a uniform grid pattern with approval of TCC. Boreholes were inclined and drilled to a maximum depth of 78.80 m to intersect the mineralized zones. Additionally, four pits were excavated in the mineralized zones for resource estimation purposes

9.2.1 Spacing of Boreholes:

The borehole locations were selected based on the anomalous SP zones and extrapolated outcrops in the Nala section. NPBH-1 was positioned in a high-potential anomaly zone (SP value of -110mV).

- Spacing of NPBH-1 and NPBH-2- 81.00 m X 42.00 m (NPBH-2 is located to the southeast of NPBH-1)
- Spacing of NPBH-3 and NPBH-4 - 73.5 m X 36.00 m (NPBH-4 is located to the Northwest of NPBH-3)
- Spacing of NPBH-5 and NPBH-6 -99.0 m X 18.00 m (NPBH-6 is located to the Northwest of NPBH-5). This pair is located approximately 46.5 meters from the exposed graphite body in the Nala section.

In order to ensure optimum core recovery within the fragile ore zone, Drilling was done by deploying triple tube barrels and the core recovery was satisfactory. The core recovery percentage for the graphite zone in individual boreholes provided in Table 9.4.

9.2.2 Level of Intersection.

All boreholes yielded positive results, reinforcing the area's potential for graphite mineralization. Detailed information regarding the borehole locations, depths, graphite thickness, and sample generation is provided in Table 9.1.

Table. 9.1. Depth of Boreholes and thickness of mineralised Zones in the block

Bore Hole	Inclined Depth(m)	Vertical Depth(m)	R.L(m)	Apparent Thickness of Graphite(m)	True Thickness of Graphite(m)	Samples Generated (Nos.)
NPBH-1	70.00	49.50	331.40	24.55	17.36	31
NPBH-2	55.00	38.89	333.31	9.65	6.82	24
NPBH-3	74.50	52.68	331.02	19.55	13.82	31
NPBH-4	56.50	39.95	335.52	18.55	13.11	31
NPBH-5	78.80	55.72	329.86	5.50	3.89	28
NPBH-6	63.20	44.69	334.14	6.50	4.59	15
Total	398.00	281.43		84.30	59.60	160

Interpretation of the intercepted ore horizons indicates that there exist two to four levels of ore zones whose dispositions are structurally controlled synchronous with the F₂ &

F₃ foldings as revealed from the borehole cuttings of first level boreholes. As the area is litho-structurally controlled, with steep dipping sub surface litho assemblages, more levels of mineralisation can be proved in the second level and third level boreholes. The depth of intersection of graphite mineralisation in the six drilled holes is furnished below.

Table 9.2 Level of interception of ore zones in different bore holes.

SL.NO	BHs. No	Lode No	From (m)	To (m)
1	NPBH-1	1	12.00	14.00
2		2	21.00	34.00
3		3	43.50	44.30
4		4	52.10	69.50
5	NPBH-2	1	12.00	13.00
6		2	15.60	20.50
7		3	26.50	27.00
8		4	41.45	45.45
9		5	50.45	51.70
10	NPBH-3	1	20.50	21.10
11		2	48.60	71.95
12	NPBH-4	1	11.00	13.05
13		2	21.00	23.00
14		3	31.00	49.00
15	NPBH-5	1	60.50	66.00
16		2	73.50	75.00
17	NPBH-6	1	25.00	31.00
18		2	51.20	51.70

9.2.3 Co-ordinates & RL of Collar

The depths of the boreholes varied from 55.0 m (NPBH-02) to 78.80 m (NPBH-05). Graphite occurrences were intercepted in all boreholes, confirming mineralization across the drilled locations. Cumulatively, a total thickness of 84.30 m of graphite was intercepted. The maximum graphite thickness of 24.55 m was encountered in NPBH-01, while the minimum thickness of 5.50 m was noted in NPBH-05. To recover high-quality core samples, short drilling runs were performed as needed, ensuring 95% core recovery in the mineralized zones, which is considered satisfactory. Some minor deviations occurred, but overall, the quality of drilling and sampling was well-maintained. Graphite was found

associated with quartzo-feldspathic gneiss and migmatized khondalite at varying depths, further validating the geological model. After completion of drilling, all boreholes were properly sealed and plugged with cement pillars to ensure environmental and operational safety. The boreholes drilled are given in the following Table 9.3

Table 9.3 Borehole Positions with Corresponding Depths and Reduced Levels.

BH No	RL(m)	Longitude	Latitude	Inclined Depth(m)
NPBH-01	331.402	83°33'14.310" E	19°43'29.218" N	70.00
NPBH-02	333.308	83°33'17.377" E	19°43'29.744" N	55.00
NPBH-03	331.021	83°33'19.901" E	19°43'24.906" N	74.50
NPBH-04	335.519	83°33'21.096" E	19°43'27.307" N	56.50
NPBH-05	329.859	83°33'21.790" E	19°43'22.260" N	78.80
NPBH-06	334.140	83°33'24.069" E	19°43'24.704" N	63.20

The overburden, consisting primarily of soil and weathered lithologies, ranges in thickness from 11 m to 20 m (Inclined depth)..

A mylonitic horizon was intercepted in boreholes NPBH-03 and NPBH-05, at depths ranging from 61.0 m to 69.0 m and 60.50 m to 65.00 m, respectively, indicating significant structural deformation zones. Detailed lithologs, capturing these geological features, are included in Annexure-II, while graphic lithologs are presented in Plate-IV for visual representation and interpretation.

9.2.4 Borehole Logging

Core Logging:

The cores recovered from the boreholes, drilled using both dry and wet techniques, were systematically logged to identify and delineate various litho-units. The average core recovery across all boreholes was approximately 95%, indicating a high-quality sampling process. The logging process involved run-wise examination of the core as well as the cuttings from the boreholes. This helped in discerning the physical characteristics such as the colour, shape, and size of lithologies, the nature of graphite mineralization, and other textural and structural features. Key structural features like joints, fractures, and foliations, along with their orientation relative to the core axis, drags, kinks, silicifications, slickensides etc, were also meticulously recorded.

In addition to the physical observations, qualitative analytical data were used to delineate ore-bearing and non-ore litho-units. Since the litho-units showed minimal variation along the down-hole direction and the run lengths were relatively short, a consolidated and summarized litholog was prepared for all boreholes. This litholog provides a graphical representation of the litho-units along geological cross-sections, offering a clear visualization of subsurface geology.

The litho-units identified during the logging process were classified into distinct groups: soil, migmatized khondalite, quartzo-feldspathic gneiss, khondalite + graphite, quartzo-feldspathic gneiss + graphite, garnetiferous quartzo-feldspathic gneiss, and granulite. These groupings reflect the diversity of lithologies encountered in the boreholes. Detailed lithologs and summarized lithologs, providing comprehensive data on the lithological sequences and distributions, are included in Annexure-II for reference and have been utilised in borehole correlations.

Data spacing for reporting of exploration results

Graphite is observed to occur in multiple forms, including disseminated, flaky, veinlet bands, and irregular lensoidal bodies. It is closely associated with quartzo-feldspathic gneiss and khondalite lithologies. The graphite mineralization is believed to have been emplaced along shear planes and within hinge areas of folds present in the quartzo-feldspathic gneiss. BHs are planned on the geophysical anomalous zones so as to intercept the ore body and BH location plan was reviewed & approved by the TCC-NMET.

Exploration at the G3 level was planned based on surface exposures observed in nala sections. Drilling was carried out to investigate the subsurface distribution of graphite, with borehole samples collected at one-meter intervals for grade evaluation. Notably, no borehole was terminated, ensuring comprehensive data acquisition across the drilled sections.

The spacing and distribution of data collected for this G3-level reporting are deemed sufficient to establish the degree of geological and grade continuity necessary for reliable mineral resource estimation and classification procedures.

Drilling techniques and drill sampling employed:

Both dry and wet drilling methods have been adopted to puncture the boreholes. The drilling operation commenced with dry drilling using a TC (Tungsten Carbide) bit to penetrate the soft formations. Loose formations were secured with NQ casings of varying lengths, ranging from 3m to 6m. Following this, diamond core wet drilling was performed. Unlike a uniform grid pattern, the drilling plan was designed to target the ore zone by inclined boreholes. These were positioned based on field observations of graphite exposures along the Nala section and anomalies identified through the SP survey. This systematic approach resulted in a total cumulative drilling meterage of 398.00m, meeting G3-level exploration standards.

The drilled depths ranged from a minimum of 55.0m (NPBH-2) to a maximum of 78.8m (NPBH-5), using HW (66.67mm) and HQ (53.97mm) core barrels. Volt-180 and Volt-90 rigs were employed to execute the drilling. Wet drilling techniques were adopted to maximize sample recovery. Friable cores were carefully collected from the return water after sediment settling in a pond, followed by sun drying to ensure sample integrity and avoid contamination.

Data from drilling revealed no correlation between core recoveries and grade. The average core recovery of all stratas was approximately 95%, with losses attributed to voids, weathering, and alteration in quartzo-feldspathic gneiss and altered khondalite. Weathered formations, such as weathered khondalite and weathered quartzo-feldspathic gneiss, experienced preferential core loss, recovered as sludge. Sludge samples were meticulously collected at the casing mouths using polythene bags to minimize material loss and contamination.

9.2.5 Core Recovery Percentage:

Geological logging of borehole cores carried out to identify the lithology/rock type. The logging data have been recorded and preserved. As per the format of the record of the core length and percentage of the recovery recorded and result assessed properly. The core recovery is measured as retrieved from the core barrels $\text{Vis} - a - \text{Vis}$ the drilling meterage run i.e., recovery is determined by the formula: The average core recovery during the

drilling operation was calculated to be 95%, influenced by the degree of intense weathering and alteration in quartzo-feldspathic gneiss, altered and weathered khondalite.

$$\text{Recovery} = \frac{\text{Length of core recovered}}{\text{Meterage of drill run}} \times 100$$

Standard tube conventional core drilling rigs were used during core drilling operations for maximum core recovery purpose. Utmost care is taken to avoid any contamination of the samples. Overall average recovery of core was 95% while that for the graphite zone in individual boreholes provided in the following table.

Table 9.4: Core Recovery Summary from Graphite Zones in Individual Boreholes.

Core Recovery of Graphite zone in individual Boreholes		
SL No.	Borehole no	Recovery (%)
1	NPBH-1	95%
2	NPBH-2	95%
3	NPBH-3	92%
4	NPBH-4	91%
5	NPBH-5	95%
6	NPBH-6	92%
	Average core recovery.	93.33%

All drill cores were logged meter wise visually in the field for both qualitative and quantitative. The logs were later modified with the laboratory results. The detailed core logs along with sample analysis results are appended at Annexure-II. All samples generated through core drilling have been analysed in the Research Laboratory, Bhubaneswar by wet chemical method.

The detailed core logging was done for each meter run visually in the field with pocket lens. The logs were later modified with the laboratory results. In Naringpanga graphite block have been analysed for the core samples by standard procedure of wet chemical analysis and ICP-MS. The bulk density was also determined to calculate the resource by following the IS: 5842-1986 (Reaffirmed 2008) procedure.

9.3 Mineralogy of Ore Zone:

Graphite mineralization in the Naringpanga block is primarily localised along the foliation planes of migmatized khondalites & quartzo-feldspathic gneiss. It occurs as disseminations, with graphite flakes ranging from a few millimeters to 5 millimeters. The mineralization exhibits variations in concentration, such as swelling and pinching, reflecting the structural complexity of the area. The graphite is primarily flaky, indicating low-grade metamorphism, and is deposited along the foliation planes of both khondalite and quartzo-feldspathic gneiss rocks, suggesting structural control over its emplacement.

The mineralized zones are concordant with the host rock, and the graphitised lithologies are masked beneath a thick alluvial soil cover. This soil may influence the distribution of graphite, potentially indicating the mineralization extends over a larger area than present area. The combination of structural controls, disseminated flaky graphite, and the alluvial soil cover makes this deposit unique and potentially extensive.

9.4 Methodology of Ore Zone Sampling and sample preparation

After extraction of core from core barrel, the drilled cores are spread systematically in the designated core boxes. During sampling, meter wise longitudinal half of the core has splitted and was crushed manually by iron mortar and pestle and the other half is preserved for future reference. In case of sludge cores, samples were reduced by standard coning and quartering.

The length of each sample was in general kept around one meter for the purposes of the investigation. The graphite cores having longitudinal length of less than 0.5m were accounted for in the preceding samples. While the sample lengths of +0.5 to 1m were drawn as one sample when recorded. After extraction of core from core barrel, the drilled cores are spread systematically in the designated core boxes. The samples thus collected

were reduced to the desired quantity by coning and quartering were powdered to 200 mesh ASTM size. About 50 g of each sample was collected in duplicate by coning and quartering method and packed with proper leveling tags. All the core samples were analysed at the Research Laboratory Bhubaneswar, by wet chemical analysis method. In Naringpanga block, Al_2O_3 , SiO_2 , F.C, Ash and LOI have been analysed as per approval of NABL.

Based on the chemical assay result a comprehensive lithology of drill holes has been prepared for the individual ore zones of each bore hole.

Utmost care is taken to avoid any contamination of the sample and following standard procedures for core collection from drill holes and core boxes, marked core length by using metal tags.

The sample sizes are based on the lithology and its homogeneity. Any contrast in the lithology etc. has been taken into consideration for sample size. However, in core drilling maximum one meter length is considered and final samples reduced and sieved to 200 mesh size for analysis.

9.5 Chemical Analysis of Samples and Laboratory Procedures

The assaying and laboratory procedures adopted are as per the BIS standard. All the core samples were analysed at the Research laboratory, Bhubaneswar in wet chemical analysis method. Again 13 Nos. core samples have been analysed for petrographic, and 14 Nos. core sample XRD study each at Research Laboratory, Bhubaneswar. For check sample analysis, the samples will be tested at New Green Environmental Services Lab Ltd. (NABL accredited), Bhubaneswar. Further 20 Nos. of internal check samples are also analysed in wet chemical methods in the Departmental Laboratory of DoMG (O) which shows some positive correlation (Annexure-VI).

Another 20 samples have been analysed at MECL Laboratory, Nagpur for 34 REE elements (Method used- acid digestion followed by ICPMS) Instrument used Agilent make ICPMS Model- 7800 (Report annexed in Annexure -XIII).

Samples have been properly coded after preparation by indexing with references of the investigation area, borehole number and sample serial number and maintained in a register. The quality and appropriateness of the assaying and laboratory procedures used, and the technique are considered as total.

The Naringpanga Graphite exploration Project was conducted at G3 level. The tonnage has been estimated as an in-situ body with natural moisture content. To ensure the accuracy of analytical results, the pulp duplicate of core samples were introduced as check samples, one in nearly every 10 samples. Out of 160 primary samples, 20 samples were chosen and considered as check samples.

Chemical Analysis:

Laboratory Procedure: The chemical analysis of primary samples has been carried out in Chemical Research Laboratory Bhubaneswar for determining 8 radicals i.e Al_2O_3 , moisture, SiO_2 , FC, V.M, Ash, V_2O_5 and LOI.

Graphite Analysis:

Sample preparation: Crush and grind the sample to a fine powder.

Acid digestion: Digestion of the sample in a mixture of acids (e.g., sulfuric acid, nitric acid, and hydrofluoric acid) to break down the graphite.

Filtration: Filtration of the solution to separate the graphite from the acid-soluble impurities.

Ignition: Heating the graphite at high temperature (e.g., 1000°C) to remove volatile matter and moisture.

Gravimeter: Determination of the graphite content by weighing the residue.

The Wet Chemical Method is a traditional and reliable technique for analyzing the graphite, but it may be time-consuming and require specialized equipment and expertise.

Trace Elements Studies:

A total of 20 composite samples from graphite-mineralized zones were analysed using ICP-MS (Inductively Coupled Plasma Mass Spectrometry) at MECL laboratory. These analysis targeted minor and trace elements, covering 34 elements, including Li, Be, Sc, V, Cr, Co, Ni, Cu, U, Zn, Ga, As, Se, Rb, Sr, Y, Zr, Ge, Nb, Mo, Ag, Cd, In, Sn, Sb, Te, Cs, Ba, Hf, Ta, W, Pb, Bi, and Th at MECL Laboratory, Nagpur, the results of which are furnished in Annexure- XIII.

The ICP-MS studies show that Cr, V, Zn, Zr, Ba and Sr show good concentration. The ranges of trace elements detected are given below.

X-Ray Diffraction Studies:

A total 14 no of samples have been analysed by X-ray diffraction method at DOMG's Physical Laboratory to determine the proportions of major and minor constituents. The methodologies and results are given in Annexure-XVI(C).

The XRD studies identified the presence of the following constituent minerals: Quartz, Graphite, Biotite, Kaolinite, Orthoclase, Andesine, Almandine, Pyrite, Titanite, Montmorillonite, Sillimanite, Clinocllore, Microcline and Epidote are the constituent minerals which have been verified with the petrographic studies.

Beneficiation study

Beneficiation study has not been undertaken for Naringpanga graphite block as the exploration is at G-3 Stage.

9.6 Details of intersected ore zones of the boreholes drilled and their correlation.

Borehole core sample analysis for FC content indicates that mineralisation of graphite has been encountered at minimum inclined level of 11 m level in NPBH-4 and maximum intercepted inclined depth of interception is 75 m in BH-5. Deatailed analysis and plotting of analytical assay of FC values indicates 3 intersected zones in NPBH-1 with a minor inter calation of 80 cm between the second and third level; 3 zones in NPBH-2 with an intercalated graphite zone of 50 cm between first and second level; 3 zones in NPBH-3; 5 zones in NPBH-4; 3 zones in NPBH- 5 but the mineralisation is deep seated at an inclined depth of 60 m & 2 zones in NPBH - 6. The details are furnished in the table below.

Table No. 9.5 Depth of interception of graphite mineralisation in the boreholes.

SL.N o	FROM	TO	LENGT H	NPBH- 1	NPBH- 2	NPBH- 3	NPBH- 4	NPBH- 5	NPBH- 6
1	11.00	12.00	1.00						
2	12.00	13.00	1.00	F.C- 7.2%	F.C- 2.04%		F.C- 2.03%		
3	13.00	13.05	0.05						
4	13.05	14.00	0.95						
5	14.00	15.60	1.60						
6	15.60	16.50	0.90		F.C-				

					2.66%				
7	16.50	17.50	1.00						
8	17.50	18.00	0.50		F.C- 2.14%				
9	18.00	19.00	1.00						
10	19.00	20.00	1.00		F.C- 2.01%				
11	20.00	20.50	0.50						
12	20.50	21.00	0.50			F.C- 3.93%			
13	21.00	21.10	0.10						
14	21.10	22.00	0.90				F.C- 2.15%		
15	22.00	23.00	1.00						
16	23.00	24.00	1.00						
17	24.00	25.00	1.00						
18	25.00	26.50	1.50						
19	26.50	27.00	0.50	F.C- 3.89%	F.C- 2.30%				
20	27.00	28.00	1.00						F.C- 2.86%
21	28.00	29.00	1.00						
22	29.00	30.00	1.00						
23	30.00	31.00	1.00						
24	31.00	32.00	1.00						
25	32.00	33.00	1.00				F.C- 2.03%		
26	33.00	34.00	1.00						
27	34.00	35.00	1.00						
28	35.00	36.00	1.00						
29	36.00	37.00	1.00						
30	37.00	38.00	1.00				F.C- 4.11%		
31	38.00	39.00	1.00						
32	39.00	40.00	1.00						
33	40.00	40.50	0.50						
34	40.50	41.45	0.95						
35	41.45	42.00	0.55						
36	42.00	43.50	1.50						
37	43.50	44.30	0.80	F.C- 2.19%	F.C- 2.00%				
38	44.30	45.45	1.15						
39	45.45	46.00	0.55						
40	46.00	47.00	1.00						
41	47.00	48.00	1.00						
42	48.00	48.60	0.60						
43	48.60	49.00	0.40						
44	49.00	50.45	1.45						
45	50.45	51.20	0.75						
46	51.20	51.70	0.50		F.C- 2.15%	F.C- 2.20%			F.C- 2.4%
47	51.70	52.10	0.40						

48	52.10	53.10	1.00	F.C- 2.0%					
49	53.10	53.60	0.50						
50	53.60	54.10	0.50						
51	54.10	55.10	1.00	F.C- 2.07%	BH closed				
52	55.10	55.60	0.50						
53	55.60	56.35	0.75			F.C- 2.23%	BH closed		
54	56.35	58.30	1.95	F.C- 2.34%					
55	58.30	58.60	0.30						
56	58.60	60.00	1.40						
57	60.00	60.50	0.50						
58	60.50	61.00	0.50					F.C- 2.94%	
59	61.00	61.50	0.50						
60	61.50	62.00	0.50						
61	62.00	63.00	1.00						
62	63.00	63.30	0.30					F.C- 2.26%	BH closed
63	63.30	64.00	0.70						
64	64.00	65.00	1.00						
65	65.00	66.00	1.00						
66	66.00	67.00	1.00						
67	67.00	68.00	1.00						
68	68.00	69.50	1.50	F.C- 3.09%					
69	69.50	70.00	0.50	BH closed					
70	70.00	71.00	1.00						
71	71.00	72.00	1.00						
72	72.00	73.50	1.50						
73	73.50	74.50	1.00			BH closed		F.C- 2.35%	
74	74.50	75.00	0.50						
75	75.00	78.80	3.80					BH closed	

Note: - Values are rounded off as per convention.

9.7 Depth of the Ground Water Condition

Groundwater was encountered between 10.6 m and 12.7 m vertical depth across the inclined boreholes (drilled at 45°), indicating a moderately shallow to moderately deep water table. This variation is governed by the area's lithology, predominantly khondalite and quartzo-feldspathic

gneiss, which exhibit variable degrees of weathering and fracturing. These hydrogeological conditions significantly affect drilling operations, particularly in terms of core recovery issues in graphitic zones, drilling fluid losses, and borehole instability in sheared sections. Such factors should be carefully considered in future exploration programs, drilling strategies, and mine planning.

CHAPTER-10

10.1 Bulk density

Bulk density is a critical parameter in the estimation of mineral resources, influencing both the tonnage calculations and the subsequent economic evaluation of mineral commodities. To assess the bulk density of graphite ore in the study area, five representative samples exhibiting varying physical characteristics were collected and analysed.

The analyses were conducted at *New Green Environmental Labs Pvt. Ltd.*, Bhubaneswar, (NABL Accredited)(Annexure - XVIII) following the guidelines prescribed in IS: 5842-1986 (Reaffirmed 2008). The bulk density of graphite ore of different grades varies between 1.48 and 1.70, with an average bulk density of 1.606.

CHAPTER-11

RESOURCE ESTIMATION

11. 1 Detailed description of ore zones

The Naringpanga block hosts graphite zones that vary in size, with consistent lateral and vertical grade continuity. Given the area's qualitative and quantitative graphite potential, an estimation of the resource and grade has been attempted by integrating the average values through the cross-sectional area method and LV panel area method. The chemical analysis of the samples reveals that most exhibit an FC content ranging from 2% to 10.03%. Grades were determined based on this range, with samples containing less than the threshold FC being classified as altered varieties and excluded from the grade calculations. Only samples with an FC content of $\pm 2\%$ or higher were considered for grade determination. The disseminated graphite bands occur either regular lenses, streaks or pockets in conformity to the S2 and F3 foliation. Graphite has been encountered at minimum inclined level of 11 m level in NPBH-4 and maximum intercepted inclined depth of interception is 75 m in BH-5. Detailed analysis and plotting of analytical assay of FC values indicates 3 intersected zones in NPBH-1 with a minor intercalation of 80 cm between the second and third level; 3 zones in NPBH-2 with an intercalated graphite zone of 50 cm between first and second level; 3 zones in NPBH-3; 5 zones in NPBH-4; 3 zones in NPBH- 5 but the mineralisation is deep seated at an inclined depth of 60 m & 2 zones in NPBH - 6.

The resource estimation extends up to a maximum vertical depth of 55.72 meters from the ground profile, corresponding to an elevation of 270.0 m RL. The assessment has been conducted using the cross-sectional area method, which involves integrating the areas of delineated ore zones across cross-sections. To ensure realistic resource estimation, a 70% recovery factor has been applied. This factor accounts for the presence of intercalated waste material, potential voids within the ore body, sampling errors, and other geological uncertainties. These considerations ensure that the estimate is robust and reflective of the actual recoverable graphite.

Characteristics of High-Silica Graphite Ore:

The graphite in the Naringpanga Block is characterized as low-grade and high-silica ore, with silica (SiO₂) as a significant impurity. The elevated silica content presents challenges for processing and beneficiation, particularly in applications requiring high-purity graphite. Such ore types demand advanced techniques to separate silica and enhance the Fixed Carbon content, which is crucial for industrial applications like refractories, batteries, and lubricants.

11.2 Cut-off grade and minimum stoping width consideration

To classify the graphite into appropriate grades, the threshold limits and specifications provided by the IBM in Circular No. C-284/3/CMG/2017 were adhered. As per these guidelines, graphite from the Naringpanga block has been categorized as low grade, FC (2-5%). The ore zones less than 15 cm are not taken into account during sampling and hence not considered in estimation. However, the partings of 20 to 30 cm within the ore zones are taken into account during sampling and resource estimation.

According to IBM vide Circular No. C-284/3/CMG/2017

Sl. No.	MINERAL	THRESHOLD VALUE
1.	Graphite	(i) For flaky variety- 2% Fixed Carbon (F.C) (Min.) (ii) For amorphous variety - 10% Fixed Carbon (F.C) (Min.)

“**Threshold value of minerals**” will have meaning as defined in Minerals (Evidence of Mineral Contents) Rule, 2015.

“**Cut-off grade**” means the minimum economic assay grade of the mineral for a deposit below which the mining operations become unviable in the present market dynamics or end use quality. It may vary from deposit to deposit depending upon the market conditions.

The significantly thick weathered quartzo-feldspathic gneiss, weathered khondalite altered to kaolinite, and weathered brecciated zones encountered in boreholes have not been included in the resource estimation. Graphite bearing gneisses, with respect to the grade (FC 2-5%), were used to identify ore horizons and assess vertical and lateral continuity.

Graphite in Naringpanga is of flaky variety and resource estimation is done with respect to the threshold values.

11.3 Description and correlation of lodes

The mineral resource has been explored at the G3 level of the MEMC Rule, 2015, ensuring a better confidence level. The tonnage has been estimated as an in-situ body. Boreholes that intersected altered and weathered quartzo-feldspathic gneiss and barren khondalites were excluded from resource estimation but considered in delineating mineralized zones with appreciable graphite content. Out of the six boreholes drilled, all were found positive, and their data were fully utilized for evaluating the resource and grade of graphite ores.

To estimate the graphite resources in the Naringpanga block, one surface method was applied for Pit-2 and five cross-sections were constructed perpendicular to the general foliation trend of the country rocks at a 1:2000 scale, providing a detailed representation of smaller graphite bands. These cross-sections, designated as A–A', B–B', C–C', D–D', and E–E' (Annexure-X), were positioned at irregular intervals, guided by anomalous SP zones and observed surface exposures (Plate-II). The assay logs of six positive boreholes (BHs), along with their physical characteristics and intercepted lithologies, were plotted to establish sectional correlations. These correlations, with respect to the grade (FC 2-5%), were used to identify ore horizons and assess vertical continuity. The geometry of the graphite bodies is predominantly concordant with the host lithologies, namely quartzo-feldspathic gneiss and migmatized Khondalite. Altered khondalite, Void spaces, and weathered Quartzo-feldspathic gneiss areas were excluded from the cross-sectional area computation. The ore zones encountered in the bore holes were extrapolated on either side proportionately in compliance to the length of influence prescribed in M (EMC) Rules. The ore zones are joined as per core angle geometry and structural signatures recorded in the recovered litho cores.

11.4 Preparation of LV section and Level plan

The resources of graphite in the explored strike length of the block have been calculated by the LV panel method. The strike influence of the ore zone was taken at 50 % of the spacing between two positive bore holes and 25 %, when the adjacent bore hole is

negative or if there is neither any borehole nor any surface evidence to substantiate the physical continuity of the ore zone. The third level borehole was generally drilled at more or less 200.0 m strike interval to check the depth persistence of the mineralization. When there is no borehole on the either side of a borehole the strike influence was extended to 50.0 m on either side considering the positive intersection of the shallower boreholes on the either side of the borehole. The RL of Lode intersection along with up dip and down dip RL for the respective lodes taken from the cross section, and were plotted on a Longitudinal- Vertical section on 1:1000 scale. The length of the panel of lodes of a borehole was prepared based on the strike influence as discussed above whereas the breadth of the panel was constructed based on the up dip and down dip RL of the respective lodes. The dip influence of the ore zone was taken at 50 % of the difference in the centre of intersection of the ore body at two positive levels of two boreholes along the same profile line, however, this was not strictly followed when there is a variation of thickness along different levels and rule of gradual change was applied. If there is a single borehole along a profile, the dip length was extended only up to 1/4th of the intersection considering the surface profile. These parameters were not followed, if the dip influence is falling within the zone itself, and the dip length was simply extended up to the bottom RL of the intersected ore zone.

11.5 Specific Gravity/Bulk density calculation:

In order to estimate the resource of different grades of graphite associated with migmatized khondalite and quartzo-feldspathic gneiss, 5 samples have been subjected to physical analysis in a NABL Laboratory. The range of BD varies between 1.48 and 1.70, with an average bulk density of 1.606. This range corresponds to variations in the physical grades of the ore, reflective of their mineralogical and compositional differences. The detailed bulk density results are given below. (Annexure- XVIII)

Table 11.1: Bulk density result of the Block

Name of the Block	Sample mark	Test Result in kg/ltr	Average Bulk density
Naringpanga Graphite Block	NBD1	1.62	1.606
	NBD2	1.63	
	NBD3	1.70	
	NBD4	1.48	
	NBD5	1.60	

11.6 Assumption for Resource Estimation

Parameters Considered for Resource Computation:

- a. **Depth Level:** Resource has been estimated up to a depth level of 270.00 mRL (as the highest borehole drilled was 78.80 m, corresponding to a vertical depth of 55.72 m) to 335.52 mRL. The up dip and & down dip is taken at 50m on either side w.r.t the thickness of ore band/zone
- b. **Grade Selection:** For resource calculation, graphite samples with $\geq 2\%$ FC were considered for grade estimation, adhering to the threshold limits prescribed by IBM.
- c. **Recovery Factor:** In the absence of beneficiation studies and time-series production data for the Taken over Lease, and the parameters of estimations in the adjacent auctioned block, an average recovery factor of 70% was assumed for graphite. This accounts for its distinct localization with sharp to gradational contacts, sampling errors, altered/weathered zones, geo-scientific factors, miniature silica veinlets, and thin host rock intercalations.
- d. **Bulk Density:** The average bulk density for graphite in the block was calculated as 1.606, derived from five representative graphite samples of different grades.
- e. **Length of Influence:** The halfway distance between two consecutive section lines was taken as the length of influence for resource estimation, with actual measurements used for peripheral section lines. In case of isolated BHs, an influence of 25-50 m was considered keeping in view the thickness of ore zone.
- f. **Thin Intercalations and Sub-Grade Ore:** In cases of thin intercalations and/or sub-grade ore within a high-grade/sub-grade ore band, the average assay value of the entire similar-quality ore zone in the borehole was used for consolidated grade correlation.

11.7: Resource Estimation

11.7.1 Resource estimation by Cross Sectional Area method:

The volume of the ore body was calculated using the cross-sectional area of each section and its respective length of influence. The length of influence for each section was

determined based on the proximity to the block boundary and the spacing between adjacent sections. For **Section A-A'**, the length of influence was 17.5 m on one side and 21.5 m on the other. Similarly, for **Section B-B'**, the lengths of influence were 21.5 m on one side and 63.5 m on the other. Moving to **Section C-C'**, the lengths of influence were calculated as 63.5 m on one side and 18.5 m on the other. For **Section D-D'**, the corresponding lengths were 18.5 m and 47.5 m, respectively. In the case of **Section E-E'**, the lengths of influence were measured as 48.0 m on one side and 50.0 m on the other. In addition to the cross-sectional analysis, **Pit-2** was considered separately, with a uniform length of influence of 25.0 m on either side. The total volume for each section was then obtained by multiplying its cross-sectional area by the sum of its respective lengths of influence. The lithological units in the cross-sections were extrapolated laterally, proportionate to the thicknesses observed in the boreholes.

The resource estimation has been done by the following formula.

$$\text{Resource (R)} = V (\text{Cross Sectional Area} \times \text{Length of Influence}) \times \text{BD} \times \text{RF}$$

Where R= Resource in mt, V = volume in M³,

BD= Bulk density (Determined), RF= Recovery factor 70% (Assumed)

Table 11.2: Section wise resource Calculation of Naringpanga (S) Graphite Block, Rayagada District. (A)

Ore category	Section area(m ²)	Length of influence(m)	Volume(m ³)	Recovery Factor (%)	Bulk density	Resource(t)
	A-A'					
FC (2-5%)	2172.95	38	82572.1	70	1.606	92827.55
	B-B'					
FC (2-5%)	560.25	85	47621.25	70	1.606	53535.81
	C-C'					
FC (2-5%)	1211.37	82	99332.34	70	1.606	111669.40
	D-D'					
FC (2-5%)	1212.81	66	80045.46	70	1.606	89987.11
	E-E'					
FC (2-5%)	586.05	98	57432.9	70	1.606	64566.07
			367004.05	Total (A)		412585.95

During excavation, graphite incidences have been encountered in Pit-2 for about 30 cm in

the pit floor. So an influence of about 25 m was taken on all sides of the pit to calculate the inferred resource by surface area method.

Resource calculation by Surface area method for the panel around pit-2. (B)

Ore category	Surface area(m ²)	Thickness(m)	Volume(m ³)	Recovery Factor (%)	Bulk density	Resource(t)
FC (2-5%)	2500	0.3	750	70	1.606	843.15
Total resource of the Block (In metric tonnes): (A+B) in Metric Tonnes						413429
Total resource of the Block (In Million tonnes) in mt						0.41343

Thus, geological resource estimation (G3) has been carried out for the Naringpanga block to evaluate the graphite resources. The estimation reveals a net geological resource of **0.41343** million tonnes of graphite of inferred category. This calculation accounts for the recoverable quantity after considering various limiting factors.

11.7.2 Resource estimation by Longitudinal-Vertical Panel method

The resources of graphite in the explored block have also been estimated by the Longitudinal-Vertical section method for better confidence level. The LV panel method is discussed as follows.

(i) Strike influence:

The strike influence of the ore zone was taken at 50 % of the spacing between two positive bore holes and 25 %, when the adjacent bore hole is negative or if there is neither any borehole nor any surface evidence to substantiate the physical continuity of the ore zone. The third level borehole was generally drilled at more or less 200.0 m strike interval to check the depth persistence of the mineralization. When there is no borehole on either side of a borehole the strike influence was extended to 50.0 m on either side considering the positive intersection of the shallower boreholes on the either side of the borehole.

(ii) Dip influence:

The dip influence of the ore zone was taken at 50 % of the difference in the centre

of intersection of the ore body at two positive levels of two boreholes along the same profile line, however, this was not strictly followed when there is a variation of thickness along different levels and rule of gradual change was applied. If there is a single borehole along a profile, the dip length was extended only up to 1/4th of the intersection considering the surface profile. These parameters were not followed, if the dip influence is falling within the zone itself, and the dip length was simply extended up to the bottom RL of the intersected ore zone. When there is a single 1st level borehole in between two 1st and 2nd level boreholes the dip length for the 1st level boreholes was extended to a RL which is average between the two. The down dip length of the 1st level boreholes become the up dip length of the 2nd level boreholes on the either side of the 1st level. This was done in order to avoid overlapping of resources.

(iii) Preparation of Panel and calculation of Panel area:

The RL of Lode intersection along with up dip and down dip RL for the respective lodes taken from the cross section, was plotted on a Longitudinal- vertical section on an mm square graph sheet on 1:1000 scale. The length of the panel of lodes of a borehole was prepared based on the strike influence as discussed above whereas the breadth of the panel was constructed based on the up dip and down dip RL of the respective lodes. The panel area was calculated and multiplied with the horizontal width to get the volume of the ore lode of the borehole. The up dip RL of the 1st level boreholes have been kept at 290.0 mRL. The down dip RL of the 1st level boreholes is the up dip RL of the 2nd level boreholes. The horizontal width of the respective lodes was calculated by using the formula $HW = TW / \sin \text{ of Ore dip}$. The following formulae is used for resource estimation:

$$\text{Tonnage} = \text{Panel Area} \times \text{Horizontal width} \times \text{Tonnage factor (Bulk density)}$$

Panel wise ore resources as computed are shown in the table (11.3)

Table 11.3: Graphite Resource Estimation by LV Panel Method (2% Cut-off Grade).

SL .N O	BH s. No	Lod e No	From (m)	To (m)	CI (β)	Sin(β)	App. Widt h(m)	T.W	Lode Top RL(m)	Lode Bottom RL(m)	Up dip RL (m)	Down Dip RL(m)	Ind_ Area	Σ(ind_ A rea)	V(total)	AREA OF LVP	Σ(Ov erlap _Are a)	T.W (overl ap)	V(ove rlap)	Vpanel	BD	Resource in tonnes
1	NP BH -1	1	12.00	14.0 0	55	0.82	2.00	1.64	322.91	321.54	327.10	320.40	495.4 1	6909.58	82574.25	3910.5 9	2998. 99	11.95	35840 .00	46734. 25	1.60 6	75055.21
2		2	21.00	34.0 0	65	0.91	13.0 0	11.7 8	316.55	307.36	327.10	304.76	1653. 11									
3		3	43.50	44.3 0	65	0.91	0.80	0.73	300.64	300.07	309.49	298.00	850.4 7									
4		4	52.10	69.5 0	65	0.91	17.4 0	15.7 7	294.55	282.26	327.10	274.25	3910. 59									
5	NP BH -2	1	12.00	13.0 0	70	0.94	1.00	0.94	324.65	323.83	330.20	322.42	778.5 9	10122.42	26096.12	4311.6 2	5810. 80	2.58	14980 .5451	11115. 58	1.60 6	17851.61
6		2	15.60	20.5 0	70	0.94	4.90	4.60	322.00	318.53	330.20	316.49	1792. 65									
7		3	26.50	27.0 0	70	0.94	0.50	0.47	314.29	313.93	324.65	311.37	1328. 57									
8		4	41.45	45.4 5	70	0.94	4.00	3.76	303.72	300.89	329.65	294.14	3551. 19									
9		5	50.45	51.7 0	70	0.94	1.25	1.17	297.35	296.47	318.01	291.30	2671. 42									
10	NP BH -3	1	20.50	21.1 0	55	0.82	0.60	0.49	316.51	316.08	328.01	313.33	1894. 92	9089.77	158799.59	7194.0 7	1895. 70	17.47	33118 .1339 1	125681 .45	1.60 6	201844.41
11		2	48.60	71.9 5	70	0.94	23.3 5	21.9 4	296.71	280.13	328.01	272.29	7194. 86									
12	NP BH -4	1	11.00	13.0 5	65	0.91	2.05	1.86	327.83	326.37	331.42	325.49	592.7 1	5794.12	55364.80	3622.5 7	2171. 55	9.56	20749 .8770 3	34614. 93	1.60 6	55591.57
13		2	21.00	23.0 0	55	0.82	2.00	1.64	320.76	319.34	331.42	315.63	1711. 35									
14		3	31.00	49.0 0	55	0.82	18.0 0	14.7 4	313.68	300.95	331.42	296.52	3490. 05									
15	NP BH -5	1	60.50	66.0 0	65	0.91	5.50	4.98	287.15	283.26	304.34	279.01	2503. 87	4192.21	14555.53	3029.8 2	1162. 39	3.47	4035. 86811 6	10519. 67	1.60 6	16894.58
16		2	73.50	75.0 0	55	0.82	1.50	1.23	277.96	276.89	290.77	273.69	1688. 34									
17	NP BH -6	1	25.00	31.0 0	65	0.91	6.00	5.44	316.54	312.30	331.54	308.58	2509. 22	4269.41	14442.37	3940.5 5	328.8 6	3.38	1112. 43933	13329. 93	1.60 6	21407.86
18		2	51.20	51.7 0	65	0.91	0.50	0.45	298.01	297.66	311.87	294.27	1760. 19									
																		Total Resource in Metric Tonnes(t):			388645.25	
																		Total Resource in Million Tonnes (mt):			0.388645255	

A comparison of the resources estimated using the LV panel method and the cross-sectional area method reveals a difference of 0.0244 million tonnes which may be attributed to inhomogeneity of graphite mineralisation. In the present estimate, the cross sectional area method is accepted without any bias.

Cross checking has been done by the L-V panel method & the resource & grade has been compared.

11.8: Grade Estimation:

The average grade of graphite in the Naringpanga Block has been determined by analyzing all 160 core samples, of which 71 samples yielded positive analysis results ($\geq 2\%$). These samples were selected due to their high graphite purity. The grade estimation process involves multiple steps to ensure accuracy and reliability.

Initially, the weighted average of key chemical constituents viz: including Alumina, M, SiO₂, Ash, Fixed Carbon (FC), and Loss on Ignition (L.O.I) was calculated for each core sample. This was achieved by multiplying the sample length by the percentage of each constituent within the sample.

Subsequently, the average grade for each borehole was computed using the weighted averages of all samples from the borehole. To extrapolate these results across the deposit, the average grade of each cross-section was calculated by weighing the borehole averages of all boreholes situated within that cross-section against the corresponding cross-sectional area.

Finally, the block-wise weighted average grade was determined by integrating the average grades from all cross-sections. This approach ensures that the grade estimation reflects the geological variability and distribution of graphite within the block.

Based on the content of Fixed Carbon (FC), the graphite in this block has been categorized into a single grade that is graphite with FC range of 2–5%.

The summation of the tonnage for all the section lines for each ore type indicates the total tonnage of the entire block. The average grade for that tonnage is calculated initially by calculating the weighted average grade for individual borehole and again for total number of boreholes falling in a particular cross section, then the average grade for the total tonnage of the block is obtained by calculating the weighted average grade of all sections to represent

the grade of graphite. The final resource has been calculated separately and represented under a single grade, namely F.C. (2-5%), for this block.

- i. In similar fashion, average grade of that particular ore type is to be calculated for other boreholes lying in the same cross section.
- ii. Thus, weighted average for a particular grade strip lying in the same cross section, $G_w = (G_1T_1 + G_2T_2 + \dots + G_nT_n) / (T_1 + T_2 + \dots + T_n)$; where, G_1 -Average grade of a borehole lying in a cross section, T_1 -Total thickness of the corresponding borehole.
- iii. Then the tonnage is calculated by multiplying the strike influence w.r.t. the cross-sectional area of strip and bulk density. i.e., Tonnage or mass, $M = A \cdot S \cdot d$; where, A - cross sectional area of a particular strip, S - strike influence of the corresponding strip, and d -bulk density.
- iv. Now the weighted average grade for the whole block of a particular ore type, $G_a = (G_{w1} \cdot M_1 + G_{w2} \cdot M_2 + \dots + G_{wn} \cdot M_n) / (M_1 + M_2 + \dots + M_n)$; where G_{w1} = weighted average grade of an individual cross section strip, M_1 - Tonnage or mass of the respective strip of that section.
- v. The lateral extension has been considered for resource assessment to a maximum influence of 50% of grid spacing of the probe point depending on geological considerations supplemented by geological continuity by mapping.

Section wise grade calculation of different categories of graphite of Naringpanga Block is furnished below:

Table 11.4: Section wise Graphite average FC content

Section wise Graphite grade average								
	Borehole	Average (%)						
		M	Al₂O₃	SiO₂	Ash	LOI	F.C	F.C weighted avg.
Section-AA'	NPBH-1	1.81	11.06	67.74	89.35	8.41	3.7	3.21
	Section average	1.81	11.06	67.74	89.35	8.41	3.7	3.21
Section-B-B'	NPBH -2	1.32	13.31	67.8	95.87	7.76	2.21	2.19
	Section average	1.32	13.31	67.8	95.87	7.76	2.21	2.19
Section-C-C'	NPBH -4	1.51	8.93	71.37	92.02	10.40	4.58	3.34
	Section average	1.51	8.93	71.37	92.02	10.40	4.58	3.34
Section-D-D'	NPBH -3	1.18	14.77	62.21	90.00	7.08	2.35	2.27
	Section average	1.18	14.77	62.21	90.00	7.08	2.35	2.27
Section-E-E'	NPBH -5	1.19	12.08	60.12	84.87	6.04	2.20	2.52
	NPBH -6	4.42	16.48	68.12	95.20	12.49	3.01	2.63
	Section average	14.28	64.12	90.04	9.26	2.60	2.80	2.57
Graphite Average of PIT-2								
		M	Al₂O₃	SiO₂	Ash	LOI	F.C	F.C weighted avg.
PIT-2	Average	1.96	19.44	50.20	87.40	12.60	2.82	2.82

Resource and Grade

Table 11.5: Summary of Resource Calculation of Naringpanga Block

Cross Section method(A)	Graphite in metric tonnes (t)
A-A'	92827.55
B-B'	53535.81
C-C'	111669.40
D-D'	89987.11
E-E'	64566.07
Total (A)	412585.95
Surface area method(B)	
PIT-2	843.15
Grand Total Resource in Metric Tonnes(t): (A+B)	413429.1
Grand Total Resource in Million Tonnes (mt)	0.41343

Table 11.6 : Average Grade & Resource of graphite of Naringpanga block

Ore	Resource in (t)	Average Grade
Graphite F.C (2-5%)	0.41343	3.01%

So, the total estimated resource of graphite across all grades in the Naringpanga Block is **0.41343** million tonnes, with an average grade of 3.01% Fixed Carbon (FC). This estimation reflects the block's graphite resource potential, with variations in quantity and quality observed across different sections. The resource distribution highlights that section C-C' holds the maximum resource of 111669.40 t, indicating a concentration of graphite mineralization in this area. In contrast, Pit-2 has the minimum resource of 843.15 t, reflecting limited graphite occurrence in this part of the block.

Overburden:

Overburden has been calculated from the cross-sections. The overburdens comprise khondalite, quartzite, felspathic gneiss, soil and alluvium. The thickness of overburden varies from 3.70 m to 24.00 m. Ore overburden ratio calculated is 1:0.546.

Implications for Resource Utilization:

The low-grade, high-silica nature of the ore limits its direct industrial utility, necessitating cost-intensive processing methods. Moreover, silica-rich ores can pose environmental concerns, as mining and beneficiation may result in tailings disposal issues and potential pollution from silica and other associated impurities infiltrating the local ecosystem.

Efforts to sustainably utilize the resources from the Naringpanga Block must focus on improving beneficiation techniques, optimizing resource recovery, and mitigating environmental impacts. By addressing these challenges, the potential of graphite resources in the block can be maximized for industrial and commercial purposes.

11. 9 Category of resources as per MEMC, 2015 along with UNFC classification

The exploration over the Naringpanga block was carried out as per Part III of MEMC and resource has been reported as per Part-IV A of MEMC rules, 2015.

Economic axis (E): The quantity of Graphite in tonnes with average grade has been estimated by preliminary Exploration. The resource identified is of intrinsically economic (E3) interest and economic viability of the resource is to be further ascertained through a pre-feasibility study by application of appropriate modifying factors. Therefore, the feasibility stage can be **of E3 category**.

Feasibility Axis (F): A preliminary and general geological study involving delineation of lithological units, mineralogical and chemical data and its interpretation and assessment of mineral resource with quantity and grade have been undertaken during the exploration. The data related to topographical setting, nature of land and infrastructure roads, railways, electricity, water etc. have been acquired. The mineralization was defined based on the IBM's threshold value of graphite. No feasibility studies, encompassing mining, Environmental Impact Assessment (EIA), infrastructures, costing of mining, investment decision of the deposit were worked out. Therefore, the feasibility stage can be **of F3 category**. Hence, the block is covered under F3 coding in the Feasibility Axis.

Geological axis (G): General exploration was conducted in Naringpanga block following the exploration norms and technological inputs comprising surface geological mapping and

topographical survey at 1:2000 scales, geophysical prospecting, core drilling at located BH points, systematic core sampling at 1m interval, chemical analysis, petrographic and mineralogical studies etc., Trace element analysis to decipher the extent of mineralization and to evaluate mineral quantity and quality. Hence the geological axis is in compliance to **the G3 level** of exploration.

The estimated mineral resource has been assigned as inferred mineral resource (333) of as per Mineral (Evidence and Mineral Content) Rules 2015 & (Amendment) 2021.

CHAPTER-12

CORE PRESERVATION

G-3 level of exploration in Naringpanga Graphite block achieved a drilling meterage of 398 m in six inclined boreholes. The recovered cores are preserved in GI core boxes with partitions. All core boxes are properly leveled with BH No., Length of cores preserved with an arrow mark from top to bottom. (Fig. 32)



Fig. 32: Preservation of drilled cores in GI Core box

Thus, all the litho cores are systematically preserved in 83 GI core boxes of 3m x 1m size with inner partitions. All the core boxes are now available in the Zonal Office, the Directorate at Koraput. Details of the core boxes are given in Table 12.1.

Table: 12.1:- Deatails of Cores and core boxes preserved

Sl No	BH No	Used No of Core Boxes	Total Cores (in m)	Core box dimension (L X W)
1	NPBH-1	14	70.00m	1.00 m X 0.30m
2	NPBH-2	12	55.00m	1.00 m X 0.30m
3	NPBH-3	16	74.50m	1.00 m X 0.30m
4	NPBH-4	12	56.50m	1.00 m X 0.30m
5	NPBH-5	16	78.80m	1.00 m X 0.30m
6	NPBH-6	13	63.20m	1.00 m X 0.30m
	Total	83	398.00 m	

CHAPTER-13

CONCLUSION AND RECOMENDATIONS

Conclusion:

The Naringpanga graphite block, featured T.S. No. E44F10 (65 M/10), has been covered at G3-level exploration over an area of 0.143 sq. km with approval of NMET through topographic survey, detailed geological mapping, limited pitting & trenching at 4 locations, self-potential geophysical survey, drilling of six angle boreholes and sampling of cores followed by laboratory analysis. Detailed geological mapping of the area on 1:2000 scale, revealed that the area is mostly soil covered and graphite bearing gneisses & schists are exposed only in the Nala bed flowing in the western margin of the block.

The Naringpanga area lies within the Eastern Ghats Mobile Belt, a region known for its complex geological and tectono-metamorphic history. The lithological framework comprises migmatized khondalite, quartzo-feldspathic gneiss, leptynite, and mylonite, which host the graphite mineralization. The mineralization is litho-structurally controlled, occurring along the foliation planes of the host rocks as well as in conformity to the sympathetic lineaments of the Tumudibandha major shear. Secondary silicification, mylonitisations, dragging of foliations, slickensides and quartz overgrowths further highlight the complex post-metamorphic history of the area. The occurrence of secondary graphite enrichments and associated mineral assemblages' points to multi-phase deformations & mineralization events.

Surface geophysical investigations, Self-Potential (SP) surveys, detected distinct negative anomalies ranging from -0.04 mV to -154.6 mV. These anomalies correlate with areas of high graphite potential, particularly in the central and eastern parts of the block, which align with the regional NW-SE trend of the geological formations. Drilling of six inclined boreholes totaling 398 meters and trial excavations in 4 locations with interception of graphite in two trial pits provided critical insights into the block's geological and mineralogical characteristics. The investigations revealed 84.60 meters of mineralized zones, with an average thickness of 14.05 meters. Notably, the shallowest borehole (NPBH-2) intersected 9.65 meters of graphite mineralization, while the deepest (NPBH-5) revealed 5.5 meters, confirming the presence of amorphous graphite as fine-grained, flaky disseminations. The fixed carbon content in the mineralized zones ranged between 2% and 10.03%, establishing the deposit's potential for commercial exploitation.

Mineralogical assemblages revealed retrograde metamorphic features indicative of granulite facies metamorphism followed by retrogression. Observations included biotite growth along garnet fractures, feldspar saussuritization, and the development of secondary minerals like pyrite, epidote, and garnet. These features point to a dynamic tectono-metamorphic environment marked by partial melting, recrystallization, and fluid activity. Such processes have significantly influenced the distribution and concentration of graphite within the host rocks. Geochemical analysis further enriched the understanding of the area's mineralization. The mineralization occurs as bands, pockets, and disseminations within the host rock, lying beneath a thick alluvial cover. Structural complexities such as mylonitization and foliation patterns have played a significant role in localizing the graphite mineralization, with variability in thickness and grade observed across the boreholes. This heterogeneity underscores the need for targeted exploration at a finer scale to delineate the mineralization more accurately. The study revealed rare earth element (REE) enrichment, with higher concentrations of light REEs (LREEs) such as cerium and lanthanum, alongside trace elements like vanadium, strontium, zirconium, and rubidium. These geochemical signatures reflect the effects of partial melting and recrystallization associated with the tectonic and metamorphic processes in the region. The presence of rare metals, including hafnium and tantalum, as well as uranium and thorium, are of concern and their potentialities can be ascertained after beneficiation during higher stages of exploration.

The estimated geological resource of the block by cross sectional methods is about 0.403 million tonnes with average fixed carbon content of 3.01%, which is of inferred category

Based on the findings, the Naringpanga graphite ore block demonstrates substantial potential for commercial graphite extraction, subject to further refinement through G2-level exploration. This next phase of exploration will involve more detailed geological, geophysical, and geochemical studies, as well as additional drilling to confirm the continuity and grade of the mineralization. It will also facilitate the preparation of a comprehensive mining plan that aligns with sustainable practices and economic viability.

The current exploration activities in the block reveals that out of the total block area of 14.3 Ha (0.143 Sq.Km), 0.078 sq. km is identified as mineralized, while the remaining 0.065 sq. km consists of non-mineralized zones at the peripheral areas of the block. These non-mineralized regions offer potential for mining infrastructure and other developmental

activities, including facilities for ore processing, waste management, and ancillary activities. Proper utilization of these areas can significantly enhance the operational efficiency and economic feasibility of mining in the region. The resource thus estimated can be classified under UNFC 333 and MEMC 2015& 2021.

Recommendations:

The geological investigation of the Naringpanga graphite block has successfully identified a promising graphite resource within the Eastern Ghats Mobile Belt. The integrated geological, geophysical, and geochemical studies offer a clear understanding of the deposit's characteristics and potential. These findings emphasize the need for advanced exploration to fully realize the resource's potential, ensuring sustainable and viable extraction. The study underscores Naringpanga's potentiality and it is recommended to upgrade the resource and grade estimation upto G 2 level for higher confidence level.

CHAPTER-14

EXPENDITURE

The Naringpanga graphite Project was approved in the 27th EC of NMET with an estimated cost of Rs 120.93 lakhs. The expenditure incurred by the Department so far is ₹61,78,802/- , which doesnot include the Salary components of the Officials engaged in the execution of the Project and In-house laboratory Charges. The Drilling, Topographic Survey and geo-physical survey components have been Out-Sourced.

The details of expenditure incurred are furnished below:-

Total approved cost: **RS 1,20,92,849 /-**

Total amount received: **Rs 96,74,280/-**

Total Expenditure of Naringapanga Graphite Project, Rayagada Dist

In house expenses	
Field expenses	₹6,34,161/-
Laboratory expenses	₹3,05,839/-
The outsourcing agency, M/s Geo Environmental Services has been paid against the Topographical Survey Work	₹2,01,780/-
	₹44,85,062/-
Against the Drilling of 06 no's of Bore Holes	
Against the Geo Physical Work	₹5,56,960 /-
Total amount against the outsourcing agency	₹52,43,802/-
Total expenditure	₹61,78,802/-

CHAPTER-15

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CHAPTER-16

LOCALITY INDEX

Sl. No.	Name of the Village	Latitude	Longitude
1	Naringpanga	19°43'26.33"N	83°32'46.68"E
2	Solagudi	19°43'51.64"N	83°32'01.63"E
3	Kalupadar	19°42'10.55"N	83°32'09.67"E
4	Muniguda	19°35'21.47"N	83°30'25.88"E
5	Sano Mudra	19°43'00.32" N	83°34' 15.00"E
6	Jagdapur	19°45'49.30"N	83°32'56.30"E
7	Kumdabali	19°40'06.08" N	83°32'10.56" E

ABBREVIATIONS USED

SL. No.	Abbreviation	Full form
1	m	Meter
2	Cu m	Cubic Meter
3	mt	Million Tonnes
4	t	Metric tonne
5	RL	Reduced Level
6	mRL	Meter Reduced Level
7	MSL	Mean Sea Level
8	UNFC	United Nations Frame work Classification
9	IBM	Indian Bureau of Mines
10	GSI	Geological Survey of India
11	BF	Blast Furnace
12	NMET	National Mineral Exploration Trust
13	TCC	Technical cum Cost Committee
14	EC	Executive Committee
15	MMDR	Mines & Minerals (Development and Regulation)
16	MEMC	Minerals (Evidence of Mineral Contents)
17	DoMG	Directorate of Mines and Geology, Odisha
18	NABL	National Accreditation Board for Testing and Calibration Laboratories
19	MECL	Mineral Exploration and Consultancy Limited
20	QA/QC	Quality Assessment/Quality Checks
21	WGS-84	World Geodetic System-84
22	DMS	Degree Minute Second
23	UTM	Universal Transverse Mercator
24	F.S.P.	Field Season Programme
25	DGPS	Differential Global Positioning System
26	GPS	Global Positioning System
27	T.S. No.	Toposheet Number
28	ppm	Parts per million
29	F.C.	Fixed Carbon
30	ML	Mining Lease
31	TSO	Technical Supervising officer
32	SP	Self-Potential
33	BRS	Bed Rock Sample
34	LOI	Loss of Ignition
35	EGMB	Eastern Ghats Mobile Belt
36	XRF	X-ray Fluorescence
37	XRD	X-ray Diffraction
38	ICP-MS	Inductively Coupled Plasma Mass Spectrometry
39	E.I.C	Exploration In-Charge
40	BHs.	Bore holes

41	ORG	Ocean Ridge Granites
42	VAG	Volcanic Arc Granites
43	WPG	Within-Plate Granites
44	COLG	Collision Granites
45	TC	Tungsten Carbide
46	RM	Rare Metal
47	HREE	Heavy Rare Earth Element
48	LREE	Light Rare Earth Element
49	REE	Rare Earth Element

ANNEXURE-I
LOCALITY INDEX

Sl. No.	Name of the Village	Latitude	Longitude
1	Naringpanga	19°43'26.33"N	83°32'46.68"E
2	Solagudi	19°43'51.64"N	83°32'01.63"E
3	Kalupadar	19°42'10.55"N	83°32'09.67"E
4	Muniguda	19°35'21.47"N	83°30'25.88"E
5	Sano Mudra	19°43'00.32" N	83°34' 15.00"E
6	Jagdapur	19°45'49.30"N	83°32'56.30"E
7	Kumdabali	19°40'06.08" N	83°32'10.56" E

ANNEXURE -II

Physical & Chemical Assay log of NPBH-1 (Naringpanga Graphite Block)

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24													
Bore Hole No-	NPBH-1						Date of Commencement					13.07.2024	
Location(DGPS)	767689.2503			2183040.786			Date of Completion					30.07.2024	
(DMS)	83°33'14.31000" E			19°43'29.21880" N			Total Graphite Thickness					24.55 m	
Hole depth	70.00 m						Total Recovery of Core					67.28 m	
R.L	331.40 m						Percentage of Core Recovery					96.11%	
Water table depth	15.00 m												
Sl. NO	Sample ID	From	To	ASH %	M%	V.M%	LOI%	SiO₂	Al₂O₃%	V₂O₅%	F.C%	Length	Lithology
1		0.00	6.00									6.00	Soil
2		6.00	12.00									6.00	Quartzofeldspathic Gneiss ± Garnet
3	NPG-1/1	12.00	13.00	88.63	1.15	2.38	11.37	80.78	2.58	0.00	7.84	1.00	Quartzofeldspathic Gneiss + Graphite
4	NPG-1/2	13.00	14.00	89.77	0.71	1.93	10.23	82.87	2.72	0.00	7.59	1.00	
5		14.00	21.00									7.00	Quartzofeldspathic Gneiss ± Garnet
6	NPG-1/3	21.00	22.00	86.59	2.97	3.68	13.41	68.94	5.58	0.00	6.76	1.00	Quartzofeldspathic Gneiss + Graphite
7	NPG-1/4	22.00	23.00	89.08	2.70	4.31	10.93	72.80	5.32	0.00	3.92	1.00	
8	NPG-1/5	23.00	24.00	91.38	2.11	3.99	8.63	75.94	6.68	0.01	2.53	1.00	
9	NPG-1/6	24.00	25.00	90.32	1.24	3.66	9.69	74.92	7.09	0.01	4.79	1.00	
10	NPG-1/7	25.00	26.00	85.49	4.68	5.73	14.50	54.57	15.80	0.01	4.10	1.00	
11	NPG-1/8	26.00	27.00	85.55	1.79	5.41	14.45	61.66	12.77	0.00	7.25	1.00	
12	NPG-1/9	27.00	28.00	93.91	1.65	1.01	6.10	74.90	8.42	0.00	3.44	1.00	

13		28.00	28.30									0.30	
14	NPG-1/10	28.30	29.00	94.29	1.38	1.06	5.72	68.95	14.09	0.00	3.28	0.70	
15	NPG-1/11	29.00	30.00	94.43	1.01	1.09	5.58	71.40	14.42	0.00	3.48	1.00	
16	NPG-1/12	30.00	31.00	94.10	1.42	0.98	5.91	70.28	13.82	0.00	3.51	1.00	
17		31.00	31.85									0.85	
18	NPG-1/13	31.85	32.85	91.12	2.40	4.08	8.88	64.76	13.31	0.00	2.40	1.00	
19	NPG-1/14	32.85	34.00	91.18	2.33	1.12	8.82	66.62	13.75	0.00	5.37	1.15	Quartzofeldspathic Gneiss ± Garnet
20		34.00	42.50									8.50	
21	NPG-1/15	42.50	43.50	94.56	1.79	2.42	5.44	64.52	16.20	0.00	1.23	1.00	Quartzofeldspathic Gneiss + Graphite
22	NPG-1/16	43.50	44.30	92.46	2.31	3.04	7.54	63.27	17.76	0.00	2.19	0.80	Quartzofeldspathic Gneiss ± Garnet
23		44.30	45.15									0.85	
24	NPG-1/17	45.15	45.65	95.44	1.12	2.33	4.56	69.05	13.16	0.00	1.11	0.50	
25		45.65	47.50									1.85	
26		47.50	52.10									4.60	Quartzofeldspathic Gneiss + Graphite
27	NPG-1/18	52.10	53.10	92.30	1.75	3.95	7.70	63.24	17.09	0.00	2.00	1.00	
28	NPG-1/19	53.10	54.10	94.64	1.67	2.37	5.36	66.04	16.18	0.00	1.32	1.00	Quartzofeldspathic Gneiss ± Garnet
29	NPG-1/20	54.10	55.10	92.40	2.13	3.40	7.60	67.35	13.56	0.00	2.07	1.00	Quartzofeldspathic Gneiss + Graphite
30	NPG-1/21	55.10	56.35	93.94	1.18	3.31	6.06	72.53	9.74	0.00	1.57	1.25	Quartzofeldspathic Gneiss ± Garnet
31	NPG-1/22	56.35	57.35	92.98	1.48	2.95	7.02	68.21	12.90	0.00	2.59	1.00	Quartzofeldspathic Gneiss + Graphite
32	NPG-1/23	57.35	58.30	94.10	1.43	2.39	5.90	72.24	10.41	0.00	2.08	0.95	
33		58.30	59.00									0.70	Quartzofeldspathic Gneiss ± Garnet
34	NPG-1/24	59.00	60.00	93.28	1.90	2.89	6.72	68.30	12.69	0.00	1.93	1.00	
35	NPG-1/25	60.00	61.00	92.98	1.66	3.18	7.02	67.34	12.88	0.00	2.18	1.00	Quartzofeldspathic Gneiss + Graphite
36	NPG-1/26	61.00	62.00	93.08	1.72	3.29	6.92	69.16	11.01	0.00	1.91	1.00	

37	NPG-1/27	62.00	63.30	90.40	2.48	4.25	9.60	61.94	13.89	0.00	2.87	1.30	
38		63.30	64.00									0.70	Granulite
39		64.00	65.00									1.00	
40	NPG-1/28	65.00	65.80	93.02	2.26	0.00	6.98	65.94	13.76	0.00	1.31	0.80	Quartzofeldspathic Gneiss ± Garnet
41		65.80	66.00									0.20	
42		66.00	67.00									1.00	
43	NPG-1/29	67.00	68.00									1.00	Quartzofeldspathic Gneiss + Graphite
44	NPG-1/30	68.00	69.00	94.50	0.98	1.95	5.50	67.06	14.21	0.00	2.57	1.00	
45	NPG-1/31	69.00	69.50	92.52	1.04	2.30	7.48	73.73	11.50	0.00	4.14	0.50	Granulite+Garnet
46		69.50	70.00									0.50	
												70.00	

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24											
Bore Hole No-	NPBH-2					Date of Commencement					03.05.2024
Location(DGPS)	767778.4465			2183058.278		Date of Completion					19.05.2024
(DMS)	83°33'17.37720" E			19°43'29.74440" N		Total Graphite Thickness					9.65 m
Hole depth	55.00 m					Total Recovery of Core					50.61 m
R.L	333.31 m					Percentage of Core Recovery					92.02%
Water table depth	15.00 m										
Sl. NO	Sample ID	From	To	ASH %	M%	LOI%	SiO ₂	Al ₂ O ₃ %	F.C%	Length	Lithology
1		0.00	4.00							4.00	Soil
2		4.00	6.20							2.20	Khondalite
3	NPG - 2/1	6.20	7.20	93.16	2.10	6.84	67.86	9.54	0.79	1.00	
4	NPG - 2/2	7.20	8.20	90.44	3.51	9.06	62.86	11.28	0.96	1.00	
5	NPG - 2/3	8.20	9.50	92.64	2.08	7.36	65.58	8.74	1.20	1.30	

6		9.50	12.00							2.50	
7	NPG - 2/4	12.00	13.00	91.80	1.55	8.20	63.02	14.44	2.04	1.00	Khondalite+ Graphite
8	NPG - 2/5	13.00	13.50	93.92	1.27	6.08	66.18	12.42	1.20	0.50	Quartzofeldspathic Gneiss \pm Garnet
9		13.50	15.60							2.10	
10	NPG - 2/6	15.60	16.50	91.30	1.91	8.70	64.90	12.94	2.66	0.90	Khondalite+ Graphite
11		16.50	17.50							1.00	Khondalite
12	NPG - 2/7	17.50	18.00	92.30	1.80	7.70	67.20	10.72	2.14	0.50	Khondalite+ Graphite
13		18.00	19.00							1.00	Khondalite
14	NPG - 2/8	19.00	20.50	94.40	1.17	5.60	70.02	6.70	2.01	1.50	Khondalite+ Graphite
15		20.50	21.90							1.40	Khondalite
16	NPG - 2/9	21.90	22.00	96.18	0.63	3.82	74.68	13.50	1.50	0.10	
17	NPG - 2/10	22.00	23.90	96.46	0.99	3.54	70.74	12.50	0.98	1.90	
18		23.90	24.50							0.60	
19	NPG - 2/11	24.50	25.30	95.26	1.01	4.74	72.46	9.70	1.36	0.80	
20		25.30	26.50							1.20	
21	NPG - 2/12	26.50	27.00	92.20	1.56	7.80	64.76	13.94	2.39	0.50	Khondalite+ Graphite
22		27.00	29.50							2.50	Khondalite
23		29.50	41.45							11.95	Quartzofeldspathic Gneiss \pm Garnet
24	NPG - 2/13	41.45	42.45	92.88	0.91	7.12	63.54	15.26	2.09	1.00	Quartzofeldspathic Gneiss + Graphite
25	NPG - 2/14	42.45	43.45	93.18	0.40	6.82	68.34	10.94	1.80	1.00	
26	NPG - 2/15	43.45	44.45	91.88	1.04	8.12	60.50	17.76	2.24	1.00	
27	NPG - 2/16	44.45	45.45	93.34	1.06	6.66	67.72	13.72	1.88	1.00	
28	NPG - 2/17	45.45	46.45	93.90	0.76	6.10	67.00	11.38	1.61	1.00	Quartzofeldspathic Gneiss \pm Garnet
29	NPG - 2/18	46.45	47.45	92.96	0.82	7.04	66.66	11.02	1.63	1.00	
30	NPG - 2/19	47.45	48.45	93.00	0.93	7.00	63.66	15.46	1.98	1.00	
31	NPG - 2/20	48.45	49.45	92.44	1.50	7.56	61.20	17.56	1.47	1.00	
32	NPG - 2/21	49.45	50.45	94.40	1.23	5.60	66.48	12.38	0.58	1.00	
33	NPG - 2/22	50.45	51.70	91.88	1.33	8.12	64.30	12.02	2.00	1.25	Khondalite+ Graphite
34		51.70	53.00							1.30	Quartzofeldspathic Gneiss \pm Garnet

35	NPG - 2/23	53.00	54.00	92.04	2.06	7.96	61.14	19.68	0.48	1.00	
36		54.00	54.50							0.50	
37	NPG - 2/24	54.50	55.00	94.58	1.52	5.42	58.94	18.02	0.53	0.50	
										55.00	

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24											
Bore Hole No-	NPBH-3					Date of Commencement				22.05.2024	
Location(DGPS)	767854.1705			2182910.55		Date of Completion				03.06.2024	
(DMS)	83°33'19.90080" E			19°43'24.90600" N		Total Graphite Thickness				19.55 m	
Hole depth	74.50 m					Total Recovery of Core				72.38 m	
R.L	331.02 m					Percentage of Core Recovery				97.15%	
Water table depth	17.00 m										
Sl. NO	Sample ID	From	To	ASH %	M%	LOI%	SiO ₂	Al ₂ O ₃ %	F.C%	Length	Lithology
1		0.00	5.50							5.50	Soil
2		5.50	15.50							10.00	Quartzofeldspathic Gneiss ± Garnet
3	NPG - 3/1	15.50	16.30	93.48	2.49	6.52	64.34	15.58	1.39	0.80	Khondalite
4		16.30	18.50							2.20	
5	NPG - 3/2	18.50	19.50	96.30	0.78	3.70	72.08	15.16	0.98	1.00	Quartzofeldspathic Gneiss ± Garnet
6		19.50	20.50							1.00	Khondalite
7	NPG - 3/3	20.50	21.10	86.00	5.14	12.00	55.06	14.32	3.93	0.60	Quartzofeldspathic Gneiss + Graphite
8		21.10	36.50							15.40	Quartzofeldspathic Gneiss ± Garnet
9		36.50	37.50							1.00	Khondalite
10		37.50	41.60							4.10	Quartzofeldspathic Gneiss ± Garnet
11	NPG - 3/4	41.60	42.60	95.94	0.80	4.06	67.48	12.74	1.18	1.00	
12	NPG - 3/5	42.60	43.60	94.78	0.85	5.22	63.28	18.44	0.93	1.00	

13	NPG - 3/6	43.60	44.60	93.34	1.55	6.66	64.50	19.20	1.26	1.00	
14	NPG - 3/7	44.60	45.60	93.20	1.04	6.80	64.46	17.74	1.55	1.00	
15	NPG - 3/8	45.60	46.60	93.86	1.35	6.14	65.90	16.44	1.02	1.00	
16	NPG - 3/9	46.60	47.60	94.18	0.85	5.82	65.80	16.22	1.33	1.00	
17	NPG - 3/10	47.60	48.60	94.42	0.78	5.58	62.58	19.78	1.27	1.00	
18	NPG - 3/11	48.60	49.60	94.28	0.85	5.72	65.40	16.30	1.65	1.00	Quartzofeldspathic Gneiss + Graphite
19	NPG - 3/12	49.60	50.60	93.36	0.84	6.64	63.12	17.96	2.37	1.00	
20	NPG - 3/13	50.60	51.60	93.06	0.93	6.94	59.74	16.42	1.96	1.00	
21	NPG - 3/14	51.60	52.60	92.78	0.87	7.22	63.58	16.48	2.57	1.00	
22	NPG - 3/15	52.60	53.60	93.00	0.93	7.00	63.10	16.06	2.43	1.00	
23	NPG - 3/16	53.60	54.60	94.78	1.04	5.22	63.62	18.30	1.21	1.00	Quartzofeldspathic Gneiss ± Garnet
24	NPG - 3/17	54.60	55.60	94.02	0.64	5.98	65.92	17.84	1.74	1.00	
25	NPG - 3/18	55.60	56.60	93.08	0.81	6.92	66.34	12.08	2.64	1.00	Quartzofeldspathic Gneiss + Graphite
26	NPG - 3/19	56.60	57.60	92.90	0.95	7.10	65.22	16.34	2.73	1.00	
27	NPG - 3/20	57.60	58.60	95.04	0.95	4.96	65.56	16.08	1.33	1.00	
28		58.60	61.00							2.40	Quartzofeldspathic Gneiss ± Garnet
29	NPG - 3/21	61.00	62.00	93.30	0.84	6.70	65.60	16.30	2.08	1.00	Quartzofeldspathic Gneiss + Graphite
30	NPG - 3/22	62.00	63.00	92.12	0.96	7.80	60.78	11.78	2.82	1.00	
31	NPG - 3/23	63.00	64.00	92.80	0.86	7.20	65.00	9.54	2.81	1.00	
32	NPG - 3/24	64.00	65.00	92.60	0.99	7.40	62.08	17.66	2.79	1.00	
33	NPG - 3/25	65.00	66.00	92.42	0.71	7.58	64.54	16.42	2.94	1.00	
34	NPG - 3/26	66.00	67.00	92.88	0.94	7.12	66.04	13.64	1.85	1.00	
35	NPG - 3/27	67.00	68.00	89.96	1.78	10.04	61.60	17.34	2.94	1.00	
36	NPG - 3/28	68.00	69.00	92.04	1.38	7.96	67.04	15.48	2.24	1.00	

37	NPG - 3/29	69.00	71.00	93.84	1.24	6.16	70.16	12.76	1.84	2.00	Quartzofeldspathic Gneiss ± Garnet
38	NPG - 3/30	71.00	71.95	93.96	1.14	6.04	66.26	15.78	2.07	0.95	
39		71.95	72.50							0.55	
40	NPG - 3/31	72.50	73.40	95.16	1.09	4.84	71.96	13.58	1.50	0.90	
41		73.40	74.50							1.10	Khondalite
										74.50	

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24											
Bore Hole No-	NPBH-4					Date of Commencement		07.06.2024			
Location(DGPS)	767887.8965			2182985		Date of Completion		28.06.2024			
(DMS)	83°33'21.09600" E			19°43'27.30720" N		Total Graphite Thickness		18.55 m			
Hole depth	56.50 m					Total Recovery of Core		54.32 m			
R.L	335.52 m					Percentage of Core Recovery		96.14%			
Water table depth	18.00 m										
Sl. No.	Sample ID	From	To	ASH %	M%	LOI%	SiO ₂	Al ₂ O ₃ %	FC%	Length	Lithology
1		0.00	6.00							6.00	Soil
2		6.00	11.00							5.00	Quartzofeldspathic Gneiss ± Garnet
3	NPG - 4/1	11.00	12.00	88.86	3.58	11.14	59.14	14.44	2.12	1.00	Quartzofeldspathic Gneiss + Graphite
4	NPG - 4/2	12.00	13.05	90.76	3.11	9.24	66.22	12.30	1.95	1.05	
5		13.05	15.80							2.75	Quartzofeldspathic Gneiss ± Garnet
6		15.80	17.00							1.20	Khondalite
7	NPG - 4/3	17.00	18.00	93.24	1.68	6.76	66.84	11.28	0.91	1.00	
8	NPG - 4/4	18.00	19.00	90.56	2.08	9.44	60.82	17.14	1.52	1.00	
9	NPG - 4/5	19.00	20.00	90.34	1.82	9.66	58.32	19.86	1.89	1.00	
10	NPG - 4/6	20.00	21.00	91.46	1.93	8.54	57.04	12.94	0.91	1.00	

11	NPG - 4/7	21.00	22.00	89.82	2.45	10.18	65.58	9.72	3.11	1.00	Khondalite + Graphite
12	NPG - 4/8	22.00	23.00	93.34	1.78	6.66	66.30	12.42	1.19	1.00	
13	NPG - 4/9	23.00	24.00	89.10	3.11	10.90	53.42	14.58	1.67	1.00	Khondalite
14	NPG - 4/10	24.00	25.00	91.32	1.76	8.68	64.24	10.10	1.92	1.00	
15	NPG - 4/11	25.00	26.00	94.30	1.48	5.70	65.40	10.20	0.56	1.00	
16	NPG - 4/12	26.00	27.00	93.54	1.45	6.46	60.72	14.16	0.66	1.00	
17		27.00	28.00							1.00	
18	NPG - 4/13	28.00	29.00	92.32	1.83	7.68	67.60	10.94	1.80	1.00	
19	NPG - 4/14	29.00	30.00	92.24	1.88	7.76	64.14	13.46	1.60	1.00	
20		30.00	31.00							1.00	
21	NPG - 4/15	31.00	32.00	90.18	2.31	9.82	66.02	11.80	2.33	1.00	Khondalite + Graphite
22	NPG - 4/16	32.00	33.00	90.62	1.00	9.38	67.68	11.56	2.38	1.00	
23		33.00	33.50							0.50	
24	NPG - 4/17	33.50	34.00	91.42	1.21	8.58	72.46	10.30	2.74	0.50	
25	NPG - 4/18	34.00	35.00	91.50	1.38	8.50	67.36	10.28	1.92	1.00	Khondalite
26	NPG - 4/19	35.00	36.00	91.66	1.50	8.34	68.52	7.58	1.78	1.00	
27	NPG - 4/20	36.00	37.00	91.44	1.15	8.56	68.32	14.90	2.25	1.00	Quartzofeldspathic Gneiss + Graphite
28	NPG - 4/21	37.00	38.00	89.50	0.97	10.50	70.78	8.50	4.60	1.00	
29	NPG - 4/22	38.00	39.00	87.72	2.48	12.28	66.42	7.68	5.47	1.00	Quartzofeldspathic Gneiss ± Garnet
30		39.00	40.50							1.50	
31	NPG - 4/23	40.50	41.50	85.24	3.89	14.76	54.36	8.50	4.15	1.00	Khondalite + Graphite
32	NPG - 4/24	41.50	42.50	89.48	0.20	10.52	81.44	0.50	8.16	1.00	
33	NPG - 4/25	42.50	43.50	89.60	0.21	10.40	82.70	1.80	8.06	1.00	
34	NPG - 4/26	43.50	44.50	87.48	0.30	12.52	78.62	3.00	10.03	1.00	
35	NPG - 4/27	44.50	45.50	87.62	0.35	12.38	80.34	1.00	9.84	1.00	
36	NPG - 4/28	45.50	46.30	88.60	0.19	11.40	80.72	0.60	9.26	0.80	
37	NPG - 4/29	46.30	47.00	91.74	0.69	8.26	62.38	13.48	2.36	0.70	

38	NPG - 4/30	47.00	48.00	90.80	0.67	9.20	65.66	11.26	3.10	1.00	
39	NPG - 4/31	48.00	49.00	92.84	1.42	7.16	68.82	11.86	1.95	1.00	
40		49.00	54.15							5.15	Khondalite
41		54.15	56.50							2.35	Quartzofeldspathic Gneiss ± Garnet
										56.50	

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24											
Bore Hole No-	NPBH-5					Date of Commencement				09.06.2024	
Location(DGPS)	76910.4273			2182829.996		Date of Completion				10.07.2024	
(DMS)	83°33'21.79080" E			19°43'22.26000" N		Total Graphite Thickness				5.50 m	
Hole depth	78.80 m					Total Recovery of Core				75.98 m	
R.L	329.86 m					Percentage of Core Recovery				96.42%	
Water table depth	18.00 m										
Sl. NO	Sample ID	From	To	ASH %	M%	LOI%	SiO ₂	Al ₂ O ₃ %	FC%	Length	Lithology
1		0.00	5.00							5.00	Soil
2		5.00	13.70							8.70	Quartzofeldspathic Gneiss ± Garnet
3		13.70	19.00							5.30	Khondalite
4		19.00	21.00							2.00	Quartzofeldspathic Gneiss ± Garnet
5		21.00	23.00							2.00	Khondalite
6		23.00	31.00							8.00	Quartzofeldspathic Gneiss ± Garnet
7	NPG - 5/1	31.00	32.00	95.38	1.08	4.62	69.14	13.26	1.57	1.00	Khondalite
8		32.00	34.00							2.00	Quartzofeldspathic Gneiss ± Garnet

9	NPG - 5/2	34.00	35.00	95.36	0.83	4.64	65.34	15.46	0.58	1.00	Khondalite
10	NPG - 5/3	35.00	36.00	94.66	1.52	5.34	65.38	12.06	1.09	1.00	
11		36.00	40.00							4.00	Quartzofeldspathic Gneiss ± Garnet
12	NPG - 5/4	40.00	41.00	98.16	0.37	1.84	64.16	17.18	0.41	1.00	Khondalite
13		41.00	44.00							3.00	Quartzofeldspathic Gneiss ± Garnet
14	NPG - 5/5	44.00	45.00	95.66	0.87	4.34	65.34	15.62	1.03	1.00	
15	NPG - 5/6	45.00	46.00	94.88	0.90	5.12	66.92	12.52	1.39	1.00	
16	NPG - 5/7	46.00	46.50	96.76	0.55	3.24	70.48	12.38	1.01	0.50	
17		46.50	52.30							5.80	
18	NPG - 5/8	52.30	53.00	95.24	0.78	4.76	68.20	14.48	1.70	0.70	
19		53.00	53.50							0.50	
20	NPG - 5/9	53.50	54.00	95.42	0.88	4.58	63.70	15.66	1.60	0.50	
21		54.00	54.50							0.50	
22	NPG - 5/10	54.50	55.50	94.94	0.81	5.06	61.38	17.88	1.26	1.00	
23	NPG - 5/11	55.50	56.50	95.28	0.94	4.72	66.28	18.16	0.88	1.00	
24	NPG - 5/12	56.50	57.50	94.36	1.14	5.64	63.84	16.06	1.15	1.00	
25	NPG - 5/13	57.50	58.50	94.76	1.19	5.24	67.68	14.22	1.01	1.00	
26	NPG - 5/14	58.50	59.50	93.30	1.09	6.70	63.86	14.06	1.96	1.00	
27	NPG - 5/15	59.50	60.50	93.14	1.02	6.86	63.42	17.64	1.85	1.00	
28	NPG - 5/16	60.50	61.50	91.76	1.22	8.26	62.70	14.02	2.94	1.00	Khondalite + Graphite
29	NPG - 5/17	61.50	62.30	93.58	1.20	6.42	56.92	16.44	1.61	0.80	Khondalite
30		62.30	63.00							0.70	
31	NPG - 5/18	63.00	64.00	93.60	1.03	6.40	66.86	13.82	2.53	1.00	Khondalite + Graphite
32	NPG - 5/19	64.00	65.00	94.52	1.08	5.48	67.84	12.86	1.76	1.00	
33	NPG - 5/20	65.00	66.00	93.66	1.31	6.34	66.12	12.56	2.50	1.00	

34	NPG - 5/21	66.00	67.00	95.76	0.89	4.24	69.72	12.16	1.34	1.00	Quartzofeldspathic Gneiss ± Garnet
35	NPG - 5/22	67.00	68.00	96.04	1.10	3.96	70.56	10.92	1.14	1.00	
36	NPG - 5/23	68.00	69.00	94.58	1.51	5.42	68.18	9.82	1.54	1.00	
37	NPG - 5/24	69.00	70.00	95.52	1.43	4.48	67.20	13.62	0.64	1.00	
38	NPG - 5/25	70.00	71.00	95.70	1.01	4.30	75.66	4.16	1.26	1.00	
39	NPG - 5/26	71.00	72.00	96.96	1.60	3.04	80.98	4.92	0.90	1.00	
40	NPG - 5/27	72.00	73.50	97.44	0.61	2.56	68.92	13.92	0.36	1.50	Quartzofeldspathic Gneiss + Graphite
41	NPG - 5/28	73.50	75.00	93.24	1.90	6.76	67.16	13.16	2.35	1.50	
42		75.00	78.80							3.80	Quartzofeldspathic Gneiss ± Garnet
										78.80	

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24													
Bore Hole No-	NPBH-6						Date of Commencement					05.07.2024	
Location(DGPS)	767975.6609			2182906.237			Date of Completion					27.07.2024	
(DMS)	83°33'24.06960" E			19°43'24.70440" N			Total Graphite Thickness					6.50 m	
Hole depth	63.20 m						Total Recovery of Core					60.5 m	
R.L	334.14 m						Percentage of Core Recovery					95.72%	
Water table depth	16.00m												
Sl. NO	Sample ID	From	To	ASH %	M%	V.M%	LOI%	SiO ₂	Al ₂ O ₃ %	V ₂ O ₅ %	FC%	Length	Lithology
1		0.00	5.00									5.00	Soil
2		5.00	8.00									3.00	Quartzofeldspathic Gneiss ± Garnet
3		8.00	17.80									9.80	Khondalite
4	NPG 6/1	17.80	19.00	90.64	3.28	4.33	9.37	66.99	14.47	0.00	1.76	1.20	
5		19.00	21.00									2.00	

6	NPG 6/2	21.00	21.50	89.30	3.56	6.26	10.71	66.21	15.59	0.00	0.89	0.50	
7		21.50	25.00									3.50	
8	NPG 6/3	25.00	26.00	90.00	3.49	4.69	10.00	61.20	17.10	0.00	1.82	1.00	Khondalite + Graphite
9	NPG 6/4	26.00	27.00	86.62	4.81	4.66	13.38	62.02	16.05	0.00	3.91	1.00	
10	NPG 6/5	27.00	28.00	90.20	3.74	3.46	9.81	69.86	12.16	0.00	2.61	1.00	
11	NPG 6/6	28.00	29.00	88.33	4.66	4.42	11.68	66.72	13.74	0.00	2.60	1.00	
12	NPG 6/7	29.00	30.00	86.84	5.19	5.09	13.17	61.94	16.16	0.00	2.89	1.00	
13	NPG 6/8	30.00	31.00	85.56	5.31	5.76	14.45	57.56	16.18	0.00	3.38	1.00	
14		31.00	37.00									6.00	Khondalite
15		37.00	46.50									9.50	Quartzofeldspathic Gneiss ± Garnet
18	NPG 6/9	46.50	47.50	94.78	1.00	3.61	5.23	64.63	16.22	0.00	0.62	1.00	
19	NPG 6/10	47.50	48.50	95.16	1.04	3.77	3.09	67.79	15.73	0.00	0.03	1.00	
20	NPG 6/11	48.50	49.00	91.33	1.69	5.10	8.67	61.69	17.48	0.00	1.88	0.50	
21		49.00	51.20									2.20	
22	NPG 6/12	51.20	51.70	91.31	1.51	4.79	8.70	63.38	15.72	0.00	2.40	0.50	Quartzofeldspathic Gneiss + Graphite
23		51.70	52.05									0.35	Quartzofeldspathic Gneiss ± Garnet
24	NPG 6/13	52.05	53.05	98.03	0.70	1.19	0.27	70.06	17.06	0.00	0.08	1.00	
25	NPG 6/14	53.05	53.60	94.64	0.98	3.62	5.36	65.25	17.69	0.00	0.76	0.55	
26		53.60	56.00									2.40	
27	NPG 6/15	56.00	57.10	91.24	1.56	5.46	8.77	64.44	15.59	0.00	1.75	1.10	
28		57.10	63.20									6.10	
												63.20	

ANNEXURE –III

HOLE WISE WEIGHT AND AVERAGE OF THE BLOCK

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24														
Bore Hole No.	NPBH-1						Date of Commencement					13.07.2024		
Location (DGPS)	767689.2503			2183040.786			Date of Completion					30.07.2024		
(DMS)	83°33'14.31000" E			19°43'29.21880" N			Total Graphite Thickness					24.55 m		
Hole depth	70.00 m						Total Recovery of Core					67.28 m		
R.L	331.40 m						Percentage of Core Recovery					96.11%		
Water table depth	15.00 m													
Sl. No.	Sample ID	From	To	ASH %	M%	V.M%	LOI%	SiO ₂	Al ₂ O ₃ %	V ₂ O ₅ (%)	F.C%	F.C weight avg.	Length	Lithology
1	NPG-1/1	12.00	13.00	88.63	1.15	2.38	11.37	80.78	2.58	0.00	7.84	7.72	1.00	Quartzofeldspathic Gneiss + Graphite
2	NPG-1/2	13.00	14.00	89.77	0.71	1.93	10.23	82.87	2.72	0.00	7.59		1.00	
3	NPG-1/3	21.00	22.00	86.59	2.97	3.68	13.41	68.94	5.58	0.00	6.76	3.89	1.00	Quartzofeldspathic Gneiss + Graphite
4	NPG-1/4	22.00	23.00	89.08	2.70	4.31	10.93	72.80	5.32	0.00	3.92		1.00	
5	NPG-1/5	23.00	24.00	91.38	2.11	3.99	8.63	75.94	6.68	0.01	2.53		1.00	
6	NPG-1/6	24.00	25.00	90.32	1.24	3.66	9.69	74.92	7.09	0.01	4.79		1.00	
7	NPG-1/7	25.00	26.00	85.49	4.68	5.73	14.50	54.57	15.80	0.01	4.10		1.00	
8	NPG-1/8	26.00	27.00	85.55	1.79	5.41	14.45	61.66	12.77	0.00	7.25		1.00	
9		28.00	28.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.30	
10	NPG-1/9	27.00	28.00	93.91	1.65	1.01	6.10	74.90	8.42	0.00	3.44		1.00	
11	NPG-1/10	28.30	29.00	94.29	1.38	1.06	5.72	68.95	14.09	0.00	3.28		0.70	
12	NPG-1/11	29.00	30.00	94.43	1.01	1.09	5.58	71.40	14.42	0.00	3.48		1.00	
13	NPG-1/12	30.00	31.00	94.10	1.42	0.98	5.91	70.28	13.82	0.00	3.51		1.00	

14		31.00	31.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.85	
15	NPG-1/13	31.85	32.85	91.12	2.40	4.08	8.88	64.76	13.31	0.00	2.40		1.00	
16	NPG-1/14	32.85	34.00	91.18	2.33	1.12	8.82	66.62	13.75	0.00	5.37		1.15	
17	NPG-1/16	43.50	44.30	92.46	2.31	3.04	7.54	63.27	17.76	0.00	2.19	2.19	0.80	Quartzofeldspathic Gneiss + Graphite
18	NPG-1/18	52.10	53.10	92.30	1.75	3.95	7.70	63.24	17.09	0.00	2.00	2.00	1.00	Quartzofeldspathic Gneiss + Graphite
19	NPG-1/20	54.10	55.10	92.40	2.13	3.40	7.60	67.35	13.56	0.00	2.07	2.07	1.00	Quartzofeldspathic Gneiss + Graphite
20	NPG-1/22	56.35	57.35	92.98	1.48	2.95	7.02	68.21	12.90	0.00	2.59	2.34	1.00	Quartzofeldspathic Gneiss + Graphite
21	NPG-1/23	57.35	58.30	94.10	1.43	2.39	5.90	72.24	10.41	0.00	2.08		0.95	
22	NPG-1/25	60.00	61.00	92.98	1.66	3.18	7.02	67.34	12.88	0.00	2.18	2.37	1.00	Quartzofeldspathic Gneiss + Graphite
23	NPG-1/26	61.00	62.00	93.08	1.72	3.29	6.92	69.16	11.01	0.00	1.91		1.00	
24	NPG-1/27	62.00	63.30	90.40	2.48	4.25	9.60	61.94	13.89	0.00	2.87		1.30	
25	NPG-1/30	68.00	69.00	94.50	0.98	1.95	5.50	67.06	14.21	0.00	2.57	3.09	1.00	Quartzofeldspathic Gneiss + Graphite
26	NPG-1/31	69.00	69.50	92.52	1.04	2.30	7.48	73.73	11.50	0.00	4.14		0.50	
													24.55	
		AVERAGE		89.35	1.81	2.90	8.41	67.74	11.06	0.00	3.70	3.21		

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24													
Bore Hole No-	NPBH-2					Date of Commencement					03.05.2024		
Location(DGPS	767778.4465			2183058.278		Date of Completion					19.05.2024		
(DMS	83°33'17.37720" E			19°43'29.74440" N		Total Graphite Thickness					9.65 m		
Hole depth	55.00 m					Total Recovery of Core					50.61 m		
R.L	333.31 m					Percentage of Core Recovery					92.02%		
Water table depth	15.00 m												
Sl. NO	Sample ID	From	To	ASH %	M%	LOI%	SiO ₂	Al ₂ O ₃ %	FC%		Length	Lithology	

1	NPG - 2/4	12.00	13.00	91.80	1.55	8.20	63.02	14.44	2.04	2.04	1.00	Khondalite+ Graphite
2	NPG - 2/6	15.60	16.50	91.30	1.91	8.70	64.90	12.94	2.66	2.66	0.90	Khondalite+ Graphite
3	NPG - 2/7	17.50	18.00	92.30	1.80	7.70	67.20	10.72	2.14	2.14	0.50	Khondalite+ Graphite
4	NPG - 2/8	19.00	20.50	94.40	1.17	5.60	70.02	6.70	2.01	2.01	1.50	Khondalite+ Graphite
5	NPG - 2/12	26.50	27.00	92.20	1.56	7.80	64.76	13.94	2.39	2.39	0.50	Khondalite+ Graphite
6	NPG - 2/13	41.45	42.45	92.88	0.91	7.12	63.54	15.26	2.09	2.00	1.00	Quartzofeldspathic Gneiss + Graphite
7	NPG - 2/14	42.45	43.45	93.18	0.40	6.82	68.34	10.94	1.80		1.00	
8	NPG - 2/15	43.45	44.45	91.88	1.04	8.12	60.50	17.76	2.24		1.00	
9	NPG - 2/16	44.45	45.45	93.34	1.06	6.66	67.72	13.72	1.88		1.00	
10	NPG - 2/22	50.45	51.70	91.88	1.33	8.12	64.30	12.02	2.00	2.00	1.25	Khondalite+ Graphite
											9.65	
		AVERAGE		95.87	1.32	7.76	67.80	13.31	2.20	2.18		

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24												
Bore Hole No-	NPBH-3					Date of Commencement				22.05.2024		
Location(DGPS)	767854.1705			2182910.55		Date of Completion				03.06.2024		
(DMS)	83°33'19.90080" E			19°43'24.90600" N		Total Graphite Thickness				19.55 m		
Hole depth	74.50 m					Total Recovery of Core				72.38 m		
R.L	331.02 m					Percentage of Core Recovery				97.15%		
Water table depth	17.00 m											
SL.NO	Sample ID	From	To	Ash %	M %	LOI %	SiO₂ %	Al₂O₃ %	F.C %	F.C weight avg.	Length	Lithology
1	NPG - 3/3	20.50	21.10	86.00	5.14	12.00	55.06	14.32	3.93	3.93	0.60	Quartzofeldspathic Gneiss + Graphite
2	NPG - 3/11	48.60	49.60	94.28	0.85	5.72	65.40	16.30	1.65	2.20	1.00	Quartzofeldspathic Gneiss

3	NPG - 3/12	49.60	50.60	93.36	0.84	6.64	63.12	17.96	2.37		1.00	+ Graphite
4	NPG - 3/13	50.60	51.60	93.06	0.93	6.94	59.74	16.42	1.96		1.00	
5	NPG - 3/14	51.60	52.60	92.78	0.87	7.22	63.58	16.48	2.57		1.00	
6	NPG - 3/15	52.60	53.60	93.00	0.93	7.00	63.10	16.06	2.43		1.00	
7	NPG - 3/18	55.60	56.60	93.08	0.81	6.92	66.34	12.08	2.64	2.23	1.00	Quartzofeldspathic Gneiss + Graphite
8	NPG - 3/19	56.60	57.60	92.90	0.95	7.10	65.22	16.34	2.73		1.00	
9	NPG - 3/20	57.60	58.60	95.04	0.95	4.96	65.56	16.08	1.33		1.00	
10	NPG - 3/21	61.00	62.00	93.30	0.84	6.70	65.60	16.30	2.08	2.39	1.00	Quartzofeldspathic Gneiss + Graphite
11	NPG - 3/22	62.00	63.00	92.12	0.96	7.80	60.78	11.78	2.82		1.00	
12	NPG - 3/23	63.00	64.00	92.80	0.86	7.20	65.00	9.54	2.81		1.00	
13	NPG - 3/24	64.00	65.00	92.60	0.99	7.40	62.08	17.66	2.79		1.00	
14	NPG - 3/25	65.00	66.00	92.42	0.71	7.58	64.54	16.42	2.94		1.00	
15	NPG - 3/26	66.00	67.00	92.88	0.94	7.12	66.04	13.64	1.85		1.00	
16	NPG - 3/27	67.00	68.00	89.96	1.78	10.04	61.60	17.34	2.94		1.00	
17	NPG - 3/28	68.00	69.00	92.04	1.38	7.96	67.04	15.48	2.24		1.00	
18	NPG - 3/29	69.00	71.00	93.84	1.24	6.16	70.16	12.76	1.84		2.00	
19	NPG - 3/30	71.00	71.95	93.96	1.14	6.04	66.26	15.78	2.07		0.95	
											19.55	
		AVERAGE		90.00	1.18	7.08	62.21	14.77	2.35	2.27		

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24									
Bore Hole No-	NPBH-4					Date of Commencement			07.06.2024
Location(DGPS)	767887.8965			2182985		Date of Completion			28.06.2024
(DMS)	83°33'21.09600" E			19°43'27.30720" N		Total Graphite Thickness			18.55 m

Hole depth	56.50 m					Total Recovery of Core						54.32 m
R.L	335.52 m					Percentage of Core Recovery						96.14%
Water table depth	18.00 m											
SL.NO	Sample ID	From	To	Ash %	M %	LOI %	SiO ₂ %	Al ₂ O ₃ %	F.C %	F.C weight avg.	Length	Lithology
1.	NPG - 4/1	11.00	12.00	88.86	3.58	11.14	59.14	14.44	2.12	2.03	1.00	Quartzofeldspathic Gneiss + Graphite
2.	NPG - 4/2	12.00	13.05	90.76	3.11	9.24	66.22	12.30	1.95		1.05	
3.	NPG - 4/7	21.00	22.00	89.82	2.45	10.18	65.58	9.72	3.11	2.15	1.00	Khondalite + Graphite
4.	NPG - 4/8	22.00	23.00	93.34	1.78	6.66	66.30	12.42	1.19		1.00	
5.	NPG - 4/15	31.00	32.00	90.18	2.31	9.82	66.02	11.80	2.33	2.03	1.00	Khondalite + Graphite
6.	NPG - 4/16	32.00	33.00	90.62	1.00	9.38	67.68	11.56	2.38		1.00	
7.		33.00	33.50	0.00	0.00	0.00	0.00	0.00	0.00		0.50	
8.	NPG - 4/17	33.50	34.00	91.42	1.21	8.58	72.46	10.30	2.74		0.50	
9.	NPG - 4/20	36.00	37.00	91.44	1.15	8.56	68.32	14.90	2.25	4.11	1.00	Quartzofeldspathic Gneiss + Graphite
10.	NPG - 4/21	37.00	38.00	89.50	0.97	10.50	70.78	8.50	4.60		1.00	
11.	NPG - 4/22	38.00	39.00	87.72	2.48	12.28	66.42	7.68	5.47		1.00	
12.	NPG - 4/23	40.50	41.50	85.24	3.89	14.76	54.36	8.50	4.15	6.39	1.00	Khondalite + Graphite
13.	NPG - 4/24	41.50	42.50	89.48	0.20	10.52	81.44	0.50	8.16		1.00	
14.	NPG - 4/25	42.50	43.50	89.60	0.21	10.40	82.70	1.80	8.06		1.00	
15.	NPG - 4/26	43.50	44.50	87.48	0.30	12.52	78.62	3.00	10.03		1.00	
16.	NPG - 4/27	44.50	45.50	87.62	0.35	12.38	80.34	1.00	9.84		1.00	
17.	NPG - 4/28	45.50	46.30	88.60	0.19	11.40	80.72	0.60	9.26		0.80	
18.	NPG - 4/29	46.30	47.00	91.74	0.69	8.26	62.38	13.48	2.36		0.70	
19.	NPG - 4/30	47.00	48.00	90.80	0.67	9.20	65.66	11.26	3.10		1.00	
20.	NPG - 4/31	48.00	49.00	92.84	1.42	7.16	68.82	11.86	1.95		1.00	
											18.55	
		AVERAGE		92.02	1.51	10.40	71.37	8.93	4.58	3.34		

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24												
Bore Hole No-	NPBH-5					Date of Commencement					09.06.2024	
Location(DGPS)	76910.4273			2182829.996		Date of Completion					10.07.2024	
(DMS)	83°33'21.79080" E			19°43'22.26000" N		Total Graphite Thickness					5.50 m	
Hole depth	78.80 m					Total Recovery of Core					75.98 m	
R.L	329.86 m					Percentage of Core Recovery					96.42%	
Water table depth	18.00 m											
SL.NO	Sample ID	From	To	Ash %	M %	LOI %	SiO ₂ %	Al ₂ O ₃ %	F.C %	F.C weight avg.	Length	Lithology
1	NPG - 5/16	60.50	61.50	91.76	1.22	8.26	62.70	14.02	2.94	2.94	1.00	Khondalite + Graphite
2	NPG - 5/18	63.00	64.00	93.60	1.03	6.40	66.86	13.82	2.53	2.26	1.00	Khondalite + Graphite
3	NPG - 5/19	64.00	65.00	94.52	1.08	5.48	67.84	12.86	1.76		1.00	
4	NPG - 5/20	65.00	66.00	93.66	1.31	6.34	66.12	12.56	2.50		1.00	
5	NPG - 5/28	73.50	75.00	93.24	1.90	6.76	67.16	13.16	2.35	2.35	1.50	Quartzofeldspathic Gneiss + Graphite
											5.50	
		AVERAGE		84.87	1.19	6.04	60.12	12.08	2.20	2.52		

Physical & Chemical Assay Log of Naringpanga Graphite Project, F.S.2023-24														
Bore Hole No-	NPBH-6						Date of Commencement						05.07.2024	
Location(DGPS)	767975.6609			2182906.237			Date of Completion						27.07.2024	
(DMS	83°33'24.06960" E			19°43'24.70440" N			Total Graphite Thickness						6.50 m	
Hole depth	63.20 m						Total Recovery of Core						60.5 m	
R.L	334.14 m						Percentage of Core Recovery						95.72%	
Water table depth	16.00m													
SL.NO	Sample ID	From	To	Ash %	M %	V.M %	LOI %	SiO ₂ %	Al ₂ O ₃ %	V ₂ O ₅ (%)	F.C %	F.C weight avg.	Length	Lithology
1	NPG 6/3	25.00	26.00	90.00	3.49	4.69	10.00	61.20	17.10	0.00	1.82	2.87	1.00	Khondalite + Graphite
2	NPG 6/4	26.00	27.00	86.62	4.81	4.66	13.38	62.02	16.05	0.00	3.91		1.00	
3	NPG 6/5	27.00	28.00	90.20	3.74	3.46	9.81	69.86	12.16	0.00	2.61		1.00	
4	NPG 6/6	28.00	29.00	88.33	4.66	4.42	11.68	66.72	13.74	0.00	2.60		1.00	
5	NPG 6/7	29.00	30.00	86.84	5.19	5.09	13.17	61.94	16.16	0.00	2.89		1.00	
6	NPG 6/8	30.00	31.00	85.56	5.31	5.76	14.45	57.56	16.18	0.00	3.38		1.00	
7	NPG 6/12	51.20	51.70	91.31	1.51	4.79	8.70	63.38	15.72	0.00	2.40	2.40	0.50	Quartzofeldspathic Gneiss + Graphite
													6.50	
		AVERAGE		95.21	4.42	5.06	12.49	68.11	16.48	0.00	3.01	2.63		

ANNEXURE-IV

Naringpanga Graphite Block, Rayagada, F.S.2023-24								
Section wise Graphite average								
	Borehole	Average (%)						
		M	Al ₂ O ₃	SiO ₂	Ash	LOI	F.C	F.C weighted avg.
Section-AA'	NPBH-1	1.81	11.06	67.74	89.35	8.41	3.7	3.21
	Section average	1.81	11.06	67.74	89.35	8.41	3.7	3.21
Section-B-B'	NPBH -2	1.32	13.31	67.8	95.87	7.76	2.21	2.19
	Section average	1.32	13.31	67.8	95.87	7.76	2.21	2.19
Section-C-C'	NPBH -4	1.51	8.93	71.37	92.02	10.40	4.58	3.34
	Section average	1.51	8.93	71.37	92.02	10.40	4.58	3.34
Section-D-D'	NPBH -3	1.18	14.77	62.21	90.00	7.08	2.35	2.27
	Section average	1.18	14.77	62.21	90.00	7.08	2.35	2.27
Section-E-E'	NPBH -5	1.19	12.08	60.12	84.87	6.04	2.20	2.52
	NPBH -6	4.42	16.48	68.12	95.20	12.49	3.01	2.63
	Section average	14.28	64.12	90.04	9.26	2.60	2.80	2.57
Graphite Average of PIT-2								
PIT-2	Average	1.96	19.44	50.20	87.40	12.60	2.82	2.82

ANNEXURE-V

External Check Sample Analysis results of NARINGPANGA Graphite Block, Rayagada District

SI. No.	Sample Identity No.	BH No.	Ash %	M %	F.C. %	LOI %	SiO ₂ %	Al ₂ O ₃ %
1	NCG - 1	NPBH-1/1	88.63	0.32	7.79	11.99	40.91	0.21
2	NCG - 4	NPBH-1/28	93.15	1.16	0.31	7.49	59.04	0.26
3	NCG - 6	NPBH-2/12	93.00	0.53	1.06	7.82	40.28	0.15
4	NCG - 7	NPBH-2/22	91.86	0.59	0.93	8.53	52.53	0.16
5	NCG - 8	NPBH-3/3	87.14	1.59	1.72	13.84	44.54	0.26
6	NCG - 10	NPBH-3/30	94.52	0.58	0.75	6.13	43.55	0.54
7	NCG - 13	NPBH-4/26	87.97	0.37	9.03	12.35	40.67	0.11
8	NCG - 14	NPBH-4/28	89.02	0.30	8.48	11.27	39.86	0.19
9	NCG - 16	NPBH-5/20	94.08	0.51	1.68	6.34	41.26	0.62
10	NCG - 19	NPBH-6/8	86.93	3.30	0.87	12.35	50.78	0.57



NEW GREEN ENVIRONMENTAL LABS PVT. LTD.



CIN: U13202OR2022PTC041062,
GISTIN NO. 21AAICN5648L1Z6



TC-11880

Report No: NGEL/NGP25112024/GR-81
ULR No. : TC-1188024000000148F

Issue Date: 25.11.2024

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project,
Rayagada, Odisha
Date of sampling : -----
Sampling by : Client representative
Date of Sample Received : 30.10.2024
Date of Analysis : 05.11.2024 to 20.11.2024
Sample Description : Graphite Ore
Sample Quantity : 100 gm
Location with Lab ID : (NCG-1), NGEL/24-25/GR-81
Reference No : NGEL-25112024/GR-81

Analysis Results

Sl No	Parameters	Unit	Standard Method	Test Results
1.	Ash	%	IS 11321	88.63
2.	Moisture	%	IS 11321	0.32
3.	LOI	%	NGEL/SOP/O & M/01	11.99
4.	Fixed Carbon	%	NGEL/SOP/O & M/02	7.79
5.	Alumina as Al ₂ O ₃	%	NGEL/SOP/O & M/03	0.21
6.	Silica as SiO ₂	%	NGEL/SOP/O & M/04	40.91


Authorized & Reviewed By
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Ph. 0674 - 2355490, Mob.9437568822, 9178145817, E-mail: newgreenenvolab01@gmail.com



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CIN: U13202OR2022PTC041062,
GISTIN NO. 21AAICN5648L1Z6



Report No: NGEL/NGP25112024/GR-82
ULR No. : TC-118802400000149F

Issue Date: 25.11.2024

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project,
Rayagada, Odisha
Date of sampling : -----
Sampling by : Client representative
Date of Sample Received : 30.10.2024
Date of Analysis : 05.11.2024 to 20.11.2024
Sample Description : Graphite Ore
Sample Quantity : 100 gm
Location with Lab ID : (NCG-4), NGEL/24-25/GR-82
Reference No : NGEL-25112024/GR-82

Analysis Results

Sl No	Parameters	Unit	Standard Method	Test Results
1.	Ash	%	IS 11321	93.15
2.	Moisture	%	IS 11321	1.16
3.	LOI	%	NGEL/SOP/O & M/01	7.49
4.	Fixed Carbon	%	NGEL/SOP/O & M/02	0.31
5.	Alumina as Al ₂ O ₃	%	NGEL/SOP/O & M/03	0.26
6.	Silica as SiO ₂	%	NGEL/SOP/O & M/04	59.04


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CIN: U13202OR2022PTC041062,
GISTIN NO. 21AAICN5648L1Z6



Report No: NGEL/NGP25112024/GR-83

Issue Date: 25.11.2024

ULR No. : TC-1188024000000150F

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project, Rayagada, Odisha

Date of sampling : -----

Sampling by : Client representative

Date of Sample Received : 30.10.2024

Date of Analysis : 05.11.2024 to 20.11.2024

Sample Description : Graphite Ore

Sample Quantity : 100 gm

Location with Lab ID : (NCG-6), NGEL/24-25/GR-83

Reference No : NGEL-25112024/GR-83

Analysis Results

Sl No	Parameters	Unit	Standard Method	Test Results
1.	Ash	%	IS 11321	93.00
2.	Moisture	%	IS 11321	0.53
3.	LOI	%	NGEL/SOP/O & M/01	7.82
4.	Fixed Carbon	%	NGEL/SOP/O & M/02	1.06
5.	Alumina as Al ₂ O ₃	%	NGEL/SOP/O & M/03	0.15
6.	Silica as SiO ₂	%	NGEL/SOP/O & M/04	40.28


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CIN: U13202OR2022PTC041062,
GISTIN NO. 21AAICN5648L1Z6



Report No: NGEL/NGP25112024/GR-84

Issue Date: 25.11.2024

ULR No. : TC-118802400000151F

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project,
Rayagada, Odisha

Date of sampling : -----

Sampling by : Client representative

Date of Sample Received : 30.10.2024

Date of Analysis : 05.11.2024 to 20.11.2024

Sample Description : Graphite Ore

Sample Quantity : 100 gm

Location with Lab ID : (NCG-7), NGEL/24-25/GR-84

Reference No : NGEL-25112024/GR-84

Analysis Results

Sl No	Parameters	Unit	Standard Method	Test Results
1.	Ash	%	IS 11321	91.86
2.	Moisture	%	IS 11321	0.59
3.	LOI	%	NGEL/SOP/O & M/01	8.53
4.	Fixed Carbon	%	NGEL/SOP/O & M/02	0.93
5.	Alumina as Al ₂ O ₃	%	NGEL/SOP/O & M/03	0.16
6.	Silica as SiO ₂	%	NGEL/SOP/O & M/04	52.53

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Ph. 0674 - 2355490, Mob.9437568822, 9178145817, E-mail: newgreenenvolab01@gmail.com



CIN: U13202OR2022PTC041062,
GISTIN NO. 21AAICN5648L1Z6



Report No: NGEL/NGP25112024/GR-85
ULR No. : TC-1188024000000152F

Issue Date: 25.11.2024

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project,
Rayagada, Odisha
Date of sampling : -----
Sampling by : Client representative
Date of Sample Received : 30.10.2024
Date of Analysis : 05.11.2024 to 20.11.2024
Sample Description : Graphite Ore
Sample Quantity : 100 gm
Location with Lab ID : (NCG-8), NGEL/24-25/GR-85
Reference No : NGEL-25112024/GR-85

Analysis Results

Sl No	Parameters	Unit	Standard Method	Test Results
1.	Ash	%	IS 11321	87.14
2.	Moisture	%	IS 11321	1.59
3.	LOI	%	NGEL/SOP/O & M/01	13.84
4.	Fixed Carbon	%	NGEL/SOP/O & M/02	1.72
5.	Alumina as Al ₂ O ₃	%	NGEL/SOP/O & M/03	0.26
6.	Silica as SiO ₂	%	NGEL/SOP/O & M/04	44.54

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(Dr. Tribikram Sahu)

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CIN: U13202OR2022PTC041062,
GISTIN NO. 21AAICN5648L1Z6



TC-11880

Report No: NGEL/NGP25112024/GR-86

Issue Date: 25.11.2024

ULR No. : TC-1188024000000153F

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project, Rayagada, Odisha

Date of sampling : -----

Sampling by : Client representative

Date of Sample Received : 30.10.2024

Date of Analysis : 05.11.2024 to 20.11.2024

Sample Description : Graphite Ore

Sample Quantity : 100 gm

Location with Lab ID : (NCG-10), NGEL/24-25/GR-86

Reference No : NGEL-25112024/GR-86

Analysis Results

Sl No	Parameters	Unit	Standard Method	Test Results
1.	Ash	%	IS 11321	94.52
2.	Moisture	%	IS 11321	0.58
3.	LOI	%	NGEL/SOP/O & M/01	6.13
4.	Fixed Carbon	%	NGEL/SOP/O & M/02	0.75
5.	Alumina as Al ₂ O ₃	%	NGEL/SOP/O & M/03	0.54
6.	Silica as SiO ₂	%	NGEL/SOP/O & M/04	43.55

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CIN: U13202OR2022PTC041062,
GISTIN NO. 21AAICN5648L1Z6



TC-11880

Report No: NGEL/NGP25112024/GR-87

Issue Date: 25.11.2024

ULR No. : TC-118802400000154F

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project,
Rayagada, Odisha

Date of sampling : -----

Sampling by : Client representative

Date of Sample Received : 30.10.2024

Date of Analysis : 05.11.2024 to 20.11.2024

Sample Description : Graphite Ore

Sample Quantity : 100 gm

Location with Lab ID : (NCG-13), NGEL/24-25/GR-87

Reference No : NGEL-25112024/GR-87

Analysis Results

Sl No	Parameters	Unit	Standard Method	Test Results
1.	Ash	%	IS 11321	87.97
2.	Moisture	%	IS 11321	0.37
3.	LOI	%	NGEL/SOP/O & M/01	12.35
4.	Fixed Carbon	%	NGEL/SOP/O & M/02	9.03
5.	Alumina as Al ₂ O ₃	%	NGEL/SOP/O & M/03	0.11
6.	Silica as SiO ₂	%	NGEL/SOP/O & M/04	40.67

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CIN: U13202OR2022PTC041062,
GISTIN NO. 21AAICN5648L1Z6



Report No: NGEL/NGP25112024/GR-88

Issue Date: 25.11.2024

ULR No. : TC-118802400000155F

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project,
Rayagada, Odisha

Date of sampling : -----

Sampling by : Client representative

Date of Sample Received : 30.10.2024

Date of Analysis : 05.11.2024 to 20.11.2024

Sample Description : Graphite Ore

Sample Quantity : 100 gm

Location with Lab ID : (NCG-14), NGEL/24-25/GR-88

Reference No : NGEL-25112024/GR-88

Analysis Results

Sl No	Parameters	Unit	Standard Method	Test Results
1.	Ash	%	IS 11321	89.02
2.	Moisture	%	IS 11321	0.30
3.	LOI	%	NGEL/SOP/O & M/01	11.27
4.	Fixed Carbon	%	NGEL/SOP/O & M/02	8.48
5.	Alumina as Al ₂ O ₃	%	NGEL/SOP/O & M/03	0.19
6.	Silica as SiO ₂	%	NGEL/SOP/O & M/04	39.86


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CIN: U13202OR2022PTC041062,
GISTIN NO. 21AAICN5648L1Z6



Report No: NGEL/NGP25112024/GR-89

Issue Date: 25.11.2024

ULR No. : TC-118802400000156F

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project,
Rayagada, Odisha

Date of sampling : -----

Sampling by : Client representative

Date of Sample Received : 30.10.2024

Date of Analysis : 05.11.2024 to 20.11.2024

Sample Description : Graphite Ore

Sample Quantity : 100 gm

Location with Lab ID : (NCG-16), NGEL/24-25/GR-89

Reference No : NGEL-25112024/GR-89

Analysis Results

Sl No	Parameters	Unit	Standard Method	Test Results
1.	Ash	%	IS 11321	94.08
2.	Moisture	%	IS 11321	0.51
3.	LOI	%	NGEL/SOP/O & M/01	6.34
4.	Fixed Carbon	%	NGEL/SOP/O & M/02	1.68
5.	Alumina as Al ₂ O ₃	%	NGEL/SOP/O & M/03	0.62
6.	Silica as SiO ₂	%	NGEL/SOP/O & M/04	41.26

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CIN: U13202OR2022PTC041062,
GISTIN NO. 21AAICN5648L1Z6



Report No: NGEL/NGP25112024/GR-90
ULR No. : TC-1188024000000157F

Issue Date: 25.11.2024

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project, Rayagada, Odisha

Date of sampling : -----

Sampling by : Client representative

Date of Sample Received : 30.10.2024

Date of Analysis : 05.11.2024 to 20.11.2024

Sample Description : Graphite Ore

Sample Quantity : 100 gm

Location with Lab ID : (NCG-19), NGEL/24-25/GR-90

Reference No : NGEL-25112024/GR-90

Analysis Results

Sl No	Parameters	Unit	Standard Method	Test Results
1.	Ash	%	IS 11321	86.93
2.	Moisture	%	IS 11321	3.30
3.	LOI	%	NGEL/SOP/O & M/01	14.73
4.	Fixed Carbon	%	NGEL/SOP/O & M/02	0.87
5.	Alumina as Al ₂ O ₃	%	NGEL/SOP/O & M/03	0.57
6.	Silica as SiO ₂	%	NGEL/SOP/O & M/04	50.78

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ANNEXURE-VI

Details of Internal Check Sample Analysis results of Naringpanga Graphite Block, Rayagada District.

SI. No.	Sample Identity No.	BH No.	Ash %	M %	F.C. %	LOI %	SiO ₂ %	Al ₂ O ₃ %
1	NCG - 1	NPBH-1/1	88.56	1.00	8.06	11.43	80.85	2.49
2	NCG - 2	NPBH-1/14	91.06	2.23	1.04	8.94	66.83	13.69
3	NCG - 3	NPBH-1/18	92.18	2.43	2.05	7.82	63.02	17.10
4	NCG - 4	NPBH-1/28	93.02	2.26	1.31	6.98	65.94	13.76
5	NCG - 5	NPBH-2/6	91.06	1.99	2.96	8.94	65.64	13.68
6	NCG - 6	NPBH-2/12	92.40	1.52	2.30	7.60	65.59	15.64
7	NCG - 7	NPBH-2/22	91.56	1.48	2.15	8.43	64.05	15.52
8	NCG - 8	NPBH-3/3	86.34	4.88	3.86	13.65	54.74	14.60
9	NCG - 9	NPBH-3/18	93.44	0.85	2.5	6.56	69.27	13.25
10	NCG - 10	NPBH-3/30	94.00	1.23	1.51	6.00	68.58	13.34
11	NCG - 11	NPBH-4/16	90.50	2.65	2.10	9.49	66.53	13.58
12	NCG - 12	NPBH-4/21	89.22	1.70	4.29	10.78	70.94	12.33
13	NCG - 13	NPBH-4/26	87.74	0.69	9.63	12.25	81.42	2.76
14	NCG - 14	NPBH-4/28	88.82	0.63	9.02	11.18	83.00	2.74
15	NCG - 15	NPBH-5/16	93.03	1.35	2.64	6.96	62.90	17.73
16	NCG - 16	NPBH-5/20	93.70	1.24	2.46	6.29	67.81	13.94
17	NCG - 17	NPBH-5/28	93.48	1.57	2.28	6.52	68.69	13.76
18	NCG - 18	NPBH-6/4	87.49	4.39	3.17	12.51	62.23	16.66
19	NCG - 19	NPBH-6/8	85.34	5.15	3.45	14.65	58.23	15.49
20	NCG - 20	NPBH-6/12	91.46	1.99	2.17	8.53	63.22	15.38



**DIRECTORATE OF MINES AND GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR**

Heds of Department Building, Unit-V, Pin-751001
Tel No.: 0674-2391537, Fax No.: 0674-2391684
Email ID: dirmines_odisha@rediffmail.com

No. 11210 /DoMG., Dt. 19-11-2024

From,

Dr. Sukanta Mishra,
Joint Director (C.A),
Directorate of Mines and Geology,
Odisha, Bhubaneswar.

To,

Sri Ramesh Behera,
Exploration-in-charge,
Naringpanga (S) Graphite Project.
Dist.-Rayagada,
Email Id: rameshbehera8@gmail.com

Sub: Submission of WD-XRF (Bruker Make) analysis report of 20 nos.
of Graphite Powdered samples.

Ref: Your letter No. 168/NGP/23-24, Dt.25.10.2024.

Sir,

With reference to the letter on the subject cited above, I am to
enclose herewith the WD-XRF analysis report of 20 (Twenty) nos. of
Graphite Powdered sample submitted to this Laboratory for chemical
analysis.

This is for favour of your information and necessary action.

Yours faithfully,

JOINT DIRECTOR (C.A)



**DIRECTORATE OF MINES AND GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR**

Heads of Department Building, Unit-V, Pin-751001
Tel No.: 0674-2391537, Fax No.: 0674-2391684
Email ID: dirmines_odisha@rediffmail.com

ANALYSIS REPORT

Name of the sample: Graphite Powdered sample.

Received from: EIC, Naringpanga (S) Graphite Project.

Sl. No.	Sample Identity No.	R.L. No.	Ash %	M %	F.C. %	LOI %	SiO ₂ %	Al ₂ O ₃ %
1	NCG - 1	1089-P/24	88.565	1	8.06	11.435	80.846	2.489
2	NCG - 2	1090-P/24	91.06	2.23	1.04	8.94	66.828	13.689
3	NCG - 3	1091-P/24	92.18	2.43	2.05	7.82	63.017	17.098
4	NCG - 4	1092-P/24	93.02	2.26	1.31	6.98	65.939	13.763
5	NCG - 5	1093-P/24	91.06	1.99	2.96	8.94	65.642	13.685
6	NCG - 6	1094-P/24	92.4	1.52	2.3	7.6	65.595	15.638
7	NCG - 7	1095-P/24	91.565	1.48	2.15	8.435	64.054	15.521
8	NCG - 8	1096-P/24	86.345	4.88	3.86	13.655	54.743	14.602
9	NCG - 9	1097-P/24	93.44	0.85	2.5	6.56	69.27	13.254
10	NCG - 10	1098-P/24	94	1.23	1.51	6	68.577	13.344
11	NCG - 11	1099-P/24	90.505	2.65	2.1	9.495	66.534	13.583
12	NCG - 12	1100-P/24	89.22	1.7	4.29	10.78	70.941	12.333
13	NCG - 13	1101-P/24	87.745	0.69	9.63	12.255	81.425	2.764
14	NCG - 14	1102-P/24	88.82	0.63	9.02	11.18	83	2.74
15	NCG - 15	1103-P/24	93.035	1.35	2.64	6.965	62.902	17.731
16	NCG - 16	1104-P/24	93.705	1.24	2.46	6.295	67.808	13.937
17	NCG - 17	1105-P/24	93.48	1.57	2.28	6.52	68.688	13.761
18	NCG - 18	1106-P/24	87.49	4.39	3.17	12.51	62.233	16.664
19	NCG - 19	1107-P/24	85.345	5.15	3.45	14.655	58.228	15.489
20	NCG - 20	1108-P/24	91.465	1.99	2.17	8.535	63.226	15.379


JOINT DIRECTOR (C.A.)
Joint Director (C.A.)
Directorate of Mines and Geology
Odisha, Bhubaneswar

ANNEXURE-VII

COMPOSITE SAMPLE RESULT OF NARINGPANGA (S) GRAPHITE BLOCK

SI No.	Identity Mark	Lab No.	Ash%	M%	V.M%	F.C%	LOI%	SiO ₂ %	Al ₂ O ₃ %
1	NPC1/1C	865-P/24	91.66	2.06	3.32	2.96	8.34	69.93	11.29
2	NPC1/2C	866-P/24	93.34	1.69	3.08	1.89	6.66	67.99	12.93
	NPBH-1	Average	92.50	1.88	3.20	2.43	7.50	68.96	12.11
3	NPC2/1C	867-P/24	93.80	1.50	3.26	1.44	6.20	70.54	12.52
4	NPC2/2C	868-P/24	93.00	1.29	4.50	1.21	7.00	64.06	16.21
	NPBH-2	Average	93.40	1.40	3.88	1.33	6.60	67.30	14.37
5	NPC3/1C	869-P/24	93.56	1.33	3.20	1.91	6.44	65.70	15.86
6	NPC3/2C	870-P/24	93.16	1.00	3.25	2.59	6.84	67.90	14.09
	NPBH-3	Average	93.36	1.17	3.23	2.25	6.64	66.80	14.98
7	NPC4/1C	871-P/24	91.98	2.04	4.45	1.53	8.02	66.05	14.59
8	NPC4/2C	872-P/24	90.16	1.40	3.45	4.99	9.84	72.70	9.94
	NPBH-4	Average	91.07	1.72	3.95	3.26	8.93	69.37	12.26
9	NPC5/1C	873-P/24	95.26	1.03	2.35	1.36	4.74	69.76	14.19
10	NPC5/2C	874-P/24	94.96	1.06	2.51	1.47	5.04	70.20	12.97
	NPBH-5	Average	95.11	1.05	2.43	1.42	4.89	69.98	13.58
11	NPBH-6	875-P/24	87.14	2.82	4.65	5.39	12.86	63.66	16.12



**DIRECTORATE OF MINES AND GEOLOGY
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Heads of Department Building, Unit-V, Pin-751001
Tel No.: 0674-2391537, Fax No.: 0674-2391684
Email ID: dirmines_odisha@rediffmail.com

No. 10218 /DoMG., Dt. 22-10-2024

From,

Dr. Sukanta Mishra,
Joint Director (C.A),
Directorate of Mines and Geology,
Odisha, Bhubaneswar.

To,

Exploration-in-charge,
Naringpanga (S & W) Graphite Project.
Dist.-Rayagada,
Email Id: rameshbehera8@gmail.com

Sub: Submission WD-XRF analysis report of 11 nos. of Graphite samples.

Ref: Your letter No. 125/NGP/23-24, Dt. 16.08.2024.

Sir,

With reference to your letter cited above, I am to enclose herewith the WD-XRF analysis report of 11 (Eleven) nos. of Graphite samples submitted to this Laboratory for chemical analysis.

This is for favour of your information and necessary action.

Yours faithfully,

JOINT DIRECTOR (C.A)



**DIRECTORATE OF MINES AND GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR**

Heads of Department Building, Unit-V, Pin-751001
Tel No.: 0674-2391537, Fax No.: 0674-2391684
Email ID: dirmines_odisha@rediffmail.com

ANALYSIS REPORT

Name of the sample: Graphite sample.

Received from: EIC, Naringpanga (S & W) Graphite Project.

SI No.	Identity Mark	Lab No.	Ash %	M %	V.M %	F.C %	LOI %	SiO ₂ (%)	Al ₂ O ₃ (%)	V ₂ O ₅ (%)
1	NPC1/1C	865-P/24	91.660	2.060	3.320	2.960	8.340	69.925	11.285	0.000
2	NPC1/2C	866-P/24	93.340	1.690	3.080	1.890	6.660	67.992	12.931	0.000
3	NPC2/1C	867-P/24	93.800	1.500	3.260	1.440	6.200	70.540	12.518	0.000
4	NPC2/2C	868-P/24	93.000	1.290	4.500	1.210	7.000	64.058	16.213	0.000
5	NPC3/1C	869-P/24	93.560	1.330	3.200	1.910	6.440	65.701	15.861	0.000
6	NPC3/2C	870-P/24	93.160	1.000	3.250	2.590	6.840	67.904	14.090	0.000
7	NPC4/1C	871-P/24	91.980	2.040	4.450	1.530	8.020	66.050	14.589	0.000
8	NPC4/2C	872-P/24	90.160	1.400	3.450	4.990	9.840	72.696	9.937	0.000
9	NPC5/1C	873-P/24	95.260	1.030	2.350	1.360	4.740	69.756	14.187	0.000
10	NPC5/2C	874-P/24	94.960	1.060	2.510	1.470	5.040	70.195	12.973	0.000
11	NPC6/1C	875-P/24	87.140	2.820	4.650	5.390	12.860	63.658	16.122	0.000

[Signature]
20.10.24

JOINT DIRECTOR (C.A)
Joint Director (C.A)
Directorate of Mines and Geology
Odisha, Bhubaneswar

ANNEXURE-VIII

CROSS SECTION WISE BOREHOLE DETAILS OF NARINGPANGA BLOCK

NARINGPANGA GRAPHITE BLOCK		
Section	Boreholes	
A-A'	NPBH-1	
B-B'	NPBH-2	
C-C'	NPBH-4	
D-D'	NPBH-3	
E-E'	NPBH-5	NPBH-6

ANNEXURE-IX

RESOURCE CALCULATION BY CROSS-SECTIONAL METHOD

Ore category	Section area (m ²)	Length of influence (m)	Volume (m ³)	Recovery Factor (%)	Bulk density	Resource(t)
A-A'						
FC (2-5%)	2172.95	38	82572.1	70	1.606	92827.55
B-B'						
FC (2-5%)	560.25	85	47621.25	70	1.606	53535.81
C-C'						
FC (2-5%)	1211.37	82	99332.34	70	1.606	111669.40
D-D'						
FC (2-5%)	1212.81	66	80045.46	70	1.606	89987.11
E-E'						
FC (2-5%)	586.05	98	57432.9	70	1.606	64566.07
			367004.05	Total (A)		412585.95

PIT-2 (Surface method)

Ore category	Surface area (m ²)	Thickness(m)	Volume (m ³)	Recovery Factor (%)	Bulk density	Resource (t)
FC (2-5%)	2500	0.3	750	70	1.606	843.15
Total (B)						843.15
Grand Total resource of the Block (In metric tonnes): (A+B) in t						413429
Grand Total resource of the Block (In Million tonnes) in mt						0.41343

ANNEXURE-X

SUMMARY OF RESOURCE CALCULATION

Section	Graphite F.C (2-5%) in metric tonnes (t)
A-A'	92827.55
B-B'	53535.81
C-C'	111669.40
D-D'	89987.11
E-E'	64566.07
PIT-2	843.15
Total Resource in Metric Tonnes (t)	413429.1
Total Resource in Million Tonnes (mt)	0.41343

ANNEXURE-XI

CALCULATION OF ORE: OB OF NARINGPANGA GRAPHITE BLOCK

CALCULATION OF ORE:OB OF NARINGPANGA GRAPHITE BLOCK						
Section	Sectional area of ore in m ²	Over burden Sectional area in m ²	Strike Influence in m	Volume of Ore in m ³	volume of over burden in m ³	Ore : OB
AA'	2172.95	391.61	38	82572.1	14881.18	0.180
BB'	560.25	348.33	85	47621.25	29608.05	0.622
CC'	1211.37	609.54	82	99332.34	49982.28	0.503
DD'	1212.81	404.82	66	80045.46	26718.12	0.334
EE'	586.05	719.25	98	57432.9	70486.5	1.227
	Sectional area of ore in m ²	Over burden Sectional area in m ²	Strike Influence in (m)	Volume of Ore in m ³	Volume of over burden in m ³	Ore : OB
PIT-2	15	185	50	750	9250	12.333
TOTAL				367754.05	200926.13	0.546
ORE:OB						1:0.546

ANNEXURE-XII
CHEMICAL ANALYSIS OF 160 GRAPHITE POWDERED SAMPLE OF
NARINGPANGA (S) BLOCK, RAYAGADA DISTRICT, ODISHA

	NPBH-1												
SL. No.	POWDERED SAMPLE	FROM	TO	LENGTH	R.L. No.	Ash %	M %	V.M %	F.C %	LOI %	SiO ₂ %	Al ₂ O ₃ %	V ₂ O ₅ (%)
1	NPG-1/1	12.00	13.00	1.00	834-P/24	88.63	1.15	2.38	7.84	11.37	80.78	2.58	0.00
2	NPG-1/2	13.00	14.00	1.00	835-P/24	89.77	0.71	1.93	7.59	10.23	82.87	2.72	0.00
3	NPG-1/3	21.00	22.00	1.00	836-P/24	86.59	2.97	3.68	6.76	13.41	68.94	5.58	0.00
4	NPG-1/4	22.00	23.00	1.00	837-P/24	89.08	2.70	4.31	3.92	10.93	72.80	5.32	0.00
5	NPG-1/5	23.00	24.00	1.00	838-P/24	91.38	2.11	3.99	2.53	8.63	75.94	6.68	0.01
6	NPG-1/6	24.00	25.00	1.00	839-P/24	90.32	1.24	3.66	4.79	9.69	74.92	7.09	0.01
7	NPG-1/7	25.00	26.00	1.00	840-P/24	85.49	4.68	5.73	4.10	14.50	54.57	15.80	0.01
8	NPG-1/8	26.00	27.00	1.00	841-P/24	85.55	1.79	5.41	7.25	14.45	61.66	12.77	0.00
9	NPG-1/9	27.00	28.00	1.00	842-P/24	93.91	1.65	1.01	3.44	6.10	74.90	8.42	0.00
10	NPG-1/10	28.30	29.30	1.00	843-P/24	94.29	1.38	1.06	3.28	5.72	68.95	14.09	0.00
11	NPG-1/11	29.30	30.30	1.00	844-P/24	94.43	1.01	1.09	3.48	5.58	71.40	14.42	0.00
12	NPG-1/12	30.30	31.00	0.70	845-P/24	94.10	1.42	0.98	3.51	5.91	70.28	13.82	0.00
13	NPG-1/13	31.85	32.85	1.00	846-P/24	91.12	2.40	4.08	2.40	8.88	64.76	13.31	0.00
14	NPG-1/14	32.85	34.00	1.15	847-P/24	91.18	2.33	1.12	5.37	8.82	66.62	13.75	0.00
15	NPG-1/15	42.50	43.50	1.00	848-P/24	94.56	1.79	2.42	1.23	5.44	64.52	16.20	0.00
16	NPG-1/16	43.50	44.30	0.80	849-P/24	92.46	2.31	3.04	2.19	7.54	63.27	17.76	0.00
17	NPG-1/17	45.15	45.65	0.50	850-P/24	95.44	1.12	2.33	1.11	4.56	69.05	13.16	0.00
18	NPG-1/18	52.10	53.10	1.00	851-P/24	92.30	1.75	3.95	2.00	7.70	63.24	17.09	0.00
19	NPG-1/19	53.10	54.10	1.00	852-P/24	94.64	1.67	2.37	1.32	5.36	66.04	16.18	0.00
20	NPG-1/20	54.10	55.10	1.00	853-P/24	92.40	2.13	3.40	2.07	7.60	67.35	13.56	0.00
21	NPG-1/21	55.10	55.70	0.60	854-P/24	93.94	1.18	3.31	1.57	6.06	72.53	9.74	0.00
22	NPG-1/22	56.35	57.35	1.00	855-P/24	92.98	1.48	2.95	2.59	7.02	68.21	12.90	0.00
23	NPG-1/23	57.35	58.30	0.95	856-P/24	94.10	1.43	2.39	2.08	5.90	72.24	10.41	0.00
24	NPG-1/24	59.00	60.00	1.00	857-P/24	93.28	1.90	2.89	1.93	6.72	68.30	12.69	0.00
25	NPG-1/25	60.00	61.00	1.00	858-P/24	92.98	1.66	3.18	2.18	7.02	67.34	12.88	0.00
26	NPG-1/26	61.00	62.00	1.00	859-P/24	93.08	1.72	3.29	1.91	6.92	69.16	11.01	0.00
27	NPG-1/27	62.00	63.30	1.30	860-P/24	90.40	2.48	4.25	2.87	9.60	61.94	13.89	0.00
28	NPG-1/28	65.00	65.80	0.80	861-P/24	93.02	2.26	3.33	1.31	6.98	65.94	13.76	0.00
29	NPG-1/29	67.00	68.00	1.00	862-P/24	92.64	1.75	4.06	1.55	7.36	67.37	13.20	0.00
30	NPG-1/30	68.00	69.00	1.00	863-P/24	94.50	0.98	1.95	2.57	5.50	67.06	14.21	0.00
31	NPG-1/31	69.00	69.50	0.50	864-P/24	92.52	1.04	2.30	4.14	7.48	73.73	11.50	0.00

	NPBH NO-2									
Sl. No.	Sample No.	R.L. No.	FROM	TO	Ash %	M %	F.C %	LOI %	SiO ₂ %	Al ₂ O ₃ %
1	NPG - 2/1	518-P/24	6.20	7.20	93.16	2.10	0.79	6.84	67.86	9.54
2	NPG - 2/2	519-P/24	7.20	8.20	90.44	3.51	0.96	9.06	62.86	11.28
3	NPG - 2/3	520-P/24	8.20	9.50	92.64	2.08	1.20	7.36	65.58	8.74
4	NPG - 2/4	521-P/24	12.00	13.00	91.80	1.55	2.04	8.20	63.02	14.44

5	NPG - 2/5	522-P/24	13.00	13.50	93.92	1.27	1.20	6.08	66.18	12.42
6	NPG - 2/6	523-P/24	15.60	16.50	91.30	1.91	2.66	8.70	64.90	12.94
7	NPG - 2/7	524-P/24	17.50	18.00	92.30	1.80	2.14	7.70	67.20	10.72
8	NPG - 2/8	525-P/24	19.00	20.50	94.40	1.17	2.01	5.60	70.02	6.70
9	NPG - 2/9	526-P/24	21.90	22.90	96.18	0.63	1.50	3.82	74.68	13.50
10	NPG - 2/10	527-P/24	22.90	23.90	96.46	0.99	0.98	3.54	70.74	12.50
11	NPG - 2/11	528-P/24	24.50	25.30	95.26	1.01	1.36	4.74	72.46	9.70
12	NPG - 2/12	529-P/24	26.50	27.00	92.20	1.56	2.39	7.80	64.76	13.94
13	NPG - 2/13	530-P/24	41.45	42.45	92.88	0.91	2.09	7.12	63.54	15.26
14	NPG - 2/14	531-P/24	42.45	43.45	93.18	0.40	1.80	6.82	68.34	10.94
15	NPG - 2/15	532-P/24	43.45	44.45	91.88	1.04	2.24	8.12	60.50	17.76
16	NPG - 2/16	533-P/24	44.45	45.45	93.34	1.06	1.88	6.66	67.72	13.72
17	NPG - 2/17	534-P/24	45.45	46.45	93.90	0.76	1.61	6.10	67.00	11.38
18	NPG - 2/18	535-P/24	46.45	47.45	92.96	0.82	1.63	7.04	66.66	11.02
19	NPG - 2/19	536-P/24	47.45	48.45	93.00	0.93	1.98	7.00	63.66	15.46
20	NPG - 2/20	537-P/24	48.45	49.45	92.44	1.50	1.47	7.56	61.20	17.56
21	NPG - 2/21	538-P/24	49.45	50.45	94.40	1.23	0.58	5.60	66.48	12.38
22	NPG - 2/22	539-P/24	50.45	51.70	91.88	1.33	2.00	8.12	64.30	12.02
23	NPG - 2/23	540-P/24	53.00	54.00	92.04	2.06	0.48	7.96	61.14	19.68
24	NPG - 2/24	541-P/24	54.50	55.00	94.58	1.52	0.53	5.42	58.94	18.02

Sl. No.	NPBH NO-3									
	Sample No.	R.L. No.	FROM	TO	Ash %	M %	F.C %	LOI %	SiO ₂ %	Al ₂ O ₃ %
1	NPG - 3/1	542-P/24	15.50	16.30	93.48	2.49	1.39	6.52	64.34	15.58
2	NPG - 3/2	543-P/24	18.50	19.50	96.30	0.78	0.98	3.70	72.08	15.16
3	NPG - 3/3	544-P/24	20.50	21.10	86.00	5.14	3.93	12.00	55.06	14.32
4	NPG - 3/4	545-P/24	41.60	42.60	95.94	0.80	1.18	4.06	67.48	12.74
5	NPG - 3/5	546-P/24	42.60	43.60	94.78	0.85	0.93	5.22	63.28	18.44
6	NPG - 3/6	547-P/24	43.60	44.60	93.34	1.55	1.26	6.66	64.50	19.20
7	NPG - 3/7	548-P/24	44.60	45.60	93.20	1.04	1.55	6.80	64.46	17.74
8	NPG - 3/8	549-P/24	45.60	46.60	93.86	1.35	1.02	6.14	65.90	16.44
9	NPG - 3/9	550-P/24	46.60	47.60	94.18	0.85	1.33	5.82	65.80	16.22
10	NPG - 3/10	551-P/24	47.60	48.60	94.42	0.78	1.27	5.58	62.58	19.78
11	NPG - 3/11	552-P/24	48.60	49.60	94.28	0.85	1.65	5.72	65.40	16.30
12	NPG - 3/12	553-P/24	49.60	50.60	93.36	0.84	2.37	6.64	63.12	17.96
13	NPG - 3/13	554-P/24	50.60	51.60	93.06	0.93	1.96	6.94	59.74	16.42
14	NPG - 3/14	555-P/24	51.60	52.60	92.78	0.87	2.57	7.22	63.58	16.48
15	NPG - 3/15	556-P/24	52.60	53.60	93.00	0.93	2.43	7.00	63.10	16.06
16	NPG - 3/16	557-P/24	53.60	54.60	94.78	1.04	1.21	5.22	63.62	18.30
17	NPG - 3/17	558-P/24	54.60	55.60	94.02	0.64	1.74	5.98	65.92	17.84
18	NPG - 3/18	559-P/24	55.60	56.60	93.08	0.81	2.64	6.92	66.34	12.08
19	NPG - 3/19	560-P/24	56.60	57.60	92.90	0.95	2.73	7.10	65.22	16.34
20	NPG - 3/20	561-P/24	57.60	58.60	95.04	0.95	1.33	4.96	65.56	16.08
21	NPG - 3/21	562-P/24	61.00	62.00	93.30	0.84	2.08	6.70	65.60	16.30

22	NPG - 3/22	563-P/24	62.00	63.00	92.12	0.96	2.82	7.80	60.78	11.78
23	NPG - 3/23	564-P/24	63.00	64.00	92.80	0.86	2.81	7.20	65.00	9.54
24	NPG - 3/24	565-P/24	64.00	65.00	92.60	0.99	2.79	7.40	62.08	17.66
25	NPG - 3/25	566-P/24	65.00	66.00	92.42	0.71	2.94	7.58	64.54	16.42
26	NPG - 3/26	567-P/24	66.00	67.00	92.88	0.94	1.85	7.12	66.04	13.64
27	NPG - 3/27	568-P/24	67.00	68.00	89.96	1.78	2.94	10.04	61.60	17.34
28	NPG - 3/28	569-P/24	68.00	69.00	92.04	1.38	2.24	7.96	67.04	15.48
29	NPG - 3/29	570-P/24	69.00	71.00	93.84	1.24	1.84	6.16	70.16	12.76
30	NPG - 3/30	571-P/24	71.00	71.95	93.96	1.14	2.07	6.04	66.26	15.78
31	NPG - 3/31	572-P/24	72.50	73.40	95.16	1.09	1.50	4.84	71.96	13.58

	NPBH-4									
Sl. No.	Sample No.	R.L. No.	FROM	TO	Ash %	M %	F.C %	LOI %	SiO ₂ %	Al ₂ O ₃ %
1	NPG - 4/1	573-P/24	11.00	12.00	88.86	3.58	2.12	11.14	59.14	14.44
2	NPG - 4/2	574-P/24	12.00	13.05	90.76	3.11	1.95	9.24	66.22	12.30
3	NPG - 4/3	575-P/24	17.00	18.00	93.24	1.68	0.91	6.76	66.84	11.28
4	NPG - 4/4	576-P/24	18.00	19.00	90.56	2.08	1.52	9.44	60.82	17.14
5	NPG - 4/5	577-P/24	19.00	20.00	90.34	1.82	1.89	9.66	58.32	19.86
6	NPG - 4/6	578-P/24	20.00	21.00	91.46	1.93	0.91	8.54	57.04	12.94
7	NPG - 4/7	579-P/24	21.00	22.00	89.82	2.45	3.11	10.18	65.58	9.72
8	NPG - 4/8	580-P/24	22.00	23.00	93.34	1.78	1.19	6.66	66.30	12.42
9	NPG - 4/9	581-P/24	23.00	24.00	89.10	3.11	1.67	10.90	53.42	14.58
10	NPG - 4/10	582-P/24	24.00	25.00	91.32	1.76	1.92	8.68	64.24	10.10
11	NPG - 4/11	583-P/24	25.00	26.00	94.30	1.48	0.56	5.70	65.40	10.20
12	NPG - 4/12	584-P/24	26.00	27.00	93.54	1.45	0.66	6.46	60.72	14.16
13	NPG - 4/13	585-P/24	28.00	29.00	92.32	1.83	1.80	7.68	67.60	10.94
14	NPG - 4/14	586-P/24	29.00	30.00	92.24	1.88	1.60	7.76	64.14	13.46
15	NPG - 4/15	587-P/24	31.00	32.00	90.18	2.31	2.33	9.82	66.02	11.80
16	NPG - 4/16	749-P/24	32.00	33.00	90.62	1.00	2.38	9.38	67.68	11.56
17	NPG - 4/17	750-P/24	33.50	34.00	91.42	1.21	2.74	8.58	72.46	10.30
18	NPG - 4/18	751-P/24	34.00	35.00	91.50	1.38	1.92	8.50	67.36	10.28
19	NPG - 4/19	752-P/24	35.00	36.00	91.66	1.50	1.78	8.34	68.52	7.58
20	NPG - 4/20	753-P/24	36.00	37.00	91.44	1.15	2.25	8.56	68.32	14.90
21	NPG - 4/21	754-P/24	37.00	38.00	89.50	0.97	4.60	10.50	70.78	8.50
22	NPG - 4/22	755-P/24	38.00	39.00	87.72	2.48	5.47	12.28	66.42	7.68
23	NPG - 4/23	756-P/24	40.50	41.50	85.24	3.89	4.15	14.76	54.36	8.50

24	NPG - 4/24	757-P/24	41.50	42.50	89.48	0.20	8.16	10.52	81.44	0.50
25	NPG - 4/25	758-P/24	42.50	43.50	89.60	0.21	8.06	10.40	82.70	1.80
26	NPG - 4/26	759-P/24	43.50	44.50	87.48	0.30	10.03	12.52	78.62	3.00
27	NPG - 4/27	760-P/24	44.50	45.50	87.62	0.35	9.84	12.38	80.34	1.00
28	NPG - 4/28	761-P/24	45.50	46.30	88.60	0.19	9.26	11.40	80.72	0.60
29	NPG - 4/29	762-P/24	46.30	47.00	91.74	0.69	2.36	8.26	62.38	13.48
30	NPG - 4/30	763-P/24	47.00	48.00	90.80	0.67	3.10	9.20	65.66	11.26
31	NPG - 4/31	764-P/24	48.00	49.00	92.84	1.42	1.95	7.16	68.82	11.86

	NPBH NO-5									
Sl. No.	Sample No.	R.L. No.	FROM	TO	Ash %	M %	F.C %	LOI %	SiO2 %	Al2O3 %
1	NPG - 5/1	765-P/24	31.00	32.00	95.38	1.08	1.57	4.62	69.14	13.26
2	NPG - 5/2	766-P/24	34.00	35.00	95.36	0.83	0.58	4.64	65.34	15.46
3	NPG - 5/3	767-P/24	35.00	36.00	94.66	1.52	1.09	5.34	65.38	12.06
4	NPG - 5/4	768-P/24	40.00	41.00	98.16	0.37	0.41	1.84	64.16	17.18
5	NPG - 5/5	769-P/24	44.00	45.00	95.66	0.87	1.03	4.34	65.34	15.62
6	NPG - 5/6	770-P/24	45.00	46.00	94.88	0.90	1.39	5.12	66.92	12.52
7	NPG - 5/7	771-P/24	46.00	46.50	96.76	0.55	1.01	3.24	70.48	12.38
8	NPG - 5/8	772-P/24	52.30	53.00	95.24	0.78	1.70	4.76	68.20	14.48
9	NPG - 5/9	773-P/24	53.50	54.00	95.42	0.88	1.60	4.58	63.70	15.66
10	NPG - 5/10	774-P/24	54.50	55.50	94.94	0.81	1.26	5.06	61.38	17.88
11	NPG - 5/11	775-P/24	55.50	56.50	95.28	0.94	0.88	4.72	66.28	18.16
12	NPG - 5/12	776-P/24	56.50	57.50	94.36	1.14	1.15	5.64	63.84	16.06
13	NPG - 5/13	777-P/24	57.50	58.50	94.76	1.19	1.01	5.24	67.68	14.22
14	NPG - 5/14	778-P/24	58.50	59.50	93.30	1.09	1.96	6.70	63.86	14.06
15	NPG - 5/15	779-P/24	59.50	60.50	93.14	1.02	1.85	6.86	63.42	17.64
16	NPG - 5/16	780-P/24	60.50	61.50	91.76	1.22	2.94	8.26	62.70	14.02
17	NPG - 5/17	781-P/24	61.50	62.30	93.58	1.20	1.61	6.42	56.92	16.44
18	NPG - 5/18	782-P/24	63.00	64.00	93.60	1.03	2.53	6.40	66.86	13.82
19	NPG - 5/19	783-P/24	64.00	65.00	94.52	1.08	1.76	5.48	67.84	12.86
20	NPG - 5/20	784-P/24	65.00	66.00	93.66	1.31	2.50	6.34	66.12	12.56
21	NPG - 5/21	785-P/24	66.00	67.00	95.76	0.89	1.34	4.24	69.72	12.16
22	NPG - 5/22	786-P/24	67.00	68.00	96.04	1.10	1.14	3.96	70.56	10.92
23	NPG - 5/23	787-P/24	68.00	69.00	94.58	1.51	1.54	5.42	68.18	9.82
24	NPG - 5/24	788-P/24	69.00	70.00	95.52	1.43	0.64	4.48	67.20	13.62
25	NPG - 5/25	789-P/24	70.00	71.00	95.70	1.01	1.26	4.30	75.66	4.16
26	NPG - 5/26	790-P/24	71.00	72.00	96.96	1.60	0.90	3.04	80.98	4.92
27	NPG - 5/27	791-P/24	72.00	73.50	97.44	0.61	0.36	2.56	68.92	13.92
28	NPG - 5/28	792-P/24	73.50	75.00	93.24	1.90	2.35	6.76	67.16	13.16

NPBH NO-6												
Sl. No.	SAMPLE NO.	FROM	TO	R.L. No.	Ash %	M %	V.M %	F.C %	LOI %	SiO ₂ %	Al ₂ O ₃ %	V ₂ O ₅ (%)
1	NPG 6/1	17.80	19.00	819-P/24	90.64	3.28	4.33	1.76	9.37	66.99	14.47	0.00
2	NPG 6/2	21.00	21.50	820-P/24	89.30	3.56	6.26	0.89	10.71	66.21	15.59	0.00
3	NPG 6/3	25.00	26.00	821-P/24	90.00	3.49	4.69	1.82	10.00	61.20	17.10	0.00
4	NPG 6/4	26.00	27.00	822-P/24	86.62	4.81	4.66	3.91	13.38	62.02	16.05	0.00
5	NPG 6/5	27.00	28.00	823-P/24	90.20	3.74	3.46	2.61	9.81	69.86	12.16	0.00
6	NPG 6/6	28.00	29.00	824-P/24	88.33	4.66	4.42	2.60	11.68	66.72	13.74	0.00
7	NPG 6/7	29.00	30.00	825-P/24	86.84	5.19	5.09	2.89	13.17	61.94	16.16	0.00
8	NPG 6/8	30.00	31.00	826-P/24	85.56	5.31	5.76	3.38	14.45	57.56	16.18	0.00
9	NPG 6/9	46.50	47.50	827-P/24	94.78	1.00	3.61	0.62	5.23	64.63	16.22	0.00
10	NPG 6/10	47.50	48.50	828-P/24	95.16	1.04	3.77	0.03	3.09	67.79	15.73	0.00
11	NPG 6/11	48.50	49.00	829-P/24	91.33	1.69	5.10	1.88	8.67	61.69	17.48	0.00
12	NPG 6/12	51.20	51.70	830-P/24	91.31	1.51	4.79	2.40	8.70	63.38	15.72	0.00
13	NPG 6/13	52.05	53.05	831-P/24	98.03	0.70	1.19	0.08	0.27	70.06	17.06	0.00
14	NPG 6/14	53.05	53.60	832-P/24	94.64	0.98	3.62	0.76	5.36	65.25	17.69	0.00
15	NPG 6/15	56.00	57.10	833-P/24	91.24	1.56	5.46	1.75	8.77	64.44	15.59	0.00



**DIRECTORATE OF MINES AND GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR**

Heads of Department Building, Unit-V, Pin-751001
Tel No.: 0674-2391537, Fax No.: 0674-2391684
Email ID: dirmines_odisha@rediffmail.com

No. 10219 /DoMG., Dt. 22-10-2024

From,

Dr. Sukanta Mishra,
Joint Director (C.A),
Directorate of Mines and Geology,
Odisha, Bhubaneswar.

To,

Exploration-in-charge,
Naringpanga (S & W) Graphite Project.
Dist.-Rayagada,
Email Id: rameshbehera8@gmail.com

Sub: Submission WD-XRF analysis report of 46 nos. of Graphite samples.

Ref: Your letter No. 123/NGP/23-24, Dt. 16.08.2024.

Sir,

With reference to your letter cited above, I am to enclose herewith the WD-XRF analysis report of 46 (Forty-Six) nos. of Graphite samples submitted to this Laboratory for chemical analysis.

This is for favour of your information and necessary action.

Yours faithfully,

JOINT DIRECTOR (C.A)



**DIRECTORATE OF MINES AND GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR**

Heads of Department Building, Unit-V, Pin-751001

Tel No.: 0674-2391537, Fax No.: 0674-2391684

Email ID: dirmines_odisha@rediffmail.com

ANALYSIS REPORT

Name of the sample: Graphite sample.

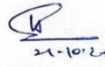
Received from: EIC, Naringpanga (S & W) Graphite Project.

Sl No.	Identity Mark	Lab No.	Ash %	M %	V.M %	F.C %	LOI %	SiO ₂ (%)	Al ₂ O ₃ (%)	V ₂ O ₅ (%)
1	NPG 6/1	819-P/24	90.635	3.280	4.330	1.755	9.365	66.991	14.471	0.000
2	NPG 6/2	820-P/24	89.295	3.560	6.260	0.885	10.705	66.205	15.593	0.000
3	NPG 6/3	821-P/24	90.000	3.490	4.690	1.820	10.000	61.203	17.101	0.000
4	NPG 6/4	822-P/24	86.620	4.810	4.660	3.910	13.380	62.015	16.046	0.000
5	NPG 6/5	823-P/24	90.195	3.740	3.460	2.605	9.805	69.864	12.162	0.000
6	NPG 6/6	824-P/24	88.325	4.660	4.420	2.595	11.675	66.721	13.744	0.000
7	NPG 6/7	825-P/24	86.835	5.190	5.090	2.885	13.165	61.944	16.162	0.000
8	NPG 6/8	826-P/24	85.555	5.310	5.760	3.375	14.445	57.558	16.184	0.000
9	NPG 6/9	827-P/24	94.775	1.000	3.610	0.615	5.225	64.628	16.216	0.000
10	NPG 6/10	828-P/24	95.161	1.040	3.770	0.029	3.085	67.790	15.730	0.000
11	NPG 6/11	829-P/24	91.330	1.690	5.100	1.880	8.670	61.686	17.480	0.000
12	NPG 6/12	830-P/24	91.305	1.510	4.790	2.395	8.695	63.382	15.717	0.000
13	NPG 6/13	831-P/24	98.030	0.700	1.190	0.080	0.270	70.061	17.060	0.000
14	NPG 6/14	832-P/24	94.640	0.980	3.620	0.760	5.360	65.253	17.689	0.000
15	NPG 6/15	833-P/24	91.235	1.560	5.460	1.745	8.765	64.439	15.593	0.000
16	NPG 1/1	834-P/24	88.630	1.150	2.380	7.840	11.370	80.775	2.583	0.000
17	NPG 1/2	835-P/24	89.770	0.710	1.930	7.590	10.230	82.873	2.717	0.000
18	NPG 1/3	836-P/24	86.590	2.970	3.680	6.760	13.410	68.941	5.580	0.000
19	NPG 1/4	837-P/24	89.075	2.700	4.310	3.915	10.925	72.795	5.320	0.001
20	NPG 1/5	838-P/24	91.375	2.110	3.990	2.525	8.625	75.937	6.675	0.005
21	NPG 1/6	839-P/24	90.315	1.240	3.660	4.785	9.685	74.921	7.094	0.005
22	NPG 1/7	840-P/24	85.490	4.680	5.730	4.100	14.500	54.570	15.804	0.010
23	NPG 1/8	841-P/24	85.550	1.790	5.410	7.250	14.450	61.663	12.767	0.000
24	NPG 1/9	842-P/24	93.905	1.650	1.010	3.435	6.095	74.896	8.422	0.000
25	NPG 1/10	843-P/24	94.285	1.380	1.060	3.275	5.715	68.945	14.089	0.000
26	NPG 1/11	844-P/24	94.425	1.010	1.090	3.475	5.575	71.403	14.422	0.000
27	NPG 1/12	845-P/24	94.095	1.420	0.980	3.505	5.905	70.282	13.824	0.000
28	NPG 1/13	846-P/24	91.120	2.400	4.080	2.400	8.880	64.758	13.311	0.000
29	NPG 1/14	847-P/24	91.180	2.330	1.120	5.370	8.820	66.624	13.751	0.000
30	NPG 1/15	848-P/24	94.560	1.790	2.420	1.230	5.440	64.519	16.201	0.000
31	NPG 1/16	849-P/24	92.460	2.310	3.040	2.190	7.540	63.266	17.759	0.000
32	NPG 1/17	850-P/24	95.440	1.120	2.330	1.110	4.560	69.051	13.161	0.000

(Signature)

Contd...

Sl No.	Identity Mark	Lab No.	Ash %	M %	V.M %	F.C %	LOI %	SiO ₂ (%)	Al ₂ O ₃ (%)	V ₂ O ₅ (%)
33	NPG 1/18	851-P/24	92.300	1.750	3.950	2.000	7.700	63.236	17.086	0.000
34	NPG 1/19	852-P/24	94.640	1.670	2.370	1.320	5.360	66.039	16.181	0.000
35	NPG 1/20	853-P/24	92.400	2.130	3.400	2.070	7.600	67.353	13.560	0.000
36	NPG 1/21	854-P/24	93.940	1.180	3.310	1.570	6.060	72.526	9.744	0.000
37	NPG 1/22	855-P/24	92.980	1.480	2.950	2.590	7.020	68.214	12.901	0.000
38	NPG 1/23	856-P/24	94.100	1.430	2.390	2.080	5.900	72.240	10.414	0.000
39	NPG 1/24	857-P/24	93.280	1.900	2.890	1.930	6.720	68.303	12.690	0.000
40	NPG 1/25	858-P/24	92.980	1.660	3.180	2.180	7.020	67.343	12.876	0.000
41	NPG 1/26	859-P/24	93.080	1.720	3.290	1.910	6.920	69.160	11.010	0.000
42	NPG 1/27	860-P/24	90.400	2.480	4.250	2.870	9.600	61.941	13.888	0.000
43	NPG 1/28	861-P/24	67.900	2.040	3.330	26.730	32.100	65.413	14.107	0.000
44	NPG 1/29	862-P/24	92.640	1.750	4.060	1.550	7.360	67.374	13.197	0.000
45	NPG 1/30	863-P/24	94.500	0.980	1.950	2.570	5.500	67.064	14.209	0.000
46	NPG 1/31	864-P/24	92.520	1.040	2.300	4.140	7.480	73.727	11.504	0.000


21-10-24
JOINT DIRECTOR (C.A)
Joint Director (C.A)
Directorate of Mines and Geology
Odisha, Bhubaneswar



**DIRECTORATE OF MINES AND GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR**

Heads of Department Building, Unit-V, Pin-751001

Tel No.: 0674-2391537, Fax No.: 0674-2391684

Email ID: dirmines_odisha@rediffmail.com

No. 8779 /DoMG., Dt. 05-09-2024

From,

Dr. Sukanta Mishra,
Joint Director (C.A),
Directorate of Mines and Geology,
Odisha, Bhubaneswar.

To,

Sri Ramesh Behera,
Exploration-in-charge,
Naringpanga (S & W) Graphite Project.
Dist.-Rayagada,
Email Id: rameshbehera8@gmail.com

Sub: Submission analysis report of 70 nos. of Graphite Powdered samples.

Ref: Your letter No. 102/NGP/2023-24 Dt.22.07.2024.

Sir,

With reference to the letter on the subject cited above, I am to enclose herewith the analysis report of 70 (Seventy) nos. of Graphite Powdered sample submitted to this Laboratory for chemical analysis.

This is for favour of your information and necessary action.

Yours faithfully,

JOINT DIRECTOR (C.A)



DIRECTORATE OF MINES AND GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR

Heads of Department Building, Unit-V, Pin-751001

Tel No.: 0674-2391537, Fax No.: 0674-2391684

Email ID: dirmines_odisha@rediffmail.com

ANALYSIS REPORT

Name of the sample: Graphite Powdered sample.

Received from: EIC, Naringpanga (S & W) Graphite Project.

Sl. No.	Sample Identity No.	R.L. No.	Ash %	M %	F.C %	LOI %	SiO ₂ %	Al ₂ O ₃ %
1	NPG - 2/1	518-P/24	93.16	2.10	0.79	6.84	67.86	9.54
2	NPG - 2/2	519-P/24	90.44	3.51	0.96	9.06	62.86	11.28
3	NPG - 2/3	520-P/24	92.64	2.08	1.20	7.36	65.58	8.74
4	NPG - 2/4	521-P/24	91.80	1.55	2.04	8.20	63.02	14.44
5	NPG - 2/5	522-P/24	93.92	1.27	1.20	6.08	66.18	12.42
6	NPG - 2/6	523-P/24	91.30	1.91	2.66	8.70	64.90	12.94
7	NPG - 2/7	524-P/24	92.30	1.80	2.14	7.70	67.20	10.72
8	NPG - 2/8	525-P/24	94.40	1.17	2.01	5.60	70.02	6.70
9	NPG - 2/9	526-P/24	96.18	0.63	1.50	3.82	74.68	13.50
10	NPG - 2/10	527-P/24	96.46	0.99	0.98	3.54	70.74	12.50
11	NPG - 2/11	528-P/24	95.26	1.01	1.36	4.74	72.46	9.70
12	NPG - 2/12	529-P/24	92.20	1.56	2.39	7.80	64.76	13.94
13	NPG - 2/13	530-P/24	92.88	0.91	2.09	7.12	63.54	15.26
14	NPG - 2/14	531-P/24	93.18	0.40	1.80	6.82	68.34	10.94
15	NPG - 2/15	532-P/24	91.88	1.04	2.24	8.12	60.50	17.76
16	NPG - 2/16	533-P/24	93.34	1.06	1.88	6.66	67.72	13.72
17	NPG - 2/17	534-P/24	93.90	0.76	1.61	6.10	67.00	11.38
18	NPG - 2/18	535-P/24	92.96	0.82	1.63	7.04	66.66	11.02
19	NPG - 2/19	536-P/24	93.00	0.93	1.98	7.00	63.66	15.46
20	NPG - 2/20	537-P/24	92.44	1.50	1.47	7.56	61.20	17.56
21	NPG - 2/21	538-P/24	94.40	1.23	0.58	5.60	66.48	12.38
22	NPG - 2/22	539-P/24	91.88	1.33	2.00	8.12	64.30	12.02
23	NPG - 2/23	540-P/24	92.04	2.06	0.48	7.96	61.14	19.68
24	NPG - 2/24	541-P/24	94.58	1.52	0.53	5.42	58.94	18.02
25	NPG - 3/1	542-P/24	93.48	2.49	1.39	6.52	64.34	15.58
26	NPG - 3/2	543-P/24	96.30	0.78	0.98	3.70	72.08	15.16
27	NPG - 3/3	544-P/24	86.00	5.14	3.93	12.00	55.06	14.32
28	NPG - 3/4	545-P/24	95.94	0.80	1.18	4.06	67.48	12.74

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Sl. No.	Sample Identity No.	R.L. No.	Ash %	M %	F.C %	LOI %	SiO ₂ %	Al ₂ O ₃ %
29	NPG - 3/5	546-P/24	94.78	0.85	0.93	5.22	63.28	18.44
30	NPG - 3/6	547-P/24	93.34	1.55	1.26	6.66	64.50	19.20
31	NPG - 3/7	548-P/24	93.20	1.04	1.55	6.80	64.46	17.74
32	NPG - 3/8	549-P/24	93.86	1.35	1.02	6.14	65.90	16.44
33	NPG - 3/9	550-P/24	94.18	0.85	1.33	5.82	65.80	16.22
34	NPG - 3/10	551-P/24	94.42	0.78	1.27	5.58	62.58	19.78
35	NPG - 3/11	552-P/24	94.28	0.85	1.65	5.72	65.40	16.30
36	NPG - 3/12	553-P/24	93.36	0.84	2.37	6.64	63.12	17.96
37	NPG - 3/13	554-P/24	93.06	0.93	1.96	6.94	59.74	16.42
38	NPG - 3/14	555-P/24	92.78	0.87	2.57	7.22	63.58	16.48
39	NPG - 3/15	556-P/24	93.00	0.93	2.43	7.00	63.10	16.06
40	NPG - 3/16	557-P/24	94.78	1.04	1.21	5.22	63.62	18.30
41	NPG - 3/17	558-P/24	94.02	0.64	1.74	5.98	65.92	17.84
42	NPG - 3/18	559-P/24	93.08	0.81	2.64	6.92	66.34	12.08
43	NPG - 3/19	560-P/24	92.90	0.95	2.73	7.10	65.22	16.34
44	NPG - 3/20	561-P/24	95.04	0.95	1.33	4.96	65.56	16.08
45	NPG - 3/21	562-P/24	93.30	0.84	2.08	6.70	65.60	16.30
46	NPG - 3/22	563-P/24	92.12	0.96	2.82	7.80	60.78	11.78
47	NPG - 3/23	564-P/24	92.80	0.86	2.81	7.20	65.00	9.54
48	NPG - 3/24	565-P/24	92.60	0.99	2.79	7.40	62.08	17.66
49	NPG - 3/25	566-P/24	92.42	0.71	2.94	7.58	64.54	16.42
50	NPG - 3/26	567-P/24	92.88	0.94	1.85	7.12	66.04	13.64
51	NPG - 3/27	568-P/24	89.96	1.78	2.94	10.04	61.60	17.34
52	NPG - 3/28	569-P/24	92.04	1.38	2.24	7.96	67.04	15.48
53	NPG - 3/29	570-P/24	93.84	1.24	1.84	6.16	70.16	12.76
54	NPG - 3/30	571-P/24	93.96	1.14	2.07	6.04	66.26	15.78
55	NPG - 3/31	572-P/24	95.16	1.09	1.50	4.84	71.96	13.58
56	NPG - 4/1	573-P/24	88.86	3.58	2.12	11.14	59.14	14.44
57	NPG - 4/2	574-P/24	90.76	3.11	1.95	9.24	66.22	12.30
58	NPG - 4/3	575-P/24	93.24	1.68	0.91	6.76	66.84	11.28
59	NPG - 4/4	576-P/24	90.56	2.08	1.52	9.44	60.82	17.14
60	NPG - 4/5	577-P/24	90.34	1.82	1.89	9.66	58.32	19.86
61	NPG - 4/6	578-P/24	91.46	1.93	0.91	8.54	57.04	12.94
62	NPG - 4/7	579-P/24	89.82	2.45	3.11	10.18	65.58	9.72
63	NPG - 4/8	580-P/24	93.34	1.78	1.19	6.66	66.30	12.42
64	NPG - 4/9	581-P/24	89.10	3.11	1.67	10.90	53.42	14.58
65	NPG - 4/10	582-P/24	91.32	1.76	1.92	8.68	64.24	10.10
66	NPG - 4/11	583-P/24	94.30	1.48	0.56	5.70	65.40	10.20
67	NPG - 4/12	584-P/24	93.54	1.45	0.66	6.46	60.72	14.16
68	NPG - 4/13	585-P/24	92.32	1.83	1.80	7.68	67.60	10.94
69	NPG - 4/14	586-P/24	92.24	1.88	1.60	7.76	64.14	13.46
70	NPG - 4/15	587-P/24	90.18	2.31	2.33	9.82	66.02	11.80

5.9.24
JOINT DIRECTOR (C.A)
 Joint Director (C.A)
 Directorate of Mines and Geology
 Odisha, Bhubaneswar



**DIRECTORATE OF MINES AND GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR**

Heads of Department Building, Unit-V, Pin-751001
Tel No.: 0674-2391537, Fax No.: 0674-2391684
Email ID: dirmines_odisha@rediffmail.com

No. 9286 /DoMG., Dt. 21-09-2024

From,

Dr. Sukanta Mishra,
Joint Director (C.A),
Directorate of Mines and Geology,
Odisha, Bhubaneswar.

To,

Exploration-in-charge,
Naringpanga (S & W) Graphite Project.
Dist.-Rayagada,
Email Id: rameshbehera8@gmail.com

Sub: Submission analysis report of 44 nos. of Graphite samples.

Ref: Your letter No. 108/NGP/23-24, Dt.30.07.2024.

Sir,

With reference to your letter cited above, I am to enclose herewith the analysis report of 44 (Forty Four) nos. of Graphite samples submitted to this Laboratory for chemical analysis.

This is for favour of your information and necessary action.

Yours faithfully,

JOINT DIRECTOR (C.A)



DIRECTORATE OF MINES AND GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR

Heads of Department Building, Unit-V, Pin-751001
Tel No.: 0674-2391537, Fax No.: 0674-2391684
Email ID: dirmines_odisha@rediffmail.com

ANALYSIS REPORT


Name of the sample: Graphite sample.

Received from: EIC, Naringpanga (S & W) Graphite Project.

Sl. No.	Sample Identity No.	R.L. No.	Ash %	M %	F.C %	LOI % (at 950°C)	SiO ₂ %	Al ₂ O ₃ %
1	NPG - 4/16	749-P/24	90.62	1.00	2.38	9.38	67.68	11.56
2	NPG - 4/17	750-P/24	91.42	1.21	2.74	8.58	72.46	10.30
3	NPG - 4/18	751-P/24	91.50	1.38	1.92	8.50	67.36	10.28
4	NPG - 4/19	752-P/24	91.66	1.50	1.78	8.34	68.52	7.58
5	NPG - 4/20	753-P/24	91.44	1.15	2.25	8.56	68.32	14.90
6	NPG - 4/21	754-P/24	89.50	0.97	4.60	10.50	70.78	8.50
7	NPG - 4/22	755-P/24	87.72	2.48	5.47	12.28	66.42	7.68
8	NPG - 4/23	756-P/24	85.24	3.89	4.15	14.76	54.36	8.50
9	NPG - 4/24	757-P/24	89.48	0.20	8.16	10.52	81.44	0.50
10	NPG - 4/25	758-P/24	89.60	0.21	8.06	10.40	82.70	1.80
11	NPG - 4/26	759-P/24	87.48	0.30	10.03	12.52	78.62	3.00
12	NPG - 4/27	760-P/24	87.62	0.35	9.84	12.38	80.34	1.00
13	NPG - 4/28	761-P/24	88.60	0.19	9.26	11.40	80.72	0.60
14	NPG - 4/29	762-P/24	91.74	0.69	2.36	8.26	62.38	13.48
15	NPG - 4/30	763-P/24	90.80	0.67	3.10	9.20	65.66	11.26
16	NPG - 4/31	764-P/24	92.84	1.42	1.95	7.16	68.82	11.86
17	NPG - 5/1	765-P/24	95.38	1.08	1.57	4.62	69.14	13.26
18	NPG - 5/2	766-P/24	95.36	0.83	0.58	4.64	65.34	15.46
19	NPG - 5/3	767-P/24	94.66	1.52	1.09	5.34	65.38	12.06
20	NPG - 5/4	768-P/24	98.16	0.37	0.41	1.84	64.16	17.18
21	NPG - 5/5	769-P/24	95.66	0.87	1.03	4.34	65.34	15.62
22	NPG - 5/6	770-P/24	94.88	0.90	1.39	5.12	66.92	12.52
23	NPG - 5/7	771-P/24	96.76	0.55	1.01	3.24	70.48	12.38
24	NPG - 5/8	772-P/24	95.24	0.78	1.70	4.76	68.20	14.48
25	NPG - 5/9	773-P/24	95.42	0.88	1.60	4.58	63.70	15.66
26	NPG - 5/10	774-P/24	94.94	0.81	1.26	5.06	61.38	17.88
27	NPG - 5/11	775-P/24	95.28	0.94	0.88	4.72	66.28	18.16
28	NPG - 5/12	776-P/24	94.36	1.14	1.15	5.64	63.84	16.06

Contd...

Sl. No.	Sample Identity No.	R.L. No.	Ash %	M %	F.C %	LOI % (at 950°C)	SiO ₂ %	Al ₂ O ₃ %
29	NPG – 5/13	777-P/24	94.76	1.19	1.01	5.24	67.68	14.22
30	NPG – 5/14	778-P/24	93.30	1.09	1.96	6.70	63.86	14.06
31	NPG – 5/15	779-P/24	93.14	1.02	1.85	6.86	63.42	17.64
32	NPG – 5/16	780-P/24	91.76	1.22	2.94	8.26	62.70	14.02
33	NPG – 5/17	781-P/24	93.58	1.20	1.61	6.42	56.92	16.44
34	NPG – 5/18	782-P/24	93.60	1.03	2.53	6.40	66.86	13.82
35	NPG – 5/19	783-P/24	94.52	1.08	1.76	5.48	67.84	12.86
36	NPG – 5/20	784-P/24	93.66	1.31	2.50	6.34	66.12	12.56
37	NPG – 5/21	785-P/24	95.76	0.89	1.34	4.24	69.72	12.16
38	NPG – 5/22	786-P/24	96.04	1.10	1.14	3.96	70.56	10.92
39	NPG – 5/23	787-P/24	94.58	1.51	1.54	5.42	68.18	9.82
40	NPG – 5/24	788-P/24	95.52	1.43	0.64	4.48	67.20	13.62
41	NPG – 5/25	789-P/24	95.70	1.01	1.26	4.30	75.66	4.16
42	NPG – 5/26	790-P/24	96.96	1.60	0.90	3.04	80.98	4.92
43	NPG – 5/27	791-P/24	97.44	0.61	0.36	2.56	68.92	13.92
44	NPG – 5/28	792-P/24	93.24	1.90	2.35	6.76	67.16	13.16


21.9.24
JOINT DIRECTOR (C.A)
Joint Director (C.A)
Directorate of Mines and Geology
Odisha, Bhubaneswar

ANNEXURE-XIII

ICPMS ANALYSIS RESULTS

मिनरल एक्सप्लोरेशन एंड कंसल्टेंसी लिमिटेड
केमिकल लैबोरेटरी
विश्लेषण रिपोर्ट

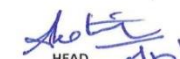
लैब क्र.	: MNC 1-20 (20 SAMPLES)
भेजनेवालाका नाम	: DMG,Koraput,Naringpanga Graphite Project,Odisha,
भेजनेवालाका रेफ* नं०	: 899/CD/14-02(54-1)/2024 Dt - 27.08.2024
विश्लेषण प्रकार	: Trace elements
ब्लॉक का नाम	: Naringpanga Graphite Project

Sr.No. अनु.क्र.	Lab No. लैब क्र.	Sender No. भेजनेवाला क्र.	Li	Be	Sc	V	Cr	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Rb	SRM PPM (LOD = 0.1 PPM)	Y	Zr	Nb	Mo	Ag	Cd	In	Sn	Sb	Te	Cs	Ba	Hf	Ta	W	Pb	Bi	Th	U
1	MNC-1	NCPV-1	6.08	2.15	5.37	184.49	59.98	7.94	24.21	125.72	141.98	12.97	1.06	34.18	1.02	62.37	379.94	43.96	179.18	1.81	3.58	0.58	0.55	0.10	2.17	1.07	0.38	0.83	492.97	4.66	0.48	0.89	24.33	0.58	8.35	5.17
2	MNC-2	NCPV-2	16.43	2.51	10.02	110.50	81.14	11.91	34.05	81.66	185.98	14.70	1.28	33.01	0.48	69.05	197.39	33.43	191.07	1.89	2.09	0.19	0.31	BDL	2.06	1.15	BDL	1.30	530.31	5.22	0.69	0.77	18.15	BDL	8.17	1.00
3	MNC-3	NCPV-3	23.87	2.13	9.23	89.67	70.14	11.81	33.81	63.40	189.14	15.73	1.31	35.20	0.46	62.64	66.89	32.60	179.35	1.12	1.76	0.22	0.39	BDL	1.68	1.07	BDL	0.88	164.14	4.79	0.18	0.17	19.08	BDL	10.10	1.44
4	MNC-4	NCPV-4	12.33	0.95	10.84	78.56	77.96	4.68	24.45	48.64	113.51	12.82	1.20	40.31	0.77	91.81	81.95	37.13	288.02	1.83	1.60	0.13	0.38	BDL	2.19	1.21	BDL	2.27	528.29	7.66	0.26	0.30	17.55	BDL	29.96	1.86
5	MNC-5	NCPV-5	23.50	2.58	12.05	96.49	84.52	11.64	37.35	49.38	128.11	18.42	1.06	34.70	0.58	106.09	80.14	35.18	232.21	2.25	1.40	0.17	0.31	BDL	1.98	1.09	BDL	1.27	655.96	6.21	1.02	0.70	24.03	BDL	15.33	1.11
6	MNC-6	NCPV-6	12.93	2.35	12.61	96.49	79.10	11.51	35.01	50.68	230.34	19.81	1.17	33.97	0.70	108.49	53.39	42.85	251.82	1.87	1.35	0.20	0.28	BDL	1.92	1.04	BDL	1.23	518.86	6.62	0.73	1.33	22.94	BDL	20.50	1.26
7	MNC-7	NCPV-7	19.84	2.92	12.33	102.69	83.78	9.19	29.17	39.40	103.08	20.72	1.10	39.00	0.59	115.86	106.72	37.11	236.47	1.30	1.39	0.17	0.25	BDL	2.18	1.18	BDL	1.53	604.71	6.48	0.43	0.24	17.50	BDL	12.69	1.06
8	MNC-8	NCPV-8	24.25	2.56	11.74	114.31	74.53	19.44	70.84	142.59	94.21	16.62	1.27	34.16	0.59	105.56	53.94	48.92	121.65	1.06	2.70	0.20	0.24	BDL	1.91	1.11	0.21	1.84	449.34	3.33	0.37	0.27	19.20	0.28	13.13	0.99
9	MNC-9	NCPV-9	22.38	2.92	9.23	65.74	63.83	11.13	39.27	47.68	148.67	11.18	1.16	34.46	0.50	70.17	63.32	25.09	175.75	2.13	1.50	0.16	0.25	BDL	1.90	0.99	BDL	2.25	378.81	4.79	0.30	0.16	13.05	BDL	10.17	0.88
10	MNC-10	NCPV-10	25.14	2.40	11.34	135.44	102.05	21.15	27.50	58.76	149.91	21.18	1.37	32.94	0.64	108.14	62.45	21.59	355.83	0.98	1.70	0.26	0.57	BDL	1.90	1.03	BDL	3.09	588.55	9.43	0.23	0.27	21.48	BDL	15.92	1.42
11	MNC-11	NCPV-11	9.51	1.74	6.82	90.93	85.11	6.69	23.38	93.00	31.54	22.86	0.96	37.36	1.33	56.84	76.52	39.68	251.82	1.37	2.13	0.39	0.30	BDL	1.50	1.63	0.24	0.68	427.57	6.79	0.48	0.52	26.48	0.27	31.59	3.90
12	MNC-12	NCPV-12	2.81	0.61	3.69	66.20	42.37	6.26	29.29	89.48	127.59	8.47	0.65	35.36	0.87	14.20	79.99	36.20	210.98	2.24	5.99	0.32	0.39	BDL	0.99	1.02	0.40	0.19	270.39	5.51	0.38	0.71	15.10	0.52	10.99	7.28
13	MNC-13	NCPV-13	28.68	2.76	11.61	85.35	79.53	11.29	34.65	49.33	118.73	17.03	1.09	37.98	0.62	88.89	153.14	43.06	319.09	1.41	1.64	0.24	0.37	BDL	3.05	1.22	BDL	1.52	609.86	8.67	0.58	0.42	21.58	BDL	20.39	1.33
14	MNC-14	NCPV-14	12.59	4.23	9.40	82.81	74.15	7.73	27.01	78.70	85.03	14.75	1.04	36.44	0.50	68.96	280.47	39.02	116.23	1.01	1.48	0.16	0.24	BDL	6.31	1.15	BDL	1.80	637.74	3.17	0.58	0.21	22.04	BDL	2.19	0.35
15	MNC-15	NCPV-15	13.51	1.56	7.31	57.66	69.75	8.74	33.20	56.54	73.19	7.72	0.89	34.50	0.39	44.63	73.51	33.60	280.21	0.79	1.44	0.20	0.24	BDL	1.46	1.11	BDL	0.96	247.91	7.40	0.21	0.17	10.82	BDL	6.34	1.05
16	MNC-16	NCPV-16	19.07	1.83	11.82	120.74	97.90	18.11	45.93	133.62	65.84	21.86	1.20	41.97	0.91	114.41	94.94	34.47	325.01	1.75	1.40	0.31	0.27	BDL	1.64	1.30	0.28	1.78	793.62	8.65	0.94	0.30	27.37	BDL	21.45	2.13
17	MNC-17	NCPV-17	9.49	2.78	9.45	166.62	87.99	17.16	23.29	156.82	46.07	19.25	2.98	33.25	0.51	97.06	189.34	23.69	227.26	1.09	1.72	0.16	0.25	BDL	1.32	0.97	0.14	0.82	777.98	5.90	0.22	0.17	31.49	0.19	11.28	1.66
18	MNC-18	NCPV-18	14.99	2.24	13.80	126.41	79.94	10.57	36.99	43.39	83.78	20.15	1.08	36.66	0.74	61.71	105.00	46.15	124.63	1.05	1.31	BDL	0.25	BDL	0.89	1.14	0.12	1.02	750.46	3.37	0.37	BDL	18.27	BDL	20.72	1.65
19	MNC-19	NCPV-19	26.71	2.22	7.11	30.83	71.16	6.23	15.99	33.22	58.70	13.67	0.67	38.20	0.30	66.64	135.48	33.64	293.03	0.56	0.82	0.21	0.29	BDL	1.02	1.18	BDL	0.29	607.06	7.67	0.11	BDL	27.64	BDL	20.93	1.16
20	MNC-20	NCPV-20	25.95	3.55	20.23	171.23	139.91	25.67	51.46	72.02	214.29	19.18	1.61	38.87	0.71	110.38	64.78	45.64	238.26	2.78	3.04	0.18	0.39	BDL	1.22	1.22	BDL	1.98	853.62	6.26	0.36	0.40	20.32	BDL	21.84	1.99

NOTE* All samples will be disposed after Three Months from the date of submission of Analytical Report.
No. MECL/CL/FIL/MNC/24-25/..... Date- 05/10/2024

प्रतिलिपि:

- DMG,Koraput,Naringpanga Graphite Project,Odisha,
- वरिष्ठ प्रबंधक (वित्त) - बिलिंग अनुभाग, एमआईसीएल, नागपूर
- महाप्रबंधक (गवेष), एमआईसीएल, नागपूर


HEAD
Rohit Kumar Sharma
Geochemical Laboratory
Head (Lab)
Chemical Lab, MECL, Nagpur-06

SL.No.	LAB NO.	Sender No.	Li	Be	Sc	V	Cr	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Rb
			PPM (LOD=0.1PPM)													
1	MNC-1	NCPV-1	6.08	2.15	5.37	184.49	59.98	7.94	24.21	125.72	141.98	12.97	1.06	34.18	1.02	62.37
2	MNC-2	NCPV-2	16.43	2.51	10.02	110.50	81.14	11.91	34.05	81.66	185.98	14.70	1.28	33.01	0.48	69.05
3	MNC-3	NCPV-3	23.87	2.13	9.23	89.67	70.14	11.81	33.81	63.40	189.14	15.73	1.31	35.20	0.46	62.64
4	MNC-4	NCPV-4	12.33	0.95	10.84	78.56	77.96	4.68	24.45	48.64	113.51	12.82	1.20	40.31	0.77	91.81
5	MNC-5	NCPV-5	23.50	2.58	12.05	96.49	84.52	11.64	37.35	49.38	128.11	18.42	1.06	34.70	0.58	106.09
6	MNC-6	NCPV-6	12.93	2.35	12.61	96.49	79.10	11.51	35.01	50.68	230.34	19.81	1.17	33.97	0.70	108.49
7	MNC-7	NCPV-7	19.84	2.92	12.33	102.69	83.78	9.19	29.17	39.40	103.08	20.72	1.10	39.00	0.59	115.86
8	MNC-8	NCPV-8	24.25	2.56	11.74	114.31	74.53	19.44	70.84	142.59	94.21	16.62	1.27	34.16	0.59	105.56
9	MNC-9	NCPV-9	22.38	2.92	9.23	65.74	63.83	11.13	39.27	47.68	148.67	11.18	1.16	34.46	0.50	70.17
10	MNC-10	NCPV-10	25.14	2.40	11.34	135.44	102.05	21.15	27.50	58.76	149.91	21.18	1.37	32.94	0.64	108.14
11	MNC-11	NCPV-11	9.51	1.74	6.82	90.93	85.11	6.69	23.38	93.00	31.54	22.86	0.96	37.36	1.33	56.84
12	MNC-12	NCPV-12	2.81	0.61	3.69	66.20	42.37	6.26	29.29	89.48	127.59	8.47	0.65	35.36	0.87	14.20
13	MNC-13	NCPV-13	28.68	2.76	11.61	85.35	79.53	11.29	34.65	49.33	118.73	17.03	1.09	37.98	0.62	88.89
14	MNC-14	NCPV-14	12.59	4.23	9.40	82.81	74.15	7.73	27.01	78.70	85.03	14.75	1.04	36.44	0.50	68.96
15	MNC-15	NCPV-15	13.51	1.56	7.31	57.66	69.75	8.74	33.20	56.54	73.19	7.72	0.89	34.50	0.39	44.63
16	MNC-16	NCPV-16	19.07	1.83	11.82	120.74	97.90	18.11	45.93	133.62	65.84	21.86	1.20	41.97	0.91	114.41
17	MNC-17	NCPV-17	9.49	2.78	9.45	166.62	87.99	17.16	23.29	156.82	46.07	19.25	2.98	33.25	0.51	97.06
18	MNC-18	NCPV-18	14.99	2.24	13.80	126.41	79.94	10.57	36.99	43.39	83.78	20.15	1.08	36.66	0.74	61.71
19	MNC-19	NCPV-19	26.71	2.22	7.11	30.83	71.16	6.23	15.99	33.22	58.70	13.67	0.67	38.20	0.30	66.64
20	MNC-20	NCPV-20	25.95	3.55	20.23	171.23	139.91	25.67	51.46	72.02	214.29	19.18	1.61	38.87	0.71	110.38

Sl. No.	LAB NO.	Sender No.	Sr	Y	Zr	Nb	Mo	Ag	Cd	In	Sn	Sb	Te	Cs	Ba	Hf
			PPM(LOD=0.1PPM)													
1	MNC-1	NCPV-1	379.94	43.96	179.18	1.81	3.58	0.58	0.55	0.10	2.17	1.07	0.38	0.83	492.97	4.66
2	MNC-2	NCPV-2	197.39	33.43	191.07	1.89	2.09	0.19	0.31	BDL	2.06	1.15	BDL	1.30	530.31	5.22
3	MNC-3	NCPV-3	66.89	32.60	179.35	1.12	1.76	0.22	0.39	BDL	1.68	1.07	BDL	0.88	164.14	4.79
4	MNC-4	NCPV-4	81.95	37.13	288.02	1.83	1.60	0.13	0.38	BDL	2.19	1.21	BDL	2.27	528.29	7.66
5	MNC-5	NCPV-5	80.14	35.18	232.21	2.25	1.40	0.17	0.31	BDL	1.98	1.09	BDL	1.27	655.96	6.21
6	MNC-6	NCPV-6	53.39	42.85	251.82	1.87	1.35	0.20	0.28	BDL	1.92	1.04	BDL	1.23	518.86	6.62
7	MNC-7	NCPV-7	106.72	37.11	236.47	1.30	1.39	0.17	0.25	BDL	2.18	1.18	BDL	1.53	604.71	6.48
8	MNC-8	NCPV-8	53.94	48.92	121.65	1.06	2.70	0.20	0.24	BDL	1.91	1.11	0.21	1.84	449.34	3.33
9	MNC-9	NCPV-9	63.32	25.09	175.75	2.13	1.50	0.16	0.25	BDL	1.90	0.99	BDL	2.25	378.81	4.79
10	MNC-10	NCPV-10	62.45	21.59	355.83	0.98	1.70	0.26	0.57	BDL	1.90	1.03	BDL	3.09	588.55	9.43
11	MNC-11	NCPV-11	76.52	39.68	251.82	1.37	2.13	0.39	0.30	BDL	1.50	1.63	0.24	0.68	427.57	6.79
12	MNC-12	NCPV-12	79.99	36.20	210.98	2.24	5.99	0.32	0.39	BDL	0.99	1.02	0.40	0.19	270.39	5.51
13	MNC-13	NCPV-13	153.14	43.06	319.09	1.41	1.64	0.24	0.37	BDL	3.05	1.22	BDL	1.52	609.86	8.67
14	MNC-14	NCPV-14	280.47	39.02	116.23	1.01	1.48	0.16	0.24	BDL	6.31	1.15	BDL	1.80	637.74	3.17
15	MNC-15	NCPV-15	73.51	33.60	280.21	0.79	1.44	0.20	0.24	BDL	1.46	1.11	BDL	0.96	247.91	7.40
16	MNC-16	NCPV-16	94.94	34.47	325.01	1.75	1.40	0.31	0.27	BDL	1.64	1.30	0.28	1.78	793.62	8.65
17	MNC-17	NCPV-17	189.34	23.69	227.26	1.09	1.72	0.16	0.25	BDL	1.32	0.97	0.14	0.82	777.98	5.90
18	MNC-18	NCPV-18	105.00	46.15	124.63	1.05	1.31	BDL	0.25	BDL	0.89	1.14	0.12	1.02	750.46	3.37
19	MNC-19	NCPV-19	135.48	33.64	293.03	0.56	0.82	0.21	0.29	BDL	1.02	1.18	BDL	0.29	607.06	7.67
20	MNC-20	NCPV-20	64.78	45.64	238.26	2.78	3.04	0.18	0.39	BDL	1.22	1.22	BDL	1.98	853.62	6.26

Sl. No.	LAB NO.	Sender No.	Ta	W	Pb	Bi	Th	U
			PPM(LOD=0.1PPM)					
1	MNC-1	NCPV-1	0.48	0.89	24.33	0.58	8.35	5.17
2	MNC-2	NCPV-2	0.69	0.77	18.15	BDL	8.17	1.00
3	MNC-3	NCPV-3	0.18	0.17	19.08	BDL	10.10	1.44
4	MNC-4	NCPV-4	0.26	0.30	17.55	BDL	29.96	1.86
5	MNC-5	NCPV-5	1.02	0.70	24.03	BDL	15.33	1.11
6	MNC-6	NCPV-6	0.73	1.33	22.94	BDL	20.50	1.26
7	MNC-7	NCPV-7	0.43	0.24	17.50	BDL	12.69	1.06
8	MNC-8	NCPV-8	0.37	0.27	19.20	0.28	13.13	0.99
9	MNC-9	NCPV-9	0.30	0.16	13.05	BDL	10.17	0.88
10	MNC-10	NCPV-10	0.23	0.27	21.48	BDL	15.92	1.42
11	MNC-11	NCPV-11	0.48	0.52	26.48	0.27	31.59	3.90
12	MNC-12	NCPV-12	0.38	0.71	15.10	0.52	10.99	7.28
13	MNC-13	NCPV-13	0.58	0.42	21.58	BDL	20.39	1.33
14	MNC-14	NCPV-14	0.58	0.21	22.04	BDL	2.19	0.35
15	MNC-15	NCPV-15	0.21	0.17	10.82	BDL	6.34	1.05
16	MNC-16	NCPV-16	0.94	0.30	27.37	BDL	21.45	2.13
17	MNC-17	NCPV-17	0.22	0.17	31.49	0.19	11.28	1.66
18	MNC-18	NCPV-18	0.37	BDL	18.27	BDL	20.72	1.65
19	MNC-19	NCPV-19	0.11	BDL	27.64	BDL	20.93	1.16
20	MNC-20	NCPV-20	0.36	0.40	20.32	BDL	21.84	1.99

ANNEXURE-XIV
DETAILS OF BOREHOLES OF NARINGPANGA BLOCK

Bore Hole	Inclined Depth(m)	Vertical Depth(m)	R.L(m)	Thickness of Graphite(m)	Samples Generated(Nos.)
NPBH-1	70.00	49.50	331.40	24.55	31
NPBH-2	55.00	38.89	333.31	9.65	24
NPBH-3	74.50	52.68	331.02	19.55	31
NPBH-4	56.50	39.95	335.52	18.55	31
NPBH-5	78.80	55.72	329.86	5.50	28
NPBH-6	63.20	44.69	334.14	6.50	15
Total	398.00	281.43		84.30	160

ANNEXURE-XV

CHEMICAL ANALYSIS OF GRAB AND PIT SAMPLES OF NARINGPANGA (S) GRAPHITE BLOCK, RAYAGADA DISTRICT, ODISHA



**DIRECTORATE OF MINES AND GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR**

Heads of Department Building, Unit-V, Pin-751001
Tel No.: 0674-2391537, Fax No.: 0674-2391684
Email ID: dirmines_odisha@rediffmail.com

No. 9063 /DoMG., Dt. 13-09-2024

From,

Dr. Sukanta Mishra,
Joint Director (C.A),
Directorate of Mines and Geology,
Odisha, Bhubaneswar.

To,

Exploration In-Charge,
Naringpanga (S & W) Graphite Project,
Rayagada
Email Id: rameshbehera8@gmail.com.

Sub: Submission of analysis report of 22 nos. of Graphite samples.

Ref: Your letter No. 110/NGP 23-24, Dt. 30.07.24.

Sir,

With reference to your letter cited above, I am to enclose herewith the analysis report of 22 (Twenty Two) nos. of Graphite samples submitted to this Laboratory for chemical analysis.

This is for favour of your information and necessary action.

Yours faithfully,

JOINT DIRECTOR (C.A)



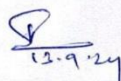
**DIRECTORATE OF MINES AND GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR**

Heads of Department Building, Unit-V, Pin-751001
Tel No.: 0674-2391537, Fax No.: 0674-2391684
Email ID: dirmines_odisha@rediffmail.com

Name of the Sample : Graphite Sample

**Received from : Exploration In-Charge, Naringpanga (S & W)
Graphite Project, Rayagada**

Sl. No.	Identity Mark	R.L. No.	Ash %	M %	F.C %	LOI%	SiO ₂ %	Al ₂ O ₃ %
1	NGS-1	793-P/24	91.98	1.90	1.94	8.02	65.82	21.58
2	NGS-2	794-P/24	90.64	1.98	0.99	9.36	64.20	15.46
3	NGS-3	795-P/24	89.90	2.45	2.89	10.10	63.36	19.48
4	NGS-4	796-P/24	87.68	1.72	5.60	12.32	67.26	9.42
5	NGS-5	797-P/24	91.72	1.67	2.02	8.28	59.14	18.77
6	NGS-6	798-P/24	88.38	2.94	2.21	11.62	56.18	20.78
7	NGS-7	799-P/24	92.32	1.73	2.01	7.68	68.14	17.58
8	NGS-8	800-P/24	88.44	2.07	4.11	11.56	63.24	14.30
9	NGPT 1/1	801-P/24	90.38	3.13	0.62	9.62	60.34	11.36
10	NGPT 1/2	802-P/24	91.34	2.96	0.50	8.66	59.24	17.66
11	NGPT 1/3	803-P/24	89.70	3.71	0.59	10.30	55.66	16.44
12	NGPT 1/4	804-P/24	93.04	2.29	0.55	6.96	60.48	22.68
13	NGPT 1/5	805-P/24	90.92	2.70	0.82	9.08	54.74	20.12
14	NGPT 1C	806-P/24	90.80	2.46	1.20	9.20	55.86	19.42
15	NGPT 2/1	807-P/24	90.04	3.63	0.85	9.96	59.78	15.44
16	NGPT 2/2	808-P/24	90.36	4.20	0.28	9.64	62.86	13.87
17	NGPT 2/3	809-P/24	95.70	1.16	0.29	4.30	75.48	9.74
18	NGPT 2/4	810-P/24	87.40	1.96	2.82	12.60	50.20	19.44
19	NGPT 2/5	811-P/24	91.36	0.69	1.89	8.64	53.92	20.76
20	NGPT 2C	812-P/24	90.90	1.56	1.81	9.10	59.20	15.34
21	NGPT 3/5	813-P/24	85.20	6.78	0.86	14.80	49.64	14.11
22	NGPT 4/5	814-P/24	89.48	4.30	0.94	10.52	60.60	12.98


12.9.24
JOINT DIRECTOR (C.A.)
Directorate of Mines and Geology
Odisha, Bhubaneswar

N.B- NGS: GRAB SAMPLE, NGPT- PIT SAMPLE

ANNEXURE-XVI

Petrographic, Mineralographic study and XRD study report By DoMG Laboratory and MECL Laboratory, Nagpur



**DIRECTORATE OF MINES & GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR**

Heads of Department Building, Unit-V, Pin-751001
Tel No.: 0674-2391537, Fax No.: 0674-2391684
Email ID: dirmines_odisha@rediffmail.com

No. GXIX-(g)-01/22.No. 11697 /DoMG., Dt. 02-12-2024

From

P. K. Chand. JDG.
Directorate of Mines & Geology, Odisha
Bhubaneswar.

To

Sri Ramesh Behera.Geologist.
EIC, Naringpanga Graphite Project,
Dist-Jajpur

Sub: Petrographic study report.

Sir,

Enclosed, please find herewith the Petrographic study report.
of eight (8) rocks sample, supplied vide your letter No.93/NGP,
dt.09.07.2024 having Lab index No.TNP-1 to 3 & NPGS-1 to 5 (in
triplicate) for further action at your end.

Encl.-:-As above

BY ORDER OF DoM&G,


JOINT DIRECTOR GEOLOGY.

Memo No. 11698 /DoMG, dt. 02-12-2024

Copy along with copy of the report forwarded to the DDG,
petrology Laboratory for information and necessary action.


JOINT DIRECTOR GEOLOGY.

Memo No. 11699 /DoMG, dt. 02-12-2024

Copy forwarded to the DDG Report for information and
necessary action.


JOINT DIRECTOR GEOLOGY.

SAMPLE INDEX: TNP-1

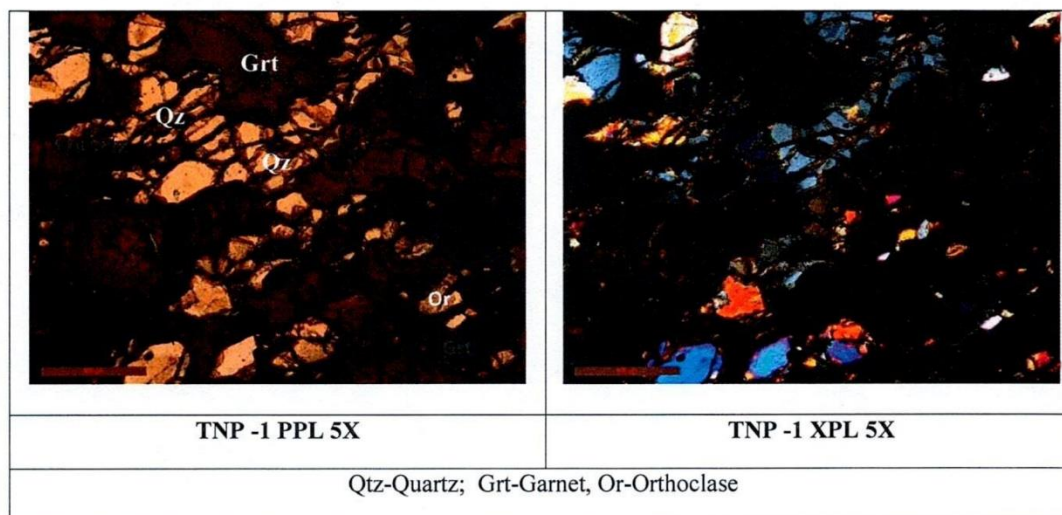
Microscopic Observation:

Minerals present:

- M₁:** The mineral occurs as anhedral colourless grains with low relief. It shows first order yellow interference colour and undulose extinction as its diagnostic properties. It has no cleavage and no alteration characteristics. From the observed optical properties, it is identified as **Quartz**.
- M₂:** Mineral grains are colourless, anhedral in shape, showing low relief, simple twinning and two sets of cleavages nearly orthogonal to each other. The grains are perthitic in nature. Hence, the mineral is **Orthoclase**.
- M₃:** It occurs as colourless, anhedral to subhedral grains with moderate relief. It exhibits two sets of cleavages and polysynthetic twinning. From the above mineral properties, it is identified as **Plagioclase**.
- M₄:** It occurs in flaky form and exhibits yellowish brown colour, pleochroism in shades of brown and straight extinction. The mineral is **Biotite**.
- M₅:** The mineral occurs as irregular grains of pale pink colour and high relief. It is isotropic in nature. Presence of numerous fractures and inclusions has been noticed. Hence, the mineral is **Garnet**.
- M₆:** The grains are greyish black in color and occur as disseminated thin flakes along the grain boundaries of quartz and feldspars. It also soils hand and hence identified as **Graphite**.

Texture: It is a medium-grained rock with a mineral composition as mentioned above, including flaky or platy graphite along the planes of foliation. The foliation (due to presence of platy mineral like biotite) parallel to the mineralogical layering is defined by the alignment of biotite and quartz. The combination of garnet, biotite, and graphite forms darker bands called melanosomes, while quartz, orthoclase and plagioclase create lighter bands known as leucosomes, which is a characteristic feature of gneissosity. Orthoclase minerals are sericitized, and plagioclase minerals are saussuritized to some extent. Garnets are highly fractured. Some mineral grains show signs of granulation along the borders. Iron solution has been leached out from the garnet, giving the rock a reddish color. At certain places, biotite and garnet are found closely associated, suggesting that biotite might have formed from the alteration of garnet. As the rock is weathered, it is difficult to identify the individual altered mineral phases and the percentages of mineral constituents under the microscope.

Conclusion: From the mineral assemblage and corresponding texture, the rock may be named as **Graphite bearing quartzo feldspathic gneiss**.



SAMPLE INDEX: TNP-2

Microscopic Observation:

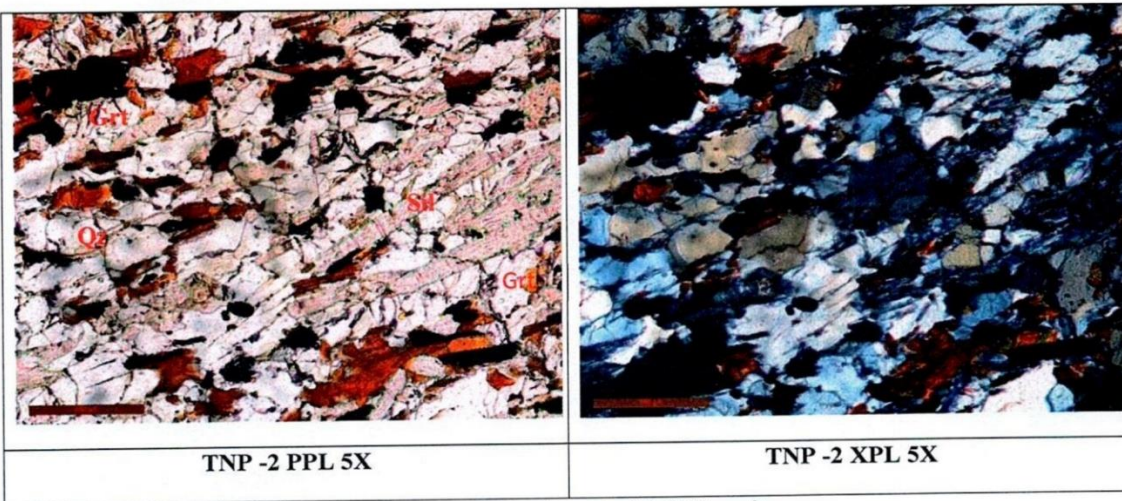
Minerals present:

- M₁:** The mineral occurs as anhedral colourless grains and shows low relief, no cleavage, no alteration, undulose extinction and 1st order grey and yellow interference colours. The mineral is identified as **Quartz**.
- M₂:** Mineral grains are colourless, anhedral in shape, showing low relief, simple twinning and two sets of cleavages nearly orthogonal to each other. The grains are perthitic in nature. Hence, the mineral is **Orthoclase**.
- M₃:** It occurs as colourless, anhedral to subhedral grains with moderate relief. It exhibits two sets of cleavages and polysynthetic twinning. From the above mineral properties, it is identified as **Plagioclase**.
- M₄:** It occurs in flaky form and exhibits yellowish brown colour, pleochroism in shades of brown and straight extinction. The mineral is **Biotite**.
- M₅:** The mineral occurs as irregular grains of pale pink colour and high relief. It is isotropic in nature. Presence of numerous fractures and inclusions has been noticed. Hence, the mineral is **Garnet**.
- M₆:** The mineral is colourless and occurs as rhomb shaped cross sections with long diagonal cleavage. It exhibits high relief, higher order interference colours and straight extinction. From the observed properties, the mineral is identified as **Sillimanite**.
- M₇:** It is found as spindle shaped crystals and is pleochroic from reddish brown to brown with high relief. The higher order white interference colour is masked by the colour of the mineral itself. Hence the mineral is identified as **Sphene**.
- M₈:** The grains are greyish black in color and occur as disseminated thin flakes along the grain boundaries of quartz and feldspars. It also soils hand and hence identified as **Graphite**.

Texture: The rock is medium to coarse grained that exhibits gneissosity, characterized by the presence of alternating bands of dark and light minerals. The darker bands (melanocratic bands) are composed of garnet and graphite, while the lighter bands (leucocratic bands) consist of quartz, feldspars and sillimanite. The orthoclase feldspar has undergone sericitization and the plagioclase feldspar shows signs of saussuritization. Additionally, the coarse-grained garnets are notably fractured, and some mineral grains have experienced granulation. Pseudomorphous sillimanite boundaries with transverse cracks have been observed. Iron solution has been leached out from the garnet, giving the rock a reddish color

Percentage of constituent minerals: Quartz contributes ~20-25%, orthoclase ~20%, plagioclase ~15-20%, garnet and sillimanite contribute ~15% each approximately.

Name: From the mineral assemblage and corresponding texture, the rock may be named as **Khondalite**
Group of rock.



SAMPLE INDEX: TNP-3

Microscopic Observation:

Minerals present:

M₁: The mineral occurs as anhedral colourless grains with low relief. It shows first order grey and yellow interference colours and undulose extinction as its diagnostic properties. It has no cleavage and no alteration characteristics. From the observed optical properties, it is identified as **Quartz**.

M₂: The mineral is colourless, anhedral in shape, showing low relief and simple twinning. The grains are perthitic in nature. Presence of perthites and simple twinning indicate that the mineral is **Orthoclase**.

M₃: It occurs in flaky form and exhibits yellowish brown colour, pleochroism in shades of brown and straight extinction. The mineral is **Biotite**.

M₄: The mineral occurs as irregular grains of pale pink colour and high relief. It is isotropic in nature. Presence of numerous fractures and inclusions has been noticed. Hence, the mineral is **Garnet**.

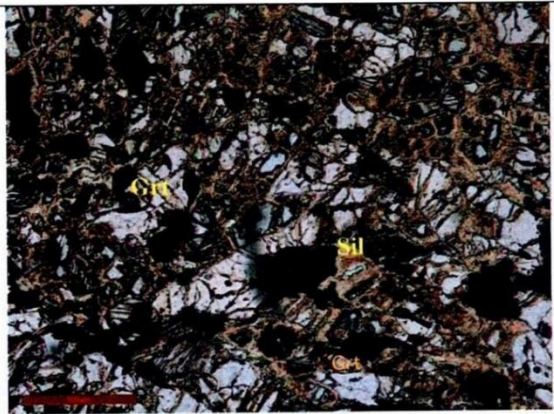

M₅: The mineral is colourless and occurs as slender prismatic crystals with transverse fractures and diamond shaped cross sections with one diagonal cleavage. It exhibits high relief, higher order interference colours and straight extinction. From the above observed properties, the mineral is identified as **Sillimanite**.

M₆: The grains are greyish black in color and occur as disseminated thin flakes along the grain boundaries of quartz and feldspars. It also soils hand and hence identified as **Graphite**.

Texture: It is a medium to coarse grained rock predominantly composed of quartz and feldspar showing crude foliation characteristics. The quartz grains are often flattened along the plane of foliation. Sillimanites are found as slender crystal with transverse fracture. The quartz grains exhibit sutured boundaries and granulation indicating a strained condition. Secondary overgrowth in shape of rims is noticed in some quartz grains. Orthoclases are perthitic in nature. Orthoclase feldspars are altered and impart a dusky appearance. The garnets are isotropic, and it is likely that iron has been leached from them, giving the rock a reddish colour.

Percentage of constituent minerals: Quartz contributes ~30%, orthoclase ~25-30%, sillimanite and garnet contribute ~10-15% each approximately.

Name: From the mineral assemblage and corresponding texture, the rock may be named as **Khondalite**
Group of rocks.

	
TNP -3 PPL 5X	TNP -3 XPL 5X
Qtz-Quartz; Grt-Garnet; Sil-Sillimanite	

SAMPLE INDEX: NPGS-1

Microscopic Observation:

Minerals present:

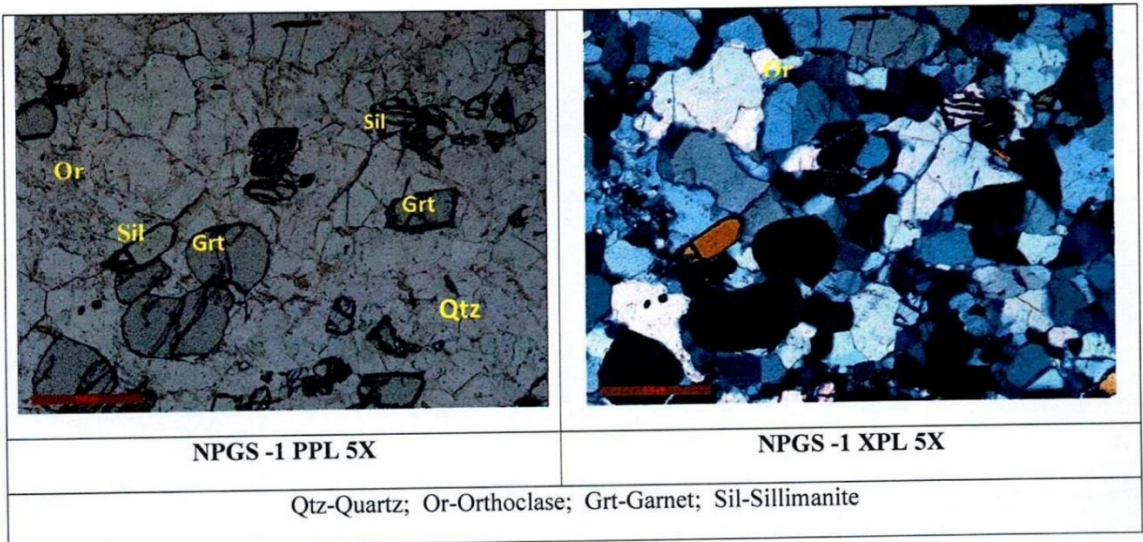
- M₁:** The mineral occurs as anhedral colourless grains with low relief. It shows first order yellow interference colour and undulose extinction as its diagnostic properties. It has no cleavage and no alteration characteristics. From the observed optical properties, it is identified as **Quartz**.
- M₂:** The mineral is colourless, anhedral in shape, showing low relief and simple twinning. The grains are perthitic in nature. Presence of perthites and simple twinning indicate that the mineral is **Orthoclase**.
- M₃:** It occurs as colourless, anhedral to subhedral grains with moderate relief. It exhibits two sets of cleavages and polysynthetic twinning. From the above mineral properties, it is identified as **Plagioclase**.
- M₄:** The mineral is colourless and occurs as rhomb shaped cross sections with long diagonal cleavage. It exhibits high relief, higher order interference colours and straight extinction. From the observed properties, the mineral is identified as **Sillimanite**.
- M₅:** The mineral is anhedral in shape, pale pink in colour, showing high relief and numerous fractures. It is getting extinct under crossed nicols due to its isotropic nature. Hence, it is identified as **Garnet**.
- M₆:** It is found as spindle shaped crystals and is pleochroic from reddish brown to brown with high relief. The higher order white interference colour is masked by the colour of the mineral itself. Hence the mineral is identified as **Sphene**.

M₇: **Opaque** minerals are completely dark both under plane polarized light and crossed nicols.

Texture: The rock is medium to coarse-grained, predominantly composed of quartz, feldspar, and exhibits crude foliation characteristics. The quartz crystals are often flattened due to deformation. Sillimanite occurs as slender crystals with transverse fractures. The granulated quartz grains, characterized by undulatory extinction is indicative of a strained condition. Some quartz grains show secondary overgrowths in the form of rims. Plagioclase feldspars are sassuritized. The garnets are isotropic and it is likely that iron has been leached from them giving the rock a reddish colour.

Percentage of constituent minerals: Quartz contributes ~20-25%, orthoclase ~20%, plagioclase ~15-20%, sillimanite and garnet contribute ~15% each approximately.

Name: From the mineral assemblage and corresponding texture, the rock may be named as **Khondalite**
Group of rocks.



SAMPLE INDEX: NPGS-2

Microscopic Observation:

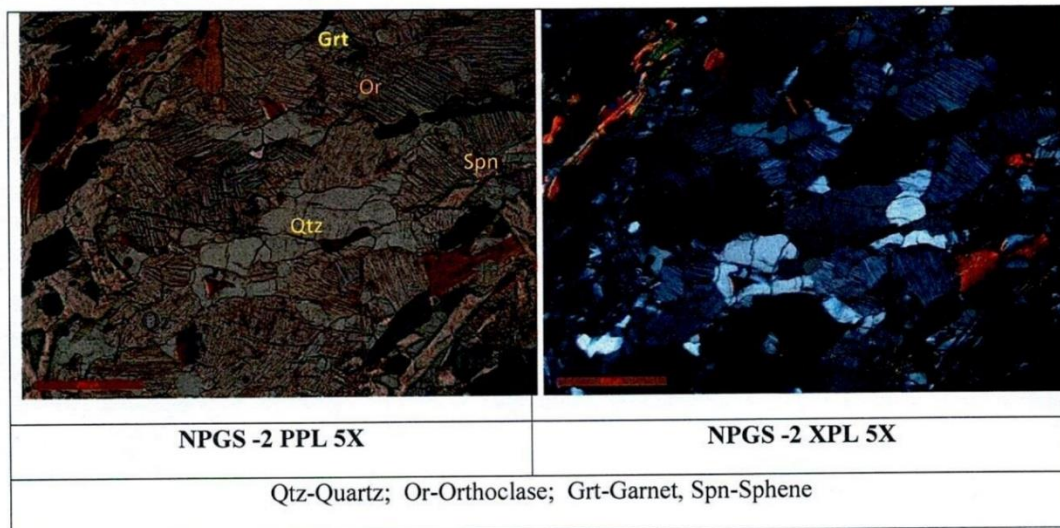
Minerals present:

- M₁:** The mineral occurs as anhedral colourless grains and shows low relief, no cleavage, no alteration, undulose extinction and 1st order grey interference colour. The mineral is identified as **Quartz**.
- M₂:** Mineral grains are colourless, anhedral in shape, showing low relief and simple twinning. The grains are perthitic in nature. Hence, the mineral is **Orthoclase**.
- M₃:** It occurs as colourless, anhedral to subhedral grains with moderate relief. It exhibits two sets of cleavages and polysynthetic twinning. From the above mineral properties, it is identified as **Plagioclase**.
- M₄:** It occurs in flaky form and exhibits yellowish brown colour, pleochroism in shades of brown and straight extinction. The mineral is **Biotite**.
- M₅:** The mineral is irregular in shape with pale pink colour and high relief. It is isotropic in nature. Presence of numerous fractures and inclusions has been noticed. Hence, the mineral is **Garnet**.
- M₆:** It is found as spindle shaped crystals and is pleochroic from reddish brown to brown with high relief. The higher order white interference colour is masked by the colour of the mineral itself. Hence the mineral is identified as **Sphene**.
- M₇:** The grains are greyish black in color and occur as disseminated thin flakes along the grain boundaries of quartz and feldspars. It also soils hand and hence identified as **Graphite**.

Texture: The rock is medium-grained, having a mineral composition stated above that includes flaky or platy graphite along the planes of Foliation. Foliation in the rock is characterized by the presence of platy mineral biotite, which is parallel to the alignment of quartz grains. Darker bands called melanosomes are formed by the combination of garnet, biotite, and graphite, while lighter bands known as leucosomes are formed by quartz, plagioclase, and orthoclase, a characteristic feature of gneissosity.. Orthoclase minerals are sericitized, and plagioclase minerals are saussuritized. Garnets are highly fractured, and some mineral grains exhibit signs of granulation. In certain areas, biotite and garnet occur close together, suggesting that biotite may have formed from the alteration of garnet.

Percentage of constituent minerals: Quartz contributes ~25%, orthoclase ~20%, plagioclase ~15-20%, biotite, sillimanite and garnet contribute ~10-15% each approximately.

Name: From the mineral assemblage and corresponding texture, the rock may be named as **Graphite bearing Quartzo feldspathic gneiss**.



SAMPLE INDEX: NPGS-3

Microscopic Observation:

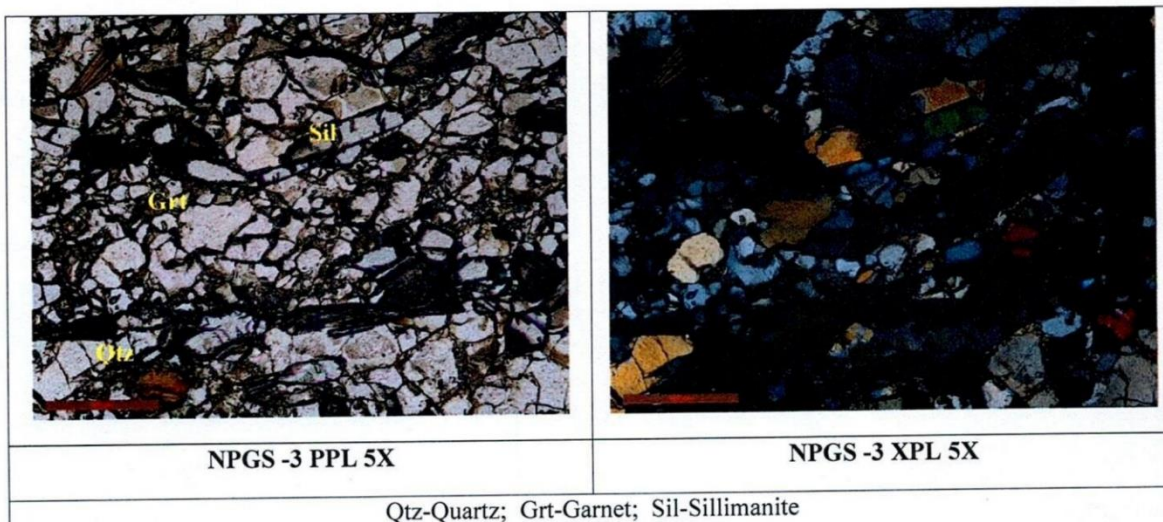
Minerals present:

- M₁:** The mineral occurs as anhedral colourless grains with low relief. It shows first order grey and yellow interference colours and undulose extinction as its diagnostic properties. It has no cleavage and no alteration characteristics. From the observed optical properties, it is identified as **Quartz**.
- M₂:** The mineral is colourless, anhedral in shape, showing low relief and simple twinning. The grains are perthitic in nature. Presence of perthites and simple twinning indicate that the mineral is **Orthoclase**.
- M₃:** The mineral is colourless, anhedral to subhedral in shape. It exhibits low relief, two sets of cleavages and lamellar twinning. Hence, the mineral is **Plagioclase**.
- M₄:** It occurs in flaky form and exhibits yellowish brown colour, pleochroism in shades of brown and straight extinction. The mineral is **Biotite**.
- M₄:** The mineral occurs as irregular grains of pale pink colour and high relief. It is isotropic in nature. Presence of numerous fractures and inclusions has been noticed. Hence, the mineral is **Garnet**.
- M₅:** The mineral is colourless and occurs as slender prismatic crystals with transverse fractures and diamond shaped cross sections with one diagonal cleavage. It exhibits high relief, higher order interference colours and straight extinction. From the above observed properties, the mineral is identified as **Sillimanite**.
- M₆:** It is found as spindle shaped crystals and is pleochroic from reddish brown to brown with high relief. The higher order white interference colour is masked by the colour of the mineral itself. Hence the mineral is identified as **Sphene**.
- M₇:** The grains are greyish black in color and occur as disseminated thin flakes along the grain boundaries of quartz and feldspars. It also soils hand and hence identified as **Graphite**.

Texture: It is an altered medium grained rock having the above mineralogy. The rock shows gneissosity due to the presence of discontinuous bands of alternate light and dark coloured minerals. Quartz, feldspars and sillimanite constitute the leucocratic bands whereas garnet, biotite and opaque minerals constitute the melanocratic bands. Quartz grains are strained and elongated. Orthoclases are sericitized and plagioclases are saussuritized to a large extent. Garnets are comparatively coarser than the surrounding minerals and are intensely fractured possessing numerous inclusions. The reddish appearance of the rock is attributed to the leaching of iron solution from garnet.

Percentage of constituent minerals: Quartz contributes ~25%, orthoclase ~20%, plagioclase ~15-20%, sillimanite, biotite and garnet contribute ~10-15% each approximately.

Name: From the mineral assemblage and corresponding texture, the rock may be named as **Khondalite group of rocks**.



SAMPLE INDEX: NPGS-4

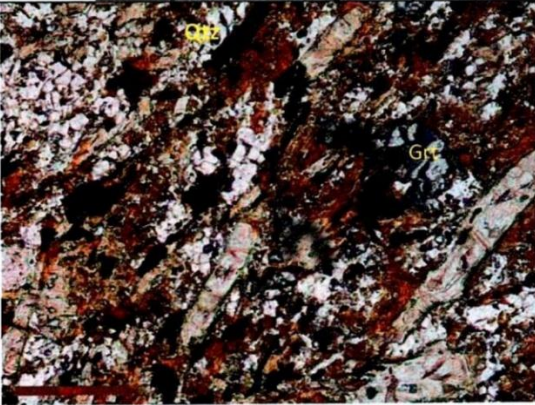
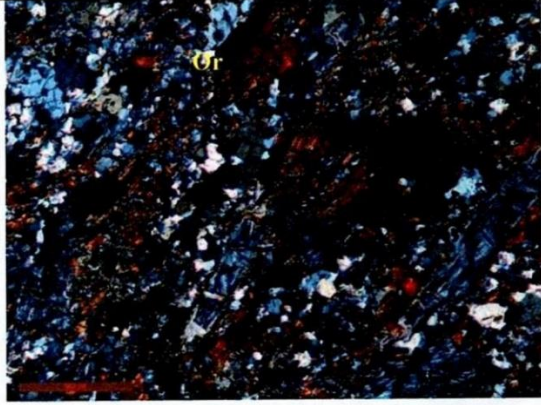
Microscopic Observation:

Minerals present:

- M₁:** The mineral occurs as anhedral colourless grains with low relief. It shows first order yellow interference colour and undulose extinction as its diagnostic properties. It has no cleavage and no alteration characteristics. From the observed optical properties, it is identified as **Quartz**.
- M₂:** Mineral grains are colourless, anhedral in shape, showing low relief, simple twinning and two sets of cleavages nearly orthogonal to each other. The grains are perthitic in nature. Hence, the mineral is **Orthoclase**.
- M₃:** It occurs in flaky form and exhibits yellowish brown colour, pleochroism in shades of brown and straight extinction. The mineral is **Biotite**.
- M₄:** The mineral is anhedral in shape, pale pink in colour, showing high relief and numerous fractures. It is getting extinct under crossed nicols due to its isotropic nature. Hence, it is identified as **Garnet**.
- M₅:** It is found as spindle shaped crystals and is pleochroic from reddish brown to brown with high relief. The higher order white interference colour is masked by the colour of the mineral itself. Hence the mineral is identified as **Sphene**.
- M₆:** The grains are greyish black in color and occur as disseminated thin flakes along the grain boundaries of quartz and feldspars. It also soils hand and hence identified as **Graphite**.

Texture: The rock is altered and medium-grained, with a mineral composition mentioned above, including flaky or platy graphite along the planes of foliation. It shows foliation(due to prescence of platy mineral biotite) parallel to the minerological layering, defined by the alignment of biotite, and quartz. The combination of garnet, biotite, and graphite forms darker bands called melanosomes, while quartz, and orthoclase create lighter bands known as leucosomes, which is a characteristic feature of gneissosity. Orthoclase minerals are sericitized, and plagioclase minerals are saussuritized. Garnets are highly fractured and some mineral grains show signs of granulation. Iron has been leached from the garnet, giving the rock a reddish color. At certain places, biotite and garnet are found close together, suggesting that biotite may have formed from the alteration of garnet.

Conclusion: From the mineral assemblage and corresponding texture, the rock may be named as **Graphite bearing Quartzo feldspathic gneiss**.

	
NPGS -4 PPL 5X	NPGS -4 XPL 5X
Qtz-Quartz; Or-Orthoclase; Grt-Garnet	

SAMPLE INDEX: NPGS-5

Microscopic Observation:

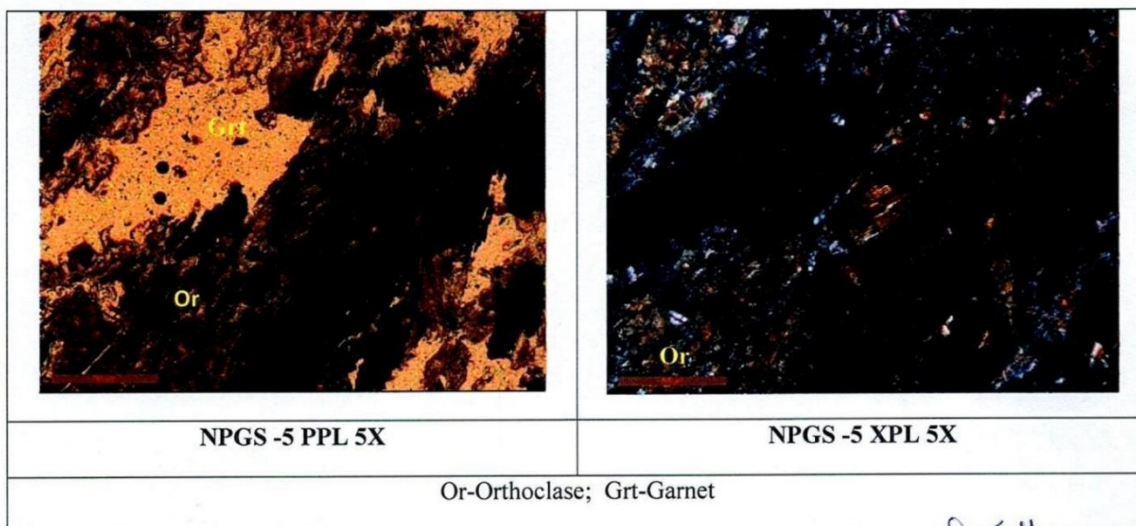
Minerals present:

- M₁:** The mineral occurs as anhedral colourless grains with low relief. It shows first order yellow interference colour and undulose extinction as its diagnostic properties. It has no cleavage and no alteration characteristics. From the observed optical properties, it is identified as **Quartz**.
- M₂:** Mineral grains are colourless, anhedral in shape, showing low relief, simple twinning and two sets of cleavages nearly orthogonal to each other. The grains are perthitic in nature. Hence, the mineral is **Orthoclase**.
- M₃:** It occurs as colourless, anhedral to subhedral grains with moderate relief. It exhibits two sets of cleavages and polysynthetic twinning. From the above mineral properties, it is identified as **Plagioclase**.
- M₄:** The mineral is anhedral in shape, pale pink in colour, showing high relief and numerous fractures. It is getting extinct under crossed nicols due to its isotropic nature. Hence, it is identified as **Garnet**.
- M₅:** It occurs in flaky form and exhibits yellowish brown colour, pleochroism in shades of brown and straight extinction. The mineral is **Biotite**.
- M₆:** The mineral is colourless and occurs as rhomb shaped cross sections with long diagonal cleavage. It exhibits high relief, higher order interference colours and straight extinction. From the observed properties, the mineral is identified as **Sillimanite**.
- M₇:** The grains are greyish black in color and occur as disseminated thin flakes along the grain boundaries of quartz and feldspars. It also soils hand and hence identified as **Graphite**.

Texture: The rock is medium grained, predominantly composed of quartz and feldspar, including flaky or platy graphite along the planes of deformation. The quartz crystals are often flattened due to deformation. Sillimanite occurs as slender crystals with transverse fractures. The quartz grains are granulated and showing sutured outlines indicating a strained condition. Some quartz grains show secondary overgrowths in the form of rims. Plagioclase feldspars are saussuritized. The garnets are isotropic, and it is likely that iron has been leached from them, giving the rock a reddish color.

Name: From the mineral assemblage and corresponding texture, the rock may be named as **Khondalite**

Group of rock.



Dr. Sasmita Sahoo, DDG

**MINERAL EXPLORATION AND CONSULTANCY LTD.
(A GOVT. OF INDIA ENTERPRISE)**



**PETROLOGY LAB
CLIENT: ODISA DMG
BLOCK: N/A**

PETROGRAPHIC STUDY RESULTS

Sl. No.	Sender's Sample ID	Texture	Mineral Composition			Description
			Major >5%	Minor <5% -> 1%	Accessory <1%	
1	NTS-1	It is a medium to fine grained rock showing gneissosity and mineralization.	Orthoclase Quartz Biotite Opaques	Sericite Pyrophyllite	Kaolinite Ferruginous matter Zircon	Orthoclase occurs as medium subhedral grains altering to dirty kaolinite, at places. Quartz occurs as medium to fine anhedral grains. Biotite is present as medium to fine flakes and patches showing parallel alignment. Opaques occur as fine to medium subhedral to anhedral and bladed/ flaky grains in dissemination and also occur as moderately coarse patches in pockets. Sericite is noted as turbid patches comprising very fine flaky aggregates. Pyrophyllite filings have seen intruded in areas. Ferruginous matter is seen present as reddish fillings and stains. Zircon occurs as very fine slender prismatic grains in accessories.

1

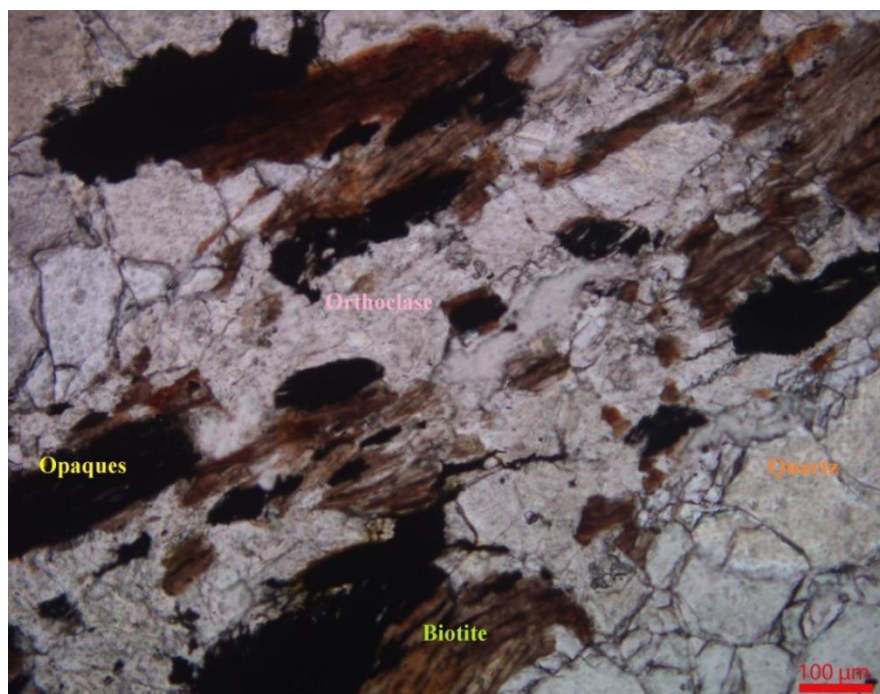
						The specimen is a <u>quartzo-feldspathic gneiss</u> .
2	NTS-2	It is a medium grained rock showing gneissosity and mineralization.	Quartz Orthoclase Biotite Opaques	Garnet Sericite	Kaolinite Ferruginous matter	Quartz occurs as medium anhedral and elongated grains showing crude alignment. Orthoclase is present as medium to fine subhedral prismatic and anhedral patchy grains altering to kaolinite. Biotite is seen present as fine to medium flakes and anhedral patches in dissemination and showing parallel alignment. Opaques occur as fine to medium anhedral to subhedral and bladed/ flaky grains in dissemination. Garnet occurs as fine to medium subrounded and anhedral patchy grains. Sericite is noted as patches and pockets comprising very fine aggregates. Reddish ferruginous fillings have seen intruded in areas. The specimen is a <u>quartzo-feldspathic gneiss</u> .
3	NTS-3	It is a medium to fine grained rock showing granular texture.	Quartz Garnet Plagioclase Orthoclase	Opaques	Biotite	Quartz occurs as medium to fine anhedral grains and patches. Garnet occurs as fine to medium subhedral to anhedral and subrounded grains in dissemination. Plagioclase and orthoclase are present as medium to fine subhedral to anhedral grains, where plagioclase is showing myrmekitic intergrowths in areas. Opaques are seen present as fine to very fine subhedral to anhedral grains. Biotite is noted as very fine flakes and fillings in accessories. The specimen is a <u>garnetiferous meta quartzo-feldspathic rock</u> .

2

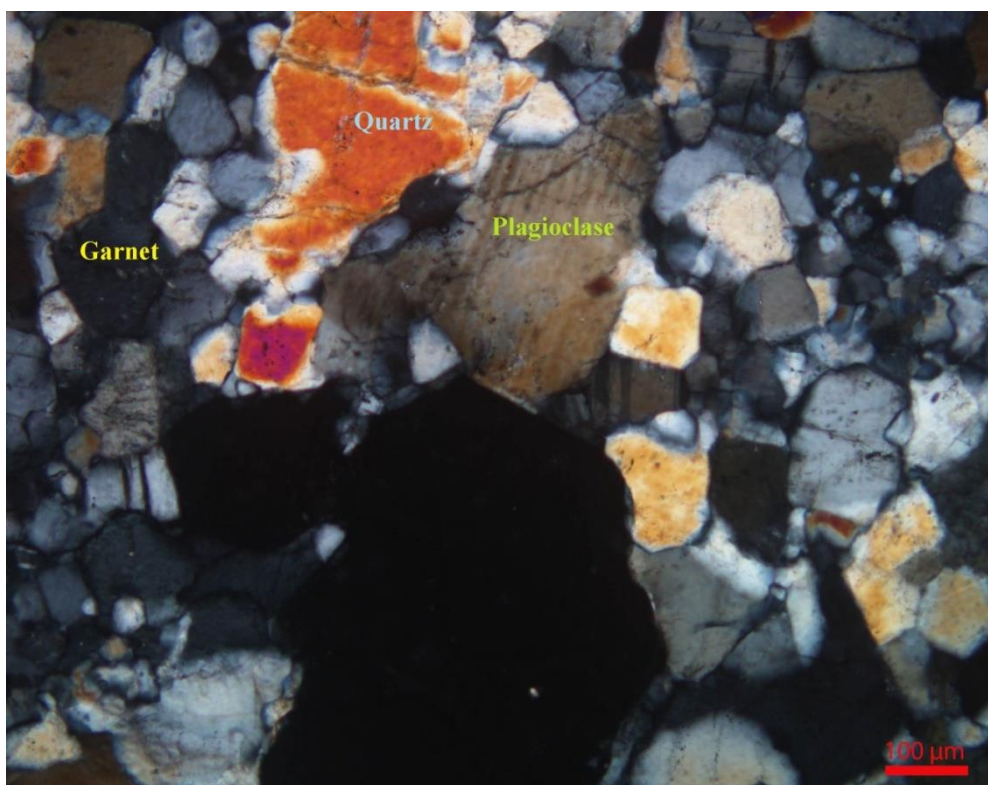
4	NTS-4	It is a medium to fine grained rock showing gneissosity and mineralization.	Quartz Orthoclase Biotite Opaques	Garnet Sericite	Kaolinite	Quartz occurs as medium to fine anhedral grains showing crude alignment. Orthoclase occurs as medium to fine subhedral and anhedral patchy grains in association with quartz. Biotite is present as fine flakes, flaky aggregates and patches showing parallel alignment. Opaques occur as fine to medium subhedral to anhedral grains and flaky aggregates in dissemination and aligned along the foliation. Garnet occurs as fine to medium anhedral grains. Sericite is seen present as patches in pockets comprising very fine aggregates. Kaolinite is noted as very fine dirty particles developing after orthoclase alterations. The specimen is a <u>quartzo-feldspathic gneiss</u> .
5	NTS-5	It is a medium to fine grained rock showing gneissosity.	Quartz Orthoclase Garnet	Sillimanite	Opaques Biotite	Quartz occurs as medium to fine anhedral and elongated grains showing parallel alignment. Orthoclase is present as fine to medium subhedral prismatic and anhedral patchy grains showing perthitic intergrowths in areas. Garnet occurs as medium to fine anhedral patchy grains showing inclusions of very fine quartz. Sillimanite is seen present as fine to very fine long prismatic grains showing parallel alignment. Opaques have intruded as thin veins and fillings. Biotite is noted as patches and patchy fillings comprising very fine micro-crystalline aggregates. The specimen is a <u>khondalite</u> .

3

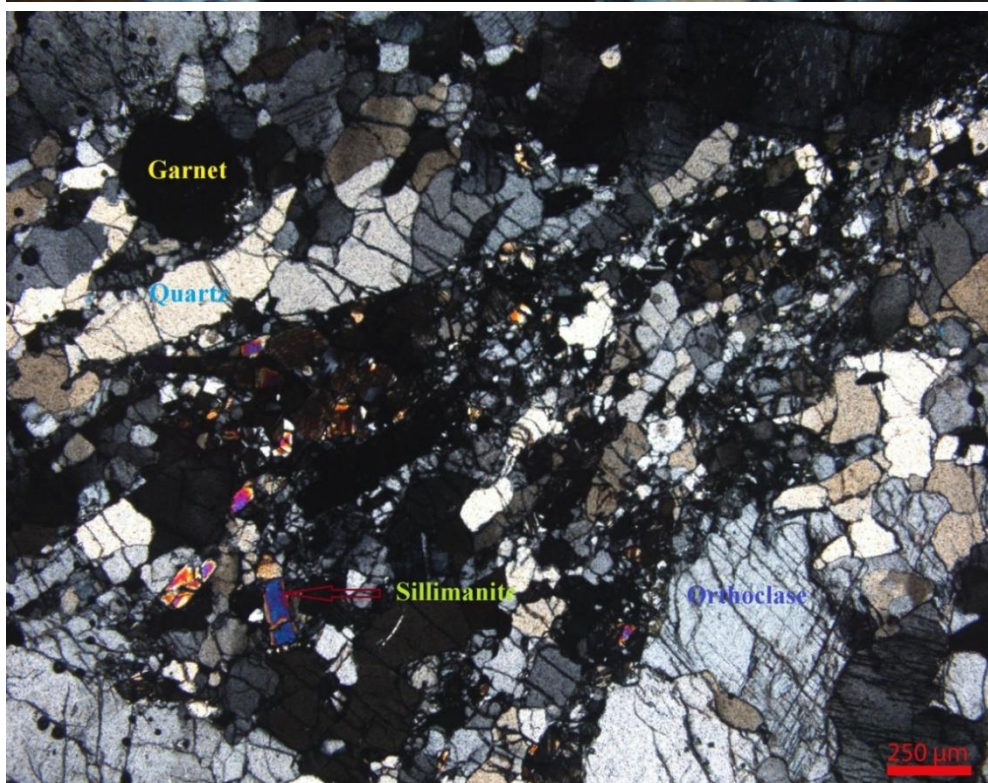
Sayantan Pal
05.11.24
SAYANTAN PAL
MANAGER (GEOLOGY)
PETROLOGY, MECL, NAGPUR.



NTS-2



NTS-3



NTS-5



GOVERNMENT OF ODISHA
DIRECTORATE OF MINES & GEOLOGY
XRD & XRF LABORATORY
Bhu- Bigyan Bhawan, Bhubaneswar-751001

XRD ANALYSES REPORT OF NARINGPANGA (S & W) GRAPHITE PROJECT.

RAYAGADA

The mineral phase identification is done by X-ray Diffractometer (XRD) of PANalytical Make (Model-Empyrean) having Copper anode tube and PIXcel1D detector. Two (2) grams of powdered sample having 150 mesh size were packed into a circular cavity type sample holder placed within a sample magazine attached to an automatic sample changer by using back loading technique. The analysis was performed with a chart speed of 1.3° per minute using Cu K α radiation ($\lambda = 1.54\text{\AA}$) with 45kV power & 30 mA current and the diffraction intensities were recorded for 2θ from 4° to 80°. The X-ray diffraction (XRD) data is presented in a graph with intensity (counts per second) on the Y-axis and 2θ values (at specific intervals) from 4° to 80° on the X-axis. Peaks were identified on the graph, and the corresponding 'd' values for each peak were determined from the XRD results. Each mineral phase exhibits a characteristic diffraction peak of its d-values. The XRD graphs obtained were analysed by comparing peaks using ICDD data file and the mineral phases were precisely identified.

Three (03) powdered samples bearing index nos. NXRD-1, 2 & 3 were analysed adopting the following methodology:

Model Name	Empyrean-PANalytical make	
Measurement	Weight of sample	2 gm
	Softwares	Data Collector Data Viewer & High Score plus
	Data file	ICDD Pdf-2
	Sample stage	Reflection-Transmission Spinner 3.0
	Scan angle	4° to 80°
	Step size	0.013°


M Ghana
DDG



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XRD-XRF LABORATORY
Bhu-Bigyan Bhawan, Bhubaneswar-751001

Sample Index: NXRD-1

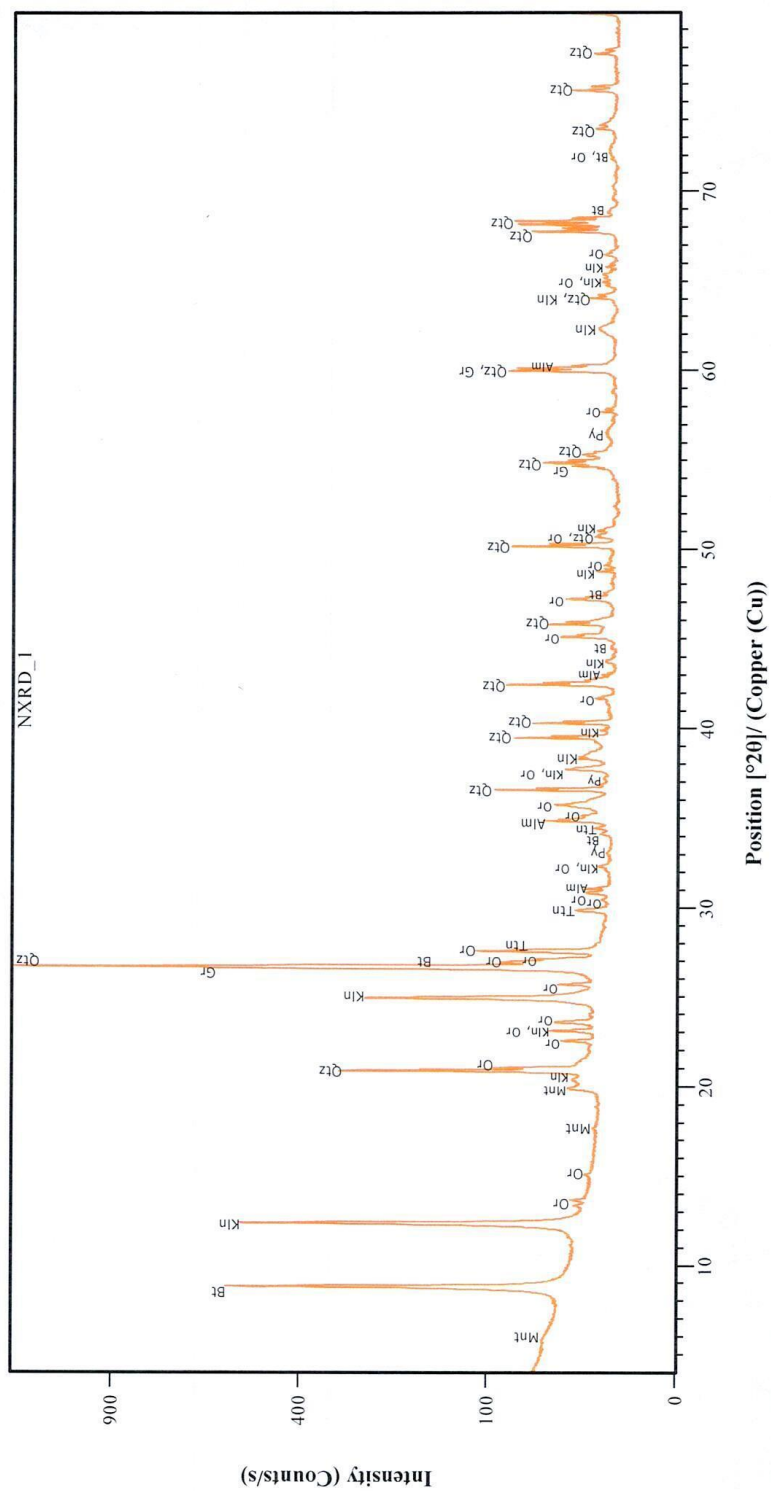
Mineral Phases identified

SI No.	Mineral Name	Position [$^{\circ}2\theta$]/ d-spacing [\AA]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 \AA ii. 20.88 / 4.25 \AA iii. 50.13 / 1.81 \AA	Qtz
2.	Graphite	i. 26.57 / 3.35 \AA ii. 59.90 / 1.54 \AA iii. 54.69 / 1.67 \AA	Gr
3.	Biotite	i. 8.81 / 10.02 \AA ii. 26.70 / 3.33 \AA iii. 34.11 / 2.62 \AA	Bt
4.	Kaolinite	i. 12.33 / 7.17 \AA ii. 24.85 / 3.58 \AA iii. 62.30 / 1.48 \AA	Kln
5.	Orthoclase	i. 27.52 / 3.23 \AA ii. 26.93 / 3.30 \AA iii. 23.59 / 3.76 \AA	Or
6.	Almandine	i. 34.89 / 2.57 \AA ii. 59.90 / 1.54 \AA iii. 31.10 / 2.87 \AA	Alm
7.	Pyrite	i. 56.28 / 1.63 \AA ii. 33.03 / 2.70 \AA iii. 37.10 / 2.42 \AA	Py
8.	Titanite	i. 27.56 / 3.23 \AA ii. 29.86 / 2.98 \AA iii. 34.53 / 2.59 \AA	Ttn
9.	Montmorillonite	i. 5.88 / 15.00 \AA ii. 19.93 / 4.45 \AA iii. 17.68 / 5.01 \AA	Mnt


M. Ghana
DDG



Sample Index: NXRD-I





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Bhu-Bigyan Bhawan, Bhubaneswar-751001

Sample Index: NXRD-2

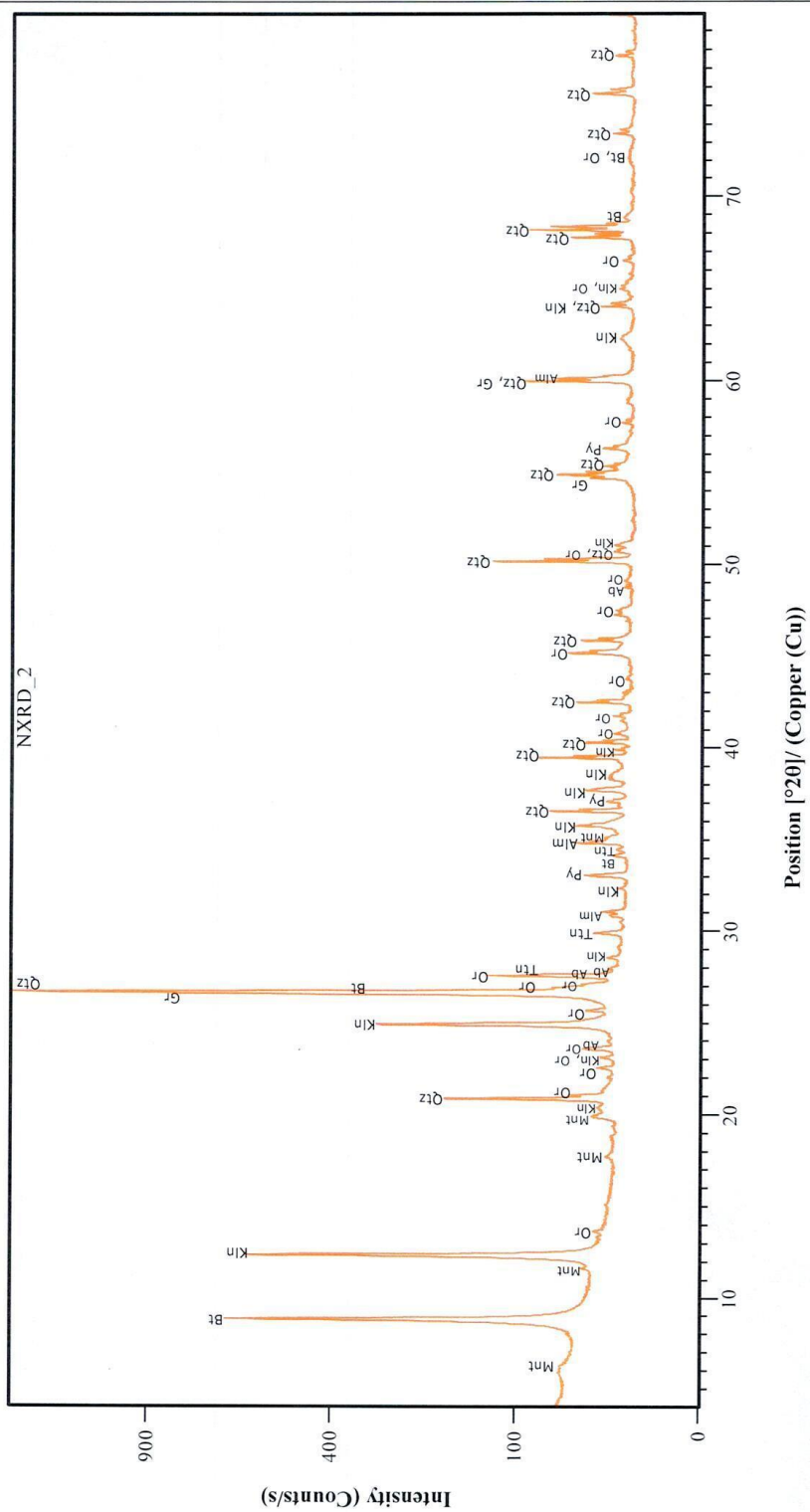
Mineral Phases identified

SI No.	Mineral Name	Position [°2θ]/ d-spacing [Å]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 Å ii. 20.88 / 4.25 Å iii. 50.13 / 1.81 Å	Qtz
2.	Graphite	i. 26.57 / 3.35 Å ii. 59.90 / 1.54 Å iii. 54.69 / 1.67 Å	Gr
3.	Biotite	i. 8.81 / 10.02 Å ii. 26.70 / 3.33 Å iii. 34.11 / 2.62 Å	Bt
4.	Kaolinite	i. 12.33 / 7.17 Å ii. 24.85 / 3.58 Å iii. 62.30 / 1.48 Å	Kln
5.	Orthoclase	i. 27.52 / 3.23 Å ii. 26.93 / 3.30 Å iii. 23.59 / 3.76 Å	Or
6.	Albite	i. 27.71 / 3.21 Å ii. 27.96 / 3.18 Å iii. 23.63 / 3.76 Å	Ab
7.	Almandine	i. 34.89 / 2.57 Å ii. 59.90 / 1.54 Å iii. 31.10 / 2.87 Å	Alm
8.	Pyrite	i. 56.28 / 1.63 Å ii. 33.03 / 2.70 Å iii. 37.10 / 2.42 Å	Py
9.	Titanite	i. 27.56 / 3.23 Å ii. 29.86 / 2.98 Å iii. 34.53 / 2.59 Å	Ttn
10.	Montmorillonite	i. 5.88 / 15.00 Å ii. 19.93 / 4.45 Å iii. 17.68 / 5.01 Å	Mnt


M Ghana
DDG



Sample Index: NXRD-2





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XRD-XRF LABORATORY
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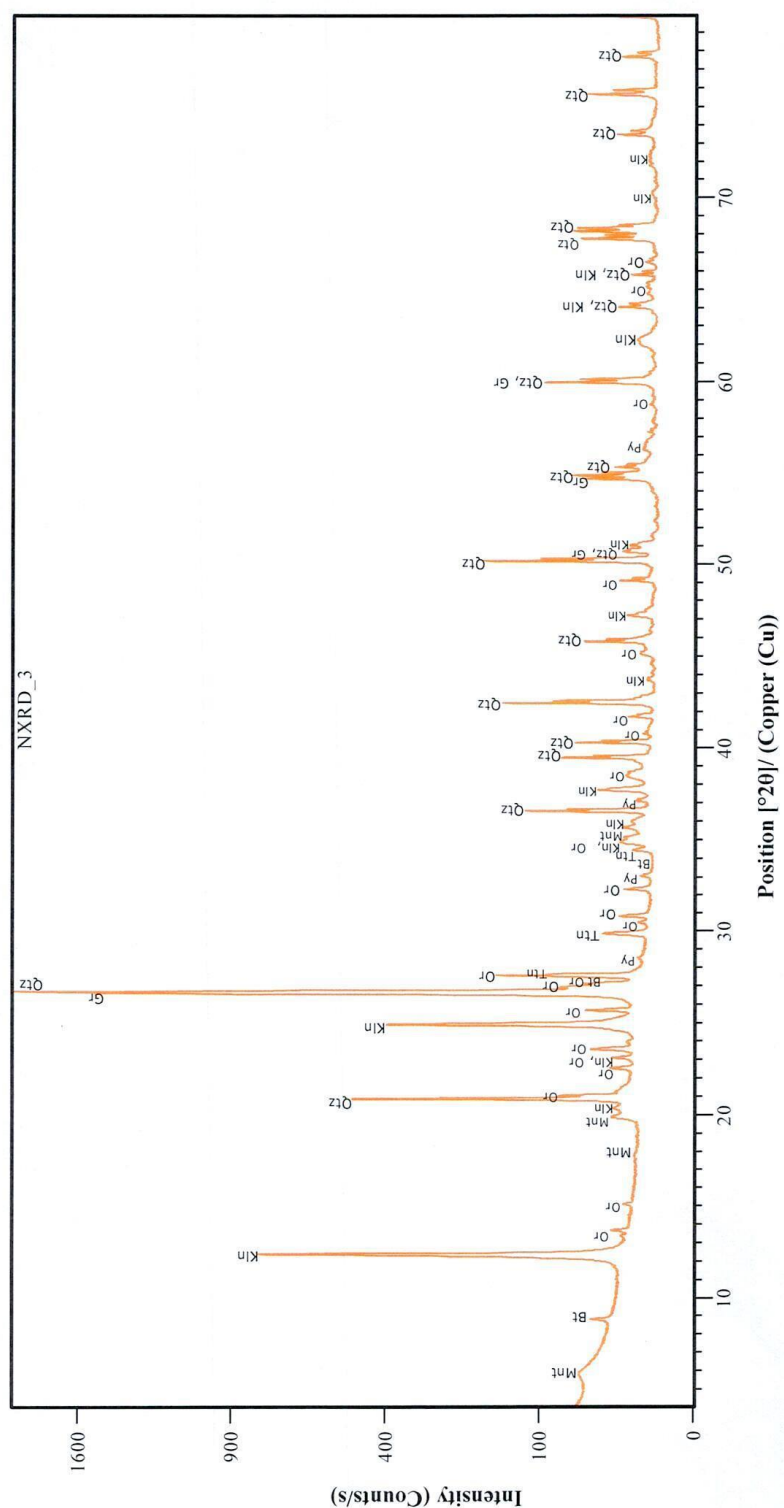
Sample Index: NXRD-3

Mineral Phases identified

SI No.	Mineral Name	Position [2θ]/ d-spacing [\AA]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 \AA ii. 20.88 / 4.25 \AA iii. 50.13 / 1.81 \AA	Qtz
2.	Graphite	i. 26.57 / 3.35 \AA ii. 59.90 / 1.54 \AA iii. 54.69 / 1.67 \AA	Gr
3.	Kaolinite	i. 12.33 / 7.17 \AA ii. 24.85 / 3.58 \AA iii. 62.30 / 1.48 \AA	Kln
4.	Orthoclase	i. 27.52 / 3.23 \AA ii. 26.93 / 3.30 \AA iii. 23.59 / 3.76 \AA	Or
5.	Titanite	i. 27.56 / 3.23 \AA ii. 29.86 / 2.98 \AA iii. 34.53 / 2.59 \AA	Ttn
6.	Biotite	i. 8.81 / 10.02 \AA ii. 26.70 / 3.33 \AA iii. 34.11 / 2.62 \AA	Bt
7.	Pyrite	i. 56.28 / 1.63 \AA ii. 33.03 / 2.70 \AA iii. 37.10 / 2.42 \AA	Py
8.	Montmorillonite	i. 5.88 / 15.00 \AA ii. 19.93 / 4.45 \AA iii. 17.68 / 5.01 \AA	Mnt

M. Ghana
30.08.20
M Ghana
DDG

NXRD_3






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XRD ANALYSES REPORT OF NARINGPANGA (S & W) GRAPHITE PROJECT,
RAYAGADA

The mineral phase identification is done by X-ray Diffractometer (XRD) of PANalytical Make (Model-Empyrean) having Copper anode tube and PIXcel1D detector. Two (2) grams of powdered sample having 150 mesh size were packed into a circular cavity type sample holder placed within a sample magazine attached to an automatic sample changer by using back loading technique. The analysis was performed with a chart speed of 1.3° per minute using Cu K α radiation ($\lambda = 1.54\text{\AA}$) with 45kV power & 30 mA current and the diffraction intensities were recorded for 2θ from 4° to 80°. The X-ray diffraction (XRD) data is presented in a graph with intensity (counts per second) on the Y-axis and 2θ values (at specific intervals) from 4° to 80° on the X-axis. Peaks were identified on the graph, and the corresponding 'd' values for each peak were determined from the XRD results. Each mineral phase exhibits a characteristic diffraction peak of its d-values. The XRD graphs obtained were analysed by comparing peaks using ICDD data file and the mineral phases were precisely identified.

Two (02) powdered samples bearing index nos. NXRD- 4 & 5, were analysed adopting the following methodology:

Model Name	Empyrean-PANalytical make	
Measurement	Weight of sample	2 gm
	Softwares	Data Collector Data Viewer & High Score plus
	Data file	ICDD Pdf-2
	Sample stage	Reflection-Transmission Spinner 3.0
	Scan angle	4° to 80°
	Step size	0.013°


S Swain
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Sample Index: NXRD-4

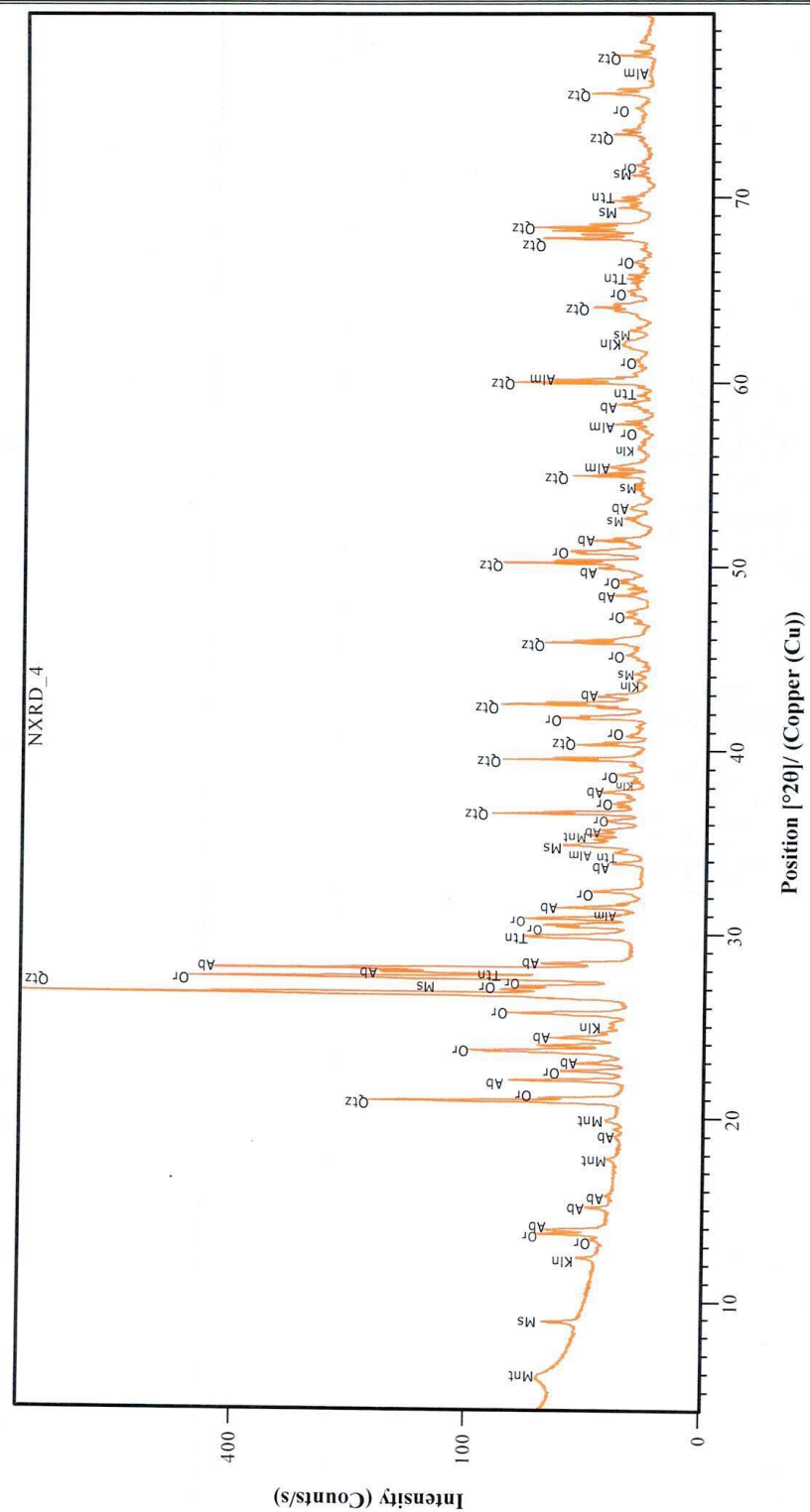
Mineral Phases identified

Sl No.	Mineral Name	Position [$^{\circ}2\theta$]/ d-spacing [\AA]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 \AA ii. 20.88 / 4.25 \AA iii. 50.13 / 1.81 \AA	Qtz
2.	Orthoclase	i. 27.52 / 3.23 \AA ii. 26.93 / 3.30 \AA iii. 23.59 / 3.76 \AA	Or
3.	Albite	i. 27.89 / 3.19 \AA ii. 27.71 / 3.21 \AA iii. 22.03 / 4.03 \AA	Ab
4.	Muscovite	i. 26.83 / 3.32 \AA ii. 8.88 / 9.95 \AA iii. 34.99 / 2.56 \AA	Ms
5.	Titanite	i. 27.56 / 3.23 \AA ii. 29.86 / 2.98 \AA iii. 34.53 / 2.59 \AA	Ttn
6.	Almandine	i. 34.89 / 2.57 \AA ii. 59.90 / 1.54 \AA iii. 31.10 / 2.87 \AA	Alm
7.	Montmorillonite	i. 5.88 / 15.00 \AA ii. 19.93 / 4.45 \AA iii. 35.44 / 2.53 \AA	Mnt
8.	Kaolinite	i. 12.33 / 7.17 \AA ii. 24.85 / 3.58 \AA iii. 62.30 / 1.48 \AA	Kln


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31.08.24

NXRD 4






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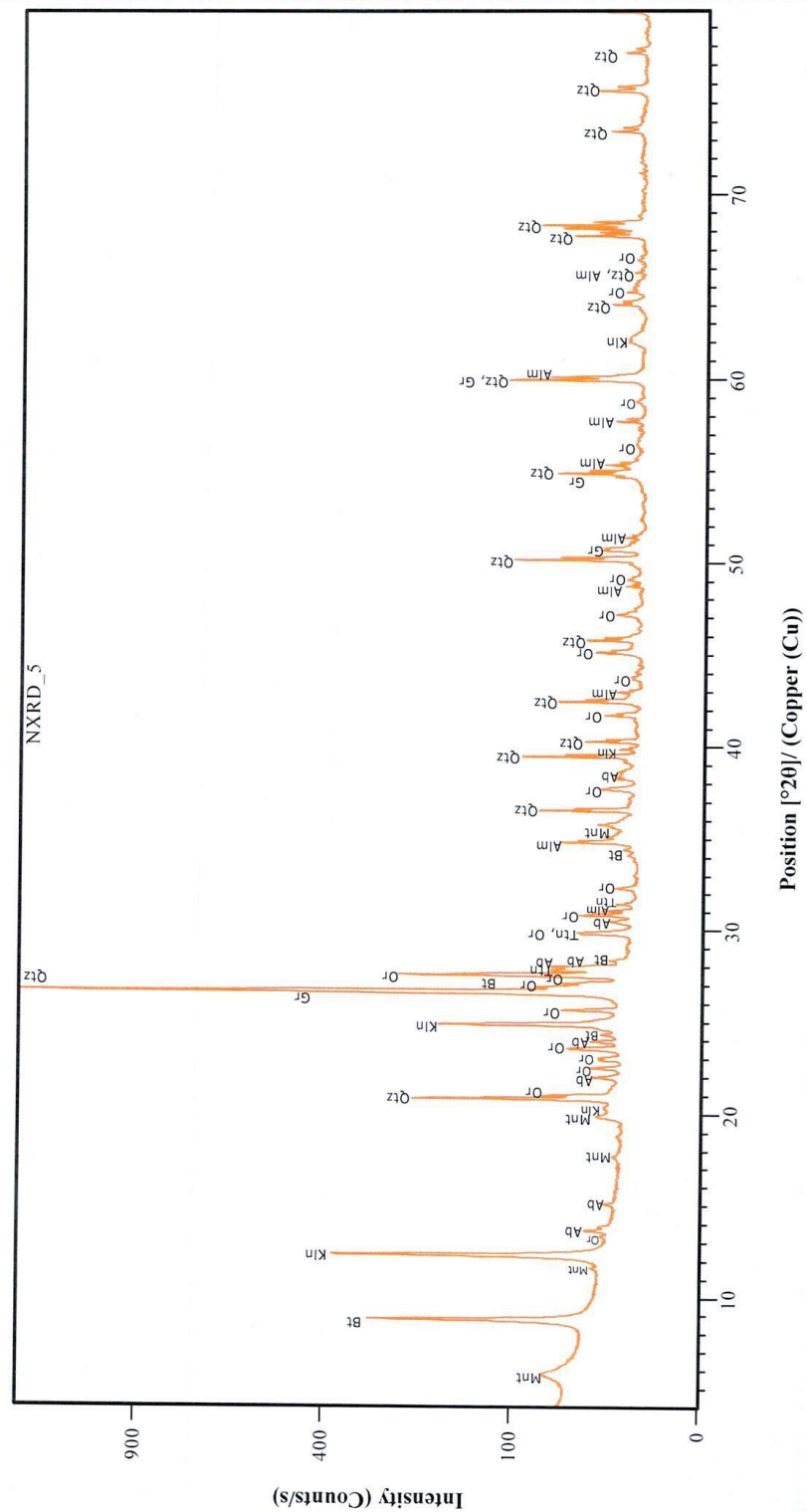
Sample Index: NXRD-5

Mineral Phases identified

Sl No.	Mineral Name	Position [$^{\circ}2\theta$]/ d-spacing [\AA]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 \AA ii. 20.88 / 4.25 \AA iii. 50.13 / 1.81 \AA	Qtz
2.	Graphite	i. 26.57 / 3.35 \AA ii. 59.90 / 1.54 \AA iii. 54.69 / 1.67 \AA	Gr
3.	Kaolinite	i. 12.33 / 7.17 \AA ii. 24.85 / 3.58 \AA iii. 62.30 / 1.48 \AA	Kln
4.	Biotite	i. 8.81 / 10.02 \AA ii. 26.70 / 3.33 \AA iii. 34.11 / 2.62 \AA	Bt
5.	Orthoclase	i. 27.52 / 3.23 \AA ii. 26.93 / 3.30 \AA iii. 23.59 / 3.76 \AA	Or
6.	Albite	i. 27.89 / 3.19 \AA ii. 27.71 / 3.21 \AA iii. 22.03 / 4.03 \AA	Ab
7.	Titanite	i. 27.56 / 3.23 \AA ii. 29.86 / 2.98 \AA iii. 34.53 / 2.59 \AA	Ttn
8.	Almandine	i. 34.89 / 2.57 \AA ii. 59.90 / 1.54 \AA iii. 31.10 / 2.87 \AA	Alm
9.	Montmorillonite	i. 5.88 / 15.00 \AA ii. 19.93 / 4.45 \AA iii. 35.44 / 2.53 \AA	Mnt


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NXRD 5





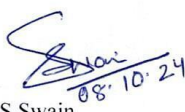
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XRD & XRF LABORATORY
Bhu- Bigyan Bhawan, Bhubaneswar-751001

XRD ANALYSES REPORT OF NARINGPANGA (S & W) GRAPHITE PROJECT,
RAYAGADA

The mineral phase identification is done by X-ray Diffractometer (XRD) of PANalytical Make (Model-Empyrean) having Copper anode tube and PIXcel1D detector. Two (2) grams of powdered sample having 150 mesh size were packed into a circular cavity type sample holder placed within a sample magazine attached to an automatic sample changer by using back loading technique. The analysis was performed with a chart speed of 1.3° per minute using Cu K α radiation ($\lambda = 1.54\text{\AA}$) with 45kV power & 30 mA current and the diffraction intensities were recorded for 2 θ from 4° to 80°. The X-ray diffraction (XRD) data is presented in a graph with intensity (counts per second) on the Y-axis and 2 θ values (at specific intervals) from 4° to 80° on the X-axis. Peaks were identified on the graph, and the corresponding 'd' values for each peak were determined from the XRD results. Each mineral phase exhibits a characteristic diffraction peak of its d-values. The XRD graphs obtained were analysed by comparing peaks using ICDD data file and the mineral phases were precisely identified.

Four (04) powdered samples bearing index nos. NXRD- 6, 9, 10 & 11, were analysed adopting the following methodology:

Model Name	Empyrean-PANalytical make	
Measurement	Weight of sample	2 gm
	Softwares	Data Collector Data Viewer & High Score plus
	Data file	ICDD Pdf-2
	Sample stage	Reflection-Transmission Spinner 3.0
	Scan angle	4° to 80°
	Step size	0.013°


08.10.24
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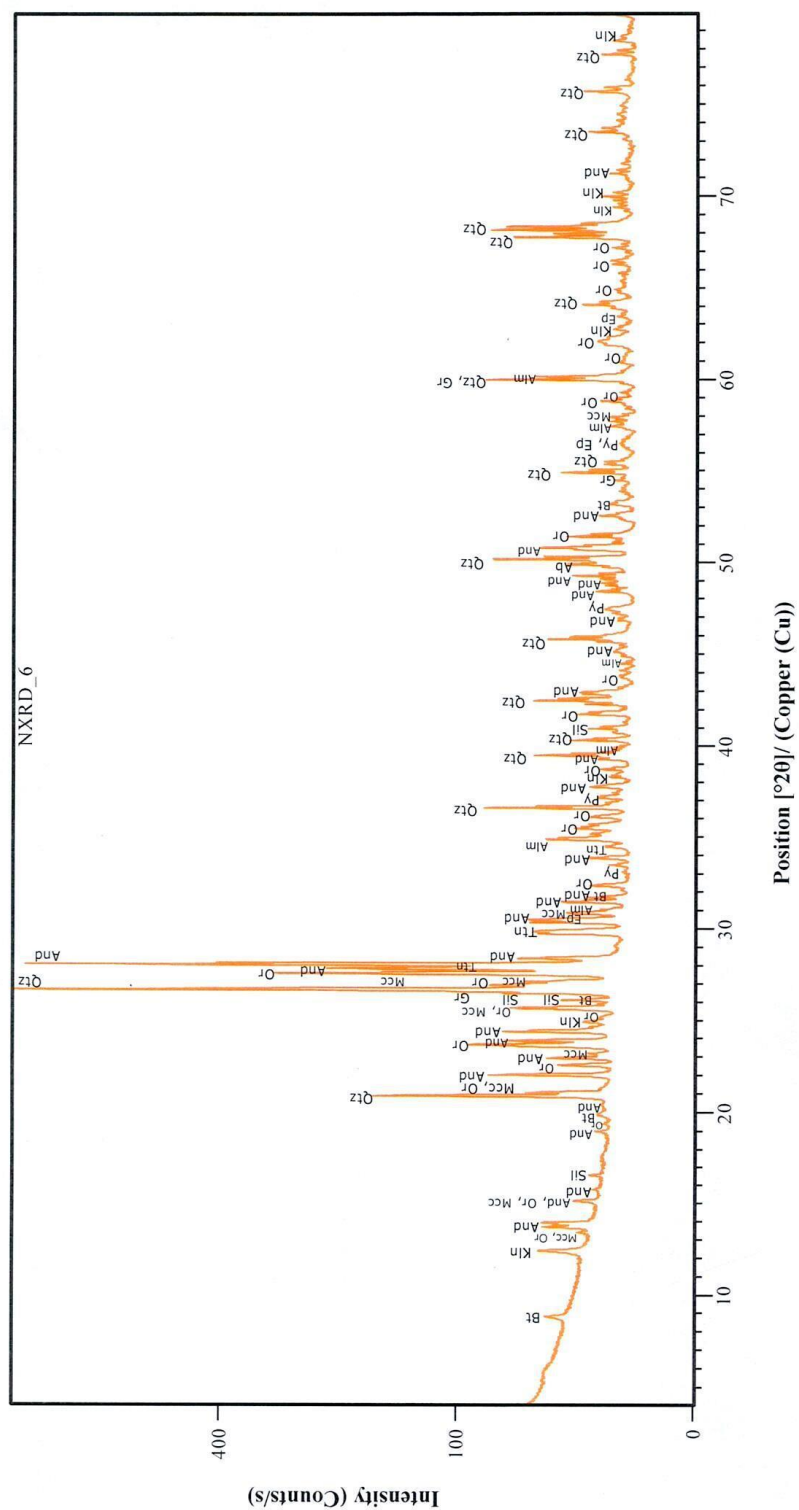
Sample Index: NXRD-6

Mineral Phases identified

Sl No.	Mineral Name	Position [$^{\circ}2\theta$]/ d-spacing [\AA]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 \AA ii. 20.88 / 4.25 \AA iii. 50.13 / 1.81 \AA	Qtz
2.	Andesine	i. 28.04 / 3.18 \AA ii. 27.85 / 3.20 \AA iii. 21.99 / 4.03 \AA	And
3.	Orthoclase	i. 27.52 / 3.23 \AA ii. 26.93 / 3.30 \AA iii. 23.59 / 3.76 \AA	Or
4.	Microcline	i. 27.49 / 3.24 \AA ii. 27.05 / 3.29 \AA iii. 21.02 / 4.22 \AA	Mcc
5.	Graphite	i. 26.57 / 3.35 \AA ii. 59.90 / 1.54 \AA iii. 54.69 / 1.67 \AA	Gr
6.	Titanite	i. 27.56 / 3.23 \AA ii. 29.86 / 2.98 \AA iii. 34.53 / 2.59 \AA	Ttn
7.	Almandine	i. 34.89 / 2.57 \AA ii. 59.90 / 1.54 \AA iii. 31.10 / 2.87 \AA	Alm
8.	Sillimanite	i. 26.50 / 3.36 \AA ii. 40.98 / 2.20 \AA iii. 26.11 / 3.41 \AA	Sil
9.	Kaolinite	i. 12.33 / 7.17 \AA ii. 24.85 / 3.58 \AA iii. 62.30 / 1.48 \AA	Kln
10.	Biotite	i. 8.81 / 10.02 \AA ii. 26.50 / 3.36 \AA iii. 34.11 / 2.62 \AA	Bt
11.	Pyrite	i. 56.28 / 1.63 \AA ii. 33.03 / 2.70 \AA iii. 37.10 / 2.42 \AA	Py
12.	Epidote	i. 56.28 / 1.63 \AA ii. 30.80 / 2.90 \AA iii. 64.17 / 1.45 \AA	Ep


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NXRD_6






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Sample Index: NXRD-9

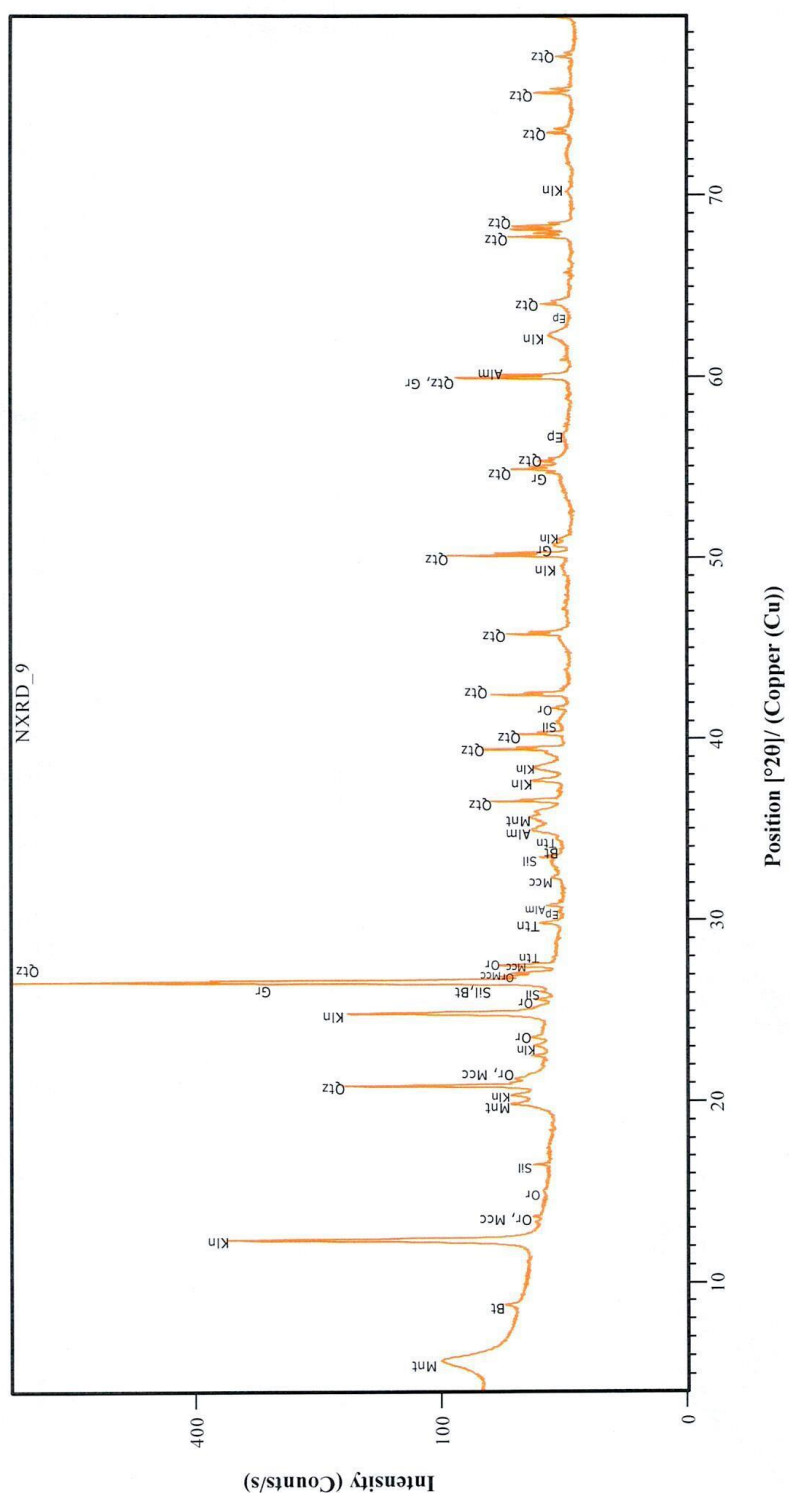
Mineral Phases identified

Sl No.	Mineral Name	Position [°2θ]/ d-spacing [Å]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 Å ii. 20.88 / 4.25 Å iii. 50.13 / 1.81 Å	Qtz
2.	Kaolinite	i. 12.33 / 7.17 Å ii. 24.85 / 3.58 Å iii. 62.30 / 1.48 Å	Kln
3.	Graphite	i. 26.57 / 3.35 Å ii. 59.90 / 1.54 Å iii. 54.69 / 1.67 Å	Gr
4.	Montmorillonite	i. 5.88 / 15.00 Å ii. 19.93 / 4.45 Å iii. 35.44 / 2.53 Å	Mnt
5.	Orthoclase	i. 27.52 / 3.23 Å ii. 26.93 / 3.30 Å iii. 23.59 / 3.76 Å	Or
6.	Microcline	i. 27.49 / 3.24 Å ii. 27.05 / 3.29 Å iii. 21.02 / 4.22 Å	Mcc
7.	Titanite	i. 27.56 / 3.23 Å ii. 29.86 / 2.98 Å iii. 34.53 / 2.59 Å	Ttn
8.	Biotite	i. 8.81 / 10.02 Å ii. 26.50 / 3.36 Å iii. 34.11 / 2.62 Å	Bt
9.	Sillimanite	i. 26.50 / 3.36 Å ii. 40.98 / 2.20 Å iii. 26.11 / 3.41 Å	Sil
10.	Almandine	i. 34.89 / 2.57 Å ii. 59.90 / 1.54 Å iii. 31.10 / 2.87 Å	Alm
11.	Epidote	i. 56.28 / 1.63 Å ii. 30.80 / 2.90 Å iii. 64.17 / 1.45 Å	Ep


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Sample Index: NXRD-9



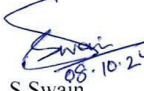


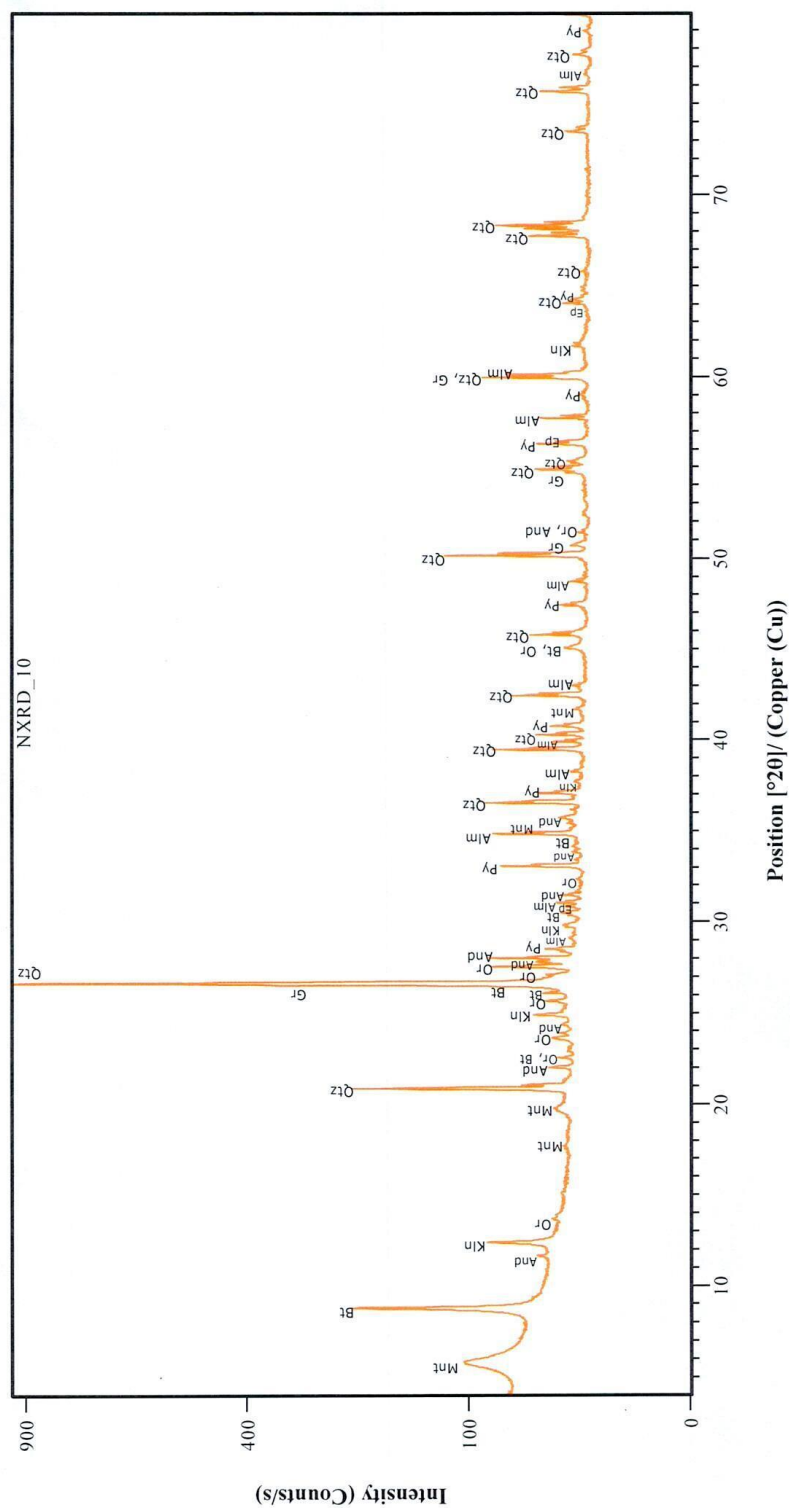
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Sample Index: NXRD-10

Mineral Phases identified

Sl No.	Mineral Name	Position [°2θ]/ d-spacing [Å]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 Å ii. 20.88 / 4.25 Å iii. 50.13 / 1.81 Å	Qtz
2.	Graphite	i. 26.57 / 3.35 Å ii. 59.90 / 1.54 Å iii. 54.69 / 1.67 Å	Gr
3.	Biotite	i. 8.81 / 10.02 Å ii. 26.50 / 3.36 Å iii. 34.11 / 2.62 Å	Bt
4.	Andesine	i. 28.04 / 3.18 Å ii. 27.85 / 3.20 Å iii. 21.99 / 4.03 Å	And
5.	Orthoclase	i. 27.52 / 3.23 Å ii. 26.93 / 3.30 Å iii. 23.59 / 3.76 Å	Or
6.	Almandine	i. 34.89 / 2.57 Å ii. 59.90 / 1.54 Å iii. 31.10 / 2.87 Å	Alm
7.	Kaolinite	i. 12.33 / 7.17 Å ii. 24.85 / 3.58 Å iii. 62.30 / 1.48 Å	Kln
8.	Montmorillonite	i. 5.88 / 15.00 Å ii. 19.93 / 4.45 Å iii. 35.44 / 2.53 Å	Mnt
9.	Pyrite	i. 56.28 / 1.63 Å ii. 33.03 / 2.70 Å iii. 37.10 / 2.42 Å	Py
10.	Epidote	i. 56.28 / 1.63 Å ii. 30.80 / 2.90 Å iii. 64.17 / 1.45 Å	Ep


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Sample Index: NXRD-11

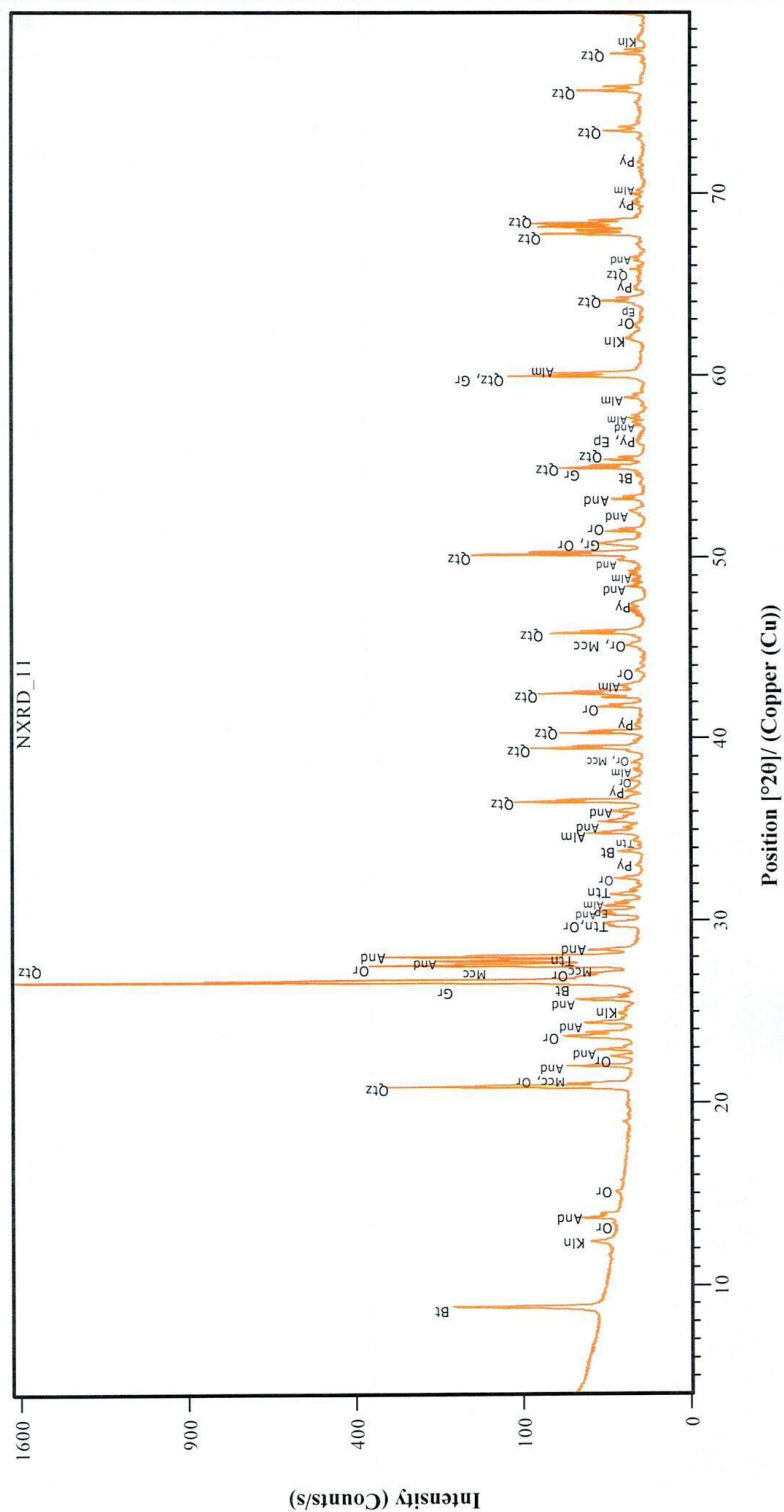
Mineral Phases identified

Sl No.	Mineral Name	Position [°2θ]/ d-spacing [Å]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 Å ii. 20.88 / 4.25 Å iii. 50.13 / 1.81 Å	Qtz
2.	Orthoclase	i. 27.52 / 3.23 Å ii. 26.93 / 3.30 Å iii. 23.59 / 3.76 Å	Or
3.	Andesine	i. 28.04 / 3.18 Å ii. 27.85 / 3.20 Å iii. 21.99 / 4.03 Å	And
4.	Microcline	i. 27.49 / 3.24 Å ii. 27.05 / 3.29 Å iii. 21.02 / 4.22 Å	Mcc
5.	Biotite	i. 8.81 / 10.02 Å ii. 26.50 / 3.36 Å iii. 34.11 / 2.62 Å	Bt
6.	Graphite	i. 26.57 / 3.35 Å ii. 59.90 / 1.54 Å iii. 54.69 / 1.67 Å	Gr
7.	Almandine	i. 34.89 / 2.57 Å ii. 59.90 / 1.54 Å iii. 31.10 / 2.87 Å	Alm
8.	Titanite	i. 27.56 / 3.23 Å ii. 29.86 / 2.98 Å iii. 34.53 / 2.59 Å	Ttn
9.	Kaolinite	i. 12.33 / 7.17 Å ii. 24.85 / 3.58 Å iii. 62.30 / 1.48 Å	Kln
10.	Pyrite	i. 56.28 / 1.63 Å ii. 33.03 / 2.70 Å iii. 37.10 / 2.42 Å	Py
11.	Epidote	i. 56.28 / 1.63 Å ii. 30.80 / 2.90 Å iii. 64.17 / 1.45 Å	Ep


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Geologist



Sample Index: NXRD-11





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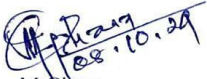
XRD ANALYSIS REPORT OF NARINGPANGA (S & W) GRAPHITE PROJECT,

RAYAGADA

The mineral phase identification is done by X-ray Diffractometer (XRD) of PANalytical Make (Model-Empyrean) having Copper anode tube and PIXcel1D detector. Two (2) grams of powdered sample having 150 mesh size was packed into a circular cavity type sample holder placed within a sample magazine attached to an automatic sample changer by using back loading technique. The analysis was performed with a chart speed of 1.3° per minute using Cu K α radiation ($\lambda = 1.54\text{\AA}$) with 45kV power & 30 mA current and the diffraction intensities were recorded for 2θ from 4° to 80°. The X-ray diffraction (XRD) data is presented in a graph with intensity (counts per second) on the Y-axis and 2θ values (at specific intervals) from 4° to 80° on the X-axis. Peaks were identified on the graph, and the corresponding 'd' values for each peak were determined from the XRD results. Each mineral phase exhibits a characteristic diffraction peak of its d-values. The XRD graphs obtained were analysed by comparing peaks using ICDD data file and the mineral phases were precisely identified.

Four (04) powdered sample bearing index no. NXRD-7, 12, 13 & 14 were analysed adopting the following methodology:

Model Name	Empyrean-PANalytical make	
Measurement	Weight of sample	2 gm
	Softwares	Data Collector Data Viewer & High Score plus
	Data file	ICDD Pdf-2
	Sample stage	Reflection-Transmission Spinner 3.0
	Scan angle	4° to 80°
	Step size	0.013°


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Sample Index: NXRD-7

Mineral Phases identified

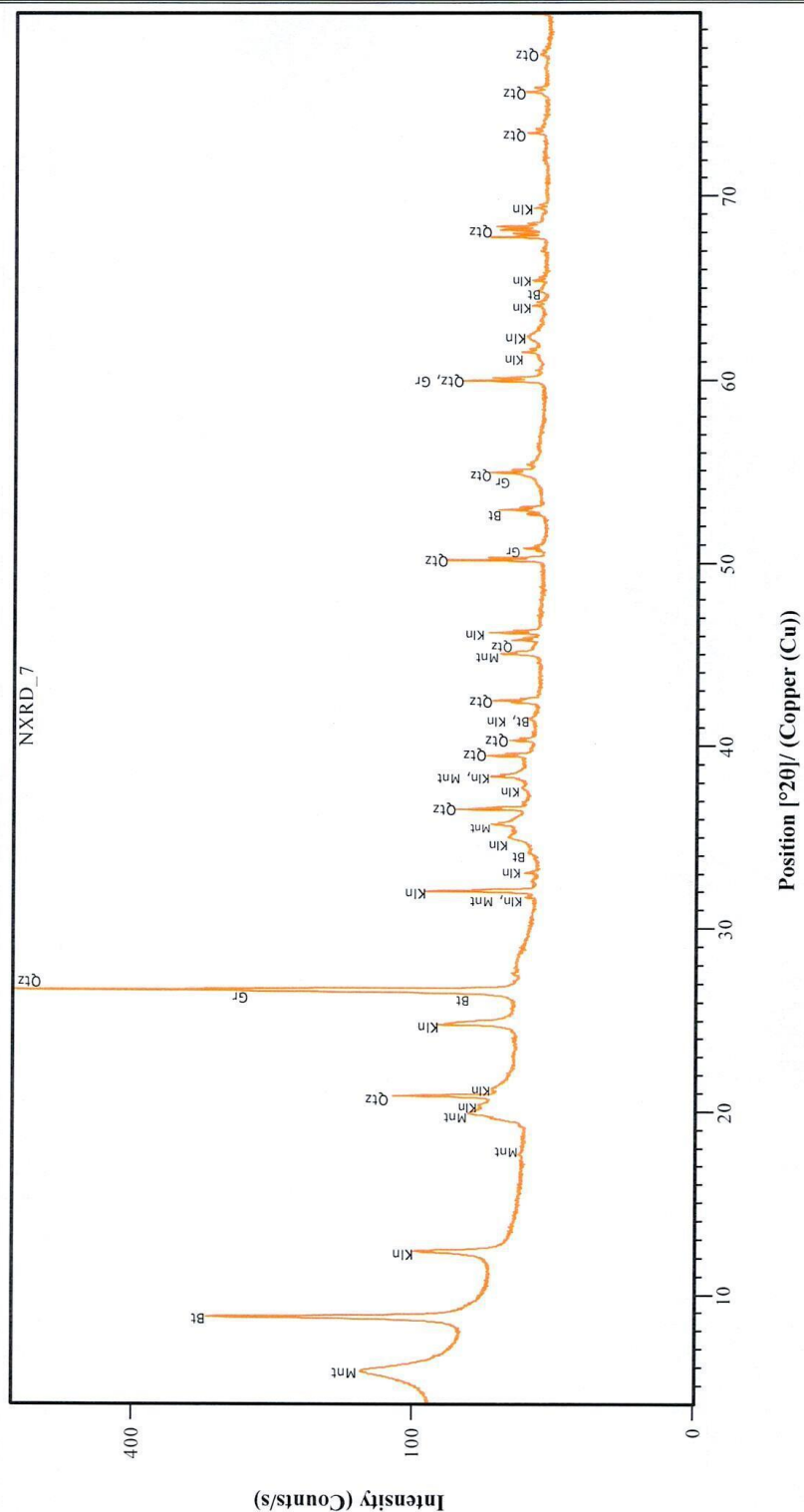
Sl No.	Mineral Name	Position [$^{\circ}2\theta$]/ d-spacing [\AA]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 \AA ii. 20.88 / 4.25 \AA iii. 50.13 / 1.81 \AA	Qtz
2.	Biotite	i. 8.81 / 10.02 \AA ii. 26.50 / 3.36 \AA iii. 34.11 / 2.62 \AA	Bt
3.	Graphite	i. 26.57 / 3.35 \AA ii. 59.90 / 1.54 \AA iii. 54.69 / 1.67 \AA	Gr
4.	Montmorillonite	i. 5.88 / 15.00 \AA ii. 19.93 / 4.45 \AA iii. 35.44 / 2.53 \AA	Mnt
5.	Kaolinite	i. 12.33 / 7.17 \AA ii. 24.85 / 3.58 \AA iii. 62.30 / 1.48 \AA	Kln


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Sample Index: NXRD-7





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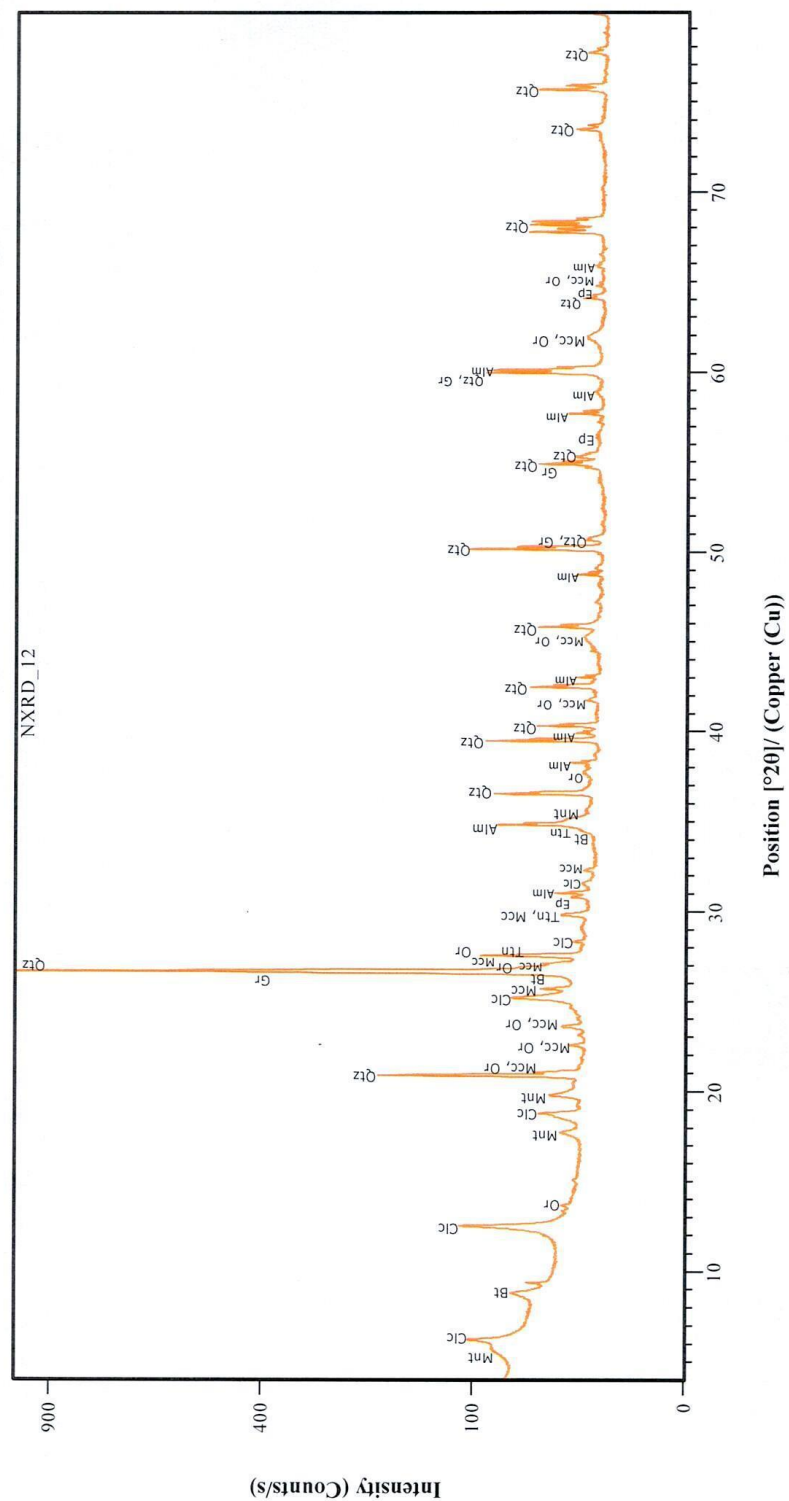
Sample Index: NXRD-12

Mineral Phases identified

Sl No.	Mineral Name	Position [2θ]/ d-spacing [\AA]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 \AA ii. 20.88 / 4.25 \AA iii. 50.13 / 1.81 \AA	Qtz
2.	Graphite	i. 26.57 / 3.35 \AA ii. 59.90 / 1.54 \AA iii. 54.69 / 1.67 \AA	Gr
3.	Clinochlore	i. 12.50 / 7.07 \AA ii. 25.14 / 3.54 \AA iii. 6.26 / 14.10 \AA	Clc
4.	Orthoclase	i. 27.52 / 3.23 \AA ii. 26.93 / 3.30 \AA iii. 23.59 / 3.76 \AA	Or
5.	Almandine	i. 34.89 / 2.57 \AA ii. 59.90 / 1.54 \AA iii. 31.10 / 2.87 \AA	Alm
6.	Microcline	i. 27.49 / 3.24 \AA ii. 27.05 / 3.29 \AA iii. 21.02 / 4.22 \AA	Mcc
7.	Titanite	i. 27.56 / 3.23 \AA ii. 29.86 / 2.98 \AA iii. 34.53 / 2.59 \AA	Ttn
8.	Biotite	i. 8.81 / 10.02 \AA ii. 26.50 / 3.36 \AA iii. 34.11 / 2.62 \AA	Bt
9.	Montmorillonite	i. 5.88 / 15.00 \AA ii. 19.93 / 4.45 \AA iii. 35.44 / 2.53 \AA	Mnt
10.	Epidote	i. 56.28 / 1.63 \AA ii. 30.80 / 2.90 \AA iii. 64.17 / 1.45 \AA	Ep


M. Ghana
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Sample Index: NXR-D-12





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Sample Index: NXRD-13

Mineral Phases identified

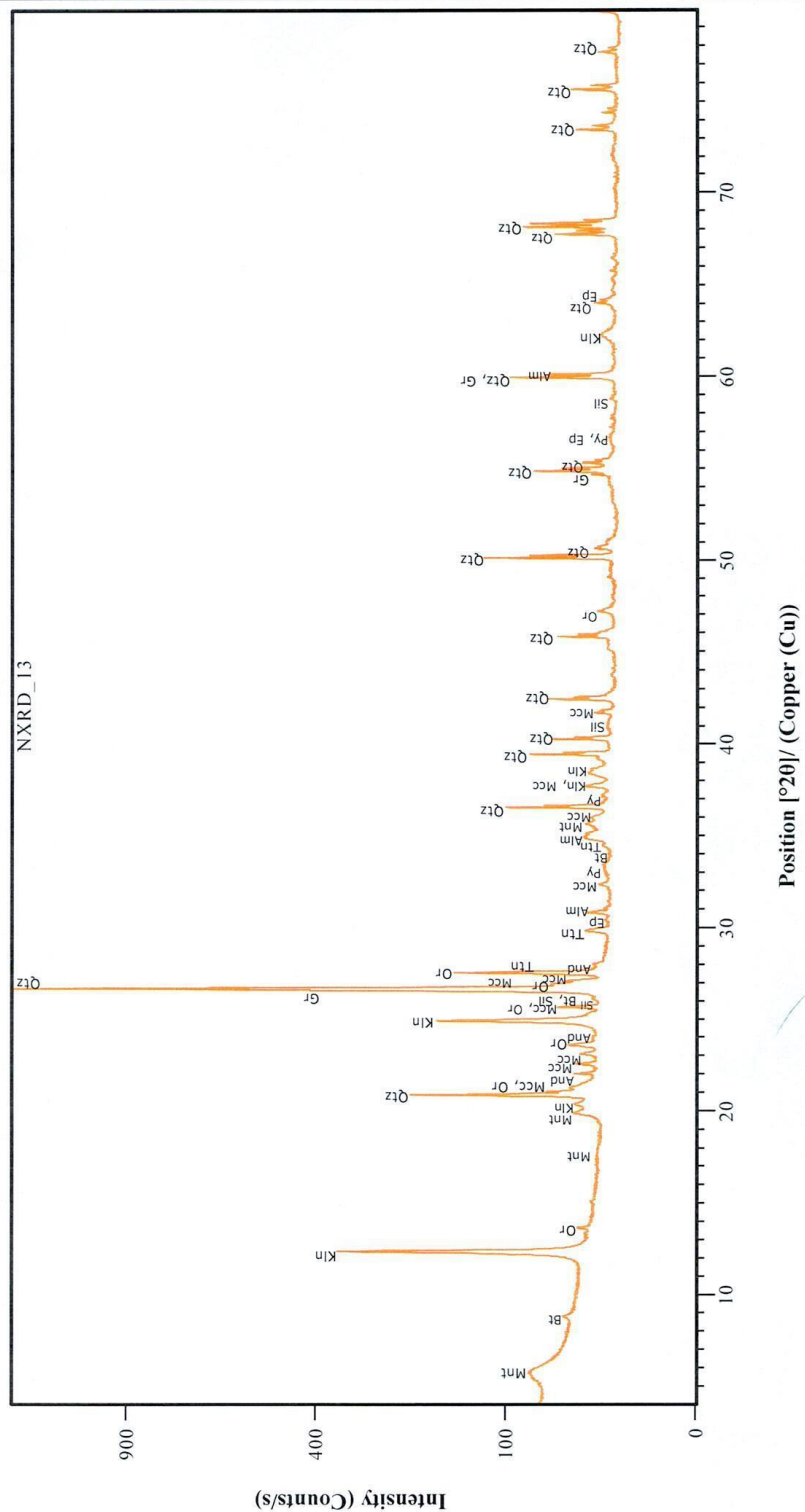
Sl No.	Mineral Name	Position [$^{\circ}2\theta$]/ d-spacing [\AA]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 \AA ii. 20.88 / 4.25 \AA iii. 50.13 / 1.81 \AA	Qtz
2.	Graphite	i. 26.57 / 3.35 \AA ii. 59.90 / 1.54 \AA iii. 54.69 / 1.67 \AA	Gr
3.	Kaolinite	i. 12.33 / 7.17 \AA ii. 24.85 / 3.58 \AA iii. 62.30 / 1.48 \AA	Kln
4.	Orthoclase	i. 27.52 / 3.23 \AA ii. 26.93 / 3.30 \AA iii. 23.59 / 3.76 \AA	Or
5.	Microcline	i. 27.49 / 3.24 \AA ii. 27.05 / 3.29 \AA iii. 21.02 / 4.22 \AA	Mcc
6.	Titanite	i. 27.56 / 3.23 \AA ii. 29.86 / 2.98 \AA iii. 34.53 / 2.59 \AA	Ttn
7.	Almandine	i. 34.89 / 2.57 \AA ii. 59.90 / 1.54 \AA iii. 31.10 / 2.87 \AA	Alm
8.	Montmorillonite	i. 5.88 / 15.00 \AA ii. 19.93 / 4.45 \AA iii. 35.44 / 2.53 \AA	Mnt
9.	Andesine	i. 28.04 / 3.18 \AA ii. 27.85 / 3.20 \AA iii. 21.99 / 4.03 \AA	And
10.	Biotite	i. 8.81 / 10.02 \AA ii. 26.50 / 3.36 \AA iii. 34.11 / 2.62 \AA	Bt
11.	Sillimanite	i. 26.50 / 3.36 \AA ii. 40.98 / 2.20 \AA iii. 26.11 / 3.41 \AA	Sil
12.	Pyrite	i. 56.28 / 1.63 \AA ii. 33.03 / 2.70 \AA iii. 37.10 / 2.42 \AA	Py
13.	Epidote	i. 56.28 / 1.63 \AA ii. 30.80 / 2.90 \AA iii. 64.17 / 1.45 \AA	Ep

[Signature]
M Ghana
DDG



GOVERNMENT OF ODISHA
DIRECTORATE OF MINES & GEOLOGY
XRD-XRF LABORATORY
Bhu-Bigyan Bhawan, Bhubaneswar-751001

Sample Index: NXRD-13





GOVERNMENT OF ODISHA
DIRECTORATE OF MINES & GEOLOGY
XRD-XRF LABORATORY
Bhu-Bigyan Bhawan, Bhubaneswar-751001

Sample Index: NXRD-14

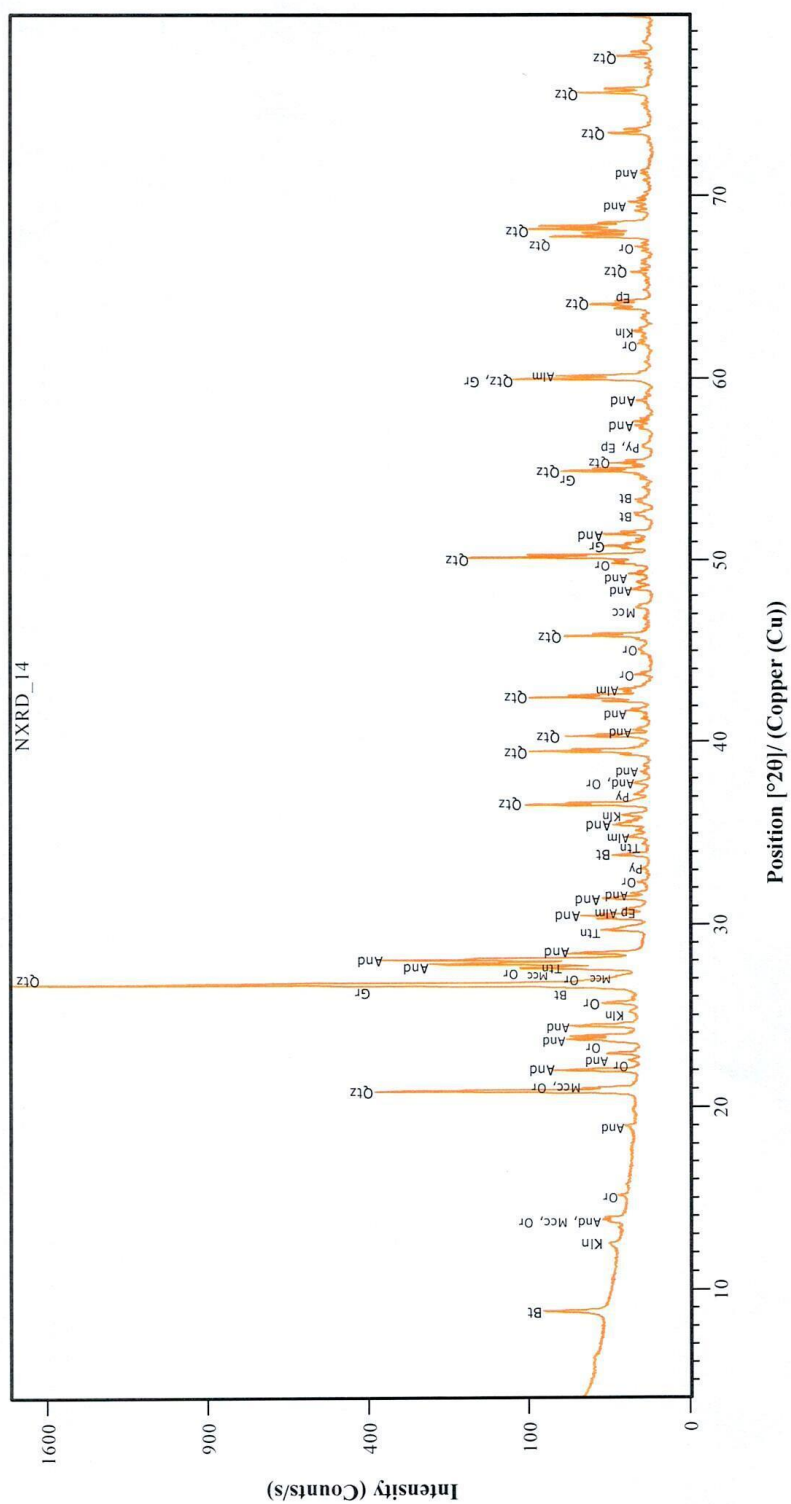
Mineral Phases identified

Sl No.	Mineral Name	Position [°2θ]/ d-spacing [Å]	Abbreviation
1.	Quartz	i. 26.66 / 3.34 Å ii. 20.88 / 4.25 Å iii. 50.13 / 1.81 Å	Qtz
2.	Graphite	i. 26.57 / 3.35 Å ii. 59.90 / 1.54 Å iii. 54.69 / 1.67 Å	Gr
3.	Andesine	i. 28.04 / 3.18 Å ii. 27.85 / 3.20 Å iii. 21.99 / 4.03 Å	And
4.	Orthoclase	i. 27.52 / 3.23 Å ii. 26.93 / 3.30 Å iii. 23.59 / 3.76 Å	Or
5.	Microcline	i. 27.49 / 3.24 Å ii. 27.05 / 3.29 Å iii. 21.02 / 4.22 Å	Mcc
6.	Almandine	i. 34.89 / 2.57 Å ii. 59.90 / 1.54 Å iii. 31.10 / 2.87 Å	Alm
7.	Biotite	i. 8.81 / 10.02 Å ii. 26.50 / 3.36 Å iii. 34.11 / 2.62 Å	Bt
8.	Titanite	i. 27.56 / 3.23 Å ii. 29.86 / 2.98 Å iii. 34.53 / 2.59 Å	Ttn
9.	Kaolinite	i. 12.33 / 7.17 Å ii. 24.85 / 3.58 Å iii. 62.30 / 1.48 Å	Kln
10.	Pyrite	i. 56.28 / 1.63 Å ii. 33.03 / 2.70 Å iii. 37.10 / 2.42 Å	Py
11.	Epidote	i. 56.28 / 1.63 Å ii. 30.80 / 2.90 Å iii. 64.17 / 1.45 Å	Ep


M Ghana
DDG



NMRD_14



ANNEXURE-XVII

DGPS SURVEY AND TOPOGRAPHICAL SURVEY

SURVEY REPORT OF THE NARINGPANGA BLOCK OF RAYAGADA DISTRICT , ODISHA UNDER G3 LEVEL OF MINERAL EXPLORATION AND A NMET APPROVED PROJECT.

There are two types of Survey was conducted in the year of 2023-24 in Naringpanga Block of Rayagada District, Odisha is detailed in this report, i.e. **DGPS survey** & topographical survey through **Total station**.

Instrument used:

- Trimble R8 s Internal Gnss Dual frequency Receiver.
- Topcon total station. (Model: IM55)



Method of Survey: -

- Adopted the DGPS RTk survey method & Total station survey for completing the survey.
- We have undertaken the observations with reference to the nearest SOI base.
- All the topographical features are taken with the help of Total station by linear measurement method.
- Co-ordinates of BHs & RL of BHs & Topography by DGPS.

TOPOGRAPHIC SURVEY:-

Detailed topographic survey is conducted using contemporary tools and techniques to enable engineers in carrying out detailed engineering design of Project in accordance with the requirements identified in the Terms of Reference. The following flow-chart briefly describes the procedures of different components of this topographic survey

After reviewing project requirements vis-à-vis topographic survey, following field teams were mobilized with their equipment

- (i) Monument Fixing Team
- (ii) GPS Survey Team
- (iii) Traverse Survey Team
- (iv) Control Leveling Team
- (v) Topographic & X-Sec Survey Teams

Software used for post processing and mapsPreparation:-

- TBC 3.6 for DGPS data processing.
- Arcgis software for geo-referencing and other work
- Auto-cad software for contour and other map Preparation.

INTRODUCTION TO SURVEY SITE

The surveyed area is located on Naringpanga which comes under Block Naringpanga, District Rayagada, Odisha. Rayagada longitude latitude is 83°25'12.00"E 19°10'12.00"N. The survey area is featured in survey of India Toposheet No. E44F10(65M/10) and situated to the north of Naringpanga Village, which comes under the MunigudaTahasil of Rayagada District. The Naringpang village is at a distance of 64 km from the district headquarters Rayagada. Muniguda is the nearest railway station which lies about 20km from the project. The nearest airport is Visakhapatnam Airport which is at a distance of 260km.

AREA DETAIL

SL.NO.	NAME OF AREA	AREA IN HECT.
1	Naringpanga Block	29.22

SURVEY PILLAR POINTS

PILLAR ID	LONGITUDE	LATITUDE	EASTING	NORTHING
1	83°33'12.89664	19°43'28.79616	767648.325	2183027.174
2	83°33'18.40104	19°43'33.03300	767806.703	2183159.921
3	83°33'22.53888	19°43'28.77816	767929.205	2183030.846
4	83°33'25.87356	19°43'31.61568	768025.026	2183119.601
5	83°33'33.40656	19°43'22.03716	768248.905	2182828.258
6	83°33'25.23672	19°43'15.12624	768014.12	2182612.074
7	83°33'16.44804	19°43'28.35480	767751.977	2183015.153
8	83°33'14.31180	19°43'26.98248	767690.39	2182971.999

BORE HOLE POINT CO-ORDINATES

NAME	LONGITUDE	LATITUDE	EASTING	NORTHING	ELEVATION
NPBH-01	83°33'14.310"	19°43'29.218"	767689.2503	2183040.786	331.402
NPBH-02	83°33'17.377"	19°43'29.744"	767778.4465	2183058.278	333.308
NPBH-03	83°33'19.901	19°43'24.906	767854.1705	2182910.55	331.021
NPBH-04	83°33'21.096"	19°43'27.307"	767887.8965	2182985.00	335.519
NPBH-05	83°33'21.790"	19°43'22.260"	767910.4273	2182829.996	329.859
NPBH-06	83°33'24.069"	19°43'24.704	767975.6609	2182906.237	334.140

SURVEY DATE:

Survey Date	Survey time
28.06.2024	10AM- 5PM

Weather was nice with clear sun light. Survey pillar marking has been done before itself so it was easy to get the location point.

Your's faithfully,



M/s Geo-Environmental Services

ANNEXURE-XVIII
BULK DENSITY ANALYSIS RESULT OF NARINGPANGA (S)
GRAPHITE BLOCK BY NEW GREEN ENVIRONMENTAL PVT. LTD.,
BHUBANESWAR (NABL ACCREDITED LAB)



NEW GREEN ENVIRONMENTAL LABS PVT. LTD.



CIN: U13202OR2022PTC041062,
GSTIN NO. 21AAICN5648L1Z6



Report No: NGEL/NGP22082024/BD-11

Issue Date: 22.08.2024

ULR No. : TC-11880240000091F

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project,
Rayagada
Date of sampling : NA
Sampling by : Client Representative
Date of Sample Received : 17.08.2024
Date of Analysis : 18.08.2024 to 22.08.2024
Sample Description : Graphite Ore
Sample Quantity : 250 gm
Location with Lab ID : NBD-1, NGEL/24-25/BD-11
Reference No : NGEL-22082024/BD-11

Analysis Results

Sl. No.	Parameters	Unit	Reference Standards	Test Results
1.	Bulk Density	kg/lit	NGEL/SOP/OM/LD/03, Issue No.01, Issue Date:04.10.2022	1.62

T. Caly

Authorized & Reviewed By
(Dr. Tribikram Sahu)

Notes:

Disclaimer:

- The test results relate only to the sample tested and applicable parameters, endorsement of product is neither inferred nor implied.
- The test shall not be reproduced wholly or in part without prior written consent of the Laboratory.
- The Test Report shall not be used in any advertising media or as evidence in the court of law without prior written consent of the Laboratory.
- The samples received shall be destroyed after two weeks from the date of issue of the Test Report unless specified otherwise.
- The Sample is analyzed at New Green Environmental Labs Pvt Ltd; Bhubaneswar and the testing has been performed to the best of our ability and our responsibility. The certificate reflects our findings at the time and place of testing.
- If the report is misplaced by any means shall be returned to the mentioned address of New Green Environmental Labs Pvt Ltd.

-----End of Report-----

Page 1 of 1

MoEF&CC, Govt. Of India, Recognised Environment & NABL Accredited Laboratory
Ananta Niwas, Plot No- 576/4502, Jagannath Vihar, Airfield, Sundarpada, Bhubaneswar- 751002, Khurda, Odisha
Ph. 0674 - 2355490, Mob.9437568822, 9178145817, E-mail: newgreenenvolab01@gmail.com



CIN: U13202OR2022PTC041062,
GSTIN No. 21AAICN5648L1Z6



Report No: NGEL/NGP22082024/BD-12

Issue Date: 22.08.2024

ULR No. : TC-118802400000092F

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project, Rayagada
Date of sampling : NA
Sampling by : Client Representative
Date of Sample Received : 17.08.2024
Date of Analysis : 18.08.2024 to 22.08.2024
Sample Description : Graphite Ore
Sample Quantity : 250 gm
Location with Lab ID : NBD-2, NGEL/24-25/BD-12
Reference No : NGEL-22082024/BD-12

Analysis Results

Sl. No.	Parameters	Unit	Reference Standards	Test Results
1.	Bulk Density	kg/lit	NGEL/SOP/OM/LD/03, Issue No.01, Issue Date:04.10.2022	1.63

T. Caly

Authorized & Reviewed By
(Dr. Tribikram Sahu)

Notes:

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-----End of Report-----



CIN: U13202OR2022PTC041062,
GSTIN No. 21AAICN5648L1Z6



Report No: NGEL/NGP22082024/BD-13

Issue Date: 22.08.2024

ULR No. : TC-118802400000093F

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project, Rayagada
Date of sampling : NA
Sampling by : Client Representative
Date of Sample Received : 17.08.2024
Date of Analysis : 18.08.2024 to 22.08.2024
Sample Description : Graphite Ore
Sample Quantity : 250 gm
Location with Lab ID : NBD-3, NGEL/24-25/BD-13
Reference No : NGEL-22082024/BD-13

Analysis Results

Sl. No.	Parameters	Unit	Reference Standards	Test Results
1.	Bulk Density	kg/lit	NGEL/SOP/OM/LD/03, Issue No.01, Issue Date:04.10.2022	1.70

T. Sahu

Authorized & Reviewed By
(Dr. Tribikram Sahu)

Notes:

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-----End of Report-----



CIN: U13202OR2022PTC041062,
GSTIN No. 21AAICN5648L1Z6



Report No : NGEL/NGP22082024/BD-14

Issue Date: 22.08.2024

ULR No. : TC-11880240000094F

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project, Rayagada
Date of sampling : NA
Sampling by : Client Representative
Date of Sample Received : 17.08.2024
Date of Analysis : 18.08.2024 to 22.08.2024
Sample Description : Graphite Ore
Sample Quantity : 250 gm
Location with Lab ID : NBD-4, NGEL/24-25/BD-14
Reference No : NGEL-22082024/BD-14

Analysis Results

Sl. No.	Parameters	Unit	Reference Standards	Test Results
1.	Bulk Density	kg/lit	NGEL/SOP/OM/LD/03, Issue No.01, Issue Date:04.10.2022	1.48

T. Caly

Authorized & Reviewed By
(Dr. Tribikram Sahu)

Notes:

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5. The Sample is analyzed at New Green Environmental Labs Pvt Ltd; Bhubaneswar and the testing has been performed to the best of our ability and our responsibility. The certificate reflects our findings at the time and place of testing.
6. If the report is misplaced by any means shall be returned to the mentioned address of New Green Environmental Labs Pvt Ltd.

-----End of Report-----



CIN: U13202OR2022PTC041062,
GSTIN No. 21AAICN5648L1Z6



Report No: NGEL/NGP22082024/BD-15

Issue Date: 22.08.2024

ULR No. : TC-118802400000095F

TEST REPORT

Name & Address of the Client : Exploration In-Charge, Naringpanga (S & W) Graphite Project, Rayagada
Date of sampling : NA
Sampling by : Client Representative
Date of Sample Received : 17.08.2024
Date of Analysis : 18.08.2024 to 22.08.2024
Sample Description : Graphite Ore
Sample Quantity : 250 gm
Location with Lab ID : NBD-5, NGEL/24-25/BD-15
Reference No : NGEL-22082024/BD-15

Analysis Results

Sl. No.	Parameters	Unit	Reference Standards	Test Results
1.	Bulk Density	kg/lit	NGEL/SOP/OM/LD/03, Issue No.01, Issue Date:04.10.2022	1.60

T. Caly
Authorized & Reviewed By
(Dr. Tribikram Sahu)

Notes:

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3. The Test Report shall not be used in any advertising media or as evidence in the court of law without prior written consent of the Laboratory.
4. The samples received shall be destroyed after two weeks from the date of issue of the Test Report unless specified otherwise.
5. The Sample is analyzed at New Green Environmental Labs Pvt Ltd; Bhubaneswar and the testing has been performed to the best of our ability and our responsibility. The certificate reflects our findings at the time and place of testing.
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-----End of Report-----

ANNEXURE-XIX

Self-potential anomaly Data of Naringpanga Graphite Block

SL NO	NORTHING	EASTING	SP VALUE
1	2182669.811	767688.1354	70.19
2	2182676.28	767695.7618	70.21
3	2182682.748	767703.3883	70.32
4	2182688.878	767671.965	71.65
5	2182689.216	767711.0148	70.45
6	2182695.346	767679.5914	71.35
7	2182695.684	767718.6412	70.48
8	2182701.814	767687.2179	71.09
9	2182702.153	767726.2677	70.34
10	2182707.944	767655.7946	72.56
11	2182708.282	767694.8443	70.78
12	2182708.621	767733.8941	69.18
13	2182714.412	767663.421	72.03
14	2182714.75	767702.4708	70.27
15	2182715.089	767741.5206	65.55
16	2182720.881	767671.0474	71.28
17	2182721.218	767710.0973	69.41
18	2182721.557	767749.1471	60.61
19	2182727.01	767639.6242	74.64
20	2182727.349	767678.674	70.11
21	2182727.687	767717.7237	67.70
22	2182728.025	767756.7735	53.43
23	2182733.478	767647.2506	73.84
24	2182733.817	767686.3004	69.10
25	2182734.155	767725.3502	64.84
26	2182734.494	767764.4	43.79
27	2182739.946	767654.8771	72.42
28	2182740.285	767693.9268	68.05
29	2182740.623	767732.9766	60.74
30	2182740.962	767772.0264	33.98
31	2182746.077	767623.4538	77.43
32	2182746.414	767662.5035	70.84
33	2182746.753	767701.5534	66.41
34	2182747.091	767740.6031	55.66
35	2182747.43	767779.6528	25.36
36	2182752.545	767631.0802	76.33
37	2182752.883	767670.13	69.19
38	2182753.221	767709.1798	64.41
39	2182753.559	767748.2296	49.71
40	2182753.897	767787.2794	18.56

41	2182759.012	767638.7066	74.74
42	2182759.351	767677.7565	67.94
43	2182759.689	767716.8063	61.60
44	2182760.027	767755.856	43.13
45	2182760.366	767794.9059	15.32
46	2182765.142	767607.2833	80.12
47	2182765.48	767646.3332	72.81
48	2182765.819	767685.3829	66.78
49	2182766.157	767724.4327	58.65
50	2182766.496	767763.4825	36.23
51	2182766.834	767802.5323	11.77
52	2182771.61	767614.9098	79.15
53	2182771.949	767653.9596	70.82
54	2182772.287	767693.0094	65.16
55	2182772.625	767732.0592	55.57
56	2182772.964	767771.1089	29.97
57	2182773.302	767810.1587	7.59
58	2182778.079	767622.5363	77.44
59	2182778.417	767661.5861	68.75
60	2182778.755	767700.6358	63.17
61	2182779.094	767739.6856	52.00
62	2182779.432	767778.7354	24.88
63	2182779.77	767817.7852	3.43
64	2182784.208	767591.113	78.73
65	2182784.547	767630.1627	75.19
66	2182784.885	767669.2125	66.79
67	2182785.223	767708.2623	60.42
68	2182785.562	767747.3121	46.55
69	2182785.9	767786.3619	20.71
70	2182786.239	767825.4116	0.44
71	2182790.677	767598.7394	77.58
72	2182791.015	767637.7892	72.39
73	2182791.353	767676.8389	65.06
74	2182791.692	767715.8887	56.67
75	2182792.03	767754.9385	40.03
76	2182792.368	767793.9883	16.09
77	2182792.707	767833.038	0.06
78	2182797.145	767606.3659	75.53
79	2182797.483	767645.4156	68.89
80	2182797.822	767684.4655	63.41
81	2182798.16	767723.5152	52.06
82	2182798.498	767762.565	33.26
83	2182798.836	767801.6148	10.19
84	2182799.175	767840.6646	0.31

85	2182803.274	767574.9425	66.87
86	2182803.613	767613.9923	73.75
87	2182803.951	767653.0421	64.79
88	2182804.29	767692.0919	61.54
89	2182804.628	767731.1417	46.71
90	2182804.967	767770.1915	27.89
91	2182805.305	767809.2412	3.82
92	2182805.643	767848.291	-3.08
93	2182809.743	767582.569	65.32
94	2182810.081	767621.6187	72.18
95	2182810.419	767660.6686	60.90
96	2182810.758	767699.7183	56.51
97	2182811.096	767738.7681	40.79
98	2182811.435	767777.8179	24.30
99	2182811.773	767816.8677	0.56
100	2182812.112	767855.9175	-14.44
101	2182816.211	767590.1955	63.31
102	2182816.549	767629.2452	66.92
103	2182816.887	767668.295	58.06
104	2182817.226	767707.3448	50.07
105	2182817.564	767746.3946	34.56
106	2182817.903	767785.4443	18.60
107	2182818.241	767824.4941	0.83
108	2182818.58	767863.5439	-19.99
109	2182822.341	767558.7721	56.87
110	2182822.679	767597.8219	60.65
111	2182823.018	767636.8717	58.08
112	2182823.356	767675.9215	55.81
113	2182823.694	767714.9713	45.06
114	2182824.032	767754.021	28.80
115	2182824.371	767793.0708	8.46
116	2182824.709	767832.1206	-5.00
117	2182825.048	767871.1704	-20.61
118	2182828.809	767566.3986	54.33
119	2182829.147	767605.4484	57.21
120	2182829.486	767644.4982	52.53
121	2182829.824	767683.5479	52.88
122	2182830.163	767722.5977	40.06
123	2182830.5	767761.6475	23.43
124	2182830.84	767800.6973	1.01
125	2182831.177	767839.7471	-17.25
126	2182831.515	767878.7968	-23.70
127	2182835.277	767574.0251	51.40
128	2182835.615	767613.0748	52.78

129	2182835.954	767652.1246	49.39
130	2182836.292	767691.1744	49.20
131	2182836.631	767730.2241	33.62
132	2182836.969	767769.274	13.42
133	2182837.307	767808.3238	1.39
134	2182837.645	767847.3735	-21.08
135	2182837.984	767886.4233	-27.70
136	2182841.407	767542.6017	53.78
137	2182841.746	767581.6515	48.04
138	2182842.083	767620.7013	47.76
139	2182842.422	767659.7511	48.01
140	2182842.76	767698.8009	45.28
141	2182843.099	767737.8506	27.85
142	2182843.437	767776.9004	2.81
143	2182843.775	767815.9502	-7.13
144	2182844.113	767855	-20.49
145	2182844.452	767894.0498	-29.92
146	2182847.875	767550.2282	52.06
147	2182848.214	767589.278	44.04
148	2182848.552	767628.3277	43.06
149	2182848.891	767667.3775	46.86
150	2182849.228	767706.4273	41.06
151	2182849.566	767745.4771	21.42
152	2182849.905	767784.5269	0.00
153	2182850.243	767823.5766	-19.08
154	2182850.582	767862.6264	-22.76
155	2182850.92	767901.6763	-30.33
156	2182854.343	767557.8546	49.88
157	2182854.682	767596.9044	39.88
158	2182855.02	767635.9542	39.44
159	2182855.359	767675.0039	45.31
160	2182855.696	767714.0538	36.23
161	2182856.035	767753.1035	8.02
162	2182856.373	767792.1533	-2.51
163	2182856.712	767831.2032	-20.35
164	2182857.05	767870.2529	-26.44
165	2182857.388	767909.3027	-30.17
166	2182860.473	767526.4313	51.91
167	2182860.811	767565.4811	46.73
168	2182861.15	767604.5309	37.13
169	2182861.488	767643.5807	36.98
170	2182861.826	767682.6305	43.44
171	2182862.165	767721.6802	30.95
172	2182862.503	767760.73	-1.17

173	2182862.841	767799.7798	-14.66
174	2182863.18	767838.8296	-21.32
175	2182863.518	767877.8794	-29.47
176	2182863.857	767916.9291	-29.29
177	2182866.942	767534.0578	51.32
178	2182867.279	767573.1076	42.75
179	2182867.618	767612.1573	33.74
180	2182867.956	767651.2071	36.03
181	2182868.294	767690.2569	40.86
182	2182868.633	767729.3067	25.46
183	2182868.971	767768.3565	-1.06
184	2182869.309	767807.4063	-20.51
185	2182869.648	767846.456	-23.24
186	2182869.986	767885.5058	-30.61
187	2182870.325	767924.5556	-27.73
188	2182873.41	767541.6842	49.97
189	2182873.748	767580.734	38.68
190	2182874.086	767619.7838	30.42
191	2182874.424	767658.8336	35.47
192	2182874.763	767697.8834	36.39
193	2182875.101	767736.9331	16.29
194	2182875.439	767775.9829	-6.78
195	2182875.778	767815.0327	-20.62
196	2182876.116	767854.0825	-25.58
197	2182876.454	767893.1323	-30.79
198	2182876.793	767932.182	-25.75
199	2182879.539	767510.2609	45.09
200	2182879.878	767549.3107	47.95
201	2182880.216	767588.3605	35.04
202	2182880.554	767627.4102	29.02
203	2182880.892	767666.46	34.04
204	2182881.231	767705.5098	31.15
205	2182881.569	767744.5596	3.08
206	2182881.908	767783.6094	-15.56
207	2182882.246	767822.6592	-21.94
208	2182882.585	767861.7089	-27.76
209	2182882.922	767900.7587	-30.45
210	2182883.261	767939.8085	-23.47
211	2182886.007	767517.8874	44.38
212	2182886.346	767556.9371	42.94
213	2182886.684	767595.9869	32.40
214	2182887.022	767635.0367	29.40
215	2182887.361	767674.0865	31.32
216	2182887.699	767713.1362	26.77

217	2182888.037	767752.1861	-0.21
218	2182888.376	767791.2358	-19.92
219	2182888.714	767830.2856	-24.24
220	2182889.053	767869.3354	-29.10
221	2182889.391	767908.3852	-29.23
222	2182889.73	767947.4349	-20.66
223	2182892.475	767525.5138	42.58
224	2182892.814	767564.5636	36.91
225	2182893.152	767603.6134	30.84
226	2182893.49	767642.6631	29.96
227	2182893.829	767681.713	26.47
228	2182894.167	767720.7628	18.22
229	2182894.505	767759.8125	-2.77
230	2182894.844	767798.8623	-20.69
231	2182895.182	767837.9121	-26.77
232	2182895.521	767876.9619	-29.77
233	2182895.859	767916.0117	-26.08
234	2182896.197	767955.0614	-11.06
235	2182898.606	767494.0905	35.74
236	2182898.944	767533.1403	39.44
237	2182899.282	767572.19	32.37
238	2182899.62	767611.2399	30.23
239	2182899.959	767650.2897	29.65
240	2182900.297	767689.3394	17.28
241	2182900.636	767728.3892	5.63
242	2182900.974	767767.439	-13.36
243	2182901.312	767806.4887	-22.32
244	2182901.65	767845.5385	-28.97
245	2182901.989	767884.5883	-30.25
246	2182902.327	767923.6381	-21.90
247	2182902.665	767962.6878	-9.94
248	2182905.074	767501.7169	34.70
249	2182905.412	767540.7667	34.95
250	2182905.75	767579.8165	30.41
251	2182906.088	767618.8663	30.08
252	2182906.427	767657.9161	28.33
253	2182906.765	767696.9659	3.81
254	2182907.104	767736.0156	-0.06
255	2182907.442	767775.0654	-20.06
256	2182907.781	767814.1152	-24.61
257	2182908.118	767853.165	-30.16
258	2182908.457	767892.2148	-29.78
259	2182908.795	767931.2646	-17.15
260	2182911.541	767509.3434	33.57

261	2182911.88	767548.3932	29.64
262	2182912.218	767587.443	30.83
263	2182912.557	767626.4928	29.59
264	2182912.895	767665.5426	19.14
265	2182913.233	767704.5923	0.53
266	2182913.572	767743.6421	-5.93
267	2182913.91	767782.6919	-20.39
268	2182914.249	767821.7416	-27.22
269	2182914.587	767860.7915	-30.77
270	2182914.925	767899.8412	-27.09
271	2182915.263	767938.891	-12.41
272	2182917.671	767477.9201	29.87
273	2182918.01	767516.9699	31.77
274	2182918.348	767556.0197	25.05
275	2182918.686	767595.0694	31.39
276	2182919.025	767634.1192	28.09
277	2182919.363	767673.169	1.63
278	2182919.701	767712.2188	-6.37
279	2182920.04	767751.2685	-15.68
280	2182920.378	767790.3184	-20.55
281	2182920.716	767829.3681	-29.65
282	2182921.055	767868.4179	-31.13
283	2182921.393	767907.4676	-22.94
284	2182921.731	767946.5175	-9.56
285	2182924.14	767485.5466	28.92
286	2182924.478	767524.5964	29.03
287	2182924.816	767563.6461	22.26
288	2182925.155	767602.6959	30.99
289	2182925.493	767641.7457	24.00
290	2182925.832	767680.7955	-9.84
291	2182926.17	767719.8453	-14.93
292	2182926.509	767758.895	-19.84
293	2182926.846	767797.9448	-22.12
294	2182927.185	767836.9946	-30.83
295	2182927.523	767876.0444	-31.03
296	2182927.861	767915.0942	-18.79
297	2182930.608	767493.173	28.43
298	2182930.946	767532.2227	20.84
299	2182931.284	767571.2726	21.44
300	2182931.623	767610.3223	29.39
301	2182931.961	767649.3721	13.10
302	2182932.3	767688.4219	-21.80
303	2182932.638	767727.4717	-20.68
304	2182932.976	767766.5215	-19.98

305	2182933.314	767805.5713	-24.17
306	2182933.653	767844.6211	-31.26
307	2182933.991	767883.6708	-29.93
308	2182934.33	767922.7206	-15.70
309	2182936.737	767461.7496	29.35
310	2182937.076	767500.7995	27.31
311	2182937.414	767539.8492	9.13
312	2182937.753	767578.899	20.88
313	2182938.091	767617.9488	26.56
314	2182938.429	767656.9986	1.66
315	2182938.768	767696.0483	-21.24
316	2182939.106	767735.0982	-20.64
317	2182939.444	767774.1479	-20.21
318	2182939.783	767813.1977	-26.21
319	2182940.121	767852.2475	-31.42
320	2182940.459	767891.2973	-27.05
321	2182940.798	767930.3471	-13.85
322	2182943.205	767469.3761	28.87
323	2182943.544	767508.4259	24.87
324	2182943.882	767547.4757	-0.46
325	2182944.221	767586.5255	19.22
326	2182944.559	767625.5752	22.66
327	2182944.897	767664.6251	-2.42
328	2182945.236	767703.6748	-22.95
329	2182945.574	767742.7246	-22.82
330	2182945.912	767781.7744	-22.22
331	2182946.251	767820.8242	-27.98
332	2182946.589	767859.8739	-31.28
333	2182946.927	767898.9238	-23.09
334	2182949.674	767477.0026	28.56
335	2182950.012	767516.0524	19.57
336	2182950.351	767555.1021	-2.79
337	2182950.689	767594.152	15.60
338	2182951.028	767633.2017	15.90
339	2182951.366	767672.2515	-15.36
340	2182951.704	767711.3013	-32.33
341	2182952.042	767750.3511	-26.52
342	2182952.381	767789.4009	-24.16
343	2182952.719	767828.4507	-29.40
344	2182953.058	767867.5004	-30.90
345	2182953.396	767906.5502	-19.80
346	2182955.804	767445.5793	30.95
347	2182956.142	767484.6291	28.21
348	2182956.48	767523.6789	10.46

349	2182956.819	767562.7286	-1.83
350	2182957.157	767601.7784	9.96
351	2182957.496	767640.8281	6.07
352	2182957.834	767679.878	-20.44
353	2182958.172	767718.9278	-45.70
354	2182958.51	767757.9775	-32.87
355	2182958.849	767797.0273	-25.49
356	2182959.187	767836.0771	-30.26
357	2182959.526	767875.1269	-29.77
358	2182959.864	767914.1767	-18.25
359	2182962.272	767453.2057	30.23
360	2182962.61	767492.2555	26.71
361	2182962.948	767531.3053	1.22
362	2182963.287	767570.3551	-1.21
363	2182963.625	767609.4049	4.70
364	2182963.964	767648.4546	1.63
365	2182964.302	767687.5044	-25.77
366	2182964.64	767726.5542	-51.63
367	2182964.979	767765.604	-41.01
368	2182965.317	767804.6538	-25.96
369	2182965.655	767843.7036	-30.41
370	2182965.994	767882.7533	-28.11
371	2182968.74	767460.8322	29.90
372	2182969.078	767499.8819	23.44
373	2182969.417	767538.9318	-2.93
374	2182969.755	767577.9815	-1.16
375	2182970.093	767617.0313	1.72
376	2182970.431	767656.0811	-10.61
377	2182970.77	767695.1309	-40.39
378	2182971.108	767734.1807	-50.95
379	2182971.447	767773.2305	-46.68
380	2182971.785	767812.2802	-26.69
381	2182972.123	767851.33	-30.08
382	2182972.462	767890.3797	-27.86
383	2182974.87	767429.4089	39.22
384	2182975.208	767468.4587	29.39
385	2182975.547	767507.5084	16.24
386	2182975.885	767546.5582	-3.43
387	2182976.224	767585.608	-0.75
388	2182976.561	767624.6578	0.70
389	2182976.9	767663.7076	-21.39
390	2182977.238	767702.7574	-55.23
391	2182977.577	767741.8071	-58.62
392	2182977.915	767780.8569	-49.65

393	2182978.254	767819.9066	-29.23
394	2182978.592	767858.9565	-29.01
395	2182978.93	767898.0063	-29.12
396	2182981.338	767437.0354	38.20
397	2182981.676	767476.0851	28.03
398	2182982.015	767515.1349	5.16
399	2182982.353	767554.1847	-1.97
400	2182982.692	767593.2345	0.09
401	2182983.03	767632.2843	-1.87
402	2182983.368	767671.3341	-30.11
403	2182983.706	767710.3838	-65.61
404	2182984.045	767749.4336	-66.30
405	2182984.383	767788.4834	-51.57
406	2182984.722	767827.5332	-32.87
407	2182985.06	767866.5829	-28.59
408	2182987.806	767444.6617	36.29
409	2182988.144	767483.7116	25.23
410	2182988.483	767522.7613	-1.76
411	2182988.821	767561.8111	-0.22
412	2182989.16	767600.8609	-0.63
413	2182989.498	767639.9107	-16.81
414	2182989.836	767678.9605	-43.92
415	2182990.175	767718.0103	-75.42
416	2182990.513	767757.06	-69.68
417	2182990.851	767796.1098	-53.43
418	2182991.19	767835.1596	-33.73
419	2182991.528	767874.2094	-30.38
420	2182993.936	767413.2385	42.51
421	2182994.274	767452.2882	34.04
422	2182994.613	767491.338	20.15
423	2182994.951	767530.3878	-2.21
424	2182995.289	767569.4376	-0.84
425	2182995.627	767608.4874	-7.50
426	2182995.966	767647.5372	-22.94
427	2182996.304	767686.587	-60.76
428	2182996.643	767725.6367	-83.25
429	2182996.981	767764.6864	-71.10
430	2182997.319	767803.7363	-54.99
431	2182997.658	767842.786	-31.46
432	2182997.996	767881.8359	-37.07
433	2183000.404	767420.8649	42.04
434	2183000.743	767459.9147	31.27
435	2183001.081	767498.9645	11.72
436	2183001.42	767538.0143	-0.78

437	2183001.757	767577.0641	-5.19
438	2183002.096	767616.1138	-16.91
439	2183002.434	767655.1636	-42.43
440	2183002.773	767694.2134	-79.99
441	2183003.111	767733.2632	-87.69
442	2183003.45	767772.3129	-72.68
443	2183003.788	767811.3628	-55.87
444	2183004.126	767850.4126	-32.58
445	2183006.872	767428.4914	40.66
446	2183007.211	767467.5411	27.90
447	2183007.549	767506.591	2.94
448	2183007.888	767545.6406	0.50
449	2183008.226	767584.6905	-11.81
450	2183008.564	767623.7403	-21.43
451	2183008.902	767662.7901	-64.38
452	2183009.241	767701.8399	-99.87
453	2183009.579	767740.8897	-89.21
454	2183009.918	767779.9394	-75.08
455	2183010.256	767818.9892	-54.44
456	2183010.594	767858.039	-35.46
457	2183013.002	767397.068	42.72
458	2183013.34	767436.1179	37.81
459	2183013.679	767475.1676	23.28
460	2183014.017	767514.2174	-1.29
461	2183014.356	767553.2671	-1.14
462	2183014.694	767592.317	-19.45
463	2183015.032	767631.3668	-24.82
464	2183015.37	767670.4165	-84.41
465	2183015.709	767709.4663	-118.77
466	2183016.047	767748.5161	-89.57
467	2183016.385	767787.5659	-77.79
468	2183016.724	767826.6157	-48.73
469	2183017.062	767865.6654	-31.49
470	2183017.062	767865.6654	-31.49
471	2183019.47	767404.6945	42.55
472	2183019.809	767443.7443	33.67
473	2183020.147	767482.794	16.49
474	2183020.485	767521.8439	-1.01
475	2183020.823	767560.8937	-6.91
476	2183021.5	767638.9932	-47.21
477	2183021.839	767678.043	-104.62
478	2183022.178	767717.0928	-115.68
479	2183022.515	767756.1426	-89.90
480	2183022.854	767795.1923	-79.26

481	2183023.192	767834.2421	-40.58
482	2183023.531	767873.2918	-29.89
483	2183025.938	767412.3209	41.83
484	2183026.277	767451.3708	29.04
485	2183026.616	767490.4205	7.65
486	2183026.953	767529.4703	0.01
487	2183027.292	767568.5201	-14.03
488	2183027.969	767646.6197	-74.96
489	2183028.307	767685.6695	-122.28
490	2183028.646	767724.7192	-108.33
491	2183028.983	767763.769	-90.94
492	2183029.322	767802.8187	-79.86
493	2183029.66	767841.8686	-34.77
494	2183029.999	767880.9183	-30.12
495	2183032.068	767380.8977	40.15
496	2183032.407	767419.9474	39.49
497	2183032.745	767458.9972	24.44
498	2183033.084	767498.047	-0.33
499	2183033.422	767537.0968	-1.36
500	2183033.76	767576.1465	-21.26
501	2183034.437	767654.2461	-98.76
502	2183034.775	767693.2959	-133.10
503	2183035.114	767732.3457	-103.05
504	2183035.452	767771.3955	-92.50
505	2183035.79	767810.4452	-79.36
506	2183036.128	767849.4951	-31.19
507	2183036.129	767849.495	-31.19
508	2183036.467	767888.5448	-29.93
509	2183038.536	767388.5241	39.15
510	2183038.875	767427.5739	34.09
511	2183039.213	767466.6237	19.91
512	2183039.552	767505.6734	-1.95
513	2183039.89	767544.7233	-6.84
514	2183040.905	767661.8726	-122.65
515	2183041.243	767700.9224	-134.43
516	2183041.581	767739.9721	-101.13
517	2183041.92	767779.0219	-93.97
518	2183042.258	767818.0717	-79.09
519	2183042.597	767857.1214	-29.73
520	2183042.935	767896.1712	-29.80
521	2183045.005	767396.1506	37.58
522	2183045.343	767435.2003	28.27
523	2183045.681	767474.2501	15.79
524	2183046.019	767513.2999	-0.91

525	2183046.358	767552.3497	-14.32
526	2183047.373	767669.499	-141.43
527	2183047.711	767708.5488	-127.56
528	2183048.05	767747.5986	-100.52
529	2183048.388	767786.6484	-94.87
530	2183048.727	767825.6982	-77.52
531	2183049.065	767864.7479	-29.78
532	2183049.404	767903.7977	-26.59
533	2183051.134	767364.7272	39.42
534	2183051.473	767403.777	34.67
535	2183051.811	767442.8268	22.67
536	2183052.149	767481.8766	12.62
537	2183052.488	767520.9263	-0.51
538	2183052.826	767559.9762	-21.77
539	2183053.842	767677.1254	-152.60
540	2183054.179	767716.1753	-119.26
541	2183054.518	767755.225	-99.47
542	2183054.856	767794.2749	-94.65
543	2183055.195	767833.3246	-65.16
544	2183055.195	767833.3246	-65.16
545	2183055.533	767872.3743	-29.04
546	2183055.872	767911.4241	-21.03
547	2183057.603	767372.3537	37.59
548	2183057.941	767411.4035	30.52
549	2183058.28	767450.4532	18.68
550	2183058.618	767489.5031	8.07
551	2183058.956	767528.5528	-3.40
552	2183060.309	767684.752	-154.57
553	2183060.648	767723.8018	-113.01
554	2183060.986	767762.8515	-98.63
555	2183061.324	767801.9013	-93.10
556	2183061.663	767840.951	-45.51
557	2183062.001	767880.0008	-28.28
558	2183062.34	767919.0506	-20.50
559	2183064.071	767379.9801	35.15
560	2183064.409	767419.03	25.86
561	2183064.748	767458.0796	16.72
562	2183065.086	767497.1295	4.58
563	2183065.424	767536.1793	-8.73
564	2183066.777	767692.3784	-131.81
565	2183067.116	767731.4282	-108.98
566	2183067.454	767770.4779	-98.26
567	2183067.792	767809.5278	-88.98
568	2183068.132	767848.5774	-34.89

569	2183068.469	767887.6273	-27.85
570	2183068.808	767926.6771	-23.30
571	2183070.201	767348.5569	39.63
572	2183070.539	767387.6066	31.95
573	2183070.877	767426.6564	21.65
574	2183071.216	767465.7061	15.31
575	2183071.554	767504.756	3.62
576	2183071.892	767543.8057	-14.39
577	2183073.246	767700.0049	-119.88
578	2183073.584	767739.0547	-104.83
579	2183073.923	767778.1045	-97.39
580	2183074.261	767817.1542	-76.18
581	2183074.261	767817.1542	-76.18
582	2183074.6	767856.204	-30.95
583	2183074.938	767895.2537	-27.92
584	2183075.276	767934.3035	-29.01
585	2183076.669	767356.1833	38.45
586	2183077.007	767395.2331	27.99
587	2183077.345	767434.2829	18.48
588	2183077.683	767473.3326	14.12
589	2183078.022	767512.3824	1.01
590	2183079.714	767707.6313	-113.19
591	2183080.052	767746.6811	-101.13
592	2183080.391	767785.7309	-95.48
593	2183080.729	767824.7806	-59.04
594	2183081.068	767863.8304	-29.04
595	2183081.406	767902.8802	-29.11
596	2183081.745	767941.93	-29.94
597	2183083.137	767363.8098	36.49
598	2183083.476	767402.8595	23.39
599	2183083.814	767441.9093	16.65
600	2183084.152	767480.9591	12.67
601	2183084.49	767520.0089	-4.02
602	2183086.182	767715.2578	-108.33
603	2183086.52	767754.3076	-98.88
604	2183086.859	767793.3573	-90.95
605	2183087.197	767832.4071	-47.38
606	2183087.536	767871.4568	-28.68
607	2183087.874	767910.5066	-30.11
608	2183088.213	767949.5564	-29.84
609	2183089.267	767332.3864	40.09
610	2183089.605	767371.4362	33.81
611	2183089.944	767410.486	19.30
612	2183090.282	767449.5358	15.72

613	2183090.62	767488.5856	9.49
614	2183090.958	767527.6354	-9.43
615	2183092.65	767722.8843	-104.10
616	2183092.988	767761.9341	-97.05
617	2183093.328	767800.9838	-80.35
618	2183093.328	767800.9838	-80.35
619	2183093.665	767840.0335	-39.77
620	2183094.004	767879.0834	-29.21
621	2183094.342	767918.1331	-30.25
622	2183094.681	767957.1828	-30.29
623	2183095.735	767340.0129	39.87
624	2183096.073	767379.0627	30.83
625	2183096.412	767418.1124	16.70
626	2183096.75	767457.1623	14.54
627	2183097.088	767496.212	3.10
628	2183099.119	767730.5107	-100.49
629	2183099.457	767769.5605	-93.77
630	2183099.796	767808.6102	-66.08
631	2183100.134	767847.66	-34.53
632	2183100.472	767886.7098	-29.95
633	2183100.81	767925.7596	-29.55
634	2183101.148	767964.8094	-33.68
635	2183102.203	767347.6394	38.10
636	2183102.541	767386.6891	26.74
637	2183102.88	767425.7389	14.82
638	2183103.218	767464.7887	12.61
639	2183103.556	767503.8385	-3.09
640	2183105.587	767738.1372	-96.16
641	2183105.925	767777.187	-87.09
642	2183106.263	767816.2366	-53.38
643	2183106.602	767855.2865	-31.06
644	2183106.94	767894.3363	-30.06
645	2183107.278	767933.386	-28.76
646	2183107.617	767972.4359	-39.27
647	2183108.671	767355.2658	31.89
648	2183109.01	767394.3156	21.62
649	2183109.349	767433.3653	13.56
650	2183109.686	767472.4152	9.29
651	2183110.025	767511.4649	-8.09
652	2183112.055	767745.7636	-91.52
653	2183112.393	767784.8134	-76.89
654	2183112.393	767784.8133	-76.89
655	2183112.731	767823.8632	-44.85
656	2183113.07	767862.9129	-29.59

657	2183113.408	767901.9627	-29.40
658	2183113.747	767941.0125	-28.78
659	2183114.085	767980.0623	-37.76
660	2183115.14	767362.8923	30.21
661	2183115.478	767401.9421	16.32
662	2183115.816	767440.9918	12.38
663	2183116.154	767480.0416	4.11
664	2183118.523	767753.3901	-87.29
665	2183118.861	767792.4398	-65.42
666	2183119.2	767831.4896	-38.76
667	2183119.538	767870.5394	-29.55
668	2183119.876	767909.5892	-28.64
669	2183120.215	767948.6389	-31.62
670	2183120.553	767987.6887	-34.25
671	2183121.608	767370.5187	27.23
672	2183121.946	767409.5685	11.28
673	2183122.284	767448.6182	10.53
674	2183122.623	767487.6681	-2.53
675	2183124.991	767761.0165	-81.19
676	2183125.33	767800.0663	-53.27
677	2183125.668	767839.1161	-33.59
678	2183126.006	767878.1658	-29.73
679	2183126.345	767917.2156	-28.36
680	2183126.683	767956.2654	-37.55
681	2183127.021	767995.3152	-30.26
682	2183128.076	767378.1452	21.95
683	2183128.414	767417.195	7.14
684	2183128.752	767456.2447	6.00
685	2183129.091	767495.2945	-9.15
686	2183131.459	767768.643	-68.85
687	2183131.459	767768.643	-68.85
688	2183131.798	767807.6927	-42.73
689	2183132.136	767846.7425	-30.45
690	2183132.474	767885.7923	-29.18
691	2183132.813	767924.8421	-29.74
692	2183133.151	767963.8919	-39.05
693	2183133.49	768002.9416	-26.29
694	2183134.544	767385.7716	9.72
695	2183134.882	767424.8214	3.72
696	2183135.221	767463.8711	0.42
697	2183137.928	767776.2694	-54.32
698	2183138.266	767815.3192	-36.13
699	2183138.604	767854.3689	-29.75
700	2183138.943	767893.4187	-29.34

701	2183139.281	767932.4685	-34.10
702	2183139.619	767971.5183	-33.44
703	2183139.958	768010.568	-23.21
704	2183141.013	767393.3981	0.64
705	2183141.35	767432.4479	0.56
706	2183141.689	767471.4976	-2.87
707	2183144.396	767783.8959	-40.14
708	2183144.734	767822.9456	-32.13
709	2183145.073	767861.9955	-29.80
710	2183145.411	767901.0452	-31.89
711	2183145.749	767940.095	-38.51
712	2183146.087	767979.1448	-26.71
713	2183146.426	768018.1946	-21.30
714	2183147.481	767401.0245	-4.30
715	2183147.818	767440.0744	-1.99
716	2183148.157	767479.1241	-8.95
717	2183150.525	767752.4725	-35.85
718	2183150.864	767791.5223	-32.58
719	2183151.202	767830.5721	-30.24
720	2183151.541	767869.6219	-30.70
721	2183151.879	767908.6717	-36.65
722	2183152.218	767947.7215	-37.90
723	2183152.556	767986.7712	-21.56
724	2183152.894	768025.821	-22.45
725	2183153.948	767408.651	-3.66
726	2183154.287	767447.7008	-4.55
727	2183156.994	767760.099	-30.44
728	2183157.332	767799.1487	-30.00
729	2183157.67	767838.1986	-29.69
730	2183158.009	767877.2483	-34.12
731	2183158.347	767916.2981	-39.51
732	2183158.686	767955.3479	-30.45
733	2183159.024	767994.3977	-19.61
734	2183159.363	768033.4475	-29.32
735	2183160.416	767416.2775	-2.37
736	2183160.755	767455.3273	-7.17
737	2183163.462	767767.7255	-26.36
738	2183163.8	767806.7752	-29.66
739	2183164.138	767845.825	-29.22
740	2183164.477	767884.8748	-38.20
741	2183164.815	767923.9246	-37.65
742	2183165.154	767962.9743	-22.56
743	2183165.492	768002.0241	-20.40
744	2183165.831	768041.0739	-29.68

745	2183166.885	767423.9039	-2.59
746	2183167.223	767462.9537	-9.59
747	2183169.592	767736.3021	-10.04
748	2183169.93	767775.3519	-24.45
749	2183170.269	767814.4017	-29.24
750	2183170.607	767853.4515	-30.80
751	2183170.945	767892.5013	-38.52
752	2183171.283	767931.551	-31.93
753	2183171.4	767389.3706	12.25
754	2183171.622	767970.6008	-19.36
755	2183171.96	768009.6506	-22.45
756	2183172.299	768048.7004	-29.82
757	2183173.353	767431.5304	-3.91
758	2183176.06	767743.9286	-2.63
759	2183176.398	767782.9784	-20.72
760	2183176.737	767822.0282	-28.79
761	2183177.075	767861.0779	-36.50
762	2183177.414	767900.1277	-34.43
763	2183177.751	767939.1775	-24.77
764	2183177.868	767396.997	11.92
765	2183178.091	767978.2273	-20.00
766	2183178.428	768017.2771	-25.03
767	2183178.766	768056.3268	-32.52
768	2183179.821	767439.1568	-5.90
769	2183182.528	767751.5551	0.35
770	2183182.866	767790.6048	-20.66
771	2183183.205	767829.6546	-29.77
772	2183183.543	767868.7044	-38.74
773	2183183.882	767907.7541	-28.50
774	2183184.22	767946.804	-20.31
775	2183184.336	767404.6235	9.06
776	2183184.558	767985.8538	-21.96
777	2183184.896	768024.9035	-27.09
778	2183185.235	768063.9533	-38.94
779	2183186.289	767446.7833	-8.75
780	2183188.658	767720.1317	-3.08
781	2183188.997	767759.1815	-2.14
782	2183189.334	767798.2313	-23.08
783	2183189.673	767837.2811	-34.44
784	2183190.011	767876.3309	-33.14
785	2183190.35	767915.3806	-23.24
786	2183190.688	767954.4304	-20.67
787	2183190.804	767412.2499	5.38
788	2183191.026	767993.4802	-24.59

789	2183191.364	768032.53	-28.71
790	2183191.703	768071.5798	-40.24
791	2183195.126	767727.7582	0.77
792	2183195.465	767766.808	-9.44
793	2183195.803	767805.8577	-27.28
794	2183196.142	767844.9075	-38.77
795	2183196.479	767883.9573	-25.38
796	2183196.817	767923.0071	-20.55
797	2183196.935	767380.8266	6.50
798	2183197.156	767962.0569	-22.81
799	2183197.272	767419.8764	2.88
800	2183197.494	768001.1066	-27.33
801	2183197.833	768040.1564	-30.96
802	2183198.171	768079.2063	-40.09
803	2183201.594	767735.3846	1.05
804	2183201.933	767774.4344	-13.57
805	2183202.271	767813.4842	-33.67
806	2183202.61	767852.5339	-35.58
807	2183202.947	767891.5838	-19.87
808	2183203.286	767930.6335	-21.09
809	2183203.403	767388.4531	4.62
810	2183203.624	767969.6833	-25.52
811	2183203.741	767427.5028	0.85
812	2183203.963	768008.7332	-29.68
813	2183204.301	768047.7829	-34.75
814	2183204.639	768086.8327	
815	2183207.724	767703.9613	-1.50
816	2183208.062	767743.0111	-1.52
817	2183208.401	767782.0609	-16.62
818	2183208.739	767821.1107	-39.12
819	2183209.077	767860.1605	-25.98
820	2183209.416	767899.2102	-19.21
821	2183209.754	767938.26	-23.92
822	2183209.871	767396.0795	2.58
823	2183210.092	767977.3098	-28.31
824	2183210.209	767435.1293	-1.86
825	2183210.431	768016.3596	-31.36
826	2183210.769	768055.4094	-37.58
827	2183214.193	767711.5878	-0.05
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829	2183214.869	767789.6873	-23.69
830	2183215.207	767828.7371	-38.10
831	2183215.545	767867.7869	-19.93
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833	2183216	767364.6562	-6.71
834	2183216.222	767945.8865	-27.58
835	2183216.339	767403.706	2.72
836	2183216.56	767984.9363	-30.32
837	2183216.677	767442.7558	-5.22
838	2183216.899	768023.986	-33.08
839	2183217.237	768063.0358	-39.01
840	2183220.661	767719.2142	-0.80
841	2183220.999	767758.264	-11.93
842	2183221.337	767797.3138	-35.57
843	2183221.675	767836.3636	-30.89
844	2183222.014	767875.4134	-19.23
845	2183222.352	767914.4631	-22.81
846	2183222.468	767372.2827	-10.12
847	2183222.69	767953.5129	-29.43
848	2183222.807	767411.3324	2.77
849	2183223.029	767992.5627	-31.73
850	2183223.145	767450.3822	-8.68
851	2183223.367	768031.6125	-35.14
852	2183223.705	768070.6623	-39.98
853	2183226.79	767687.7909	-0.06
854	2183227.129	767726.8407	-3.89
855	2183227.467	767765.8905	-18.14
856	2183227.805	767804.9402	-40.81
857	2183228.143	767843.99	-22.18
858	2183228.482	767883.0398	-20.85
859	2183228.82	767922.0896	-25.54
860	2183228.937	767379.9091	-11.60
861	2183229.159	767961.1394	-30.17
862	2183229.275	767418.9589	1.81
863	2183229.497	768000.1892	-33.26
864	2183229.613	767458.0087	-10.27
865	2183229.836	768039.2389	-36.81
866	2183233.258	767695.4174	0.51
867	2183233.597	767734.4671	-8.85
868	2183233.935	767773.5169	-25.95
869	2183234.273	767812.5667	-35.56
870	2183234.612	767851.6165	-20.73
871	2183234.95	767890.6662	-23.19
872	2183235.288	767929.7161	-28.50
873	2183235.405	767387.5356	-5.32
874	2183235.627	767968.7658	-31.55
875	2183235.743	767426.5853	-0.71
876	2183235.965	768007.8156	-34.83

877	2183236.081	767465.6351	-10.08
878	2183236.304	768046.8654	-38.27
879	2183239.726	767703.0438	-1.34
880	2183240.065	767742.0936	-14.36
881	2183240.403	767781.1434	-34.78
882	2183240.741	767820.1931	-27.74
883	2183241.08	767859.243	-24.01
884	2183241.418	767898.2928	-25.86
885	2183241.535	767356.1122	-9.97
886	2183241.756	767937.3425	-30.70
887	2183241.873	767395.162	1.44
888	2183242.095	767976.3923	-33.45
889	2183242.211	767434.2118	-4.56
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891	2183242.55	767473.2616	-9.67
892	2183242.772	768054.4919	-39.54
893	2183245.857	767671.6205	1.54
894	2183245.857	767671.6205	1.54
895	2183246.195	767710.6703	-5.71
896	2183246.533	767749.72	-20.15
897	2183246.871	767788.7699	-39.28
898	2183247.21	767827.8197	-21.17
899	2183247.548	767866.8694	-27.21
900	2183247.887	767905.9192	-28.28
901	2183248.003	767363.7387	-9.54
902	2183248.225	767944.969	-32.37
903	2183248.341	767402.7885	0.58
904	2183248.563	767984.0187	-35.01
905	2183248.679	767441.8382	-7.89
906	2183248.901	768023.0685	-38.20
907	2183249.018	767480.8881	-9.72
908	2183252.325	767679.2469	1.07
909	2183252.326	767679.2469	1.07
910	2183252.663	767718.2967	-11.39
911	2183253.001	767757.3465	-25.89
912	2183253.339	767796.3963	-36.08
913	2183253.678	767835.4461	-25.64
914	2183254.016	767874.4959	-29.67
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916	2183254.471	767371.3651	-7.86
917	2183254.693	767952.5954	-34.12
918	2183254.809	767410.415	-1.76
919	2183255.032	767991.6452	-36.51
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923	2183258.792	767686.8734	-3.15
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927	2183259.808	767804.0228	-28.56
928	2183260.146	767843.0726	-31.64
929	2183260.484	767882.1223	-31.23
930	2183260.601	767339.9418	-9.65
931	2183260.823	767921.1721	-32.95
932	2183260.939	767378.9916	-6.05
933	2183261.161	767960.2219	-35.86
934	2183261.277	767418.0414	-4.47
935	2183261.5	767999.2716	-38.11
936	2183261.616	767457.0912	-12.82
937	2183261.838	768038.3215	-40.52
938	2183261.954	767496.141	-10.24
939	2183264.924	767655.4501	-2.32
940	2183265.261	767694.4999	-9.95
941	2183265.262	767694.4999	-9.95
942	2183265.599	767733.5497	-22.96
943	2183265.937	767772.5994	-37.63
944	2183266.276	767811.6492	-21.60
945	2183266.614	767850.699	-33.04
946	2183266.952	767889.7488	-32.75
947	2183267.069	767347.5683	-9.98
948	2183267.291	767928.7985	-35.32
949	2183267.407	767386.6181	-5.79
950	2183267.629	767967.8484	-37.11
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952	2183267.967	768006.8981	-39.66
953	2183268.084	767464.7177	-16.85
954	2183268.422	767503.7674	-10.02
955	2183271.392	767663.0765	-4.64
956	2183271.729	767702.1264	-16.95
957	2183271.73	767702.1263	-16.95
958	2183272.067	767741.1761	-28.05
959	2183272.406	767780.2259	-38.54
960	2183272.744	767819.2757	-21.28
961	2183273.083	767858.3255	-33.70
962	2183273.421	767897.3753	-34.62
963	2183273.537	767355.1948	-10.01
964	2183273.76	767936.425	-37.67

965	2183273.875	767394.2445	-6.91
966	2183274.097	767975.4748	-38.33
967	2183274.214	767433.2943	-9.07
968	2183274.436	768014.5246	-40.41
969	2183274.552	767472.3441	-17.72
970	2183277.86	767670.703	-8.80
971	2183278.197	767709.7527	-23.86
972	2183278.199	767709.7528	-23.86
973	2183278.535	767748.8026	-33.15
974	2183278.874	767787.8523	-32.25
975	2183279.212	767826.9021	-25.80
976	2183279.551	767865.9519	-34.65
977	2183279.889	767905.0017	-36.93
978	2183280.005	767362.8212	-9.92
979	2183280.227	767944.0515	-39.77
980	2183280.344	767401.871	-8.35
981	2183280.565	767983.1013	-39.32
982	2183280.682	767440.9208	-11.18
983	2183280.904	768022.1511	-40.61
984	2183281.021	767479.9706	-15.75
985	2183283.99	767639.2797	-9.00
986	2183284.328	767678.3294	-14.03
987	2183284.665	767717.3792	-30.02
988	2183284.667	767717.3792	-30.03
989	2183285.004	767756.429	-38.14
990	2183285.342	767795.4788	-23.96
991	2183285.68	767834.5286	-29.57
992	2183286.019	767873.5783	-35.98
993	2183286.135	767331.3978	-9.70
994	2183286.137	767331.3979	-9.70
995	2183286.357	767912.6282	-39.23
996	2183286.473	767370.4477	-9.85
997	2183286.695	767951.6779	-41.21
998	2183286.812	767409.4974	-9.38
999	2183287.034	767990.7277	-39.91
1000	2183287.15	767448.5472	-18.93
1001	2183287.489	767487.597	-12.22
1002	2183290.458	767646.9061	-11.34
1003	2183290.796	767685.9559	-19.61
1004	2183291.133	767725.0057	-34.51
1005	2183291.135	767725.0057	-34.51
1006	2183291.472	767764.0555	-39.36
1007	2183291.81	767803.1052	-19.76
1008	2183292.148	767842.1551	-31.79

1009	2183292.487	767881.2048	-37.61
1010	2183292.603	767339.0243	-9.75
1011	2183292.605	767339.0243	-9.75
1012	2183292.825	767920.2546	-41.37
1013	2183292.942	767378.0741	-10.13
1014	2183293.163	767959.3044	-42.02
1015	2183293.28	767417.1239	-10.23
1016	2183293.502	767998.3542	-40.01
1017	2183293.618	767456.1737	-22.31
1018	2183296.927	767654.5325	-14.57
1019	2183297.264	767693.5824	-25.13
1020	2183297.602	767732.6321	-37.91
1021	2183297.603	767732.6322	-37.91
1022	2183297.94	767771.682	-34.17
1023	2183298.279	767810.7317	-21.13
1024	2183298.617	767849.7815	-33.52
1025	2183298.955	767888.8313	-39.50
1026	2183299.071	767346.6508	-10.58
1027	2183299.073	767346.6508	-10.58
1028	2183299.293	767927.8811	-44.15
1029	2183299.41	767385.7006	-11.15
1030	2183299.632	767966.9309	-41.93
1031	2183299.748	767424.7503	-10.98
1032	2183299.97	768005.9807	-39.93
1033	2183300.086	767463.8002	-20.42
1034	2183303.056	767623.1093	-14.43
1035	2183303.395	767662.1591	-18.50
1036	2183303.733	767701.2088	-30.33
1037	2183304.07	767740.2586	-39.78
1038	2183304.071	767740.2586	-39.78
1039	2183304.408	767779.3084	-26.09
1040	2183304.747	767818.3581	-24.36
1041	2183305.085	767857.408	-35.31
1042	2183305.202	767315.2275	-9.07
1043	2183305.423	767896.4578	-41.40
1044	2183305.54	767354.2772	-11.88
1045	2183305.541	767354.2773	-11.88
1046	2183305.761	767935.5075	-46.70
1047	2183305.878	767393.3271	-12.80
1048	2183306.1	767974.5573	-40.80
1049	2183306.217	767432.3768	-11.90
1050	2183306.555	767471.4266	-15.28
1051	2183309.524	767630.7357	-16.44
1052	2183309.863	767669.7855	-22.49

1053	2183310.201	767708.8353	-35.22
1054	2183310.538	767747.8851	-37.45
1055	2183310.54	767747.8851	-37.45
1056	2183310.876	767786.9349	-20.33
1057	2183311.215	767825.9846	-27.73
1058	2183311.553	767865.0344	-37.20
1059	2183311.671	767322.8539	-9.16
1060	2183311.891	767904.0842	-43.26
1061	2183312.008	767361.9037	-11.50
1062	2183312.009	767361.9037	-11.50
1063	2183312.23	767943.134	-48.85
1064	2183312.346	767400.9535	-15.44
1065	2183312.568	767982.1838	-39.43
1066	2183312.685	767440.0032	-12.55
1067	2183313.023	767479.0531	-11.97
1068	2183315.992	767638.3622	-18.98
1069	2183316.331	767677.4119	-26.30
1070	2183316.669	767716.4617	-38.78
1071	2183317.006	767755.5115	-31.90
1072	2183317.008	767755.5115	-31.90
1073	2183317.344	767794.5613	-20.23
1074	2183317.682	767833.6111	-30.64
1075	2183318.021	767872.6609	-39.16
1076	2183318.139	767330.4804	-10.58
1077	2183318.359	767911.7107	-45.88
1078	2183318.476	767369.5302	-10.26
1079	2183318.478	767369.5302	-10.26
1080	2183318.698	767950.7605	-49.09
1081	2183318.814	767408.58	-19.16
1082	2183319.036	767989.8102	-38.31
1083	2183319.153	767447.6297	-15.92
1084	2183322.123	767606.9389	-19.12
1085	2183322.46	767645.9886	-22.13
1086	2183322.799	767685.0385	-29.88
1087	2183323.137	767724.0882	-39.13
1088	2183323.475	767763.138	-25.48
1089	2183323.476	767763.1379	-25.48
1090	2183323.812	767802.1878	-22.79
1091	2183324.151	767841.2376	-33.02
1092	2183324.269	767299.057	-7.85
1093	2183324.489	767880.2874	-41.03
1094	2183324.607	767338.1068	-15.94
1095	2183324.828	767919.3371	-48.15
1096	2183324.944	767377.1566	-12.32

1097	2183324.946	767377.1566	-12.32
1098	2183325.166	767958.3869	-45.60
1099	2183325.282	767416.2064	-24.04
1100	2183325.62	767455.2562	-19.35
1101	2183328.591	767614.5653	-20.10
1102	2183328.929	767653.6151	-25.58
1103	2183329.267	767692.6649	-34.73
1104	2183329.605	767731.7147	-35.16
1105	2183329.943	767770.7645	-20.81
1106	2183329.943	767770.7645	-20.81
1107	2183330.281	767809.8143	-26.19
1108	2183330.619	767848.8641	-35.08
1109	2183330.737	767306.6836	-8.78
1110	2183330.957	767887.9138	-42.82
1111	2183331.075	767345.7333	-19.01
1112	2183331.296	767926.9636	-50.03
1113	2183331.413	767384.7831	-16.71
1114	2183331.414	767384.783	-16.71
1115	2183331.634	767966.0134	-39.74
1116	2183331.75	767423.8329	-29.25
1117	2183332.089	767462.8827	-20.74
1118	2183335.058	767622.1917	-22.40
1119	2183335.397	767661.2416	-29.16
1120	2183335.735	767700.2914	-39.09
1121	2183336.073	767739.3411	-28.85
1122	2183336.411	767778.3909	-20.58
1123	2183336.412	767778.391	-20.58
1124	2183336.749	767817.4407	-29.47
1125	2183337.087	767856.4905	-37.03
1126	2183337.205	767314.31	-9.46
1127	2183337.426	767895.5403	-45.19
1128	2183337.543	767353.3598	-12.79
1129	2183337.764	767934.59	-51.66
1130	2183337.881	767392.4096	-21.74
1131	2183337.881	767392.4096	-21.74
1132	2183338.102	767973.6398	-36.47
1133	2183338.219	767431.4594	-32.35
1134	2183341.526	767629.8183	-25.15
1135	2183341.865	767668.868	-33.53
1136	2183342.203	767707.9178	-37.75
1137	2183342.542	767746.9676	-22.98
1138	2183342.878	767786.0174	-22.98
1139	2183342.88	767786.0174	-22.98
1140	2183343.217	767825.0672	-31.72

1141	2183343.555	767864.117	-39.14
1142	2183343.673	767321.9365	-9.78
1143	2183343.894	767903.1667	-47.34
1144	2183344.011	767360.9862	-11.16
1145	2183344.232	767942.2164	-48.33
1146	2183344.349	767400.036	-26.42
1147	2183344.35	767400.0361	-26.42
1148	2183344.687	767439.0858	-32.61
1149	2183347.995	767637.4447	-28.22
1150	2183348.333	767676.4945	-37.78
1151	2183348.671	767715.5443	-31.53
1152	2183349.01	767754.594	-20.35
1153	2183349.347	767793.6438	-26.05
1154	2183349.348	767793.6438	-26.05
1155	2183349.685	767832.6936	-33.62
1156	2183349.803	767290.5131	0.87
1157	2183350.024	767871.7434	-41.16
1158	2183350.141	767329.5629	-9.59
1159	2183350.362	767910.7932	-48.95
1160	2183350.48	767368.6127	-15.69
1161	2183350.701	767949.8429	-39.26
1162	2183350.816	767407.6625	-29.22
1163	2183350.818	767407.6625	-29.22
1164	2183351.155	767446.7123	-31.44
1165	2183354.463	767645.0712	-31.60
1166	2183354.801	767684.1209	-39.99
1167	2183355.14	767723.1707	-24.59
1168	2183355.478	767762.2205	-21.76
1169	2183355.815	767801.2703	-28.59
1170	2183355.816	767801.2703	-28.59
1171	2183356.153	767840.3201	-35.51
1172	2183356.271	767298.1396	1.55
1173	2183356.492	767879.3699	-42.14
1174	2183356.609	767337.1894	-9.65
1175	2183356.83	767918.4197	-48.98
1176	2183356.948	767376.2391	-22.01
1177	2183357.169	767957.4694	-34.91
1178	2183357.285	767415.2889	-30.08
1179	2183357.286	767415.2889	-30.08
1180	2183357.623	767454.3387	-29.90
1181	2183360.931	767652.6976	-34.89
1182	2183361.269	767691.7474	-35.39
1183	2183361.608	767730.7972	-20.40
1184	2183361.946	767769.847	-25.03

1185	2183362.283	767808.8968	-30.46
1186	2183362.285	767808.8967	-30.46
1187	2183362.621	767847.9465	-37.34
1188	2183362.739	767305.766	1.86
1189	2183362.96	767886.9963	-43.12
1190	2183363.078	767344.8158	-9.90
1191	2183363.298	767926.0461	-45.57
1192	2183363.416	767383.8656	-28.21
1193	2183363.753	767422.9154	-30.01
1194	2183363.754	767422.9154	-30.01
1195	2183367.399	767660.324	-37.79
1196	2183367.738	767699.3738	-26.52
1197	2183368.076	767738.4236	-21.19
1198	2183368.414	767777.4734	-28.70
1199	2183368.751	767816.5232	-32.77
1200	2183368.753	767816.5231	-32.77
1201	2183369.09	767855.573	-38.49
1202	2183369.207	767313.3925	2.07
1203	2183369.429	767894.6228	-43.44
1204	2183369.546	767352.4423	-10.30
1205	2183369.766	767933.6726	-39.95
1206	2183369.884	767391.4921	-29.89
1207	2183370.221	767430.5419	-29.92
1208	2183370.223	767430.5418	-29.92
1209	2183373.868	767667.9506	-39.09
1210	2183374.206	767707.0003	-20.67
1211	2183374.544	767746.0501	-24.03
1212	2183374.882	767785.0999	-31.22
1213	2183375.22	767824.1497	-34.91
1214	2183375.221	767824.1497	-34.91
1215	2183375.558	767863.1995	-39.66
1216	2183375.676	767321.0189	1.05
1217	2183375.897	767902.2492	-42.87
1218	2183376.014	767360.0687	-13.20
1219	2183376.234	767941.299	-36.64
1220	2183376.352	767399.1185	-30.01
1221	2183376.689	767438.1683	-29.95
1222	2183376.691	767438.1682	-29.95
1223	2183380.336	767675.577	-35.20
1224	2183380.674	767714.6268	-21.17
1225	2183381.013	767753.6766	-27.47
1226	2183381.351	767792.7263	-32.92
1227	2183381.688	767831.7761	-36.56
1228	2183381.689	767831.7761	-36.56

1229	2183382.026	767870.8259	-40.46
1230	2183382.144	767328.6454	-0.75
1231	2183382.365	767909.8757	-41.38
1232	2183382.482	767367.6952	-18.06
1233	2183382.82	767406.745	-30.07
1234	2183386.804	767683.2034	-24.05
1235	2183387.142	767722.2532	-24.92
1236	2183387.481	767761.303	-30.56
1237	2183387.819	767800.3528	-34.62
1238	2183388.156	767839.4026	-38.05
1239	2183388.158	767839.4026	-38.06
1240	2183388.494	767878.4524	-40.81
1241	2183388.612	767336.2719	-2.40
1242	2183388.832	767917.5021	-39.57
1243	2183388.951	767375.3217	-23.10
1244	2183389.289	767414.3714	-30.22
1245	2183393.272	767690.8299	-21.95
1246	2183393.61	767729.8797	-28.61
1247	2183393.949	767768.9294	-32.75
1248	2183394.287	767807.9792	-36.26
1249	2183394.624	767847.029	-39.36
1250	2183394.626	767847.029	-39.36
1251	2183394.962	767886.0788	-40.77
1252	2183395.08	767343.8983	-5.35
1253	2183395.301	767925.1286	-38.14
1254	2183395.419	767382.9481	-26.93
1255	2183395.757	767421.9979	-30.36
1256	2183399.74	767698.4564	-24.97
1257	2183400.078	767737.5061	-30.99
1258	2183400.417	767776.5559	-34.72
1259	2183400.755	767815.6057	-37.70
1260	2183401.093	767854.6554	-40.00
1261	2183401.094	767854.6555	-40.00
1262	2183401.43	767893.7053	-40.41
1263	2183401.548	767351.5248	-10.20
1264	2183401.887	767390.5745	-29.16
1265	2183402.225	767429.6243	-30.22
1266	2183406.209	767706.0828	-29.27
1267	2183406.546	767745.1326	-32.81
1268	2183406.886	767784.1824	-36.49
1269	2183407.223	767823.2322	-39.01
1270	2183407.56	767862.282	-40.02
1271	2183407.561	767862.2819	-40.02
1272	2183407.899	767901.3318	-39.89

1273	2183408.016	767359.1512	-18.94
1274	2183408.355	767398.201	-29.94
1275	2183412.677	767713.7092	-31.73
1276	2183413.015	767752.7591	-34.57
1277	2183413.353	767791.8089	-38.10
1278	2183413.691	767830.8586	-39.93
1279	2183414.028	767869.9084	-40.06
1280	2183414.03	767869.9084	-40.06
1281	2183414.367	767908.9582	-39.22
1282	2183414.484	767366.7777	-28.27
1283	2183414.824	767405.8275	-30.10
1284	2183419.145	767721.3357	-33.20
1285	2183419.483	767760.3855	-36.26
1286	2183419.821	767799.4353	-39.46
1287	2183420.159	767838.4851	-40.18
1288	2183420.497	767877.5349	-40.07
1289	2183420.498	767877.5349	-40.07
1290	2183420.953	767374.4042	-30.21
1291	2183421.291	767413.454	-30.29
1292	2183425.612	767728.9622	-34.48
1293	2183425.951	767768.012	-37.86
1294	2183426.289	767807.0617	-40.29
1295	2183426.628	767846.1115	-40.16
1296	2183426.965	767885.1613	-39.98
1297	2183426.966	767885.1614	-39.98
1298	2183427.421	767382.0306	-29.70
1299	2183432.081	767736.5886	-35.73
1300	2183432.419	767775.6384	-39.33
1301	2183432.758	767814.6883	-40.71
1302	2183433.096	767853.738	-40.04
1303	2183433.433	767892.7878	-39.64
1304	2183433.434	767892.7878	-39.64
1305	2183433.889	767389.6571	-27.94
1306	2183438.549	767744.2151	-36.80
1307	2183438.887	767783.2649	-40.40
1308	2183439.226	767822.3147	-40.83
1309	2183439.564	767861.3645	-40.02
1310	2183445.017	767751.8416	-37.99
1311	2183445.355	767790.8914	-40.86
1312	2183445.694	767829.9411	-40.74
1313	2183446.032	767868.9909	-40.00
1314	2183451.485	767759.468	-39.17
1315	2183451.824	767798.5178	-40.99
1316	2183452.162	767837.5676	-40.50

1317	2183452.5	767876.6174	-39.75
1318	2183457.954	767767.0945	-39.98
1319	2183458.292	767806.1443	-40.95
1320	2183458.631	767845.194	-40.00
1321	2183464.422	767774.7209	-40.38
1322	2183464.76	767813.7707	-40.86
1323	2183465.099	767852.8205	-40.00
1324	2183470.89	767782.3474	-40.55
1325	2183471.228	767821.3972	-40.71
1326	2183471.567	767860.447	-40.00
1327	2183477.358	767789.9738	-40.59
1328	2183477.696	767829.0236	-40.52
1329	2183483.827	767797.6003	-40.55
1330	2183484.164	767836.6501	-40.43
1331	2183490.295	767805.2267	-40.43
1332	2183490.633	767844.2766	-40.03
1333	2183496.762	767812.8532	-40.27
1334	2183503.231	767820.4797	-40.12
1335	2183509.699	767828.1062	-40.01

ANNEXURE-XX

TCC & EC MEETING MINUTES OF NARINGPANGA (S) GRAPHITE BLOCK, RAYAGADA DISTRICT, ODISHA

Ministry of Mines
National Mineral Exploration Trust

Minutes of the 48th Technical-cum-Cost Committee [TCC] meeting held on 22nd and 23rd December 2022 through videoconference at DGCO, GSI, New Delhi

The 48th Technical-cum-Cost Committee [TCC] meeting of National Mineral Exploration Trust [NMET] was held under the chairmanship of Shri Janardan Prasad, Additional Director General, Geological Survey of India [ADG, GSI] and Chairman, TCC, NMET on 22nd and 23rd December, 2022 at DGCO, GSI, New Delhi through videoconference. The TCC members and representatives of Exploration Agencies [EAs] have attended the meeting through videoconference. The list of participants is in **annexure-1**.

Shri Suresh Chander, Director, GSI and Member Secretary, TCC NMET, welcomed Shri Janardan Prasad, ADG, GSI & Chairman, TCC; Members of the TCC and participants representing various Exploration Agencies [EAs]. He conveyed that total 16 nos. of new project proposals including eight proposals for financial assistance for procurement of machinery/ laboratory equipment/ instruments etc. have been received from different EAs and State Government for technical cum cost evaluation by the committee.

Shri Vivek Kumar Sharma, Director, NMET welcomed Chairman, TCC; Members of the TCC and participants representing various EAs and State Government Officials. It has been submitted that the Ministry of Mines envisage to increase the pace of exploration in country. In line of this total 13 private exploration agencies have been empanelled by Ministry for taking up exploration projects through NMET fund.

Shri Janardan Prasad, ADG, GSI, and Chairman, TCC welcomed the members and other participants from various EAs. The proceeding of the meeting was initiated as per the circulated agenda.

Agenda wise discussions are summarised as follows.

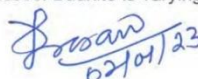
48.1. Technical evaluation of new project proposals:

48.1.1. Preliminary exploration (G3) of bauxite in Dhuluapat block (4.0 sq. km), District: Lohardaga and Gumla, Jharkhand. [Implementing Agency: CMPDI]

- a) The proposal was discussed in 44th TCC meeting held in August 2022 wherein the committee suggested to collate the geological report and reassess the available geological data collected by GSI and, if warranted, a revised proposal may be submitted for drilling in the gap areas and analyses of borehole samples for aluminous laterite.
- b) The principal rock formation of this area comprised of Chhota Nagpur granite gneiss resting over the unclassified metamorphics, followed by Lameta beds overlain by laterite and bauxite.
- c) It has been submitted that the bauxite occurs as segregated sheets and lenses within the laterite capping over the diorite/granite/and granite gneisses. Bauxite is varying in

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48.1.8. Preliminary exploration (G3) for graphite around Naringapanga block (S & W) (0.143 sq. km) block, District: Rayagada, Odisha. [Implementing Agency: DGM, Odisha]

- a) The proposal was sent to GSI for their considered comments, in response to this, CSI has submitted that the proposed block (G3) of D/o MG is not being considered for the current FSP and upcoming FSP, i.e., FS 2023-24.
- b) The Preliminary exploration (G3) in the south-west block of Naringapanga Block has been formulated on the basis of the findings of the previous General exploration (G2) around north-east of the present block.
- c) The area under consideration forms a part of Eastern Ghats Super Group of rocks comprising lithounits like khondalite suite of rocks, charnockite, quartzo-feldspathic gneiss and pegmatite overlain by recent soil and alluvium.
- d) It has been conveyed that both migmatized khondalite & quartzo-feldspathic gneiss occur concomitantly & graphite mineralization is restricted only to the contact zone. Graphite mineralization is litho-structurally controlled & mineralization has been confined in quartzo-feldspathic gneiss which seems to act like a scavenger and graphite is a remobilized product.
- e) It has been conveyed that the Naringapanga block was auctioned with a good resource, and it is expected that the similar geological set-up may continue in the south and west of the Naringapanga block.
- f) Keeping this in view the Directorate of Mines and Geology, Odisha has proposed to take up preliminary exploration (G3 stage) in the south-west of Naringapanga block.
- g) It has been conveyed that the Fixed Carbon in the adjoining block recorded at 11%FC.
- h) Based on detailed deliberations the committee suggested that the geophysical survey [Self Potential (12 L km)] may be taken up in the expected potential areas. After review of the SP survey, 600m drilling in six boreholes with 30m vertical depth for five boreholes and one borehole up to 60m will be taken.
- i) The Committee suggested to initially take up first level drilling up to 30m vertical depth, thereafter, in case of encouraging results the second level drilling up to 60m vertical depth may be taken up.
- j) The outcome of the project will be reviewed after completion of SP survey and pitting after four months.

The committee recommended the proposal for approval of EC, Preliminary exploration (G3) for graphite around Naringapanga block (S & W) (0.143 sq. km) block, District: Rayagada, Odisha with an estimated cost of Rs. 120.93 Lakh (including GST) in time schedule of 9 months for carrying out the proposed work and submission of report as per annexure- 5A & 5B.


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Estimated cost for Preliminary exploration (G3) for graphite around Naringapanga block (S & W) (0.143 sq. km) block, District: Rayagada, Odisha.

[Block area: 0.143 sq. km, No. of Boreholes: 6, Timeline: 9 months]

S. No.	Activities	Unit	Soc-Item-Sl.No.	SoC Rate (Rs.)	QTY	Amount (Rs.)	Remarks
A DRILLING (Outsourced)							
1	Drilling (6 BHs) outsourcing	m	2.2.1.4a	11,500	400	46,00,000	
2	Drill Core Preservation	per m	5.3	1,590	100	1,59,000	
						47,59,000	reimbursement of outsource component will be made as per Para 3 of NMET-SoC
	Tender Processing Cost	2% of the above Project or 5 lakh whichever is lower will be paid.				95,180	
	Reimbursement of cost in case of outsourced components of project work.		SOC Para 3 (i)			4,75,900	will be reimbursed as per point 3 of NMET-SoC after recalculation when actual cost of outsourcing component will be provided. The copy of contract agreement for outsourced component and work completion report are also required to reimburse the operational charge
						Sub Total- A	48,54,180
B GEOLOGICAL WORK							
1	Bore Hole Fixation and determination of co-ordinates & Reduced Level of the boreholes by DGPS	Per Point of observation	1.6.2	19,200	6	1,15,200	
2	Survey days (One Surveyor Charges)	day	1.6.1a	8,300	15	1,24,500	
3	Labours (4 Nos) Base rate - Rs. 326*4=1304/-	day	5.7	1,304	15	19,560	Amount will be reimburse as per the notified rates for unskilled labor by the Central Labour Commissioner or respective State Govt. whichever is higher
4	Charges for one Geologist per day at HQ	day	1.2	9,000	60	5,40,000	

5	Geological Mapping, Core Logging (Charges for one Geologist per day at field)	day	1.2	11,000	120	13,20,000	
6	Labours (2 Nos) Base rate - Rs. 326*2=652/-	day	5.7	652	120	78,240	Amount will be reimbursed as per the notified rates for unskilled labour by the Central Labour Commissioner or respective State Govt. whichever is higher
7	Sampler	day	1.5.2	5,100	15	76,500	
8	Labours (4 Nos) Base rate - Rs. 326*4=1304/-	day	5.7	1,304	15	19,560	Amount will be reimbursed as per the notified rates for unskilled labour by the Central Labour Commissioner or respective State Govt. whichever is higher
9	Pitting	Cu.m	2.1.3	5,330	100	5,33,000	
						Sub Total- B	28,26,560
C GEOPHYSICAL WORK							
1	Charges for one Geophysicist per day at field	day	3.18	11,000	20	2,20,000	
2	Charges for one Geophysicist per day at HQ	day	1.2	9,000	7	63,000	
3	Self-Potential Survey (2500x500m)	Line Km	3.3a	29,600	12	3,55,200	
4	Labours (2 Nos) Base rate - Rs. 326*2=652/-	day	5.7	652	20	13,040	Amount will be reimbursed as per the notified rates for unskilled labour by the Central Labour Commissioner or respective State Govt. whichever is higher
						Sub Total- C	6,51,240
D LABORATORY STUDIES							
1	Chemical Analysis						
i)	Primary check samples						
	Primary samples for 5 radicals (Al ₂ O ₃ , SiO ₂ , FC, Ash and LOI)	Nos	4.1.1	8,157	100	8,15,700	
	X-RD Studies	Nos	4.5.1	4,000	5	20,000	
	ICPMS/ICP-AES (34 Elements Analysis) REE & Vn	Nos	4.1.14	7,731	20	1,54,620	
ii)	Check samples Internal						
	Check samples for 5 radicals (Al ₂ O ₃ , SiO ₂ , FC, Ash and LOI)	Nos	4.1.1	8,157	5	40,785	

ii)	Check samples External					
	Check samples for 5 radicals (Al ₂ O ₃ , SiO ₂ , FC, Ash and LOI)	Nos	4.1.1	8,157	10	81,570
iii)	Composite Samples					
	Check samples for 5 radicals (Al ₂ O ₃ , SiO ₂ , FC, Ash and LOI)	Nos	4.1.1	8,157	10	81,570
2	Physical Analysis					
i)	Preparation of thin section	Nos	4.3.1	2,353	5	11,765
ii)	Petrographic studies	Nos	4.3.4	4,232	5	21,160
v)	Digital Photographs	Nos	4.3.7	280	5	1,400
vi)	Density	Nos	4.8.3	1,568	5	7,840
Sub Total- D						12,36,410
Total A+B+C+D						95,68,390
E	Preparation of Exploration Proposal	One number (5 Hard copies with a soft copy)	5.1	2% of the approved project cost or 3.8 lakh whichever is lower.		1,91,368
F	Geological Report Preparation	5 Hard copies with a soft copy	5.2	For the projects having cost more than Rs. 50 lakh but less than Rs 150, A minimum of Rs. 2.5 lakh or 5% of the value of work whichever is more.		4,78,420
G	Peer review Charges	As per EC decision				10,000
H	Total Estimated Cost without GST					1,02,48,177
I	GST @18%					18,44,671.91
J	Total Estimated Cost with GST					1,20,92,849.21
Note - If any part of the project is outsourced, the amount will be reimbursed as per the Paragraph 3 of NMET SoC and Item no. 6 of NMET SoC. In case of execution of the project by NEA on its own, a Certificate regarding non outsourcing of any component/project is required.						or Say Rs. 120.93 Lakhs

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Annexure-5B

Scheduled time for Preliminary exploration (G3) for graphite around Naringapanga block (S & W) (0.143 sq. km) block, District: Rayagada, Odisha.

S. No.	Work Components	Units	1	2	3	4	5	6	7	8	9
1	Camp Setting	Days									
2	Survey Work units (Total Station survey)	Days									
3	Detailed Geological Mapping (1:2000)	Days									
4	Self-Potential Survey	Days									
5	Pitting										
6	Drilling	Months									
7	BH core Logging & Sampling	Months									
8	Sample processing & Analysis	Month									
9	Camp Winding	Days									
10	Data Analysis (DA) & Report Writing with Peer Review	Month									

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Only through e-mail

Government of India
Ministry of Mines
National Mineral Exploration Trust


F.No.6/2/2015-NMET/302

New Delhi, 30th January, 2023

Subject: Circulation of minutes of 27th meeting of the Executive Committee (EC) of National Mineral Exploration Trust (NMET) held on 10th January, 2023.

Please find enclosed the minutes of 27th meeting of Executive Committee of NMET held on 10th January, 2023 for your kind perusal.

Action Taken Report on relevant paras may kindly be forwarded to this office.


[Vivek Kumar Sharma]
Director & HoD, NMET
30.01.23

To,

1. The Secretary, Dept. of Atomic Energy, Anushakti Bhawan, C.S.M. Marg, Mumbai- 400001.
2. The Secretary, Ministry of Coal, Shastri Bhawan, New Delhi- 110001.
3. The Secretary, Ministry of Petroleum and Natural Gas, Shastri Bhawan, New Delhi-110001.
4. The Joint Secretary and Financial Advisor, Ministry of Mines, Shastri Bhawan, New Delhi-110001.
5. The Director General, Geological Survey of India, 27, J. L. Nehru Road, Kolkata-700016.
6. The Controller General, Indian Bureau of Mines, 2nd Floor, Indira Bhawan, Civil Lines, Nagpur- 440001.
7. The Principal Secretary, Mineral Resources Department, Govt. of Madhya Pradesh, Mantralaya, Vallabh Bhawan, Bhopal- 462004.
8. The Principal Secretary, Industries, Energy and Labour Dept. 114 Annex Building Mantralaya, Mumbai- 400032.
9. The Additional Chief Secretary, Department of Mines and Petroleum Main Building Secretariat, Jaipur- 302005.
10. The Additional Chief Secretary, Industries, Investment Promotion and Commerce Dept. Industries Department Secretariat, Chennai- 600009.
11. Shri Alok Sharma, (Retd.) GM &HoD (Exploration), CMPDIL, 402, Lake Garden, Kanke Road, Ranchi- 834008.
12. Shri Naresh Nautiyal, Head (Business Development & Planning) (Retd.), MECL, 109, KT Nagar, Katol Road, Nagpur- 440013.

EC Decision:

EC approved the project with estimated cost of ₹81.10 Lakh and timeline of 9 months.

(Action: NMET)

7.23 Preliminary exploration (G3) of graphite occurrence around Bandhabhuin area (1.00 sq. km), District: Dhenkanal, Odisha. [Estimated cost ₹166.17 Lakh and Scheduled Timeline- 10 months] [Implementing agency- DMG, Odisha]

Discussion:

Shri Janardan Prasad, ADG GSI & Chairman, TCC, NMET discussed the technical and financial aspect of project. He informed that 700m drilling in 10 boreholes will be carried out in both first and second level of drilling [first level (30m vertical depth) and second level (60m vertical depth)]. The second level drilling will be taken up only in case of encouraging results of first level drilling. The outcome of project will be reviewed after completion of first level drilling in six months.

EC Decision:

EC approved the project with estimated cost of ₹166.17 Lakh and timeline of 10 months.

(Action: NMET)

7.24 Preliminary exploration (G3) for graphite around Naringapanga block (S & W) (0.143 sq. km) block, District: Rayagada, Odisha. [Estimated cost ₹120.93 Lakh and Scheduled Timeline- 9 months] [Implementing agency- DMG, Odisha]

Discussion:

Shri Janardan Prasad, ADG GSI & Chairman, TCC, NMET discussed the technical and financial aspect of project. He informed that geophysical survey [Self Potential (12 Line km)] and after review of the SP survey, 400m drilling in six boreholes with 30m vertical depth for five boreholes and one borehole up to 60m will be taken. The outcome of the project will be reviewed after completion of SP survey and pitting after four months.

EC Decision:

EC approved the project with estimated cost of ₹120.93 Lakh and timeline of 9 months.

(Action: NMET)

7.25 Research project on genesis of BIF-hosted high grade Iron ores in Chhattisgarh State with special reference to geological controls on mode of occurrence of Ore Beneath ore and implications on future game changing exploration in India.[Estimated cost ₹86.59 Lakh and Scheduled Timeline- 24 months] [Implementing agency- NMDC]

	District: Gulbarga (Kalaburagi), Karnataka.				
21	Preliminary exploration (G3) for limestone, bauxite and fire clay in Piparhat-Kubri block (2.51 sq. km), District: Satna, Madhya Pradesh.	Limestone & Bauxite	G3	9	81.10
					1528.99
Implementing Agency: Directorate of Geology, Odisha					
22	Preliminary exploration (G3) of graphite occurrence around Bandhabhuin area (1.00 sq. km), District: Dhenkanal, Odisha.	Graphite	G3	10	166.17
23	Preliminary exploration (G3) for graphite around Naringapanga block (S & W) (0.143 sq. km) block, District: Rayagada, Odisha.	Graphite	G3	9	120.93
					287.10
Sub Total- A					3698.56 Lakh

B. Financial assistance projects

S. No.	Project/Block Name	Duration (Months)	Proposed cost (₹ Lakh including GST)
Implementing Agency: GSI			
1	Procurement of geophysical instruments for capacity enhancement in ground gravity-magnetic mapping of GSI.	12	7020.0
			7020.0
Implementing Agency: IBM			
2	Procurement of laboratory scale mineral processing equipments, characterization and analysis instruments for modern mineral processing laboratory, IBM, Nagpur.	12	1180.0
3	Procurement of laboratory scale mineral processing equipment's, characterization and analysis instruments for Regional Mineral Processing Laboratory, Bengaluru.	12	760.0
			1940.0
Implementing Agency: DMG, Karnataka			
4	Procurement of machinery/ laboratory equipment/instruments etc. aimed at enhancing the exploration activities.	12	417.0
			417.0
Implementing Agency: DGM, Maharashtra			
5	Procurement of machinery/ laboratory equipment/instruments etc. aimed at enhancing the	12	442.615

Ministry of Mines
National Mineral Exploration Trust
Minutes of the 63rd Technical-cum-Cost Committee (TCC) meeting held on 22nd, 26th & 27th March, 2024 through video conferencing

The 63rd meeting of Technical-cum-Cost Committee [TCC] of National Mineral Exploration Trust [NMET] was held through video conferencing under the chairmanship of Dr. S. Ravi, Dy. Director General, Geological Survey of India (DDG, GSI) and Chairman, TCC, NMET on 22nd, 26th & 27th March, 2024.

Members of TCC-NMET and representatives from MECL, NMDC, KIOCL, Karnataka, CMPDI, MPSMC, OMC, Odisha, JEMCL, Jharkhand, DMG, Rajasthan, DGM, Karnataka, DMG, Telangana, DGM, Chhattisgarh, DMG, Odisha, DGM, Assam, DGM, Mizoram, DGM, Maharashtra, CGM, Gujarat, Ecomen, Gemcokati, Geovale Services Private Limited, Kartikay Exploration and Mining Services Pvt. Ltd, Nagpur, United Exploration India Pvt Ltd, GeoExpore Pvt. Ltd have attended the meeting through their respective VC modes.

The list of participants is at Annexure-1.

Shri C. Parthasarathi, Director, GSI and Member Secretary, TCC-NMET, welcomed Dr. S. Ravi, DDG, GSI and Chairman, TCC, NMET, Members of the TCC and participants representing various Notified Exploration Agencies [NEAs] and Notified Private Exploration Agencies [NPEAs].

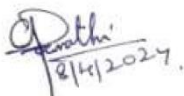
Dr. S. Ravi, DDG, GSI and Chairman, TCC extended a warm welcome to the TCC members and participants representing various Notified Exploration Agencies (NEAs) and Notified Private Exploration Agencies (NPEAs). During his opening remarks, the chairman again advised the NPEAs and NEAs to submit the proposals on time to allow members to prepare adequately for the meeting. He expressed concern about the exhaustive agenda and proposed splitting the meeting into two phases. The first phase would focus on reviewing ongoing items and items for approval in principle, while the second phase would cover the review of new proposals and the costing of approved items. Considering the comprehensive agenda, the chairman advised all agencies to be concise and precise during their presentations on ongoing items and items for approval in principle. Furthermore, the Chairman instructed all agencies to conduct field visits before formulating proposals to assess the viability of the items. With the chair's permission, Shri. Hemraj Suryavanshi, Addl. Director General (Retd.) of GSI and TCC member, recommended that all agencies avoid overlapping with areas explored by GSI and any other NEA or NPEA while preparing their proposals.

Subsequently, the proceeding of meeting was initiated as per circulated agenda.

Agenda 63.1 Review of Ongoing Projects/Completed Project & Timeline Extension

Agenda 63.1.1. Reconnaissance Survey (G-4) for tin and associated minerals in Pendra Block (110.362 sq. km), District- Gaurela-Pendra-Marwahi, Chhattisgarh [Implementing Agency: MECL]

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Agenda 63.1.24. Preliminary Exploration (G3) for graphite in Lamer-Panga Block- B (13.00 sq. Km) in Kalahandi district of Odisha. [Implementing Agency: OMC]

- a) OMC informed that the project was approved in 27th meeting of EC held on 10th January, 2023. The Sanction order was issued on 03rd February, 2023 with timeline of 14 months and approved cost ₹ 2,23,65,315/-.
- b) OMC informed that Geological mapping (1:4000 scale) has been completed over the total area of 12.994 Sq Km. Further, 30 line km of SP survey has been done in the block. On the basis of the anomalous zone from SP survey, graphite occurrences and chemical analysis result of surface samples; 05 nos. of boreholes having 35m each have been drilled. Out of these 5 borehole, the analysis result of 2 BH have been obtained and other 3 BH have been sent to laboratory.
- c) OMC requested permission to continue the drilling to intersect the graphite schist and time extension up to six months .
- d) In view of the above, the committee suggested to extend the drilling depth of the boreholes and bring the outcome for discussion in the next month TCC.

Recommendation TCC:

The committee approved to extend the drilling depth of the boreholes and bring the outcome for discussion in the next month TCC.

Agenda 63.1.25. Preliminary exploration (G3) for Manganese Hardatal block (1.38 sq. km), District: Balangir, Odisha [Implementing Agency: DGM Odisha]

- a) DGM Odisha informed that the project was approved in 25th meeting of EC held on 29th June 2022 with approved cost of ₹1.52 Crore and 9 months time duration.
- b) The 30th EC of NMET held on 6th June 2023, approved additional cost of ₹6.9 Lakhs for carrying out additional drilling of 60 m.
- c) Further, in the 32nd EC of NMET held on 6th December 2023, time extension was approved upto 31.03.2024 for the project considering the additional drilling recommended by the committee.
- d) In view of above DGM Odisha requested for time extension upto 30th June 2024 for completion of the project.

Recommendation TCC:

The Committee recommended timeline extension upto 30th June 2024 for completion of the project.

Agenda 63.1.26. Preliminary exploration (G3) for graphite around Naringapanga block (S & W) (0.143 sq. km) block, District: Rayagada, Odisha. [Implementing Agency: DGM Odisha]

- a) DGM Odisha informed that the project was approved in 27th meeting of EC held on 10th January, 2023. The sanction order was issued on 04th September, 2023 with timeline of 09 months and approved cost ₹ 1,20,92,849/-.
- b) DGM, Odisha informed that, ML area is overlapping with approved area and requested the committee for excluding ML area and including additional areas in adjacent side. Recommended to add geological and other relevant inputs of the adjoining areas and bring it to next TCC for review.

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Recommendation TCC:

The Committee directed DGM Odisha to submit the revised cost sheet along with the block boundaries after adding geological and other relevant inputs of the adjoining areas in the next TCC.

Agenda 03.1.27. Preliminary exploration (G3) of graphite occurrence around Bandhabhuin area (1.00 sq. km), District: Dhenkanal, Odisha. [Implementing Agency: DGM Odisha]

- a) DGM Odisha informed that the project was approved in 27th meeting of EC held on 10th January, 2023. Sanction order was issued on 04th September, 2023 with timeline of 10 months and approved cost ₹ 1,66,16,423/-.
- b) DGM Odisha requested for cancellation of the project as the block area falls within Eco sensitive zone of Satkosia tiger reserve.
- c) In view of the above, the committee agreed for cancellation of the project and directed DGM Odisha for submission of the 1st installment disbursed by NMET amounting to ₹ 66,46,569/- with interest.

Recommendation TCC:

The Committee recommended cancellation of the project as the block falls under eco-sensitive zone.

Agenda 03.1.28. Preliminary exploration (G3) for amalgamated limestone blocks in Jevargi area, Kalaburagi district, Karnataka (3 Blocks : Block ID : KIOCL_20_KA_KLB_08), Block ID: KIOCL_21_KA_KLB_08) & (Block ID: KIOCL_25_KA_KLB_13) [Implementing Agency: KIOCL]

- a) KIOCL informed that the project was approved in 28th meeting of EC held on 16th March, 2023. Sanction order was issued on 03rd April, 2023 with timeline of 12 months and approved cost ₹ 2,32,87,514/-.
- b) KIOCL informed exploration activities have been completed and the comments of the peer reviewer for each of the 3 blocks have been received and incorporated.
- c) Further, informed that revised cost of the project is ₹1,72,93,660/- instead of approved ₹2,32,87,515/- owing to the reduced cost in surface drilling.
- d) In view of the above, the committee suggested to submit the revised cost sheet for the project and agreed for GR submission.

Recommendation TCC:

The Committee agreed for the submission of GR and suggested to submit the revised cost sheet for the project.

Agenda 03.1.29. Reconnaissance Survey (G-4) for polymetallic mineralization (Au,Cu,Ni,Co) in Dharwar Shimoga Schist Belt of Nagavanda area Dhavangere, Haveri and Shimoga District, Karnataka (Block area- 03.02 sq. km) [Implementing Agency: KIOCL]

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8/4/2024

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08/04/2024

Ministry of Mines
National Mineral Exploration Trust
Minutes of the 64th Technical-cum-Cost Committee (TCC) meeting held on 25th, 29th & 30th
April, 2024 through video conferencing

The 64th meeting of Technical-cum-Cost Committee [TCC] of National Mineral Exploration Trust [NMET] was held through video conferencing under the chairmanship of Dr. S. Ravi, Dy. Director General, Geological Survey of India (DDG, GSI) and Chairman, TCC, NMET on 25th, 29th & 30th April, 2024.

Members of TCC-NMET and representatives from Geological Survey of India, MECL, KIOCL, Karnataka, CMPDI, MPSMC, OMC, Odisha, DMG, Rajasthan, DGM, Karnataka, DMG, Telangana, DGM, Chhattisgarh, DMG, Odisha, DGM, Assam, DGM, Mizoram, DGM, Maharashtra, DGM, Assam, DGM, Madhya Pradesh, DGM, Nagaland, DGM, J&K, Gemcokati Exploration Pvt. Ltd, Maheshwari Mining Pvt. Ltd, Geovale Services Private Limited, United Exploration India Pvt Ltd, GeoMarine Solutions Pvt. Ltd, GeoExpore Pvt. Ltd, Novamine India Pvt Ltd, V. M. Salgaocar and Brother Pvt Ltd, have attended the meeting through their respective VC modes.

The participants are listed in Annexure-1.

Shri C. Parthasarathi, Director, GSI and Member Secretary, TCC-NMET, welcomed Dr. S. Ravi, DDG, GSI and Chairman, TCC, NMET, Members of the TCC and participants representing various Notified Exploration Agencies [NEAs] and Notified Private Exploration Agencies [NPEAs].

Dr. S. Ravi, DDG, GSI and Chairman, TCC extended a warm welcome to the TCC members and participants representing various Notified Exploration Agencies (NEAs) and Notified Private Exploration Agencies (NPEAs). During his opening remarks, the chairman recommended that all NEAs and NPEAs adhere to a standard colour code when preparing geological maps. He emphasized the importance of agencies proposing items based on their manpower capabilities to ensure high-quality outputs. Additionally, he instructed all the agencies to clearly indicate in-house and outsourced components when submitting new project proposals.

Subsequently, the proceeding of meeting was initiated as per circulated agenda.

Agenda 64.1 Review of Ongoing Projects/Completed Project & Timeline Extension

Agenda 64.1.1. Reconnaissance Survey (G4 stage) for Lithium and Potassium in Merak Block (114.19 sq. km), Districts- Leh, Ladakh (UT) [Implementing Agency: MECL]

- a) MECL informed that the project was approved in the 23rd EC Meeting held on 16th March, 2022. Sanction order was issued on 25th March, 2022 with timeline of 24 months and approved cost was INR Rs. 2,13,04,062/-.
- b) MECL informed that the comments of the peer reviewer have been incorporated and the GR is ready for submission.

CP Parthasarathi
16/5/2024

Dr. S. Ravi
06/05/2024

- d) The committee after the review, opined that planning of boreholes needs to be done with the diligent understanding on the structure of the block.
- e) The committee deliberated on the matter and suggested modifications before drilling inclined boreholes. The project is to be brought for review in the next TCC.

Recommendation TCC:

The Committee recommended inclined boreholes in the area and asked review of the project in next TCC.

Agenda 64.1.11. Reconnaissance Survey (G-4) for Manganese ore in Taljuri- Gunchadihi Block (80.00 sq. km), Balangir District, Odisha.

[Implementing Agency: MECL]

- a) MECL informed that the project was approved in 27th EC Meeting held on 10th January, 2023. Sanction order was issued on 03rd February, 2023 with timeline of 14 months and approved cost of INR Rs.1,66,59,625/-.
- b) MECL informed that geophysical activities completed and trenching work is in progress. Time period completed on 02.04.2024
- c) MECL sought approval for time extension required 05 months i.e up to 02.09.2024 for trenching, drilling and other associated works.

Recommendation TCC:

The Committee recommended timeline extension upto 31st August 2024 and asked MECL to submit justification for the delay to NMET Secretariat at the earliest.

Agenda 64.1.12. Preliminary exploration (G3) for graphite around Naringapanga block (S & W) (0.143 sq. km) block, District: Rayagada, Odisha.

[Implementing Agency: DGM Odisha]

- a) DGM Odisha informed that the project was approved in 27th meeting of EC held on 10th January, 2023. Sanction order was issued on 04th September, 2023 with timeline of 09 months and approved cost ₹ 1,20,92,849/-.
- b) In the 63rd TCC meeting, revision of area was discussed. The Committee directed DGM Odisha to submit the revised cost sheet along with the block boundaries after adding geological and other relevant inputs of the adjoining areas.
- c) DGM Odisha informed that, in the 27th EC, approval was given for 14.326 Ha (0.143 Sq.km). However, the total revised area is 57 Ha (overlap area- 8.5 Ha).
- d) It was also informed that as per approval, 12 line Km was covered by Self-potential data gathered in 25m x 10m grid pattern over 641 station points.
- e) DGM Odisha sought permission for revised area of 57 km, completion of geological mapping and topographic survey in additional 48.5 Ha & Geophysical survey 48.5 Ha with additional timeline for 60 days with additional cost of Rs.26,50,233/-.

GP Panthi
10/5/2024

San
06/05/2024

- f) The committee opined that the additional area may be taken up as new project. Committee suggested to carry out drilling (6 bhs) and complete the project in the already approved area (as per 27th EC) within the allocated cost.

Recommendation TCC:

The Committee recommended drilling of boreholes and completion of project as already approved. The committee did not approve additional area.

Agenda 64.1.13. Preliminary exploration for coal in West of ChahnoRikba block North Karanpura CF Jharkhand.

[Implementing Agency: CMPDI]

- a) CMPDI informed that the project was approved in 24th meeting of EC held on 18th May, 2022. Sanction order was issued on 02nd June, 2022 with timeline of 12 months and approved cost ₹ 3,74,86,303/-.
- b) CMPDI informed that the project has been completed and requested for time extension of 1 month up to 30th April 2024 for GR submission.

Recommendation TCC:

The Committee recommended time extension upto 30th April 2024 for GR submission

Agenda 64.1.14. Preliminary exploration for coal in North of Saoner block, Kamptee Coalfield, Kamptee CF, Maharashtra.

[Implementing Agency: CMPDI]

- a) CMPDI informed that the project was approved in 27th meeting of EC held on 10th January, 2023. Sanction order was issued on 03rd February, 2023 with timeline of 14 months and approved cost of ₹ 2,65,01,074/-.
- b) CMPDI presented the progress of the project and sought for time extension up to 2nd July 2024 for GR submission.

Recommendation TCC:

The Committee recommended noted the progress of the project and approved time extension upto 2nd July 2024.

Agenda 64.1.15. Reconnaissance Survey for Coal in Khapia block, North Karanpura CF Jharkhand.

[Implementing Agency: CMPDI]

- a) CMPDI informed that the project was approved in 28th meeting of EC held on 16th March, 2023. Sanction order was issued on 03rd April, 2023 with timeline of 12 months and approved cost of ₹ 1,61,48,115/-.
- b) CMPDI informed that the project has been delayed due to non-receipt of forest clearance and sought time extension for 6 months.

Pranathi
16/5/2024

San
06/05/2024

**Ministry of Mines
National Mineral Exploration Trust**

**Minutes of the 37th Executive Committee (EC) meeting of National Mineral
Exploration Trust (NMET) held on 23rd September, 2024 at Khanij Kaksh,
Shastri Bhawan, New Delhi**

The 37th meeting of Executive Committee (EC) of NMET was held under Chairmanship of Shri V. L. Kantha Rao, Secretary, Mines/Chairman EC on 23rd September, 2024 at Shastri Bhawan, New Delhi in hybrid mode. The list of participants is given in Annexure-1.

Shri Sanjay Lohiya, Addl. Secretary, Mines welcomed all the members, invitees and other participants in the meeting. Smt. Geetika Sharma, Deputy Secretary & HoD, NMET presented the agenda points for the meeting. The details of agenda points discussed and decisions taken in the meeting are given below:

Agenda 37.1: Approval of minutes of 36th Meeting of EC held on 29th July, 2024.

The minutes of the 36th EC meeting were circulated on 13th August, 2024. No comments were received from the members.

Decision of EC: EC approved the minutes of the 36th Executive Committee (EC) meeting of National Mineral Exploration Trust (NMET).

Agenda 37.2: Action Taken Report (ATR) for minutes of 36th EC meeting.

EC was briefed on the action taken on decisions taken during the 36th EC meeting. Action on all the 10 actionable points has been completed.

Regarding the observation of Secretary, Mines during the 35th EC meeting to explore the strategies to fund offshore exploration, the house was apprised that the matter was referred to Department of Legal Affairs (DoLA) for advice. DoLA has suggested few amendments/changes in the MMDR act to fund offshore mineral exploration projects from NMET. Presently, the matter is being examined by Policy Section. The house was also informed that agenda for the workshop on Exploration License has been approved and the workshop would be organized at a suitable date.

Decision of EC: (i) Chairman, EC directed to organize the workshop on Exploration License scheme.

(ii) EC accepted the Action Taken Report on the minutes of 36th EC meeting.

2	Reconnaissance Survey (G-4) for Gold in Yediyur area, Yediyur-Karighatta Schist Belt, Mandya District, Karnataka. [68th TCC]	KIOCL	1,29,16,573/- (~129.57 lakhs)	41,840/- (129.58 lakhs)	Analysis of 20 nos samples were carried out in IBM@Rs. 4900/-* per sample which is higher than the approved SoC cost (Rs 2808/-*)
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* Amount is inclusive of GST/-

Decision of EC: EC approved the additional cost of the ongoing project at Sl. No. 1. Further, EC directed that additional cost of the ongoing project at Sl. No. 2 will be approved after completion of the project.

[Action: NMET]

Agenda 37.9: Approval of Extension of timeline for ongoing projects recommended by TCC

TCC in its 67th meeting held on 24th, 25th and 26th July, 2024 and 68th meeting held on 28th, 29th & 30th August, 2024 recommended the following 23 ongoing projects for extension of timeline for approval of EC:

S. No.	Block/Project	Agency	Schedule date of completion	Required timeline (up to)	Remarks
1	Reconnaissance survey (G4) for Tin in Pokhar-Chhaili Block, District, Tehri-Garhwal, Uttarakhand. [67th TCC]	MECL	30.6.2024	31.8.2024 (2 months)	For GR submission
2	Reconnaissance survey (G4) for REE and Rare Metals in Khairlanji Block, District-Balaghat and Seoni, Madhya Pradesh. [67th TCC]	MECL	31.05.2024	31.08.2024 (3 months)	For GR preparation
3	Preliminary exploration for coal in North of Rajathari block, Pench Kanhan Tawa valley CF, Madhya Pradesh [67th TCC]	CMPDI	1.08.2024	31.10.2024 (3 months)	For GR sample analysis of additional samples
4	Reconnaissance Survey (G4) for graphite in Lamer-	OMC	20.02.2024	15.09.2024 (7 months)	For GR preparation

	Panga area (40.084 sq. Km) in Kalahandi district of Odisha. [67th TCC]				
5	Preliminary exploration (G3) for Graphite around Naringapanga Rayagada district, Odisha	DGM Odisha	03.06.2024	3.11.2024 (5 months)	Additional 1.35 LKm SP Survey
6	Reconnaissance Survey (G4) for PGE, Gold & REE in Maneri-Sitapala area, Balaghat District, MP. [67th TCC]	DGM Maharashtra (M/s GemcoKati Exp. Pvt. Ltd.)	31.07.2024	31.12.2024 (5 month)	Delay in forest clearance
7	Reconnaissance Survey (G4) for PGE, Vanadium & associated minerals in Bhursadongari-Murum area (100 Sq Km), Balaghat District, Madhya Pradesh. [67th TCC]	M/s GemcoKati Exp. Pvt. Ltd.	12.09.2024	31.12.2024 (3.5 months)	
8	Reconnaissance survey for Iron Ore in Lengupara area, District: Goalpara, Assam. [67th TCC]	DGM, Assam	30.04.2024	31.07.2024 (3 months)	For GR preparation
9	Reconnaissance Survey (G4 Stage) for Graphite in Nawadih Block (32.04 sq.km.), District: Balrampur, State: Chhattisgarh. [67th TCC]	UEIPL	31.5.2024	30.11.2024 (6 months)	Sampling and GR preparation
10	Reconnaissance Survey (G-4) for REE in Sarnu Block (118.10 sq. km), Barmer District, Rajasthan. [68th TCC]	MECL	31.08.2024	30.09.2024 (1 month)	GR Submission
11	Reconnaissance Survey (G-4 Stage) for Phosphorite in Kathyur Block (9.0 Sq. Km) Districts- Dehradun, Uttarakhand [68th TCC]	MECL	31.07.2024	15.09.2024 (1.5 months)	GR Submission
12	Reconnaissance survey (G4) for Polymetals (Cu, Au, Ag) in Miregaon block (40.769 sq. km), Districts: Bhandara and Gondiya, Maharashtra. [68th TCC]	MECL	15.08.2024	15.09.2024 (1 months)	GR Submission
13	Reconnaissance survey for PGE, Nickel, Cobalt and Gold	MECL	31.08.2024	15.10.2024 (1.5 months)	GR Submission

Ministry of Mines
National Mineral Exploration Trust
Minutes of the 70th Technical-cum-Cost Committee (TCC-I) meeting held on
24th and 25th October, 2024 through video conferencing

The 70th meeting of the Technical-cum-Cost Committee-I (TCC-I) of the National Mineral Exploration Trust (NMET) was held via video conferencing under the chairmanship of Dr. S. Ravi, Deputy Director General (DDG), Geological Survey of India (GSI) and Chairman, TCC, NMET, on 24th and 25th October 2024.

Members of TCC-I, NMET and representatives from DGM, Chhattisgarh, DMG Karnataka, DMG Goa, DMG, Odisha, CSIR-IMMT, MECL, KIOCL, Bhushilp Mine and Minerals, OMC, , Mining Tech Consultancy Services Ltd, DMG Maharashtra, , Gemcokati, , GeoMarine, Indian Mine Planner and Consultant, Geo Technical Mining Solutions, Critical Mineral Trackers, , Kartikay Exploration and Mining Services private Limited, Geo Exploration and Mining Solution, Tata Steel Ltd, Maheshwari Mining Pvt Ltd and PRB Infra have attended the meeting through their respective VC modes. The list of participants is enclosed in Annexure-1.

Shri C. Parthasarathi, Director, GSI and Member Secretary, TCC-I, NMET, welcomed Dr. S. Ravi, DDG, GSI and Chairman, TCC, NMET, Members of the TCC and participants representing various Notified Exploration Agencies (NEAs) and Notified Private Exploration Agencies (NPEAs).

Dr. S. Ravi, Chairman of TCC-I, NMET, extended a warm welcome all TCC members and participants representing various NEAs and NPEAs. In his opening remarks, he suggested that all NEAs and NPEAs should complete the G4 items within 10 months as instructed by Ministry of mines and also focus more on critical and strategic commodities instead of bulk minerals like limestone, dolomite, iron ore etc.

Subsequently, the proceedings of meeting were initiated as per circulated agenda

Agenda 70.1: Technical evaluation of new project proposals

Agenda 70.1.1. Preliminary Exploration (G-3) for Chromite around Umundira & Kateni areas, Dhenkanal and Jajpur Districts, Odisha.
[Implementing Agency: DMG, Odisha]

- a. The study area is NW extension of Sukinda ultramafic complex of Odisha, Jajpur and forms a part of Iron Ore Supergroup.
- b. During the field season of 1999-2001, petrographic study conducted by DoMG, Odisha identified disseminations and stringers of chromite within the ultramafic rocks of the Umundira Valley.
- c. The findings reported Cr₂O₃ content ranging from trace amounts up to 8.21% in in-situ soil and trace to 15.87% in laterite, suggesting a promising potential for further exploration at G3 level.


06/11/2024


06/11/2024

- c) The committee noted the peer reviewer comments and suggested DMG, Odisha to submit the IPR compliance report in table format and recommended time extension upto 15th November 2024 for submission of GR.

Recommendation of TCC:

The Committee agreed for submission of GR and recommended time extension upto 15th November 2024 .

Agenda 70.2.14. Preliminary exploration (G3) for graphite around Naringapanga block (S & W) (0.143 sq. km) block, District: Rayagada, Odisha.

[Implementing Agency: DMG Odisha]

- a) DMG Odisha informed that the project was approved in the 27th EC Meeting held on 10th January, 2023. The sanction order was issued on 04th September, 2023 with timeline of 09 months and approved cost was INR 1,20,92,849/-.
- b) DMG Odisha reported that the block was reviewed during the 64th TCC meeting on April 25, 2024. In the 37th EC of NMET held on 23rd September 2024, time extension upto 4.11.2024 was approved. The committee was apprised that drilling has been completed in the block and three months' time is required to execute the additional work like check sample analysis, preparation of GR etc
- c) The committee reviewed the project and suggested DMG, Odisha to expedite the chemical analysis and submit the GR for review in the next TCC-I meeting. Besides also recommended for timeline extension upto 31st December 2024.

Recommendation of TCC:

The Committee recommended for time extension upto 31st December 2024 for GR submission

Agenda 70.2.15. Reconnaissance Survey (G4) for Gold in Yedyur area, Yedyur - Karighatta schist belt, Mandya district, Karnataka

[Implementing Agency: KIOCL]

- a) KIOCL informed that the project was approved in the 33rd EC Meeting held on 19th February, 2024. The sanction order was issued on 28th February, 2024 with timeline of 10 months (up to 27.12.2024) and approved cost was INR 1,29,16,573/-.
- b) KIOCL informed that Detailed LSM work was completed over 50.00 Sq.km at 1:12,500 scale. Total 100nos of BRS and 55 nos of trench samples have been collected. Primary analysis of 100 samples for Au content by Fire Assay method the 21 samples have resulted 0.06 to 1.29 g/t.
- c) Detailed sampling was carried out in zone 2 (BRS, channel and trenching). KIOCL requested approval to carry out drilling work (500m) in 5 Scout boreholes indicated locations in BIF gold potential zones.(03 boreholes in Zone II and 1 borehole each in Zone III and Zone IV) .
- d) It was apprised that 03 BH's falling in private land and 02 BH's falling in Hatna reserved forest area. If the committee approved, KIOCL will submit the request to State forest dept. for grant of forest permission for drilling work.
- e) The committee noted the outcome and suggested KIOCL to initiate drilling across the potential zone along the profiles with anomalous values.

Recommendation of TCC:

The Committee recommended KIOCL to initiate drilling across the potential zone.


06/11/2024


06/11/2024