

STRICTLY RESTRICTED
FOR COMPANY USE ONLY

RESTRICTED
THE INFORMATION GIVEN IN THIS REPORT
SHOULD NOT BE PUBLISHED WITHOUT
PERMISSION OF THE CLIENT AND CMPDI.

**PRELIMINARY EXPLORATION (G₃)
REPORT FOR
MAGNETITE AND ASSOCIATED
MINERALS IN
PIPRADIH AREA (7 SQ KM)
DISTRICT- GIRIDIH (JHARKHAND)**

TEXT

AUGUST- 2026

**GEOLOGY DEPARTMENT
REGIONAL INSTITUTE – II
DHANBAD, JHARKHAND**



CMPDI

(A Subsidiary of Coal India Ltd.)

Draft Report for Preliminary Exploration (G3) for magnetite and associated minerals in Pipradih area, District: Giridih, Jharkhand

Content

Chapter No	Title	Page No.
1	Executive Summary	6-8
	Executive Summary (English)	6-7
	Executive Summary (Hindi)	7-8
2	Introduction	9-16
2.1	Investigating Agency	10
2.2	Objectives of investigation	10-11
2.3	Basis for taking up investigation	11-12
2.4	Nature and Quantum of work proposed vs. achievement	12-14
2.5	Personnel involved	14-15
2.6	Mode of Operation and Associated Agencies	15-16
3	Property Description	17-23
3.1	Village Name, District and State	17
3.2	Survey of India Toposheet No.	18
3.3	Geo-Coordinates of the Investigated Area	18
3.4	Land Use/Cover and Forest	18
3.5	Freehold/Leasehold Details	18-19
3.6	Location and Accessibility	20
3.7	Climate	21
3.8	Flora and Fauna	21
3.9	Geomorphology	21-22
3.10	Local Infrastructure	22-23
3.11	Population	23
3.12	Archaeological, Historical sites and Environment	23

4	Previous Work	24-25
4.1	Details of Previous Geological mapping	24
4.2	Details of Previous Geophysical Investigation	24
4.3	Details of Previous Exploration/ Investigation	24-25
5	Geology of the Area	26-31
5.1	Aerial Reconnaissance	26
5.2	Regional Geological Setup	27-30
5.2.1	Regional geological set up and stratigraphy	27-29
5.2.2	Regional structure	29
5.2.3	Metamorphism in the region	29-30
5.3	Surface Indication of mineralisation in the region	30-31
6	Activity During the Period	32-71
6.1	Geological Mapping	33-46
6.2	Geophysical Exploration	46-60
6.3	Geochemical Exploration	60-61
6.4	Topographic Survey	62-67
6.5	DGPS Survey	67-70
7	Integration of Geology, Geophysics and Geochemical investigation and Interpretation	71-72
8	Mineral Prospect	73-74
8.1	Surface Indication	73
8.2	Mode of occurrence	73
8.3	Strike length and width	73-74
8.4	Alteration Zone	74
8.5	Genesis of mineralisation	74
9	Exploration by scout drilling	75-80
9.1	Methodology of drilling	75-76

		CMPDI
9.2	Borehole Planning	76-77
9.3	GP Logging	77
9.4	Mineralogy of the Ore Zone	77-78
9.5	Borehole deviation test	78
9.6	Ore zone sampling and sample preparation	78-79
9.7	Chemical Analysis and Laboratory Procedures	79
9.8	Details of intersected ore zones and correlation.	79
9.9	Depth of Ground water	80
10	Geotechnical Studies	81
11	Resource Estimation	82-91
11.1	Introduction	82
11.2	Detailed description of ore zones with core recovery	82
11.3	Cut of grade consideration	83
11.4	Minimum stoping width consideration	83
11.5	Correlation of ore lodes	83
11.6	Description of lodes	83-84
11.7	Assumptions for resource estimation	84-85
11.8	Methodology of ore resource estimation	85-89
11.9	Category of resources/reserve as per UNFC classification	89-91
12	Core Preservation	92
13	Conclusion and recommendation	93
14	Expenditure	94-96
15	References	97-98
16	Locality Index	99

List of Annexure

Annexure	Title	Page No.
Annexure-IA	UTM Coordinates of Bed Rock Sample (BRS)	100
Annexure-IB	UTM Coordinates of Bed Rock Sample (BRS)	101
Annexure-IC	UTM Coordinates of Trenches in Pipradih Area,	101
Annexure-IIA	Major Oxide Analysis of Bed Rock Sample (BRS)	102-103
Annexure-IIB	Major Oxide Analysis of Magnetite Bed Rock Sample (BRS)	103-104
Annexure-IIC	Major Oxide Analysis of Trench Samples	105-107
Annexure-IIIA	Petrographic Study Result of Bed Rock Sample (BRS)	108-109
Annexure-IIIB	Mineragraphic Studies of Bed Rock Sample (BRS)	110-111
Annexure-IVA	Summarized Litholog of boreholes	112-120
Annexure-IVB	Run-wise RQD details of boreholes	121-124
Annexure-V	List of Drill Core Samples Sent for Analysis	125-127
Annexure-VIA	Major Oxide Analysis of Drill Core Samples	128-132
Annexure-VIB	Trace Element Analysis of Drill Core Samples	133-137
Annexure-VIC	Petrographic and Mineragraphic study result of Drill Core Samples	138-139

List of Plates

Plate No	Plate Name
Plate-I	Location Plan
Plate-II	Topographic Plan
Plate-III	Outcrop Plan
Plate-IV	Geological Plan
Plate-V	Geomorphological Plan
Plate-VI	LULC Plan
Plate-VII	Depth Solution Plan
Plate-VIII	Trench Section
Plate-IX	Borehole Litholog
Plate-X	Cross Section Plan for Resource Estimation
Plate-XI	LV Section Plan for Cobalt & Tungsten

Chapter-1

Executive Summary

Preliminary Exploration (G3) Report for Magnetite and Associated Minerals in Pipradih Area (7 sq km), Giridih District, Jharkhand was taken up by CMPDI vide NMET sanction order F.No. 23/544/2024-NMET/599, Dated: 13th December 2024 to evaluate the magnetite potential and associated mineralisation in the Pipradih area located within the western extension of the Hesatu–Belbathan polymetallic belt of the Chhotanagpur Gneissic Complex. The area has a history of small-scale base-metal occurrences in earlier investigations by GSI and MECL.

The area is dominated by granite gneiss with enclaves of quartz-mica schist, amphibolite/hornblende schist, calc-magnesian schist and quartzite. Magnetite is mainly associated with garnetiferous quartz-biotite schist and calc-magnesian rocks, commonly accompanied by pyrite, chalcopyrite and other sulphides. The formations strike predominantly WNW–ESE and are steeply dipping, indicating strong structural control.

Objective of exploration was to delineate magnetite-bearing formations through detailed geological mapping and ground magnetic survey; to identify structural and lithological controls on mineralisation; to undertake geochemical sampling, trenching and exploratory drilling; and assess the potential for UNFC-compliant resources, where feasible.

Completed work included 1:4,000 scale geological mapping over 7 sq km, 26.1 line-km magnetic survey, bedrock sampling, petrographic and mineragraphic studies, trenching (50 m³), and four exploratory boreholes with 243 m of core drilling. DGPS survey and laboratory investigations were also completed.

Surface mapping confirmed multiple magnetite occurrences near old mine workings. Magnetic survey, geological observations and geochemical results indicate localized magnetite mineralisation associated with hydrothermal activity and metamorphic processes. Drilling intersected magnetite-bearing zones but indicates discontinuous and lensoidal mineralisation.

The exploration has established favourable geological conditions for magnetite and associated polymetallic mineralisation within the Pipradih block. Although the present

G3 investigation confirms the occurrence of magnetite, the available drilling density is insufficient to define a continuous economic ore body across the area. The integrated geological, geophysical and geochemical datasets provide a sound basis for identifying priority targets.

A detailed investigation over identified anomaly zones specially near borehole SPPM-3 through closer-spaced drilling, detailed structural studies and expanded geophysical surveys is recommended. Special emphasis may be placed on zones where magnetite is spatially associated with sulphide mineralisation to evaluate the potential for iron as well as critical and base metals.

कार्यकारी सारांश

प्रारंभिक अन्वेषण (G3) रिपोर्ट, पिपराडीह क्षेत्र (7 वर्ग किमी), जिला गिरिडीह, झारखंड में मैग्नेटाइट और संबद्ध खनिजों के लिए छोटानागपुर नीसिक कॉम्प्लेक्स की हेसातु-बेलबाथन बहुधात्विक पट्टी के पश्चिमी विस्तार में स्थित पिपराडीह क्षेत्र में मैग्नेटाइट क्षमता और संबद्ध खनिजीकरण का मूल्यांकन करने के लिए एनएमईटी के तहत की गई थी। जीएसआई और एमईसीएल द्वारा किए गए पूर्व अन्वेषणों में इस क्षेत्र में छोटे पैमाने पर बेस-मेटल की उपस्थिति का इतिहास रहा है।

यह क्षेत्र क्वार्ट्ज-मायका शिस्ट, एम्फिबोलाइट/हॉर्नब्लेंड शिस्ट, कैल्क-मैग्नेशियन शिस्ट और क्वार्ट्जाइट के एनक्लेव के साथ मुख्य रूप से ग्रेनाइट नीस द्वारा शासित है। मैग्नेटाइट मुख्य रूप से गार्नेटिफेरस क्वार्ट्ज-बायोटाइट शिस्ट और कैल्क-मैग्नेशियन चट्टानों से जुड़ा हुआ है, जिसके साथ आमतौर पर पाइराइट, चालकोपाइराइट और अन्य सल्फाइड मौजूद रहते हैं। यहाँ की संरचनाएँ मुख्य रूप से पश्चिम-उत्तर-पश्चिम से पूर्व-दक्षिण-पूर्व दिशा में स्थित हैं और तीव्र ढलान वाली हैं, जो मजबूत संरचनात्मक नियंत्रण को दर्शाती हैं।

अन्वेषण का उद्देश्य विस्तृत भूवैज्ञानिक मैपिंग और ज़मीनी चुंबकीय सर्वेक्षण के माध्यम से मैग्नेटाइट-युक्त संरचनाओं को चिह्नित करना; खनिजीकरण पर संरचनात्मक और लिथोलॉजिकल नियंत्रणों की पहचान करना; भू-रासायनिक नमूने एकत्र करना, ट्रेसिंग और खोजपूर्ण ड्रिलिंग करना; तथा जहाँ संभव हो, यूएनएफसी-मानकों के अनुसार संसाधनों की क्षमता का आकलन करना था।

पूर्ण किए गए कार्यों में 7 वर्ग किमी क्षेत्र में 1:4,000 पैमाने पर भूवैज्ञानिक मैपिंग, 26.1 लाइन-किमी चुंबकीय सर्वेक्षण, बेड्रॉक सैंपलिंग, पेट्रोग्राफिक और मिनराग्राफिक अध्ययन, ट्रेचिंग (50 घन मीटर), और 243 मीटर कोर ड्रिलिंग के साथ चार खोजपूर्ण बोरहोल शामिल थे। डीजीपीएस सर्वेक्षण और प्रयोगशाला जांच भी पूरी की गई।

सतही मैपिंग ने पुरानी खदानों के पास कई स्थानों पर मैग्नेटाइट की उपस्थिति की पुष्टि की। चुंबकीय सर्वेक्षण, भूवैज्ञानिक अवलोकनों और भू-रासायनिक परिणामों से पता चलता है कि यहाँ हाइड्रोथर्मल गतिविधि और कायांतरित प्रक्रियाओं से जुड़ा स्थानीयकृत मैग्नेटाइट खनिजीकरण मौजूद है। ड्रिलिंग के दौरान मैग्नेटाइट-युक्त क्षेत्र तो मिले, लेकिन यह असतत और लेंस के आकार में खनिजीकरण को दर्शाता है।

अन्वेषण ने पिपराडीह ब्लॉक के भीतर मैग्नेटाइट और संबद्ध बहुधात्विक खनिजीकरण के लिए अनुकूल भूवैज्ञानिक स्थितियों की स्थापना की है। यद्यपि वर्तमान G3 जांच मैग्नेटाइट की उपस्थिति की पुष्टि करती है, लेकिन पूरे क्षेत्र में एक निरंतर आर्थिक अयस्क निकाय को परिभाषित करने के लिए उपलब्ध ड्रिलिंग घनत्व अपर्याप्त है। एकीकृत भूवैज्ञानिक, भूभौतिकीय और भू-रासायनिक डेटासेट प्राथमिकता वाले लक्ष्यों की पहचान करने के लिए एक मजबूत आधार प्रदान करते हैं।

विशेष रूप से बोरहोल SPPM-3 के निकट पहचाने गए विसंगति क्षेत्रों पर सघन ड्रिलिंग, विस्तृत संरचनात्मक अध्ययन और विस्तारित भूभौतिकीय सर्वेक्षणों के माध्यम से विस्तृत जांच की सिफारिश की जाती है। उन क्षेत्रों पर विशेष जोर दिया जा सकता है जहाँ मैग्नेटाइट स्थानिक रूप से सल्फाइड खनिजीकरण से जुड़ा हुआ है, ताकि लोहे के साथ-साथ महत्वपूर्ण और आधार धातुओं की क्षमता का मूल्यांकन किया जा सके।

Chapter-2

Introduction

Iron, the metal of common man has its use in every sphere of life. It forms the backbone of the industrial growth of a nation. As a foundational material for technological innovation, iron has historically functioned as a critical driver of civilizational progress, shaping the structural and economic evolution of human societies. The transition from the Bronze Age to Iron Age is arguably the most transformative technological leap in human history. Magnetite (Fe_3O_4), the most magnetic of all the naturally occurring iron oxides has been inseparably associated with journey of human civilization. Due to its high iron content (up to 72%), it serves as a primary ore of iron worldwide along with hematite. In the 21st century, critical importance of magnetite has expanded spanning across several key fields like metallurgy, heavy media separation, medicine, environmental science etc.

Chhotanagpur Gneissic Complex (CGC), due to its history of intense polyphase magmatism, high-grade metamorphism and hydrothermal activity, is emerging as a significant potential region of magnetite reserves. Hesatu-Belbathan polymetallic mineralized belt is located within Chhotanagpur Gneissic Complex. It is highly regarded for its medium to small sized hydrothermal base-metal deposits commonly hosted within calc-silicate rocks. Magnetite formed under high-temperature hydrothermal alteration if also associated with the base-metal sulfide mineralization of Hesatu-Belbathan belt makes an interesting potential of a poly-metallic ore deposit.

Pipradih and Kusmarja areas are situated within the western extension of Hesatu-Belbathan polymetallic mineralized belt (SOI Toposheet No. 72 H/16). Localized, detached pockets of base metal deposits and magnetite in and around these areas have already been reported and intermittently mined since colonial era.

The present investigation entitled “Preliminary Exploration (G3) for Magnetite and associated minerals in Pipradih Area (7.00 Sq km), District: Giridih, Jharkhand” was taken up by CMPDI vide NMET sanction order F.No. 23/544/2024-NMET/599, Dated: 13th December 2024.

2.1. Investigating Agency

Name: Central Mine Planning & Design Institute Limited (CMPDI)

Address: Gondwana Place, Kanke Road
Ranchi-834031

Telephone: +91 651 2230483

Email id: gmexpl.cmpdi@coalindia.in

CMPDI is a Government of India enterprise having its corporate headquarters at Ranchi in India. It is a subsidiary of Coal India Limited (CIL) and a Schedule-B company. It is a Mini Ratna (Category I) company since June 2019 and ISO 9001 certified since March 1998.

In 1972, CMPDI was originally conceived and proposed by a joint study group with Polish experts as a comprehensive planning set-up under one roof for entire Indian mining industry, which was then operating on a rudimentary planning system. This was also the time when Indian coal-industry was being nationalized to enable it to support the high growth of energy sector required for speedy industrial growth of the country in the coming years.

At present CMPDI operates its mine planning, exploration and allied activities through seven regional offices (RI-I to VII) in Asansol, Dhanbad, Ranchi, Nagpur, Bilaspur, Singrauli and Bhubaneswar and numerous drilling camps. The field activity for the present work has been executed by CMPDI RI-III, Ranchi and CMPDI RI-II, Dhanbad.

2.2. Objectives of investigation

the present exploration program has been formulated to fulfil the following objectives.

- To find out the potential zone of Magnetite mineralization.
- To carry out geological mapping on 1:4,000 scale & Ground Geophysical Survey (Magnetic survey) to demarcate the rock types of Magnetite bearing formations with the structural features to identify the surface

manifestations and lateral disposition of the ore body.

- To collect surface samples to analyze them for Magnetite to decide further course of exploration program.
- To undertake trenching across the potential ore body for estimation of its thickness and quality.
- To ascertain depth continuity of potential ore body by drilling select number of boreholes.
- To estimate Resources of magnetite and associated minerals, if any as per UNFC norms and Minerals (Evidence of Mineral Contents) Rules 2015 and Minerals (Evidence of Mineral Contents) Amendment Rules 2021 restricted to 1st level of intersection.

2.3. Basis for taking up investigation

The area under investigation falls within the western part of the Hesatu-Belbathan polymetallic mineralised belt. Hesatu-Belbathan belt is an NE-SW trending prominent, narrow polymetallic mineralization tract that spans an extensive linear distance of about 250 km across the eastern part of the Chhotanagpur gneissic complex. Numerous Small bands of limestones, calciphyres, tremolite-actinolite schists, calc-silicate rocks, quartzites, bedded chert and amphibolites containing beds of magnetite and sulfide mineralization, occur in a country of granitic gneiss of this belt (Mohanty, 2023). These Archean to lower Proterozoic litho-units form the basement of Chhotanagpur Gneissic complex and are clubbed as “Unclassified Metamorphics” (Srivastava, 1956 & 1960). Many old mine workings and small pockets of base metal deposits are located within these litho-units, for example: Hesatu, Baraganda, Jalakdiha, Chandio, Kusmarja, Pipradih, Chakripahari, Baghmari, Bhorsar, Khajuria, Toolsitanr, Belbathan etc.

Earlier Test drilling near Kusmarja old quarry (within present area of investigation) by GSI during 1967-70 indicated thin veins of magnetite associated with Quartz-mica schist with minor pyrite and chalcopyrite (Kar & Guha, 1970). MECL during Reconnaissance survey (G-4 level) for Copper, Lead and Zinc in Kusmarja and adjoining areas also reported considerable development of garnet and magnetite crystals in quartz- mica schist near calc- magnesian schist around Kusmarja, Dondlo

CMPDI and Pipradih (Dhara & Kumar, 2018). The association of magnetite with sulphide mineral occurrences in the area, if related to hydrothermal activity and subsequent deposition of magnetite and sulphides in shear zone, faults and other weaker planes may also enrich the potential magnetite ore body in terms of many valuable critical minerals.

During the field visits in the proposed area by CMPDI geologists, occurrences of magnetite were also encountered as shown in the field photographs provided in Fig-2a and 2b. Given the significance of these lithologies for magnetite, base metals and other associated minerals, systematic exploration deemed warranted and subsequently exploration proposal was submitted.



Fig-2a and 2b: Magnetite occurrence within the project area.

2.4. Nature and Quantum of work proposed vs. achievement

The details of nature of the exploratory work proposed and total achievement of the targets, for the project entitled “Preliminary Exploration (G3) for Magnetite and associated minerals in Pipradih Area (7.00 Sq km), District: Giridih, Jharkhand”, are mentioned in table 2.1:

Table 2.1: Nature and Quantum of work

Sl. No.	Nature of Work	Sanctioned Quantity	Executed Quantity
1-Outsource Component			
A	Drilling		
i	Core Drilling	400m	243m
ii	Borehole Pillaring	8 Boreholes	4 Boreholes
B	Laboratory Studies		
I	<i>Chemical Analysis/ICPS Studies</i>		
a	<i>BRS Samples</i>		
i	Primary samples for XRF	250 no.	188 no.
ii	Internal (5%) and External (10%) samples for 5 radicals	38 no.	-
b	<i>Physical & Petrological Studies</i>		
i	Preparation of thin section	5 no.	5 no.
ii	Complete Petrographic studies	5 no.	5 no.
iii	Preparation of polished section	5 no.	5 no.
iv	Complete Mineragraphic studies (added after TCC review)	5 no.	5 no.
v.	Specific Gravity Determination	5 no.	5 no.
2-In-House Component			
A	GEOLOGICAL WORK		
i	Geological Mapping (1:4000 scale)	7 sq. km	7 sq. km
B	GEOPHYSICAL STUDIES		
i	Magnetic Survey	30Lkm	26.1 Lkm

Sl. No.	Nature of Work	Sanctioned Quantity	Executed Quantity
C	SURVEY WORK		
i	Topographic Survey	7 sq. km	7 sq. km
ii	DGPS Survey of Borehole and boundary points	12 no.	8 no.
D	TRENCHING		
i	Trenching	50 Cu. m	50 Cu. m
E	REPORT PREPARATION		
i	Preparation of Exploration Proposal	1 no.	1 no.
ii	Geological Report Preparation	1 no.	1 no.

2.5. Personnel involved

List of Personnel involved in Pipradih Area, Giridih for Preliminary Exploration (G3) for Magnetite and associated minerals, is provided below in table 2.2:

Table 2.2: List of Personnel involved

Responsibility Assigned	Personnel involved
Overall Cooperation	Sri Rajiva Kumar Singh, ED (Exploration), CIL
	Sri G. S. Gahlot, RD, CMPDI, RI-II
	Sri S. K. Gupta, GM (Exploration), CMPDI, HQ
Overall Technical Supervision	Dr. R. P. Singh, Chief Manager (Geology)
	Sri Saurabh Singh, Chief Manager (Geology)
Overall Co-ordination	Sri R. Adhikary, HoD (Geology)
Exploration Scheme Preparation	Sri Saurabh Singh, Chief Manager (Geology)
Field Activity Co-ordinator	Sri Arijit Saha, Senior Manager (Geology)

Field Geological Mapping	Sri Tanmoy Sarkar, Senior Manager (Geology)
	Smt. Ranjana Boro, Manager (Geology)
Geophysical Data Acquisition	Sri Subhrajit Das, Manager (Geology)
	Sri Indivar Agnivesh, Deputy Manager (Geology)
	Sri Amritansh Rai, Assistant Manager (Geology)
Geophysical Data Processing	Sri Vikash Kumar Gupta, Senior Manager (Geology)
	Sri Amritansh Rai, Assistant Manager (Geology)
Survey Work Co-ordinator	Arun Kumar Suman, Chief Manager (Mining)
Topographic Survey and DGPS Survey	Tanmoy Pramanik, Manager (Geology)
	Bhubnesh Kumar Gupta, Manager (Geology)
Trenching, Monitoring of outsourced drilling, Drill core logging and Geological Report preparation	Sri P. S. Anu, Senior Manager (Geology)
	Sri A. Shahidullah, Manager (Geology)
	Sri Apurba Paul, Manager (Geology)
	Sri A. C. Behera, Deputy Manager (Geology)

2.5. Mode of Operation and Associated Agencies

Exploration Proposal for Preliminary Exploration (G3) for Magnetite and associated minerals in Pipradih Area, Giridih was prepared by **CMPDI (HQ), Ranchi**. Magnetic survey for the area under investigation was carried out by **Geophysics Department, CMPDI RI-III & HQ, Ranchi**. Geological mapping work was carried out by **CMPDI, RI-III, Ranchi**. Bedrock samples collected during geological mapping were sent to **MECL Geochemical Laboratory, Nagpur** for chemical analysis and to **MECL Petrology Laboratory, Nagpur** for petrographic and Mineragraphic studies.

Based on the findings of geophysical survey work and geological mapping, trenching work was carried out by **CMPDI, RI-II, Dhanbad**. Trench samples were sent to **MECL Geochemical Laboratory, Nagpur** for chemical analysis.

Drilling within the exploration area was outsourced and it was carried out by **M/s Sathi Planners Pvt. Ltd., Ranchi** under the supervision of CMPDI, RI-II, Dhanbad. CMPDI, RI-II also completed drill core logging and geological report preparation. Core samples were analysed by MECL Geochemical Laboratory, Nagpur.

The **Geomatics Department, CMPDI (HQ), Ranchi** conducted topography survey of the study area and DGPS survey of all the drilled boreholes and boundary points.

Chapter-3

Property Description

3.1. Village Name, District and State

The area is partly under the administrative control of Bagodar and partly under Suriya blocks of Giridih District with its district headquarters at Giridih of Jharkhand, India (Fig-3a & 3c). Pipradih and Chichaki villages located in northern and north eastern part of the block respectively and Kusmarja village located in the south eastern part of the block are the important villages in and around study area. A Small settlement named Sirisdiha is in the central part of the block. The exploration block falls within the jurisdiction of Sariya Police Station, Giridih.

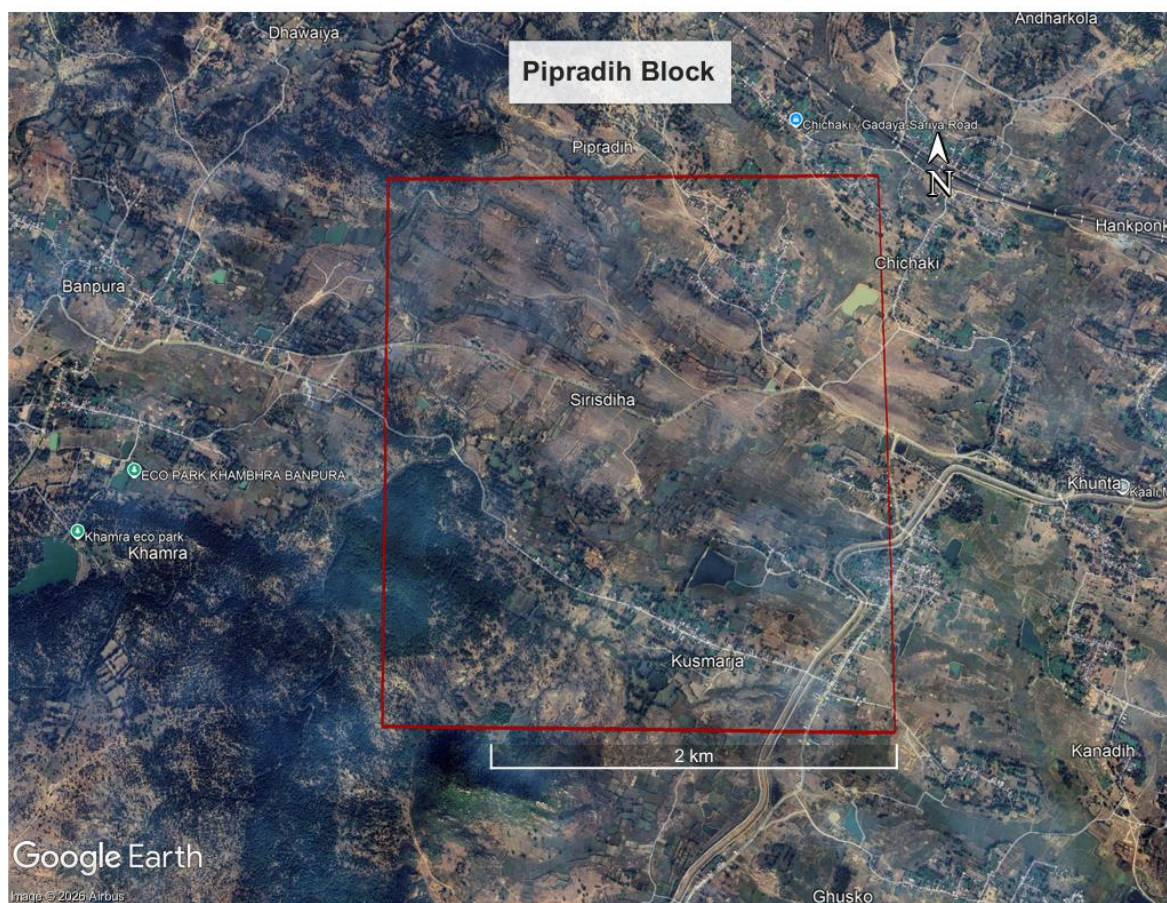


Fig. 3a.: Area of investigation given as google earth image

3.2. Survey of India Toposheet No.

The studied area is covered in SOI Toposheet No. 72H/16, 1: 50,000 scale.

3.3. Geo-Coordinates of the Investigated Area

Co-ordinates of all the four corner points of the investigated area after DGPS survey is provided below:

Point	UTM Co-ordinates		WGS 84 Co-ordinates		Elevation from MSL (m)
	Easting (m)	Northing (m)	Latitude(N)	Longitude(E)	
A	388900.808	2667379.278	24°06' 53.59"	85°54' 24.37"	321.506
B	391434.411	2667374.471	24°06' 54.07"	85°55' 54'.11"	327.562
C	391430.901	2664559.526	24°05' 22.56"	85°55' 54.75"	344.975
D	388897.029	2664609.942	24°05' 23.56"	85°54' 25.00"	338.259

3.4. Land Use/Cover and Forest

The area under investigation includes barren /wasteland, plantation, rural built-up area and agricultural land (Fig.3b). Area covered by rural built up is in three separate patches and also scattered along road. Almost 80% of the area is agricultural land/crop land. Forests/plantation within proposed study area are open jungle and do not fall under category of reserve forest.

3.5. Freehold/Leasehold Details

The area under investigation does not fall within any existing prospecting/mining lease and therefore it can be categorized as *Freehold*.

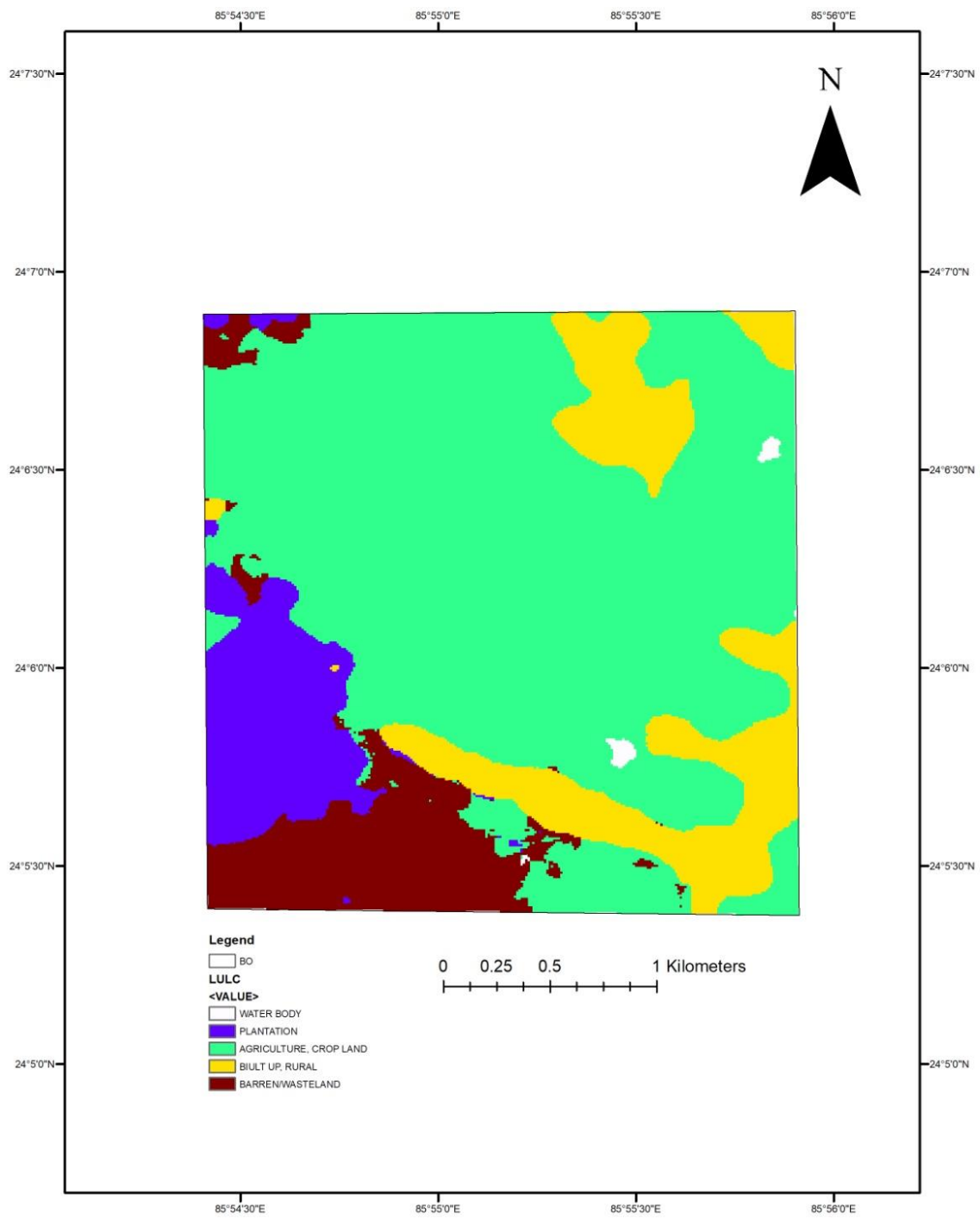
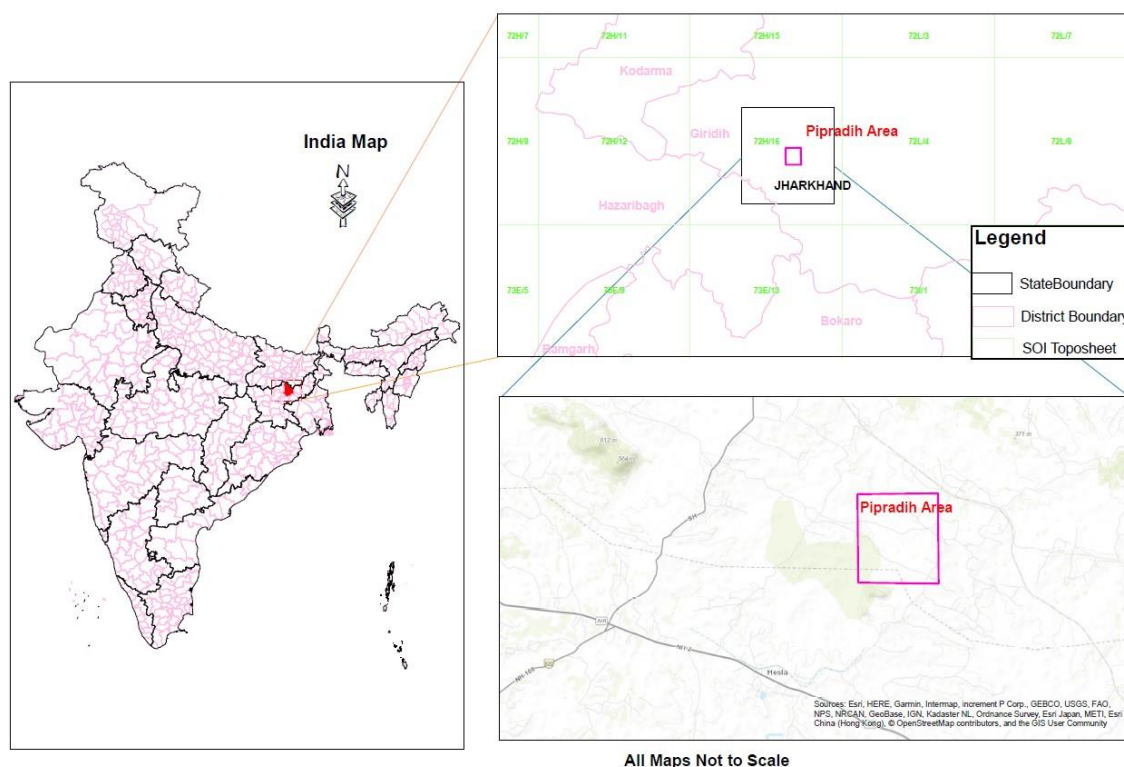


Fig. 3b.: Land Use Land Cover map of study area. (Credit: ESRI, Sentinel-2 10m)

Location Map, Pipradih Area, District : Giridih, Jharkhand**Fig. 3c.: Location Map of Pipradih Area, Giridih**

3.6. Location and Accessibility

The study area falls under toposheet no. 72H/16 covering an area of around 7 sq.km in Bagodar and Suriya Block of Giridih district, Jharkhand. It is located about 60 km south west from Giridih district headquarters and also around 65 km north east of neighbouring Hazaribagh district headquarters. Bagodar is the nearest town located at a distance of around 14 km south west of the study area. It falls under Bagodar-Sariya subdivision of Giridih District. The Grand Trunk Road (AH-1) passes about 10 km south of the area and two metalled road join it with the study area. Chichaki-Hesla Road passes along the eastern limit of the study area, whereas, Chichaki-Banpura-Gaghra Road passes in E-W direction through the middle of the block. The nearest railway station is Chichaki on the Howrah-Delhi Grand Chord line located just outside the north eastern corner of the study area.

3.7. Climate

In general, the study area experiences tropical humid climate with cold winter and hot summer. There are three well defined seasons in this region. The cold-weather season, from November to February, is the most pleasant part of the year. The hot summer season lasts from March to mid-June. May, the hottest month, is characterized by daily high temperatures. Summer is extremely hot and dry having the temperature rising up to 42°C which causes dryness in moisture. Similarly, winter shows the extreme of low temperature which falls down to 5°C. The area experiences temperature ranging from 32°-42°C during summer months and 5°- 15°C during winter months. The season of the southwest monsoon, from mid-June to October, brings major portion of the annual rainfall. The average rainfall is between 700 mm to 1200 mm approximately.

3.8. Flora and Fauna

The low-lying mounds and small hillocks within the area under investigation are covered by bushes and trees. In rainy season area is covered by dense vegetation. The predominant trees are; Sal (*Shorea robusta*) and Shisham (*Dalbergia sissoo*), Kendu (*Disopyros melanoxylon*), Mahua (*Madhuca longifolia*), Palash (*Butea monosprema*) etc. Amongst the small trees found near the outskirts of village and planted for their fruits or for medicinal/commercial values are: Mango (*Mangifera indica*), Papaya (*Carica papaya*), Jamun, Khajoor, Jackfruit tree or Kathal (*Artocarpus hetrophyllus*), Saijan (*Moringa oleifera*), Kusum (*schleichera olcosa*), Nim (*Azadirachta indica*), Ber (*Zigiphus mauritiana*), Imli (*Tamerindus indica*), Semal (*Bombax Ceiba*) etc. The valley flats in this area are mainly cultivated land. The cultivated lands are marked by the growth of mainly rice, small amount of tomatoes and variety of beans, pulses and vegetables. Few species of animals and birds are also present among which jackals and Titahri bird (Red-Wattled Lapwing) are dominant. Snakes are abundant, especially during the rainy seasons.

3.9. Geomorphology

Geomorphologically, the area is mostly comprising of denudational origin pediment-pediplain complex. Major part of the study area mainly constituted by denudational origin landforms including moderately dissected hills and valleys (Fig. 3d). Highest

elevation of the study area is approximately 370m in northern part in amphibolite ridge and lowest elevation is approximately 310m in the north western corner near the Bakra river. Drainage of the area is controlled by a northwards flowing small nala/river (Bakra river) flowing along the western limit of the study area.

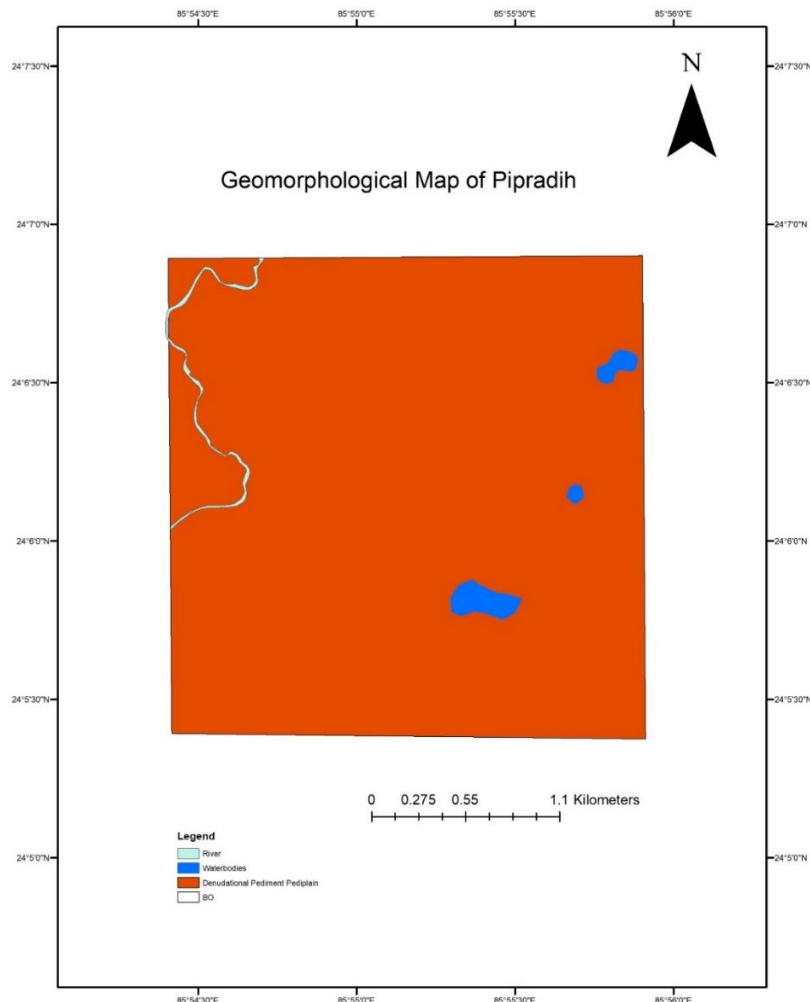


Fig. 3d.: Geomorphology map of study area. Data prepared by National Remote Sensing Centre, Hyderabad (Downloaded from: <https://bhuvan-app1.nrsc.gov.in>).

3.10. Local Infrastructure

The Grand Trunk Road (AH-1) passes about 10 km south of the area and two metalled road join it with the study area. Chichaki-Hesla Road passes along the eastern limit of the study area, whereas, Chichaki-Banpura-Gaghra Road passes in E-W direction through the middle of the block. The nearest railway station is Chichaki on the Howrah-

Delhi Grand Chord line located just outside the north eastern corner of the study area. Nearest airport Birsa Munda airport, Ranchi is located around 160 kilometres from the block. Nearest port is Kolkata located about 350 km from the study area.

In the study area, the electricity is supplied by Jharkhand Bijli Vitran Nigam Limited. Bagodar block has one 33/11 KV electric sub-station for power supply in the local area.

Bagodar is the main commercial hub near the study area. Multiple banks have branches in Bagodar and they provide banking services through multiple Pragya Kendra (CSP) in the study area.

Nearest post offices to the study area are Koiridih Branch post office near Chichaki and Bagodar Central Sub-Station post office.

3.11. Population

The study area falls within two village Panchayats. Pipradih, Chichaki and Sirisdiha villages fall within Chichaki Panchayat of Suriya Block, whereas, Kusmarja falls within Kusmarja Panchayat of Bagodar Block. As per the census data of 2011, Total number of households in Pipradih and Sirisdiha are 160 and 45 respectively. Villages Chichaki and Kusmarja have total 343 and 575 households respectively. Both these villages fall partly within the study area. Average literacy rate of these villages is approximately 65 percent. Around 80 percent of the work force in the study area is engaged in cultivation, agricultural labour and marginal activities for livelihood.

3.12. Archaeological, Historical sites and Environment

One prominent Shiva temple is located near the western edge of the study area on the bank of Bakra river. There are a few other temples and mosques within villages. Khambra Ecological Park is located outside the study area at a distance of around 1.5 km from the western limit.

Chapter-4

Previous Work

4.1. Details of Previous Geological mapping

The area under investigation falls within the east-central part of the Chhotanagpur Gneissic Complex. The geological account of area was first presented through early works of McClelland (1850), Smith (1857), Mallet (1874) and Oates (1895).

Srivastava (1956 & 1960) mapped the area on a scale of 1:63,360 and clubbed the litho-units under unclassified Metamorphic, Chhotanagpur Gneissic Complex and Bihar Mica Belt etc. He reported the occurrence of malachite and azurite encrustations on garnetiferous-quartz-actinolite-talc schist outcrops in the talc quarry at Kusmarja. Hoda (1967) reported malachite stains and galena disseminations from the east of Banpura (Sirishdiha) and near Kusmarja village.

4.2. Details of Previous Geophysical Investigation

Geophysical investigation by S.P. and magnetic methods were carried out in Kusmarja area during 1967-68 by Rao and party of GSI. During later part of 1967-68, Chakraborty and Kar carried, out detailed geological studies and geochemical prospecting in the Kusmarja talc quarry area where some promising geophysical anomalies were reported by geophysical investigation and initiated exploratory drilling in this area for base metals.

4.3. Details of Previous Exploration/ Investigation

Kar and Guha (1970) initiated exploratory drilling of 5 nos. of borehole (KJ/1 to KJ/5) near old Kusmarja Quarry which falls in the western part of the study area. Three of these boreholes intersected the sulphide mineralized zone. Exploratory drilling revealed the existence of a sub-vertical ore body; lens shaped in transverse section near Kusmarja. They described the mineralized body as roughly 170 m long and 3.12 m wide with an average 1.02% Cu in the form of minute and sporadic disseminations of sulphide minerals. Drilling in these boreholes also indicated thin veins of magnetite associated with Quartz-mica schist with minor pyrite and chalcopyrite.

During the field season 2013-14 GSI covered the entire terrain of Toposheet 72 H/16 by National Geochemical Mapping (NGCM) with the objective of creation of baseline geochemical data and delineation of anomalous areas. In course of NGCM mapping,

geological traverse around Ambadih and Khamra area of Toposheet 72 H/16 and study of brecciated amphibolite unit to the south of Ambadih village (about 5 km west of the study area) indicated sulphide mineralization in the form of malachite and limonitic stains.

MECL carried out Reconnaissance survey (G-4 level) for Copper, Lead and Zinc in Kusmarja and adjoining areas in 2017. The field work commenced in end of January, 2017 and concluded in the month of May, 2017. During the work Remote Sensing study, detailed mapping on 1: 12,500 scale was carried out covering 100 sq. km area supported by Bedrock, Stream sediment and Soil sampling to locate probable mineralized zones. The results of detailed mapping and sampling in Kusmarja and surrounding area showed few detached positive pockets of Cu, Pb and Zn mineralization. MECL has also reported occurrence of Magnetite near Pipradih, Banpura and Kusmarja old quarry. Area covered under G4 exploration by MECL and the present study area has been given below in Fig-4a.

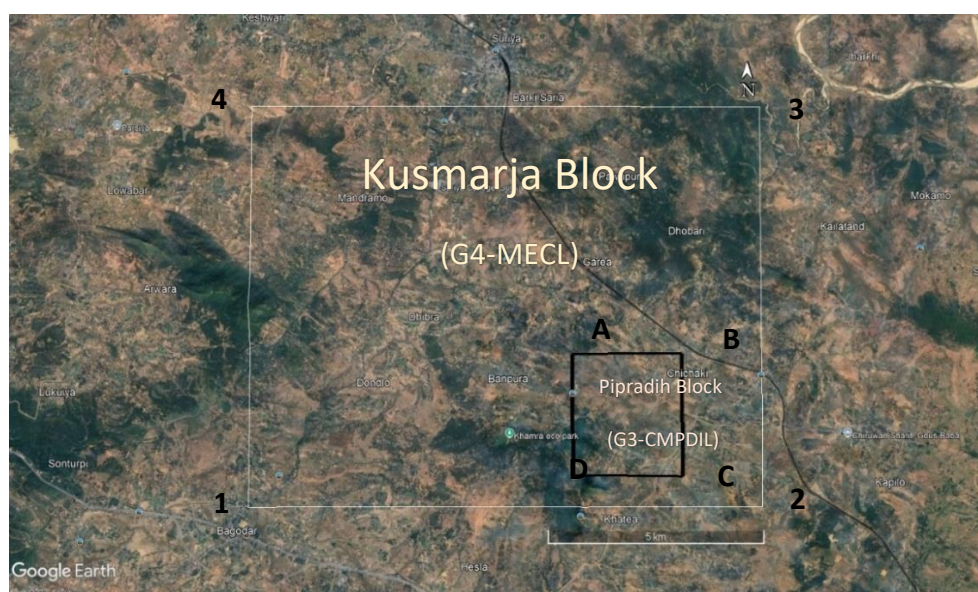


Fig. 4a.: Location of present study area with respect to MECL Block

Co-ordinates of corner points of Kusmarja Block

Corner points	WGS 84 (DD MM SS)	
	Latitude (N)	Longitude (E)
1	24°05' 00"	85°50' 00"
2	24°05' 00"	85°57' 00"
3	24°10' 00"	85°57' 00"
4	24°10' 00"	85°50' 00"

Co-ordinates of corner points of Pipradih Block

Corner points	WGS 84 (DD MM SS)	
	Latitude (N)	Longitude (E)
A	24°06' 54"	85°54' 25'
B	24°06' 54"	85°55' 54"
C	24°05' 23"	85°55' 55'
D	24°05' 24"	85°54' 25"

Chapter-5

Geology of the Area

5.1. Aerial Reconnaissance

Aerial photographs available for the study area (Google Earth imagery and DEM) show ESE-WNW trending moderately dissected hills and valleys. These hills during geological mapping were found to be of amphibolites rocks which have stood above adjacent softer lithologies due to their resistance to weathering and erosion. The trend of these hillocks follows the strike of lithological formations.

These aerial photographs also show two small parallel lines at a distance of around 500 meters following the same ESE-WNW trend and each line carrying small pockets of old quarries/mine workings.



Fig. 5a.: Aerial Photographs of the northern part of the study area with yellow line showing dissected amphibolite hills and red line showing trend along which small pockets of old mine workings are located.

5.2. Regional Geological Setup

5.2.1. Regional geological set up and stratigraphy

Present study area in general is occupied by the Precambrian meta sedimentary sequences and granite gneisses that belong to the Chhotanagpur gneissic complex lying in the north eastern part of the peninsular India. The present study area is located in the north-central part of Chhotanagpur Gneissic Complex. Paleo-Mesoproterozoic rocks of Bihar mica belt are exposed further north of the study area. Generalised geological map of Chhotanagpur gneissic complex and surrounding blocks is shown in figure: 5b.

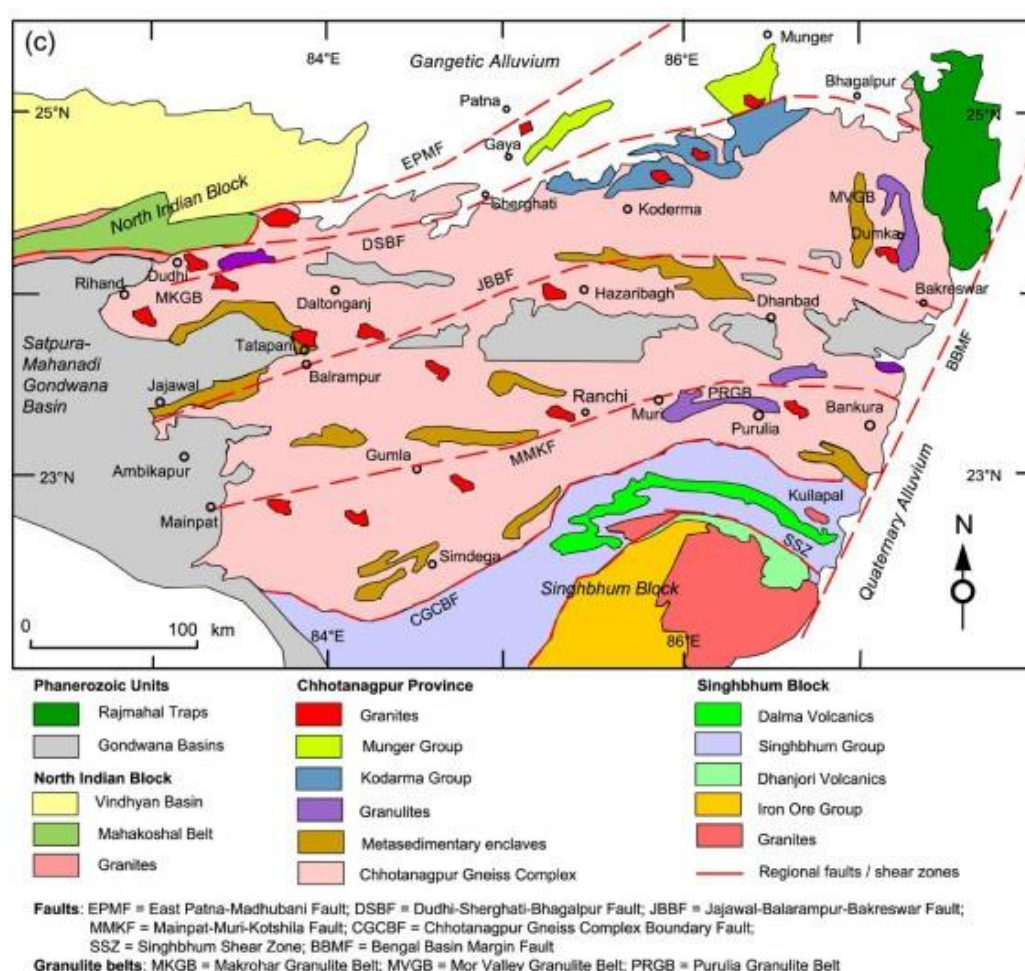


Figure-5b: Generalised Geological Map of Chhotanagpur Gneissic Complex (source: Mohanty,2023)

Chhotanagpur gneissic complex (CGC) covers a large area (around 1,00,000 sq. km) north of Dalma volcanics and Precambrian rocks of Singhbhum. It is characterized by the presence of a large number of plateaus and elongated ridges aligned in a dominantly NNE-SSW to E-W direction, which is the eastern continuity of

the “Satpura Trend” (Krishnan.1943). The CGC is roughly divided into northern and southern belts by E-W aligned half grabens of Gondwana basins.

The most dominant litho-unit in Chhotanagpur gneissic complex is granite gneisses with enclaves of older metamorphic rocks/schistose rocks (Quartzite, quartz-schist, quartz mica schist, biotite schist and hornblende schist). At regional level granitic rocks show largely a concordant relationship with these metasediments. A number of occurrences of Charnockite, Khondalite and granulites have been reported from various parts of Chhotanagpur gneissic complex.

Gneisses are also traversed by numerous quartz veins, pegmatites and basic to ultrabasic dykes cutting across it. Generalised succession and stratigraphic sequence of the northern part of the Chhotanagpur gneissic complex is given in Table: 5.1.

Table-5.1: Stratigraphic sequence of the region (as per GSI)

Age	Group	Formation	Lithology
Quaternary			Sand, Silt and Clay
-----Unconformity-----			
Jurassic-Cretaceous			Dolerite
Carboniferous-Permian	Gondwana	Barakar	Sandstone, shale, Coal
		Karharbari	Carbonaceous shale, sandstone
		Talchir	Conglomerate, sandstone, shale
-----Unconformity-----			
Neoproterozoic		Hazaribagh Granite and Pegmatites	Monzogranite, Syenogranite
Paleo-Mesoproterozoic	Bihar Mica Belt		Amphibolite, Quartzite, Quartz- mica schist, Mica schist
Paleoproterozoic			Pegmatite, Quartz vein and Dolerite dykes

Age	Group	Formation	Lithology
Archean-Proterozoic	Chhotanagpur Gneissic Complex		Granitoid gneiss
Archean-paleoproterozoic	Unclassified Metamorphics		Amphibolite/hornblende schist, Quartzite, Quartz schist, Quartz-mica schist, mica schist

The present study area is occupied mainly by granitic gneisses and Precambrian unclassified metamorphics, comprising quartz mica schist with interbedded bands of amphibolites/hornblende schist and lenticular pockets of calc magnesian schist. Quartzite and quartz schist are also found in some places.

5.2.2. Regional structure

Granite gneisses and rocks of schistose formation are generally reported to be well foliated. General strike of the formation is WNW-ESE (Kar and Guha,1970) and dip towards north and south both directions has been reported.

Chhotanagpur gneissic complex in general has been reported to have undergone three phases of deformation producing folds and related linear features. First generation of folds (F1) are isoclinal and regional schistosity has developed parallel to its axial plane. Second phase of folding (F2) is manifested by the axial planar crenulation cleavages in metapelites and fracture cleavages in quartzite. Third phase of folding (F3) has been reported to be open folds and there is an absence of axial planar structures.

Axial planar shearing to variable degree has accompanied first two phases of folding (Ghose,1983).

5.2.3. Metamorphism in the region

Rocks in and around the study area have been subjected to regional metamorphism predominantly of intermediate to high grade indicated by amphibolite

bands predominantly bearing hornblende and large garnet porphyroblasts in mica schist rocks. Higher grade of metamorphism specially highly garnetiferous diopside granulite has been reported from different locations of north-central region of Chhotanagpur gneissic complex. Schistose rocks of Chhotanagpur gneissic complex have been also migmatized to a variable extent and reported from various parts of the region.

Gneissosity in granitoid rocks has been well developed but also reported to be indistinct at places.

5.3. Surface Indication of mineralisation in the region

Many old mine workings and small pockets of base metal deposits are located within the “unclassified metamorphics” litho-units in and around the study area, for example: Baraganda, Dondlo, Dhibra, Jalakdiha, Chandio, Kusmarja, Pipradih, etc.

Magnetite in the region is mainly associated with Garnetiferous Quartz-Biotite schist and calc-magnesian schist with minor pyrite, chalcopyrite and other sulphide minerals. Earlier works of GSI and MECL in Kusmarja and adjoining areas also reported considerable development of garnet and magnetite crystals in quartz- mica schist near calc- magnesian schist around Kusmarja, Dondlo and Pipradih.

Small accessory grains of magnetite can be found scattered in the soil and sediments in the Garnetiferous quartz mica schist zone on the surface. Larger massive-crystalline martitized magnetite rocks (Fig-2a, 2b) and martitized magnetite floats (Fig-5c) have also been reported from the study area.



Fig-5c: Magnetite float occurrence within the project area.

The association of magnetite with garnetiferous biotite schist may possibly indicate recrystallization of pre-existing iron bearing clay minerals into magnetite during metamorphism. In addition to that, its association with sulphide mineral occurrences in the area may also indicate possible role of hydrothermal activity/reaction zone resulting in subsequent deposition of magnetite and sulphides in shear zone, faults and other weaker planes.

Chapter-6

Activity During the Period

6.1. Geological Mapping

The area of investigation falls under SOI Toposheet No. 72 H/16. The block is bounded by co-ordinates Latitude $24^{\circ} 5' 23''$ N & $24^{\circ} 6' 54''$ N and Longitude $85^{\circ} 54' 25''$ E & $85^{\circ} 55' 55''$ E. The objective of the investigation was to map different lithologies and structural features within the study area, as well as to map potential ore body of magnetite and associated mineralisation.

The present work involved detailed geological mapping of 7 sq.km. area on 1: 4,000 scale and collection of bed rock samples for geochemical analysis, petrographic and mineragraphic studies. The field activity for the present work i.e. geological mapping, collection of bedrock samples has been executed by Department of Geology, CMPDI, Regional Institute-III, Ranchi, Jharkhand under the supervision of Exploration Division CMPDI (HQ), Ranchi.

6.1.1 Outcrop Mapping

Outcrop mapping was carried out on 1:4,000 scale and covered about 7 sq. km area in Pipradih Area, Giridih District, Jharkhand. The detailed geological outcrop map is shown in Plate-III. Interpreted geological map is given in Plate-IV and Fig-6a.

6.1.2 Description of Rock Types

Granite gneiss is extensively developed in the area and constitutes the dominant country rock. These granitic rocks have engulfed older metasedimentary schistose rocks. Quartz biotite schist, hornblende schist are two others prominent lithologies within the study area. Calc-magnesian schist, quartz-schist, and quartzite are also present at few places as lenses and patches within the quartz mica schist and granite gneisses. Calc magnesian schists coincides with old talc quarries and mine workings of the western and south eastern part of the area under investigation.

Gneisses are also traversed by numerous quartz veins and pegmatites cutting across it. Description of various lithologies exposed in the study area is as follows:

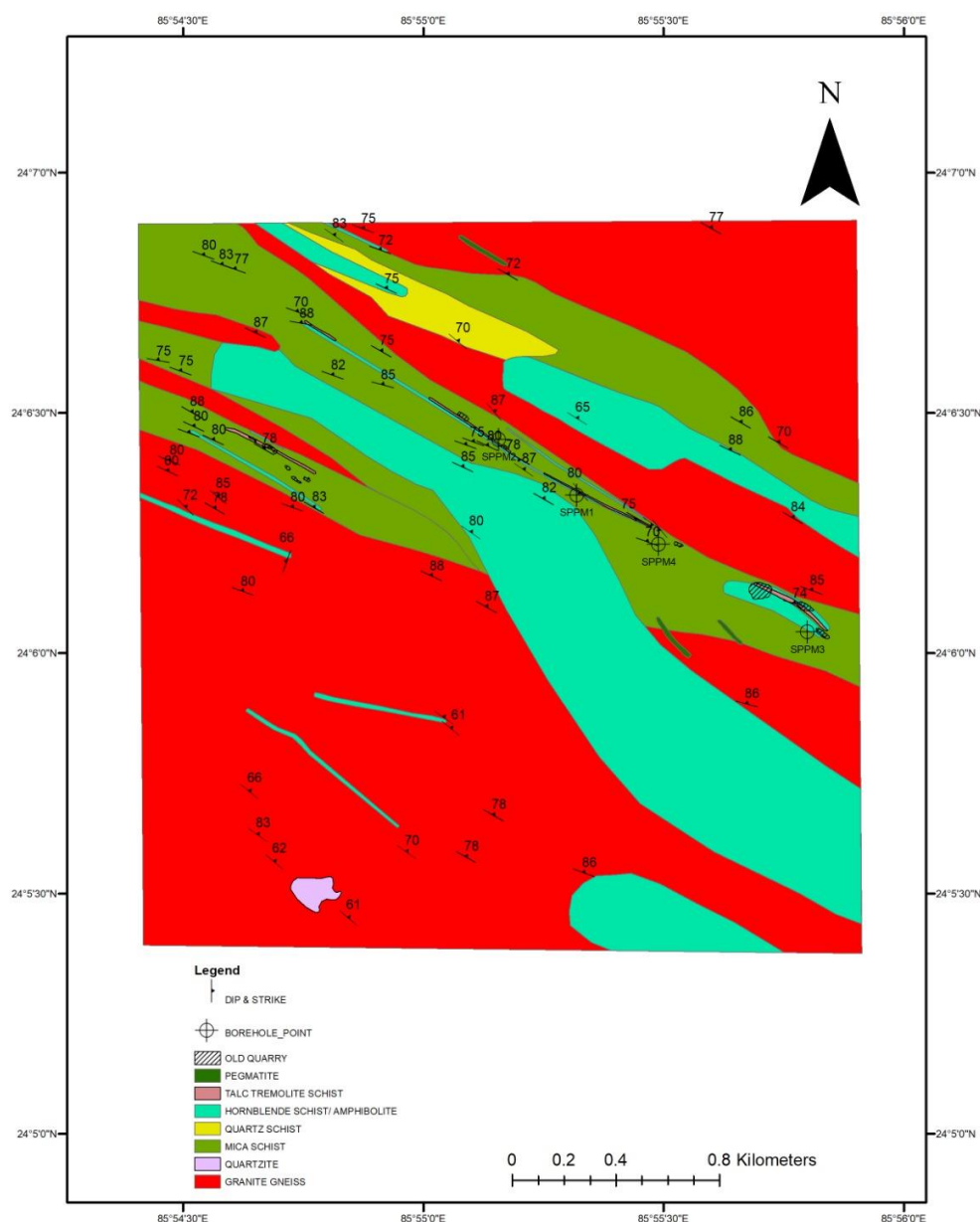


Fig-6a: Geological map of the area under investigation.

Granite Gneisses

Granitic gneisses are the most dominant rock type within the study area, mainly exposed in the south western and north eastern part. These granitic gneisses are concordant to meta sediments of the area, i.e. they occur parallel to general foliation of the schistose rocks. General strike of the foliation varies between N110°E and N130°E and steeply dipping towards north (>70° to almost vertical). Granitic rocks vary

from granular to gneissic in texture within study area. They are also associated with quartz veins and pegmatite.

The major oxide analysis of granitic rocks within the area under investigation show slight alumina undersaturation with molecular A/CNK ratio (Alumina saturation index) 0.96 to 1.00. K_2O/Na_2O ratio is high with value around 2.70 and low CaO content of around 0.70 percent. Therefore, the rock may be categorised as meta to sub-aluminous syenogranite.

Petrological studies of this rock type reveal quartz, microcline, plagioclase, biotite and muscovite as major minerals. Quartz grains show tight quartzitic contact in some areas instead of smooth igneous boundaries.

Quartz Mica Schist

Quartz mica schists are exposed mainly in the northern half of the study area. These schistose rocks vary greatly in composition from almost micaceous quartzite to quartz-biotite schist, quartz-muscovite schist and mica schist. While moving from mica schist towards granitic gneiss, increasing effects of granitization are noted. As granitic terrains are approached, these schists ultimately grade into foliated granite. Garnet and magnetite crystals have developed in this rock type near the contact with hornblende schist and calc-magnesian bodies.

Foliation is quite well developed in these rocks. General strike of the foliation is N110°E to N130°E and steeply dipping (>70° to almost vertical) towards north direction generally (Fig-6b) but also towards south in a narrow but elongated zone in the central part of the study area. Crenulation have developed in bands rich in mica. Major oxide analysis of this rock type shows increase in SiO_2 concentration (from 65 to 73 percent) and decrease in MgO (4.96 percent to 0.20 percent) and alumina saturation index value while moving towards granitic rocks.

Petrographic study of one Quartz mica schist rock sample shows Quartz, biotite, microcline and albite as major mineral and muscovite/phlogopite as minor minerals. Mica grains under microscope show parallel alignment while feldspar grains also show crude alignment.



Fig-6b: Quartz mica schist steeply dipping towards north.

Amphibolite (Hornblende Schist)

Amphibolite occurs prominently as two large concordant bodies extending parallel from north-western to south eastern part within the study area. In addition to that, there are many thinner bodies of amphibolite occurring parallel to foliation of country rock in different parts of the area.

Major oxide analysis of these rock type shows low silica and K_2O content of around 45% and 0.7% respectively. They also show around 12 percent average concentration of total Fe and 1 percent concentration of TiO_2 .

Petrographic study of the amphibolite samples within the area provides hornblende and plagioclase as major mineral within the rock. Additionally, minor amount of sericite, sphene and trace amount of epidote are also present, indicating retrograde metamorphism or hydrothermal activity.

Narrow stringers and veins of quartzo-felspathic material are noted along the schistosity planes of the amphibolites at a few places and the sulphide minerals are particularly abundant in these quartzo-feldspathic stringers.

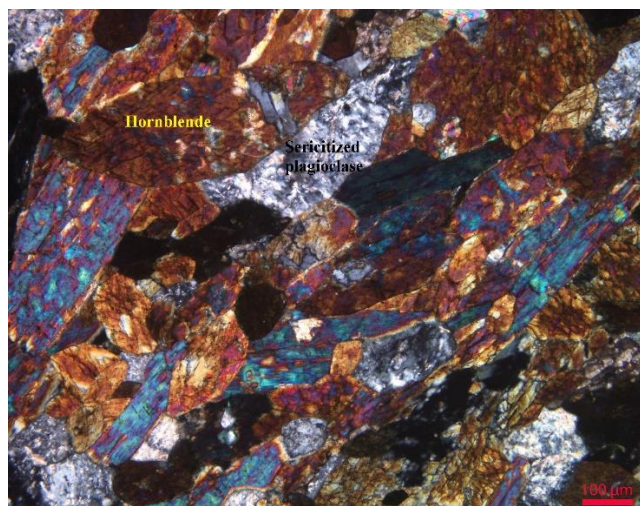


Fig-6c: Photo micrograph of hornblende schist

Calc Magnesian schist

These rocks, varying in composition from almost pure talc-schist to tremolite-actinolite-schist, occur as impersistent bands and lenses within the study area. Specks and streaks of sulphides of copper, lead and zinc are found in most of these outcrops. Talc-schist have been mined in the study area and a few old quarries exist locally known as Kusmarja and Pipradih quarries. Garnetiferous quartz-biotite-actinolite-tremolite-schist, which is found near Kusmarja quarry and also nearly half a kilometer further north and one kilometer towards east, contains very big crystals of garnet with inclusions of quartz and also sulphides. Garnet porphyroblasts are generally embedded in a coarse groundmass of quartz, biotite and needle-shaped actinolite-tremolite and subhedral opaque minerals. Magnetite veinlets are also observed within these rocks.

In tremolite-actinolite-schist, the major constituents are tremolite and actinolite with accessory of subhedral opaque minerals. Talc occurs in variable proportions in rocks of this group. Schistosity ranges from crude to very well developed. Actinolite and tremolite occur as radiating needles or sometimes in bunches.

Major oxide analysis of these rock type show MgO content of 15 to 26 percent (average value of 20.7 percent). CaO ranges from 0.15 percent in talc rich rocks to 16.6 percent in tremolite rich rocks.

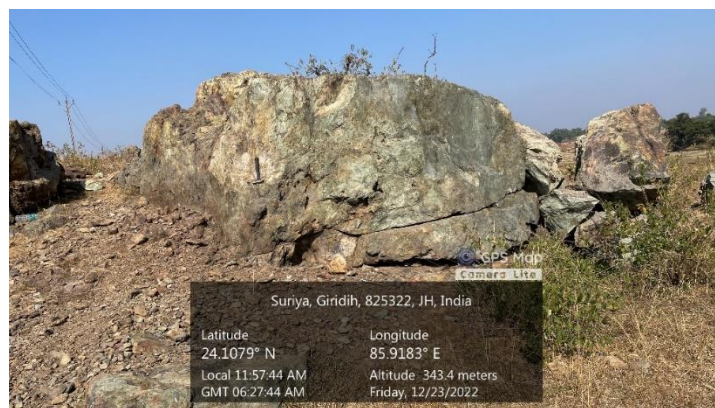


Fig-6d: Calc-Magnesian rock near Pipradih Quarry

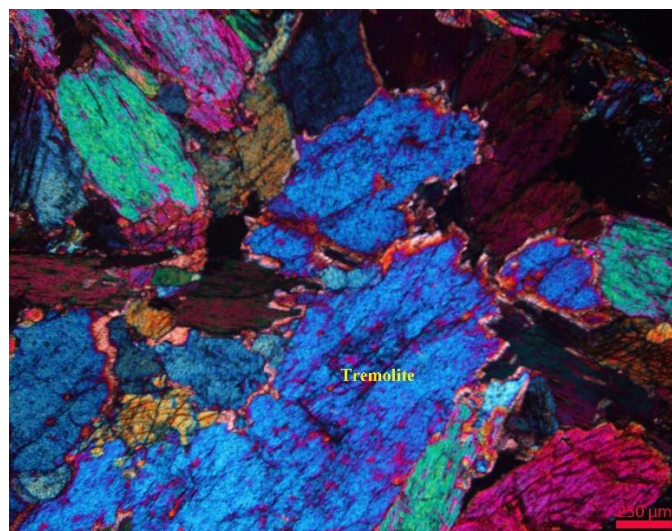


Fig-6e: Photo micrograph of Tremolite schist

6.1.3 Structure

The study area is highly metamorphosed and deformed which exhibits well developed foliations at many places. The area has suffered multiple phases of deformation. The deformational signatures are represented in the form of planar and linear fabric. The various structural features observed in the study area discussed below:

Isoclinal folding in mica schists (Fig-6f) has been observed in the study area. Foliation planes of these mica schists mark the earliest structure (S_{G1}) within the study area.



Fig-6f: Isoclinal folding in mica schist



Fig-6g: Displaced veins

The second episode of deformation and associated metamorphism has resulted into development of WNW-ESE trending regional foliation. As a result, amphibolites, mica schists and other rock types are oriented in WNW-ESE trend with generally steep northerly dip (65° to almost vertical) (fig-6h). At places steep southerly dip has also been observed in mica schist close to the contact with inter-banded hornblende schist.

Although later stage folding at regional level has not been confirmed within the study area, development of $N70^{\circ}$ E trending crenulation cleavage has been observed within mica schists at places (Fig-6i).

Evidences of faulting/shearing at small scale has also been found within the area under investigation (Fig-6g).



Fig-6h: Steeply dipping quartz mica schist



Fig-6i: Crenulations in mica schists

6.1.4 Metamorphism

General grade of metamorphism within the study area is intermediate to high grade. Occurrence of hornblende schists and Garnetiferous mica schist indicates amphibolite facie of metamorphism. In addition to that, presence of sillimanite within quartz mica schist rocks as observed in the petrographic study of the drill core sample points towards a higher temperature regime, possibly a higher amphibolite facie.

These rock types at later stage may possibly have gone through retrograde metamorphism/hydrothermal activity as indicated by presence of sericite and sphene in the hornblende schist and presence of chlorite in the calc magnesian schists.

6.1.5 Mineralogy of the Ore Zone

Magnetite ore body within the study area is most evident around the old talc quarries of Kusmarja and Pipradih (Fig-2b). These quarries are located within the isolated

lenses of calc magnesian rocks. Adjoining rock types are quartz mica schist and hornblende schist of the “unclassified metamorphics”. Hornblende schists are inter-banded with the garnetiferous quartz mica schists and calc magnesian rocks. Magnetite ore zone found here appears to be 3-4m thick body and it appears to be associated with the lithological contact of hornblende schists with other two rock types. Rock of these talc quarries have been reported to have anomalous concentration of Cu, Pb and Zn by earlier workers and malachite stain was visible in the area (Fig: 6n)

Magnetite ore body during the course of mapping appeared to follow the general foliation trend of rocks of the area, i.e. N120°E. Its outcrops ranging in thickness of less than 1m to around 3m was mapped at multiple places along the same trend line (Fig-2a).

Floats of magnetite rocks were found to at numerous places within the study area primarily in and around quartz mica schist and calc magnesian bodies (Fig-5c & 6j). Here top soil was also found to be rich in magnetite.

Major rock analysis of total 17 bed rock samples of magnetite ore collected from the area under investigation showed Total Fe content ranging from 22.39 percent to 59.81 percent. These ore samples showed poor concentration of V_2O_5 (average 0.02%) and TiO_2 (average 0.36%). Details of major oxide analysis of bed rock samples of magnetite bearing rocks is given in Annexure-II B.

Mineragraphic studies were carried out in 04 polished sections prepared from magnetite rich rocks and details is enclosed as Annexure-III B.



Fig-6j: Magnetite floats

Specimens under ore microscope show the rock to be composed of fine to medium subhedral to anhedral aggregates of magnetite/ maghemite, leaving pores and gangues in between. Hematite is seen developing after martitisation of magnetite/ maghemite. Pyrrhotite is noted as very fine inclusions within maghemite and magnetite (Fig-6m). Limonite and goethite occur as very fine reddish amorphous aggregates along pores and cavities (Fig-6l). In one sample Chalcopyrite was noted as very fine specks in accessories (Fig-6k).

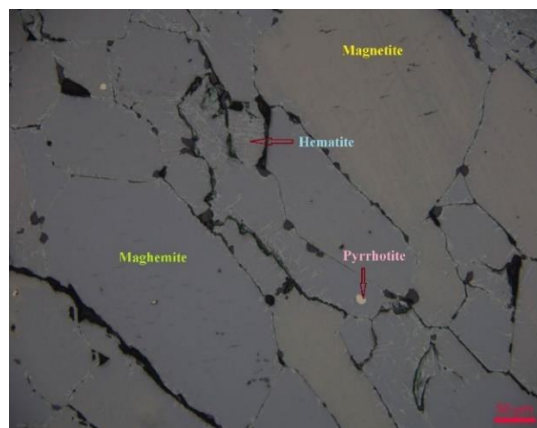
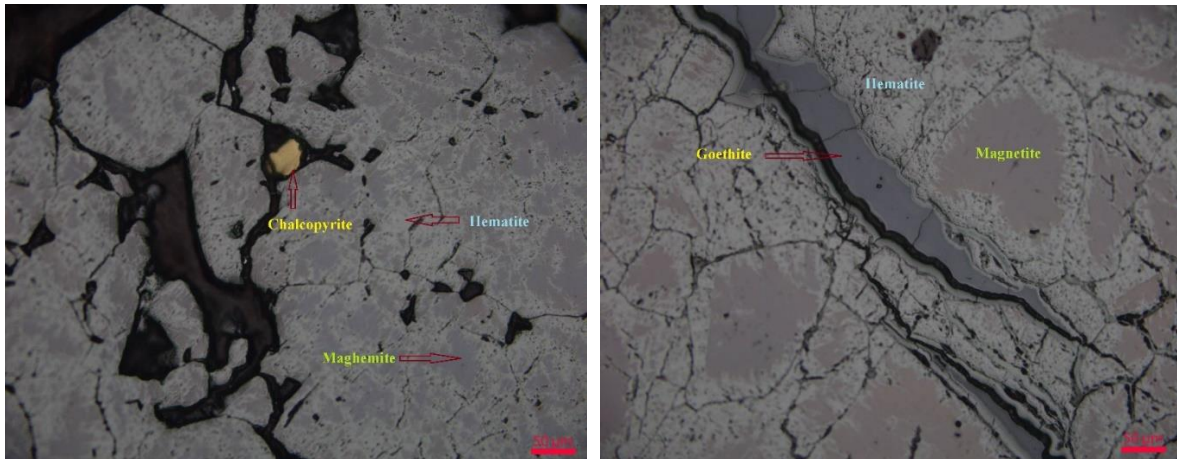


Fig-6k,6l & 6m: Photo-micrograph of magnetite ore (20X)



Fig-6n: Malachite stains on quarry walls.

6.1.6 Pitting and Trenching

Based on geological field mapping, two primary WNW-ESE trending anomalous zones were observed running parallel to each other. One anomalous zone stretched from the vicinity of Pipradih quarry till old quarry workings in Kusmarja village in the east. Second zone starts from Kusmarja quarry in the west and runs parallel to the first one.

To ascertain thickness of magnetite ore zone, 04 trenches were made on the first anomalous zone. One trench (Trench-C) was cut closer to the eastern corner of the Pipradih quarry. Another trench (Trench-E) was cut closer to the western corner of the old quarries within Kusmarja village. Two trenches were cut in between on the same trend line (Trench-A and B) (Fig-6o). In addition to that, a fifth trench (Trench-D) was cut on the second trend line west of Kusmarja quarry to ascertain western extent of the anomalous zone. Location of all five trenches has been given in Annexure-IC.

Trenches were cut perpendicular to the anomalous zone i.e. in NNE-SSW direction. Sample collection from trenches were done starting from northern end. Each sample represented 1m length of trench except for the break at change in rock types. Samples were collected on a plastic sheet by collecting linear chip samples from both the walls of the trench as well as from the floor after cleaning trench floor. A total 42 trench samples were collected and sent for major oxide analysis. Trench sections have been provided as Plate-VIII and analysis result of trench samples has been given in Annexure-II C.



Fig-6o: Trench cutting at Trench-A and Trench-B.

6.1.7 Sampling

The majority of samples were collected from different litho-units viz. calc magnesian schist, hornblende schist, quartz mica schists and granite gneisses present in both of the probable mineralised target zones identified within the study area. Samples were also collected from the area outside these target mineralised zones where magnetite mineralisation has been observed on the surface. Utmost care has been taken during collection of bedrock and trench samples and chemical analysis. All samples were grounded and sieved to (-)200 mesh size as per guidelines of NMET technical committee and reduced in size by progressive coning and quartering. The objective was to examine Total Fe concentration in magnetite rich rocks, understanding the major oxide concentration of the host rocks and ascertain thickness and total Fe concentration of intersected ore bodies in trenches.

The sampling and chemical analysis was done in Chemical Laboratory, MECL, Nagpur using XRF.

6.1.8 Discussion

Field mapping of the study area shows that remnants of older metamorphic rocks exist as enclaves within granitic gneiss. Based on petrographic and major oxide analysis of collected samples, it can be said that a pre-existing sedimentary and volcanic sequence of shales, dolostones marls and basalts was preserved within a younger invading granitic pluton. This pre-existing sequence was later metamorphosed into amphibolite grade and converted into mica schist, tremolite- actinolite schists and hornblende schists respectively at the time of regional metamorphism along with granitic gneiss which also follows the foliation of the older metamorphic rocks.

General trend of foliation within the study area is WNW to ESE steeply dipping towards north. Evidence of shearing and hydrothermal alteration of the country rock is also observed within the study area.

Calc-magnesian rocks of the study area have been reported to have enriched value of Cu, Pb and Zn. Malachite stains on these rocks were also observed during the course of present mapping work. Magnetite veins and disseminations are also present within these rocks.

In addition to the above mentioned litho-units, a thin elongated band of steeply southerly dipping litho-units (75-80 degrees) is observed in and around the altered zone. Litho-units showing southerly dip are generally mica schist/biotite-chlorite schist. This zone runs parallel to sub parallel to the general foliation extending from close to Pipradih quarry to old quarries within Kusmarja village. These bands are less than 1m to up to 3m thick. At places they contain garnet porphyroblasts specially where the mica schist comes in contact with hornblende schist. Magnetite is also present in this rock.

6.1.9 Ore Zones

Based on geological investigation, magnetite is found to be associated with country rocks in two different ways. In the first, it is found associated as disseminated veins and grains within talc-tremolite-actinolite schists, prominently exposed near old talc quarries in the study area. These rock types are characterised by low alumina and low alkali ($\text{Na}_2\text{O}+\text{K}_2\text{O}$) content.

In another assemblage, magnetite is found to be associated with garnetiferous mica schist with minor chlorite. This particular zone is dipping towards south, contrary to the general foliation. At places, its adjacent lithology is hornblende schist.

The southerly dipping garnetiferous schists runs at a very low angle with respect to regional foliation in general and the lenses of calc-magnesian schists in particular. It appears to intersect the calc-magnesian rocks near old quarries within Kusmarja village. At the intersection, a thicker body of magnetite was found. Trenching was done at this place (Trench-E).

The southerly dipping band of quartz-mica schist containing garnet possibly marks the fluid pathway within the shear zone. Isoclinal folding in mica schist and displacement of veins was found in this area (fig-6f and 6g). In addition to that, increased amount of sericitization of feldspar has also been observed within this zone. This zone is also generally marked by contact between bodies of hornblende schist and quartz mica schist, two rocks of considerably different mechanical properties, their contact therefore indicating presence of a weak zone suitable for hydrothermal fluid movement.

Therefore, a low angle intersection between the hydrothermal fluid conduit (southerly dipping garnetiferous mica schist) and the reactive rock layer of calc magnesian rock is potentially important from ore mineralisation point of view and it may be the place of a relatively thicker pocket of polymetallic ore mineralisation.

6.2. Geophysical Exploration

6.2.1 Objective

With the objective of deciphering magnetite and associated minerals in Pipradih area in Giridih district, Jharkhand ground magnetic survey was carried out by CMPDI on the basis of exploration design described in Agenda 52.1.1 of the 52nd meeting of Technical Cum Cost Committee of national Mineral Exploration Trust. The mandate was to conduct G3 stage of exploration with preliminary inferences related to spatial location with depth of anomalous body. The magnetic methods of potential field exploration being sensitive to the inclination of the dipping body, to prove the dip and strike line of the magnetized body was also a prime objective of the survey.

6.2.2 Geology

The area under exploration lies in the north central part of Chhotanagpur Gneissic Complex flanked further north by Bihar Mica belt. The area is occupied mainly by Precambrian unclassified metamorphics, comprising quartz mica schist with interbedded bands of amphibolites/hornblende schist and talc magnesian schist. Quartzite with quartz mica schist is also found in some places.

6.2.3. Equipment

The GEM System GSMP-35 potassium magnetometer was used to carry out the magnetic survey. GSMP-35 is an electron spin resonance magnetometer. It operates on principle similar to other alkali vapour magnetometers. However, benefits from the unique nuclear properties of potassium are unique to this magnetometer. Precession signal amplification is obtained by optical pumping via a potassium spectral line. The GSMP-35 has .0003nT of sensitivity combined with ± 0.1 nT absolute accuracy over its full operating range. The instrument also has a gradient tolerance of 50,000 nT/m.

6.2.4. Survey Pattern

The detailed survey scheme was drawn to cover the entire Pipradih area covering approx. 7 sq km along 13 lines separated by 200m mostly in dip direction. The magnetic data was taken in continuous walkmag mode with time interval of 1 sec with a flagged data on each 25 meters on ground. Their end point co-ordinates are given in Table 6.2.1 below. All stations coordinates are taken with GPS associated with GSMP-35 potassium magnetometer.

Table 6.2.1: Co-ordinates of Magnetic Profile Lines

Profile Lines	Start Point	End Point
L1	24°06'53.4"N 85°54'35.0"E	24°06'22.9"N 85°54'24.5"E
L2	24°06'53.9"N 85°54'42.2"E	24°06'02.1"N 85°54'24.7"E
L3	24°06'53.8"N 85°54'49.7"E	24°06'02.1"N 85°54'34.7"E
L4	24°06'53.9"N 85°54'57.1"E	24°05'58.4"N 85°54'38.7"E
L5	24°06'54.0"N 85°55'04.4"E	24°05'56.9"N 85°54'45.7"E
L6	24°06'54.1"N 85°55'12.1"E	24°05'54.4"N 85°54'52.3"E
L7	24°06'53.5"N 85°55'19.2"E	24°05'52.0"N 85°54'59.0"E
L8	24°06'12.8"N 85°55'13.5"E	24°05'50.0"N 85°55'05.0"E
L9	24°06'51.1"N 85°55'25.3"E	24°05'48.9"N 85°55'12.6"E
L10	24°06'46.4"N 85°55'39.7"E	24°05'46.7"N 85°55'19.1"E
L11	24°06'44.5"N 85°55'45.8"E	24°05'45.3"N 85°55'26.1"E
L12	24°06'42.4"N 85°55'52.7"E	24°05'43.3"N 85°55'32.8"E
L13	24°06'24.8"N 85°55'54.0"E	24°05'41.2"N 85°55'39.6"E

Also, to consider diurnal variations of earth's magnetic field, magnetic reading was taken repeatedly at fixed location base with coordinates 391273.21, 2666145.36. in the survey area daily.

6.2.5. Processing and Interpretation

Acquired data indicates Total magnetic field, which consists of the vector sum of Earth's magnetic field (B_E) and the stray magnetic field (ΔB) of an ore body. Generally, ΔB is very less than B_E , so that the direction of the total field does not deviate far from

the Earth's field. In Fig.6gp1, a plot of Total Magnetic Intensity map has been depicted using minimum curvature method of gridding.

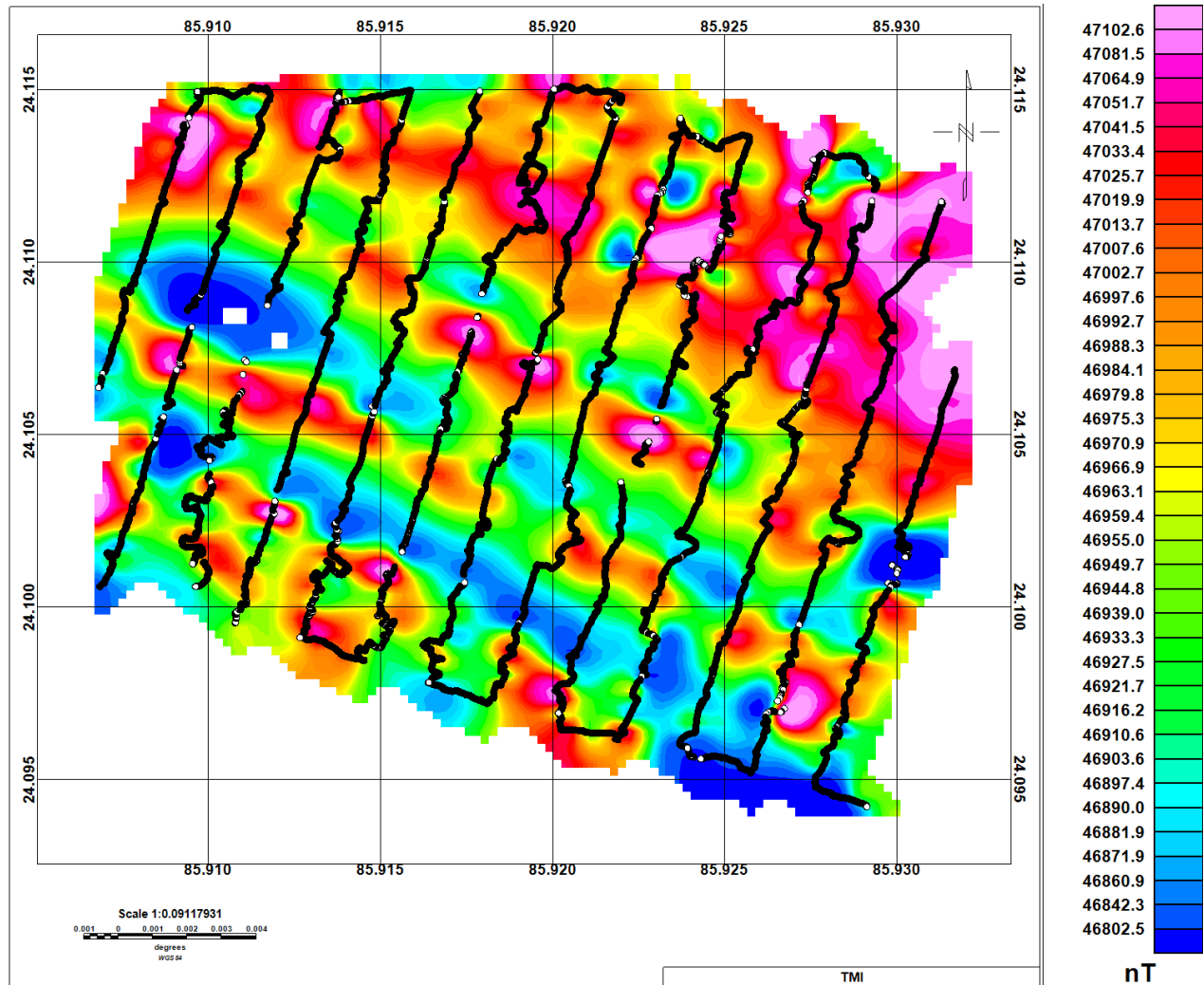


Fig 6gp1: TMI Map

Earth's Magnetic Field (B_E) can be obtained from that of International Geomagnetic Reference Field (IGRF) for that area. Removing the effect of B_E from magnetometer recorded data yields the anomalies caused by local and deep-seated features. After applying corrections for diurnal variations caused by an apparent movement of Sun above earth's ionosphere, the resultant anomaly has been separated for regional (Fig 6gp2a) and residual sources (Fig 6gp2b).

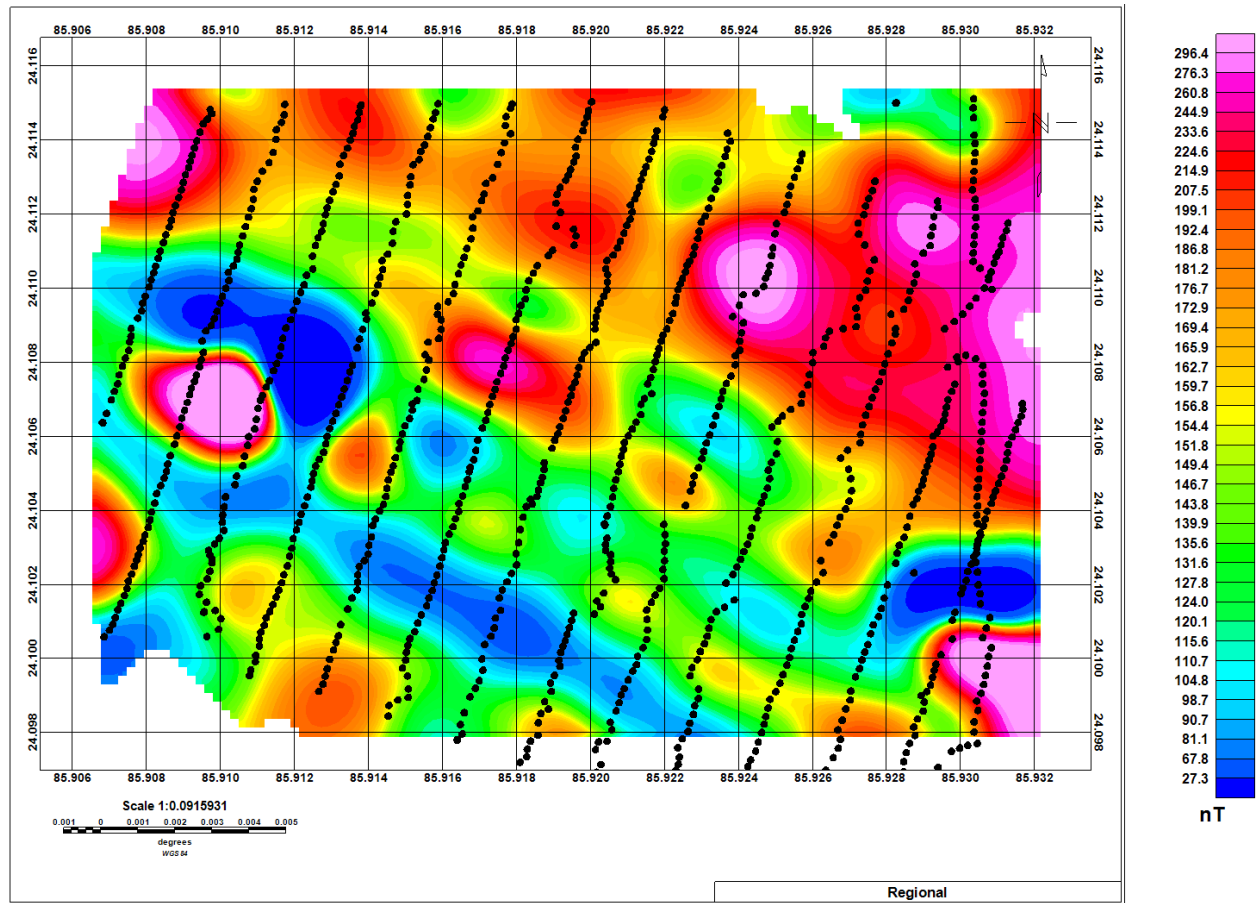


Fig 6gp2(a): Regional Magnetic Anomaly Map

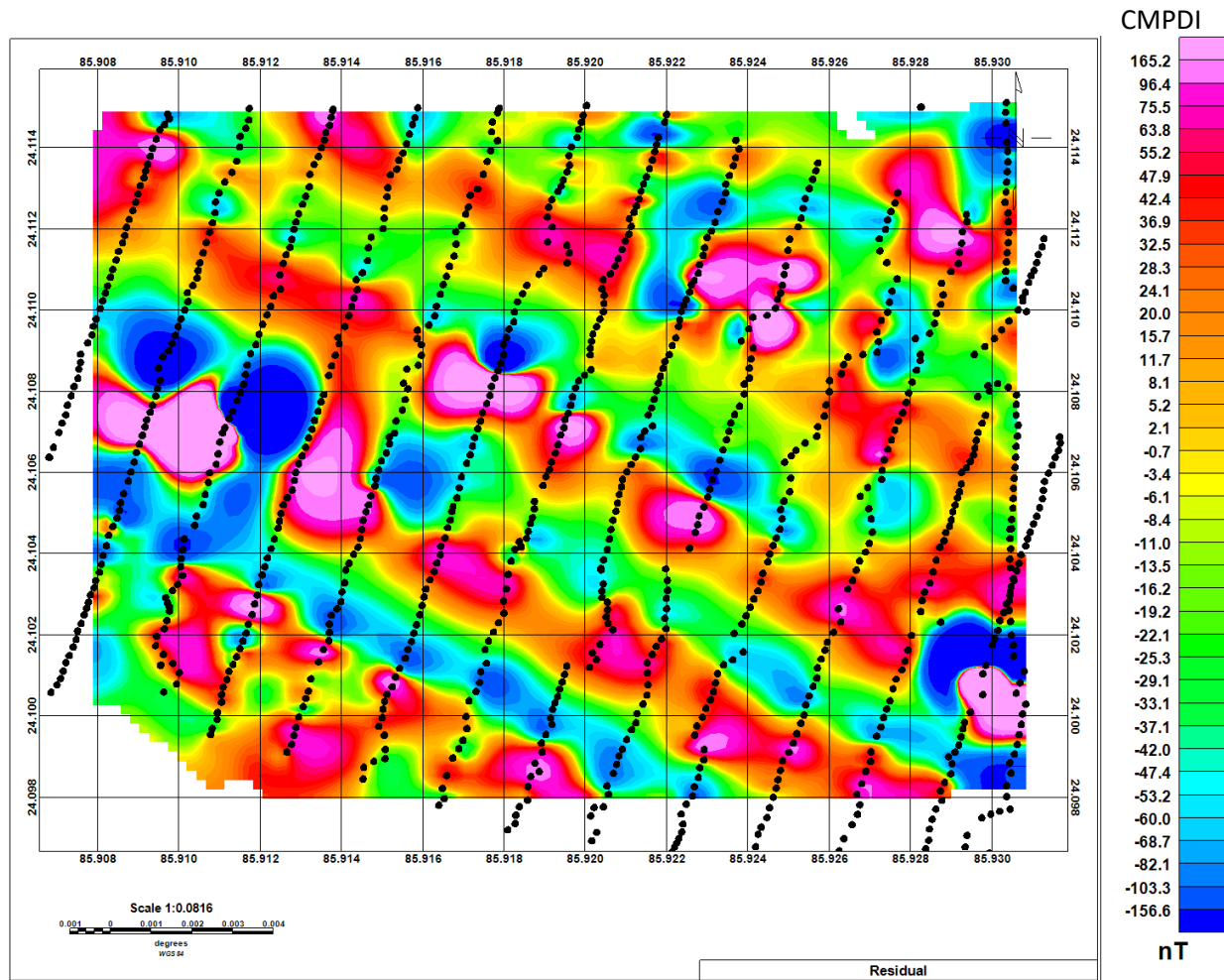


Fig gp2(b): Residual Magnetic Anomaly Map

A magnetic anomaly originates in the magnetization contrast (ΔM) between rocks with different magnetic properties. However, the shape of the anomaly depends not only on the shape and depth of the source object but also on its orientation to the profile and to the inducing magnetic field, which itself varies in intensity and direction with geographical location.

Removing, broad wavelength signals that arise due to regional features, a better image of shallow-seated body can be obtained as shown in Fig 6gp2(b) as residual anomaly map. It is obvious that magnetic anomaly contrasts are concentrated linearly, extending from coordinates 24.107118, 85.911105 to 24.096725, 85.928376.

Its radial averaged power spectrum and depth estimation is presented in Fig :6gp3. It is obvious that the causative body is mostly situated between surface to not more than 40 meters depth along abovesaid anomalous zone.

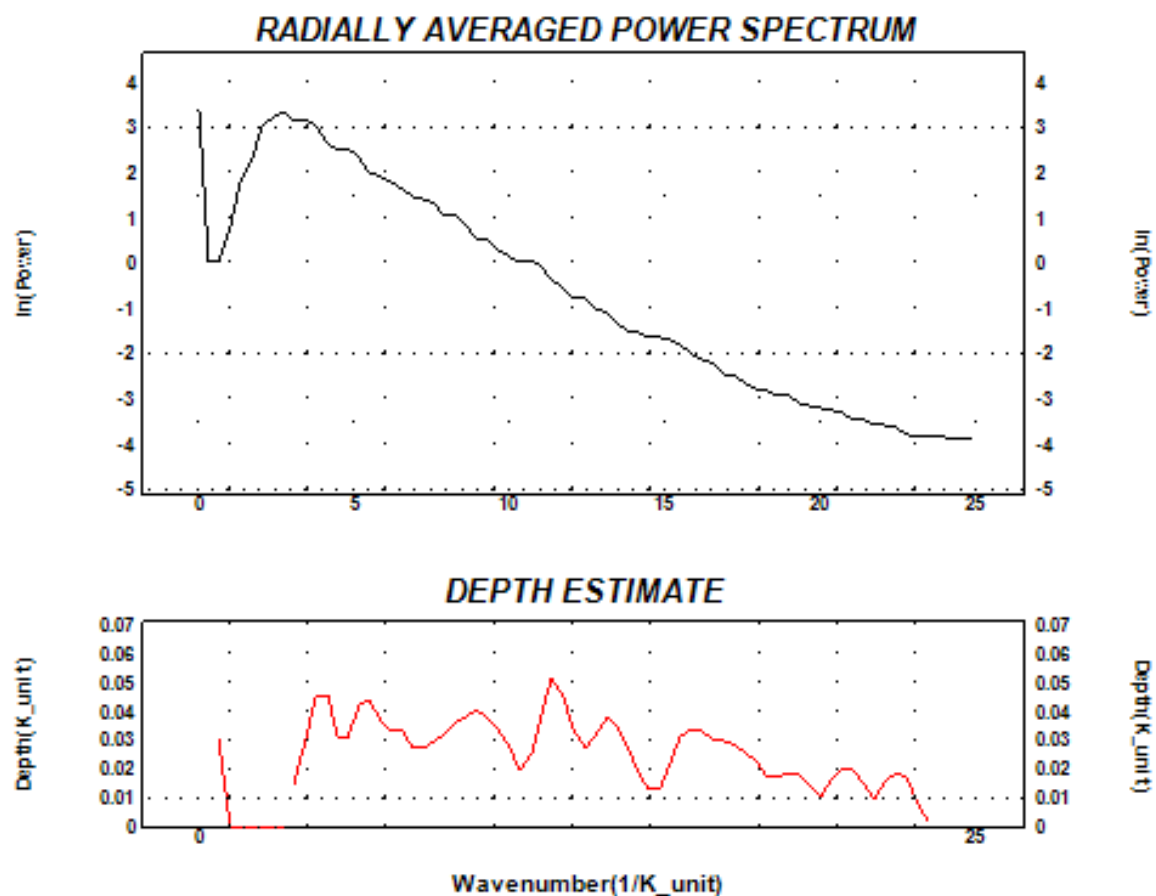


Fig 6gp3: Depth estimate from Radially Averaged Power Spectrum of Residual Anomaly

A 2D Fourier transform of the data in Fig 6gp2(b) is done to obtain the power spectrum in the frequency domain. The power values across all the directions in the spectrum is averaged for each wavenumber (spatial frequency). This results in a single curve representing the average power distribution across different wavenumbers that is presented in Fig 6gp 3. By analysing the slope of the radially averaged power spectrum, the depth of geological structures responsible for magnetic anomalies can be estimated. Steeper slopes at lower wavenumbers indicate deeper sources, while shallower slopes at higher wavenumbers indicate shallower sources.

The depth to the source can be calculated from the slope of the log radially averaged power spectrum using the formula: $h = s / (4 * \pi)$, where 'h' is the depth and 's' is the

slope. It is obvious from the Fig 6gp3, that at even the lowest wavenumber with coordinate (3,3.5) & (6,2) on power spectrum map, the slope comes out to be -0.5 which corresponds to the depth of 39.7m. All other slopes give even shallower depths for higher wavenumbers.

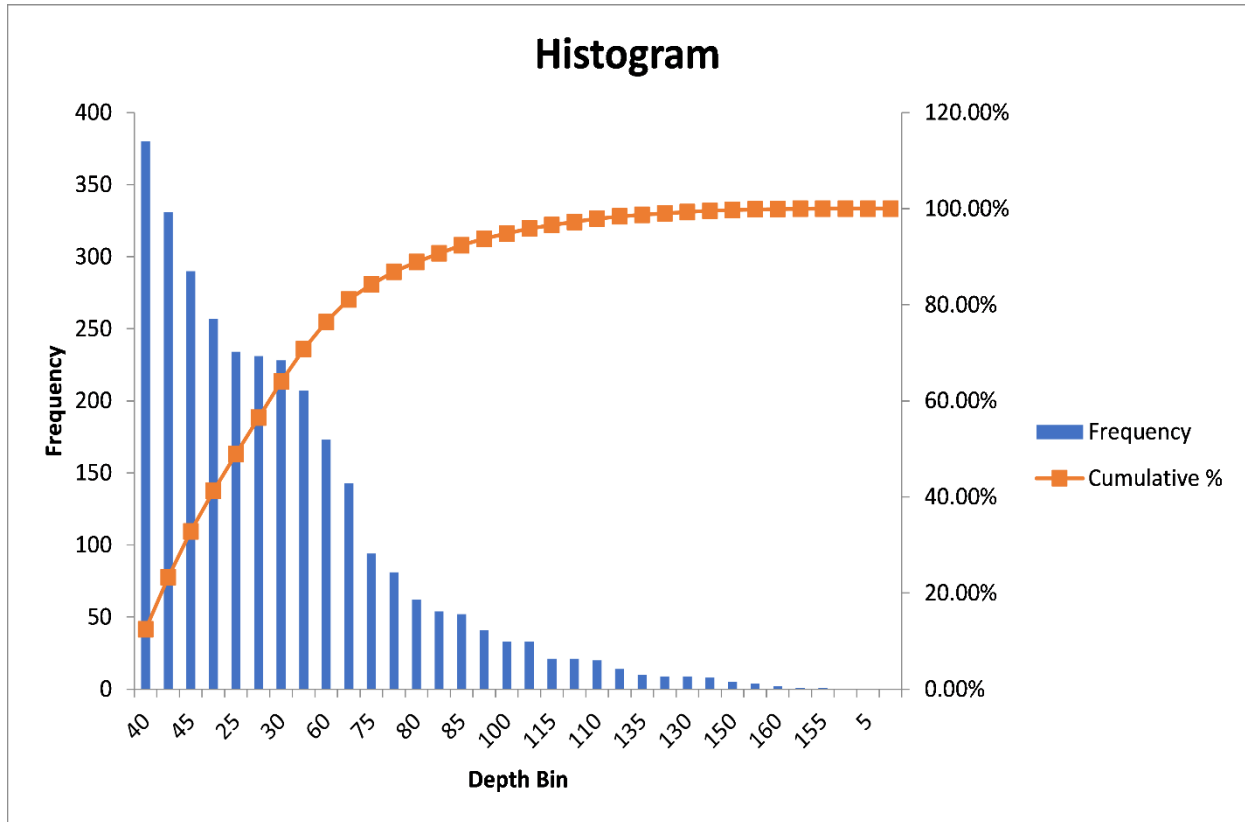


Fig 6gp3(a): Depth distribution with spatial frequency.

The Euler deconvolution technique for estimating the depth and the horizontal position of the magnetic sources is based on solving Euler's homogeneity equation $(x-x_0)\partial F/\partial x + (y-y_0)\partial F/\partial y + (z-z_0)\partial F/\partial z = -nF$, where the homogeneous function F is the magnetic anomaly in Fig 6gp2(b) at location (x,y,z) , caused by a source at location (x_0,y_0,z_0) , and n , denoted as the structural index, is a measure of the rate of change of the anomaly with distance. Considering $n = 2$ for cylindrical structures, the equation is solved for z (depth) for different (x,y) locations and observed anomaly field F .

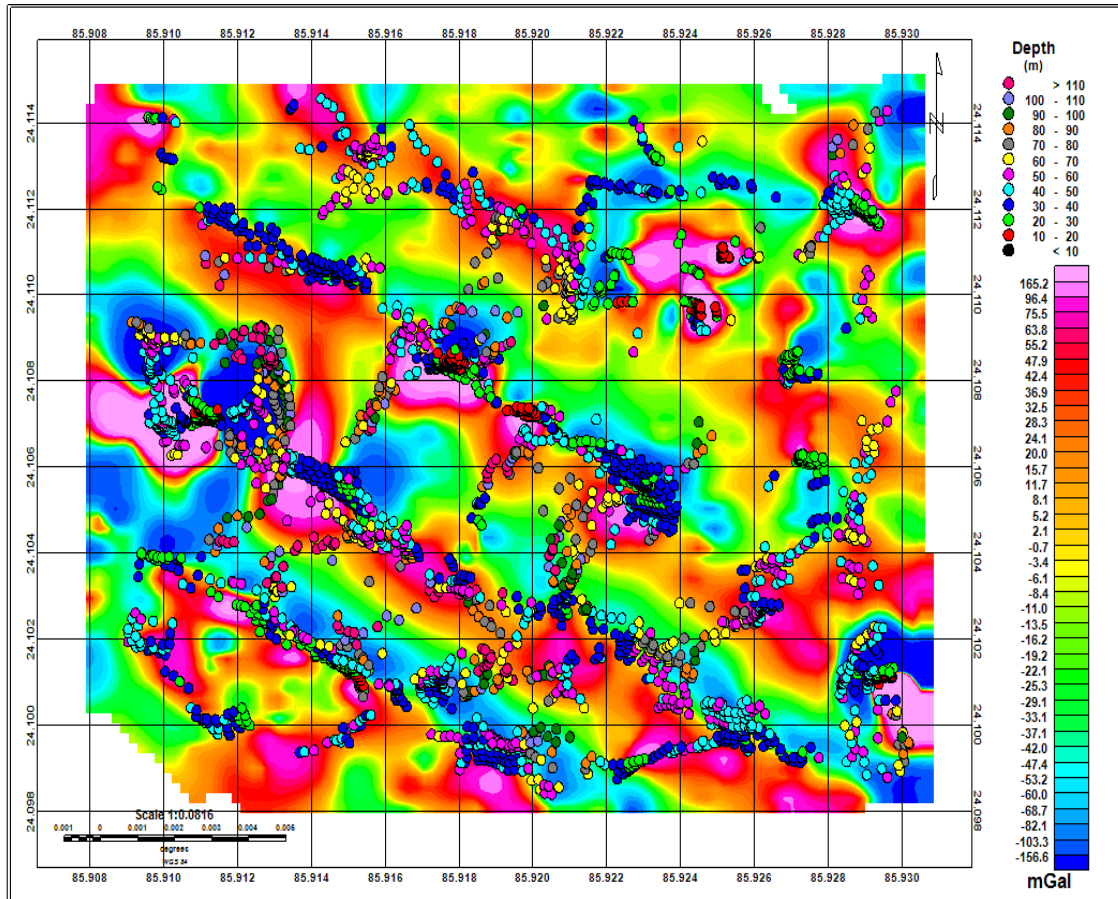


Fig 6gp4: Depth Solution Map obtained from Euler Deconvolution

In Fig 6gp4, depth solutions for target bodies based on Euler's method have been mapped where blue dots being most prominent indicates causative body to lie in the depth range of 30-40m. While black dots mark the surface exposure of source which correlates with observed field data.

In Fig 6g5, depth contours are drawn with a contour interval of 5m.

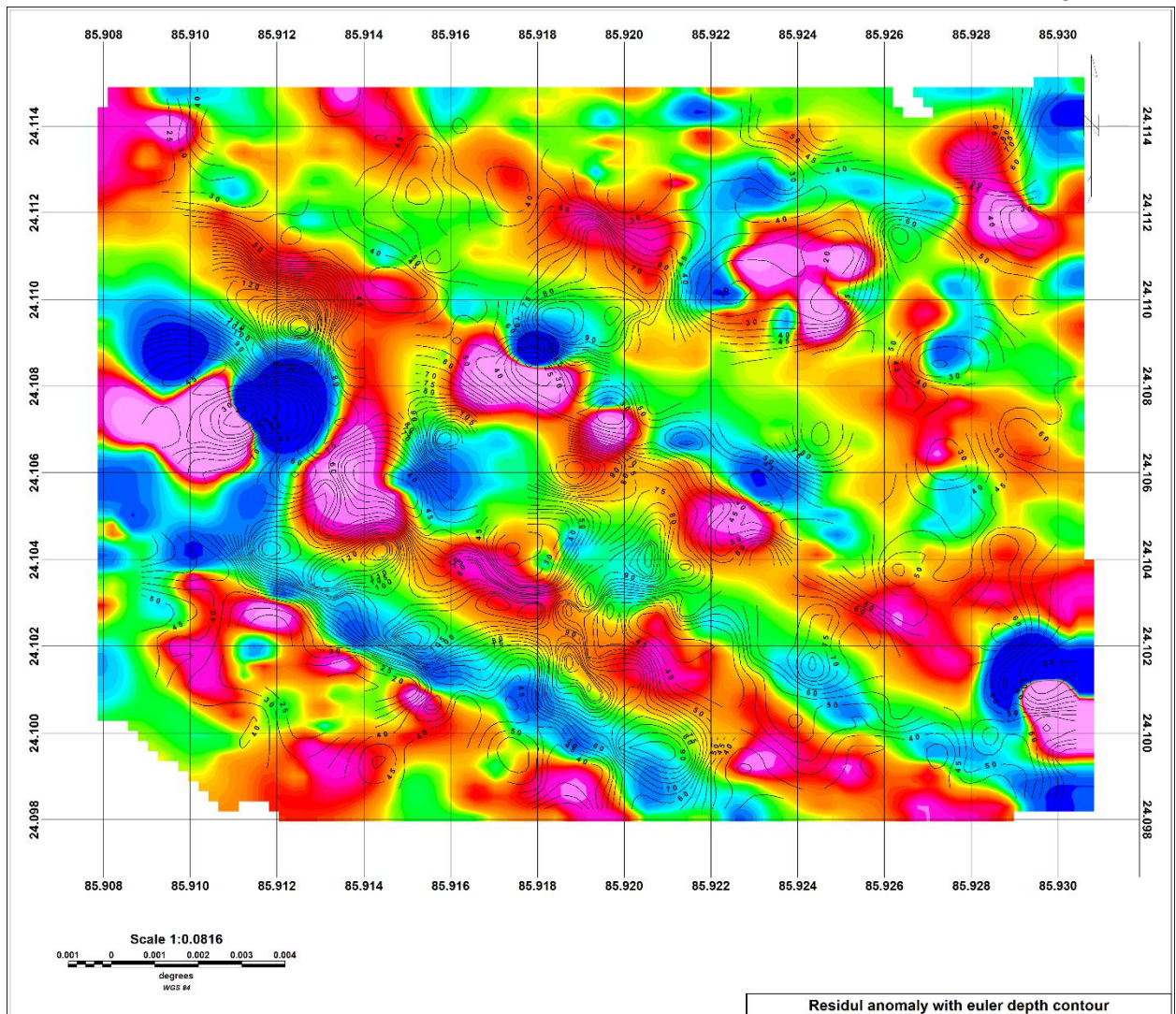


Fig 6gp5: Depth contours over residual anomaly map.

Reduction to the equator is used in low magnetic latitudes because it makes the magnetic field of the Earth and magnetization of the magnetic sources appear horizontal and it also centres the peaks of magnetic anomalies over their sources.

The anomaly map when reduced to equator is presented in Fig 6gp6.

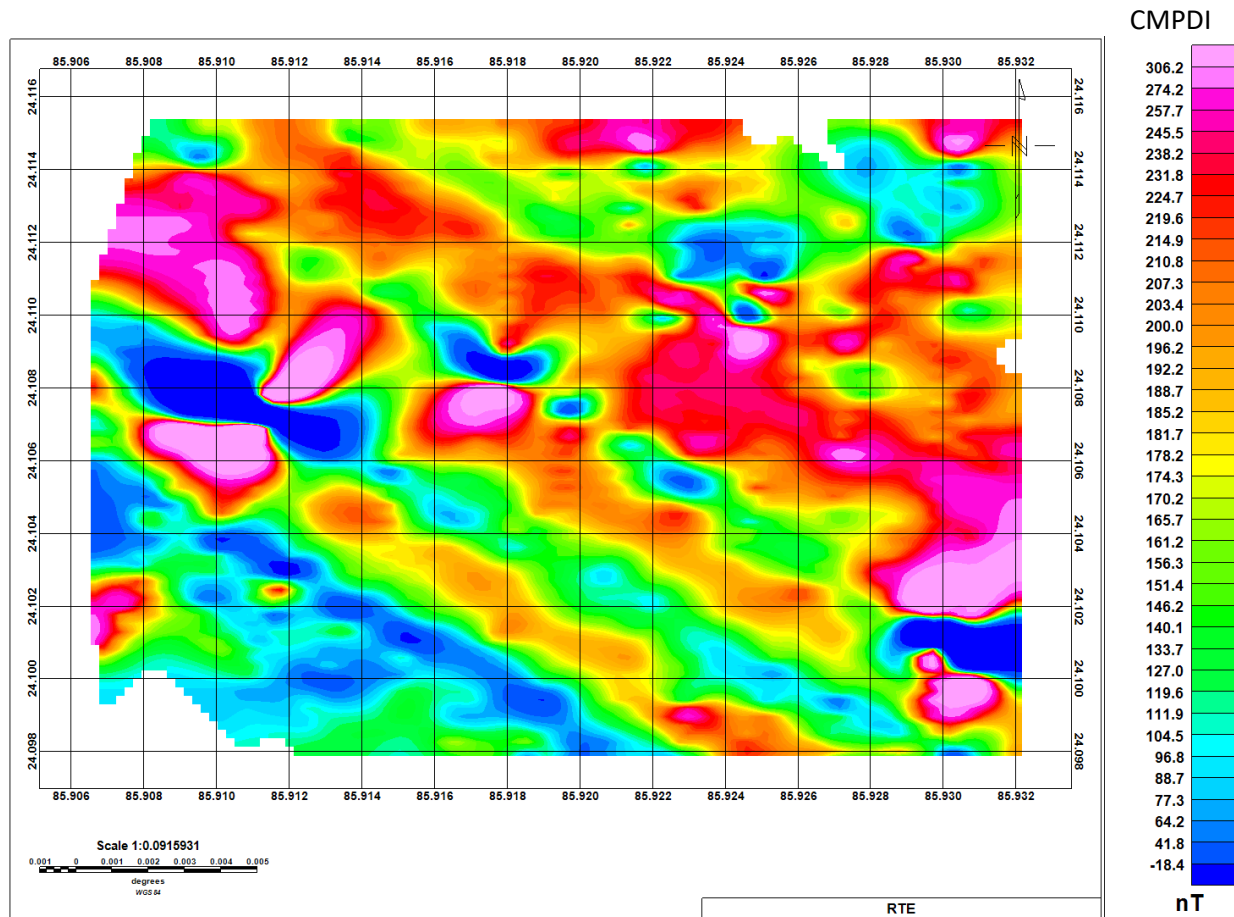


Fig 6gp6: Reduction to Equator Map

Horizontal derivative maps in magnetic data processing are crucial for identifying the lateral edges of subsurface geological structures and enhancing subtle anomalies. They highlight rapid changes in the magnetic field, which often correspond to boundaries between different rock types. While vertical derivative maps enhance shallow geological features and highlight the edges of magnetic bodies. In Fig 6gp7(a), 7(b) & 7(c) derivative maps of residual anomaly has been presented.

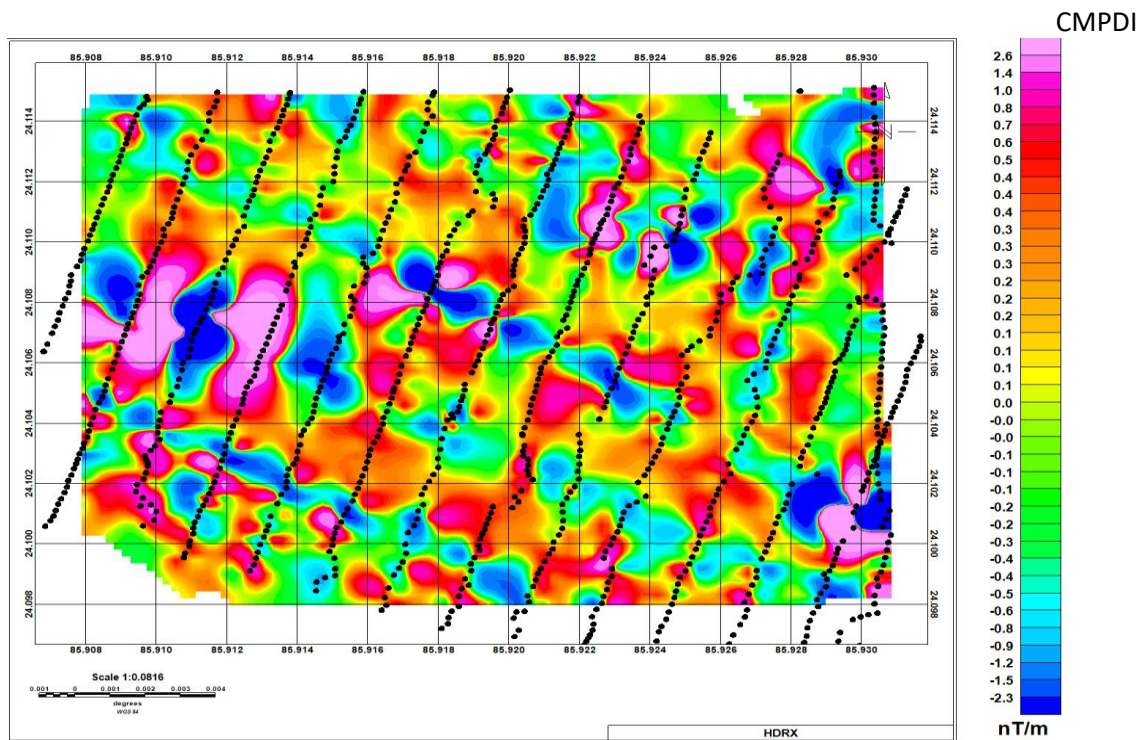


Fig 6gp7(a): Horizontal derivative map in the direction of latitudes.

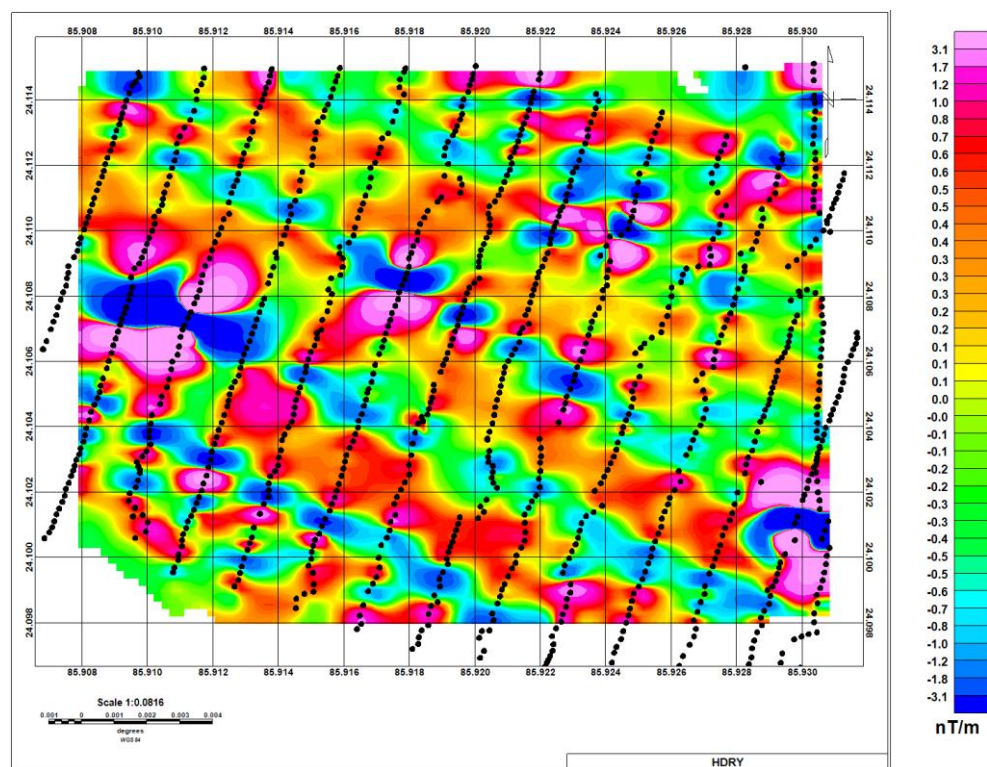


Fig 6gp7(b): Horizontal derivative map in the direction of longitudes.

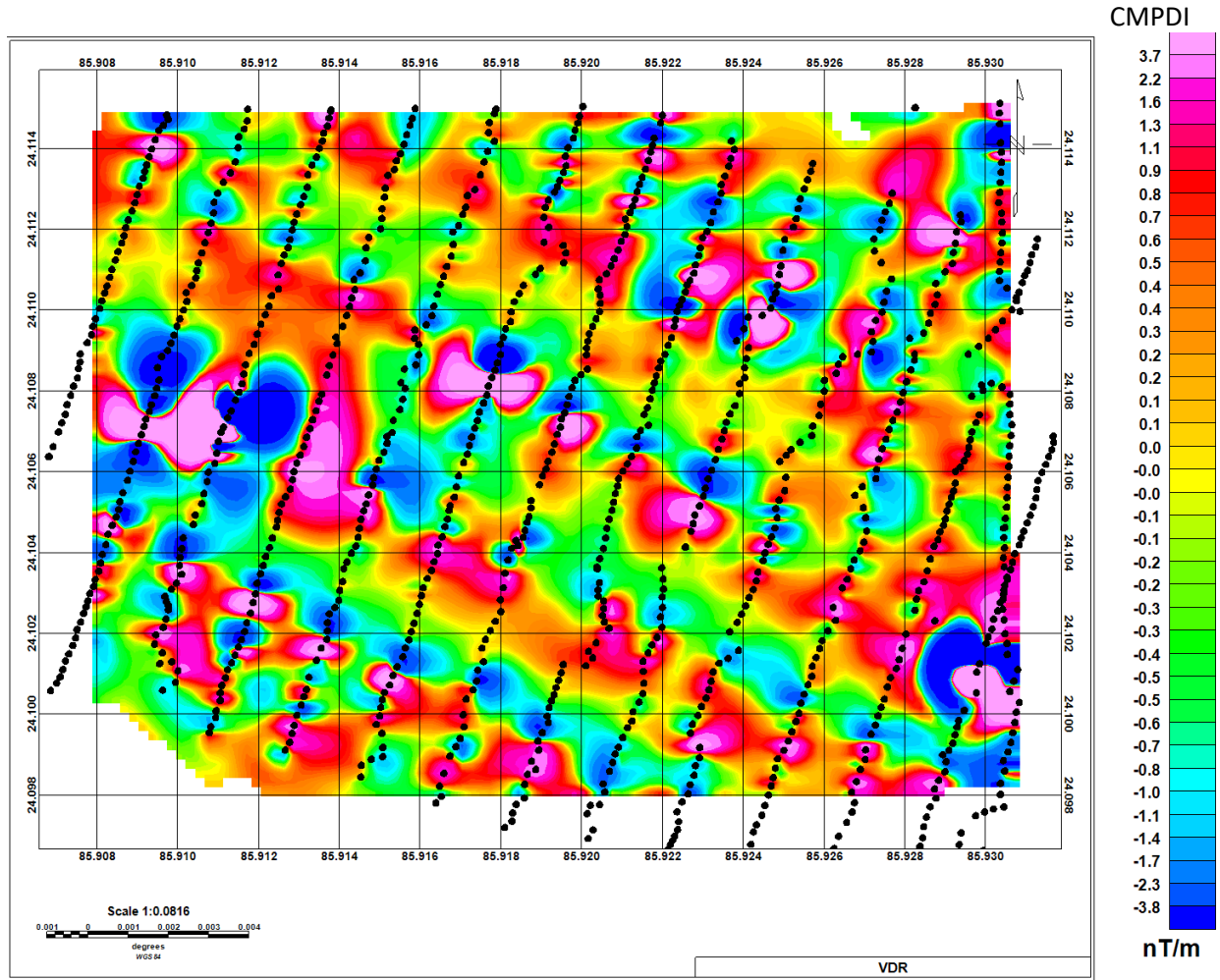


Fig 6gp7(c): Vertical derivative map.

The analytical signal is formed by the horizontal and vertical gradient of the magnetic anomaly and is given by

$$A(x, z) = \sqrt{(\partial T / \partial x)^2 + (\partial T / \partial y)^2 + (\partial T / \partial z)^2}.$$

An analytical signal map (presented in Fig 6gp8) enhances the visibility of anomalous features and boundaries without having dip information. Since the dependence on the direction of magnetization and the source's attitude (dip and strike) are removed, it becomes simplified for edge detection and source location as features like the asymmetry of magnetic anomalies caused by dipping sources are lost.

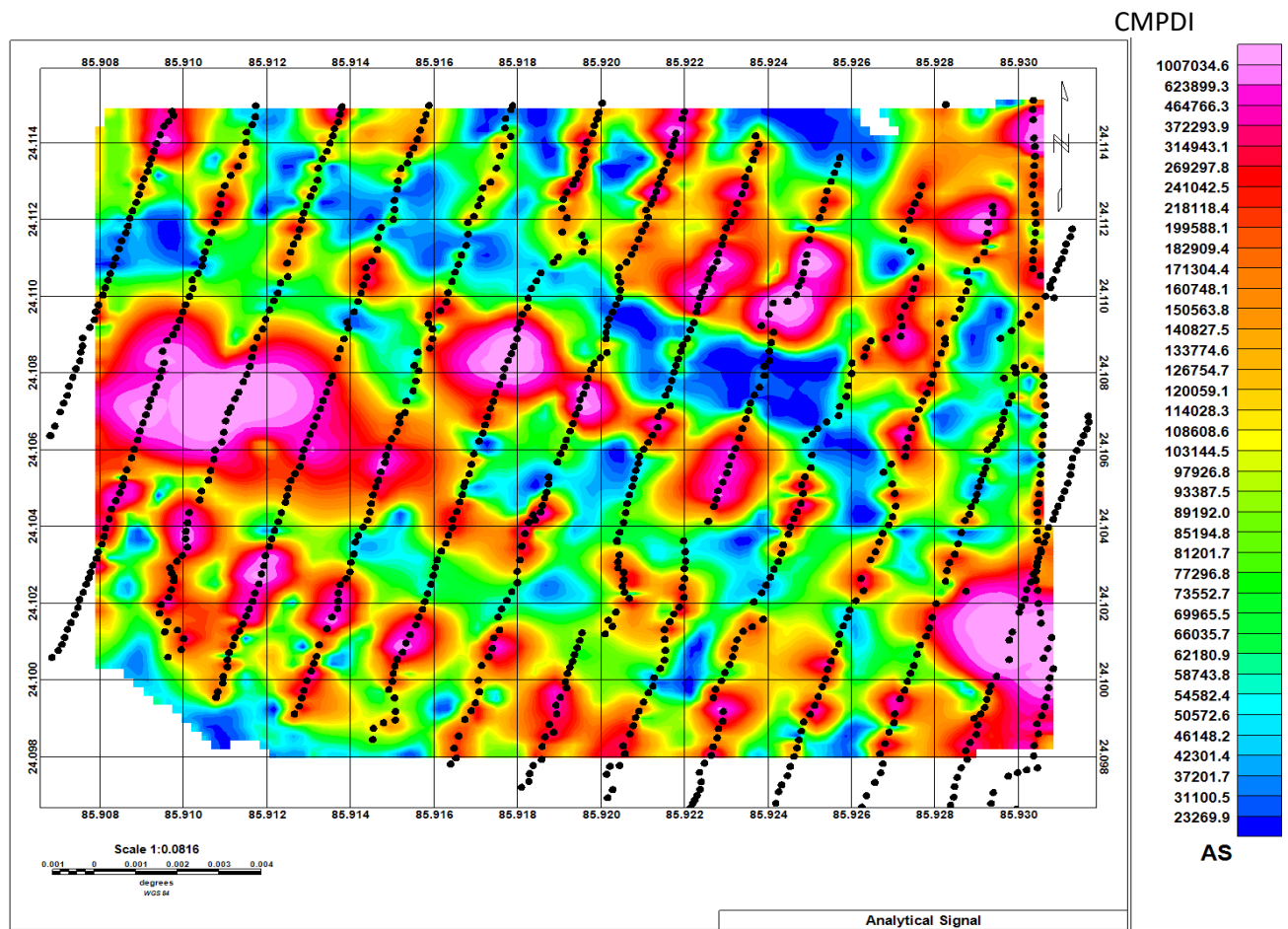


Fig 6gp8: Analytic Signal map

A "tilt derivative" in magnetic data refers to a calculated value that represents the ratio between the vertical derivative and the horizontal gradient of the magnetic field, essentially indicating the "tilt" of the magnetic anomaly, and is often used to highlight the edges of magnetic sources within a data set by emphasizing sharp changes in the field direction. From Fig 6gp9, it can be easily observed the sharp contrasts in linear pattern indicating the strike line of an anomalous body.

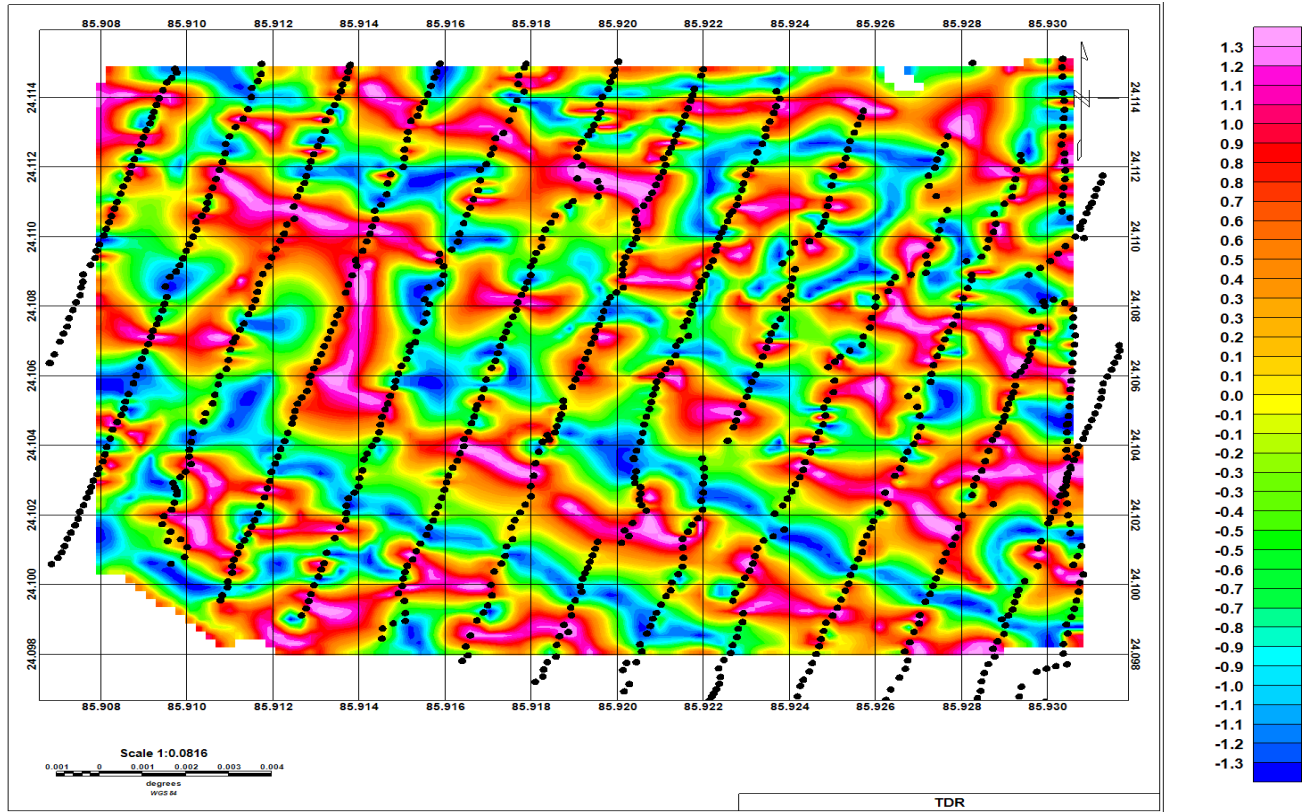


Fig 6gp9: Tilt Derivative Map.

6.2.6. Conclusion and Recommendations

The magnetic survey conducted over around 7 sq km of Pipradih area under consideration provides many promising spatial locations with depth of causative body having anomalous magnetization. The anomaly observed coincides wherever outcrop of magnetite is developed. In the following table 6.2.2, eleven promising zones have been segregated giving rise to magnetic value contrast. Figure 3 & 4 clearly establishes that the depth of target body lies at around 40 meters in two linear trends as marked in Fig 6gp10 along with recommendation for trenching over high anomaly.

Table 6.2.2: High magnetic anomaly locations.

LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
24.105	85.914	24.105	85.923
24.103	85.917	24.103	85.927
24.101	85.921	24.112	85.920
24.111	85.912	24.114	85.928
24.108	85.918	24.103	85.912
24.107	85.920		

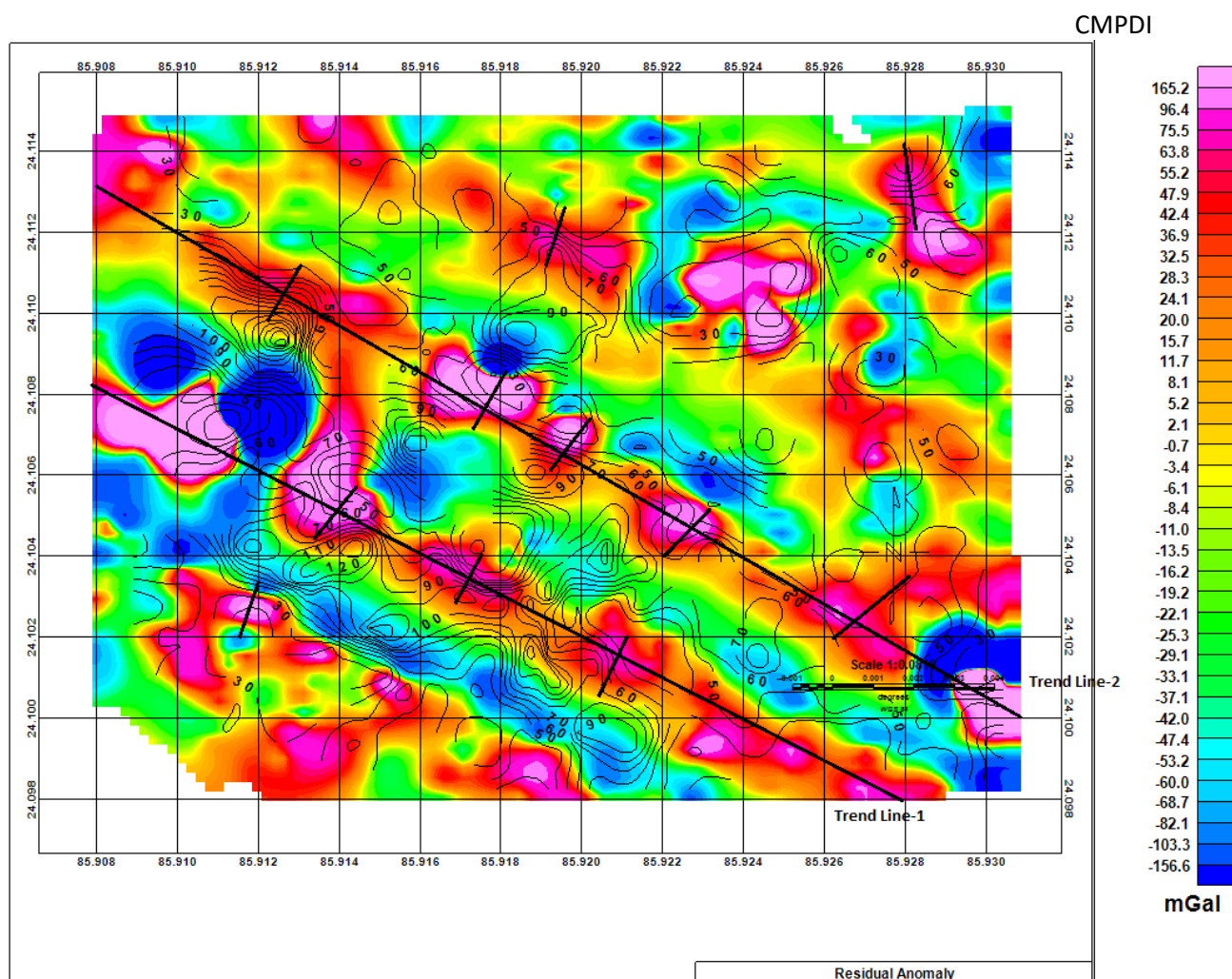


Fig 6gp10: Trend Lines over probable high anomaly zones.

6.3. Geochemical Exploration

Major oxide analysis was carried out of total 42 bed rock samples collected during field work. 25 of these samples were from various country rock types collected from the field and 17 bedrock samples were of magnetite ore. Details of major oxide analysis of these samples have been provided in Annexure-II A and II B.

Thin sections were prepared from total 04 (four) number of bed rock samples collected during the field mapping work and petrographic studies were carried out by MECL Petrology Laboratory, Nagpur. Detail of petrographic studies is given in Annexure-III A.

On the basis of chemical analysis two WNW-ESE trending ore zone were established. Figure:6p shows magnetite sample location and trench locations on the geological plan.

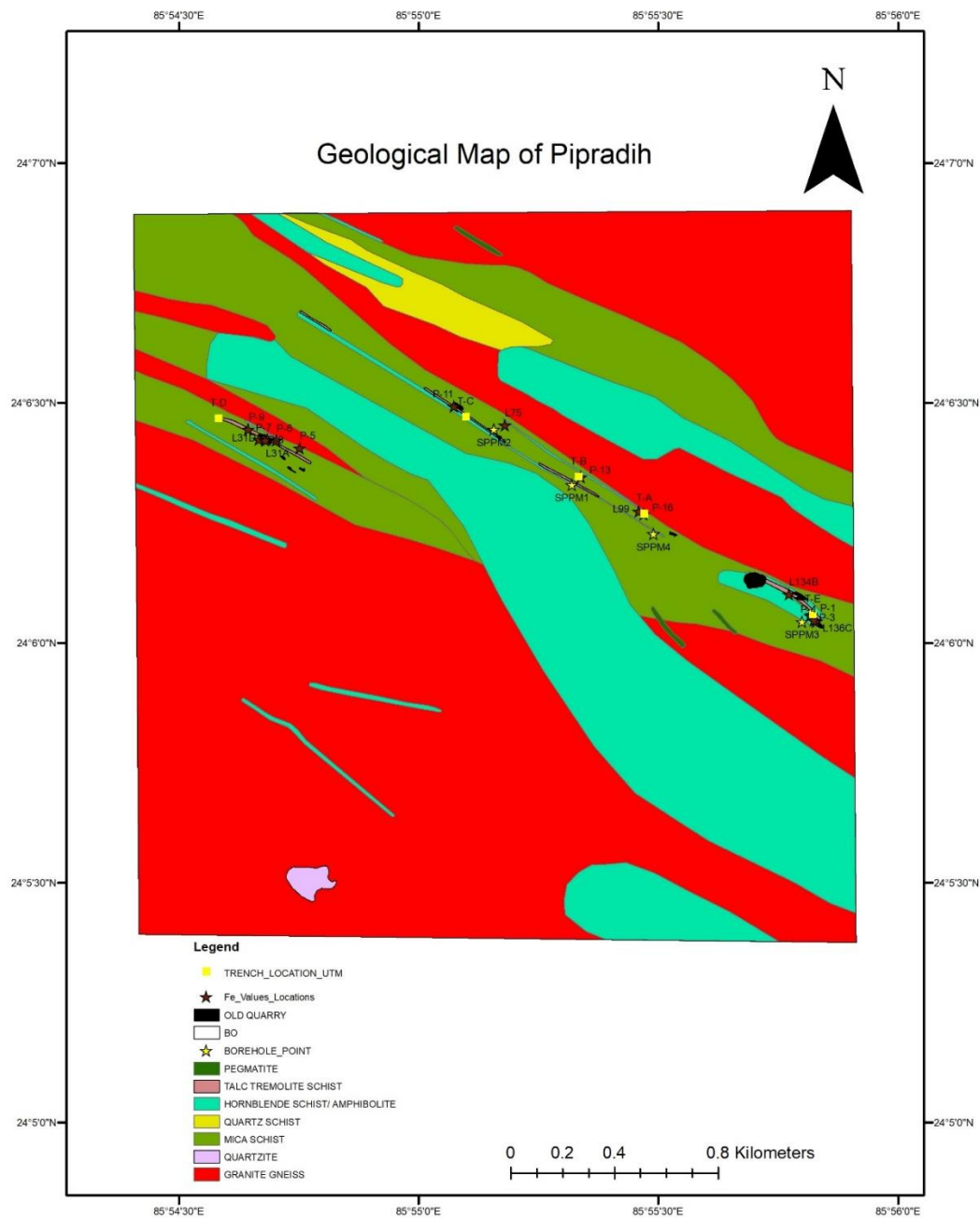


Fig-6p: Magnetite occurrence and trench locations on the geological plan.

6.4. Topographic Survey

6.4.1 Introduction

A drone survey was carried out at Pipradih Block, Giridih District, Jharkhand on 30.05.2025 to generate dataset for preliminary exploration in Pipradih Block, Giridih district, Jharkhand. The survey was executed using an Idea Forge Q6 V2 unmanned aerial vehicle (UAV) equipped with a PPK-enabled positioning system and a Sony 24.3 MP photogrammetric camera (Fig 6s1). Eight Ground Control Points (GCPs) were established to strengthen the horizontal and vertical accuracy of the photogrammetric products.



Figure 6s1: Idea Forge Q6 V2 Drone Used for the Survey

6.4.2 Survey Methodology

Prior to the drone flight, the entire area was planned in Google earth and the GCPs were marked in the ground to ensure uniform spatial distribution. The UAV mission was executed using Idea forge Blue fire touch software following standard photogrammetric practices. Approximately 4330 numbers of drone acquired imagery were geotagged in Blue fire map assist software. The geotagged images then processed in Agisoft Metashape software, where image alignment, camera optimization, dense point cloud generation, Digital Terrain Model (DTM) generation, orthomosaic creation and contour extraction were carried out. Quality checks were performed throughout the workflow to ensure reliable outputs.

6.4.3 Survey Outputs

The processed datasets comprised of a high-resolution ortho-photo mosaic (Fig 6s2), a Digital Terrain Model (DTM) (Fig 6s3) representing the bare-earth surface, and a contour map generated at a 2 m interval (Fig 6s3). These outputs provide an accurate representation of the terrain and can be used for planning, engineering design, volume estimation and other geospatial analyses.

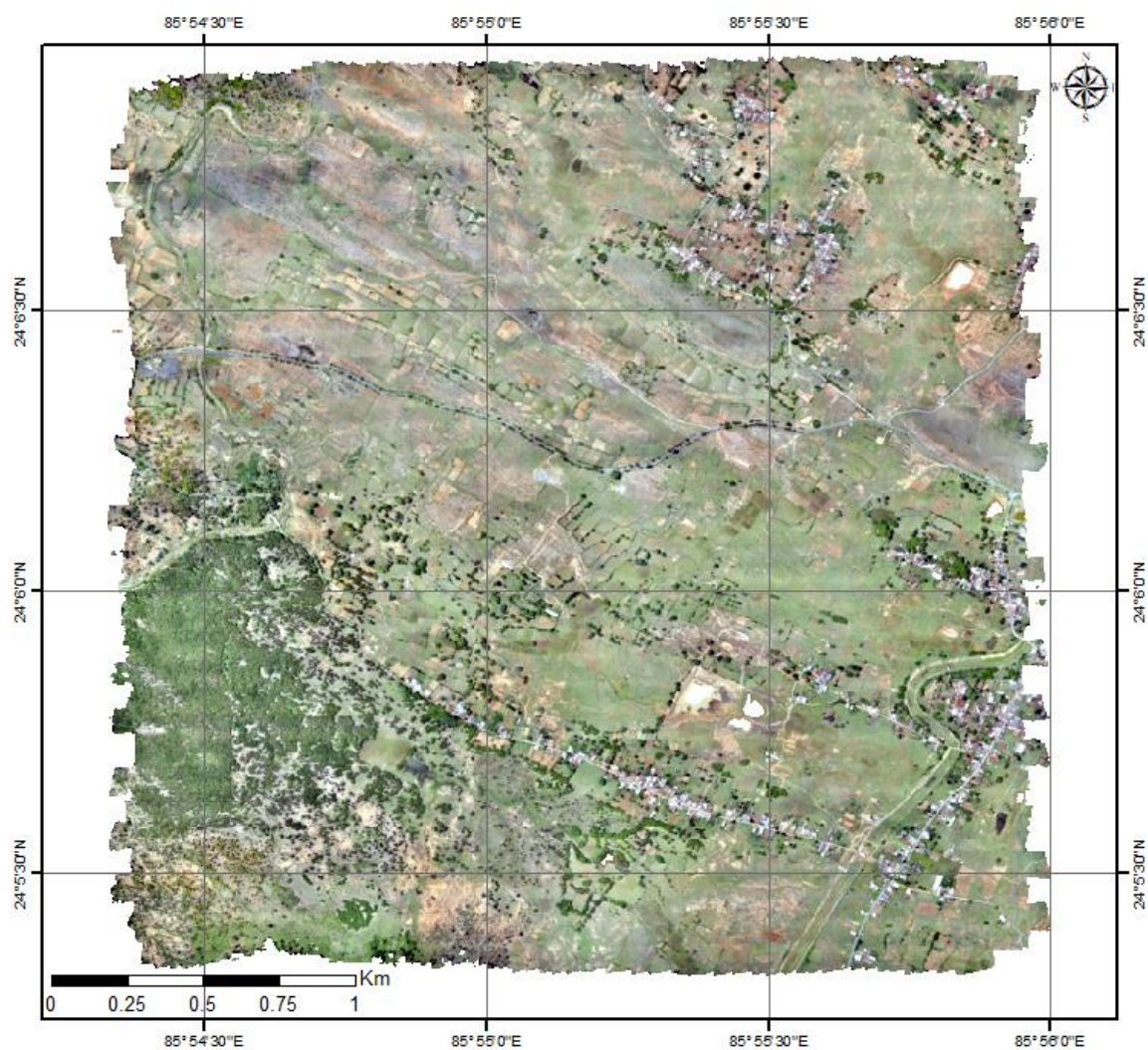


Figure 6s2: High Resolution Ortho-photo of the Survey Area

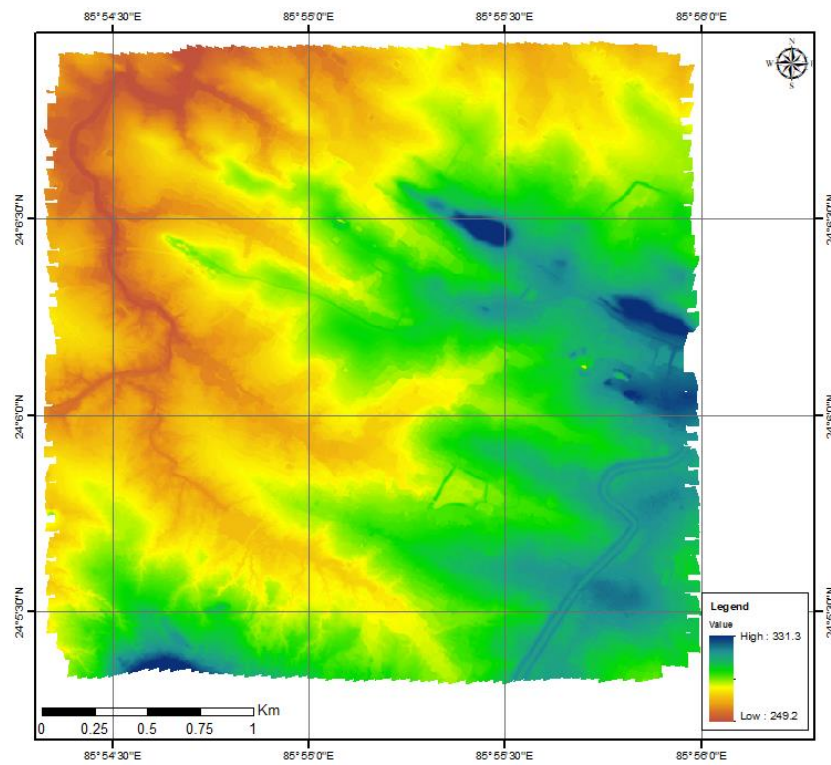


Figure 6s3: Digital Terrain Model (DTM)

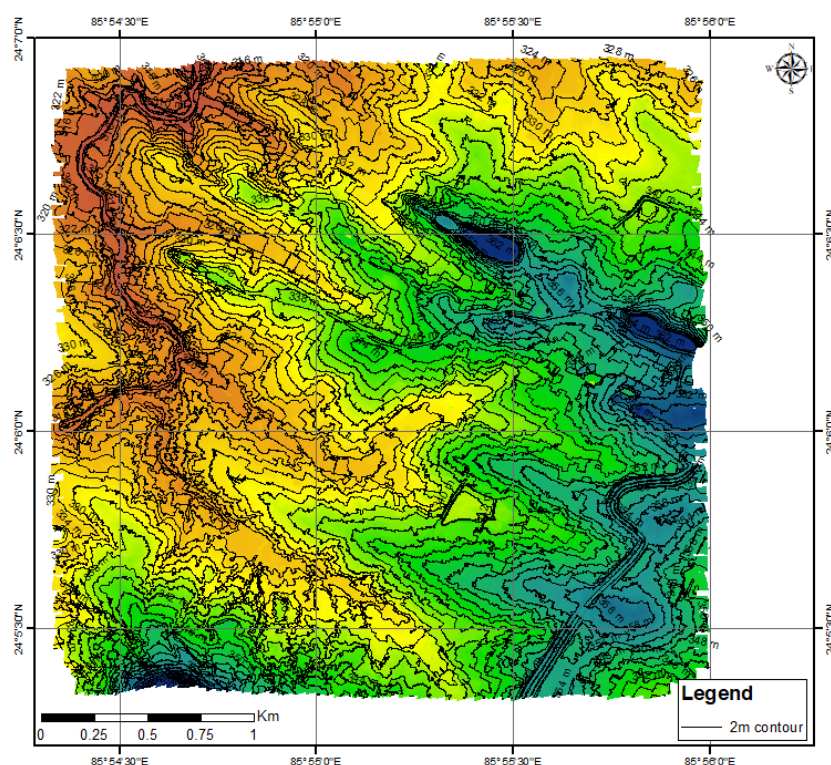


Figure 6s4: Contour Map (2 m Interval) over DTM

6.4.4 Conclusion

The drone survey of Pipradih Block was completed successfully using the Idea Forge Q6 V2 PPK-enabled UAV and Sony photogrammetric camera. The establishment of eight GCPs and rigorous photogrammetric processing resulted in high-quality geospatial products, including a high-resolution ortho-photo, DTM and 2m contour map. The higher elevation areas of the block are shown in blue color and the lower areas are shown in dark orange color as observed from the DTM. These datasets provide a dependable spatial database for subsequent analysis and decision-making.

Technical Specification of Q6V2 UAV

Attributes	Values
1. General	The UAV offers enhanced surveillance and intelligence capabilities, which provides real-time data. Its compact design and advanced technology enables high performance in diverse applications
2. Maximum Take-off Weight (MTOW)	Approx. 5905 gm (with battery and max. pay load) UAV falls under small category (As per Drone Rules 2021)
3. UAV Size	Arm Tip to Arm Tip: 1054 mm (max) Diagonal Length: 1484 mm (max)
4. Endurance (upto 1000 m AMSL Take-off)	70 minutes (upto 1000m AMSL Take-off)
5. Range of Communication:	Day Operation: 2 km Night Operation: 1 km
6. Launch and Recovery	Vertical Take-off and Landing (VTOL) from within an area of 15 m x 15 m.
7. Dust & Drizzle Resistance	IP54 rating (OEM Certification)
8. Flight Modes	(a) Fully autonomous Vertical Take-off and Landing (b) Altitude Hold (c) Hover at a defined way point (d) Autonomous Waypoint Navigation (pre-defined as well as dynamically adjustable waypoints during flight) (e) Remotely Piloted Vehicle (RPV) mode

	(f) Real-time Target Tracking of designated static and moving targets
9. Pay load carrying capacity	Capability to carry Daylight, Thermal, Photogrammetric and 4-band Multispectral Payload
10. Operational Envelope	(a) Maximum Ceiling Height: 6000m AMSL (Above Mean Sea Level) (b) Maximum operating altitude (AGL): Restricted to 400 feet AGL by GCS (Approx. 120m) (As per Drone rules 2021) (c) Wind resistance: Up to 10 m/s (36 kmph or ~20 knots) (d) Cruise Speed: 14 m/s (50 km/hr) (e) Functional Temp Range: -20°C to +55°C
11. Fail safe Features (Return to Home)	(a) Auto-Return to Home and Land on Communication Failure (b) Auto-Return to Home and Land on Low Battery (c) Multiple GPS on-board for redundancy (d) Auto-Return to Home and Land on exceeding Wind limit of the system (e) Auto-Return to Home and Land on Battery Imbalance. (f) Auto-Return to Home and Land on exceeding UAV health parameters (Temperature vibration and Throttle limit of the system)
12. Navigation Lights	Switchable (from GCS)
13. Day light Pay load	(a) Resolution: 1920 x 1080 pixel (b) Optical Zoom: 27 x (c) Digital Zoom: 4x (d) Human size target detection: 1500 m slant range (e) Purpose: Daylight Surveillance (f) Model: IF11747
14. Photogrammetric Payload	(a) Purpose: Mapping. (b) 24.3 MP Photogrammetry payload. (c) High accuracy L1 & L2 Frequency Band Enabled PPK. (d) X, Y Accuracy: <10 cm at 120 m AGL (with 95% confidence interval). (e) Z Accuracy: <20 cm at 120 m AGL (with 95% confidence interval). (f) On board Storage: Minimum 64 GB (expandable) (g) Model: IF6682
15. Pay load Control (in flight)	Pan: 360° continuous Tilt: 90°
16. GUI Display parameters	(a) Geographic Map along with UAV location, UAV trajectory, camera view polygon, way points and flight plan. (b) Real-time video displayed at all times during the flight (c) Artificial Horizon indicating UAV attitude
17. GCS Application Software	3D Maps: Switchable between 2D/3D map views, capable to tilt/rotate 3D maps as per user input
18. Maps Support	(a) Capable of working with some publicly available open-source

	maps. (b) Application has the capability to download maps automatically after specifying location GPS co-ordinates. (c) 2D Maps: Capable to integrate geo-referenced raster maps provided in at least one of the commonly used digital map formats (e.g.GIF, TIFF) as well as shape file (.shp)
--	--

6.5. DGPS Survey

6.5.1 Methodology

DGPS (Differential Global Positioning System) survey was used for boundary demarcation of Pipradih Magnetite Block & determination of coordinates of boreholes.

The Global Positioning System (GPS) is a satellite-based location, timing and navigation system in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. Presently, 32 orbiting satellites of GPS constellation of USA and 24 GLONASS (Globalnaya navigatsionnaya sputnikovaya sistema or Global Navigation Satellite System) satellites of Russia are operational for the purpose of GPS survey.

The Global Positioning System is made up of three parts: satellites orbiting the Earth; control and monitoring stations on Earth; and the GPS receivers owned by users. GPS satellites transmit three information – the satellite's number, its position in space, and the time. These signals are picked up by the GPS receiver on ground. With signals from three or more satellites, a GPS receiver can triangulate its location on the ground (i.e., longitude and latitude) from the known position of the satellites. With four or more satellites, a GPS receiver can determine a 3D position (i.e., latitude, longitude, and elevation).

Differential Global Positioning System (DGPS) refers to using two or more GPS receivers to achieve greater positional accuracy. Basic methods of DGPS survey are Static, Rapid-Static, Real-time Kinematic (RTK) and Real-time Kinematic with smart link.

In static surveys, one GPS receiver is used as base Station and other GPS receivers can be used as Rover stations. Base receiver is stationed at a point of known Coordinates for longer duration and the rover stations are kept at unknown stations for comparatively shorter duration. Data from Base and rovers are then post-

CMPDI processed in GPS data processing software to achieve sub-centimeter level accuracies, especially in case of dual-frequency GPS receivers, which is in possession of CMPDI. ArcGIS software was used for preparation of creation of shape files of boundary points and borehole points in WGS-84 and UTM Coordinates.

Real-time kinematic (RTK) with smart link method was used for boundary demarcation of Pipradih Magnetite Block & determination of coordinates of boreholes. In RTK survey with smart link facility, which is a subscription based service, the real time correction is derived from satellite.

6.5.2 Survey Instrument



Figure 6s5: DGPS instrument

Brief specifications of the available DGPS consisting of Base and Rover receivers are as follows:

(a) Instrument:	
Make	Leica
Model	GS25 (Base Receiver), GS16 (Rover Receivers)

Signal	GPS: L1, L2 L2C & L5, GLONASS: L1, L2 & L3 GALILEO: E1, E5a, E5b, Alt-BOC & E6 BeiDou : B1, B2 & B3 QZSS: L1, L2, L5 & LEX NavIC : L5 SBAS: WAAS, EGNOS, MSAS, GAGAN L-band
Channels	555
Accuracy :	
Post Processed Static DGPS	3mm +0.1ppm horizontal, 3.5mm + 0.4 ppm vertical
Real Time RTK	8mm + 1 ppm horizontal, 15mm + 1 ppm vertical
RTK with Smart Link facility	± 3 cm horizontal
Power:	
Internal Battery	Exchangeable Li-Ion, 2.6Ah, 7.4V
Communication :	
Bluetooth	Bluetooth standard 1.2
USB	1.1 Version
(b) Software	
	i) Leica Captivate for data recording

6.5.3 Field Activity

Reconnaissance survey was done after reaching the site. Officials from Exploration department and Geomatics Division were associated during reconnaissance and subsequent survey work.

I) Boundary demarcation: Boundary points were provided by Exploration department (*Table-6.5.1*). The coordinates of boundary points in UTM Zone 45 were entered in

the controller of DGPS rovers and the rover receiver was used to stake out the boundary points of Pipradih Magnetite Block by RTK method with smart link.

II) Borehole survey: DGPS rover receivers were used to ascertain UTM coordinates of borehole) by RTK method with above smart link enabled DGPS rover receiver.

Boundary points of Pipradih Magnetite block

T A B L E - 6.5.1					
Points	Geographical Coordinates (WGS-84)		UTM Coordinates (Zone 45)		Reduced Level (m)
	Longitude	Latitude	Easting (m)	Northing (m)	
A	85° 54' 24.37171"E	24° 06' 53.59233"N	388900.808	2667379.278	321.506
B	85° 55' 54.11218"E	24° 06' 54.07092"N	391434.411	2667374.471	327.562
C	85° 55' 54.74699"E	24° 05' 22.55584"N	391430.901	2664559.526	344.975
D	85° 54' 25.00212"E	24° 05' 23.56066"N	388897.029	2664609.942	338.259

Chapter-7

Integration of Geology, Geophysics and Geochemical investigation and Interpretation

Based on geological field mapping, geochemical analysis and petrographic studies, geological map of the study area was prepared and is provided as Plate-IV. Geological field mapping showed presence of isolated lenses of talc-tremolite actinolite schist following the trend of regional foliation. Magnetite occurrence is also roughly following the same trend. (Fig:6p)

Ground magnetic survey also establishes two linear trends in magnetic anomaly. The magnetic anomaly zone matches well with the magnetite occurrence and trench locations.

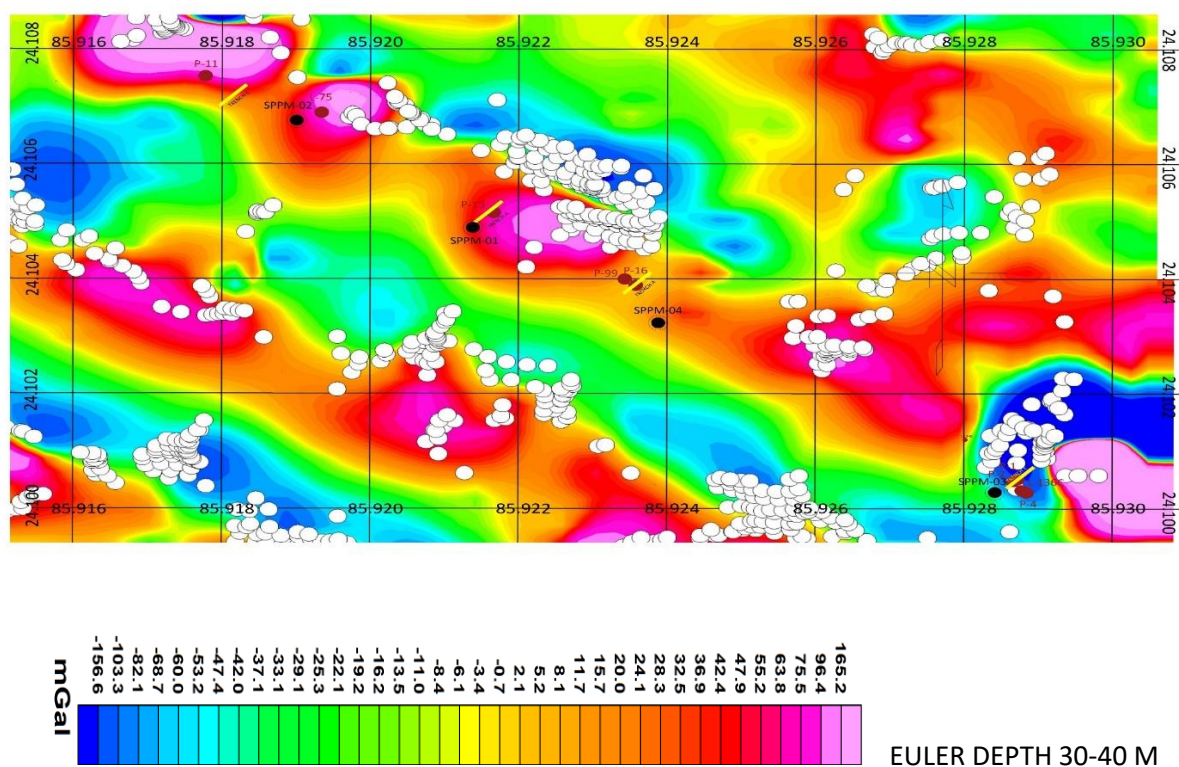


Fig-7a: superimposition of magnetite occurrence over magnetic anomaly.

Depth contour vs residual magnetic anomaly map as shown in fig:6gp5. shows that the higher depth of anomalous zone is towards south, indicating that the magnetic

anomalous body is dipping southerly. This observation supports the observation that the southerly dipping garnetiferous biotite schist body is connected to ore formation.

Depth distribution vs spatial frequency graph shows maximum frequency at a depth of 40m and a noticeable decrease beyond 60m depth. This may restrict the depth continuity of magnetite occurrence to 50-55m depth only.

Chapter-8

Mineral Prospect

8.1. Surface Indication

Surface occurrence of magnetite mineralisation was found at the old talc quarries within the study area. Malachite veins were observed on the walls of old talc quarries.

Southerly dipping garnetiferous mica schists body within the quartz mica schist zone was also found to contain magnetite. Rocks containing magnetite strongly attract magnets. Top soil and sediment in this area contain small grains and fragments of magnetite.

At surface, the exposed magnetite vein outcrops have suffered martitisation and its partially loses the magnetic property. Limonite can also be observed over these outcrops.

8.2. Mode of occurrence

Magnetite associated with talc-actinolite-tremolite schists are generally in the form of disseminated grains and veinlets, whereas, where it is associated with garnetiferous quartz mica schists, it exists in the form of larger crystals or massive structural aggregates.

The garnetiferous quartz mica schist seems to intersect the calc-magnesian body at a low angle at two places:

- a. Near the old quarries within Kusmarja village in the eastern part of the study area
- b. On the Kusmarja quarry near western edge of the project area.

This intersection zone marks a relatively thicker zone (3-5m) of magnetite and since there is also presence of malachite stains on these rocks, this pocket may contain polymetallic ore mineralisation.

8.3. Strike length and width

Residual magnetic anomaly survey of the study area indicates two parallel WNW-ESE trending anomalous zones of around 3km and 2.5 km in length, separated by a distance of 350-400m. However, the anomaly within this zone is not continuous and is present only in the form of small pockets.

The ore zone in the study area has thickness ranging from <1m to around 4m.

8.4. Alteration Zone

The anomalous zone is located within the shear zone and indication of hydrothermal alterations are present. Garnet porphyroblasts and magnetite marks the core of the hydrothermal alteration. Chalcopyrite is also present within this zone in trace amount. Presence of talc within actinolite-tremolite schist and presence of sericite within mica schists indicates a lower temperature zone.

8.5. Genesis of mineralisation

Magnetite mineralization within the study area appears to be related to hydrothermal activity during the intrusion of granitic magma into the older metamorphic rocks. The southerly dipping garnetiferous mica schist possibly marks the main zone of hydrothermal fluid movement within the shear zone. This high temperature hydrothermal fluid deposited garnets and magnetite close to the contact with hornblende schist and also where it intersected the tremolite-actinolite schist.

Chapter-9

Exploration by scout drilling

9.1. Methodology of drilling

Drilling activity for the present work was carried out by M/s Sathi Planners Private Limited, Ranchi. Total 04 number of boreholes were drilled with the combined meterage of 243m to ascertain depth continuity and quality of the ore body.

Inclined core drilling was carried out using a KDR-600 wireline diamond core drilling rig. The borehole was drilled at an inclination of 50° from the horizontal to intersect the targeted geological formations and obtain continuous subsurface information.

Drilling was executed using the NQ wireline core barrel with diamond bits. The wireline drilling technique enabled recovery of the core barrel without withdrawing the drill rods, thereby minimizing non-productive time and improving drilling efficiency. Suitable drilling parameters and flushing arrangements were maintained throughout the operation to ensure borehole stability and achieve optimum core recovery.



Fig-9a: drilling of borehole SPPM-1

The recovered cores were preserved in sequentially labelled core boxes and subjected to detailed geological logging. Core recovery, lithological variations, structural features, and other relevant geological observations were recorded systematically.

9.2. Borehole Planning

04 boreholes were planned to intersect the ore body at approximately 30m depth. On the basis of field geological mapping and also upon interpretation of magnetic anomaly data, it was concluded that the ore body is dipping towards south. Hence boreholes were planned from south towards north in order to intersect the ore body at high angle.

First borehole was drilled to ascertain depth continuity of the ore body exposed at Trench-B. In Trench-B a 4m thick anomalous zone with average Total Fe content of 23.11 percent was encountered. This orebody was found to be dipping at an angle of 78 degrees due S30°W. Hence a borehole named SPPM-1 was planned at a distance of 30m from the ore body inclined at an angle of 50° towards N30°E.

Two boreholes were planned on either side of borehole SPPM-1 at a spacing of around 350m. Borehole SPPM-2 was planned west of SPPM-1, to intersect the ore zone from where bedrock sample no-L75 (Total Fe-53.54%) was collected. SPPM-4 was planned east of SPPM-1 in order to intersect the garnetiferous magnetite ore body encountered in trench-A (5.3m thick anomalous zone with 22.53% average Total Fe).

One more borehole namely SPPM-3 was planned to intersect the ore zone below Trench-E near old quarry of Kusmarja village, where garnetiferous magnetite bearing calc magnesian rocks were encountered. UTM co-ordinates, RL and total drilling meterage of boreholes are given below in table- 9.1:

Table-9.1: Bore co-ordinates

Borehole No	UTM Co-ordinates (m)		RL(m)	Borehole length (m)
	Easting	Northing		
SPPM-1	390440.431	2666326.496	350.236	54
SPPM-2	390167.267	2666541.743	342.974	60
SPPM-3	391250.153	2665794.440	357.026	63
SPPM-4	390727.835	2666134.958	350.086	66

Overall core recovery percentage of >95 % was maintained except for top soil and weathered zone.

9.3. GP Logging

Geophysical logging of boreholes was not in the scope of work.

9.4. Mineralogy of the Ore Zone

Mineralised zone is most distinctly marked by garnet porphyroblasts and magnetite veins. The geochemical analysis of the ore zone of borehole: SPPM-3 shows low silica (avg. 27%) and low alkali (Na_2O -0.2%, K_2O -0.6%). It contains low CaO (0.8%) and high MgO (13.25%). Alumina content is around 16.7%. In addition to garnet and magnetite, low CaO and high MgO concentration confirms that talc is present in high amount and the mineral assemblage is garnet-magnetite-talc-tremolite-actinolite schist.



Fig-9b & c: Ore Zone core sample and photo micrograph of SPPM-3.

The ore zone also has considerable presence of sulphide minerals mostly pyrite and chalcopyrite. Under ore microscope magnetite, maghemite appear predominantly with pyrite and chalcopyrite as minor minerals and ilmenite and molybdenite present in trace amount. Chemical analysis of this ore zone shows it to be a low-grade magnetite (24.66% total Fe) and polymetallic ore body with 1199 ppm of Bi, 161 ppm of Mo and minor amount of Cu, Pb and Zn.

One Chalcopyrite bearing thin quartz veins (8cm thick) has been intersected in this borehole (Fig-9d) confirming the evidence of hydrothermal activity. Stringers of quartzo feldspathic minerals rich in sulphide minerals is also present deeper into the hornblende schist country rocks where it can be found parallel to schistosity also (Fig:9e).



. **Fig-9d &e:** *chalcopyrite and pyrite bearing quartz vein and hornblende schist.*

At point of intersection of the supposed ore zone in the boreholes elevated concentration of tungsten was found ranging from 115 ppm to 356 ppm. Anomalous concentration of Cobalt (>100 ppm) was also recorded in two of these boreholes. The presence of tungsten within sericite rich altered schist strongly points towards a hot channelized hydrothermal fluid flow.

9.5. Borehole deviation test

Not part of the scope of work.

9.6. Ore zone sampling and sample preparation

Based on borehole core logging, the ore zone was divided into multiple samples of 1m each subject to continuity of Lithology. The core samples of ore zone were splitted, grounded and sieved to -200 mesh size and progressively reduced by coning and

quartering. Sample preparation and chemical analysis was carried out at MECL geochemical laboratory, Nagpur.

9.7. Chemical Analysis and Laboratory Procedures

Chemical analysis of core samples was carried out at MECL geochemical laboratory, Nagpur where major oxides and trace element analysis was conducted using XRF. Elements covered under trace element analysis were Cu, Pb, Zn, Co, Ni, Bi, Mo, W, Te and As. Result is included in annexure-VI A and VI B.

9.8. Details of intersected ore zones and correlation.

Total four scout boreholes have been drilled in the study area to intersect the mineralization at first level. However, only 02 magnetite mineralized zones in borehole SPPM-3 were intersected along the boreholes and a few with the true width of ore zone less than 01 meter, which is not considered as lode. Hence correlation of ore zone was not attempted. In addition, two mineralised zones of tungsten and Cobalt (W>250 ppm and Co> 100 ppm) were also intersected in borehole SPPM-1 and SPPM-3.

A single low grade ore zone was intersected in borehole SPPM-01 at a depth of 22.05m to 24.30 m with 14.73% Total Fe and another two zones were intersected in borehole SPPM-03 at depths of 38.59m to 40.20 m with 26.75% Total Fe and at 42.27m to 49.20m with 24.66% Total Fe.

The mineralized zone of SPPM-03 at depth of 38.59 to 40.20 m shows polymetallic prospect with values of 26.75% Total Fe, 2275 ppm of Cu, 363.60 ppm of Bi, 301.50 ppm of Mo and 122.52 ppm of Tungsten and another zone of 6.93 meter at depth of 42.27 to 49.20 shows value of 24.66% Total Fe along with 1199 ppm of Bismuth, 161 ppm of Molybdenum and above 1000 ppm of Zn & Pb respectively.

Mineralised zone intersected in borehole no. SPPM-3 is depth continuation of the ore zone partly encountered in Trench-E. Mineralised zone in Borehole SPPM-1 appears to be continuation of the surface outcrop of tremolite-actinolite band, but chemical analysis of any bed rock sample from this exposure is not available.

9.9. Depth of Ground water

Average water level in all boreholes is given below:

- a. SPPM-1: 10.70m
- b. SPPM-2: 9.58m
- c. SPPM-3: 10.1m
- d. SPPM-4: 7.85m

Chapter-10

Geotechnical Studies

Beyond the scope of present work.

Chapter-11

Resource Estimation

11.1 Introduction

In the present study, the exploration around Pipradih block, Giridih district, Jharkhand has been carried out under G-3 stage and the resources have been estimated up to 25m of strike length under 331, 25-50m of strike length under 332 and 50-100m of strike length under 333 categories of UNFC.

Resource estimation is based on presence of the mineralized veins/lode, dissemination of magnetite, chalcopyrite, molybdenite, tungsten, Cobalt and bismuth bearing minerals along depth. All factors have been determined in the exploration by drilling. Total 04 numbers of boreholes have been drilled in the block but resource estimation is attempted for two mineralized inclined boreholes. Mineralized zone/lode has been considered as minimum 1.00 m stoping width and average total iron value equal to or greater than 15% Fe cut off. In case of Tungsten-Cobalt mineralization cut off has been taken as 250 ppm of tungsten and 100 ppm of cobalt.

For calculation of proved, indicated and inferred resource, the strike length is considered as 25M, 50M and 100M distance respectively on both side of the borehole which have intersected the mineralized zone/load. The dip length is taken as 15 m down dip of the intersection up to the surface manifestation (trench). Tonnage factor has been considered as 3.61 gm/cc for resource calculation of total Fe and 2.94 gm/cc and 2.76 gm/cc for resource calculation of Co and W, which was measured by specific gravity measurement at petrology lab, MECL, Nagpur.

11.2 Detailed description of ore zones with core recovery

The investigation by drilling in and around study area has indicated the presence of magnetite and associated mineralization in borehole SSPM-1 and 3. Out of 4 boreholes 2 boreholes intersected magnetite and associated mineralization and magnetite, chalcopyrite, molybdenite, bismuth, cobalt and tungsten bearing lodes were established in 2 boreholes (SSPM-1 and 3) by considering 1.00 m stoping width. Core recovery in the mineralized zone of both of boreholes is 100%.

11.3 Cutoff grade consideration

In Pipradih block, Cut-off grade for resource estimation is considered as 15% Total Fe for magnetite and 0.2% for Cu.

Bi, Mo, Co and W considered as byproduct and hence the cutoff grade has been considered as 0.01%.

In case of Tungsten-Cobalt mineralization cut off has been taken as 250 ppm of tungsten and 100 ppm of cobalt.

11.4 Minimum stoping width consideration

Stoping width is the minimum mineable width that can be safely mined. In Pipradih block, minimum stoping width 1.0m has been considered for estimation of ore resource considering open cast prospect. An ore zone will be called as lode when the true width of the zone will be more than or equal to 1.0m stoping width and the grade is above the cutoff grade i.e 15% Total Fe. Ore zones below the stoping width and cutoff grade has not be considered in resource estimation.

11.5 Correlation of ore lodes

The correlation of lodes at 15% total Fe for magnetite cut off has not been possible because lodes are not encountered in all the boreholes.

11.6 Description of lodes

The lode is defined by mineralized zones having equal or more than 1.00 m width and with Total Fe concentration more than or equal to a particular cut off which has been kept at 15% Total Fe. The deposit is vein type deposit and mineralization is mainly associated with the garnetiferous talc tremolite schist. The lodes have been demarcated in the borehole sections at 15% Total Fe or in case of Tungsten-Cobalt lode as 0.01% Co and 0.025% W together cut off (Plate-IX). The average grade of the lode is determined by traditional weighted average method i.e. sum of the multiples of sample length with the grade (at a particular cut off) and dividing that by the total length

of the lode.

Borehole SPPM-01 intersected ore zone at along the hole depth of 43.80m to 46.95m (3.15 meter) for Tungsten-Cobalt. In borehole SPPM-03 ore zone intersected at depth 38.59m to 40.20m (1.61 meter) and 42.27 to 49.20 (6.93 meter) for magnetite and 37.08m to 38.59m (1.51 meter) and 40.20 to 42.27 (2.07 meter) for Tungsten-Cobalt.

The mineralized zone of SPPM-03 at depth of 38.59 to 40.20 m shows polymetallic prospect with values of 26.75% Total Fe, 2275 ppm of Cu, 363.60 ppm of Bi, 301.50 ppm of Mo and 122.52 ppm of Tungsten and another zone of 6.93 meter at depth of 42.27 to 49.20 shows value of 24.66% Total Fe along with 1199 ppm of Bismuth, 161 ppm of Molybdenum and above 1000 ppm of Zn & Pb respectively.

In addition to that in borehole no SPPM-03 quartz vein having about 10 cm thick veins of chalcopyrite and Bornite resulting in Cu-6227ppm at the depth of 13.92-15.00 m in core sample.

11.7 Assumptions for resource estimation

As per sub-surface data, magnetite and associated mineralization in the soil covered area around Pipradih block is vein type which is erratic, randomly distributed with surface and subsurface correlation. For resource estimation, the thickness and grade of each mineralized zone intersected in the borehole have been considered as it is for the entire influence area of the borehole.

➤ Strike length

The strike length considered for calculation of proved, indicated and inferred resource, as 25m, 50m and 100m distance respectively on both side of the borehole which have intersected the mineralized zone/load.

➤ Dip length of lodes

- i) The ore zone has been considered to be starting from the surface as manifested in the form of surface outcrop and exposure in trench cutting.
- ii) The ore zone has been considered to be extending up to 15M vertically below the footwall of the lode intersection in borehole.

➤ True thickness (width) of lodes

- i) In Pipradih block, the true thickness of the lode in each borehole is determined at different cut-off of total Fe 15%, with minimum 1.00 m stoping width and minimum true thickness of 1.0m (± 5 cm) for each lode.
- ii) Dip of the ore body has been considered based on field data as 78° towards S and borehole has been drilled at an inclination of 50° from horizontal towards N.

➤ Tonnage Factor

The tonnage factor has been determined by measuring the specific gravity from the samples taken from the mineralized zone of garnetiferous magnetite vein, and measured petrology laboratory, MECL Nagpur. The average density or tonnage factor measured as 3.61 gm/cc and 2.76 gm/cc for mineralized zone intersected in SPPM03 and 2.93 gm/cc for mineralized zone intersected in SPPM01 for resource calculation.

11.8 Methodology of ore resource estimation

The magnetite and associated mineralization around Pipradih block are found to be vein type mineralization. The ore resource has been calculated by Cross section (CS) and longitudinal vertical (LV) section method for each mineralized borehole separately and tabulated below.

Cross Section Method

Cross sections were drawn along the borehole profiles (Plate-X). Lithology and mineralized zones/lodes were plotted. The lithologies intersected in boreholes were correlated with surface geology wherever possible. The profiles were drawn along $S30^\circ W-N30^\circ E$ in all boreholes. Details of calculation of proved resource for lodes are given in Table-11.1 & 11.2 respectively.

The following formula is being used for the purpose of resource estimation:

In CS method: Resource = Strike length x Dip length x Thickness (true thickness) x tonnage factor (Specific Gravity)

Table 11.1: Proved Resource of Magnetite lode using CS method at 15% cut off and 1.00m stoping width in Pipradih block, Giridih district, Jharkhand.

Table 11.1.A

Sl. No.	Lode Name	Strike Length (m)	Thickness (m)	True Thickness (m)	Average grade (PPM)				
					Total Fe (%)	Cu	Bi	Mo	W
2	MZ-II	50	1.61	1.27	26.75	2275	363.66	301.50	122.52
3	MZ-III	50	6.93	5.46	24.66	BDL	1199	BDL	BDL

Table 11.1.B

Name of Lode	Borehole No.	True Thickness (m)	Proved Resource (Tonnes)	Average Grade (%)
MZ-II	SPPM-03	1.27	12472.68	26.75% Total Fe 0.22% Cu 0.022% W 0.036% Bi 0.03% Mo
MZ-III	SPPM-03	5.46	53800.08	24.66% Total Fe 0.12% Bi 0.016% Mo

Table 11.1.C

Cutoff grade	Proved resource of Magnetite using cross-section method	
	Tonnage (T)	Average grade
Total Fe @ 15%	66272.76 T	25.05% Total Fe

Table 11.1.D

Mineralized zone	Proved metal content in Tons at 15% Total Fe cut off using cross-section method				
	Total Fe	Cu	Bi	Mo	W
MZ-II	3336.44	27.44	4.49	3.74	2.74
MZ-III	13267.1	-	64.56	8.61	-

Table 11.2: Proved Resource of Tungsten-Cobalt lode using CS method at 0.01% Co, 0.025% W cut off and 1.00m stoping width in Pipradih block, Giridih district, Jharkhand.

Table 11.2

Sl. No.	Borehole No	RUN		Strike Length (m)	Thickness (m)	True Thickness (m)	Sp. Gr.	Tonnage (Proved)	Average grade (PPM)	
		From	To						WO ₃	Co
1	SPPM-01	43.8	46.95	50	3.15	2.45	2.94	18958.296	430	143
2	SPPM-03	37.08	38.59	50	1.51	1.19	2.76	7953.1746	415	120
3	SPPM-03	40.20	42.27	50	2.07	1.63	2.76	10893.8442	375	116

11.8.1 Longitudinal Vertical Projected section (LVS) method

In Pipradih block, the LVS of the mineralized zones at 15% and total Fe cut off for magnetite and associated minerals has been prepared of each lode intersected in individual borehole for resource estimation. Details of calculation of proved resource for lodes are given in **Table-11.3 & 11.4** respectively.

$$\text{Resource} = \text{Strike length} \times \text{Difference in dip RL} \times \text{Horizontal thickness} \times \text{tonnage factor (Specific Gravity)}$$

Horizontal thickness = True thickness / Sin α , where α is the dip of the ore body.

Based on the 4 number of boreholes drilled, in-situ proved ore resource has been calculated using longitudinal vertical section method have been tabulated in **Table-11.3 & 11.4**.

Table 11.3: Proved Resource of Magnetite Lode using LVS method at 15% cut off and 1.00m stoping width in Pipradih block, Giridih district, Jharkhand.**Table 11.3.A**

Sl. No.	Section no.	Lode Name	Strike Length (m)	Difference in dip RL	Horizontal Thickness (m)	Average grade (PPM)				
						Total Fe (%)	Cu	Bi	Mo	W
SPPM03										
2	S-2-S-2'	MZ-II	50	53.40	1.30	26.75	2275	363.66	301.50	122.52
3	S-2-S-2'	MZ-III	50	53.40	5.58	24.66	BDL	1199	BDL	BDL

Table 11.3.B

Name of Lode	Section No.	Borehole No.	Horizontal Thickness (m)	Proved Resource (Tonnes)	Average Grade (%)
MZ-II	S-2-S-2'	SPPM-03	1.30	12530.31	26.75% Total Fe 0.22% Cu 0.022% W 0.036% Bi 0.03% Mo
MZ-III	S-2-S-2'	SPPM-03	5.58	53783.95	24.66% Total Fe 0.12% Bi 0.016% Mo

Table 11.3C

Cutoff grade	Proved resource of Magnetite using cross-section method	
	Tonnage (T)	Average grade
Total Fe @ 20%	66314.26 T	25.05% Total Fe

Table 11.3.D

Mineralized zone	Proved metal content in Tons at 15% Total Fe cut off using cross-section method				
	Total Fe	Cu	Bi	Mo	W
MZ-II	3351.86	27.57	4.51	3.76	2.76
MZ-III	13263.12	-	64.54	8.61	-

Table 11.4: Proved Resource of Tungsten-Cobalt lode using LVS method at 0.01% Co, 0.025% W cut off and 1.00m stoping width in Pipradih block, Giridih district, Jharkhand.

Table 11.4

Sl. No.	Borehole No	RUN		Strike Length (m)	Thickness (m)	Horizontal Thickness (m)	Sp. Gr.	Tonnage (Proved)	Average grade (PPM)	
		From	To						WO ₃	Co
1	SPPM-01	43.8	46.95	50	3.15	2.50	2.94	18922.575	430	143
2	SPPM-03	37.08	38.59	50	1.51	1.22	2.76	7975.2132	415	120
3	SPPM-03	40.20	42.27	50	2.07	1.67	2.76	10916.8902	375	116

11.8.3 Reliability of resource

Resources were calculated using cross-section method and longitudinal vertical section method for magnetite and associated minerals at 15% total Fe cut-off and in case of Tungsten-Cobalt mineralization cut off has been taken as 250 ppm of tungsten and 100 ppm of cobalt. The comparison between the resources estimated by the CS & LVS methods does not show much variation in tonnage. The comparison is summarized below in table 11.5. However, the tonnage estimated by CS method is taken into consideration and quoted in the report.

Table-11.5 Comparison of resource calculated using cross-section method and Longitudinal vertical section method

Element with cutoff	Resource by CS method		Resource by LVS method		Difference in resource
	Tonnage	Average grade	Tonnage	Average grade	
MZ-II	12472.68	26.75% Total Fe	12530.31	26.75% Total Fe	0.46%
MZ-II	53800.08	24.66% Total Fe	53783.95	24.66% Total Fe	0.03%

11.9 Category of resources/reserve as per UNFC classification

In compliance with the Minerals (Evidence of Mineral Contents) (MEMC) Rules, block was mapped on 1:4000 scale in Pipradih block and detailed topographic survey depicting all the geological and structural details with 2 m contour interval. The boreholes were planned to intersect the mineralized zone upto first level of intersection. Core samples were systematically collected from the mineralized zones. Petrographic, ore microscopic and XRF analysis were carried out from the representative core samples to understand texture, ore minerals and other relevant information. Geophysical ground survey has been carried out within the study area. All the above works were performed and systematically executed. Hence, the Pipradih block, Giridih district, Jharkhand fall under G1 code in the Geological Axis up to 25m strike length, G2 code for strike length between 25m and 50m and G3 code for strike length between 50m and 100m in compliance of MEMC rules, 2015 and United

Nations Framework Classification (UNFC) code.

No feasibility studies, encompassing mining, infrastructures, costing of mining, investment decision of the deposit were carried out in the present study. Hence, the block may fall under F3 code in the Technical Feasibility and Maturity Axis of UNFC code. No environmental-socio-economic studies were carried out. Hence, the block may fall under E3 code in Environmental-Socio-Economic Viability axis of UNFC code. So, the geological investigation in Pipradih block, Giridih district, Jharkhand has been carried out in the present study and resource has been categorized under 331 to 333 category of MEMC rules, 2015 and UNFC.

Category wise summarised resource tables for magnetite lodes and Tungsten-Cobalt lodes has been provided in Table-11.6 and 11.7 respectively

Table 11.6: Summarised Resource of Magnetite lode at 15% cut off and 1.00m stoping width in Pipradih block, Giridih district, Jharkhand.

Name of Lode	Borehole No.	True Thickness (m)	Proved Resource (Tonnes)	Indicated Resource (Tonnes)	Inferred Resource (Tonnes)
MZ-II	SPPM-03	1.27	12472.68	12472.68	24945.36
MZ-III	SPPM-03	5.46	53800.08	53800.08	107600.16

Table 11.7: Summarised Resource of Tungsten-Cobalt lode at 0.01% Co, 0.025% W cut off and 1.00m stoping width in Pipradih block, Giridih district, Jharkhand.

Sl. No.	Borehole No	Thickness (m)	True Thickness (m)	Proved Resource (Tonnes)	Indicated Resource (Tonnes)	Inferred Resource (Tonnes)
1	SPPM-01	3.15	2.45	18958.30	18958.30	37916.60
2	SPPM-03	1.51	1.19	7953.18	7953.18	15906.36
3	SPPM-03	2.07	1.63	10893.84	10893.84	21787.68

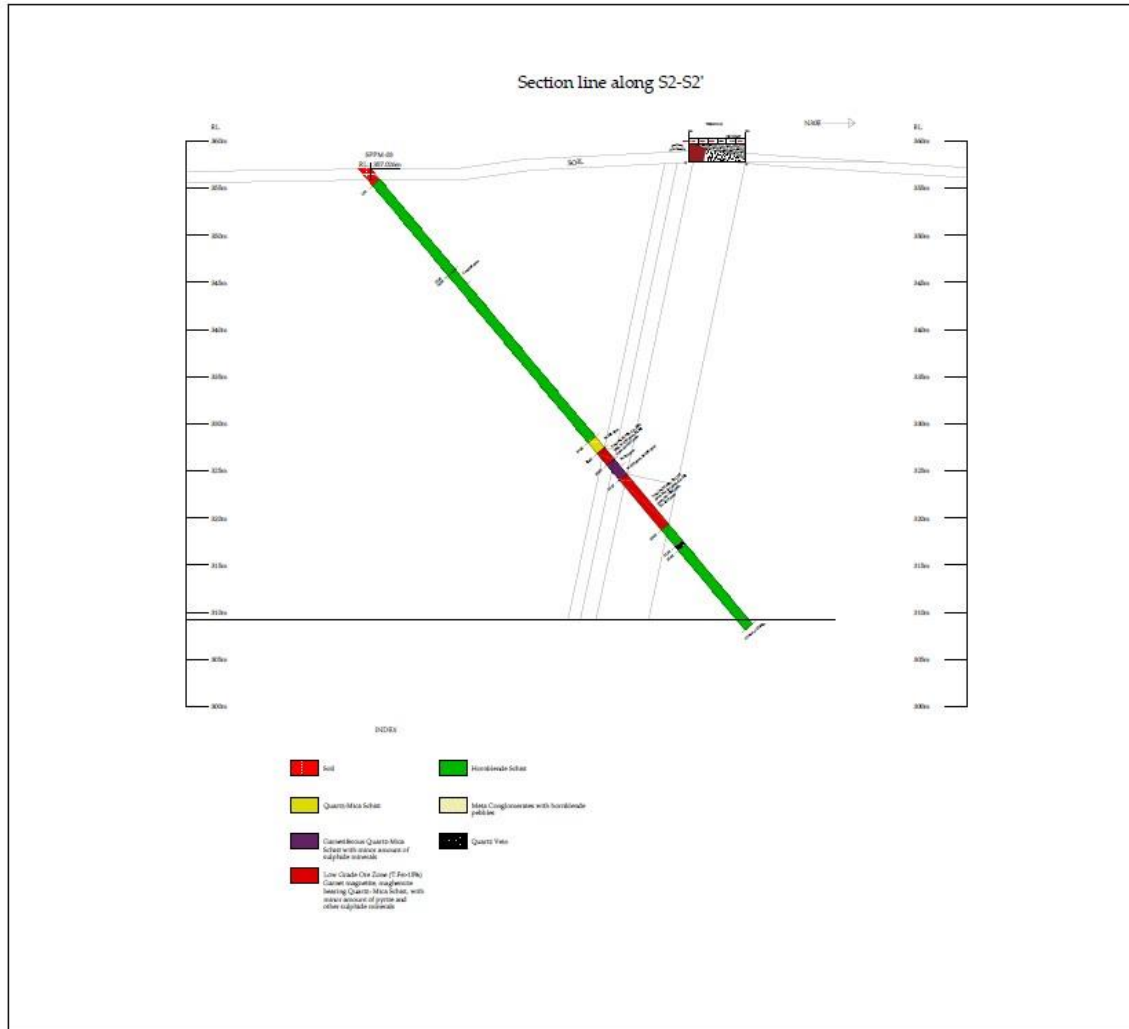


Fig-11.1: Ore Zone intersected in borehole SPPM-3.

Chapter-12
Core Preservation
Not Applicable

Chapter-13

Conclusion and recommendation

Based on geological field mapping, geochemical and geophysical studies, two WNW-ESE trending anomalous zones were identified in the study area. Litho-units within this anomalous zone dip at a very high angle towards south unlike the general northerly dipping pattern of the country rocks. These anomalous zones however are not continuous in strike direction and are also restricted in depth continuity.

This southerly dipping litho-unit is possibly related to medium to high temperature hydrothermal fluid activity in the shear zone as suggested by alteration of feldspar to sericite, presence of sillimanite indicating high temperature regime and anomalous concentration of tungsten (115-356 ppm) and cobalt (>100 ppm).

This high temperature hydrothermal fluid activity zone runs parallel to sub-parallel to the country rock which within the study area appears to be litho-units of older unclassified metamorphics of Chhotanagpur Gneissic Complex. Places, where this high temperature zone comes in contact with hornblende schists, small pockets of garnet porphyroblasts and aggregates of magnetite have been found.

One particular zone in the eastern part of the study area near the old quarries of Kusmarja village is significant from mineralization point of view. Here the hydrothermal fluid activity zone appears to intersect hornblende schist and tremolite-actinolite schist at a very low angle. One borehole drilled to intersect the mineralized zone present at this contact shows presence of a 5.4m thick low grade magnetite deposit (around 26% total Fe) with anomalous concentration of critical elements like Bi, Mo, and W. The calc-magnesian rocks also host small amount of Cu-Pb-Zn making it a potential zone of polymetallic mineralization which may need detailed investigation of this zone.

Chapter-14

Expenditure

The details of nature of the exploratory work proposed and total achievement of the targets, for the project entitled “Preliminary Exploration (G3) for Magnetite and associated minerals in Pipradih Area (7.00 Sq km), District: Giridih, Jharkhand”, and expenditure are mentioned below in table 14.1:

Table 2.1: Nature and Quantum of work and expenditure

Sl. No.	Nature of Work	Executed Quantity	Rate/unit	Expenditure
1-Outsource Component				
A	Drilling			
i	Core Drilling	243m	11,500	27,94,500
ii	Borehole Pillaring	4 Boreholes	2000	8000
B	Laboratory Studies			
I	<i>Chemical Analysis/ICPS Studies</i>			
a	<i>BRS Samples</i>			
i	Primary samples for XRF	188 no.	4200	7,89,600
ii	Internal (5%) and External (10%) samples for 5 radicals	-	-	-
b	<i>Physical & Petrological Studies</i>			
i	Preparation of thin section	5 no.	2353	11,765
ii	Complete Petrographic studies	5 no.	4232	21,160
iii	Preparation of polished section	5 no.	1549	7,745

Sl. No.	Nature of Work	Executed Quantity	Rate/unit	Expenditure
iv	Complete Mineragraphic studies (added after TCC review)	5 no.	2800	14,000
v.	Specific Gravity Determination	5 no.	1605	8,025
2-In-House Component				
A	GEOLOGICAL WORK			
i	Geological Party days Field	120	11,000	13,20,000
	Geological Party days HQ	60	9,000	5,40,000
	2 labours/party			Data awaited
B	GEOPHYSICAL STUDIES			
i	Magnetic Survey	26.1Lkm	72,000	18,79,200
C	SURVEY WORK			
i	DGPS Survey of Borehole and boundary points	8 no.	19,200	1,53,600
ii	Drone Topographic Survey	7 sq km	2,49,000	2,49,000
D	TRENCHING			
i	Trenching	50 Cu. m	3,330	1,66,500
E	SAMPLING			
i	Sampling-1 sampler without labour	24	5,100	1,22,400
ii	4 Labours/party	96	494	Data awaited
E	REPORT PREPARATION			
i	Preparation of Exploration Proposal	1 no.		To be finalised

Sl. No.	Nature of Work	Executed Quantity	Rate/unit	Expenditure
ii	Geological Report Preparation	1 no.		To be finalised
iii	Peer Review	1 no.	30,000	30,000
iv	Tendering process cost for outsourced component			To be finalised
v	Operational charges for outsourced components			To be finalised

Chapter-15

References

Mohanty S.P.,2023: Structure and tectonic analyses of Chhotanagpur gneiss complex of the eastern Satpura orogen, India: Significance for a global model, Geosystems and Geoenvironment: Volume-2 Issue-4.

Dhara. S & Kumar. J, 2018: Geological Report on regional exploration (g-4 level) for copper, lead and zinc in Kusmarja and adjoining areas, Giridih, Jaharkhand

Sahu, S. and Parida, S. (F.S. 2013-14): Interim report on regional geochemical mapping around Bagodar, Bishungarh, Kubri, Maskedih, areas in Giridih, Hazaribagh and Koderma Districts of Jharkhand covering toposheet No. 72H/16 & 72H/15 (parts), Unpublished report, G.S.I, F.S. 2013-14.

Ghose N.C.,1983: Geology, tectonics and evolution of the Chhotanagpur granite gneiss complex, Eastern India, Recent researches in geology, volume-10.

Kar, S.K. and Guha, P. K., (1970): Progress report on the investigation for copper, lead and zinc in Kusmarja and adjoining area, Dist.: Hazaribagh, Bihar, Unpublished report, GSI.

Srivastava, S.N.P. (1956): Progress report on Geological mapping in toposheet no. 72H/16: Unpub. Rep. Geol. Surv. Ind.; F.S. 1954-55.

Srivastava, S.N.P. (1960): Geological mapping in a part of Hazaribagh district, Bihar: Unpub. Rep. Geol. Surv. Ind.; F.S. 1958-59.

Krishnan M.S.,1943: Geology of India and Burma.

Mallet,1918: La Touche Bibliography of Indian geology & physical geography, 1918.

Oates, R. (1895): Trans. Fed. Inst. Min. Eng. Vol. IX.

Mallet, F.R. (1874): Rec. Geol. Srv. Ind. 1874.

Mc. Clelland, J. (1850): Report of Geological Survey of India for the field season 1848-49, P: 23.

Reference for Geophysical Study Report

- 1. G. K. Ghosh* and R. Dasgupta; P 070;** 10th Biennial International Conference & Exposition P 070.
- 2. Gordon R.J. Cooper;** Euler Deconvolution applied to Potential Field Gradients.
- 3. Journal of Applied Geophysics;** Volume 159, December 2018, Pages 553-563.
- 4. William Lowrie;** Fundamentals of Geophysics.
- 5. Stefan Maus and Vijay Dimri;** Depth estimation from the scaling power spectrum of potential fields.
- 6. Bilim Funda and Ates Abdullah;** Analytic Signal Inferred From Reduced To The Pole Data.
- 7. Ahmad AlHassan, Auwal Aliyu et al.** Comparison Between Second Vertical Derivative and Tilt Angle Methods in Detecting Edges of Gravity Anomaly.

Chapter-16

Locality Index

Sl. No.	Locality	Latitudes(N)	Longitudes (E)
1.	Kusmarja Quarry	24°06' 25.56''	85°54' 41.05''
2.	Pipradih Quarry	24°06' 29.51''	85°55' 05.15''
3.	Kusmarja Village old Quarry	24°06' 02.26''	85°55' 50.00''
4.	Pipradih	24°06' 35.42''	85°55' 30.07''
5.	Bakra Bridge	24°06' 07.44''	85°54' 37.49''

Annexure-I A

**UTM Coordinates of Bed Rock Sample (BRS) of Pipradih Area, Giridih District,
Jharkhand Toposheet No. 72H/16**

Sr. No.	Sample No	Lithology	Easting (UTM)	Northing (UTM)
1	L-2	Quartz biotite schist	389112	2666596
2	L-94	Granite gneiss	390508	2667128
3	L-13	composite gneiss	389332	2666954
4	L-18	Granite gneiss	389026	2666468
5	L-62	hornblende schist	390060	2666433
6	L-136B	Magnetite bearing talc-tremolite schist	391291	2665795
7	L-16	tremolite schist	389208	2666591
8	L-50	hornblende gneiss	389782	2666791
9	L-56	hornblende schist	389417	2666105
10	L-134C	talc chlorite tremolite schist	391217	2665903
11	L-63	Quartz mica schist	390070	2666520
12	L-150	quartzite	389553	2664841
13	L-106	hornblende schist	390628	2664846
14	L-76B	muscovite chlorite schist	390172	2666519
15	L-127	quartz chlorite schist	390954	2665989
16	L-65	actinolite tremolite schist	390054	2666610
17	L-38	tremolite schist	389494	2666995
18	L-12	Quartz vein	389288	2667150
19	L-30	quartz mica schist and amphibolite	389193	2666322
20	L-22	hornblende schist	389003	2666287
21	L-87	amphibolite schist	390599	2666504
22	L-31B	talc chlorite schist	389360	2666506
23	L-31C	talc tremolite actinolite schist	389360	2666506
24	L-31D	magnetite bearing chlorite actinolite schist	389360	2666506
25	L-31A	magnetite bearing talc actinolite schist	389360	2666506

Annexure-I B**UTM Coordinates of Bed Rock Sample (BRS) of Magnetite ore in Pipradih Area,
Giridih District, Jharkhand Toposheet No. 72H/16**

Sr. No.	Sample No	Easting (UTM)	Northing (UTM)
1	L-75	390206	2666558
2	L-136C	391292	2665798
3	L-99	390676	2666223
4	L-134B	391204	2665900
5	P-1	391284.56	2665820.25
6	P-3	391278.57	2665816.36
7	P-4	391299.36	2665793.43
8	P-5	389480.02	2666474.97
9	P-6	389398.17	2666505.2
10	P-7	389366.47	2666508.45
11	P-8	389336.69	2666509.88
12	P-9	389299.79	2666549.39
13	P-10	390057.39	266600.62
14	P-11	390025.97	2666631.02
15	P-12	380900.13	2666688.01
16	P-13	390472.81	2666356.38
17	P-16	390693.12	2666210.468

Annexure-I C**UTM Coordinates of Trenches in Pipradih Area, Giridih District, Jharkhand
Toposheet No. 72H/16**

Sr. No.	Trench	Easting (UTM)	Northing (UTM)
1	T-A	390695	2666215
2	T-B	390464	2666359
3	T-C	390069	2666592
4	T-D	389194	2666593
5	T-E	391288	2665823

Major Oxide Analysis of Bed Rock Sample (BRS) of Pipradih Area, Giridih District, Jharkhand Toposheet No. 72H/16

S.N.	Lab No.	Sender No.	SiO ₂ %	Al ₂ O ₃ %	T. Fe%	Fe ₂ O ₃ %	TiO ₂ %	CaO%	MgO%	Na ₂ O%	K ₂ O%	MnO%	P ₂ O ₅ %	SO ₃ %	LOI%
1	PPM-01	L-2	73.27	13.19	2.49	3.56	0.35	2.90	0.20	3.83	1.34	0.23	0.04	0.02	0.76
2	PPM-02	L-94	75.51	11.05	1.80	2.57	0.24	0.68	0.52	2.24	6.06	0.09	0.02	0.05	0.73
3	PPM-03	L-13	78.73	10.91	1.35	1.92	0.14	0.54	1.54	1.96	2.70	0.08	0.04	0.02	1.09
4	PPM-04	L-18	72.62	12.06	2.02	2.89	0.22	0.70	1.21	2.36	6.35	0.07	0.02	0.01	1.09
5	PPM-05	L-62	43.64	13.65	12.55	17.94	1.75	11.94	5.46	2.05	1.10	0.29	0.51	0.01	1.32
6	PPM-06	L-136B	48.46	2.46	13.77	19.69	0.03	5.60	15.83	0.25	0.06	1.85	0.03	0.04	2.64
7	PPM-07	L-16	56.48	1.14	1.68	2.41	0.04	16.02	21.02	0.07	0.02	0.47	0.07	0.01	1.93
8	PPM-08	L-50	44.34	14.64	13.44	19.22	1.21	12.31	5.78	0.96	0.27	0.39	0.25	0.01	0.38
9	PPM-09	L-56	45.02	13.36	13.80	19.72	1.31	10.97	5.29	2.24	0.70	0.34	0.31	0.08	0.38
10	PPM-10	L-134C	49.01	7.09	2.65	3.79	0.07	11.11	23.77	0.06	0.02	0.61	0.01	0.01	4.04
11	PPM-11	L-63	65.38	15.62	2.65	3.78	0.38	0.42	4.96	3.00	4.65	0.17	0.06	0.02	1.30
12	PPM-12	L-150	69.39	19.72	3.25	4.64	0.29	0.10	0.06	0.03	0.06	0.06	0.05	0.01	5.30
13	PPM-13	L-106	45.84	18.95	9.08	12.98	0.65	12.15	4.05	2.76	0.94	0.24	0.15	0.02	1.00
14	PPM-14	L-76B	37.31	22.73	3.69	5.28	0.33	0.52	19.94	0.70	3.01	0.33	0.01	0.01	9.15
15	PPM-15	L-127	79.77	5.90	4.32	6.18	0.14	0.25	4.75	<0.01	0.14	0.10	0.04	0.01	2.50
16	PPM-16	L-65	53.78	1.72	4.75	6.79	0.05	15.50	18.75	0.19	0.06	0.72	0.05	0.03	1.76
17	PPM-17	L-38	55.54	1.83	2.88	4.12	0.06	16.16	20.19	0.17	0.05	0.42	0.02	0.01	1.20
18	PPM-18	L-12	98.33	0.38	0.55	0.79	<0.01	0.10	0.07	0.05	0.04	0.01	0.01	<0.01	0.09

S.N.	Lab No.	Sender No.	SiO ₂ %	Al ₂ O ₃ %	T. Fe%	Fe ₂ O ₃ %	TiO ₂ %	CaO%	MgO%	Na ₂ O%	K ₂ O%	MnO%	P ₂ O ₅ %	SO ₃ %	LOI%
19	PPM-19	L-30	51.86	12.97	9.99	14.28	0.58	10.75	4.54	2.03	0.32	0.83	0.31	0.01	1.19
20	PPM-20	L-22	48.45	15.67	10.05	14.36	0.83	10.93	4.79	3.12	0.42	0.39	0.12	0.01	0.62
21	PPM-21	L-87	45.52	16.00	9.98	14.27	0.70	13.91	6.02	1.47	0.66	0.26	0.11	0.01	0.82
22	PPM-22	L-31B	55.71	2.85	5.45	7.79	0.05	0.15	25.97	0.16	0.12	0.32	<0.01	0.03	5.06
23	PPM-23	L-31C	50.74	4.02	5.91	8.45	0.04	6.35	23.49	0.05	0.02	1.06	0.03	0.05	4.19
24	PPM-24	L-31D	32.46	12.07	17.26	24.68	0.05	2.44	19.99	0.03	0.02	0.68	0.07	0.06	6.49
25	PPM-25	L-31A	34.97	4.40	23.85	34.10	0.03	3.17	18.39	0.02	0.01	0.93	0.06	0.04	2.68

Annexure-II B

Major Oxide Analysis of Magnetite Bed Rock Sample (BRS) of Pipradih Area, Giridih District, Jharkhand Toposheet No. 72H/16

S.N.	Sample No.	SiO ₂ %	Al ₂ O ₃ %	T. Fe%	FeO%	Fe ₂ O ₃ %	TiO ₂ %	CaO%	MgO%	Na ₂ O%	K ₂ O%	MnO%	P ₂ O ₅ %	SO ₃ %	LOI%	V ₂ O ₅ %
1	L-75	7.40	12.76	53.54	NA	76.55	0.05	0.24	0.30	0.02	0.04	0.64	0.04	0.03	1.73	NA
2	L-136C	55.43	4.80	25.94	NA	37.09	<0.01	0.32	0.46	0.04	0.04	0.18	0.01	0.03	1.37	NA
3	L-99	6.00	6.32	59.56	NA	85.16	0.26	0.26	0.73	0.02	0.05	0.23	0.01	0.06	0.66	NA
4	L-134B	4.56	6.55	59.81	NA	85.51	0.04	0.21	0.85	0.02	0.03	0.10	0.02	0.08	1.76	NA
5	P-1	9.67	5.69	55.11	6.84	15.18	0.39	0.21	1.36	0.01	0.04	0.18	0.03	NA	3.22	0.03

S.N.	Sample No.	SiO ₂ %	Al ₂ O ₃ %	T. Fe%	FeO%	Fe ₂ O ₃ %	TiO ₂ %	CaO%	MgO%	Na ₂ O%	K ₂ O%	MnO%	P ₂ O ₅ %	SO ₃ %	LOI%	V ₂ O ₅ %
6	P-3	5.06	5.73	59.68	12.78	28.37	0.03	0.13	2.23	0.01	0.02	0.17	0.04	NA	0.45	0.01
7	P-4	14.74	8.45	48.54	10.80	23.98	0.04	0.21	4.40	0.03	0.05	0.20	0.01	NA	2.20	0.01
8	P-5	8.50	6.71	53.74	9.54	21.18	0.07	0.18	5.66	0.01	0.03	0.36	0.03	NA	0.92	0.01
9	P-6	15.35	6.59	48.67	21.24	47.15	0.33	2.16	3.76	0.35	0.08	0.68	0.04	NA	0.93*	0.02
10	P-7	9.07	9.71	47.44	5.67	12.59	0.02	0.03	10.38	0.01	0.01	0.35	0.02	NA	2.13	0.01
11	P-8	7.46	6.96	51.14	8.19	18.18	0.03	0.02	9.56	0.01	0.01	0.55	0.03	NA	1.49	0.01
12	P-9	12.58	10.83	43.24	12.06	26.77	0.13	0.08	9.63	0.07	0.65	0.32	0.03	NA	2.60	0.01
13	P-10	17.17	12.19	37.61	11.52	25.57	0.90	4.39	7.99	0.21	0.06	0.47	0.28	NA	2.14	0.03
14	P-11	28.70	13.64	22.39	9.54	21.18	2.51	11.47	5.92	0.56	0.29	0.77	0.73	NA	2.46	0.11
15	P-12	14.03	16.24	39.48	10.98	24.38	0.07	0.34	8.29	0.02	0.03	0.28	0.03	NA	3.92	0.01
16	P-13	19.44	13.13	39.53	14.04	31.17	0.15	0.16	7.22	0.18	0.04	0.24	0.02	NA	2.60	0.03
17	P-16	5.81	8.49	58.37	7.92	17.58	0.05	0.03	0.40	0.03	0.03	0.43	0.04	NA	0.99	0.02

Annexure-II C

Major Oxide Analysis of Trench Samples of Pipradih Area, Giridih District, Jharkhand Toposheet No. 72H/16

S.N.	Trench No.	Sender No.	Al ₂ O ₃ %	T. Fe%	FeO%	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	V ₂ O ₅ %	P ₂ O ₅ %	LOI%	MnO%	CaO%	MgO%	K ₂ O%	Na ₂ O%	SO ₃ %
1	Trench-A	TA01	15.11	4.04	1.08	2.40	64.88	0.43	0.01	0.04	4.29	0.17	2.38	3.04	0.99	2.72	0.03
2	Trench-A	TA02	13.33	2.14	1.08	2.40	70.32	0.25	<0.01	0.02	3.26	0.17	0.81	2.92	1.20	2.07	0.01
3	Trench-A	TA03	17.06	3.17	0.72	1.60	61.83	0.31	<0.01	0.01	7.47	0.17	1.58	5.14	0.72	0.95	0.01
4	Trench-A	TA04	18.01	8.65	1.44	3.20	45.38	0.88	0.03	0.06	12.24	0.31	1.88	6.78	1.21	0.59	0.05
5	Trench-A	TA05	17.59	2.49	1.08	2.40	59.23	0.28	<0.01	0.01	10.04	0.15	1.36	5.06	0.77	0.43	0.01
6	Trench-A	TA06	15.94	2.77	0.72	1.60	59.43	0.29	<0.01	0.01	10.09	0.16	1.06	7.99	0.57	0.17	0.01
7	Trench-A	TA07	19.71	2.37	1.08	2.40	60.54	0.24	<0.01	0.01	8.35	0.12	1.11	3.28	1.08	0.30	0.01
8	Trench-A	TA08	18.38	5.58	1.62	3.60	56.33	0.26	<0.01	0.01	9.62	0.28	0.97	4.10	1.73	0.15	0.01
9	Trench-A	TA09	13.28	13.17	3.24	7.20	54.92	0.78	0.01	0.09	5.93	0.48	0.98	3.21	1.18	0.11	0.02
10	Trench-A	TA10	14.04	16.21	7.52	16.71	42.03	2.34	0.07	0.76	2.05	0.36	8.38	3.41	0.43	0.51	0.01
11	Trench-A	TA11	14.52	30.27	9.72	21.60	31.24	0.31	0.02	0.03	5.17	0.75	0.85	3.36	0.30	0.08	0.01
12	Trench-A	TA12	13.83	29.06	12.06	26.80	32.44	0.42	0.02	0.02	5.99	0.42	0.71	3.99	0.35	0.14	0.02
13	Trench-A	TA13	16.99	25.59	7.92	17.60	27.17	0.40	0.01	0.02	10.42	0.57	0.77	5.87	0.93	0.05	0.02
14	Trench-A	TA14	17.29	19.77	5.04	11.20	30.56	0.26	<0.01	0.02	13.13	0.46	1.05	7.49	1.00	0.06	0.01
15	Trench-A	TA15	20.74	16.29	7.92	17.60	25.59	0.26	<0.01	0.02	11.01	0.14	0.79	10.79	1.12	0.03	0.01
16	Trench-B	TB01	9.01	4.34	0.90	2.00	76.12	0.33	0.01	0.05	3.58	0.24	2.08	1.40	0.65	0.18	0.04
17	Trench-B	TB02	12.89	16.34	4.86	10.80	53.27	0.21	<0.01	0.04	6.68	0.29	0.28	2.23	0.43	0.08	0.02

S.N.	Trench No.	Sender No.	Al ₂ O ₃ %	T. Fe%	FeO%	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	V ₂ O ₅ %	P ₂ O ₅ %	LOI%	MnO%	CaO%	MgO%	K ₂ O%	Na ₂ O%	SO ₃ %
18	Trench-B	TB03	12.15	34.03	12.60	28.00	29.19	0.31	0.01	0.03	4.71	0.68	0.32	3.48	0.13	0.07	0.04
19	Trench-B	TB04	20.71	22.41	9.90	22.00	24.43	0.26	<0.01	0.02	8.99	0.27	0.16	8.68	0.17	0.01	0.02
20	Trench-B	TB05	18.64	19.67	2.34	5.20	36.31	0.27	0.01	0.04	13.28	0.34	0.32	1.87	0.51	0.08	0.03
21	Trench-C	TC01	21.83	4.17	2.34	5.20	33.32	0.33	<0.01	0.02	15.71	0.33	1.03	14.44	1.65	0.76	0.02
22	Trench-C	TC02	20.85	5.20	2.52	5.60	38.09	0.36	<0.01	0.02	9.35	0.32	1.87	15.81	1.09	0.72	0.02
23	Trench-C	TC03	20.89	11.92	2.16	4.80	40.31	0.41	0.03	0.05	16.15	0.22	1.51	2.36	0.32	0.11	0.01
24	Trench-C	TC04	18.24	11.62	4.32	9.60	40.36	0.42	0.01	0.04	8.06	0.98	4.90	7.98	1.15	0.41	0.02
25	Trench-C	TC05	11.34	7.60	3.24	7.20	65.24	0.29	0.01	0.04	4.40	1.30	1.00	4.32	0.65	0.31	0.03
26	Trench-C	TC06	11.49	7.31	0.90	2.00	69.16	0.28	<0.01	0.03	3.80	0.33	0.36	1.68	2.17	0.07	0.02
27	Trench-C	TC07	14.06	6.27	3.02	6.71	63.25	0.32	<0.01	0.03	3.26	0.19	0.38	3.11	2.93	0.09	0.02
28	Trench-C	TC08	11.86	5.87	2.16	4.80	70.45	0.34	0.01	0.03	3.55	0.19	0.36	2.16	2.36	0.08	0.02
29	Trench-C	TC09	8.47	6.12	0.27	0.60	76.05	0.18	<0.01	0.02	2.39	0.19	0.30	1.92	1.45	0.07	0.01
30	Trench-C	TC10	15.23	24.30	5.67	12.60	38.97	0.40	0.01	0.05	5.33	0.74	0.58	3.15	0.41	0.13	0.03
31	Trench-D	TD01	9.28	3.95	0.90	2.00	77.42	0.38	0.01	0.03	4.62	0.21	0.27	0.96	0.82	0.09	0.03
32	Trench-D	TD02	9.75	3.81	0.54	1.20	77.97	0.36	0.01	0.04	3.66	0.47	0.29	0.91	0.79	0.09	0.03
33	Trench-D	TD03	14.43	4.66	0.36	0.80	67.98	0.60	0.01	0.05	5.76	0.27	0.57	1.76	1.40	0.20	0.04
34	Trench-D	TD04	9.30	3.66	0.18	0.40	78.14	0.39	0.01	0.03	4.35	0.21	0.30	0.83	0.88	0.11	0.03
35	Trench-D	TD05	10.80	4.13	0.27	0.60	75.30	0.37	0.01	0.04	4.71	0.21	0.35	0.82	1.17	0.15	0.03
36	Trench-D	TD06	11.88	11.52	0.45	1.00	54.98	0.70	0.02	0.06	6.68	0.47	0.68	4.61	2.86	0.09	0.04
37	Trench-E	TE01	17.52	16.18	3.06	6.80	39.10	1.27	0.05	0.39	11.91	0.36	2.62	2.67	0.17	0.14	0.02
38	Trench-E	TE02	16.55	14.74	3.78	8.40	42.15	0.74	0.03	0.07	11.85	0.29	2.67	3.54	0.22	0.23	0.01
39	Trench-E	TE03	13.86	9.98	1.26	2.80	59.03	0.20	0.01	0.02	7.77	0.21	0.48	3.16	0.37	0.10	0.02

S.N.	Trench No.	Sender No.	Al ₂ O ₃ %	T. Fe%	FeO%	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	V ₂ O ₅ %	P ₂ O ₅ %	LOI%	MnO%	CaO%	MgO%	K ₂ O%	Na ₂ O%	SO ₃ %
40	Trench-E	TE04	11.07	19.53	1.44	3.20	44.00	0.14	0.01	0.02	11.75	0.30	0.57	3.32	0.16	0.13	0.03
41	Trench-E	TE05	13.55	32.25	5.58	12.40	25.13	0.15	0.01	0.05	6.39	0.36	0.41	6.33	0.65	0.07	0.02
42	PPM-84	TE06	16.24	27.48	4.32	9.60	24.25	0.11	0.01	0.08	9.80	0.38	0.36	7.07	0.35	0.01	0.04

Annexure-III A

Petrographic Study Result of Bed Rock Sample (BRS) of Pipradih Area, Giridih District, Jharkhand Toposheet No. 72H/16

Sl. No.	Sender's Sample ID	Texture	Mineral Composition			Description
			Major >5%	Minor <5%->1%	Accessory <1%	
1	L-94	It is a fine to medium grained rock showing gneissosity.	Quartz Microcline Plagioclase Biotite Muscovite		Opakes Ferruginous matter	Quartz occurs as fine subhedral to anhedral grains, showing tight quartzitic contacts in areas. Microcline and plagioclase are present as fine to medium subhedral to anhedral grains. Biotite and muscovite are present as fine disseminated flakes showing parallel alignment. Opakes are noted as very fine specks in accessories. Ferruginous matter is seen present as reddish patches and fillings, at places. The specimen is a <u>quartz-feldspar-mica gneiss.</u>
2	L-62	It is a dark greenish grey coloured medium to fine grained rock showing schistosity.	Hornblende Plagioclase	Sericite Sphene	Epidote Opakes	Hornblende occurs as medium to fine subhedral prismatic and rhombic grains showing parallel alignment. Plagioclase is present as subhedral prismatic laths and turbid patches showing parallel alignment and sericitization. Sericite is present as cloudy patches comprising very fine flaky aggregates developing after sericitization of plagioclase. Sphene occurs as fine to very fine wedges, often seen segregating in pockets.

						Epidote is noted as very fine granular aggregates in pockets, possibly developing after saussuritization in areas. Opaques occur as very fine to fine subhedral to anhedral grains and as relicts within sphene. The specimen is an <u>amphibolite schist</u>.
3	L-63	It is a fine to medium grained rock showing gneissosity.	Quartz Albite/ Plagioclase Microcline Biotite	Phlogopite/ Muscovite	Opaques	Quartz occurs as fine anhedral grains. Albite/plagioclase and microcline are present as fine to medium subhedral to anhedral grains showing crude alignment. Biotite and phlogopite/muscovite are seen present as fine flakes showing parallel alignment. Opaques are noted as very fine specks in accessories. The specimen is a <u>quartz-feldspar-mica gneiss</u>.
4	L-38	It is a light greenish grey coloured medium to fine grained rock showing granular texture.	Tremolite		Biotite Opaques	The specimen is entirely mono-mineralic, composed of medium to fine subhedral prismatic, rhombic, flaky and platy aggregates. Biotite is seen present as very fine flakes and hairline fillings in areas. Opaques are noted as very fine specks in accessories. The specimen is a <u>tremolite rich rock</u>.

Annexure-III B

Mineragraphic Studies of Bed Rock Sample (BRS) of Pipradih Area, Giridih District, Jharkhand Toposheet No. 72H/16

Sl. No.	Sender's Sample ID	% of ore minerals in polished section	ORE MINERAL COMPOSITION				Description
			Major >5%	Minor <5% - >1%	Accessory <1% - >0.1%	Traces <0.1%	
1.	L-31A	56	Magnetite (85) Hematite (15)		Goethite Limonite		Magnetite occurs as fine to medium subhedral to anhedral aggregates, segregating into medium to coarse patches. Hematite is seen developing after martitisation of magnetite. Goethite occurs as very fine fillings in accessories. Limonite is noted as reddish patches and filling in areas. The specimen is showing very strong magnetism.
2.	7-75	80	Magnetite/ Maghemite (58) Hematite (40)	Limonite (2)	Chalcopyrite		The specimen is composed of fine to medium subhedral to anhedral aggregates of magnetite/maghemite, leaving pores and gangues in between. Hematite is seen developing after martitisation of magnetite/maghemite. Limonite occurs as very fine reddish amorphous aggregates along pores and cavities. Chalcopyrite is noted as very fine specks in accessories. The specimen is showing very strong magnetism.
3.	L-136C	86	Maghemite (60) Magnetite (33) Hematite (6)	Goethite (1)	Pyrrhotite Limonite		Maghemite and magnetite occur as fine to medium subhedral to anhedral aggregates throughout the specimen. Maghemite can be distinguished from magnetite with typical bluish shade. Hematite is seen developing after martitisation of maghemite and

							magnetite. Goethite occurs as very fine hairline fillings in areas. Pyrrhotite is noted as very fine inclusions within maghemite and magnetite. Limonite is seen present as very fine reddish amorphous aggregates along pores and cavities. The specimen is showing very strong magnetism.
4.	L-99	88	Hematite (70) Magnetite/ Maghemite (28)	Goethite (2)	Pyrrhotite Limonite		The specimen is made up of fine to medium subhedral to anhedral aggregates of hematite and magnetite/ maghemite leaving pores and gangues in-between, where magnetite/ maghemite is being replaced by hematite. Goethite occurs as fine fillings cutting across hematite-magnetite/ maghemite aggregates. Pyrrhotite is noted as very specks, often included within hematite-magnetite/ maghemite. Limonite is seen present as reddish amorphous aggregates along pores and cavities. The specimen is showing strong magnetism.

Summarized Litholog of boreholes of Pipradih Block, Giridih District, Jharkhand
Toposheet No. 72H/16

Borehole No. SPPM-01	Area: Pipradih Block (G3), Giridih District, Jharkhand
Angle: 50°	Latitude: 24°06'19.75"
Azimuth: N30°E	Longitude: 85°55'19.19"
Date of commencement: 28-03-2026	R.L. at collar: 350.24m
Date of completion: 31-03-2026	R.L. at bottom: 307.64m
Drilled by unit no.: SPCDR-2 (Sathi Planners Pvt. Ltd.)	Total depth drilled:54m

Drill Run(m)		Length of Run(m)	Length Core recovery (m)	Length of Core (>10cm)	Core Recovery (%)	Lithology & Structure	Mineralisation	Remarks
From	To							
0	5.50	5.50	5.33		96.91	Top Soil	NA	
5.50	8.25	2.75	2.75		100	Weathered Quartz Biotite Schist	NA	
8.25	8.75	0.50	0.50		100	Quartz Biotite Schist inter-banded with Amphibolite.	NA	
8.75	16.18	7.43	7.22		97.17	Amphibolite		

Drill Run(m)		Length of Run(m)	Length Core recovery (m)	Length of Core (>10cm)	Core Recovery (%)	Lithology & Structure	Mineralisation	Remarks
From	To							
16.18	20.70	4.52	4.40		97.34	Garnetiferous-Quartz Biotite Schist with magnetite Crystals. Talc bearing near fracture planes.	Disseminated crystals of Magnetite are observed at depth of 16.18-17.50m .	
20.70	23.20	2.50	2.50		100	Quartz-biotite-actinolite-tremolite-schist with Quartz vein.	No significant mineralisation observed.	
23.20	50.50	27.30	27.03		99	Garnetiferous-quartz-biotite-actinolite-tremolite-schist with chalcopyrite, pyrite, galena and magnetite.	1. Grains of Pyrite and pyrrhotite observed at depth of 23.50-24.15m within Garnet porphyroblast. 2. Magnetite veins are observed at depth of 24.17-24.30m. 3. Magnetite vein observed at depth of 35.71-35.94m. 4. Disseminated grains of Magnetite, pyrite and chalcopyrite observed at depth of 35.94-36.66m. 5. Disseminated grains of Magnetite, pyrite and chalcopyrite observed at depth of 42.80-44.25m.	

Drill Run(m)		Length of Run(m)	Length Core recovery (m)	Length of Core (>10cm)	Core Recovery (%)	Lithology & Structure	Mineralisation	Remarks
From	To							
							6. Disseminated Specks of chalcopryite observed at depth of 44.95-45.75m 7. Magnetite vein and disseminated grains of chalcopryite observed at the depth of 46.95-47.5m.	
50.50	53.05	2.55	2.51		98.43	Quartz-sericite-biotite- schist with Quartz vein.	NA	
53.05	54.00	0.95	0.95		100	Fine grained Amphibolite with mineralised biotite schist bands the middle.	1.Disseminated grains of magnetite and chalcopryite observed at the depth of 53.5-53.73m.	

Borehole No. SPPM-02	Area: Pipradih Block (G3), Giridih District, Jharkhand
Angle: 50°	Latitude: 24°06'26.68"
Azimuth: N30°E	Longitude: 85°55'09.46"
Date of commencement: 02-04-2026	R.L. at collar: 342.97m
Date of completion: 07-04-2026	R.L. at bottom: 295.72m
Drilled by unit no.: SPCDR-2 (Sathi Planners Pvt. Ltd.)	Total depth drilled:60m

Drill Run(m)		Length of Run(m)	Length Core recover y (m)	Length of Core (>10cm)	Core Recover y (%)	Lithology & Structure	Mineralisation	Remarks
From	To							
0	6.60	6.60	4.60		69.70	Top Soil	NA	
6.60	14.40	7.80	7.73		99.10	Weathered Amphibolite.	NA	
14.40	23.13	8.73	8.63		98.85	Amphibolite with Quartz vein.	NA	
23.13	39.00	15.87	15.64		98.55	Quartz-sericite-biotite- schist with Quartz vein.	NA	
39.00	45.86	6.86	6.86		100	Composite Gneiss	NA	

Drill Run(m)		Length of Run(m)	Length Core recovery (m)	Length of Core (>10cm)	Core Recovery (%)	Lithology & Structure	Mineralisation	Remarks
From	To							
45.86	50.61	4.86	2.50		100	Quartz-biotite-schist with Quartz vein.	1. Specks of pyrite observed at depth of 45.86-46.00m 2. Disseminated pyrite, pyrrhotite and chalcopyrite observed at depth of 46.00-47.77m	
50.61	60.00	9.39	9.35		99.57	Composed Gneiss with biotite schist band and quartz vein	1. Biotite schist band is rich in sulphides at depth of 58.80-59.00m.	

Borehole No. SPPM-03	Area: Pipradih Block (G3), Giridih District, Jharkhand
Angle: 50°	Latitude: 24°06'2.66"
Azimuth: N30°E	Longitude: 85°55'48.01"
Date of commencement: 10-04-2026	R.L. at collar: 357.03m
Date of completion: 14-04-2026	R.L. at bottom: 308.12m
Drilled by unit no.: SPCDR-2 (Sathi Planners Pvt. Ltd.)	Total depth drilled:63m

Drill Run(m)		Length of Run(m)	Length Core recovery (m)	Core Recovery (%)	Lithology & Structure	Mineralisation	Remarks
From	To						
0	1.50	1.50	0.60	40	Top Soil	NA	
1.50	13.82	12.32	11.88	96.43	Weathered Amphibolite	NA	
13.82	37.08	23.26	23.15	99.52	Amphibolite with quartz vein.	1. Specks of Chalcopryrite and Bornite observed at depth of 13.92-14.00m within quartz vein. 2. Grains of Chalcopryrite observed at depth of 15.00-15.20m. 3. Veinlets of Chalcopryrite observed at depth of 16.60-17.50m. 4. Veinlets of Chalcopryrite observed at depth of 18.50-20.20m. 5. Veinlets of Chalcopryrite	

Drill Run(m)		Length of Run(m)	Length Core recovery (m)	Core Recovery (%)	Lithology & Structure	Mineralisation	Remarks
From	To						
						observed at depth of 24.50-25.30m. 6. Veinlets of Chalcopyrite observed at depth of 26.12-37.08m.	
37.08	49.20	12.12	12.10	99.83	Garnetiferous-Quartz-Biotite Schist along with Talc-actinolite-Tremolite Schist	1.Veinlets of Chalcopyrite and magnetite with specks of pyrite observed at depth of 38.59-40.20m. 2. Veinlets of Chalcopyrite and magnetite with specks, blebs & stringers of Galena and Sphalerite observed at depth of 42.27-49.20m.	
49.20	63.00	13.80	13.75	99.64	Amphibolite with quartz vein.	1.Disseminated specks and veinlets of chalcopyrite along schistosity planes are observed at depth of 49.20-63.00m .	

Borehole No. SPPM-04	Area: Pipradih Block (G3), Giridih District, Jharkhand
Angle: 50°	Latitude: 24°06'13.60"
Azimuth: N30°E	Longitude: 85°55'29.42"
Date of commencement: 17-04-2026	R.L. at collar: 350.09m
Date of completion: 24-04-2026	R.L. at bottom: 303.89m
Drilled by unit no.: SPCDR-2 (Sathi Planners Pvt. Ltd.)	Total depth drilled:66m

Drill Run(m)		Length of Run(m)	Length Core recovery (m)	Core Recovery (%)	Lithology & Structure	Mineralisation	Remarks
From	To						
0	3.40	3.40	2.00	58.82	Top Soil	NA	
3.40	4.08	0.68	0.68	100	Weathered Quartz Biotite Schist	NA	
4.08	5.76	1.68	1.68	100	Quartz Vein.	NA	
5.76	9.10	3.34	3.21	96.11	Biotite Schist with Talc along fracture zone.	NA	Broken/ Fractured
9.10	28.60	19.50	19.28	98.87	Garnetiferous-Quartz Biotite Schist with Talc along fracture zone.	1.Disseminated crystals and veinlets of Magnetite, specks & veinlets of Chalcopryrite along schistosity are observed at depth of 9.10-17.58m. 2. Disseminated crystals of Magnetite & veinlets of Chalcopryrite along	Fractured & filled with talc

Drill Run(m)		Length of Run(m)	Length Core recovery (m)	Core Recovery (%)	Lithology & Structure	Mineralisation	Remarks
From	To						
						schistosity are observed at depth of 18.83-19.87m. 3. Very few specks of Pyrite observed at depth of 21.00-28.60m.	
28.60	30.90	2.30	2.26	98.26	Amphibolite.	1.Veinlets of Chalcopyrite along schistosity observed at depth of 28.60-30.90m.	
30.90	54.47	23.67	34.49	99.41	Quartz-biotite-schist with talc along fracture zone.	1.Disseminated Grains of Pyrite and pyrrhotite observed at depth of 30.90-33.37m. 2. Specks of pyrite and chalcopyrite observed at depth of 45.72-46.00m.	
54.47	66.00	11.53	11.46	99.39	Talc Schist with sericite, biotite and chlorite.		1.Euhedral quartz crystal observed from 54.47-66.00m.

**Run-wise RQD details of boreholes of Pipradih Block, Giridih District,
Jharkhand
Toposheet No. 72H/16**

Borehole No. SPPM001: RQD					
Drill Run(m)		Length of Run(m)	Length of Core (>10cm)	RQD (%)	Remarks
From	To				
0.00	1.50			NA	Top Soil
1.50	14.50			NA	Weathered Amphibolite
14.50	17.50	3.00	2.30	76.67	
17.50	20.50	3.00	1.85	61.67	
20.50	23.50	3.00	2.16	72.00	
23.50	26.50	3.00	2.41	80.33	
26.50	29.50	3.00	2.33	77.67	
29.50	32.50	3.00	2.79	93.00	
32.50	35.50	3.00	2.89	96.33	
35.50	38.50	3.00	2.93	97.67	
38.50	41.50	3.00	2.79	93.00	
41.50	44.50	3.00	2.86	95.33	
44.50	47.50	3.00	2.73	91.00	
47.50	50.50	3.00	2.90	96.67	
50.50	53.50	3.00	2.96	98.67	
53.50	54.00	3.00	0.42	14.00	

Borehole No. SPPM002: RQD					
Drill Run(m)		Length of Run(m)	Length of Core (>10cm)	RQD (%)	Remarks
From	To				
0.00	3.00			NA	Top Soil
3.00	15.00	3.00		0.00	Weathered Amphibolite
15.00	18.00	3.00	1.74	58.00	
18.00	21.00	3.00	2.23	74.33	
21.00	24.00	3.00	2.27	75.67	
24.00	27.00	3.00	2.53	84.33	
27.00	30.00	3.00	2.29	76.33	
30.00	33.00	3.00	2.91	97.00	
33.00	36.00	3.00	2.82	94.00	
36.00	39.00	3.00	2.83	94.33	
39.00	42.00	3.00	2.89	96.33	
42.00	45.00	3.00	2.93	97.67	
45.00	48.00	3.00	2.49	83.00	
48.00	51.00	3.00	2.85	95.00	
51.00	54.00	3.00	2.88	96.00	
54.00	57.00	3.00	2.89	96.33	

Borehole No. SPPM003: RQD					
Drill Run(m)		Length of Run(m)	Length of Core (>10cm)	RQD (%)	Remarks
From	To				
0.00	1.50			NA	Top Soil
1.50	3.00			NA	Weathered Granite Gneiss
3.00	6.00	3.00		0.00	Weathered Granite Gneiss
6.00	9.00	3.00		0.00	Weathered Granite Gneiss

9.00	12.00	3.00		0.00	Weathered Granite Gneiss
12.00	15.00	3.00		0.00	Weathered Granite Gneiss
15.00	18.00	3.00	1.55	51.67	
18.00	21.00	3.00	1.78	59.33	
21.00	24.00	3.00	2.56	85.33	
24.00	27.00	3.00	2.68	89.33	
27.00	30.00	3.00	2.77	92.33	
30.00	33.00	3.00	2.90	96.67	
33.00	36.00	3.00	2.78	92.67	
36.00	39.00	3.00	2.47	82.33	
39.00	42.00	3.00	2.62	87.33	
42.00	45.00	3.00	2.75	91.67	
45.00	48.00	3.00	2.45	81.67	
48.00	51.00	3.00	1.68	56.00	
51.00	54.00	3.00	2.89	96.33	
54.00	57.00	3.00	2.80	93.33	
57.00	60.00	3.00	2.73	91.00	
60.00	63.00	3.00	2.89	96.33	

Borehole No. SPPM004: RQD					
Drill Run(m)		Length of Run(m)	Length of Core (>10cm)	RQD (%)	Remarks
From	To				
0.00	3.00			NA	Top Soil
3.00	6.00	3.00		0.00	Weathered Mica Schist
6.00	9.00	3.00	0.90	30.00	
9.00	12.00	3.00	2.55	85.00	
12.00	15.00	3.00	1.46	48.67	

15.00	18.00	3.00	1.58	52.67	
18.00	21.00	3.00	1.62	54.00	
21.00	24.00	3.00	1.66	55.33	
24.00	27.00	3.00	1.85	61.67	
27.00	30.00	3.00	2.45	81.67	
30.00	33.00	3.00	2.37	79.00	
33.00	36.00	3.00	2.41	80.33	
36.00	39.00	3.00	2.55	85.00	
39.00	42.00	3.00	2.61	87.00	
42.00	45.00	3.00	1.22	40.67	
45.00	48.00	3.00	2.60	86.67	
48.00	51.00	3.00	1.07	35.67	
51.00	54.00	3.00	2.13	71.00	
54.00	57.00	3.00	2.34	78.00	
57.00	60.00	3.00	1.49	49.67	
60.00	63.00	3.00	1.67	55.67	
63.00	66.00	3.00	2.27	75.67	

List of Drill Core Samples Sent for Analysis

SL No	Borehole	From (m)	To (m)	Extrapolated Length (m)	Sample No
1	SPPM-1	15.18	16.18	1	SPPM-1/01
2	SPPM-1	16.18	17.18	1	SPPM-1/02
3	SPPM-1	17.18	17.5	0.32	SPPM-1/03
4	SPPM-1	17.5	18.5	1	SPPM-1/04
5	SPPM-1	22.2	23.5	1.3	SPPM-1/06
6	SPPM-1	23.5	24.3	0.8	SPPM-1/07
7	SPPM-1	24.3	25.3	1	SPPM-1/08
8	SPPM-1	34.71	35.71	1	SPPM-1/09
9	SPPM-1	35.71	36.66	0.95	SPPM-1/10
10	SPPM-1	36.66	37.66	1	SPPM-1/11
11	SPPM-1	41.8	42.8	1	SPPM-1/12
12	SPPM-1	42.8	43.8	1	SPPM-1/13
13	SPPM-1	43.8	44.25	0.45	SPPM-1/14
14	SPPM-1	44.25	44.95	0.7	SPPM-1/15
15	SPPM-1	44.95	45.75	0.8	SPPM-1/16
16	SPPM-1	45.75	46.35	0.6	SPPM-1/17
17	SPPM-1	46.35	46.95	0.6	SPPM-1/18
18	SPPM-1	46.95	47.5	0.55	SPPM-1/19
19	SPPM-1	47.5	48.5	1	SPPM-1/20
20	SPPM-1	53.05	53.5	0.45	SPPM-1/21
21	SPPM-1	53.5	54	0.5	SPPM-1/23
22	SPPM-2	45	45.86	0.86	SPPM-2/01
23	SPPM-2	45.86	46.77	0.91	SPPM-2/03
24	SPPM-2	46.77	47.77	1	SPPM-2/04
25	SPPM-2	47.77	48.88	1.11	SPPM-2/06
26	SPPM-2	57.8	58.8	1	SPPM-2/07
27	SPPM-2	58.8	60	1.2	SPPM-2/09
28	SPPM-3	12.82	13.82	1	SPPM-3/01
29	SPPM-3	13.82	15	1.18	SPPM-3/03
30	SPPM-3	15	15.9	0.9	SPPM-3/05
31	SPPM-3	15.9	16.6	0.7	SPPM-3/06
32	SPPM-3	16.6	17.5	0.9	SPPM-3/07
33	SPPM-3	17.5	18.5	1	SPPM-3/08

SL No	Borehole	From (m)	To (m)	Extrapolated Length (m)	Sample No
34	SPPM-3	18.5	19.5	1	SPPM-3/09
35	SPPM-3	19.5	20.2	0.7	SPPM-3/10
36	SPPM-3	20.2	21	0.8	SPPM-3/11
37	SPPM-3	23.5	24.5	1	SPPM-3/12
38	SPPM-3	24.5	25.3	0.8	SPPM-3/13
39	SPPM-3	25.3	26.12	0.82	SPPM-3/14
40	SPPM-3	26.12	27.12	1	SPPM-3/15
41	SPPM-3	27.12	28	0.88	SPPM-3/17
42	SPPM-3	28	29	1	SPPM-3/18
43	SPPM-3	29	29.74	0.74	SPPM-3/19
44	SPPM-3	29.74	30.74	1	SPPM-3/20
45	SPPM-3	30.74	31.74	1	SPPM-3/21
46	SPPM-3	31.74	32.74	1	SPPM-3/22
47	SPPM-3	32.74	33.74	1	SPPM-3/23
48	SPPM-3	33.74	34.74	1	SPPM-3/24
49	SPPM-3	34.74	35.74	1	SPPM-3/25
50	SPPM-3	35.74	36.74	1	SPPM-3/26
51	SPPM-3	36.74	37.08	0.34	SPPM-3/27
52	SPPM-3	37.08	38	0.92	SPPM-3/28
53	SPPM-3	38	38.59	0.59	SPPM-3/29
54	SPPM-3	38.59	39.59	1	SPPM-3/30
55	SPPM-3	39.59	40.2	0.61	SPPM-3/31
56	SPPM-3	40.2	41.2	1	SPPM-3/32
57	SPPM-3	41.2	42.27	1.07	SPPM-3/33
58	SPPM-3	42.27	43.27	1	SPPM-3/34
59	SPPM-3	43.27	44.27	1	SPPM-3/35
60	SPPM-3	44.27	45.27	1	SPPM-3/36
61	SPPM-3	45.27	46.27	1	SPPM-3/37
62	SPPM-3	46.27	47.27	1	SPPM-3/38
63	SPPM-3	47.27	48.27	1	SPPM-3/39
64	SPPM-3	48.27	49.2	0.93	SPPM-3/40
65	SPPM-3	49.2	50.18	0.98	SPPM-3/41
66	SPPM-3	50.18	51	0.82	SPPM-3/42
67	SPPM-3	51	51.5	0.5	SPPM-3/43A
68	SPPM-3	51.5	52	0.5	SPPM-3/43B
69	SPPM-3	52	53	1	SPPM-3/44
70	SPPM-3	53	54	1	SPPM-3/45
71	SPPM-3	54	55	1	SPPM-3/46
72	SPPM-3	55	56	1	SPPM-3/47
73	SPPM-3	56	57	1	SPPM-3/48

SL No	Borehole	From (m)	To (m)	Extrapolated Length (m)	Sample No
74	SPPM-3	57	58	1	SPPM-3/49
75	SPPM-3	58	59	1	SPPM-3/50
76	SPPM-3	59	60	1	SPPM-3/51
77	SPPM-3	60	61	1	SPPM-3/52
78	SPPM-3	61	62	1	SPPM-3/53
79	SPPM-3	62	63	1	SPPM-3/54
80	SPPM-4	8.1	9.1	1	SPPM-4/01
81	SPPM-4	9.1	10.1	1	SPPM-4/02
82	SPPM-4	10.1	11.1	1	SPPM-4/03
83	SPPM-4	11.1	12.1	1	SPPM-4/04
84	SPPM-4	12.1	13.1	1	SPPM-4/05
85	SPPM-4	13.1	14.1	1	SPPM-4/06
86	SPPM-4	14.1	15.1	1	SPPM-4/07
87	SPPM-4	15.1	16.1	1	SPPM-4/08
88	SPPM-4	16.1	17.1	1	SPPM-4/09
89	SPPM-4	17.1	17.58	0.48	SPPM-4/10
90	SPPM-4	17.58	18	0.42	SPPM-4/11
91	SPPM-4	18	18.83	0.83	SPPM-4/12
92	SPPM-4	18.83	19.87	1.04	SPPM-4/13
93	SPPM-4	19.87	20.6	0.73	SPPM-4/14
94	SPPM-4	27.6	28.6	1	SPPM-4/15
95	SPPM-4	28.6	29.6	1	SPPM-4/16
96	SPPM-4	29.6	30.6	1	SPPM-4/17
97	SPPM-4	30.6	30.9	0.3	SPPM-4/18
98	SPPM-4	30.9	31.9	1	SPPM-4/19
99	SPPM-4	31.9	32.9	1	SPPM-4/20
100	SPPM-4	32.9	33.37	0.47	SPPM-4/21
101	SPPM-4	33.37	34.37	1	SPPM-4/22
102	SPPM-4	45	45.72	0.72	SPPM-4/23
103	SPPM-4	45.72	46	0.28	SPPM-4/24
104	SPPM-4	46	47	1	SPPM-4/25

Major Oxide Analysis of Drill Core Samples of Pipradih Area, Giridih District, Jharkhand Toposheet No. 72H/16

S.N.	Sample No.	SiO ₂ %	Al ₂ O ₃ %	Fe ₂ O ₃ %	TiO ₂ %	CaO%	MgO%	Na ₂ O%	K ₂ O%	MnO%	P ₂ O ₅ %	LOI%	T. Fe%
1	SPPM-1/01	41.22	13.46	20.16	1.15	11.39	5.70	1.28	0.40	0.36	0.29	4.34	14.10
2	SPPM-1/02	62.41	11.74	11.32	0.49	1.07	4.95	0.59	2.45	0.15	0.05	4.29	7.91
3	SPPM-1/03	55.91	14.50	12.84	0.32	0.38	6.85	0.28	4.58	0.26	0.01	3.57	8.98
4	SPPM-1/04	52.44	16.38	11.90	0.48	1.00	8.06	0.52	3.32	0.23	0.03	5.03	8.32
5	SPPM-1/06	42.50	13.71	19.14	0.24	0.87	13.21	0.15	2.16	0.16	0.01	7.36	13.39
6	SPPM-1/07	42.30	13.37	24.54	0.22	1.21	10.64	0.15	1.15	0.21	0.01	5.88	17.16
7	SPPM-1/08	72.53	6.54	14.64	0.21	0.28	2.91	0.22	1.17	0.15	0.01	0.77	10.23
8	SPPM-1/09	77.67	10.03	5.42	0.26	0.38	1.15	0.55	2.76	0.07	0.02	1.41	3.79
9	SPPM-1/10	64.39	9.22	14.53	1.01	1.04	2.55	0.67	2.89	0.18	0.24	2.68	10.16
10	SPPM-1/11	75.00	11.72	4.86	0.27	0.56	1.20	1.38	2.87	0.05	0.02	1.52	3.40
11	SPPM-1/12	68.75	9.44	10.17	0.60	1.43	3.24	1.43	2.42	0.18	0.08	1.90	7.11
12	SPPM-1/13	56.68	10.10	17.93	1.81	5.10	4.16	1.12	1.16	0.24	0.33	0.92	12.54
13	SPPM-1/14	62.57	8.25	20.83	0.22	0.67	4.37	0.19	1.75	0.26	0.01	0.45	14.57
14	SPPM-1/15	73.69	7.63	9.57	0.40	0.76	3.58	0.60	2.28	0.05	0.05	1.10	6.69
15	SPPM-1/16	74.00	7.55	10.82	0.26	0.79	2.79	0.63	1.98	0.15	0.06	0.73	7.57
16	SPPM-1/17	79.12	7.10	7.15	0.26	0.48	2.14	0.55	2.31	0.07	0.02	0.52	5.00
17	SPPM-1/18	77.03	6.89	9.34	0.18	0.37	2.25	0.39	2.52	0.20	0.01	0.57	

S.N.	Sample No.	SiO ₂ %	Al ₂ O ₃ %	Fe ₂ O ₃ %	TiO ₂ %	CaO%	MgO%	Na ₂ O%	K ₂ O%	MnO%	P ₂ O ₅ %	LOI%	T. Fe%
18	SPPM-1/19	50.80	11.44	21.54	0.42	2.24	6.38	0.67	3.57	0.17	0.06	2.40	15.06
19	SPPM-1/20	58.08	19.17	7.06	0.78	5.52	1.45	5.22	1.62	0.13	0.19	0.43	4.94
20	SPPM-1/21	41.50	11.85	19.63	1.62	9.68	5.20	0.92	1.31	0.34	0.39	7.13	13.73
21	SPPM-1/23	58.53	9.82	17.80	0.70	2.31	5.81	0.87	2.59	0.25	0.09	0.80	12.44
22	SPPM-2/01	69.68	14.86	2.61	0.32	0.92	2.60	3.17	4.10	0.08	0.02	1.05	1.83
23	SPPM-2/03	68.37	13.60	3.79	0.42	1.77	2.89	2.78	3.97	0.11	0.04	1.35	2.65
24	SPPM-2/04	68.31	14.34	3.40	0.39	1.07	3.41	3.24	4.14	0.11	0.02	1.16	2.38
25	SPPM-2/06	71.31	13.40	2.55	0.26	0.99	2.98	3.10	3.80	0.09	0.02	0.95	1.78
26	SPPM-2/07	72.38	13.69	2.61	0.26	1.24	1.97	4.07	2.64	0.10	0.02	0.74	1.83
27	SPPM-2/09	61.07	15.71	6.71	0.51	1.27	4.64	4.28	3.90	0.25	0.05	1.04	4.69
28	SPPM-3/01	39.72	13.83	22.78	1.73	8.63	6.73	1.79	0.68	0.48	0.38	2.95	15.93
29	SPPM-3/03	45.32	11.20	20.83	2.14	10.42	4.56	1.66	0.39	0.31	0.57	1.13	14.57
30	SPPM-3/05	42.63	12.16	21.73	2.44	11.72	4.71	1.79	0.44	0.32	0.46	1.17	15.19
31	SPPM-3/06	42.83	12.99	20.92	2.52	11.45	4.82	2.10	0.45	0.36	0.49	0.81	14.63
32	SPPM-3/07	42.61	12.50	21.90	2.11	11.31	5.08	1.90	0.48	0.33	0.54	0.80	15.32
33	SPPM-3/08	43.34	12.81	21.07	2.02	11.39	5.12	1.84	0.50	0.29	0.40	0.97	14.74
34	SPPM-3/09	42.85	13.00	20.70	1.94	12.05	4.73	1.93	0.56	0.30	0.57	1.03	14.47
35	SPPM-3/10	43.22	12.42	21.57	2.34	11.36	4.87	1.81	0.60	0.30	0.44	0.69	15.08
36	SPPM-3/11	42.74	11.93	21.14	2.29	12.26	5.31	1.67	0.55	0.30	0.35	1.17	14.78
37	SPPM-3/12	42.79	12.33	20.17	2.05	11.73	6.31	2.25	0.61	0.30	0.42	0.79	14.11
38	SPPM-3/13	43.33	12.30	20.19	2.26	11.19	5.56	2.24	0.57	0.29	0.46	1.12	14.12
39	SPPM-3/14	43.89	12.59	19.79	2.10	11.29	5.64	2.32	0.60	0.30	0.40	0.80	13.84

S.N.	Sample No.	SiO ₂ %	Al ₂ O ₃ %	Fe ₂ O ₃ %	TiO ₂ %	CaO%	MgO%	Na ₂ O%	K ₂ O%	MnO%	P ₂ O ₅ %	LOI%	T. Fe%
40	SPPM-3/15	44.13	12.94	19.78	2.02	11.15	5.49	2.44	0.62	0.28	0.40	0.55	13.83
41	SPPM-3/17	42.40	11.91	21.88	2.40	11.27	5.74	2.07	0.58	0.34	0.41	0.76	15.30
42	SPPM-3/18	42.68	12.26	21.16	2.21	11.28	5.75	2.36	0.54	0.34	0.45	0.80	14.80
43	SPPM-3/19	42.19	12.30	20.76	2.20	11.97	5.51	2.36	0.56	0.32	0.43	1.11	14.52
44	SPPM-3/20	45.16	11.92	21.27	2.78	9.65	4.18	2.38	0.53	0.30	0.51	0.94	14.88
45	SPPM-3/21	44.15	12.73	20.70	2.59	10.47	4.31	2.64	0.48	0.31	0.52	0.67	14.48
46	SPPM-3/22	44.54	12.54	20.83	2.47	10.65	4.46	2.37	0.46	0.31	0.45	0.55	14.57
47	SPPM-3/23	44.27	12.10	21.16	2.51	10.79	4.60	2.43	0.39	0.31	0.54	0.58	14.80
48	SPPM-3/24	43.79	12.09	21.56	2.75	10.67	4.60	2.43	0.38	0.31	0.43	0.57	15.08
49	SPPM-3/25	46.04	12.58	19.99	2.31	9.95	4.77	2.24	0.40	0.31	0.31	0.75	13.98
50	SPPM-3/26	43.03	13.83	20.32	2.23	10.28	5.75	2.53	0.29	0.33	0.39	0.66	14.21
51	SPPM-3/27	45.54	12.63	20.93	2.27	8.50	5.84	2.79	0.21	0.39	0.49	0.22	14.64
52	SPPM-3/28	78.69	6.32	7.78	0.16	0.49	3.60	0.94	1.09	0.07	0.03	0.63	5.44
53	SPPM-3/29	78.58	6.39	7.61	0.21	0.61	3.56	1.03	1.07	0.04	0.02	0.68	5.32
54	SPPM-3/30	37.21	11.96	38.57	0.33	0.83	7.47	0.44	0.77	0.64	0.01	0.21	26.97
55	SPPM-3/31	35.15	12.94	37.73	0.22	0.83	9.94	0.49	1.67	0.52	0.02	0.18	26.38
56	SPPM-3/32	77.24	5.48	10.75	0.09	0.32	3.85	0.52	0.88	0.07	0.01	0.47	7.52
57	SPPM-3/33	73.57	5.96	11.79	0.13	0.25	5.04	0.38	1.63	0.09	0.02	0.67	8.24
58	SPPM-3/34	42.33	8.25	38.63	0.14	0.85	7.02	0.22	0.19	0.70	0.02	0.19	27.01
59	SPPM-3/35	31.30	17.11	30.38	0.31	0.43	14.11	0.30	1.13	0.18	0.02	4.41	21.25
60	SPPM-3/36	23.53	20.02	31.32	0.28	0.28	16.40	0.04	0.20	0.12	0.01	7.54	21.90
61	SPPM-3/37	23.91	19.90	33.08	0.37	0.58	15.31	0.06	0.31	0.32	0.01	5.61	23.13

S.N.	Sample No.	SiO ₂ %	Al ₂ O ₃ %	Fe ₂ O ₃ %	TiO ₂ %	CaO%	MgO%	Na ₂ O%	K ₂ O%	MnO%	P ₂ O ₅ %	LOI%	T. Fe%
62	SPPM-3/38	22.18	18.40	36.29	0.24	0.77	14.68	0.03	0.12	0.36	0.01	5.19	25.38
63	SPPM-3/39	23.65	17.95	36.81	0.34	1.33	13.75	0.23	0.47	0.40	0.02	4.63	25.74
64	SPPM-3/40	24.76	15.21	40.73	0.21	1.41	11.46	0.51	1.24	0.56	0.02	2.91	28.48
65	SPPM-3/41	36.40	15.79	16.69	1.26	6.90	11.43	1.13	3.00	0.42	0.22	5.57	11.67
66	SPPM-3/42	44.18	13.62	19.10	1.97	9.04	6.21	2.28	0.88	0.47	0.41	1.28	13.35
67	SPPM-3/43A	42.15	13.26	20.76	2.25	9.95	5.89	2.20	0.78	0.44	0.38	1.40	14.52
68	SPPM-3/43B	46.51	11.64	19.52	2.00	8.54	4.73	2.05	0.97	0.31	0.24	2.14	13.65
69	SPPM-3/44	44.12	12.31	20.59	2.51	10.73	5.27	2.21	0.76	0.34	0.33	0.55	14.40
70	SPPM-3/45	44.35	12.49	20.64	2.42	10.74	4.52	2.38	0.79	0.31	0.41	0.62	14.43
71	SPPM-3/46	45.07	13.34	19.95	2.47	10.18	4.34	2.39	0.72	0.34	0.31	0.54	13.95
72	SPPM-3/47	44.99	14.36	18.16	1.79	10.74	4.91	2.69	0.70	0.29	0.32	0.73	12.70
73	SPPM-3/48	44.30	13.16	20.19	2.20	10.60	4.81	2.33	0.70	0.32	0.44	0.63	14.12
74	SPPM-3/49	43.67	12.33	21.92	2.81	10.35	4.74	2.04	0.69	0.33	0.33	0.42	15.33
75	SPPM-3/50	42.43	12.85	20.47	2.18	11.59	5.87	2.13	0.64	0.31	0.42	0.80	14.32
76	SPPM-3/51	42.19	13.09	20.38	2.15	11.80	5.75	2.13	0.67	0.30	0.36	0.83	14.25
77	SPPM-3/52	41.97	13.22	20.57	2.10	11.62	5.89	2.02	0.70	0.31	0.40	0.90	14.39
78	SPPM-3/53	42.93	12.68	20.13	2.06	11.41	6.15	2.11	0.69	0.30	0.43	0.77	14.08
79	SPPM-3/54	42.53	13.40	20.13	2.11	11.16	5.90	2.11	0.73	0.29	0.37	0.89	14.07
80	SPPM-4/01	54.70	16.26	4.12	0.42	0.94	12.66	0.90	5.73	0.15	0.03	3.55	2.88
81	SPPM-4/02	66.63	15.47	5.54	0.53	2.02	0.82	3.25	3.74	0.12	0.06	1.11	3.88
82	SPPM-4/03	68.05	14.06	4.94	0.45	1.59	0.56	2.47	6.19	0.09	0.08	0.91	3.45
83	SPPM-4/04	67.49	13.48	4.94	0.43	2.35	0.42	2.48	6.85	0.12	0.07	0.68	3.45

S.N.	Sample No.	SiO ₂ %	Al ₂ O ₃ %	Fe ₂ O ₃ %	TiO ₂ %	CaO%	MgO%	Na ₂ O%	K ₂ O%	MnO%	P ₂ O ₅ %	LOI%	T. Fe%
84	SPPM-4/05	66.46	14.16	5.12	0.38	3.35	0.45	2.93	4.92	0.17	0.07	0.96	3.58
85	SPPM-4/06	65.79	14.43	5.02	0.44	2.53	0.40	2.70	6.85	0.11	0.08	0.77	3.51
86	SPPM-4/07	67.35	14.25	4.73	0.40	2.02	0.39	2.91	6.35	0.11	0.07	0.99	3.31
87	SPPM-4/08	67.12	14.39	4.84	0.45	1.57	0.36	2.27	7.50	0.10	0.07	0.76	3.39
88	SPPM-4/09	67.08	13.91	5.90	0.53	2.23	0.66	2.59	4.93	0.12	0.08	1.43	4.13
89	SPPM-4/10	53.66	15.40	11.34	1.15	2.70	6.06	1.44	4.64	0.36	0.19	2.18	7.93
90	SPPM-4/11	62.85	14.23	5.36	0.34	2.73	5.72	2.18	4.31	0.18	0.03	1.44	3.75
91	SPPM-4/12	56.62	14.69	9.63	1.31	2.52	6.56	1.73	4.33	0.22	0.23	1.73	6.73
92	SPPM-4/13	63.49	14.63	7.64	1.01	4.08	2.23	2.91	1.79	0.17	0.19	1.05	5.34
93	SPPM-4/14	67.60	14.24	3.46	0.31	1.94	4.75	3.32	2.90	0.09	0.02	0.88	2.42
94	SPPM-4/15	65.01	14.34	3.22	0.23	1.39	7.25	2.29	3.14	0.10	0.01	2.41	2.25
95	SPPM-4/16	43.87	12.91	19.56	1.70	11.10	6.04	1.47	0.76	0.32	0.31	1.22	13.68
96	SPPM-4/17	44.11	13.57	19.38	1.72	11.20	6.00	1.56	0.66	0.29	0.33	0.75	13.56
97	SPPM-4/18	41.92	14.27	19.00	1.62	8.85	7.63	0.90	1.48	0.31	0.28	2.57	13.29
98	SPPM-4/19	66.32	14.08	4.97	0.53	1.27	3.85	3.31	3.49	0.11	0.09	1.27	3.48
99	SPPM-4/20	69.00	14.91	2.84	0.41	0.61	3.14	3.77	3.12	0.10	0.06	1.45	1.99
100	SPPM-4/21	68.18	15.22	3.35	0.39	0.78	3.01	3.38	3.25	0.08	0.05	1.57	2.34
101	SPPM-4/22	57.82	19.67	4.71	0.52	0.50	6.76	1.63	5.86	0.15	0.08	1.97	3.29
102	SPPM-4/23	60.82	17.51	3.18	0.24	0.85	7.58	0.71	4.34	0.10	0.01	3.93	2.22
103	SPPM-4/24	61.72	15.36	4.84	0.35	0.60	8.08	0.50	4.48	0.16	0.01	3.18	3.39
104	SPPM-4/25	51.81	21.25	5.61	0.30	0.51	8.15	0.33	5.43	0.21	0.01	5.66	3.92

Annexure-VI B

Trace Element Analysis of Drill Core Samples of Pipradih Area, Giridih District, Jharkhand Toposheet No. 72H/16

S.N.	Sample No.	Cu (PPM)	Pb (PPM)	Zn (PPM)	Co (PPM)	Ni (PPM)	Bi (PPM)	Mo (PPM)	W (PPM)	Te (PPM)	As (PPM)
1	SPPM-1/01	12	25	210	86	109	BDL	BDL	BDL	BDL	BDL
2	SPPM-1/02	35	35	126	72	27	BDL	BDL	44	9	BDL
3	SPPM-1/03	4	21	156	34	BDL	BDL	BDL	BDL	BDL	BDL
4	SPPM-1/04	3	40	183	66	26	BDL	BDL	42	BDL	BDL
5	SPPM-1/06	BDL	28	291	BDL	12	BDL	BDL	BDL	BDL	BDL
6	SPPM-1/07	88	12	271	94	11	15	BDL	BDL	13	BDL
7	SPPM-1/08	117	12	123	1	17	BDL	BDL	BDL	BDL	BDL
8	SPPM-1/09	6	13	50	9	17	38	11	BDL	9	BDL
9	SPPM-1/10	158	12	135	BDL	BDL	63	15	BDL	15	BDL
10	SPPM-1/11	5	21	63	131	14	18	BDL	356	6	BDL
11	SPPM-1/12	27	23	119	132	15	42	BDL	314	9	BDL
12	SPPM-1/13	54	22	209	99	36	18	BDL	145	11	BDL
13	SPPM-1/14	46	BDL	164	153	8	4	BDL	322	BDL	BDL
14	SPPM-1/15	19	18	158	136	BDL	23	BDL	336	BDL	BDL
15	SPPM-1/16	11	16	117	143	BDL	BDL	BDL	344	BDL	BDL
16	SPPM-1/17	3	14	BDL	139	BDL	BDL	BDL	351	10	BDL

S.N.	Sample No.	Cu (PPM)	Pb (PPM)	Zn (PPM)	Co (PPM)	Ni (PPM)	Bi (PPM)	Mo (PPM)	W (PPM)	Te (PPM)	As (PPM)
17	SPPM-1/18	13	6	BDL	149	13	6	2	345	9	BDL
18	SPPM-1/19	33	19	232	125	BDL	14	81	208	BDL	BDL
19	SPPM-1/20	4	111	199	9	19	BDL	BDL	BDL	7	BDL
20	SPPM-1/21	4	25	210	1	63	8	BDL	BDL	BDL	BDL
21	SPPM-1/23	14	57	158	45	29	36	38	BDL	11	BDL
22	SPPM-2/01	6	48	101	BDL	15	BDL	BDL	BDL	6	BDL
23	SPPM-2/03	48	36	110	BDL	18	BDL	BDL	BDL	11	12
24	SPPM-2/04	BDL	30	121	32	BDL	BDL	BDL	3	7	4
25	SPPM-2/06	4	48	BDL	67	16	3	BDL	187	BDL	BDL
26	SPPM-2/07	9	21	20	71	15	BDL	BDL	215	8	BDL
27	SPPM-2/09	28	11	209	62	44	BDL	BDL	53	BDL	BDL
28	SPPM-3/01	494	409	517	80	95	BDL	BDL	BDL	BDL	BDL
29	SPPM-3/03	6227	89	363	87	72	BDL	BDL	BDL	9	BDL
30	SPPM-3/05	1137	55	306	27	69	BDL	BDL	BDL	BDL	BDL
31	SPPM-3/06	293	42	359	28	68	BDL	BDL	BDL	BDL	BDL
32	SPPM-3/07	861	30	257	73	75	BDL	BDL	BDL	9	BDL
33	SPPM-3/08	89	33	522	74	86	BDL	BDL	BDL	11	BDL
34	SPPM-3/09	84	34	194	37	83	BDL	BDL	BDL	BDL	BDL
35	SPPM-3/10	85	23	210	32	79	BDL	BDL	BDL	BDL	BDL
36	SPPM-3/11	48	20	179	77	91	BDL	BDL	BDL	BDL	BDL
37	SPPM-3/12	64	11	165	74	81	BDL	BDL	BDL	BDL	BDL
38	SPPM-3/13	182	17	157	41	68	BDL	BDL	BDL	BDL	BDL

S.N.	Sample No.	Cu (PPM)	Pb (PPM)	Zn (PPM)	Co (PPM)	Ni (PPM)	Bi (PPM)	Mo (PPM)	W (PPM)	Te (PPM)	As (PPM)
39	SPPM-3/14	63	16	162	33	75	BDL	BDL	BDL	BDL	BDL
40	SPPM-3/15	44	22	171	26	69	BDL	BDL	BDL	BDL	BDL
41	SPPM-3/17	70	21	203	64	78	BDL	BDL	BDL	BDL	BDL
42	SPPM-3/18	47	32	225	42	80	BDL	BDL	BDL	BDL	BDL
43	SPPM-3/19	95	31	216	76	73	BDL	BDL	BDL	BDL	BDL
44	SPPM-3/20	74	26	186	70	34	BDL	BDL	BDL	8	BDL
45	SPPM-3/21	116	33	199	72	47	BDL	BDL	BDL	BDL	BDL
46	SPPM-3/22	57	26	199	70	46	BDL	BDL	BDL	BDL	BDL
47	SPPM-3/23	77	23	186	52	52	BDL	BDL	BDL	BDL	BDL
48	SPPM-3/24	114	36	186	31	47	BDL	BDL	BDL	BDL	BDL
49	SPPM-3/25	111	63	208	35	46	4	BDL	BDL	BDL	BDL
50	SPPM-3/26	108	100	209	75	78	BDL	BDL	BDL	BDL	BDL
51	SPPM-3/27	33	260	247	58	74	10	BDL	BDL	BDL	BDL
52	SPPM-3/28	12	167	BDL	127	BDL	BDL	33	336	7	BDL
53	SPPM-3/29	9	215	BDL	109	4	BDL	38	319	7	BDL
54	SPPM-3/30	3627	508	691	12	10	555	411	157	42	BDL
55	SPPM-3/31	60	119	616	52	15	50	122	60	10	9
56	SPPM-3/32	16	107	215	120	4	7	22	310	8	BDL
57	SPPM-3/33	86	226	219	113	13	230	77	286	31	BDL
58	SPPM-3/34	1592	155	728	44	16	204	158	189	11	3
59	SPPM-3/35	22	112	1077	86	14	63	64	BDL	BDL	BDL
60	SPPM-3/36	47	92	1193	54	BDL	73	100	BDL	BDL	BDL

S.N.	Sample No.	Cu (PPM)	Pb (PPM)	Zn (PPM)	Co (PPM)	Ni (PPM)	Bi (PPM)	Mo (PPM)	W (PPM)	Te (PPM)	As (PPM)
61	SPPM-3/37	126	1420	781	78	12	1234	169	BDL	13	BDL
62	SPPM-3/38	271	6817	978	19	11	5917	179	BDL	35	BDL
63	SPPM-3/39	67	633	998	74	11	278	384	BDL	13	3
64	SPPM-3/40	732	1957	1367	52	14	583	71	BDL	40	BDL
65	SPPM-3/41	120	2092	3010	BDL	72	BDL	60	BDL	BDL	BDL
66	SPPM-3/42	214	198	648	46	73	BDL	BDL	BDL	BDL	BDL
67	SPPM-3/43A	405	115	624	80	71	BDL	BDL	BDL	BDL	BDL
68	SPPM-3/43B	559	92	373	125	101	BDL	BDL	BDL	BDL	BDL
69	SPPM-3/44	66	30	267	74	63	BDL	BDL	BDL	BDL	BDL
70	SPPM-3/45	60	26	233	BDL	51	BDL	BDL	BDL	BDL	BDL
71	SPPM-3/46	38	25	235	64	49	BDL	BDL	BDL	BDL	BDL
72	SPPM-3/47	38	27	180	54	57	BDL	BDL	BDL	BDL	BDL
73	SPPM-3/48	34	20	209	70	51	BDL	BDL	BDL	BDL	BDL
74	SPPM-3/49	48	9	209	70	48	BDL	BDL	BDL	8	BDL
75	SPPM-3/50	124	14	174	73	80	BDL	BDL	BDL	BDL	BDL
76	SPPM-3/51	93	11	170	77	78	BDL	BDL	BDL	BDL	BDL
77	SPPM-3/52	88	10	168	80	82	BDL	BDL	BDL	BDL	BDL
78	SPPM-3/53	83	9	185	76	84	BDL	BDL	BDL	BDL	BDL
79	SPPM-3/54	62	8	167	73	78	BDL	BDL	BDL	BDL	BDL
80	SPPM-4/01	16	159	407	64	6	BDL	BDL	146	BDL	BDL
81	SPPM-4/02	33	210	521	69	11	BDL	BDL	163	BDL	BDL
82	SPPM-4/03	22	175	319	78	13	BDL	BDL	200	BDL	7

S.N.	Sample No.	Cu (PPM)	Pb (PPM)	Zn (PPM)	Co (PPM)	Ni (PPM)	Bi (PPM)	Mo (PPM)	W (PPM)	Te (PPM)	As (PPM)
83	SPPM-4/04	32	182	220	69	14	BDL	BDL	163	BDL	BDL
84	SPPM-4/05	45	73	134	71	13	BDL	BDL	181	BDL	3
85	SPPM-4/06	14	76	162	71	11	BDL	BDL	180	BDL	BDL
86	SPPM-4/07	8	43	167	69	14	BDL	BDL	171	BDL	BDL
87	SPPM-4/08	12	46	128	70	BDL	BDL	BDL	186	7	BDL
88	SPPM-4/09	33	111	144	76	16	BDL	BDL	205	8	BDL
89	SPPM-4/10	41	159	616	69	24	BDL	BDL	79	BDL	BDL
90	SPPM-4/11	4	244	369	90	BDL	BDL	1	249	9	BDL
91	SPPM-4/12	34	228	577	73	27	BDL	BDL	154	7	BDL
92	SPPM-4/13	134	232	284	58	13	BDL	BDL	111	7	BDL
93	SPPM-4/14	BDL	508	588	BDL	20	BDL	BDL	BDL	9	BDL
94	SPPM-4/15	8	157	146	BDL	14	8	BDL	BDL	10	BDL
95	SPPM-4/16	97	27	188	17	61	BDL	BDL	BDL	BDL	BDL
96	SPPM-4/17	61	22	176	25	65	BDL	BDL	BDL	BDL	BDL
97	SPPM-4/18	152	34	211	BDL	46	BDL	BDL	BDL	BDL	BDL
98	SPPM-4/19	38	90	153	BDL	21	BDL	BDL	BDL	BDL	BDL
99	SPPM-4/20	6	101	189	65	14	BDL	BDL	190	12	BDL
100	SPPM-4/21	13	121	167	83	17	BDL	BDL	272	9	BDL
101	SPPM-4/22	37	108	400	54	43	BDL	1	121	BDL	BDL
102	SPPM-4/23	4	89	165	56	BDL	BDL	BDL	105	8	BDL
103	SPPM-4/24	4	85	211	98	28	BDL	BDL	299	7	BDL
104	SPPM-4/25	4	86	281	43	17	BDL	21	72	8	BDL

Petrographic and Mineragraphic study result of Drill Core Samples of Pipradih Area, Giridih District, Jharkhand Toposheet No. 72H/16

PETROGRAPHIC STUDY RESULTS

Sl. No.	Sender's Sample ID	Texture	Mineral Composition			Description
			Major >5%	Minor <5%->1%	Accessory <1%	
1	SPPM-4/23	It is a medium grained altered rock showing gneissosity.	Quartz Feldspar Biotite	Sillimanite Sericite	Opaques Zircon	Quartz occurs as medium to fine anhedral grains. Feldspar is present as turbid patchy relicts showing intense sericitisation. Biotite occurs as fine to medium flaky grains showing parallel alignment. Sillimanite is seen present as acicular aggregates, segregating in zones and showing parallel alignment. Sericite occurs as very fine to fine flakes, developing after feldspar alterations. Opaques occur as very fine specks and as fillings along cleavage traces of biotite. Zircon is noted as very fine inclusions within biotite, around which pleochroic halos are observed. The specimen is an <u>altered quartz-biotite-feldspar gneiss.</u>

MINERAGRAPHIC STUDY RESULTS

Sl. No.	Sender's Sample ID	% of ore minerals in polished section	ORE MINERAL COMPOSITION				Description
			Major >5%	Minor <5% - >1%	Accessory <1% - >0.1%	Traces <0.1%	
1.	SPPM-3/37	8	Magnetite (78) Maghemite (18)	Pyrite (3) Chalcopyrite (1)	Ilmenite Molybdenite	Tetrahedrite -Tennantite	Magnetite and maghemite are present as fine to moderately coarse subhedral grains, often found as inclusions within garnet porphyroblasts. Magnetite is also noted as relicts within maghemite in areas. Pyrite and chalcopyrite together occur as fine to very fine anhedral grains, patches, and streaky fillings and as inclusions within magnetite/ magnetite. Ilmenite is noted as very fine exsolutions lamellae within magnetite, at places. Molybdenite occurs as very fine flaky grains in accessories. Possible tetrahedrite-tennantite is noted as very fine inclusions within chalcopyrite. The specimen is showing strong magnetism.

Central Mine Planning and Design Institute Limited
(A Subsidiary of Coal India Limited)
Regional Institute - II
Koyla Bhawan, Koyla Nagar, Dhanbad, Ph.No.
(0341)2252086/2001
Fax: (0341) 2250935
E-Mail: cmpdiri2@gmail.com
