GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR COPPER & ASSOCIATED MINERALS IN

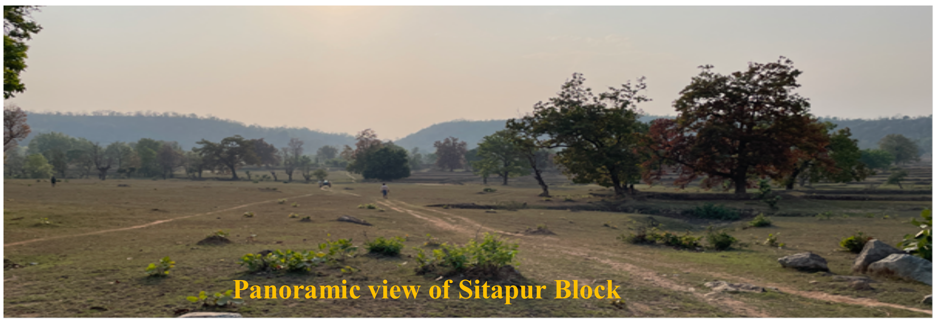
SITAPUR BLOCK

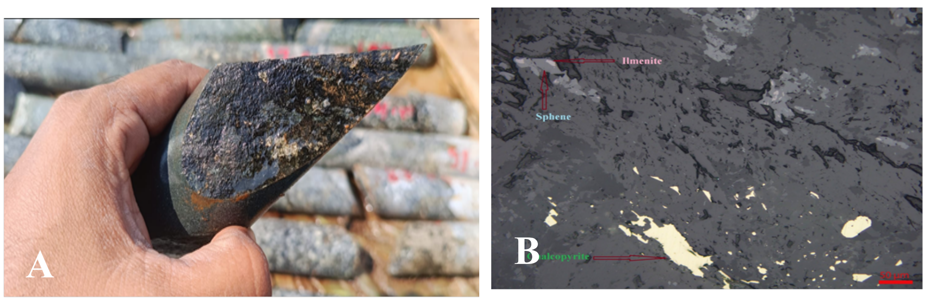
MALANJKHAND COPPER BELT,

BALAGHAT DISTRICT, STATE – MADHYA PRADESH

(Under NMET Programme)

(TEXT, ANNEXURES AND PLATES)





A. Dessiminations of Chalcopyrite, pyrite in Hand specimen of Borehole core sample (MSC-02) B. Photomicrograph of Polished section with Chalocopyrite (MSC-01)

MINERAL EXPLORATION AND CONSULTANCY LTD.

(Formerly Mineral Exploration Corporation Ltd.)

मिनरल एक्सप्लोरेशन एंड कंसल्टेंसी लिमिटेड

(पूर्व में मिनरल एक्सप्लोरेशन कार्पोरेशन लिमिटेड)

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Ministry of Mines, Govt of India Enterprise, MINIRATNA-I CPSE

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तांबे और संबंधित खनिजों के लिए
प्रारंभिक गवेषण पर भूवैज्ञानिक रिपोर्ट (G3)
सीतापुर ब्लॉक
मलंजखंड कॉपर बेल्ट,
बालाघाट जिला, राज्य - मध्य प्रदेश
<u>अध्याय-1बी</u>

कार्यकारी सारांश

1.1.1 सीतापुर ब्लॉक, जो 3.5 वर्ग किलोमीटर क्षेत्र में फैला है, मध्य प्रदेश के मलंजखंड कॉपर बेल्ट के अंतर्गत मलंजखंड ग्रेनाइट का हिस्सा है। यह ब्लॉक मध्य प्रदेश के बालाघाट जिले में मेसर्स हिंदुस्तान कॉपर लिमिटेड (एचसीएल) की वर्तमान में संचालित मलंजखंड कॉपर माइंस से लगभग 10 किलोमीटर उत्तर-पश्चिम में, टोपोशीट संख्या 64 बी/12 में स्थित है।

1.1.2 2001–03 के दौरान, एमईसीएल ने समीपवर्ती शीतलपानी ब्लॉक (2 वर्ग किमी) में एकीकृत भूवैज्ञानिक, भूभौतिकीय, भूरासायनिक और ड्रिलिंग जांच की। भूभौतिकीय सर्वेक्षण ने 800 मीटर लंबे ईएनई-डब्लूएसडब्ल्यू ट्रेंडिंग शियर ज़ोन को नकारात्मक स्व-विभव, उच्च आवेशनीयता और निम्न प्रतिरोधकता से चिह्नित किया, जो संभावित सल्फाइड खनिजकरण का संकेत देता है। भू-रासायनिक प्रतिक्रियाओं ने इन विसंगतियों का समर्थन किया। गवेषणात्मक ड्रिलिंग (कुल 1544.85 मीटर के 9 बोरहोल) ने 0.2% Cu ग्रेड पर 600 मीटर की नतिलंब लंबाई पर तांबे के खनिजकरण की पुष्टि की। इन परिणामों के आधार पर, 0.2% कट-ऑफ पर 0.37% Cu के साथ 0.36 मिलियन टन आवीक्षण संसाधनों का अनुमान लगाया गया और उन्हें UNFC श्रेणी 334 के अंतर्गत रखा गया ।

1.1.3 वित्त वर्ष 2023-24 के दौरान, तांबे के लिए शीतलपानी ब्लॉक की नीलामी मध्य प्रदेश राज्य सरकार द्वारा 13 सितंबर, 2023 को आयोजित 11वें चरण में एक समग्र लाइसेंस के तहत सफलतापूर्वक की गई।

1.1.4 शीतलपानी में पिछले कार्य की सिफारिशों के आधार पर एनएमईटी के वित्तपोषण के तहत सीतापुर ब्लॉक में ब्लॉक जी 3 चरण गवेषण कार्यक्रम शुरू किया गया, ताकि निम्न चुंबकीय तीव्रता वाले शियर ज़ोन के पूर्व की ओर विस्तार और संबंधित बेसमेंटल खनिजीकरण को रेखांकित किया जा सके और सीतापुर ब्लॉक में व्यवस्थित जांच के माध्यम से खनिज क्षमता का आकलन किया जा सके।

1.1.5 सीतापुर ब्लॉक में तांबा और संबंधित खनिजों के लिए प्रारंभिक गवेषण (जी3 चरण) परियोजना की सिफारिश एनएमईटी की 57वीं तकनीकी सह लागत समिति (टीसीसी) द्वारा 26-27 सितंबर, 2023 को की गई थी। परियोजना को बाद में 6 दिसंबर, 2023 को एनएमईटी की 32वीं कार्यकारी समिति (ईसी) द्वारा अनुमोदित किया गया था, और अनुमोदन औपचारिक रूप से एमईसीएल को एमओएम पत्र संख्या एफ.सं.23/397/2023-एनएमईटी/367 दिनांक 12 दिसंबर, 2023 के माध्यम से सूचित किया गया था।

1.1.6 सीतापुर ब्लॉक में जी3 चरण के गवेषण कार्य में चरण-I की गतिविधियाँ शामिल थीं, जिनमें 1:2000 पैमाने पर 3.5 वर्ग किलोमीटर का विस्तृत भूवैज्ञानिक मानचित्रण और स्थलाकृतिक सर्वेक्षण, 22 बेडरॉक नमूनों और 47 मृदा

नमूनों का संग्रह, 101 ट्रेंच नमूनों के साथ 150 घन मीटर की ट्रेंचिंग, और 30 लाख किलोमीटर क्षेत्र को कवर करने वाला भू-भूभौतिकीय सर्वेक्षण (आईपी, प्रतिरोधकता, एसपी और चुंबकीय विधियाँ) शामिल थे। इसके बाद गवेषणात्मक परीक्षण ड्रिलिंग (4 बोरहोल में 576.10 मीटर), बोरहोल विचलन सर्वेक्षण, बोरहोल भूभौतिकीय लॉगिंग, और रासायनिक विश्लेषण, पेट्रोग्राफी (10 नमूने) और मिनराग्राफी (10 नमूने) सहित प्रयोगशाला अध्ययन किए गए।

1.1.7 सीतापुर ब्लॉक मुख्यतः मलंजखंड ग्रेनाइटॉइड्स से ढका है, जिनमें ग्रेनाइट और ग्रैनोडायोराइट नीस चट्टानें शामिल हैं। इन चट्टानों में क्वार्ट्ज वेंस और मेटाडोलेराइट डाइक, शियर ज़ोन, ज्वाइंट्स और फ्रैक्चर के साथ-साथ मौजूद हैं। यह क्षेत्र अधिकांशतः मिट्टी से ढका है, जिसमें सीमित खुलापन है। ग्रैनोडायोराइट नीस, मेटाडोलेराइट / एम्फिबोलाइट डाइक और क्वार्ट्ज वेंस उत्तर-पश्चिमी, मध्य और पूर्वी भागों में दिखाई देती हैं, जबकि लैटेराइट/लैटेराइट मिट्टी दक्षिणी छोर पर दिखाई देती है, और ब्लॉक के सुदूर उत्तर में माइलोनाइट आउटक्रॉप पाए जाते हैं।

1.1.8 सीतापुर का अधिकांश क्षेत्र मिट्टी से ढका है और खेती के अंतर्गत है, मुख्य रूप से धान के खेत हैं, केवल कुछ बिखरे हुए बहिर्गमन हैं। सतह पर कोई खनिजयुक्त क्वार्ट्ज वेंस नहीं देखी गईं। यदि मौजूद थे, तो खनिजकरण के सतही संकेत/अभिव्यक्तियाँ मिट्टी के आवरण और खेती की गई भूमि के कारण क्षेत्र में नहीं देखी जा सकीं। हालांकि, क्वार्ट्ज वेंस, मेटाडोलेराइट डाइक/एम्फिबोलाइट्स में कुछ दुर्लभ सल्फाइड के साथ फेरुगिनाइजेशन / गोएथिटाइजेशन और लिमोनाइट स्टेंस जैसी परिवर्तन विशेषताएँ देखी गईं। ड्रिल किए गए बोरहोल में, शियर ज़ोन से जुड़े खनिजयुक्त वेंस क्वार्ट्ज सभी ड्रिल किए गए 4 बोरहोल में नहीं मिले। कुछ हद तक, कम तांबा खनिजकरण मेटाडोलर्टियों में और मध्यम रूप से शियर ग्रैनोडायोराइट नीस केवल एक बोरहोल (MSC-01) में मिला।

1.1.9 भूवैज्ञानिक मानचित्रण के दौरान, ब्लॉक क्षेत्र के विभिन्न लिथोनाइट्स से 22 बेडरॉक नमूने एकत्र किए गए । इनमें से, 4 नमूनों में ताँबे का मान 100 पीपीएम से अधिक पाया गया, जो 118.17 पीपीएम Cu (ग्रेनोडायोराइट नीस) और 493.81 पीपीएम Cu (क्वार्ट्ज वेंस) के बीच था। अन्य तत्वों जैसे Pb, Zn, Ni, Co, Te , Mo, और Se का विश्लेषण खराब और उत्साहजनक नहीं था। अग्नि परख द्वारा बेडरॉक के 3 नमूनों के स्वर्ण विश्लेषण से निम्न मान (<10 पीपीबी Au) प्राप्त हुए।

1.1.10 बेसमेटल खनिजीकरण के लिए भू-रासायनिक विसंगतियों की पहचान करने हेतु उत्तर-पश्चिमी, मध्य, पूर्वी और दक्षिणी भागों से कुल 47 मिट्टी के नमूने एकत्र किए गए । तांबे का मान 15.273 पीपीएम से 139.6 पीपीएम तक था। केवल दो नमूनों में 100 पीपीएम से अधिक तांबे का मान (111.2 पीपीएम और 139.6 पीपीएम) दर्ज किया गया, दोनों उत्तर-पश्चिमी क्षेत्र से थे। मध्य भाग में 98.16 पीपीएम तांबे की एक पृथक विसंगति भी देखी गई। तांबे के लिए भू-रासायनिक विसंगतियाँ कमजोर, पृथक, बिखरी हुई थीं और उनमें किसी भी भू-रासायनिक प्रवृत्ति की निरंतरता का अभाव था। Pb, Zn, Ni, Co, Te , Mo, और Se के लिए मिट्टी के नमूनों का विश्लेषण भी खराब और उत्साहजनक नहीं था।

1.1.11 संभावित छिपी हुई क्वार्ट्ज वेंस और उनके विस्तार का पता लगाने के लिए ब्लॉक के उत्तर-पश्चिमी और मध्य भाग में कुल 9 ट्रेंचों की खुदाई की गई थी। इनमें से केवल दो ट्रेंचों (T3 और T5) में तांबे के मान दिखाई दिए। ट्रेंच T3 ने

ग्रैनोडायोराइट नीस में 1.0 मीटर से अधिक 645.89 पीपीएम Cu का उत्पादन किया। ट्रेंच T5 ने दो ज़ोन दिखाए: एक ग्रैनोडायोराइट नीस में 2 मीटर से अधिक औसतन 385.275 पीपीएम Cu, और दूसरा ग्रैनोडायोराइट नीस और एम्फीबोलाइट के बीच संपर्क क्षेत्र में 4 मीटर से अधिक औसतन 157.728 पीपीएम Cu। किसी भी ट्रेंच में कोई खनिजयुक्त क्वार्ट्ज बेंस नहीं मिलीं। ट्रेंचिंग के परिणामों ने खराब तांबे के मान का संकेत दिया,

1.1.12 30 लाईन किलोमीटर क्षेत्र में एक एकीकृत भूभौतिकीय सर्वेक्षण (आईपी, एसपी और चुंबकीय विधियाँ) किया गया। सर्वेक्षण में भ्रंशों, अपरूपण क्षेत्रों और शिला-संबंधी संपर्कों जैसी संरचनात्मक विशेषताओं का सफलतापूर्वक चित्रण किया गया। प्रतिरोधकता और आईपी डेटा ने विसंगतियों का खुलासा किया, जबकि चुंबकीय डेटा (तीव्रता और आरटीपी) ने उत्तर-पूर्व-दक्षिण-पश्चिम की ओर प्रवृत्त निम्न चुंबकीय क्षेत्रों को परिभाषित किया, जिन्हें परिवर्तन /अपरूपण क्षेत्र या विसरित सल्फाइड क्षेत्रों के रूप में व्याख्यायित किया गया। इन परिणामों के आधार पर, पहचानी गई विसंगतियों का परीक्षण करने के लिए चार बोरहोल प्रस्तावित किए गए।

1.1.13 N50^0 E-S 50^0 W प्रवृत्ति वाले निम्न चुंबकीय तीव्रता वाले अपरूपण क्षेत्र के विस्तार को रेखांकित किया गया था, और तदनुसार, विसंगतियों का परीक्षण करने के लिए जमीन की सतह से 50 से 90 मीटर की ऊर्ध्वाधर गहराई तक चार बोरहोल ड्रिल किए गए थे।

1.1.14 चार बोरहोल से एकत्रित 200 बोरहोल कोर नमूनों में से, 26 नमूनों में ताँबे का मान 200 पीपीएम से अधिक, 213.48 पीपीएम और 0.22% Cu के बीच दर्ज किया गया। एक बोरहोल MSC-01 से केवल दो नमूनों में 0.1% से अधिक Cu पाया गया, जिसमें मेटाडोलेराइट में 0.50 मीटर पर 0.165% Cu और मध्यम रूप से अपरूपित ग्रैनोडायोराइट नीस में 0.50 मीटर पर 0.22% Cu पाया गया। Pb, Zn, Ni, Co, Te , Mo, और Se का विश्लेषण खराब और उत्साहजनक नहीं था।

1.1.15 अग्नि परख विधि द्वारा Au विश्लेषण के लिए कुल 40 बोरहोल कोर नमूनों का विश्लेषण किया गया। परिणामों से पता चला कि Au का मान <10 ppb से लेकर 92.76 ppb तक था, जो खराब और उत्साहजनक नहीं था।

1.1.16 कुल 50 बोरहोल कोर नमूनों का 34 तत्वों के लिए ICP-MS विश्लेषण किया गया। इनमें से 49 नमूनों में ΣREE+Sc+Y मान 114.24 ppm से 395.02 ppm के बीच पाए गए। REE और अन्य तत्वों के लिए ICP-MS परिणाम उत्साहजनक नहीं थे।

1.1.17 बोरहोल कोर नमूनों के विश्लेषणात्मक परिणामों के आधार पर, एक बोरहोल MSC-01 में 0.1% Cu कट-ऑफ पर दो लीन कॉपर खनिजयुक्त क्षेत्रों की पहचान की गई, जिनमें 0.50 मीटर पर 0.165% Cu और 1.0 मीटर मोटाई पर 0.157% Cu था। शेष तीन बोरहोलों में कोई भी कॉपर खनिजयुक्त क्षेत्र प्रतिच्छेदित नहीं हुआ। केवल बोरहोल MSC-01 में लीन प्रतिच्छेदन खराब, बिखरे हुए और असंतत खनिजीकरण का संकेत देते हैं जिसमें कोई पार्श्व निरंतरता नहीं है।

1.1.18 तांबा खनिजीकरण के खराब प्रतिच्छेदन का कारण तांबा युक्त सल्फाइड की समग्र निम्न सांद्रता और गवेषित गहराई सीमा के भीतर शीयर्ड ज़ोन से जुड़े किसी भी महत्वपूर्ण खनिजयुक्त क्वार्ट्ज वेंस का गैर-प्रतिच्छेदन हो सकता है।

1.1.19 बोरहोल भूभौतिकीय लॉगिंग विरल सल्फाइड क्षेत्रों को उनकी गहराई और मोटाई के साथ चित्रित करती है, जिससे डेटासेट में विवरण जुड़ता है और ड्रिलिंग से प्राप्त जानकारी में वृद्धि होती है। कुल मिलाकर, भूभौतिकीय लॉग प्रतिक्रियाओं ने ड्रिल किए गए बोरहोल में तांबा युक्त सल्फाइड की निम्न सांद्रता का संकेत दिया।

1.1.20 न्यूनतम कट-ऑफ ग्रेड (0.2% Cu) और न्यूनतम स्टॉपिंग चौड़ाई (2.0 मीटर वास्तविक चौड़ाई) मानदंडों के अनुसार, सीतापुर ब्लॉक में गवेषणात्मक ड्रिलिंग से कोई भी महत्वपूर्ण ताम्र खनिजयुक्त क्षेत्र नहीं मिला है। इसलिए, सीतापुर ब्लॉक में ताम्र संसाधन आकलन नहीं किया गया।

1.2.0 सिफारिश

1.2.1 वर्तमान G3 गवेषण ने सीतापुर ब्लॉक में उत्तर-पूर्व-दक्षिण-पश्चिम निम्न चुंबकीय तीव्रता वाले अपरूपण क्षेत्र के पूर्व की ओर विस्तार का पता लगाया है। 50-90 मीटर गहराई तक के 4 बोरहोलों की परीक्षण ड्रिलिंग में कोई महत्वपूर्ण ताम्र खनिजीकरण नहीं पाया गया। केवल बोरहोल MSC-01 में 0.1% से अधिक तांबा स्तर वाले दो लीन ज़ोन मिले, जो कमज़ोर स्थायित्व के साथ अनियमित और असंतत खनिजीकरण का संकेत देते हैं। चूँकि सीमित भूभौतिकीय सर्वेक्षण और उथली ड्रिलिंग से अयस्क प्रोह की ज्यामिति और नियंत्रण का पता नहीं लगाया जा सका, इसलिए अधिक गहरे खनिजीकरण की संभावना से इनकार नहीं किया जा सकता। इसलिए, यदि मौजूद हो, तो संभावित गहरे खनिजीकरण के लिए अनुकूल संरचनाओं की पहचान करने हेतु मैग्नेटोटेल्यूरिक /TDEM और उच्च-रिज़ॉल्यूशन वाले गहरे IP सर्वेक्षण जैसी गहरी पृथ्वी इमेजिंग विधियों को अपनाने की अनुशंसा की जाती है।

GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR COPPER & ASSOCIATED MINERALS IN SITAPUR BLOCK MALANJKHAND COPPER BELT, BALAGHAT DISTRICT, STATE – MADHYA PRADESH

CHAPTER-1B

EXECUTIVE SUMMARY

1.1.21 Sitapur Block, covering an area of 3.5 sq. km, forms part of the Malanjkhand Granitoids within the Malanjkhand Copper Belt of Madhya Pradesh. Block is located in Toposheet No. 64 B/12, about 10 km northwest of the currently operating Malanjkhand Copper Mines of M/s Hindustan Copper Limited (HCL) in Balaghat District, Madhya Pradesh.

1.1.22 During 2001–03, MECL conducted integrated geological, geophysical, geochemical, and drilling investigations in the adjoining Shitalpani Block (2 sq. km). The geophysical survey delineated an 800 m long ENE–WSW trending shear zone marked by negative self-potential, high chargeability, and low resistivity, indicating possible sulphide mineralisation. Geochemical responses supported these anomalies. Exploratory drilling (9 boreholes totaling 1544.85 m) confirmed copper mineralisation over a 600 m strike length at 0.2% Cu grade. Based on these results, 0.36 million tonnes of Reconnaissance resources with 0.37% Cu at 0.2% cut-off were estimated and placed under UNFC category 334. MECL recommended further exploration towards the eastern side, particularly near Sitapur village, as the low magnetic intensity shear zone extended beyond Shitalpani and offers potential loci for mineralization in Sitapur block.

1.1.23 During FY 2023-24, the Shitalpani Block for copper was successfully auctioned by the State Government of Madhya Pradesh under a composite licence in the 11th tranche held on 13th September 2023.

1.1.24 Based on the recommendations of previous work in Shitalpani Block, G3 stage exploration programme was initiated in Sitapur Block under NMET funding to delineate the eastward extension of the low magnetic intensity shear zone &

associated basemental mineralisation and to assess the mineral potential through systematic investigations in Sitapur Block.

1.1.25 The Preliminary Exploration (G3 stage) project for copper and associated minerals in Sitapur Block was recommended by the 57th Technical Cum Cost Committee (TCC) of NMET held on 26th–27th September 2023. The project was subsequently approved by the 32nd Executive Committee (EC) of NMET on 6th December 2023, and the approval was formally communicated to MECL via MoM letter No. F.NO.23/397/2023-NMET/367 dated 12th December 2023.

1.1.26 The G3 stage exploration work in Sitapur Block included Phase-I activities comprising detailed geological mapping and topographical survey of 3.5 sq. km on 1:2000 scale, collection of 22 bedrock samples and 47 soil samples, trenching of 150 cu.m. with 101 trench samples, and a ground geophysical survey (IP, Resistivity, SP, and Magnetic methods) covering 30 Lkm. This was followed by exploratory test drilling (576.10 m in 4 boreholes), borehole deviation survey, borehole geophysical logging, and laboratory studies including chemical analysis, petrography (10 samples) and mineragraphy (10 samples) studies.

1.1.27 Sitapur Block is predominantly underlain by Malanjkhand granitoids comprising granitic and granodiorite gneissic rocks. These rocks are intruded by quartz veins and metadolerite dykes along shear zones, joints, and fractures. The area is mostly soil-covered, with limited exposures. Granodiorite gneiss, metadolerite/amphibolite dykes, and quartz veins are seen in the northwestern, central, and eastern parts, while laterite/lateritic soil is exposed at the southern end, and mylonite outcrops occur at the extreme north of the block.

1.1.28 Most of the Sitapur area is covered by soil and under cultivation, mainly paddy fields, with only a few scattered outcrops. No mineralised quartz veins were observed on surface. Surface indications/manifestations of mineralisation if present could not be seen in the area due to soil cover and cultivated lands. However, alteration features like ferruginisation/goethitisation and limonite stains with some rare sulphides observed in Quartz vein, metadolerite dykes/amphibolites at places. In the drilled boreholes, mineralised Vein quartz associated with shear zone did not intersect in all drilled 4 boreholes. To some extent, lean copper mineralization intersected in metadolerties and moderaly sheared granodiorite gneiss in one Borehole (MSC-01) only. Overall, copper mineralisation appears weak in the block.

1.1.29 During geological mapping, 22 bedrock samples were collected from various lithounits from block area. Out of these, 4 samples recorded copper values greater than 100 ppm, ranging between 118.17 ppm Cu (granodiorite gneiss) and 493.81 ppm Cu (quartz vein). Analyses for other elements such as Pb, Zn, Ni, Co, Te, Mo, and Se were poor and not encouraging. Gold analysis of 3 bedrock samples by fire assay indicated low values (<10 ppb Au).

1.1.30 A total of 47 nos. soil samples were collected from the northwestern, central, eastern, and southern parts to identify geochemical anomalies for basemetal mineralisation in the block. Copper values ranged from 15.273 ppm to 139.6 ppm. Only two samples recorded values above 100 ppm Cu (111.2 ppm and 139.6 ppm), both from the northwestern sector. An isolated anomaly of 98.16 ppm Cu was also observed in the central part. The geochemical anomalies for copper were weak, isolated, scattered and lacked continuity of any geochemical trend. Soil sample analyses for Pb, Zn, Ni, Co, Te, Mo, and Se were also poor and not encouraging.

1.1.31 Total 9 nos. trenches were excavated in the northwestern and central parts of the block to trace possible concealed quartz veins and their extensions. Out of these, only two trenches (T3 and T5) shown copper values. Trench T3 yielded 645.89 ppm Cu over 1.0 m in granodiorite gneiss. Trench T5 showed two zones: one with an average of 385.275 ppm Cu over 2 m in granodiorite gneiss, and another with an average of 157.728 ppm Cu over 4 m in the contact zone between granodiorite gneiss and amphibolite. No mineralised quartz veins were found in any trench. Trenching results indicated poor copper values, and analyses of other associated elements (Pb, Zn, Ni, Co, Te, Mo, Se) were also poor and not encouraging.

1.1.32 An integrated geophysical survey (IP, SP, and Magnetic methods) was conducted over 30 Lkm in Sitapur Block to identify base metal zones, particularly copper. The survey successfully delineated structural features such as faults, shear zones, and lithological contacts. Resistivity and IP data revealed anomalies, while magnetic data (intensity and RTP) defined NE–SW trending low magnetic zones, interpreted as alteration/shear zone or disseminated sulphide zones. Based on these results, four boreholes were proposed to test the identified anomalies.

1.1.33 The extension of the N50^{0}E-S50^{0}W trending low magnetic intensity shear zone was delineated during Phase-I geophysical work in Sitapur Block, and accordingly, four boreholes were drilled to test the anomalies to vertical depths of 50to 90 m from ground surface.

1.1.34 Out of 200 borehole core samples collected from four boreholes, 26 samples recorded copper values above 200 ppm, ranging between 213.48 ppm and 0.22% Cu. Only two samples from one Borehole MSC-01 shown > 0.1% Cu, with 0.165% Cu over 0.50 m in metadolerite and 0.22% Cu over 0.50 m in moderately sheared granodiorite gneiss. Analyses for Pb, Zn, Ni, Co, Te, Mo, and Se were poor and not encouraging.

1.1.35 Total 40 nos. of borehole core samples analysed for Au analysis by fire assay method. The results indicated Au values ranging from <10 ppb to 92.76 ppb, which were poor and not encouraging.

1.1.36 Total 50 nos. borehole core samples were subjected to ICP-MS analysis for 34 elements. Out of these, 49 samples showed ΣREE+Sc+Y values ranging from 114.24 ppm to 395.02 ppm. The ICP-MS results for REE and other elements were not encouraging.

1.1.37 Based on analytical results of borehole core samples two lean copper mineralised zones identified in one Borehole MSC-01 at 0.1% Cu cut-off, with 0.165% Cu over 0.50 m and 0.157% Cu over 1.0 m thickness. No copper mineralised zones were intersected in the remaining three boreholes. The lean intersections in only Borehole MSC-01 suggest poor, patchy and discontinuous mineralisation with no lateral continuity.

1.1.38 The poor intersections of copper mineralisation may be attributed to the overall low concentration of copper-bearing sulphides and the non-intersection of any significant mineralised quartz veins associated with shear zones within the explored depth range.

1.1.39 Borehole geophysical logging delineated sparse sulphide zones, along with their depths and thicknesses, thereby adding detail to the dataset and enhancing the information obtained from drilling. Overall, geophysical log responses indicated poor concentration of copper bearing sulphides in the drilled boreholes.

1.1.40 Exploratory drilling has not intersected any significant copper mineralised zones in Sitapur Block as per the minimum cut-off grade (0.2% Cu) and minimum stoping width (2.0 m true width) criteria required for resource estimation. Hence, no resource estimation for copper was carried out in Sitapur Block.

1.3.0 RECOMMENDATION

1.3.1 The present G3 exploration has traced the eastward extension of the NE–SW low magnetic intensity shear zone into Sitapur Block. Test drilling of 4 boreholes up to 50-90 m depth did not intersect any significant copper mineralisation. Only Borehole MSC-01 yielded two lean zones above 0.1% Cu, indicating patchy and discontinuous mineralisation with poor persistence. Since ore shoot geometry and controls could not be ascertained from limited geophysical survey and shallow drilling, the possibility of deeper mineralisation cannot be ruled out. Hence, it is recommended to undertake deep earth imaging methods such as magnetotelluric/TDEM and high-resolution deep IP surveys to identify favourable structures for potential deep-seated mineralisation, if present.

CHAPTER-II

2.1.0 DETAILS OF THE QUALIFIED PERSON(S) / EXPLORATION AGENCY

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

Table No 2.1
Details of exploration agency involved during exploration work

TITLE	DETAILS
(a) Name:	Mineral Exploration and Consultancy Limited (Formerly Mineral Exploration Corporation Limited) (A Govt. of India Enterprise; A Miniratna-I CPSE) (Ministry of Mines, Govt of India)
(b)Communication Address:	Dr. Babasaheb Ambedkar Bhawan, Highland Drive Road, Seminary Hills, Nagpur-440006.
(c) Contact Mobile No:	0712-2510289, 0712-2511829
(d) E-Mail id:	cmd@mecl.gov.in gm-exploration@mecl.gov.in
(e) Qualification of Technical Personnel	M.Sc. Geology/ Applied Geology
(f) Experience:	Professionals have more than 30+ years of experience
(g) Affiliation to any organization/company, if yes, specify the name of the organization or company.	A Govt. of India Enterprise; A Miniratna-I CPSE Ministry of Mines, Govt. of India

2.2.0 DETAILS OF PERSONS ASSOCIATED WITH VARIOUS ASPECTS OF EXPLORATION ASSESSMENT OF RESOURCES AND RESERVES

2.2.1 The list of personnel associated with the execution of different exploration activities carried out in Sitapur Block (G-3), District: Balaghat , Madhya Pradesh given in the following **Table No-2.2.**

Table-2.2
List of Person(s) associated with the Exploration Work

S No.	Title	Name of the Personnel
1	Overall Guidance	Shri Srikant Sharma, HoD (Exploration) Shri Guljar Singh Dhami, G.M. (Geological services) Shri P. Ravindran Nair, G.M (Exploration), Retd.
2	Overall planning, Coordination & Supervision	Shri Srikant Sharma, HoD (Exploration) Shri Guljar Singh Dhami, G.M. (Geological services) Shri P. Ravindran Nair, G.M (Exploration), Retd. Shri Pradeep Kulkarni, Retd. D.G.M. (Exploration) Shri Mohamad Dasthageer, Sr. Manager (Geology)
3	Project Management & Field operation	Shri Rajnikant Singh, Project Manager, Burhar Project
4	Physical Execution of Work	
	Geology	Shri Mohammad Kaif, Asst. Manager (Geology) Shri Dipankar Manna, Asst. Manager (Geology)
	Sampling	Shri Dipankar Manna, Asst. Manager (Geology) Shri Mohammad Kaif, Asst. Manager (Geology) Shri Satish Kumar Inaparthi, Sr. Tech. (sampling) Mrs. Shikha Pradeep Pandey, Sr. Tech (sampling) Shri Ankush Haridas Wagh, Sr. Tech.(sampling)
	Survey	Shri Pratap Singh Negi, Asst. Survey & Map Officer, OIC Shri Jagdish Kumar Thakral, Survey and Map Officer (Retd.) Shri Durgesh Devarshee, Asst. Survey Map Officer

S No.	Title	Name of the Personnel
		Shri Hira Ghosh, STA (S&D) Shri Shamsher Alam (Surveyor-FTE)
	Drilling	Shri Rajnikant Singh, Project Manager, Burhar Project Shri Dushyant Singh, Drilling Engineer Shri Shrikant Sahoo, Operator (Drilling) Shri Dileep Mahanta, Operator (Drilling)
	Geophysics	Shri Guljar Singh Dhami, G M (Geological Services) Shri Bimlendu Rai, Sr. Manager (Geophysics) Bably Dey, Asst. Manager (Geophysics) Shri Rajat Kumar, Geophysicist
5	Chemical Laboratory	Shri Shri Srikant Sharma, Head (Exploration) Shri P. Ravindran Nair GM (Exploration), Retd.
		Shri Rohit Sharma, Senior Manager (Chemical)
		Dr. Deepti Rahangdale, Manager (Chemical)
		Fawaz SVP, Asst. Manager (Chemical)
6	Petrographic Studies	Shri Sayantan Pal, Manager (Geology)
7	Data Processing & Documentation	Shri Mohammad Dasthageer, Senior Manager (Geology) Shri Mohammad Kaif, Asst. Manager (Geology) Shri Dipankar Manna, Asst. Manager (Geology) Mrs. Moumita Ghosh, Asst. Manager (Geology)
		Shri Uday A. Patil, Sr. Operator (Computer) Shri N. C. Reddy, Sr. Operator (Computer)
8	Reprography and Printing	Shri Pratap Singh Negi, Asst. Survey & Map Officer, OIC
		Shri Durgesh Devarshi, Asst. Survey & Map Officer

CHAPTER-3

TITLE AND OWNERSHIP

3.1.0 TITLE OF THE REPORT

GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR COPPER & ASSOCIATED MINERALS IN SITAPUR BLOCK MALANJKHAND COPPER BELT, BALAGHAT DISTRICT, MADHYA PRADESH

Ownership: Government of Madhya Pradesh

Name of Prospector: MINERAL EXPLORATION AND CONSULTANCY LIMITED
(Formerly Mineral Exploration Corporation Limited)
(A Govt. of India Enterprise; A Miniratna-I CPSE)
(Ministry of Mines, Govt. of India)

Address of Prospector: Dr. Babasaheb Ambedkar Bhavan,
High Land Drive Road, Seminary Hills, Nagpur, Pin- 440006

E-mail of Prospector: cmd@mecl.gov.in; gm-exploration@mecl.gov.in

Telephone numbers of Prospector: 0712-2510289; 0712-2511829

3.2.0 DETAILS OF PERIOD OF PROSPECTING

Background Information

3.2.1 Copper with its unique physical, mechanical and electrical properties, has played a vital role in the industrial growth of a nation. In India, around 75% of demand is met through imports. The increasing demand of copper metal in the country could be eased with the exploration of new copper deposits of economic importance. During, preceding decades no large-scale metal deposit has been discovered in India. However, the possibility of working of small mineral bodies in proximity to each other, though technological advances and increased operational efficiency cannot be ruled out. Therefore, it is necessary and imperative to locate and explore such small copper deposits in cluster.

3.2.2 GSI carried out special thematic mapping during Field Seasons 1991-1994. Over the extent of 1100 sq. km. of area was mapped on 1:25,000 scale falling in Survey of India Toposheet Nos. 64B/12, 64B/16,64C/09 and 64C/13. Quartz vein/reef of strike length 450 m and width 15.20 m approx. to 0.9 km located west of Shitalpani village. Total 7 bedrock samples indicated cu values between 850 ppm and 0.28% of Cu.

3.2.3 Based on the positive outcome of GSI exploration, MECL carried out integrated exploration activities in the Shitalpani Block (2 sq. Km.) during F.Y. 2001 to 2003. Shitalpani Block is adjoining to Sitapur block. The integrated geophysical survey carried out by MECL helped to interpret the presence of a lineament or shear zone, trending ENE-WSW of 800 m strike length, continuing beyond the block boundary i.e. extending in Sitapur block. Exploratory drilling (9 boreholes totaling 1544.85 m) confirmed copper mineralisation. Structural manifestations such as shears and their intersections are possible loci for mineralization, thus exploration through integrated approach including geophysical, geochemical surveys etc. around Sitapur village was recommended.

3.2.4 Based on the recommendations of previous work, MECL formulated an integrated exploration scheme to explore Sitapur block in detail. As per the request of MECL, Department of Mines & Geology, Govt of Madhya Pradesh given consent to carry out exploration in the Sitapur block vide letter No. 7252 Bhowmiki/N.K./2022 dated 24/05/2022.

3.2.5 In line with this, MECL submitted G-3 stage exploration proposal for Shitalpani Block (including Sitapur Block) of total 7 sq. km area covering Block-A (5 sq.km of Sitapur sub-block) & Block-B (2.0 sq.km Shitalpani sub-block) and presented in 42nd TCC meeting of NMET held on 23rd and 24th June, 2022. Committee suggested to submit the modified proposal for Reconnaissance survey (G-4) for copper mineralisation in Block-A (5 sq. km. of Sitapur sub-block) only.

3.2.6 As advised by the 42nd TCC committee, MECL submitted modified proposal for Reconnaissance survey (G4) in Sitapur Block over 5 sq. km. area in 43th TCC meeting held on 28th & 29th July, 2022. The project was discussed detail and as per the deliberations committee advised to estimate the resource and auction possibility of the adjoining Shitalpani Block (2.0 sq.km) which was previously explored by MECL during 2001-2003 and resubmit the proposal.

3.2.7 As advised by the 43rd TCC committee, MECL estimated copper ore resources in the adjoining Shitalpani Block area (2 sq. km.) based on the previous exploratory drilling data of MECL (2001-03). Total 0.36 m.t. (million tonnes) Net geological in-situ resources with 0.37 % Cu have been estimated by Geological Cross Section Method at 0.2 % Cu cut-off (with 1 m minimum stoping width and 2m non-ore parting) and the resource placed under Reconnaissance Resource 334 category of UNFC. The Geological Report namely "Geological Report on Integrated Exploration for Copper in Shitalpani Block, Malanjkhand Granitoid, District, Balaghat, Madhya Pradesh" has been submitted on 11.10.2022 to Department of Mines & Geology, Govt. of Madhya Pradesh and the same was intimated to NMET secretariat.

3.2.8 Subsequently, Exploration Proposal (G4) was resubmitted and discussed in 46th TCC meeting held on 27 Oct, 2022. Committee opined that in view of the dismal grade and limited resources of copper in the adjoining Shitalpani block, the committee suggested to wait till auctioning of Shitalapani block before taking up exploration in the proposed Sitapur block.

3.2.9 Consequently, Shitalpani block (2.0 sq.km) for copper was successfully auctioned in 11th tranche of auction held on 13th September, 2023 by Govt. of Madhya Pradesh under composite licence (CL).

3.2.10 In view of the above fulfilling conditions of 42nd, 43rd & 46th TCC, and as per committee recommendations the G4 stage Exploration proposal for Copper in Sitapur block (5.0 sq.km) was re-submitted in 57th TCC meeting held in Sep, 2023. After detailed technical deliberations, committee suggested to reorient and modify the block to an extent of 3.5 sq.km and take up exploration for Copper and associated minerals under G-3 stage. As advised, necessary modificiations were attended and the G-3 stage proposal for Sitapur Block over 3.5 sq.km. area was recommended by 57th TCC held on 26th & 27th Sep, 2023 with an approved cost of 270.88 Lakhs within 12 months time schedule.

3.2.11 Subsequently, the 32nd Executive Committee (E.C.) held on 6th, Dec, 2024 approved the project Preliminary Exploration (G-3 stage) for Copper & Associated Minerals in Sitapur Block, Malanjkhand Copper Belt, Balaghat District, Madhya Pradesh and formally intimated to MECL vide MoM letter No. F.NO.23/397/2023-NMET/367 dated 12th Dec, 2023.

Details of Period of prospecting:

3.2.12 Following the Office Memorandum/ sanction order from NMET, MECL initiated field activities and established base camp near Baihar under administrative control of MECL's Burhar project. MECL commenced G-3 stage exploration work (Phase-I) in 1st week of Janauary, 2024 and concluded in May, 2024. Phase-1 work comprising of Detailed geological mapping (1:2000 scale) and topographic survey over 3.5 sq.km. area surface Surface geochemical sampling (Bedrock/Soil), trenching work & Ground Geophysical survey I.P. cum Resistivity, S.P. & Magnetic Survey (30 Lkm) to delineate potential mineralized zones has been completed.

3.2.13 The outcome of Phase-I work including Detailed Geological mapping, surface sampling, trenching work and Ground geophysical survey was reviewed with 67th TCC-I meeting held on 24th July, 2025. It was reported that most of the area is concealed under soil cover and cultivated land except few limited scanty outcrops in northwestern, central and eastern part of the block. Surface Bedrock, soil samples and trenching work have not shown any significant values for Cu and associated minerals. However, ground geophysical survey (I.P. cum Resistivity, S.P. & Magnetic) helped to identify N50^{0}E-S50^{0}W trending low magnetic intensity shear zone possibly indicative of disseminated type of mineralization associated with shear zone. Based on the outcome of integrated ground geophysical survey, initially 4 boreholes planned to test the geophysical anomalies at specified locations to intersect mineralization up to 50m to 90m vertical depth from surface against the approved drilling quantum (800m in 8 Boreholes). Based on the outcome of test drilling remaining infilling boreholes to be drilled at 200m interval as per the approved quantum.

3.2.14 The project was reviewed with 67th TCC-I committee and as per the delibertions, committee recommended to drill initially 4 nos. of boreholes upto 90m vertical depth to test the ground geophysical anomalies and based on the positive outcome, remaining 4 boreholes may be drilled in the area.

3.2.15 The project was reviewed with 3rd TCC-II meeting held on 5th, 6th Dec, 2024. MECL informed that proposed boreholes fall in cultivated land. Hence, drilling activities could not be commenced due to standing crops till end of Dec, 2024. The same was intimated to NMET Secretariat by Email on 03rd Oct, 2024. Time extension of the project was exteneded up to 11th Jun, 2025.

3.2.16 MECL commenced drilling activities in mid of January, 2025 and concluded all site related activities in 1st week of Jun, 2025. MECL commenced drilling work with commencing of Borehole No. MSC-01 on 17.01.2025 and concluded drilling ctivites with closure of borehole No. MSC-04 on 24.05.2025. Total 4 boreholes namely MSC-01, 02, 03 & 04 (576.10m) drilled to test the geophysical anomalies and to confirm the strike and depth persistence of copper mineralization in the area.

3.2.17 The project was reviewed with 11th TCC-II meeting held on 23rd, 24th & 25th July, 2025. MECL informed the status of the project and requested to extend timeline of the project up to 30th Sep, 2025 for submission of Final Geological Report. Committee recommended the extension of the project up to 30th Sep, 2025 for submission of the Report.

3.2.18 Draft Geological Report was peer revived by Dr. R.N. Singh, Director, GSI (Retd.) and suggested comments were attended. The project was reviewed with 13th TCC-II committee held on 22nd to 24th Sep, 2025 for submission of final Report and committee advised to submit the Final Geological Report.

CHAPTER-IV

4.0.0 DETAILS OF THE AREA UNDER STUDY

4.1.0 LOCATION AND ACCESSIBILITY OF THE BLOCK

4.1.1 The study area is situated in and around Sitapur, Shitalpani and Karhu villages in Baihar Tehsil of Balaghat District, Madhya Pradesh. Sitapur block is located at about 10 km north-western direction from prominent Malanjkhand Copper mine (MCP) of M/s Hindustan Copper Ltd and is adjoing block to Shitalpani Block which was previously explored for copper by MECL (2003) and successfully acutioned. Mohgoan/Newargaon, the nearest town and is located about 5km northwest from Malanjkhand on Malanjkhand-Baihar-Balaghat road.

4.1.2 The Sitapur block falls under Survey of India Toposheet No. 64 B/12, covering an area of 3.5 sq.km. and lies between latitudes $22^0$03' 33.2950" to $22^0$5' 08.8599" N and longitudes $80^0$39'46.3329" and $80^0$41'10.6580" E. longitudes. The block location is shown in **Plate-I** and **Text Figure-1**. The locational co-ordinates (Geographic & UTM) of the cardinal points of the Sitapur Block, Malanjkhand Copper Belt, Balaghat District, Madhya Pradesh are in given in **Table 4.1**.

Table-4.1

Co-ordinates of the corner points of the block boundary of Sitapur Block, Malanjkhand Copper Belt, Balaghat District, Madhya Pradesh

Corner Cardinal Points	DMS Co-ordinates		UTM Co-ordinates (Zone: 44)	
	Latitude	Longitude	Northing	Easting
A	22° 05' 08.8599" N	80° 40' 22.9166" E	2442359	466270.3
B	22° 04' 23.6203" N	80° 41' 10.6580" E	2440966	467635.5
C	22° 03' 33.2950" N	80° 40' 14.6315" E	2439422	466026.6
D	22° 03' 46.0005" N	80° 39' 54.0742" E	2439814	465438.2
E	22° 04' 13.8239" N	80° 40' 08.6819" E	2440668	465858.8
F	22° 04' 24.3121" N	80° 39' 46.3329" E	2440992	465219

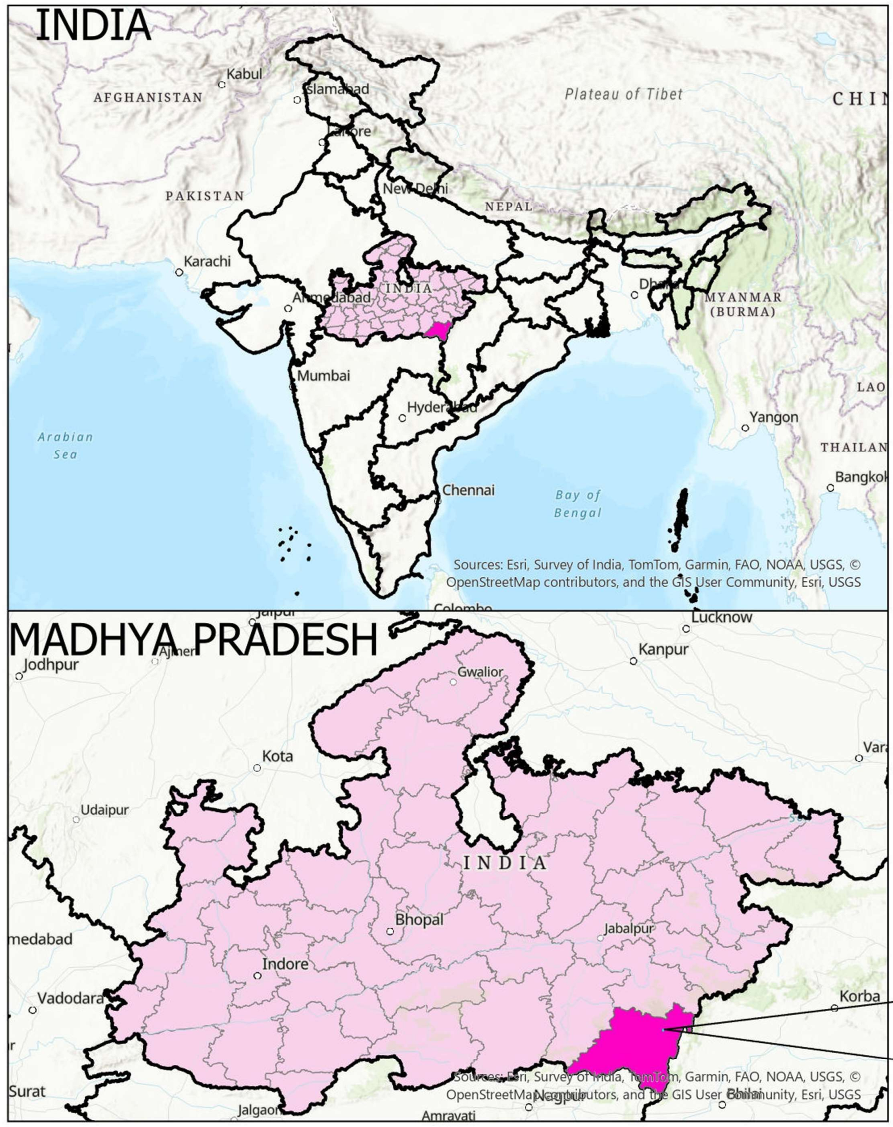
4.2.0 ACCESSIBILITY TO THE BLOCK

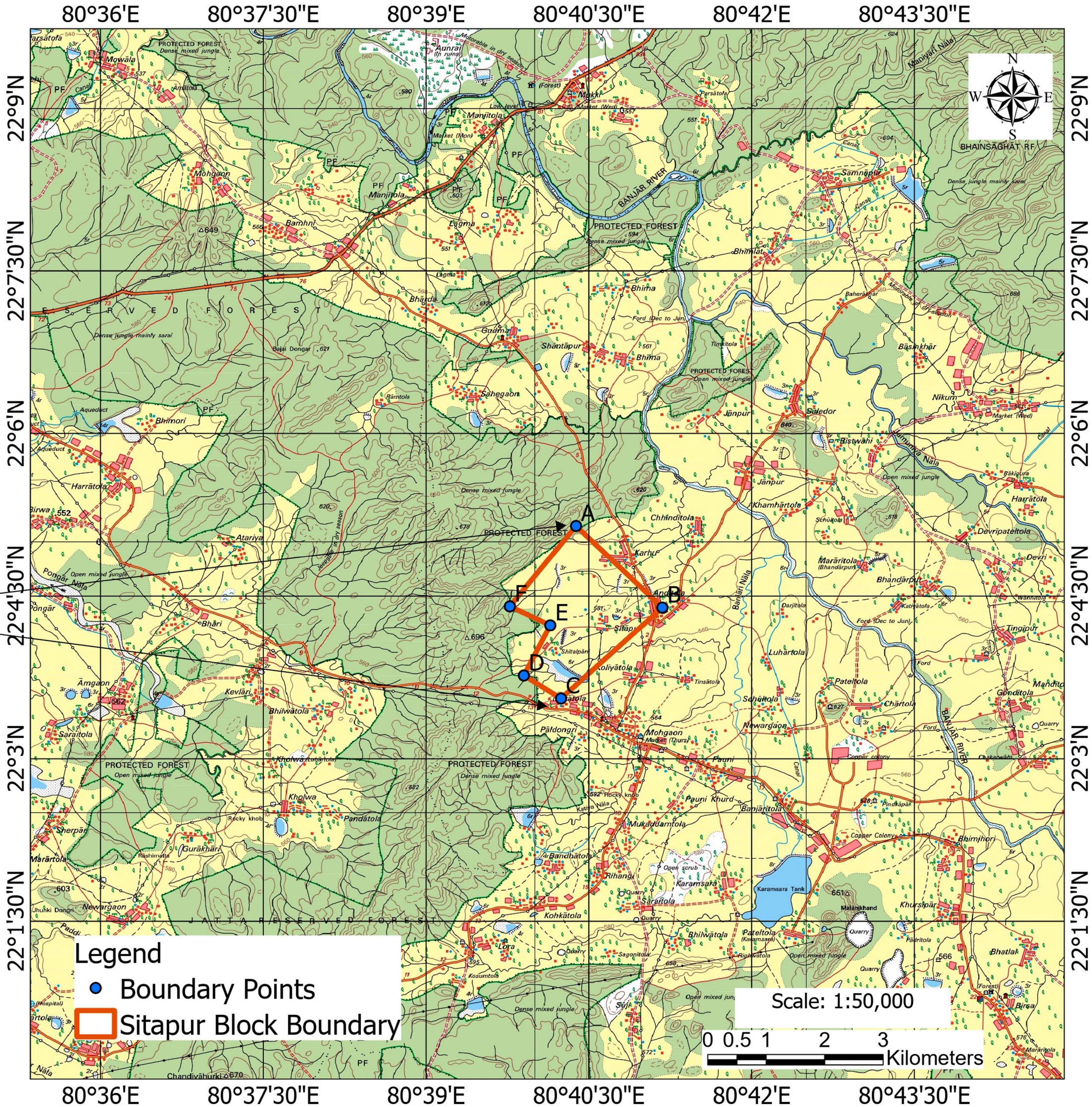
4.2.1 Mohgaon/Newargaon is located about 5 kms from Malanjkhand on Malanjkhand-Baihar-Balaghat road. The same road is passing near the southern boundary of Sitapur block. Sitapur block is about 3 km from Mohgaon and may be approached through metal road connecting Mohgaon to Anditola. Mohgaon/Newargoan is well connected with district HQ of Balaghat (86 kms) and on other side with Durg (130 kms) by metalled road.

4.2.2 The nearest railhead is Lamta, situated on Gondia-Jabalpur narrow gauge line is 70 kms from Mohgaon. Durg (130 kms) and Gondia (147 kms) are the nearest broad gauge railway stations located on Mumbai-Howrah main line of South Easter Railway. The nearest airport is Raipur which is about 165 kms from Mohgaon. Malanjkhand is accessible with Raipur, Durg, Nagpur and Jabalpur by road.

4.2.3 Mohgaon/Newargoan is a nearest town where bank, telephone, Post Office, market and Primary health Centre facility is available.

Text Figure-1: Location Map of Sitapur Block, Balaghat District, Madhya Pradesh

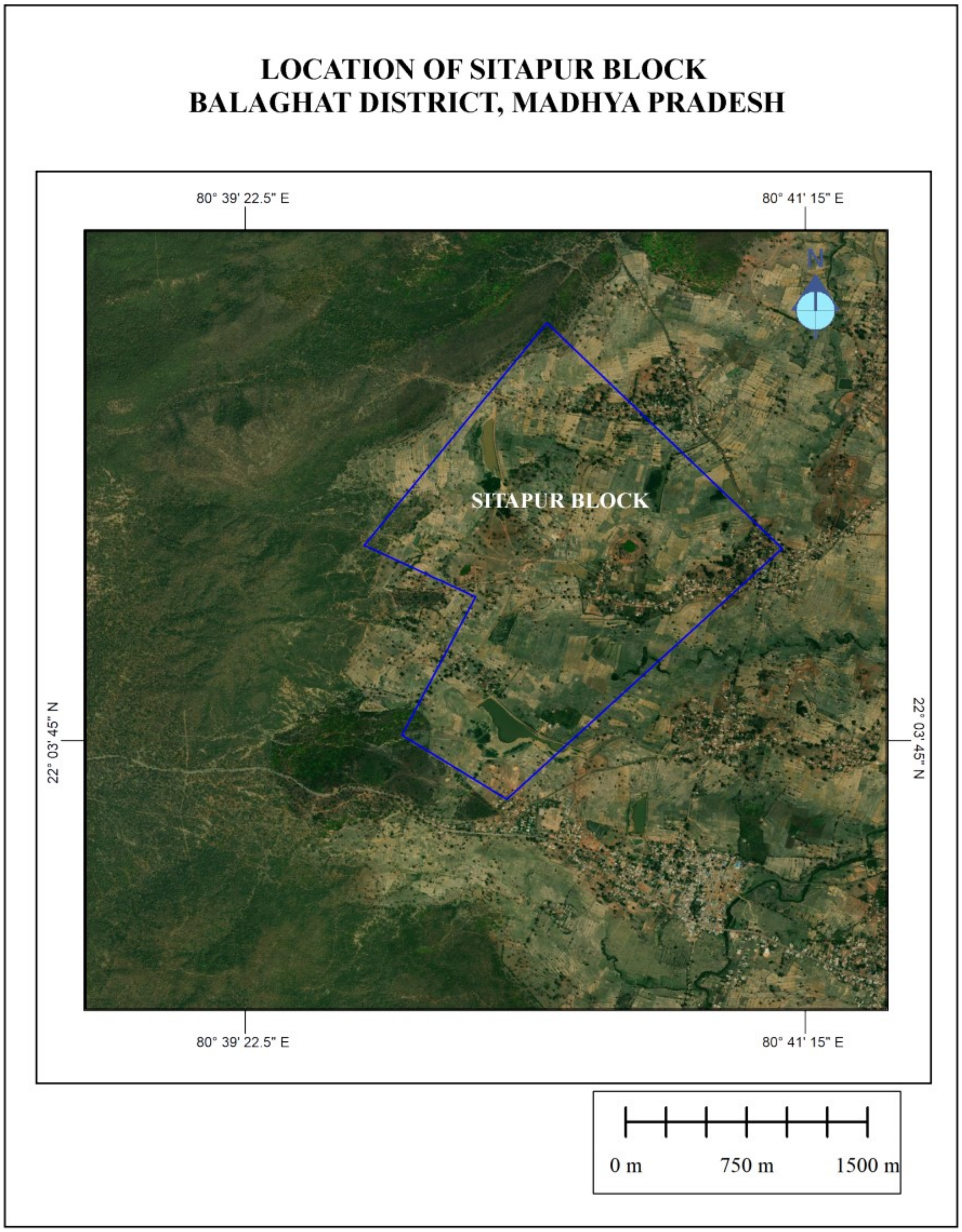




Co-ordinate of Corner Points of Sitapur Block

Cardinal Point	Easting	Northing	Latitude	Longitude	RL
A	466270.3	2442359.432	N22°05'08.85987"	E80°40'22.91658"	586.564
B	467635.5	2440965.588	N22°04'23.62032"	E80°41'10.65797"	568.403
C	466026.6	2439421.634	N22°03'33.29499"	E80°40'14.63152"	588.696
D	465438.2	2439813.571	N22°03'46.00052"	E80°39'54.07418"	582.286
E	465858.8	2440668.135	N22°04'13.82392"	E80°40'08.68194"	581.821
F	465219	2440992.017	N22°04'24.31215"	E80°39'46.33290"	590.046

Text Figure-2: Location Map of Sitapur Block on Google satellite imagery



4.3.0 DETAILS OF THE AREA WITH LAND USE

4.3.1 In general, majority of the area is occupied by soil cover except few outcrops of quartz reef and metadolerite dykes on northwestern and central part of the area. The area is under intense cultivation and most of the lands are private cultivated lands. Scattered land parcels under forest cover. Cadastral details and land details (government, private and forest) of the area are not available. Major crops in and around the area are Paddy. Three Water bodies (ponds) exist in the area two located on north and northwestern part while third one on the southern part of the block area. Water bodies mainly used for irrigation purpose. Satellite imagery sourced from Google Earth with location of the study area is given as **Text Figure No-2.**

4.4.0 MINERAL(S) UNDER INVESTIGATION

4.4.1 Sitapur block explored for copper and associated Minerals at G3 Stage.

CHAPTER-V

PHYSIOGRAPHY AND ENVIRONMENT

5.1.0 RELIEF OF THE AREA WITH MINIMUM AND MAXIMUM ELEVATION, DRAINAGE PATTERN, NATURAL WATER COURSES, RESERVOIRS, ETC.

5.1.1 The topography of the Sitapur block is almost flat terrain. One small isolated low raising hillocks located on the central part of the block area near Sitapur village. In general, the area is sloping towards north-east and eastern side. The maximum elevation recorded on western and southwestern part of the area is 588m towards Shitalpani village while Minimum elevation recorded on the northeastern part of the block area is 564m towards Sitapur village.

5.1.2 The drainage of the area is mainly controlled by tributaries of NW flowing Banjar River. The small nalas flowing from west to east/northeast drain into perennial Banjar River which is about 2km away from northern boundary of Sitapur block. The small seasonal nalas ultimately drain into Banjar River. There are three ponds located in the area with water channels of which two in the northern part and one in southern part i.e. south of Sitapur village which is the source of irrigation for cultivation land.

5.1.3 The block location depicted on google satellite imagery is shown as **Text Figure No.2 &** topographical map of Sitapur Block is shown as **Plate No. III.**

5.2.0 ROADS, RAILWAY TRACK, ELECTRIC TRANSMISSION LINE, TELEPHONE LINE, ETC.

5.2.1 Mohgaon/Newargaon is located about 5 kms from Malanjkhand on Malanjkhand-Baihar-Balaghat road. The same road is passing near the southern boundary of Sitapur block. Sitapur block is about 3 km from Mohgaon and may be approached through metal road connecting Mohgaon to Anditola.

5.2.4 No Major roads, Railway track, power transmission line and telephone line exist in the Block area.

5.3.0 HOST POPULATION (LOCAL TRIBES), HUMAN SETTLEMENTS WITHIN AND NEARBY THE AREA

5.3.1 The Sitapur Block lies in the Baihar Tehsil, Balaghat district of Madhya Pradesh. It is one of 10 Tehsils of Balaghat district. There are 330 villages and 2 towns in Baihar Tehsil. As per the Census India 2011, Baihar Tehsil has 63910 households, population of 284352 of which 140250 are males and 144102 are females. The population of children between age 0-6 is 40987 which is 14.41% of total population. The sex-ratio of Baihar Tehsil is around 1027 compared to 931 which is average of Madhya Pradesh state. The literacy rate of Baihar Tehsil is 58.19% out of which 65.65% males are literate and 50.92% females are literate. The total area of Baihar is 1346.58 sq.km with population density of 211 per sq.km.

5.3.3 Out of total population, 50% of population lives in urban area and 60% lives in rural area. The details of the Population Census 2011, of Baihar Tehsil are given in **Table-5.1.**

Table-5.1
Census Data of Baihar Tehsil, Balaghat district, Madhya Pradesh

Description	Urban	Rural
Number of households	11079	52831
Total Population	50826	233526
Population (%)	49.66%	50.75%
Male Population	25241	115009
Female Population	25585	118517
Sex Ratio	1014	1013
Literacy (%)	69.2%	55.79%

5.3.4 Out of total population, 82.13% of population lives in urban area and 17.87% lives in rural area. There are 3.01% Scheduled Caste (SC) and 55.74% Scheduled Tribe (ST) of total population in Baihar Tehsil.

5.4.0 SOCIO DEMOGRAPHIC PROFILE OF THE AREA AND NEARBY

5.4.1 Baihar Tehsil of Balaghat district has total population of 284,352 as per the Census 2011. Out of which 140,250 are males while 144,102 are females. In 2011 there were total 63,910 families residing in Baihar Tehsil. The Average Sex Ratio of Baihar Tehsil is 1,027.

5.4.2 As per Census 2011 out of total population, 17.9% people lives in urban areas while 82.1% lives in the rural areas. The average literacy rate in urban areas is 78.5% while that in the rural areas is 65.6%. Also, the Sex Ratio of Urban areas in Baihar Tehsil is 1,014 while that of rural areas is 1,031.

5.4.3 The population of Children of age 0-6 years in Baihar Tehsil is 40987 which is 14% of the total population. There are 20728 male children and 20259 female children between the ages 0-6 years. Thus, as per the Census 2011 the Child Sex Ratio of Baihar Tehsil is 977 which is less than Average Sex Ratio (1,027) of Baihar Tehsil.

5.4.4 The total literacy rate of Baihar Tehsil is 67.99%. The male literacy rate is 65.65% and the female literacy rate is 50.92% in Baihar Tehsil.

5.5.0 HISTORICAL SITES AND ARCHAEOLOGICAL MONUMENTS, PLACES OF WORSHIP, PUBLIC UTILITIES ETC.

5.5.1 No historical site and archaeological monuments and places of worship exist within the block area. An ancient temple named Joda temple is located in Baihar Tehsil. The Joda Temple is a 12th century temple that faces each other and are located by the side of an ancient tank. This is a protected monument of the Archaeological Survey of India (ASI).

5.6.0 FORESTS, SANCTUARIES, NATIONAL PARK AND WILD LIFE SANCTUARIES ETC.

5.6.1 The major part of the block area falls under private cultivated land. However, scattered isolated westeren and northern parts of the block area is occupied by forest land. Jatta Reserve Forest is located on the outside of western side from the block boundary. No National parks and wild life sanctuaries etc. exist within the block area and in the close proximity of the block area. Kanha National Park is located about 15-20 kms north of the block.

5.7.0 FLORA AND FAUNA WITHIN AND NEARBY

5.7.1 The major part of the block area falls under private cultivated land. However, the southern and western scattered parts of the block is covered by forest. Jatta Reserve Forest is located outside on the western side of the block boundary. The forest area is under the category of protected forest having open dense mixed Jungle. The flora comprises mainly Sal (Shorea robusta), Bija (Pterocarpus marsupium), Saj (Terminalia tomentose), Teak (Tectonica grandis), Aaonwala (Phyllanthus emblica), Mahua (Mahuca indica), Jamun (Eugenia eugenensis), Tendu (Disophyres tomanton), Mango (Magnifera india), Imli (Tamrindus indica), Haldu (Adina cordifolia), Bel (Aogle marmelos), Neem (Melis indica), Bamboo (Dendrocalamus stricfus) and many other herbs and shrubs.

5.7.2 The common wild animals reported are bear, monkey, deer, hare, mongoose and a large variety of common birds and snakes Tigers and leopard are occasionally reported in the area as the Kanha National Park is located about 15-20 kms north of the block.

5.8.0 WATER BODIES SUCH AS RIVER, NALA, STREAM, RESERVOIR, ETC

5.8.1 The major part of the area is covered by alluvium / soil cover. There are no major river/stream and reservoir exist in the area. However, two water bodies (pond) exist in the area. One water body is located in the central part while another one is near the eastern boundary of the block area. The drainage of the in and around the area is mainly controlled by tributaries of SE-NW flowing Banjar River. The small seansonal nalas flowing from west to east/north east drain into perennial Banjar River which is about 5 kms northeast of the block area.

5.9.0 CLIMATIC CONDITIONS

5.9.1 The area experiences a sub-tropical monsoonal climate characterized by hot summers, a humid rainy season, and cool winters. Summers (March–June) are generally hot with temperatures often exceeding 40°C, while the southwest monsoon

(June–September) brings the bulk of annual rainfall, averaging about 1,100–1,700 mm, which sustains paddy cultivation and seasonal streams. Winters (November–February) are mild to cool, with temperatures ranging between 8°C and 20°C. The overall climate supports dense forest cover and agriculture but also makes the region sensitive to seasonal variations such as heavy rains, soil erosion, and waterlogging in low-lying cultivated areas.

5.10.0 OTHER PHYSIOGRAPHIC, SOCIAL AND ENVIRONMENTAL FACTOR

5.10.1 The Sitapur Block, located in Baihar tehsil of Balaghat district, lies in the vicinity of gently undulating to hilly physiographic terrain marked by forested plateaus, lateritic uplands, and cultivated valleys drained by seasonal streams. The region is largely rural, with small villages dependent on agriculture (mainly paddy, pulses, and minor crops) and forest resources for livelihood, while mining at Malanjkhand provides limited industrial employment. Socially, the area is inhabited by a mix of tribal and non-tribal communities with a predominance of Gond and Baiga groups, whose economy is closely linked to subsistence farming, forest produce, and wage labour. Accessibility is moderate, with road links to Baihar and Balaghat, though infrastructure and services remain underdeveloped, making agriculture, forests, and mining the key influencing factors in the local socio-economic setup.

5.10.2 Environmentally, the Sitapur Block in Baihar tehsil, Balaghat district lies in the vicinity of a forested, hilly–plateau terrain with patches of cultivation, mainly paddy fields. The area receives high monsoon rainfall (~1,100–1,700 mm annually) supporting agriculture and seasonal streams. It falls near ecologically sensitive zones of the Maikal–Kanha landscape, with significant forest cover and wildlife corridors. Mining activity in the nearby Malanjkhand area has caused environmental concerns such as dust, water contamination, and vegetation impact, highlighting the need for careful monitoring, and mitigation.

CHAPTER-VI

6.0.0 INFRASTRUCTURE

6.1.0 LOCAL INFRASTRUCTURE WITH ROADS, RAILWAYS, PORT FACILITIES, ELECTRICITY, WATER ETC. WITH DISTANCE FROM THE AREA. DETAILS OF NEABY INDUSTRIES IN THE AREA WHICH MAY USE THE MINERAL COMMODITY LIKELY TO BE MINED.

6.1.1 All the local infrastructures are available at Mohgaon/Newargaon town of Balaghat district, Madhya Pradesh. Local infrastructure facilities like the government primary hospitals, health care facilities, schools, other facilities like market, workshop etc are available in Newargaon town. Banking facilities are available in Malanjkhand town. As far as mining industry in the area is concerned, at present copper ore are being commercially exploited by M/s Hinudsthan Copper Limited (HCL) in Malanjkhand located about 10km from Sitapur Block.

6.1.2 The host population, historical sites, forests, sanctuaries, national park and environmental setting of the area have been described in para 5.0.0 (Physiography and Environment).

CHAPTER-VII

7.0.0 GEOLOGY

7.1.0 REGIONAL GEOLOGY

7.1.1 Malanjkhand area is situated south of Central Indian Suture Zone (CISZ) of Yedekar et. al. (1990) and forms a part of Precambrian shield in Central India, comprising Archaean and Proterozoic sequences. It is located at the northern end of the Kotri-Dongargarh mobile belt.

7.1.2 The Malanjkhand granitoids are surrounded by older Amgaon schists and gneisses in the west, by Nandgaon metavolcanics in the south and younger Chilpis & the Deccan basalt in the east and north. The Amgaon and Nandgaon Groups classified under Archaean by A. Sarkar et.al. (1990) continue from Dongargarh area northward into the Malanjkhand area.

7.1.3 The oldest rocks belonging to Amgaon Group are resting over an unknown basement rock and is followed by rocks of Nandgaon group. Malanjkhand granitoids intrude these two older groups of rocks. It is intruded by younger Darbaritola granite and other linear bodies in the form of dykes comprising basic rocks and quartz veins. All these rocks are unconformably overlain by Chilpi Group of rocks comprising mainly of argillitic metasediments. The Chilpi group is overlain by Jamtola group of rocks Jaggi G.S. (1997) represented by quartz veins, phyllites, Micaschists, limestone etc. The youngest rock types are Deccan traps which are lateritised at places.

7.1.4 The stratigraphic succession in the Malanjkhand area, after GSI is furnished in **Table-7.1.**

Table: 7.1

Regional Stratigraphic Succession of Malanjkhand Area.

Recent to Sub-recent	Laterite
Cretaceous to Eocene	Deccan Trap
------------------------------ Unconformity ------------------------------	
JAMTOLA GROUP (Mid-Proterozoic)	Quartz Vein
	Graphite,
	Phyllite, occassional mica schists,
	Limestone lenses, quartzite, at places sandstone.
------------------------------ Unconformity ------------------------------	
CHILPI GROUP (Mid-Proterozoic)	Vein quartz
	Dark grey, finely laminated shale.
	Phyllite with banded chert and dmassive chert.
	Finely banded dark red to brown shales with thin lithic wacke and chert layers.
	Thin quartzites.
------------------------------ Unconformity ------------------------------	
DARBARITOLA GRANITOIDS	Basaltic / doleritic dykes, quartz veins, Corbonate veins, aplite veins, gabbro. Fine to medium grained grey and pink biotite bearing granites.
MALANJKHAND GRANITOIDS	Grey coarse grained, occasionally porphyritic, hornblende bearing, pink spotted, granodiorites and quartz diorites. Minor, dark grey, porphyritic Diorites as small stocks. At places the granodiorites are epidote rich. Greenish-grey granite gneisses.
…………………………...Intrusive contact …………………………...	
NANDGAON GROUP	Dark grey and pale brownish rock with characteristic altered (white) phenocrysts set in a fine grained matrix PORPHYROIDS of dacite and andesitic composition, associated with thick red, yellow, violet, grey and white coloured tuffs and pyroclastics, with thin bands of chert and carbonate.
	Pre-dominantly dark greenish and dark greenish grey, altered metabasaltic and dacitic / andesitic rocks with minor amygdular metabasalt, associated with rhyo-dacitic torhyolitic (porphyritic and non-porphyritic) rocks. Narrow zones of tuffaceous conglomerate, shaly tuffaites and quartzites.
…………………………...Intrusive (?) …………………………...	
AMGAON GROUP	Pink aplite, grey aplite veins streaky, augen, layered, banded gneisses (Migmatites) with amphibolites enclaves.
BASE NOT SEEN	

7.1.5 A brief description of rocks occurring around Malanjkhand is given below under five major group viz. i) Amgaon Group ii) Nandgaon Volcanics iii) Malanjkhand granitoids, iv) Other intrusive and v) Chilpi Groups.

a) **Amgaon Group**: Banded gneisses, augen gneisses, quartz-biotite schist, quartz-sericite schist represents older Amgaon group. The rocks in general show north westerly dip (30°-40°). Amphibolite dykes and xenoliths are commonly seen in schists and gneisses exposed on the north west and west of the pluton. Aplite veins (Pink and Grey) are occasionally present with the above rocks.

ii) **Nandgaon Volcanics**: It is represented by metavolcanic suite of rocks. They are fine tomedium grained volcanic varying from basalt to andesite with quartzite and are exposed on the southern and eastern sides of the granitoid pluton. N-S and NNW-SSE trending shears developed in the volcanic and granitoids are parallel to foliation. These volcanic have been intruded by numerous fine-grained N-S trending dolerite dykes. These dykes are at times chloritised and sheared.

i) **Malanjkhand Granitoid**: The granitoids intrude the older Amgaon gneisses and schists as well as Nandgaon volcanic. Intrusive nature of granitoids in Nandgaon volcanic is clearly seen around Garhi-Dongri area on the southern side of the Malanjkhand pluton where granite tongues intrude the volcanics. Numerous basic xenoliths occur throughout the pluton. Three major suites of granitoids have been identified in Malanjkhand pluton (Bhargava & Pal, 2000). A) Coarse grained equigranular pink & grey granitoids b) Porphyritic granitoid with alkali feldspar phenocrysts c) Fine grained microgranitoid. The modal mineral composition of granitoids varies from granite and granodiorite to quartz–monzonite. However, the rocks are predominantly granodioritic. The fine-grained rocks exhibiting aplitic texture have been classified as younger Darbaritola Granits by GSI (1997).

ii) **Other Intrusives**: These are represented by quartz veins, basic dykes and gabbroic bodies and other veins & vein lets of varying mineralogy. Most of these intrusive are emplaced in the shear zones and fault planes within a broad tectonic zone. Quartz veins have generally been emplaced along the N-S sheared and mylonitized zones in the granitoids. E-W trending veins have been observed at the contact of Nandgaon Group with granitoids. Quartz veins of at least three generations have been described by Bhargava & Pal (1999). The first generation

(Stage-I) are generally thin, of less than 1m. The second generation (Stage-II) veins are the main mineralized veins emplaced in granitoids, and are generally 10-50m thick. The strike length varies from a few meters to over 2.5 km. The third generation (Stage-III) veins of milky white quartz intrude granitoids, basic dykes as well as yonger Chilpi sediments and they are devoid of any sulphide mineralization. The basic dykes upto 50m wide are found extensively in the area. These dykes are apparently of two generations and intrude the granitoids, quartz veins and Nandgaon volcanic.

iii) **Chilpi Group**: The rocks are conglomerate, arkosic sandstone, phyllite and crystalline limestone. They show feeble metamorphic effect. The low grade metsediments of Chilpi group of rocks have been separated as Jamtola group while argillitic meta-sedimentaries have been considered as Chilpi group (Jaggi, G.S. 1997)

7.1.6 The regional geological map sourced from NGDR web portal with location of Sitapur block is given as **Plate-II** and **Text Figure-3A.**

7.1.7 MECL carried out exploration work for basemetal mineralisation in various mineral prospects located in and around Malanjkhand area and location of prospects along with location of Sitapur Block shown as **Text Figure-3B.**

7.2.0 REGIONAL STRUCTURE

7.2.1 The megascopic structural elements of the Malanjkhand pluton are foliation/ gneissosity, shears, fractures, quartz veins and veinlets, faults and post-mineralization dykes etc. Some pluton and extend to south into the older volcanics of Nandgaon Group and also to Amgaon schists of these elements, especially shears and dykes, are found extensively within Malanjkhand Granitoid & gneisses. A wide zone upto 10 km of tectonic and magmatic activity extending over 35 km length in NNW-SSE direction has been identified. This zone is conspicuous through numerous shear zones, faults, dykes and quartz veins besides emplacement of several microgranitoid plugs.

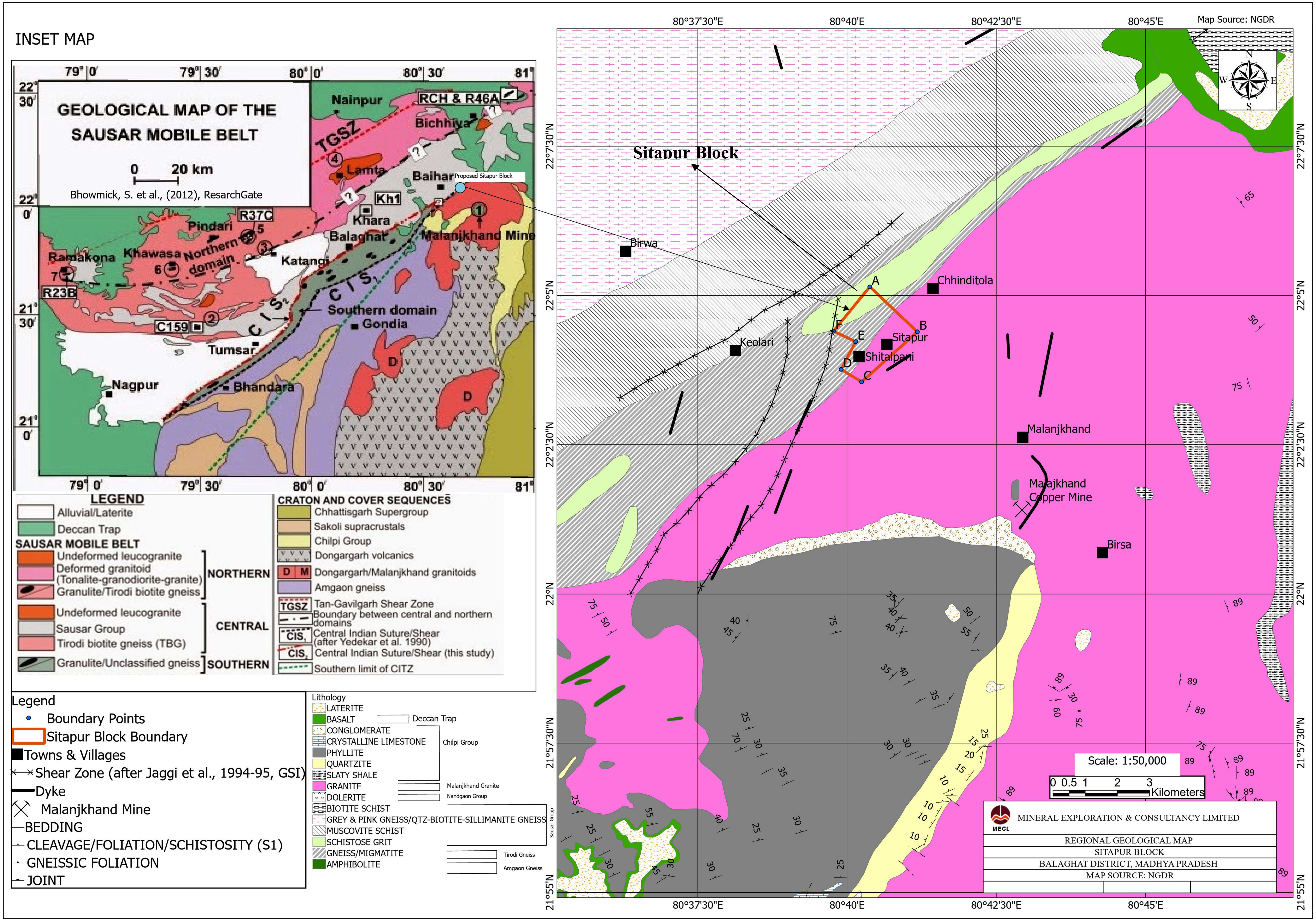
7.2.2 Structurally the area is highly deformed. The deformation is pervasive and has imposed a gneissic fabric to the granitoids, especially in the area west of mohgaon.

Three distinct sets of shears are recorded resulting in mylonitization and phyllonitization of granitoids. The ductile and ductile brittle deformation are seen in granitoids. The shears are (i) near north-south, (ii) east-west and (iii) N60°E-S60°W to N40°E-S40°W. Of these, the last mentioned is most prominent in the Sausars zone has been delineated west of Mohgaon, in which the rocks exhibit above shear to varying degree (Jaggy et.al 1993).

7.2.3 A major N–S shear zone west of Mohgaon has transformed granites into mylonites, producing a strong gneissic fabric. This shearing caused tight, asymmetric folds plunging southwest and also developed foliation in basic dykes. The shear has been repeatedly reactivated and likely controls Chilpi sedimentation, as the metasediments follow a near N–S trend bounded by steep faults/shears.

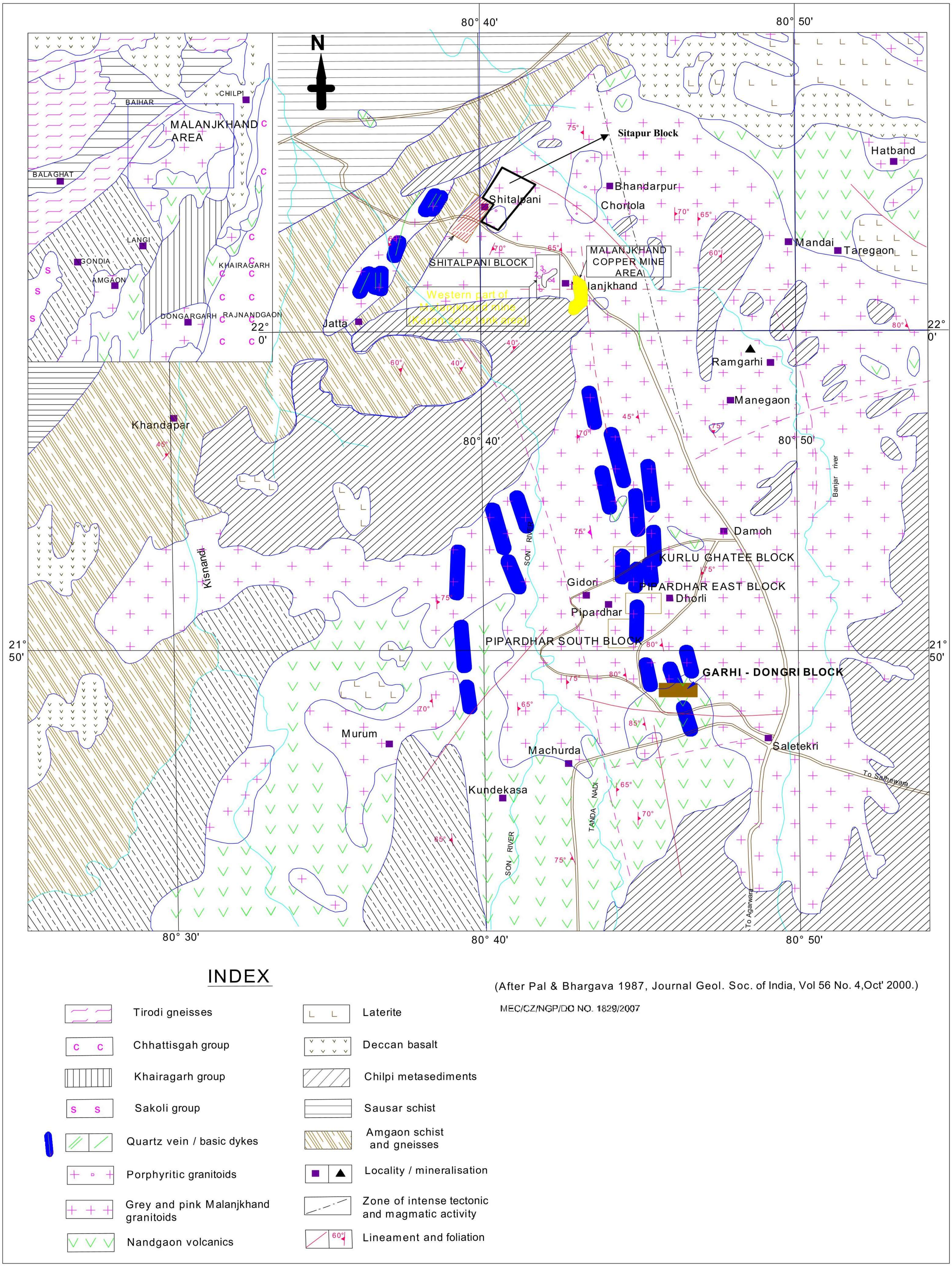
7.2.4 An E–W shear zone affects granitoids, showing ductile deformation with abundant epidote veining and sinistral (left-lateral) movement, especially near Balgaon. It appears as narrow bands of mylonites and phyllonites, forming multiple parallel shear zones from south of Schultola to Jaysinghtola and along the southern margin from Jatta to Chandyiahurki. Strong shearing produced asymmetric folds in phyllonites, and north of Dudhi, this shear was reactivated after Chilpi sedimentation. Third shear set affects both granitoids and Sausar rocks, folding the earlier foliations. The fold axes trend between N40°E–S40°W to N70°E–S70°W and plunge predominantly southwest.

TEXT FIGURE-3A: REGIONAL GEOLOGICAL MAP OF SITAPUR BLOCK, DISTRICT- BALAGHAT STATE- MADHYA PRADESH



TEXT FIGURE-3B: REGIONAL GEOLOGICAL MAP AROUND MALANJKHAND AREA SHOWING LOCATION OF SITAPUR BLOCK, DISTRICT- BALAGHAT STATE- MADHYA PRADESH

MECL



7.3.0 REGIONAL METAMORPHISM

7.3.1 The rocks exposed in this region represent evidence of polyphase metamorphism related to various folding episodes. The metamorphic mineral assemblages which are common and coexisting. The earliest of these metamorphic events was the strongest and related to F1 fold and metamorphism reached up to upper amphibolites facies. Later metamorphic events were less intense resulting in the retrogression of hornblende to chlorite and biotite to chlorite. The marginal parts of the Sausar metasediments indicate green schist facies while central part show amphibolites facies metamorphism. The granulation shown by quartz and alignment of mica flakes are synchronous to earliest fold which produced regional foliation in the gneiss. K-feldspathisation of gneisses indicates granutitic Facies. The retrogression shown by metasediments / metabasic dykes is evidenced by conversion of amphibole to mica to chlorite and this deformation took place during second fold episode, as the chlorite do not show any micro-folding.

7.4.0 MINERALISATION IN THE REGION

7.4.1 The copper mineralization in the Malanjkhand granitoids is associated with quartz reef emplaced along the ductile shear zone with late Potosic phase of granitic activity. The widespread dissemination of base metals and molybdenite within Malanjkhand granitoids possibly suggest a porphyry type of mineralization.

7.4.2 In adjoining Shitalpani block, copper mineralization mainly hosted in vein quartz and to some extent in granites. Vein quartz bodies present in Shitalpani are confined to the sheared zones and fractures which form the main channels for the entry of mineralising solution. The control of mineralisation and intensity of mineralisation is controlled by degree of fractururing and shearing. Encrustations with pyrite, chalcopyrite, bornite, and stains of limonite are the major surface indication of mineralization mainly manifested in the vein quartz. Gold occurs as very fine disseminations in negligible quantity with erratic distribution.

7.5.0 GEOLOGY OF THE BLOCK

7.5.1 The Sitapur Block is predominantly underlain by Malanjkhand granitoids comprising granitic and granodiorite gneissic rocks. These rocks are intruded by quartz veins and metadolerite dykes along shear zones, joints, and fractures. The area is mostly soil-covered, with limited exposures. Granodiorite gneiss, metadolerite/amphibolite dykes, and quartz veins are seen in the northwestern, central, and eastern parts, while laterite/lateritic soil is exposed at the southern end, and mylonite outcrops occur at the extreme north of the block. To the west of Sitapur block, Amgaon schists and gneisses are occurring. The local stratigraphic sequence in the block as per the surface and sub-surface data is given in **Table-7.2**.

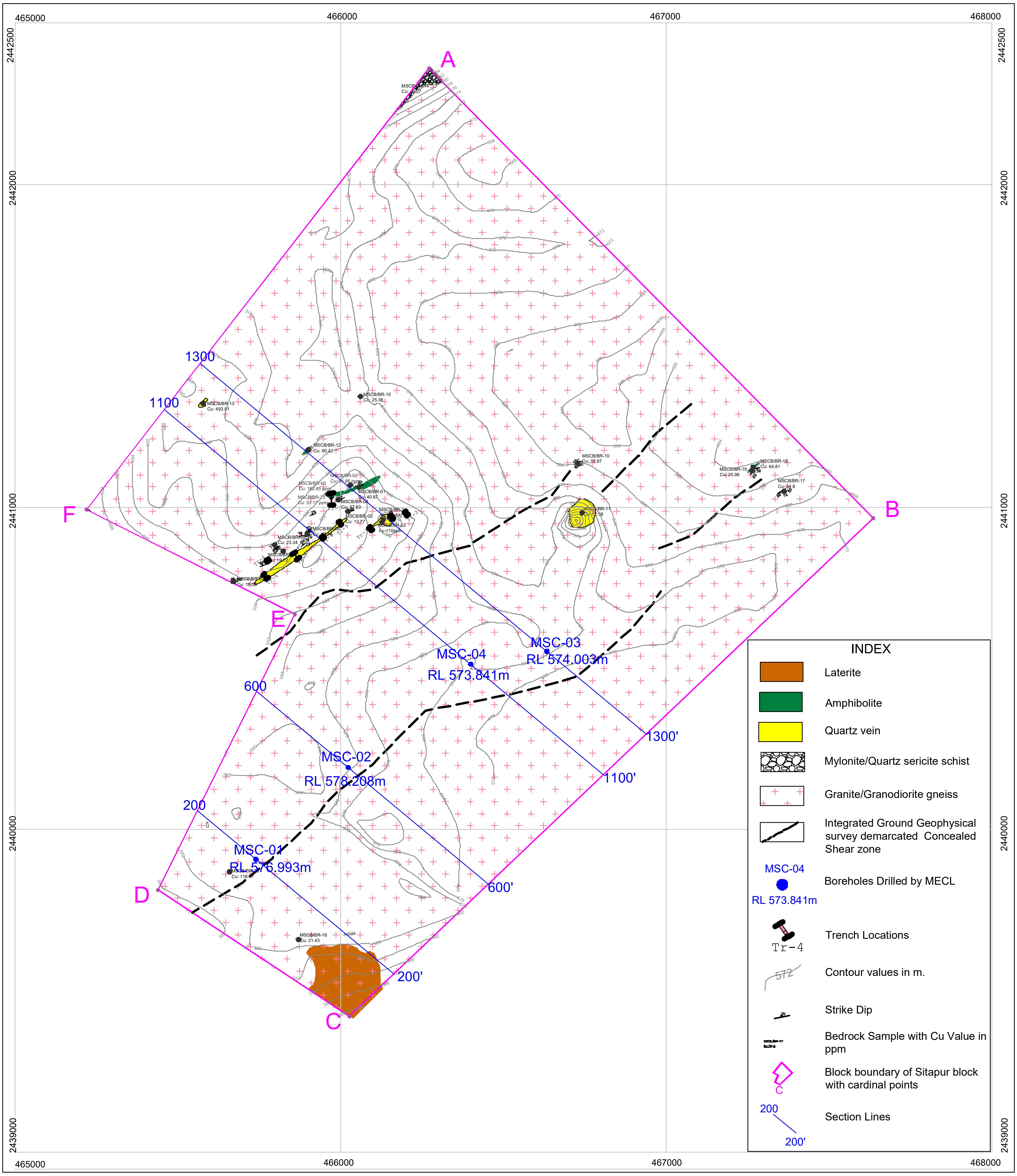
Table-7.2:
Stratigraphic Sequence in Shitalpani block, Malanjkhand Granitoid, Balaghat District, Madhya Pradesh

Group	Rock Types
Recent to Sub-recent	Laterite, Soil/Alluvium
…..Unconformity…….	
Intrusive rocks	Metadolerite dykes/Amphibolites Aplites Quartz veins
Malanjkhand granitoid	Mylonite Granitic rocks/Granodiorites gneiss

7.5.2 During present investigation, Sitapur block was covered by detailed geological mapping on 1:2000 scale over 3.05 sq.km. area. However, due to size limitations in plotter the map produced on 1:4000 scale. **(Plate No. IV-A)**. The interpreted geological map of Sitapur block with location of bedrock samples, trenches and drilled borehole locations shown as **Plate No. IV-A and Text Figure-5.**

7.5.3 The main lithounits mapped in the area include granitic rocks/ granodiorite gneiss, Quartz vein, Metadolerite dykes/Amphibolites, Mylonites, Laterite/Lateritic soil and soil/Alluvium. Litho units intersected in the boreholes drilled by MECL are granodiorite gneiss, thin quartz veins. Metadolerites/Amphibolites including Hornblende/Chlorite quartz schist.

TEXT FIGURE- 4: GEOLOGICAL MAP OF SITAPUR BLOCK, MALANJKHAND GRANITOIDS, BALAGHAT DISTRICT, MADHYA PRADESH



7.6.0 DESCRIPTION OF DIFFERENT LITHO UNITS IS GIVEN BELOW

7.6.1 The detailed megascopic charactersitics and petrography description of rocks exposed and intersected in the boreholes in Sitapur block are given below.

1.**Granitic Rock/ Granodiorite gneiss**:

A major part of the area in Sitapur block is underlain by Malanjkhand granitoids comprising granitic and granodiorite gneissic rocks. They are invariably found as detached outcrops in the flat soil covered country. Few scanty bouldery outcrops/exposures of granitic/granodiorite gneissic rocks can be seen in the northwestern and central part of the block. In composition, granitic rocks vary from granite to quartzdiorite through intermediate adamellite, tonalite and granodiorite. They are medium to coarse grained in texture and at places they become porphyritic. In general, colour is grey to pinkish grey occasionally approaching to pink. The outcrops observed on the western part of the block are having porphyritic texture while, those noticed in the central and southern part of the block are depicting incipient gneissosity (Field Photograph 7.1) and occasionally porphyritic. The trend of gneissosity is N50°E – S50°W to N60°E – S0°W with mostly north westerly dip of 70-82° with few exceptions dipping due southeast.

Megascopically it is medium to coarse grained rock showing gneissocity. The plagioclase, orthoclase, microcline, quartz, biotite are the major rock forming minerals in granitic rocks while Sericie, Epidote, Chlorite are minor minerals and Sphene, Apatite are accessory mineralas. Veins of Epidote, quartzo-feldspathic rock, carbonates can be frequently seen in the outcrops as well as in borehole cores. Granodiorites have been subjected to fracturing and mainly three sets of fractures have been noticed.

Granitic rocks are traversed by Aplitic veins at places. Mappable Aplites not exposed in the area. They are generally fine grained, equigranular and mostly felsic in nature.

*(**Field Photograph7.1:** A. Granitic rock outcrop with thin aplite vein, Central western part of Sitapur Block (B) Granodiorite specimen collected from central western part of Sitapur Block area.*

Under microscope, (Granodiorite gneissic rock/MSCB/PET05) plagioclase occurs as medium to moderately coarse subrounded patches, subhedral grains and lensoidal clusters showing intense sericitization and parallel alignment. Quartz occurs as fine to medium anhedral grains and lensoidal clusters showing recrystallization and parallel alignment. Microcline/ orthoclase are present as medium subhedral prismatic grains aligned along the foliation. Biotite is present as fine flaky segregations and patchy fillings showing parallel alignment. Sericite occurs as very fine flaky aggregates developing after plagioclase alterations. Epidote occurs as fine to very fine subhedral to anhedral grains developing after plagioclase alterations. Chlorite is present as flakes and patches being interleaved with biotite and seen replacing it. Sphene occurs as fine to very fine wedges and streaks. Apatite is noted as fine to very fine subrounded grains in accessories.

Under microscope (Granodiorite gneiss/MSCP-01), Plagioclase occurs as medium to moderately coarse subhedral grains, turbid patches and lensoidal grains showing intense saussuritization. Orthoclase/ microcline are seen present as medium subhedral to anhedral grains and as fine to very fine crushed grains. Quartz occurs as fine anhedral and elongated grains showing parallel alignment and often clustering in pockets. Biotite occurs as fine to medium flaky aggregates, segregating in zones and showing parallel alignment. Epidote is present as very fine to fine granular aggregates developing after plagioclase alterations and also occurs as medium patches and fine fillings. Sericite occurs as very fine flaky aggregates developing after plagioclase alterations. Sphene occurs as fine wedges and anhedral patches. Opaques occur as fine anhedral grains and patches in pockets. Apatite is noted as fine subrounded grains in accessories. Chlorite is found present as fine patches and flaky aggregates replacing biotite in areas. Zircon occurs as very fine inclusions within biotite, around which pleochroic haloes are observed.

2.Vein Quartz:

In Malanjkhand area, it has been observed that vein quartz traverses the granite/granodiorite rock at few places. it varies in colour from smoky white to pinkish grey and milky white. There are at least three generations of vein quartz activities identified in the area. The milky white vein quartz is of later generation and traverses through smoky grey, Pinkish grey vein quartz. The relationship between smoky grey and pinkish grey is not very clear in the field observation. (Field Photograph-7.2)

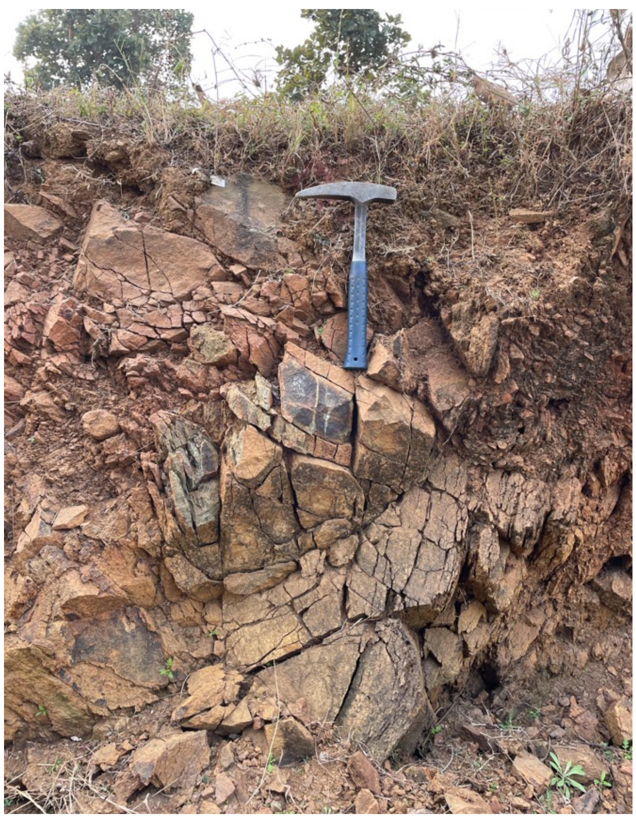
In Sitapur area, the vein quartz traverses the granitic rocks mostly in northwestern and central part of the block area. It varies in colour from smoky white to pinkish grey and milky white. The vein quartz is mostly fractured nature and exposed in the isolated hillock in the western and central part of the block. At least more than three sets of joints have been observed in the vein quartz. The ferruginous and limonitic staining are seen along the fracture and joint planes at places. The trend of quartz vein is mostly N50^{0}E-S50^{0}W trend except a few exemptions. At few places, the continuity could not be observed due to thick soil cover. Trenching work helped to establish the concealed extension of quartz vein in the northwestern and central part of the block area. These quartz veins mostly barren and no sulphide mineralisation noticed in the exposed quartz veins except some incidence of rare sulphide dessiminations (pyrite) observed at places.

*(**Field Photograph 7.2:** Vein quartz (fractured) exposure at cutting section, West of Sitapur vilalge*

*(**Field Photograph 7.3:** Smoky quart vein exposure within pinkish white Quartz vein at cutting section, West of Sitapur village*

3.Metadolerite Dykes/Amphibolites:

The granitic rocks are traversed by dykes trending N55^0-70^{0}E-S55^0-70^{0}W. Mainly two types of dykes (basic) are noticed in the block, one of these are partially altered but massive in nature. Megascopically, it is a dark green, greenish grey and greyish black in colour, mostly epidote bearing, showing equigranular in texture and invariably devoid of any significant mineralization. Some alteration patterns (ferruginisation) are seen in outcrops. (Field Photograph 7.5). The second type occurs as fine grained, altered, highly chloritised within the granitic rocks and they are well foliated as observed in borehole cores. They are sheared and fractured at places. They have been observed rarely in outcrops and mostly in the borehole's cores and thickness range from few meters to about 25m. some incidence of sulphides noted in Metadolerites/ Amphibolites. These appear to be older while the massive dykes are of younger age. In composition the massive one is mostly amphibolitic. Fracture pattern in massive dykes are show in Field Photograph 7.4.



*(**Field Photograph 7.4:** Fractured Amphibolite dyke exposure, central part of Sitapur Block.*

*(**Field Photograph 7.5:** Ferruginisation stains on Amphibolite dyke traversed with thin quartz veins Vein, Western part of Sitapur Block*

4.Mylonite

Mylonite/Phyllonite rocks are well exposed to NW of Shitalpani, trending NE-SW to NW-SE with moderate to steep dip towards either southeast or northeast. The rock is light cream colour quartz sericite schist (Jaggi et. all 1993). In Sitapur block, Mylonite rock outcrops mapped on the extreme northern part of the Block area. The rock is composed of Quartz, sericie and ferruginous matter showing schistocity at places. Mylonite rock exposure mapped on the extrene northern part of Block area. (Field photograph 7.5).

Under microscope (Mylonite rock/MSCB/PET02), Quartz occurs as fine subrounded and lensoidal clasts and as very fine crushed grains showing parallel alignment. It also occurs as moderately coarse lensoidal porphyro-clasts showing recrystallization. Sericite is present as very fine flakes and flaky aggregates, often segregating into thick zones and showing parallel alignment. Opaques occur as anhedral patches and fillings aligned along the schistosity. Reddish ferruginous fillings and stains are observed in areas.

*(**Field Photograph 7.6:** A. Weathered Mylonite outcrop, Exterme northern end of Sitapur Block. B. Hand specimen of Mylonite/Quartz sericite schist, Sitapur block.*

5.**Laterite**:

Small portion of outcrops of reddish-brown cferruginous laterite in the form of cappings and mostly lateritic soil mapped in the extreme southeastern end of Sitapur block. These laterites have possibly been formed from the ferruginous materials. Megascopicllay, it is a reddish-brown coloured weathered and altered rock showing pores, cavities and fine whitish pisolites and are cemented with ferruginous materials.

6.Soil/Alluvium:

A major portion of the block area is covered with soil and is under extensive cultivation mostly covered by paddy fields. Field photograph 7.6 & 7.7). The thickness of soil cover varies from 1.20m to 12.50m as seen in trenches and intersected in Boreholes. Soil is earthy dark grey, brown and greyish in colour. Soft Loose, fine, cohesive, sandy, poorly sorted soil occurring in the area is product of weathering of parent rock (mostly granitic rocks) underneath.

*(**Field Photograph 7.7:** Panoramic view of Sitapur Block (Looking NNW).*

*(**Field Photograph 7.8:** Cultivated paddy lands, Sitapur Block.*

7.6.2 **Borehole Core Photographs**:

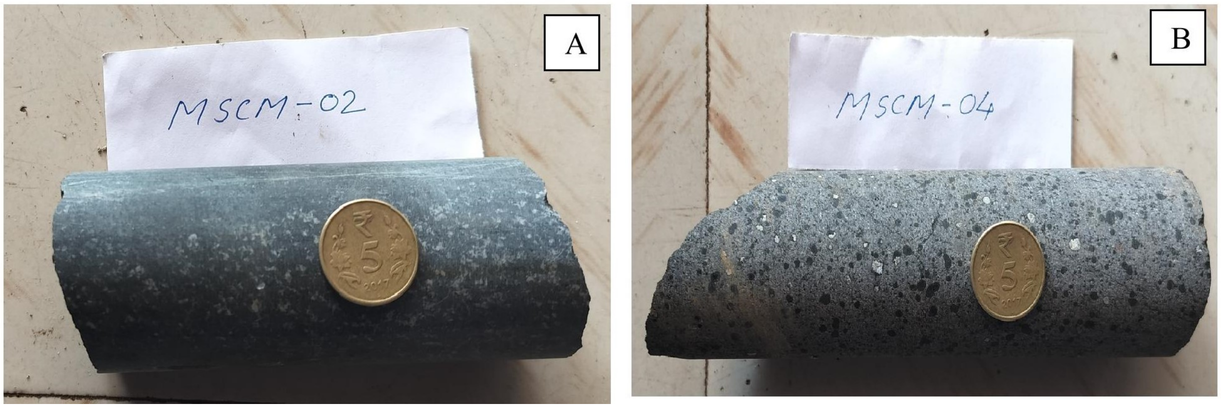


Photo 7.9: A. Borehole MSC-02 with fine dessiminations of chalcopyrite, pyrrhotite @ 79.90-80.0m. B. Borehole MSC-04 with dessiminations of pyrite, ilmenite specks @ 101.10-101.20m.

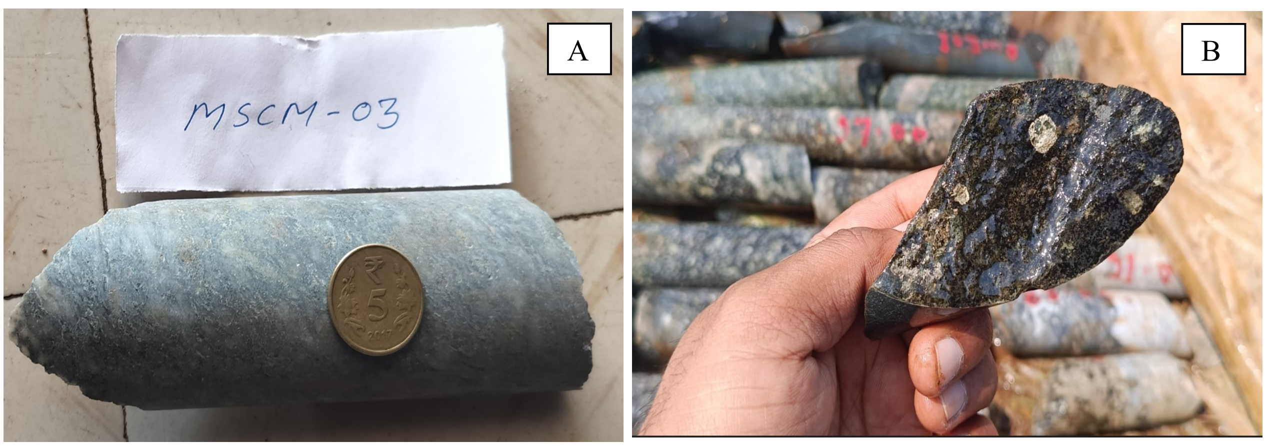
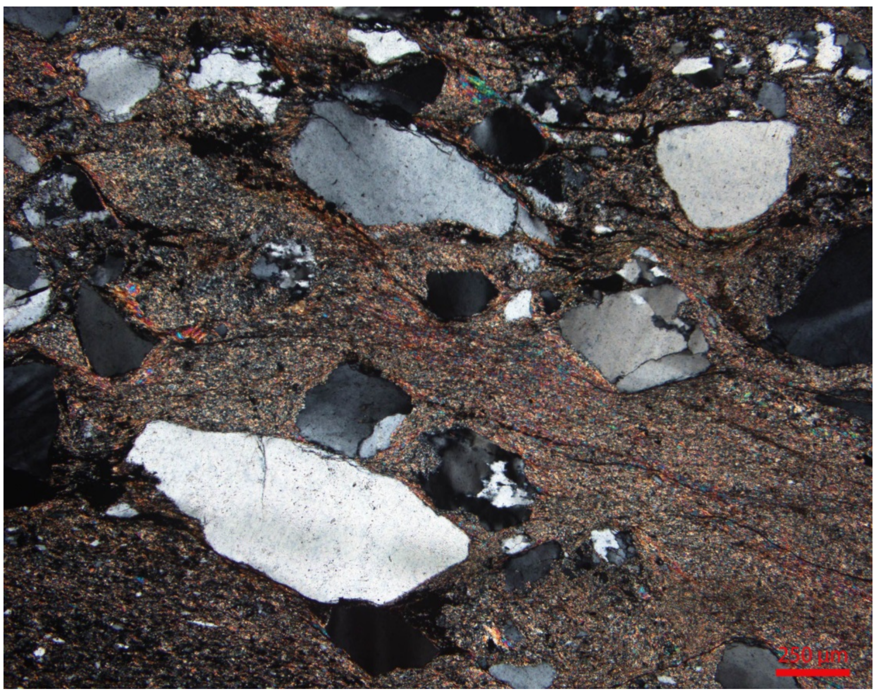


Photo 7.10: A. Borehole MSC-03 core showing fine dessiminations of pyrite @ 99.55-99.65m.
B. Borehole MSC-02 core showing dessiminations of pyrite, chalcopyrite in granodiorite gneiss fracture plane @130-134m

Photo 7.11: MSC-02 core showing dessiminations of pyrite, chalcopyrite in granodiorite gneiss fracture plane

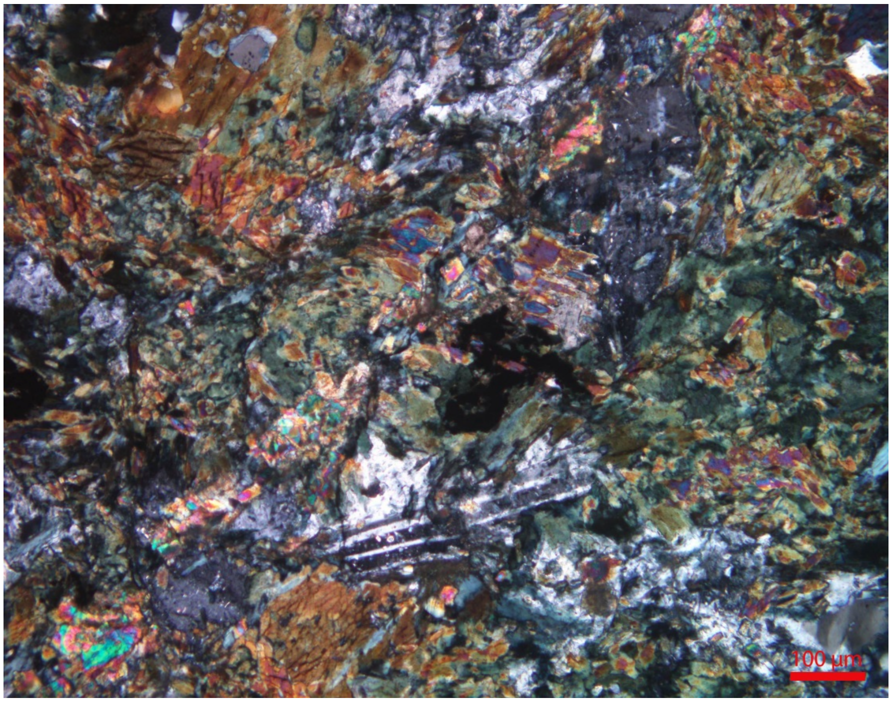
7.7.0 PETROGRAPHIC STUDY:

7.7.1 A total of 10 Nos. of rock samples collected during geological mapping and rock types intersected in the bloreholes have been subjected to petrographic studies at MECL laboratory, Nagpur. The findings of petrographic study have been discussed along with the description of rock types in the area. However, the petrographic study report has been attached as **Annexure No-XI.** The photomicrographs of the thin sections are given as **Pmg-1 to Pmg-4.**



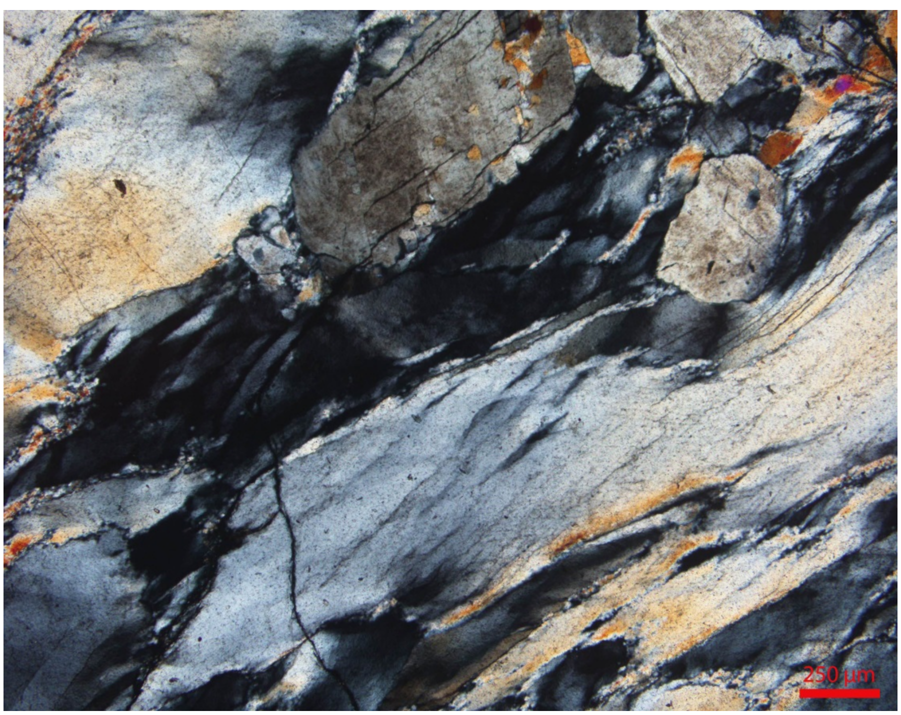
Pmg – 1: Photomicrograph showing association and parallel alignment of lensoidal and subrounded quartz and very fine sericite aggregates in quartz-sericite schist/ (mylonite?) as seen under crossed nicols.

Specimen No. : MSCB/PET02 **Magnification : 40X**



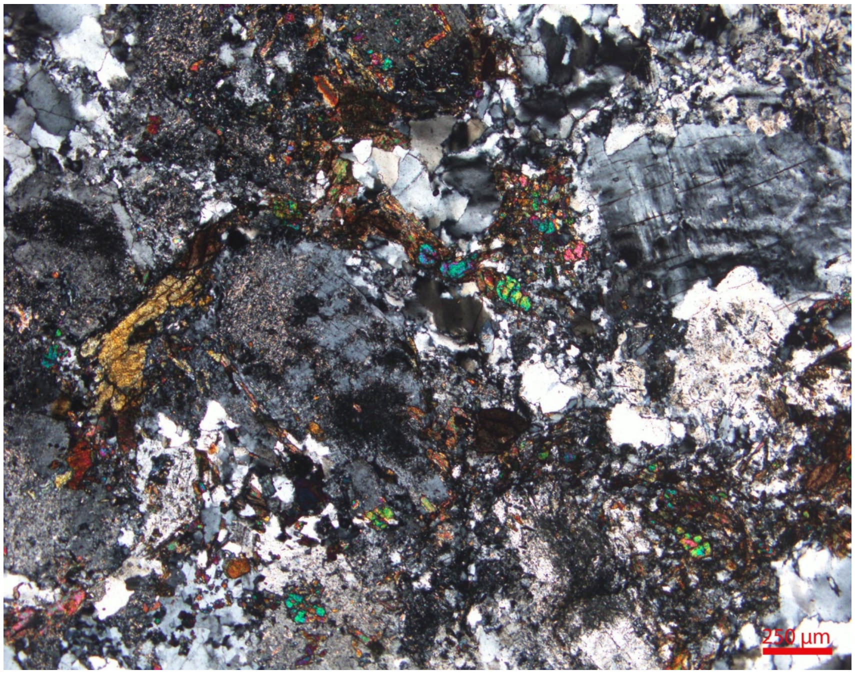
Pmg – 2: Photomicrograph showing association of hornblende, actinolite and plagioclase, where plagioclase is showing saussuritization in amphibolite as seen under crossed nicols.

Specimen No. : MSCB/PET03 **Magnification : 100X**



Pmg – 3: Photomicrograph showing quartz ribbon with high optical strain and associated subhedral orthoclase grains in vein quartz as seen under crossed nicols.

Specimen No. : MSCB/PET04 **Magnification : 40X**



Pmg – 4: Photomicrograph showing association of plagioclase, quartz, microcline/ orthoclase and biotite, where plagioclase grains are intensely saussuritised in granodiorite gneiss as seen under crossed nicols.

Specimen No. : MSCP-02 **Magnification : 40X**

7.8.0 STRUCTURE OF THE BLOCK

7.8.1 The formations within the block show a general trend of N50^{0}E -N75^{0}E to S50^{0}W-S70^{0}W with 51^0 to 83^0 towards northwestely in western part and south-easterly dips in eastern part of block. The foliation planes are the most dominant secondary penetrative structure following the general trend of the area. The foliation planes are defined by preferred orientation of micas and amphiboles in different rock units. The lineation is represented by thin siliceous bands and pitch of lineation varies from steep to down dip. The prominent joint sets trending NNE-SSW to NNW-SSE with moderate dips sub-vertical dipping joint planes are also observed.

7.9.0 MINERALISATION IN THE BLOCK

7.9.1 In the adjoining Shitalpani Block (previously explored by MECL), the vein quartz is the main host rock for copper mineralization associated with NE-SW trending low magnetic intensity shear zone. Vein quartz bodies present in Shitalpani block are confined to the sheared zones and fractures which form main channels for the entry of mineralizing solution. The main control of mineralization is structural and intensity of mineralization is controlled by degree of fracturing and shearing.

7.9.2 In Sitapur area, the major part of the Block area is concealed under soil cover expect few scatty and limited outcrops at places mostly in the northwestern and central part of the block area. Most of the area is under cultivation. No outcrops of Mineralised Vein Quartz observed in the area. Surface indications/manifestations of mineralisation present if any could not be seen in the area due to soil cover and cultivated lands. However, alteration features like ferruginisation/goethitisation and limonite stains with some rare sulphides observed in Quartz vein, metadolerite dykes/amphibolites at places mostly in western and central part of the block. The surface bedrock samples collected from quartz vein, amphibolites and granodiorite gneiss not shown any encouraging values for basemetal mineralisation.

7.9.3 Since most of the area is concealed under soil cover, Ground geophysical survey (I.P. cum Resisitivty, Magnetic) was taken up during present exploration to trace eastward extension of the low magnetic intensity shear zone in present Sitapur block. Based on geophysical survey results, the concealed extension of low magnetic intensivity shear zone trending N50^{0}E-S50^{0}W is delineated in the southern central part of Sitapur block. Total four test boreholes drilled to test the geophysical anomaly up to 50 to 90 m vertical depth from surface in shear zone bearing area. However, mineralised Vein quartz associated with shear zone has not been intersected in all the boreholes drilled in the block. To some extent, lean mineralization has been noticed in metadolerties and moderaly sheared granodiorite gneiss in one Borehole (MSC-01). Overall, base metal mineralisation appears weak in the block.

7.10.0 MINERAGRAPHIC STUDIES OF MINERALISED CORE SAMPLES

7.10.1 A total of 10 number of polished sections of mineralized core samples collected from surface samples and intersected in the boreholes subjected to mineragraphic studies. Polished section study reveals that the major (>5%) minerals are Sphene, Ilmenite. Minor minerals (<5% to >1%) are present as Chalcopyrite, Pyrrhotite, Magnetite, Ilemenite. Accessory minerals (<1% to >0.1%) are present as Pyrite and

Chalcopyrite and Traces (<0.1%) are Hematite, Sphalarite, pentalandite and Galena. The sample wise details of the mineragraphic studies are presented as **Annexure-XII** and the photomicrographs of the polished sections are given as **pmg-5 to pmg-8 & Pmg-10.**

7.7.2 The ore minerals which have been identified are given below:

Major Minerals : Sphene, Ilemenite

Minor Minerals : Chalcopyrite, Pyrrhotite, Magnetite, Ilmenite.

Accessory Minerals : Pyrite, Chalcopyrite

Trace Minerals : Sphalerite, Cobalite, Chalcopyrite, Pyrite Galena

1) **Sphene:** Occurs as fine to medium wedges, streaky aggregates, and patches, often disseminated. Commonly replaces ilmenite, forming patches and corona structures around it. Appears as anhedral to subhedral patches and wedges in different textural habits.

2) **Ilmenite:** Found as very fine to medium skeletal grains, patches, lamellae, and bladed forms. Frequently preserved as relicts within sphene, suggesting replacement. Also appears as very fine hairline fillings and blades in association with magnetite.

3) **Chalcopyrite:** Occurs as very fine to fine disseminated specks or grains, often segregated in pockets. Found in close association with pyrrhotite, sometimes enclosing sphalerite as inclusions. Also noted in traces as very fine specks.

3) Chalcopyrite are seen present as very fine to fine disseminated specks/ grains, often segregating in pockets. Chalcopyrite and pyrite are noted as very fine specks in traces.

4) **Pyrrhotite:** Present as very fine to fine disseminated grains, often segregated in pockets with chalcopyrite. Occurs in association with cobaltite (in traces).

5) **Pyrite:** Found as very fine specks, stringers, and disseminations. Appears as fine anhedral to subhedral grains, patches, and sometimes as vein fillings. Frequently associated with chalcopyrite and pyrrhotite.

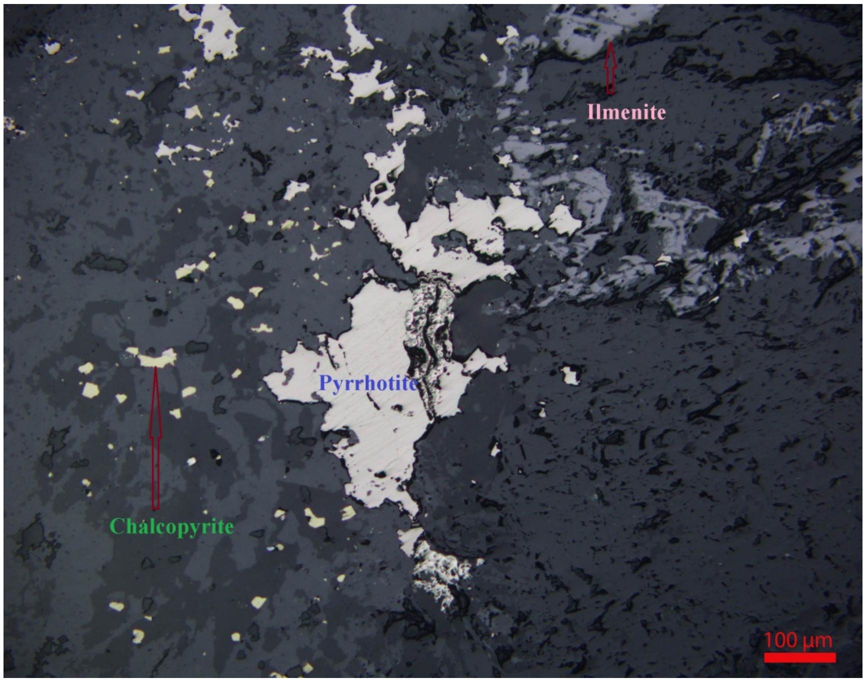
6) **Sphalerite:** Occurs as very fine inclusions within chalcopyrite. Noted only locally and in minor amounts.

7) **Cobalite:** Present in traces as very fine, near-idiomorphic grains. Occurs in association with pyrrhotite–chalcopyrite assemblages.

8) **Magnetite:** Appears along with ilmenite as very fine hairline fillings or blades. Minor accessory occurrence compared to sphene and ilmenite.

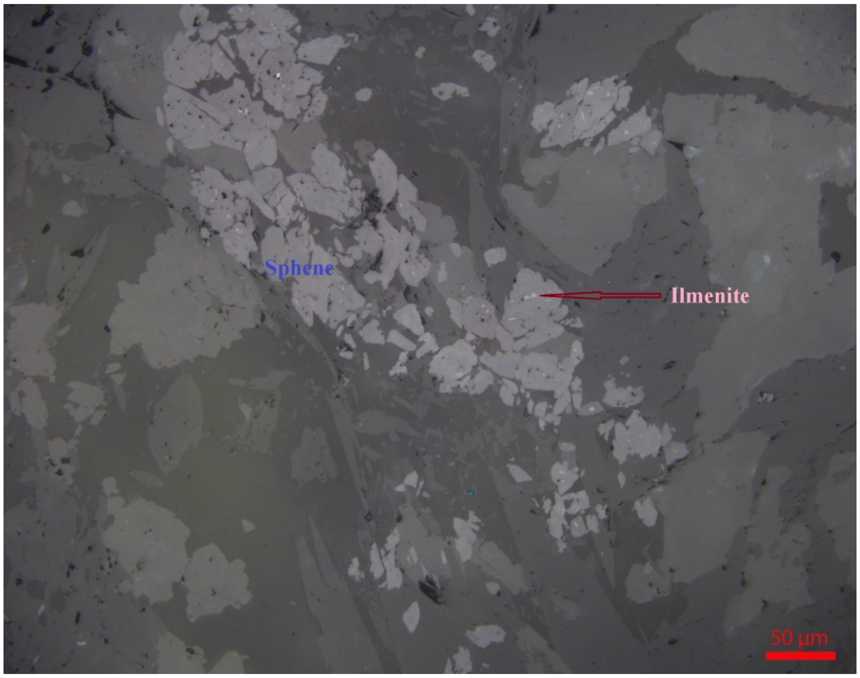
9) **Pentlandite** is noted as very fine lamellar exsolutions within pyrrhotite.

10) Galena present as very fine specks in association with pyrrhotite-chalcopyrite.



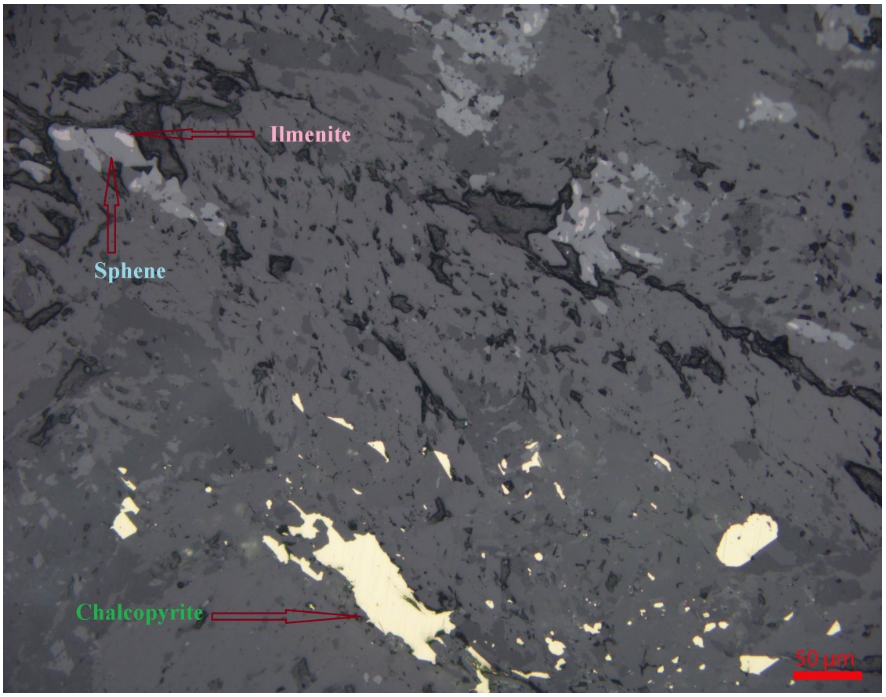
Pmg – 5: Photomicrograph showing presence of ilmenite, pyrrhotite and chalcopyrite as seen under reflected light.

Specimen No. : MSCB/MIN02 **Magnification : 100X**



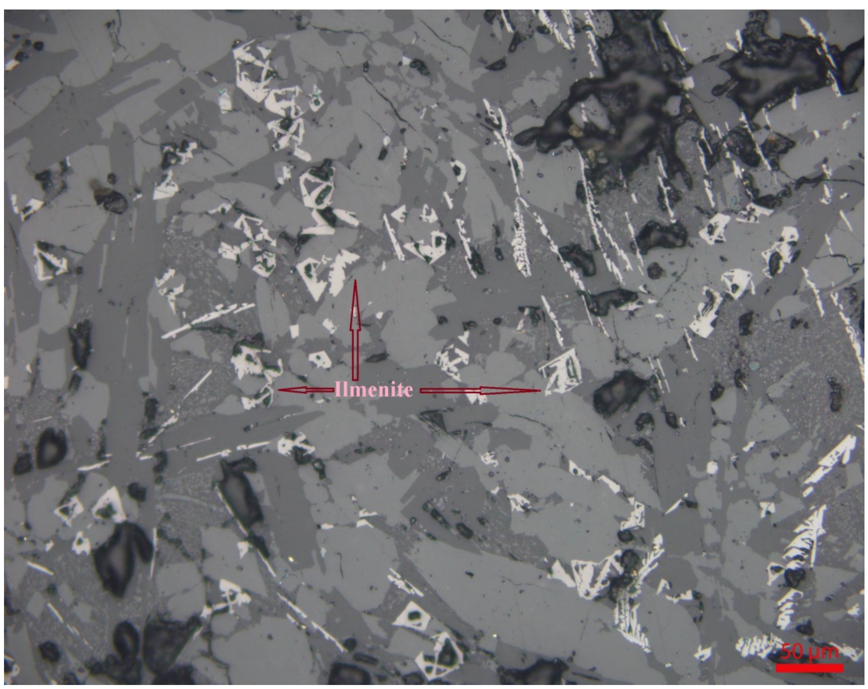
Pmg – 6: Photomicrograph showing very fine relicts of ilmenite within sphene wedges as seen under reflected light.

Specimen No. : MSCB/MIN03 **Magnification : 200X**



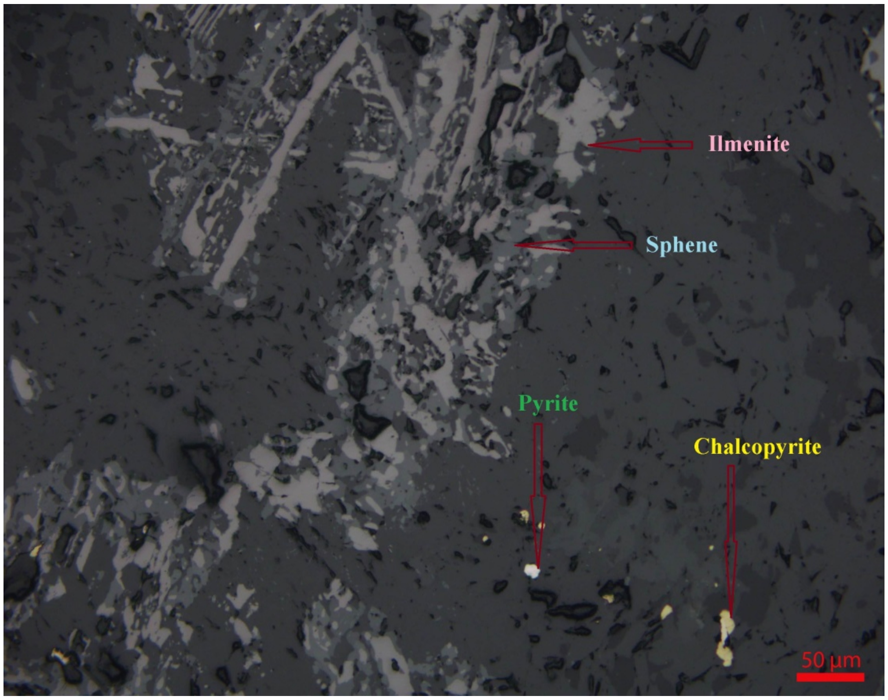
Pmg – 7: Photomicrograph showing relicts of ilmenite within sphene wedges and patches (in upper part) and chalcopyrite segregation (in lower part) as seen under reflected light.

Specimen No. : MSCM-01 **Magnification : 200X**



Pmg – 8: Photomicrograph showing lamellar/ bladed and skeletal dissemination of ilmenite as seen under reflected light.

Specimen No. : MSCM-04 **Magnification : 200X**



Pmg – 9: Photomicrograph showing ilmenite being replaced by sphene along periphery and associated specks of chalcopyrite and pyrite as seen under reflected light.

Specimen No. : MSCM-02 **Magnification : 200X**

CHAPTER-VIII

8.0.0 PREVIOUS EXPLORATION

8.1.0 DETAILS OF PREVIOUS EXPLORATION CARRIED OUT BY OTHER AGENCIES

8.1.1 An area of 100 sq. km. surrounding the Malanjkhand region bounded by latitude 22°00'N & 22°07'N and longitudes 80°40'E & 80°45'E situated in the south eastern corner of T.S.64B/12 was mapped on 1:63,630 scale by Sharma and Kumar of Geological Survey of India (1966-67).

8.1.2 Geological mapping at 1:50,000 has been carried out by Geological Survey of India (1991-94). While mapping, they had also collected seven out crop samples from Shitalpani block which is just adjacent to Sitapur block. Out of seven samples, six samples have analysed 850 ppm to 0.28% Cu. Results of outcrop samples are given in **Table-8.1**.

Table-8.1.
Results of seven outcrop samples carried out by GSI, Shitalpani block, Balaghat District, Madhya Pradesh

Sl. No.	Sample No.	Cu (ppm)	Pb (ppm)	Zn (ppm)	Sn (ppm)	Ni (ppm)	Ag (ppm)
1	189/15/BR/MKD	1400	1200	125	10	20	< 1
2	189/6/BR/MKD	1700	500	75	< 10	10	1
3	187/15/W/BR/MKD	850	300	100	20	30	< 1
4	189/4/BR/MKD	1500	1800	125	10	20	< 1
5	189/15/BR/MKD	150	125	100	< 10	10	< 1
6	189/13/BR/MKD	2400	4800	100	< 10	20	1
7	189/1/W/BR/MKD	2800	1400	30	30	< 15	5

During the mapping, soil samples were also collected on a grid of 25m x 25m. The soil sample results are quite encouraging. The values of copper concentration in soil samples range from as low as 60 ppm to as high as 675 ppm. The low values may be due to contamination of soil from the adjoining steep slopes.

8.1.3 HCL, Malanjkhand had collected 7 soil samples and 2 rock samples from the vicinity of Sitapur Block. The copper values in soil samples vary from 38 ppm to 699 ppm, whereas in the rock samples vary from 96 ppm to 198 ppm. The gold values in the soil sample vary from traces to 0.03 g/t.

8.1.4 Subsequently, MECL has carried out geophysical survey on experimental basis in view of the surface manifestation as possible host rock i.e. vein quartz, favourable geological setup, shear/ lineaments and their intersection. The results obtained by the HCL and GSI also formed the basis to carry out experimental work. Based on the limited geophysical work, it was inferred that the area around Shitalpani is likely to be favourable for sulphide mineralization.

8.1.5 **Shitalpani Block (Adjacent to Sitapur Block),** MECL (2001-03) had carried out integrated exploration for Copper in Shitalpani Block over 2 sq. km. area which is just adjacent to the Sitapur Block. The quantum of work done by MECL in Shitalpani block is given below **Table No. 8.2.**

Table No. 8.2: Quantum of previous work carried out by MECL (2001-2003) in Shitalpani Block

Sl.No.	Item of work	Achieved work
1	Geological mapping & Topographical survey (1:2000)	2.00 sq.km. area
2	Trenching/shallow pitting	500 cu.m.
3	Geophysical survey	1. 12 line km. of IP profiling at 50m interval 2. 550 stations of SP survey 3. 550 stations of Magnetic survey 4. 10 nos. of Vertical Electrical Sounding (VES)
4	Geochemical survey	2.0 Sq.km of geochemical survey at 100m x 50m grid
5	Drilling	1544.85 m of drilling in 9 boreholes
6	Analysis	➢ 821 (562+259) number of primary and check (Drill core & trench) samples for copper, 276 Primary (Drill core & trench) samples for Au, Ag by fire assay method ➢ 2 nos of composite samples for Au by fire assay method ➢ 325 Nos. of geochemical samples (105 for

Sl.No.	Item of work	Achieved work
		10 radicals+ 145 for 5 radicals+75 Nos. For gold), 18 nos of composite samples analysed for 7 radicals and 9 nos. for trace and minor elements (10 radicals) were analysed. ➢ Petrographic studies: 50 Nos. & Mineragraphic studies : 25 Nos. ➢ 40 nos of specific gravity determination test.

i. **Geological Mapping & Geochemical sampling**: Two quartz vein in the north and numerous other smaller veins scattered throughout the block were mapped. The geochemical survey in 100m X 50 m grid indicated copper anomaly zone around vein quartz outcrop between sections N-1 to S-3 and S-10 to S-14. The highest copper content in soil sample and outcrop samples were 390 ppm and 659 ppm respectively.

ii. **Geophysical Survey**: The I.P. S.P. Magnetic, Resistivity and VES results reveal the promising / target area from profile S-4 to N1 for sulphide mineralization which is in corroboration with the anomalous zone interpreted by geochemical data in the northern part of the block. The survey has also interpreted the presence of a sheared zone trending NEE-SSW for about 800m.

iii. The geophysical signatures like negative potential, high chargeability and low resistivity have been recorded in the Shitalpani block. Magnetic Survey revealed axis of low magnetic intensity in the same area. While comparing the geophysical signature noticed in the block with that of Malanjkhand mine, it has been noticed that the maximum negative SP value in Shitalpani (-20.9 mv to 10 mv) is comparatively less than Malanjkhand mine (-200 mv) and extension area of current mine bench (-30 mv).

iv. **Trenching and Exploratory Drilling**: 259 samples collected from 30 trenches (500 cu.m.) confirmed the presence of copper mineralization. Test drilling was undertaken in 9 Bhs of total 1545 m for shallow intersection of quartz vein at a vertical depth range of 75 m to 150 m. Copper mineralization is present in vein quartz and granite, the highest individual sample value of Cu is 2.17 % in borehole MSP-2. The copper zones intersected in the boreholes are given in **Table No. 8.3**.

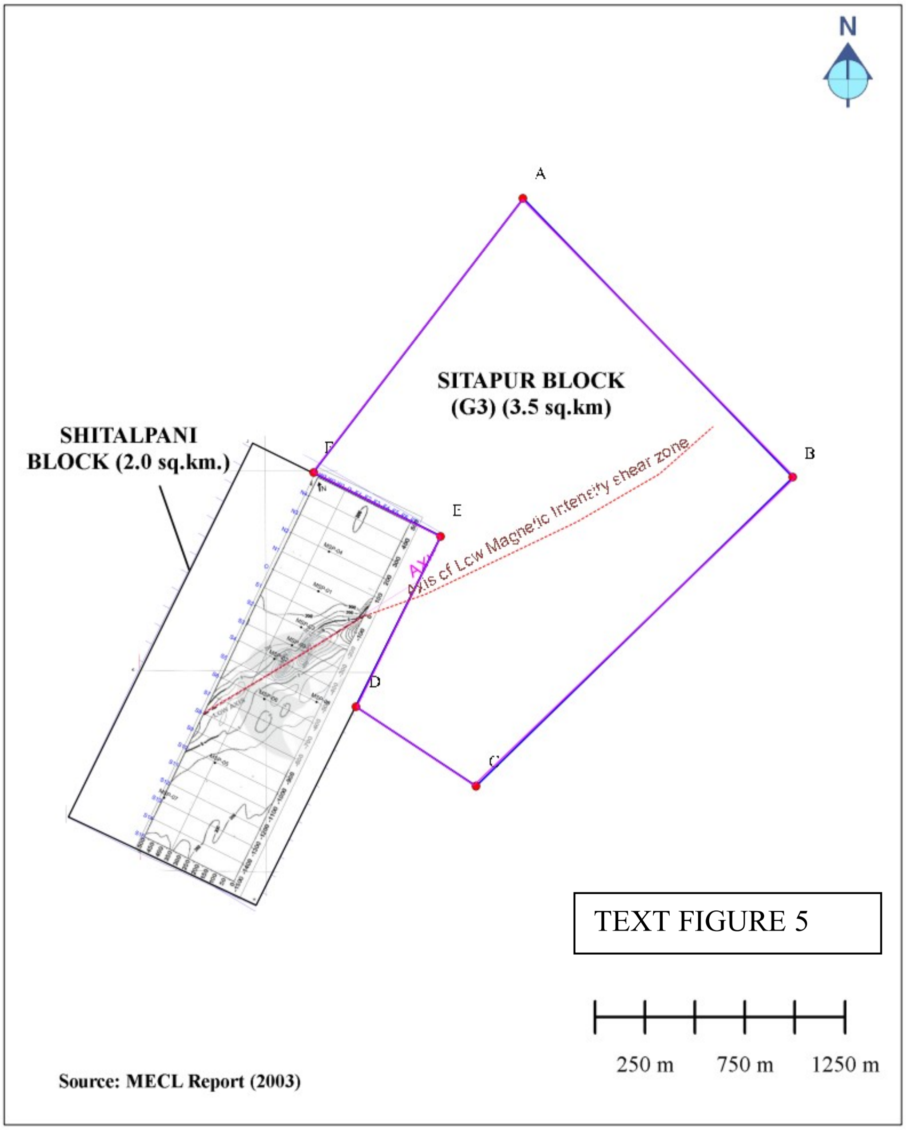
Table No. 8.3
Copper mineralized zones intersected in boreholes drilled by MECL in Shitalpani Block (2002-2003)

BH. No.	Section	From	To	Thickness	Cu%	Host Rock
MSP-1	T-1	164.25	165.25	1.00	0.26	Vein Quartz
MSP-2	S-4	142.40	147.00	4.60	0.65	Granite + Vein Quartz
MSP-3	S-2	143.11	143.30	0.15	0.31	Vein Quartz
		172.28	172.66	0.38	0.32	Vein Quartz
		180.50	182.00	1.50	0.23	Vein Quartz
		184.60	188.30	3.70	0.23	Vein Quartz
		206.70	212.70	6.00	0.33	Vein Quartz
MSP-7	Between S-12 to S-13	126.00	127.00	1.00	0.41	Granite
MSP-9	S-3	125.40	125.75	0.35	0.60	Vein Quartz
		148.01	148.29	0.28	0.41	Vein Quartz
		188.24	188.70	0.46	0.28	Vein Quartz
		212.31	212.82	0.51	0.52	Vein Quartz

Mineralized zones of Copper vary from minimum value 0.26% (over 1.00m thickness) to maximum 0.65% Cu (over 4.60m thickness) and thickness varies from minimum 0.35 m (with 0.60% Cu) to 6.00m (with 0.33% Cu).

v. **Recommendations of the Report:** The Geophysical survey has brought the presence of sheared zone trending ENE-WSW over a strike length of 800m (low axis) with the block and further continuing beyond the block boundary. (Text Figure-5). Since structural manifestations such as shears and their intersections are the possible loci for mineralization, exploration through integrated approach including geophysical, geochemical surveys etc. towards eastern side around Sitapur village is recommended.

MAP SHOWING AXIS OF LOW MAGNETIC INTENSITY SHEAR ZONE EASTWARD EXTENSION FROM SHITALPANI BLOCK TO SITAPUR BLOCK. BALAGHAT DISTRICT, MADHYA PRADESH



vi. **Further course of Action taken by MECL:** Copper ore resources were not estimated in Shitalpani Block by MECL in 2003. Keeping in view the demad for Copper, 43rd TCC committee, NMET advised MECL to estimate copper ore resource considering previous borehole data and submit Geological Report for auctioning of the block. As adviced, MECL estimated Copper ore resources based on the previous exploratory drilling data of MECL and a total 0.36 m.t. (million tonnes) Net geological in-situ resources with 0.37 % Cu have been estimated by Geological Cross Section Method at 0.2 % Cu cut-off (with 1 m minimum stoping width and 2m non-ore parting) and the resource has been categorised under Reconnaissance Resource 334 as per UNFC. The revised Geological Report along with Copper Ore resources have been submitted on date 11.10.2022 to Department of Mines & Geology, Govt. of Madhya Pradesh and intimated to NMET secretariat.

8.1.6 During FY 2023-24, the Shitalpani Block for copper was successfully auctioned by the State Government of Madhya Pradesh under a composite licence in the 11th tranche held on 13th September 2023.

8.1.7 Based on the recommendations of the previous report of Shitalpani Block, the present exploration at G3 stage exploration has been taken up to trace mineralised quartz vein associated with low magnetic intensitiy shear zone and to assess the potentiality of the prospect in Sitapur area.

CHAPTER-IX

9.0.0 AREAL OR GROUND GEOPHYSICAL OR GEOCHEMICAL DATA

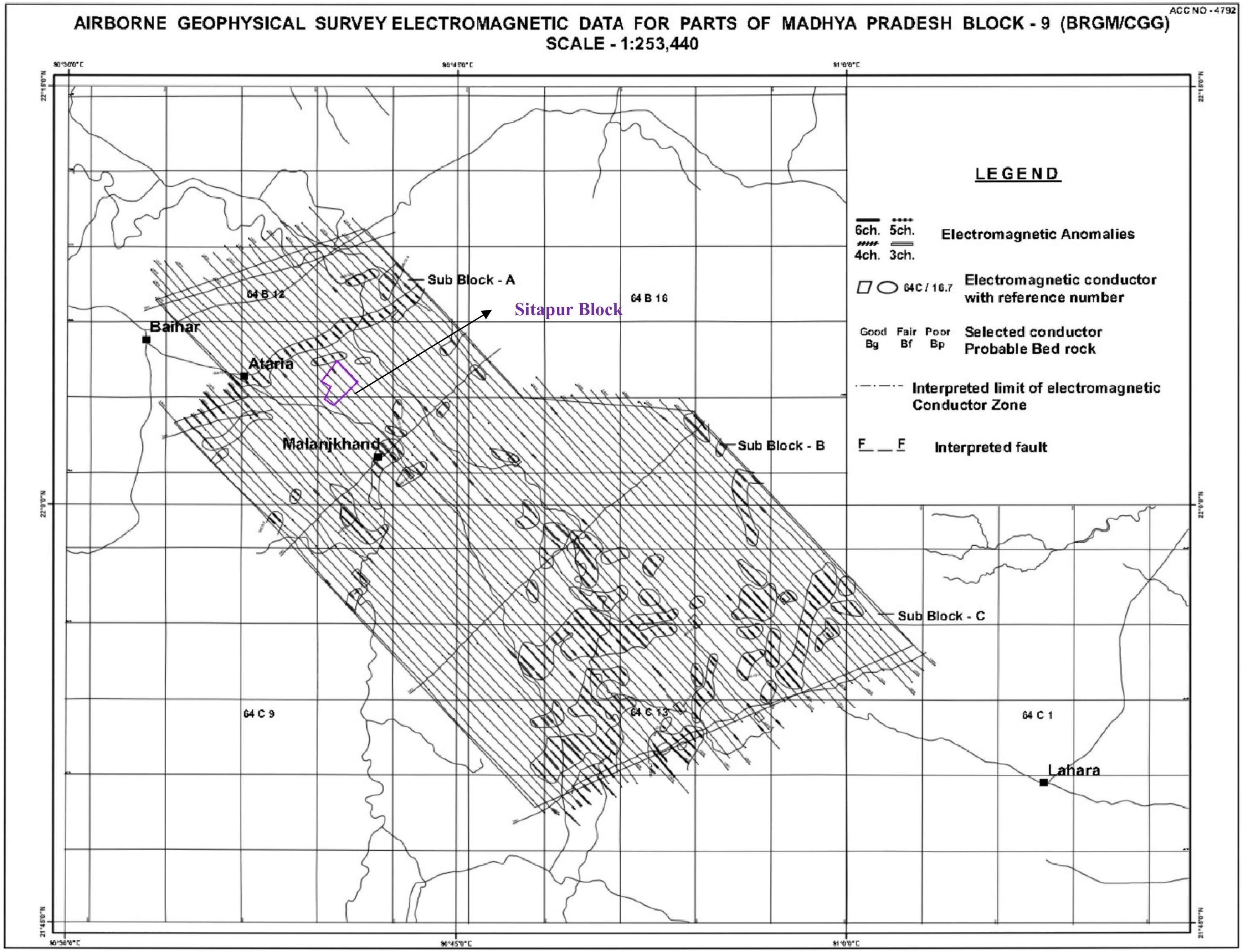
Areal/Airborne Geophysical Survey is not the scope of present exploration. However, previous exploration of Airborne Geophysical survey and Ground Evaluation Report as well as NGPM and NAGPM data has been consulted and findings are given in subsequent paragraphs.

9.1.0 AIRBORNE GEOPHYSICAL SURVEY:

9.1.1 A Multi-sensor airborne geophysical survey, covering ~830 sq. km in Block-9, was conducted by BRGM/CGG during 1971–72 using a Catalina aircraft. Flight lines were spaced 500 m apart along NW–SE direction at an altitude of ~125 m (drape flying). Observations were recorded on an electromagnetic digital analogue recorder and plotted at 1:30,000 scale. The survey delineated 479 aero-electromagnetic anomalies, in addition to aeromagnetic and scintillometric anomalies (Text Fig. 6).

9.1.2 Subsequently, the GSI (AMSE Wing), under its 1983–84 annual programme, carried out ground evaluation of 98 selected aero-EM anomalies in parts of Balaghat and Rajnandgaon districts (Sheets 64 B/12, B/16, 64 C/9, C/13, and 64 G/1). The anomalies comprised 37 three-channel, 42 four-channel, 8 five-channel, and 11 six-channel responses. Lithological associations included banded shale (42 anomalies), laterite (8), sandstone/arkose (7), granitoids (4), basic rocks (2), vein quartz (1), conglomerate (2), and covered ground (32).

9.1.3 Based on anomaly evaluation, two areas were prioritized for further exploration. 1). West of Rol village – Lateritic gossan samples yielded 0.23–0.28% Cu near a faulted contact between granitoids and the Chilpi Group. 2). North of Ataria – A serpentinite body, coinciding with a discrete closed aeromagnetic anomaly, was recommended for detailed survey to assess nickel, chromium, and associated mineralization potential. Ground geophysical surveys were also suggested for this ultramafic body.



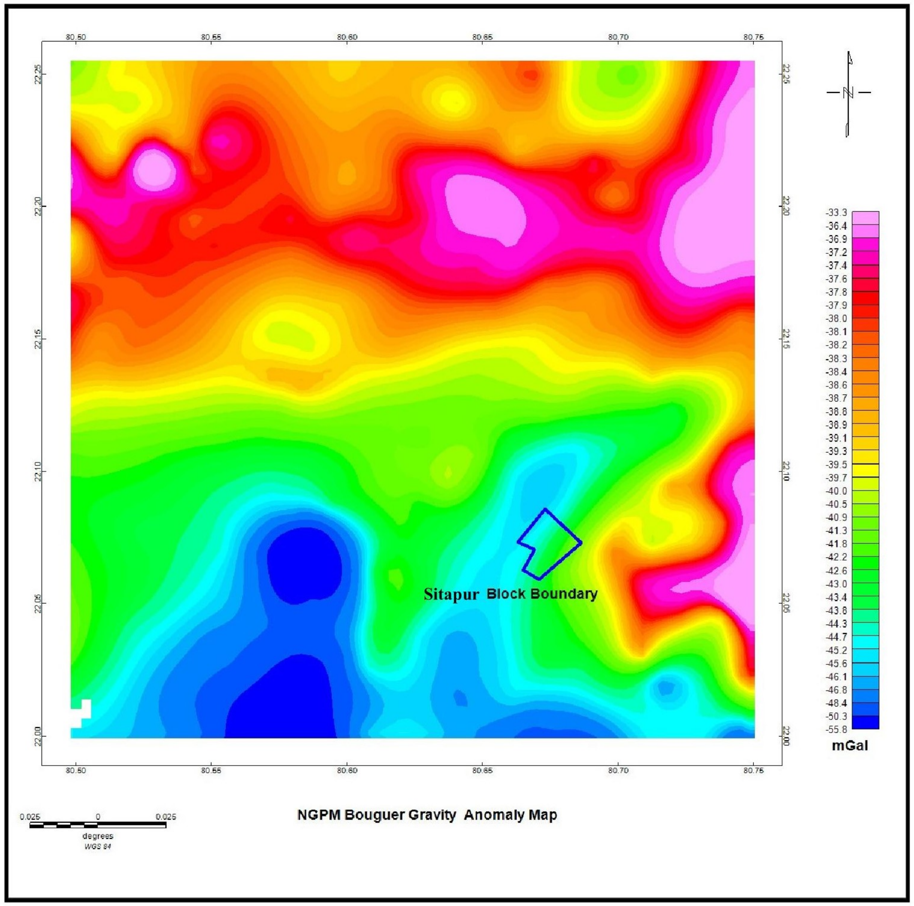
TEXT FIGURE- 6: Airborne Geophysical Survey Electromagntic for parts of Madhya Pradesh (Block-9), GSI (1983-84)

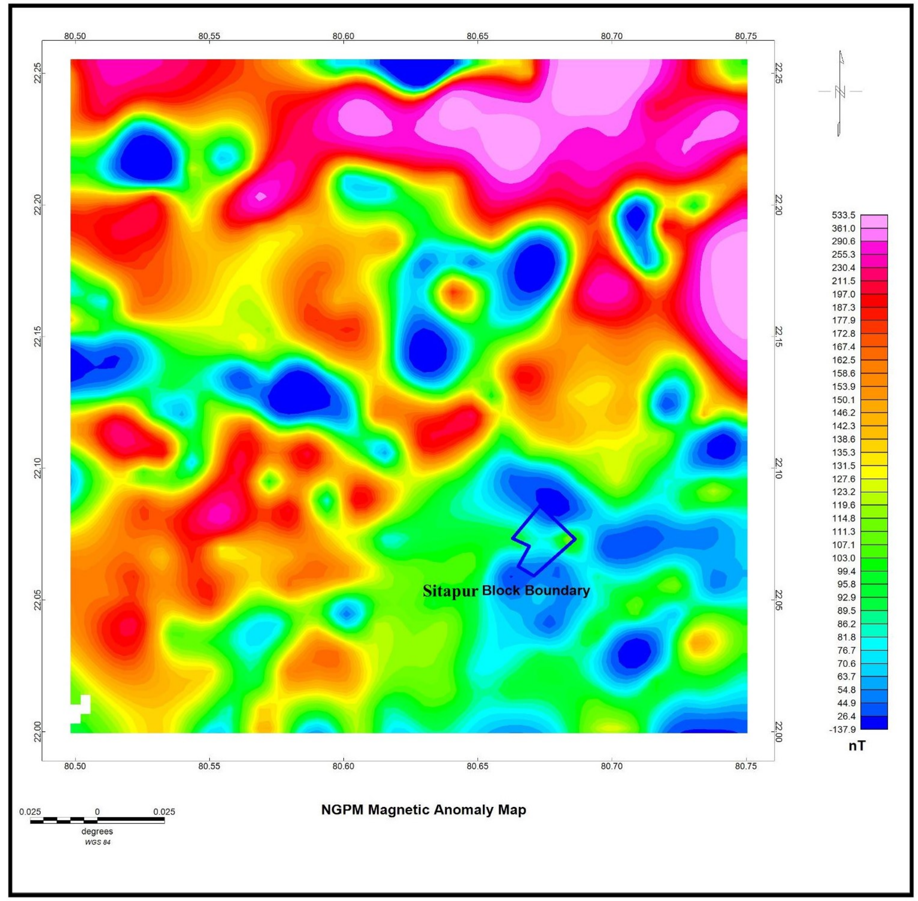
9.2.0 NGPM SURVEY:

9.2.1 GSI carried out NGPM (National Geophysical Mapping Program) survey in Toposheet No. 64B/12. NGPM data (Gravity, Magnetic) for Toposheet No. 64B/12 downloaded from NGDR portal and interpreted to identify potential exploration targets. The gravity anomaly within the block shows moderate low to low values, ranging from –45 mGal to –41 mGal. The anomaly exhibits a Northeast–Southwest (NE–SW) trend. (Text Fig.7A) Ground magnetic anomaly data reveals that the block is divided into two distinct parts. A contact zone is observed approximately at the middle of the block, indicating lithological/structural contrast which is corroborating with Gravity anomaly. (Text Fig. 7B)

9.3.0 NAGPM SURVEY:

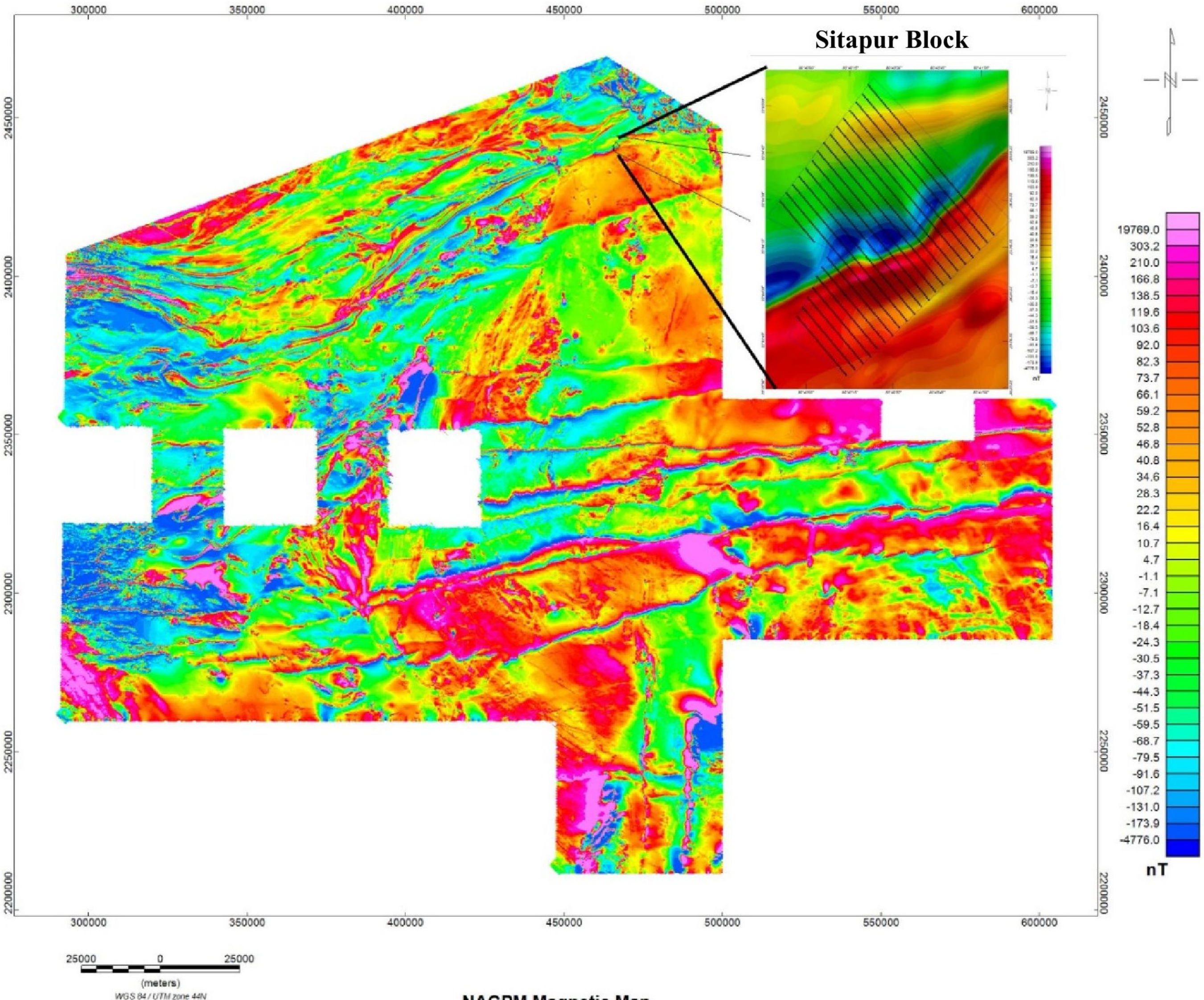
9.2.2 National Aero Geophysical Mapping program (NAGPM) carried out in Block-IV in parts of Madhya Pradesh. NAGPM data downloaded from NGDR portal and interpreted. It has been observed from the aeromagnetic anomaly map that a well-defined low magnetic anomaly zone trending Northeast–Southwest (NE–SW) passing through the center of the Sitapur block which can be interpreted as contact between two lithologies or shear zone. This contact distinctly divides the block into two parts, corroborating the ground NGPM gravity and magnetic results. (Text Fig. 8).





TEXT FIGURE- 7A: NGPM Bougar Gravity Anomaly Map with Sitapur Block location (source: NGDR)

TEXT FIGURE- 7B: NGPM Magnetic Anomaly Map with Sitapur Block location (source: NGDR)



TEXT FIGURE- 8: NAGPM Magnetic Map (Block-IV) with Sitapur Block location (source: NGDR)

9.4.0 GROUND GEOPHYSICAL SURVEY

9.4.1 During present G3 stage Explroation, Ground geophysical survey taken up in Sitapur Block as per the approved quantum and findings discussed in subsequent paragraphs.

9.5.0 INTRODUCTION

9.5.1 All available previous geological, ground geophysical survey data of NGPM as well as from adjoining Shitalpani block and Airborne Geophysical survey (Magnetic, PTHEM & Radiometric) data has been consulted and data has been utilised for the formulation of Ground Geophysical survey proposal at G3 stage for Copper and Associated mienraliastion in Sitapura Block.

9.5.2 During present investigation, Ground geophysical survey comprising of Magnetic, SP and I.P. Survey planned to demarcate concealed potential mineralisatin zones at 100m traverse interval and 20m station interval in Sitapur Block.

9.5.3 The physical properties for different expected ores of Cu, Pb, Zn, etc and host rock are shown in below **Table 9.1.**

Table -9.1 Physical Properties of different expected ores & host rocks

Ore/ rock	Chemical omposition	Density (g/cc)	Magnetic Intensity
Chalcopyrite	$CuFeS_2$	4.1-4.3	Paramagnetic
Bornite	Cu_5FeS_4	5.06-5.09	Paramagnetic
Chalcocite	Cu_2S	5.5	Diamagnetic
Covellite	CuS	4.68	Diamagnetic
Pyrite	FeS_2	5.02	Paramagnetic
Biotite	$K(Mg,Fe)_3AlSi_3O$	2.92	Medium to low magnetic
Quartz/Quartzite	SiO2	2.6-2.8	Diamagnetic
Galena	PbS	7.6	Diamagnetic
Sphalerite	ZnS	3.9-4.1	Paramagnetic

9.6.0 OBJECTIVE AND SCOPE OF THE WORK

9.6.1 The scope of work consists of Acquisition, Processing and Interpretation of ground Geophysical survey data in the potential area. The Profile lines were designed and aligned in such a way that it lays across the regional geological strike direction of the targeted potential zones and to be covered with 30 lines Km (3 Unit) of IP, SP and magnetic Survey Profile as approved by NMET. The Geophysical survey was carried out by using IP, SP and magnetic methods with 22 profile lines in grid pattern comprising 30-line Km. The lines were kept at 100 meters spacing with 20 meter as station spacing for recording data. The objective of the Geophysical survey was to delineate Cu ore and its host rock with other associated mineralized zone.

9.7.0 SURVEY LAY OUT

9.7.1 A base camp was established near the Sitapur Block to facilitate the geophysical survey. The survey team consisted of three members of geophysicist for data acquisition equipped with specialized instruments including the ENVI Pro Magnetometer for magnetic measurements, the IRIS Syscal R2 Resistivity Meter for SP data recording, the Syscal-Elrec Pro 10 Channels for IP-cum-Resistivity measurements and Trimble Juno Handheld GPS unit for precise location tracking/marking. Detailed specifications of this equipment are provided in Table 5. The block boundary map, along with its coordinates, is presented in Figure 4. and Table 3. respectively. To ensure accuracy and minimize disturbances the magnetic base was established Outside of the Sitapur block boundary area, as specified in Table 6.

9.7.2 The field activities consisted of the following:

- Fixing of survey points in 100m x 50m grid for TDEM.
- Fixing of survey points in 250m x 250m grid for MT.
- Acquisition of TDEM and MT.
- Field QC of acquired data on day-to-day basis.

The field activities consisted of the following:

- Demarcations of block boundaries were carried by DGPS system.
- Fixation of survey points in 20m X 1000m grid with GPS system.
- Magnetic data has been acquired with EnviPro Magnetometer and SP data with IRIS Syscal R2 and the Syscal-Elrec Pro 10 Channels for IP-cum-Resistivity measurements
- Field QC of acquired data on daily basis.

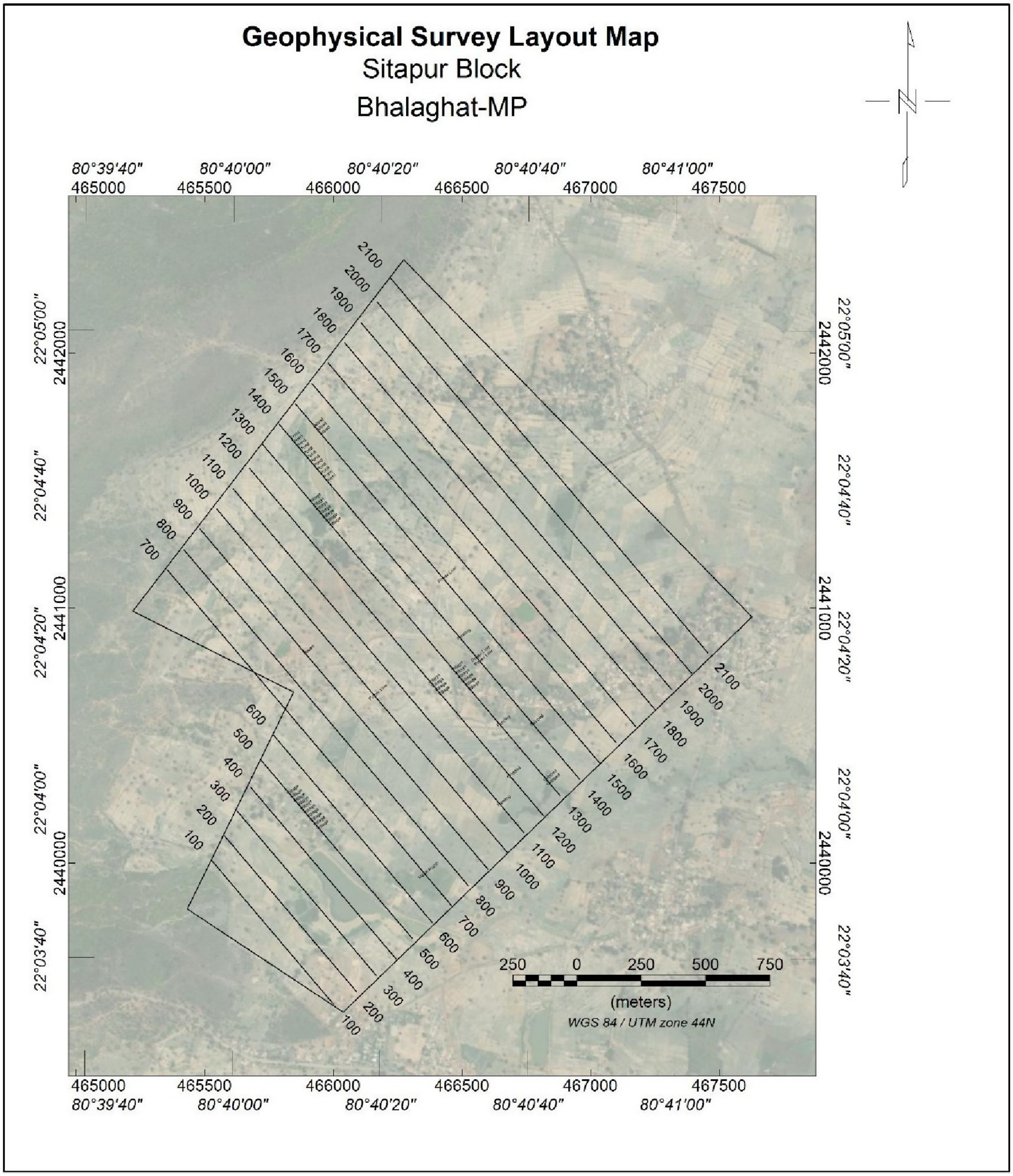
Total quantum of work i.e. area surveyed and Line Km recorded in the blocks are given below.

Table -9.1a Quantum of Ground geophysical work carried out in Sitapur Block.

Cardinal Points	Easting	Northing	Parameter	Grid	Line No	Line Km	Covered area (Km^2)
A	466273	2442365	MAGNETIC SP IP	20 x 100	L1 - L22	30	2.004
B	467625	2440966					
C	466037	2439417					
D	465434	2439816					
E	465860	2440670					
F	465220	2440991					
Magnetic Base	462365	2439989					

9.7.3 The Geophysical survey was completed within 60 days i.e. from 13-04-2024 to 11-06-2024.

9.7.4 The Lay-Out map the block is shown in Text Figure 9 with the location of traverse lines and stations of observations.



TEXT FIGURE. 9 : Block boundary of Sitapur Block along with Traverse Line

9.8.0 DATA REDUCTION AND PROCESSING

9.8.1 **Instrument Details:**

Table 9.2 : Instrument Details

INDUCED POLARIZATION DATA ACQUISITION UNIT	
Type	Syscal Elrec Pro Resistivity meter with IP & SP measurements-10 Channels
Make	IRIS Instrument
Input impedance	100 M0hm
Voltage resolution	1 µV/0.2%
Voltage accuracy	0.2%
Automatic compensation of SP	-5V to +5V
RESISTIVITY METER (SP Measuring Unit)	
Type	SYSCAL R2 Resistivity meter with IP & SP measurements
Make	IRIS Instrument
Input impedance	100 MOhm
Voltage resolution	1 µV/0.2%
Voltage accuracy	0.2%
Automatic compensation of SP	-5V to +5V
MAGNETOMETER	
Type	Proton Precision Magnetometer (PPM)
Make	Scintrex (ENVI Pro MAG)
Sensitivity	0.1 nT
Accuracy	+1nT
Range	23000 to 100000 nT
SURVEYING	
Type	Hand-Held-DGPS
Model	Trimble-Juno

9.9.0 FIELD DATA ACQUISITION:

9.9.1 **Magnetic Data Acquisition:** The survey was designed in a grid pattern with a line interval of 100 meters and a station spacing of 20 meters, with positions marked using Hand held DGPS. Survey locations were meticulously demarcated by placing pegs, each indicating the corresponding line and station number. The layout map of the traverse lines and observation stations is shown in Text Fig. 9. As one line no 4 (400) was not accessible due to pond, it was skipped and offset- line in between line number 3 and 5 as infilling was taken into consideration to infill the data gap. The Magnetic data was recorded at every station with starting and ending at the base station on routine basis. The survey was meticulously designed to detect subtle changes in the magnetic field, which could indicate the presence of geological features such as shear zones, faults, and mineralized bodies.

9.9.2 **IP Data Acquisition:** IP & Resistivity profile data was recorded by 20 m dipole-dipole array configuration with max 10 channels and min 4 channels of 20 m dipole interval. A sum of 30 L Km profile data was recorded in the surveyed block.

9.9.3 **SP Data Acquisition:** The SP survey was carried out using non-polarizing electrodes and a high-impedance voltmeter, along with an SYSCAL R2 system. The recording was done in a grid pattern, with a station spacing of 20 meters and line spacing of 100 meters. A total of 30 LKM was covered

9.10.0 DISCUSSION OF RESULTS

9.10.1 Magnetic Anomaly:

Magnetic survey investigates subsurface geology using anomalies in Earth's magnetic field caused by rock properties. Magnetic anomalies arise from induced or remnant magnetism, with shapes and amplitudes influenced by rock size, depth, geometry, susceptibility, and Earth's magnetic field. Corrected data showed a variation of 951.6 nT, maximum value 45670.3 nT, and minimum value 44718.7 nT in the TMI map.

The anomaly map shows variations in anomaly magnitude, trend, and alignments indicating ferromagnetic, paramagnetic, and diamagnetic bodies. Magnetic intensity decreases in the southeastern portion aligned NE–SW, suggesting a possible shear zone. High anomaly values indicate magnetic ore bodies with iron content. IGRF (2020 model), values range from –1159.9 nT to 511.5 nT.

Low anomalies trending NE–SW in the eastern part suggest a possible shear zone continuing from Shitalpani block. The zone has a cumulative strike length of about 1.6 km.

Reduced To Pole (RTP):

RTP was applied to diurnally corrected anomaly data to make anomalies symmetrical. The RTP map shows variation of 783 nT, with maximum 225 nT and minimum –558 nT.

After RTP correction, the low anomaly in the northeast more prominent and aligned NW–SE. The shear zone in the southeast is sharper in the RTP image.

Residual Magnetic Anomaly The residual map was obtained by subtracting 100 m upward continuation data from the anomaly map. It highlights local geological features. The northwestern anomaly disappears, suggesting it is regional, while the southeastern NE–SW anomaly remains, linked to shear facies.

Total Horizontal Derivative Map The derivative map of TMI enhances local anomalies and sharpens shallow features. It clearly demarcates anomalous zones.

Analytic Signal Analysis Map: The map shows lithological boundaries with high intensity at contacts and shallow anomalous bodies. Contours highlight causative body boundaries. Analytical signal and RTP maps both indicate NE–SW shear zones and target zones.

Radially Average Power Spectrum Most the anomaly features and causative bodies are within the depth range of 100 to 500 mt.

9.10.2 Induced Polarization (IP) Profiles:

The resistivity data were checked station wise to remove any near surface effect prevailing in the data. The pseudo-depth data were inverted using the RES2DINV software to bring out the subsurface resistivity and chargeability distribution. The inverted sections for Line-1 to Line 21. A detailed view of the subsurface characteristics, to interpret the underlying geological structures.

IP Response:

The IP (Induced Polarization) response in the survey area is characterized by high chargeability and moderate to high resistivity values, which are typically associated with alteration and shear zones. The combination of high chargeability with varying resistivity suggests the presence of mineralized zones, likely containing sulfides or other conductive bodies, within these altered geological formations.

Chargeability in the study area is ranging from 10 mV/V to 80 mV/V. The values above 40mV/V may interpreted as the presence of sulfide mineralization in the study area. A consistent trend is observed across all lines, showing a clear alignment in NE-SW direction at the shear zone derived from magnetic anomaly data in the survey area, indicates sulfide mineralization. Notably, the chargeability anomaly values in some profiles suggest that mineralization extends beyond 100 meters (up to depth of investigation).

9.10.3 Self-Potential (SP) Profiles:

The total SP anomalies along each traverse have been generated from the SP data. The total variation of SP anomaly of value 158 mV was observed with the highest value of 72 mV and – 86.1 mV as lowest. The SP data did not provide conclusive results due to structural disturbances in the area. Although it is also well correlate with the IP, Resistivity, and Magnetic data, indicating that the electro-kinetic potential developed at shear zone due to sulphide mineralization.

An integrated survey (magnetic, IP, SP) was conducted in Sitapur Block to identify base metal zones. Structural features and lithological contacts shear zones etc. were demarcated. Mineralization zones were also marked from this integrated geophysical survey with an estimated depth range from 80–140 m at sub-surface. Resistivity and IP results show similar potential mineralization zones. Magnetic and RTP maps reveal NE–SW low-intensity anomalies indicating alteration or shear zones. Four boreholes are proposed at target zones identified on analytical signal maps.

9.10.4 Integrated Geophysical interpreted anomaly zones marked on Detailed Geological map (Plate No. IV-A) and Geochemical Anomaly map (Plate No. IV-B).

9.11.0 CONCLUSIONS AND RECOMMENDATIONS

9.11.1 The integrated geophysical survey as approved by NMET has been conducted in the Sitapur Block by adopting IP, SP and Magnetic methods. The objective of the survey was to find out the potential zones for base metals comprising copper and other associated mineralisation. The effectiveness of these methods along with its limitation depends upon the physical properties contrast of the target and surroundings. The possible mineralized zones along with structural features like faults/shear zone, has been successfully demarcated with lithological contacts by adopting integrated geophysical survey. To demarcating the zones of interest and their contacts spatial filtering technique like Upward continuation, Horizontal derivatives and analytical signal analysis etc. were applied on magnetic data to enhance the outcomes. The area of Mineralization has also been marked in IP and apparent Resistivity sections and has plotted over profile (Fig.5.4.1.10). In order to obtain source depth information, radially averaged power spectrum and analytical signal analysis maps of Magnetic anomaly etc. has been generated and depth of the anomalous zones were found ranging from 80m to 140m in different segments of the block.

The results from both Resistivity and IP method surveys have a lot of similarities. The extents of potential mineralisation zone have been plotted over the AS map. The potential zones with high probability of mineralisation are also identified with continuous trend of possible mineralization within these low-intensity magnetic.

The magnetic intensity and Reduced-to-Pole (RTP) anomaly maps show the distribution of magnetic anomalies across the study area. The areas of low magnetic intensity, particularly in a NE-SW direction, are indicative of alteration zones, shear zones, or possibly zones of disseminated mineralization marked by white dotted lines in AS Map.

Based on these integrated geophysical results, four boreholes have been proposed over the Analytical Signal (Magnetic) maps (Fig. Fig.5.4.1.13), targeting the identified alteration and shear zones. Detailed information regarding the proposed borehole locations, including specific coordinates and depth recommendations, is provided in **Table 9.3.**

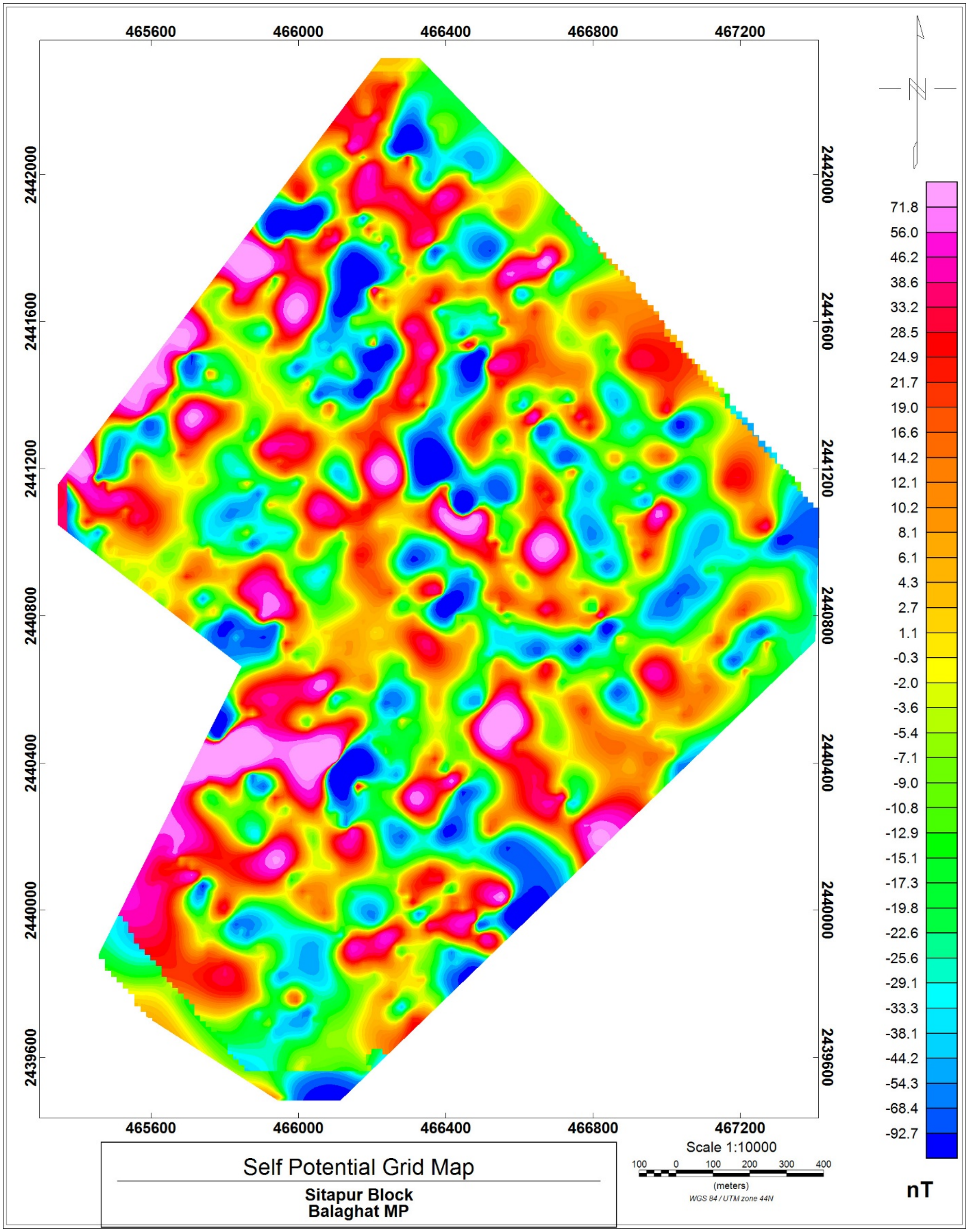
Table 9.3: Detailed of Proposed Boreholes Sitapur block

Detailed of Proposed Boreholes Sitapur Block					
PB ID	**Easting**	**Northing**	**Angle**	**Azimuth**	**Depth**
PB-1	465768.8	2439879	50	N40W	100
PB-2	465959.5	244024	50	N40W	130
PB-3	466585.7	2440616	50	N40W	100
PB-4	466265.4	2440687	50	N40W	100

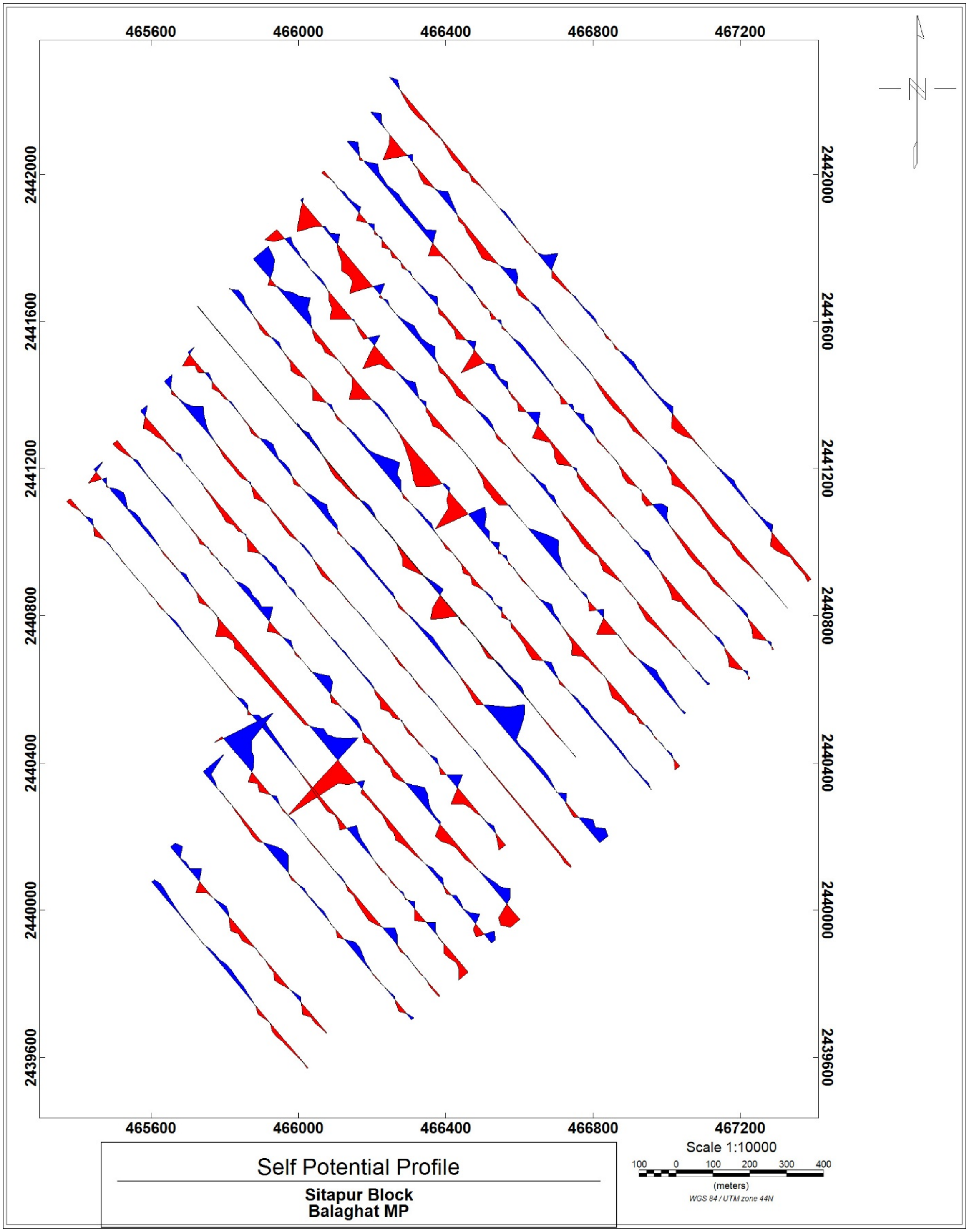
Note: The proposed boreholes depths are indicated as vertical target depths.

Hence, inclined boreholes with suitable angle are to be planned to intersect the vertical target depths.

9.11.2 Report on Induced Polarization (IP), Self-Potential (SP) and Magnetic Survey in Sitapur Block for Copper Prospecting, District Balaghat, Madhya Pradesh is enclosed as **Annexure-XIII.**

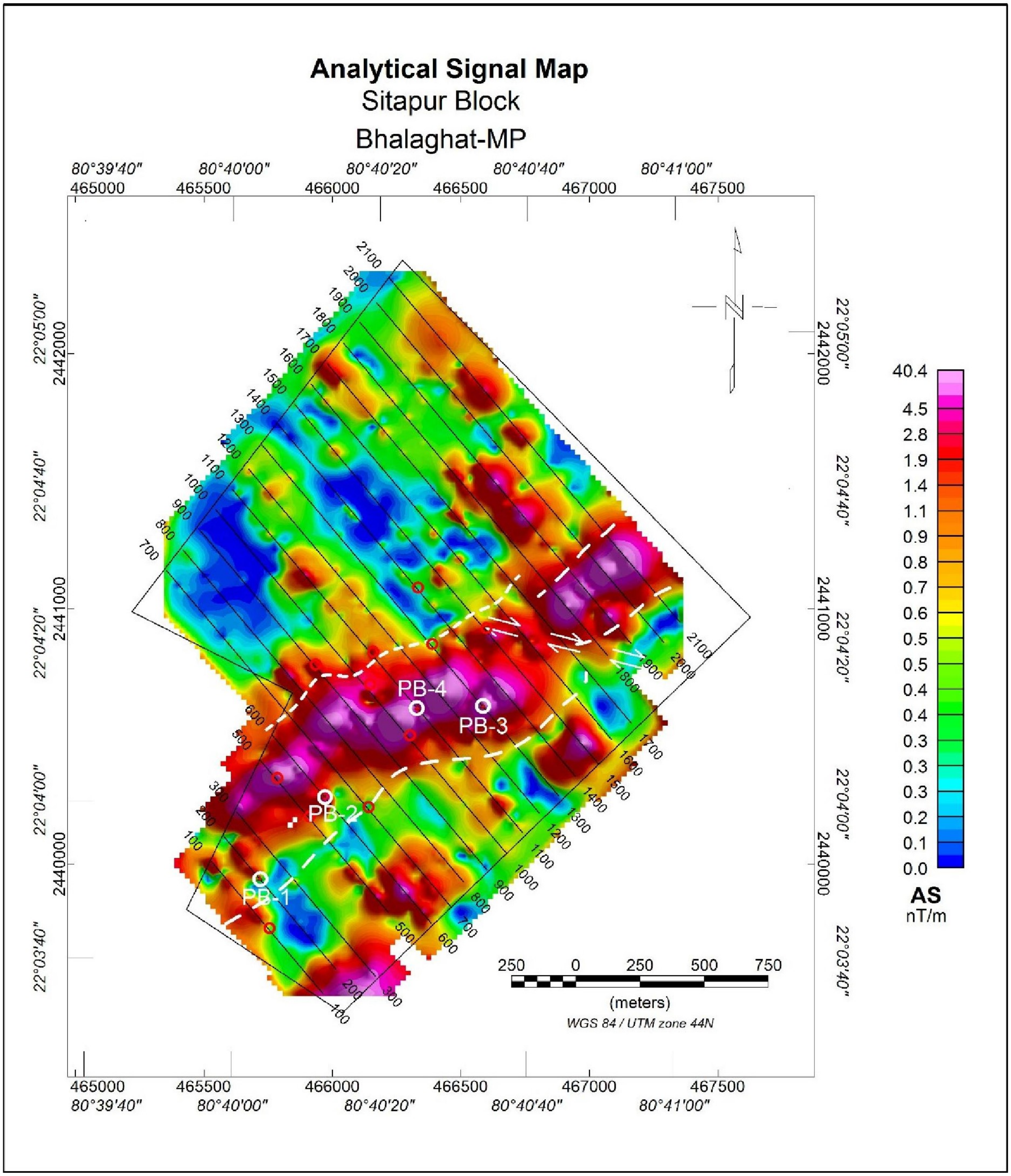


Text Figure 10: Total SP anomaly Map



Text Figure .11: SP Profile Map

Text Figure .12: Proposed Borehole locations with Marked Shear Zone overlaid on Analytical Signal Analysis (Magnetic) Map



9.12.0 GEOCHEMICAL SURVEY:

9.12.1 NGCM (National Geochemical Mapping program) for this area (Toposheet No. 64B/12) is not available on NGDR web portal. However, during present G3 stage investigation, geochemical soil sampling work carried out in Sitapur block and has been discussed in in the following **Chapter-X.**

CHAPTER-X

10.0.0 EXPLORATION UNDERTAKEN DURING CURRENT INVESTIGATION

10.1.0 Background Information

10.1.1 MECL (2001-2003) carried out integrated Geological, Geophysical, Geochemical, and drilling work in Shitalpani Block (2 sq. km) which is adjoining to the Sitapur Block. Geophysical survey helped to identify an area between profile lines S4 to N1 with signatures like negative self-potential, high chargeability and low resistivity which supported the possible occurrences of sulphide mineralization. The geochemical responses were corroborative well with the geophysical survey. 800m shear zone trending ENE-WSW was delineated/interpreted by ground geophysical survey. Based on the geological, geochemical and geophysical anomaly, Exploratory drilling (1544.85 m of drilling in 9 boreholes) in the targeted zone confirmed a continuous stretch of mineralization for 600 m strike length at 0.2 % Cu grade. In view of the potentiality of prospect, a total 0.36 m.t. (million tonnes) Net geological in-situ Reconnaissance resources with 0.37 % Cu at 0.2 % Cu cut-off estimated in the area and placed under 334 category as per UNFC. It was recommended that "The geophysical survey has brought the presence of sheared zone trending ENE-WSW over a strike length of 800m (low axis) within the block and further continuing beyond the block boundary. Since Structural manifestations such as shears and their intersections are possible loci for mineralization, thus exploration through integrated approach including geophysical, geochemical surveys etc. towards eastern side around around Sitapur village is recommended".

10.1.2 Based on previous work recommendations, Sitapur Block was taken up at G-3 level for Copper and associated minerals under NMET funding to establish the eastward extension of shear zone hosted basemetal mineralisatioon and prove the strike and depth continuity of mineralisation in Sitapur block through integrated exploration including Detailed Geological mapping, Surface geochemical sampling, trenching, ground geophysical survey and followed by drilling and associated laboratory studies.

10.1.3 The Objectives of G3 stage exploration work in Sitapur block in two phases as given below.

Phase-I

1. To carry out Geological mapping on 1:2,000 scale.
2. To carry out Geochemical sampling (Bedrock/soil) in a suitable grid to delineate the potential zone of mineralization.
3. To carry out Integrated Geophysical Surveys such as Induced Polarization (I.P.) cum Resistivity, S.P & Magnetic Survey to delineate potential mineralized zones (30Lkm).
4. To carry out trenching/pitting work in the anomalous zones identified with the help of geological mapping, geochemical sampling, geophysical survey and trenching work etc.

Phase-II (After review of Phase-I with TCC)

5. Based on the positive outcome of ground geophysical survey, geological mapping supported with geochemical sampling and trench sample results, boreholes would be drilled to test geophysical and geochemical anomalies in the area.

10.2.0 Exploration Methodology

10.2.1 The components of G-3 level of exploration for Copper and associated minerals in Sitapur Block to full fill the above-mentioned objective in accordance with MEMC rule 2015 (amended till 2021) as approved by NMET is furnished in the **Table No. 10.1** and the field component wise description has been given in subsequent paragraphs.

10.2.2 The details of the nature and quantum of work proposed Vs an actual achievement is given in **Table-10.1.**

Table – 10.1
Quantum of Work vs. Achievement by MECL in Sitapur Block, Malajkhand Copper Belt, District: Balaghat, Madhya Pradesh

Sl.No.	Description and Nature of Work	Unit	Target (Qty.)	Achieved (Qty.)
A	**GEOLOGICAL & SURVEY WORK**			
1	Detailed Geological mapping, (1:2,000 scale)	sq.km.	3.5	3.5
2	DGPS Survey of Block Boundary cardinal points by DGPS + BH fixation & RL determination	Points	14	10
B	**GROUND GEOPHYSICAL SURVEY**			
	i) IP. Induced Polarization (I.P) cum Resistivity S.P and Magnetic	Line Km	30	30
C	**EXPLORATORY MINING**			
1	Excavation of Trenches	cu m	150	150
D	**DRILLING**			
1	Drilling up to 300m (in Hard Rock)	m	800	576.1
2	Borehole deviation survey by multi shot camera	m	800	563
3	Borehole Geophysical logging	m	800	571
4	Drill Core Preservation	m	250	250
D	**LABORATORY STUDIES**			
1	**Chemical Analysis**			
i)	**Surface Sampling (Bedrock /Soil/Trench samples)**			
	a. for Cu, Pb, Zn, Ni, Co, Te, Mo and Se	Nos	200	170 (BR-22, SS-47, TR-101=170)
	b. Au by Fire Assay	Nos	20	3
	c. External Check Samples for Cu, Pb, Zn, Ni, Co, Te, Mo and Se	Nos	20	17
	d. External Check Samples for Au (Gold) by Fire Assay	Nos	2	-
ii)	**BH Core Samples**			
	a. for Cu, Pb, Zn, Ni, Co, Te, Mo and Se	Nos	200	200
	b. For Au (Gold) by Fire Assay	Nos	40	40
	c. External Check samples Cu, Pb, Zn, Ni, Co, Te, Mo and Se	Nos	20	20
	d. Check samples for Au (Gold) by Fire Assay	Nos	40	-

Sl.No.	Description and Nature of Work	Unit	Target (Qty.)	Achieved (Qty.)
	c) ICP-MS (34 elements) (for BH Samples)	Nos	50	50
2	**Petrological samples (Surface/ Trench/ BH Samples)**			
i	Preparation of thin section	Nos	10	10
ii	Study of Thin Section	Nos	10	10
3	**Mineragraphic Studies (Surface/ Trench/ BH Samples)**			10
i)	Preparation of polished section	Nos	10	10
ii)	Study of Polished Section	Nos	10	10
iii)	Digital Photographs	Nos	10	10
E	**Geological Report (5 Hard copies with a soft copy)**	**Nos**	**1**	1

10.2.3 The Preliminary exploration (G-3 stage) for Copper and associated Minerals in Sitapur Block included Topographical survey and Detailed Geological mapping (1:2000 scale) over 3.5 sq.km. area collection and analysis of total 170 nos Bedrock, soil and trench samples i.e. 22 Nos. Bedrock and 47 Nos. soil samples and 101 Nos. trench samples from 150 cu.m. trenching work. Ground geophysical survey (30Lkm) comprising of IP. Induced Polarization (I.P) cum Resistivity S.P and Magnetic totalling 30 Lkm and followed by Exploratory test drilling (576.10 m in 4 Bhs) along with associated activities i.e. borehole deviation survey & borehole geophysical logging and associated laboratory studies including petrographic (10 nos.) and mineragraphic (10 nos.) studies.

10.2.4 The exploratory drilling work in Sitapur block commenced with the surveying and exploratory drilling work with drilling of Borehole No. MSC-01 on date 17.01.2025 and completed with the closure of Borehole No. MSC-04 on date 24.05.2025. Total 576.10 m of diamond core drilling in 4 boreholes achieved in the block area. The allied field-works including borehole fixation and determination of co-ordinates & reduced level of boreholes by DGPS, drilling work and associated borehole deviation survey & borehole geophysical logging, core logging, core sampling etc. were completed simultaneously. The survey work in the block area was carried out with the help of DGPS in WGS-84 Datum. The laboratory studies including chemical analysis and physical analysis i.e. petrographic and mineragraphic studies were carried out simultaneously in MECL laboratory, Nagpur and other external laboratories. Component wise Exploration methodology and findings have been described in subsequent paragraphs.

10.2.5 Topographical Survey

Topographical survey has been carried out by DGPS survey instrument over 3.5 sq.km. area in Sitapur Block located in part of Survey of India toposheet No. 64B/12. Topographical survey map used to understand the topography, roads, drainage/water bodies of the mapped area and also used as a base map for the Geological mapping and borehole planning. Available surface features in the block have been picked up and borehole locations and their RL have been fixed during survey work. Accuracy and quality of surveys used to located drill holes and other locations have been disucussed in Chapter-XI. Topographical map prepared on 1:2000 scale with 2.0m contour interval. However due to size limitations in plotter the map produced on 1:4000 scale. **(Plate No. III)**.

10.2.6 Geological Mapping

Detailed Geological mapping carried out over the entire 3.5 sq. km area on 1:2000 scale. Topographical survey map was used to understand the topography, roads, and drainage of the mapped area and was also used as a base map for geological mapping. For recording precise sample location and to carry out a geological survey, handheld BAP-GPS device has been used. The coordinates had been recorded in UTM coordinate system with WGS 1984 datum. The entire area is occupied by soil cover and is under intense cultivation. Most of the outcrops are obliterated and only few scattered outcrops/exposures are seen at places mostly in the western and central part of the block area. Lithological units, attitude of rock types and lithological contacts were mapped. Major litho units mapped in the area are Granitic/Granodiorite gneiss, Quartz vien, Metadolerites/Amphibolites, Mylonite and Laterite have been mapped ignoring minor variations. Attitude of structural features of rocks, foliation were recorded by brunton compass. Variation of lithologies aling with the structural elements were systematically recorded and the readings and sample locations recorded in the field were plotted and produced in the form of interpreted geological map on 1:2000 scale. However, due to size limitations in plotter the map produced on 1:4000 scale. **(Plate No. IV-A)**. The description of lithology has already been furnished in **Chapter No VII.**

10.2.7 Surface Sampling (Bedrock)

During the course of geological mapping, total 22 nos. of bedrock chip samples collected from different rock types i.e. Quartz vein, Amphibolites, Mylonite and Granite/Granodiorite gneiss to know the content of copper and associated minerals. Bedrock samples were analysed for Cu, Pb, Zn, Ni, Co, Te, Mo and Se contents. Litho units showing signatures of sulphides presence or suspected for sulphide potential with alternation features were sampled to confirm the existence of mineralization through geochemical abundance. The location of bedrock sampels were recorded with handheld BAP-GPS device plloted on the surface Geological map of the block area (**Plate No, IV-A**). The sampling technique has been described in detail in the Chapter-XII. The details of bed rock samples and analytical results are provided in **Annexure-I-A**. The location of bedrock samples along with Cu value shown on Geological map of Sitapur Block is given in **Plate-IV-A.**

10.2.8 Discussion on Bedrock Sample Results:

Out of 22 nos bedrock samples, 4 No.s samples shown >100 ppm Cu value and range between 118.17 ppm Cu (BR/20, Granodiorite gneiss) and 493.81 ppm Cu (BR/13, Quartz vein). Sample analysis of other elements Pb, Zn, Ni, Co, Te, Mo and Se were poor and not encouraging. Total 3 bedrock samples analysed shown poor values for Gold (<10 ppb Au.)

10.2.9 Soil Sampling

Since most of the area is conealed under soil cover, soil sampling work carried out to identify subsurface anomalies for basemeal mineralisation. A grid of 100m X 100m laid down to collect soil samples from north western, central part where quartz veins outcrops noticed in mostly soil covered area. Moreover, lateritic soil covered southern end of block area was also subjected to soil sampling. Soil samples were collected from the suitable sites avoiding cultivated lands. ENE–WSW trending shear zone bearing area identified by ground geophysical survey in the south-central part of the block area is entirely covered by paddy fields and no outcrops available. Hence, this area could not be covered by soil sampling. Efforts were made to collect soil samples at equal spacing across the area; however, due to limitations and cultivated lands, equal spacing could not be maintained at places. While sampling, due care was taken to avoid the collection of transported material such as alluvium or colluvium and emphasis has been given on collecting from residual soil profile. Total 47 nos. soil samples collected from B, C horizon. The location of soil sampels were recorded with handheld BAP-GPS device plloted on the Geochemical Anomaly map of the block area (**Plate No, IV-B**). The sampling technique has been described in detail in the Chapter-XII. The details of soil samples and analytical results are provided in **Annexure-I-B**.

10.2.10 **Discussion on Soil Sample Results:**

Based on soil sample analysis results, Geochemical anomaly map for Copper has been prepared by using inverse distance weightage method of Interpolation module of ArcGIS Pro software. Soil samples mainly distributed in the northwestern and central parts of the block, with fewer in the southern and eastern sides. Soil sample values range from 15.273 to 139.6 ppm Cu. Out of 47 soil samples, only 2 soil samples shown >100 ppm Cu value i.e. 111.2 ppm Cu and 139.6 ppm Cu and represent a prominent isolated geochemical anaomaly in the northwestern part of the Block. Isolated scattered anomaly (98.16 ppm Cu) is also noticed in the central part of the block. The Cu anomalies are weak, isolated and scattered nature showing no potential zone for basemetal mineralisation and lacking continuous geochemical trend. (**Plate No. IV-B).** Sample analysis of other elements Pb, Zn, Ni, Co, Te, Mo and Se were not encouraging.

10.2.11 **Trenching**

10.2.11.1 Based on surface geochemical sampling work results and occurrence of Quartz vein in western and central part of the Sitapur block was targetted for trenching work to trace the concelaed extensions of mineralised quartz veins if any. Trenching work carried out through hiring one JCB (hydraulic excavtor) to expose the soil covered/concealed lithology and litho contacts, in addition to expose the extension of the mineralized zones in the area. A total 09 trenches (T1 to T9) of cumulative 150 cum. (approx.) were made and total 101 samples collected from all trenches. All trenches were excavated in the western and central part of Sitapur block to expose the concealed extension of Quartz vein in the area. Trenches exposed weathered mantel/rock, Quartz vein, Ampbilbolite and Granite/Grnanodiorite gniess below the soil cover.

10.2.11.2 Trenches were mapped to understand the disposition of lithology and mineralisation. (Field Photo-10.1). Samples were collected by cutting channels from trench walls exposed within the trenches. Channel sampling was adopted to ascertain the variation of grade both along and across the channel. The contact zones and adjoining rocks exposed in trenches were also sampled at suitable locations to know the metal content. Altogether 101 nos. trench channel samples collected at 1.0m interval and analysed for copper and associated minerals from exposed quartz vein, amphibolites and granite/granodiorite gneiss from nine Trenches.

10.2.11.3 The location of trenches were recorded with handheld GPS device and plloted on the Geological map of the block area (**Plate-IV-A**). After examination and completion of sampling work all trenches were closed immediately and land reclaimed. The details of trenches are provided in **Table 10.2** and their locations are shown in **Plate No. IV-A.** Trench profiles are given in **Plate No.IV-C.**

Field Photo-10.1: Photograph showing Excavation of Trenches (T3, T5) and Trench mapping sampling work, Sitapur Block

10.2.12 Discussion on Trenching Results:

10.2.12.1 All trench samples processed to -200 mesh size and analysed at MECL laboratory for 8 element analysis by AAS method including Co, Ni, Cu, Zn, Se, Mo, Te and Pb. Out of 9 trenches exavated in the area, only 2 trenches (T3 & T5) shown copper values i.e. Trench T3 indicated one zone with 645.89 ppm Cu over 1.0m thickness in Granite/Granodiorite gneiss and Trench T5 indicated two zones with an average 385.275 ppm Cu over 2m thickness in Granite/Granodiorite gneiss and 157.728 ppm Cu over 4m thickness in Granite/Granodiorite gneiss and Amphibolite contact zones. No mineralised Quartz vein encountered in all trenches. Trenching work indicated poor values for Copper mineralisation and no concelaed extensions of Mineralised quartz vien traced. Other associated elements Pb, Zn, Ni, Co, Te, Mo and Se were poor and not encouraging. Details of chemical analysis of trench samples for Cu, Pb, Zn, Ni, Co, Te, Mo & Te are given in **Annexure No. I-B.**

Table-10.2 Details of Trenches excavated in Sitapur Block, Balaghat District, Madhya Pradesh

Sr.No.	Trench No.	Easting & Northing (From)	Easting & Northing (To)	RL (m)	Direction	Length (m)	Width (m)	Depth (m)	Vol. (cu.m.)	Samples (Nos.)	Lithology encountered	Remarks
1	T1	466087.5868, 2440937.1825	466094.4586, 2440928.5534		N38^{0}W, S38^{0}E	11	1	2	22	3	Soil, weathered rock	
2	T2	466152.7753, 2440972.9209	466159.1704, 2440963.973		S36^{0}E, N36^{0}W	11	1	2	22	10	Soil, Quarz vein	
3	T3	466196.7281, 2440985.0067	466204.7404, 2440974.749		N37^{0}W, S37^{0}E	13	1	2	26	3	Soil, weathered rock	MSCB/T3/02: **645.89 ppm Cu @ 1.0m**
4	T4	465773.4277, 2440836.9894	465776.3346, 2440832.9281		N35^{0}W, S35^{0}E	5	1	1.5	7.5	5	Soil, Granite/Granodiorite rock	
5	T5	465969.5179, 2441046.7653	465971.5819, 2441005.8441		S03^{0}E, N03^{0}W	41	1	1.5	61.5	33	Soil, Amphibolite (Epidote rich), Granite/Granodiorite rock	MSCB/T5/11 to 12: **Avg. 385.275 ppm Cu over 2m**, MSCB/TS/17 to 20: **157.728 ppm Cu over 4m**
6	T6	465764.2216, 2440791.3754	465773.6228, 2440779.7309		N39^{0}W, S39^{0}E	15	1	1	15	14	Soil, Quarz vein	
7	T7	465855.1872, 2440856.8177	465867.3651, 2440840.9261		S37^{0}E, N37^{0}W	20	1	1.3	26	20	Soil, Quarz vein	
8	T8	465942.6766, 2440908.2666	465946.3984, 2440903.5532		S38^{0}E, N38^{0}W	6	1	1.7	10.2	5	Soil, Quarz vein	
9	T9	465994.4321, 2440954.5547	466001.2408, 2440945.8767		S38^{0}E, N38^{0}W	11	1	1.5	16.5	8	Soil, Quarz vein, Amphibolite (Epidote rich	

10.2.13 Exploratory Drilling:

10.2.13.1 As per the approved quantum of G3 stage, total 8 boreholes approved at 200m spacing interval. However, as advised by the TCC committee, initially 4 test boreholes were targeted to test the geophysical anomalies at the specified locations (boreholes spaced appox. at 200m to 500m interval) to establish the basemetal mineralisation up to explored depth range of 50m to 90m vertical depth. Based on the outcome, remaining 4 boreholes to be drilled as infilling boreholes. The details of boreholes drilled during present exploration in Sitapur Block are summerised in below given **Table No. 10.3** and also given in **Annexure No. VI-A**.

Table-10.3
Details of present & previous Boreholes drilled by MECL in Sitapur Block, Malanjkhand Copper Belt, District Balaghat, Madhya Pradesh

Sl. No.	Section No	Borehole No.	Easting (m)	Northing (m)	Elevation (m)	Azimuth	Dip	Total Depth (m)
1	200	MSC-01	465739.023	2439908.562	576.993	320°	50°	110.10
2	600	MSC-02	466022.261	2440193.13	578.208	320°	50°	160.00
3	1300	MSC-03	466632.582	2440552.887	574.003	320°	50°	140.00
4	1100	MSC-04	466398.919	2440512.946	573.841	320°	50°	166.00
Total								**576.10**

10.2.13.2 During the present G3 stage exploration program, total 4 test boreholes involving total 576.10m exploratory drilling carried out as per the approved quantum to test the ground geophysical anomalies upto depth range from 50m to 90m vertical depth from surface as well as to confirm the strike and depth persistance of copper mineralisation.

10.2.13.3 Out of four test boreholes drilled, only one Borehole (MSC-01) intersected 2 nos. lean copper mineralized zones at 0.1% Cu cut-off value. Remaining boreholes did not intersect any copper bearing zones. Other associated elements i.e. Pb, Zn, Ni, Co, Te, Mo & Se were poor and not encouraging. In view of poor copper mineralisation intersected in the boreholes, further drilling has not taken up in the area.

10.2.14 Discussion on Drilling Results:

10.2.14.1 During the present exploration, a total of 200 nos. of primary core samples have been generated from 4 boreholes and subjected to analysis for Cu, Pb, Zn, Ni, Co, Te, Mo & Se analysis. Out of 200 Nos primary samples, only 2 samples collected from one Borehole (MSC-01) shown Cu values >0.1% Cu i.e. 0.16% Cu and 0.22% Cu over 0.50m thickness. Out of 200 nos primary samples, total 26 nos. borehole core samples indicated Cu values indicated >200ppm Cu and range from minimum 213.48 ppm to maximum 0.22% Cu. Sample analysis for other elements i.e. Pb, Zn, Ni, Co, Te, Mo & Se are not encouraging. Total 40 nos. of borehole core samples analysed for Au analysis by fire assay method indicated Au values range minimum from <10 ppb Au to maximum 92.76 ppb Au. Au values are no encouraging. Total 50 nos. borehole core samples subjected to 34 element analysis (Li, Be, B, Sc, V, Ga, Rb, Sr, Y, Zr, Nb, Mo, Sn, Cs, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, W, Th and U) by ICP-MS method. The total REE+Sc+Y content varies from minimum 62.11 ppm to 395.02 ppm. ICP-Ms analysis for REE and other elements are not encouraging. Borehole primary Sample analysis details of are given in **Annexure-VIII-A,** for Gold is given in **Annexure-VIII-B** and 34 element analysis by ICP-MS is given in **Annexure-VIII-C.**

10.2.14.2 Based on the analytical results of individual primary samples, copper mineralised zones intersected in the boreholes have been identified at 0.1% Cu cut-off. Only one Borehole (MSC-01) intersected 2 nos. copper mineralized zones with 0.165% Cu over 0.50m and 0.157% Cu over 1.0m thickness identified at 0.1% Cu cut-off. Mineralized Zone details at 0.10% Cu cut-ff is given in **Table No. 10.4** and also given in **Annexure-X.**

Table-10.4
Statement showing Mineralized zone intersections for Copper at 0.1% Cu cut-off in Sitapur Block, District- Balaghat, Madhya Pradesh

Sr. No	BH.No.	From (m)	To (m)	Length (m)	Cu	Pb	Zn	Co	Ni	Se	Mo	Te
					(PPM)							
1	MSC-01	39.50	40.00	0.50	**0.165%**	5.66	197.85	135.57	140.64	1.38	1.41	0.00
2		100.80	101.80	1.00	**0.157%**	5.63	133.16	47.33	51.21	0.35	5.67	0.00

10.2.15 Outcome of Present Work:

10.2.15.1 The present G3 stage exploration work in Sitapur Block included Phase-I work comprising of Detailed Geological mapping, surface sampling (Bedrock/Soil), Trenching work and Ground Geophysical survey. Surface sampling (Bedrock/soil) and trenching work not shown any encouraging values for basemetal mineralisation. Based on the outcome of Ground geophysical survey, the extension of N50^{0}E-S50^{0}W low magnetic intensity shear zone delineated in Sitapur block and total 4 nos. test boreholes were drilled to test these geophysical anomalies and confirm the mineralisation in vertical depth range of 50m to 90m from surface.

10.2.15.2 Based on analytical results of borehole core samples two lean copper mineralised zones identified in one Borehole MSC-01 at 0.1% Cu cut-off, with 0.165% Cu over 0.50 m and 0.157% Cu over 1.0 m. No copper mineralised zones were intersected in the remaining three boreholes. The lean intersections in Borehole MSC-01 suggest poor patchy and discontinuous mineralisation with no lateral continuity.

10.2.15.3 The poor intersections of copper mineralisation may be attributed to the overall low concentration of copper-bearing sulphides and the non-intersection of any significant mineralised quartz veins associated with shear zones within the explored depth range.

10.3.0 DATA SPACING FOR REPORTING OF EXPLORATION RESULTS

10.3.1 During present G-3 stage exploration, initially total 4 nos. test boreholes were drilled at specified locations (200m to 500m interval) to test the geophysical anomalies at depth range between 50m to 90m vertical depth from surface. Exploratory drilling has not intersected any significant copper mineralised zones in Sitapur block as per the minimum cut-off grade (0.2% Cu) and minimum stoping width (2.0 m true width) criteria required for resource estimation. Hence, resources not estimated in Sitapur Block.

10.4.0 PETROGRAPHIC STUDY

Petrographic study was carried out on 10 Nos. (6 Nos. Bedrock + 4 nos of borehole core samples) collected from different litho units exposed in the area as well as intersected in the drilled boreholes. The petrographic study results have been discussed along with the description of rock types in **Chapter-VII** and petrographic study report has been attached as **Annexure No-XI.**

10.5.0 MINERAGRAPHIC STUDY

Total 10 nos including bedrock and borehole core samples collected from mineralized zones intersected in the drilled boreholes and subjected to mineragraphic study by preparing polished section. Mineragraphic study results have been disucussed in **Chapter-VII** and mineragraphic study report has been attached as **Annexure No-XII.**

10.6.0 PREPARATION OF GEOLOGICAL REPORT:

Geological Report has been prepared in Corporate Office, MECL, Nagpur by integration of geological, geochemical and sub-surface drilling data. Geosoft Oasis Montaz, AutoCAD, ArcGIS & GDM softwares have been used for preparation of various maps. The report has been written using Microsoft word and excel 2021 version.

CHAPTER-XI

11.0.0 LOCATION OF DATA POINTS

11.1.0 ACCURACY AND QUALITY OF SURVEY TO LOCATE DRILL HOLES

11.1.1 The Sitapur Block area is located in and around Sitapur, Shitalpani and Karhoo Village, District Malajkhand, Madhya Pradesh. The survey area falls under Survey of India Toposheet No. 64B/12. The survey site is situated approximately 10 km from Malajkhand town, near Newargaon village, located in the southeastern corner of Madhya Pradesh, India. The nearest railway station is at Balaghat Town, approximately 75 km away. Sitapur Block bounded by latitude & Longitude as given below **Table No. 11.1:**

Table No.11.1: Sitapur Block cooridnates

SL NO.	*LAT/LONG*	*WGS-84 DATUM (DMS)*
1	*LATITUDE*	22°05’09.6” N to 22°03’26.00” N
2	*LONGITUDE*	80°41’12.48” E to 80°39’50.00” E

Area Details.

The Block area is **3.5** Sq. Km.

General.

All the topographical features and boreholes drilled in the Sitapur Block were surveyed for accurate positioning using DGPS (Differential Global Positioning System).

TECHNICAL SPECIFICATION OF DGPS

MAKE	TRIMBLE DGPS
MODEL	R8-S
YEAR	2018

a*) MEASUREMENT ACCURACY*:

- **Static Mode:**
  - Horizontal Accuracy: ±3 mm + 0.1 ppm (or better)
  - Vertical Accuracy: ±3.5 mm + 0.4 ppm (or better)

b) SOFTWARE & COMMUNICATION: Fully functional and Trimble business centre (TBC) software for post processing.

11.1.2 **DGPS Basestation Details:** The survey work has been carried out with the help of DGPS (Make-Trimble DGPS System, Model-R8s). A DGPS Base Station named S-1 was established on a fixed pillar near the road junction adjacent to the Bus Stand at Mohgaon, Newargaon village. The details of Base stations given below **Table No. 11.2**.

Table No. 11.2: The R.L & Coordinate of Base stations determined by DGPS instrument in WGS-84 Datum. (UTM Zone 45 North)

DGPS STATIONS COORDINATES IN WGS-84 DATUM						
	WGS-84 (DMS)		**WGS-84,UTM, ZONE – 45N**			
Station ID	**Latitude**	**Longitude**	**Northing (Meter)**	**Easting (Meter)**	**RL (Meter)**	**Feature Code**
S-1	N22°03'13.63086"	E80°40'44.63848"	2438815.195	466885.328	579.365	DGPS Base Station

11.1.3 The location of the major surface features such as Forest boundary, water bodies, Channels, Roads, Villages etc. have been recorded during the survey work. These features are illustrated on **Plate No. III** of the accompanying map set.

11.1.4 **Baseline Processing Results:**

Upon completion of the field survey, raw data from both the Base and Rover units were downloaded and processed using Trimble Business Centre v5.1 (TBC v5.1). Post processing included Baseline processing and Point list generation. The baseline processing results and point list summary are appended to this report for reference (**Annexure No.V**).

Topographical survey map with 2.0m contour interval depicting surface features like road, water bodies with channels villages etc. is given as **Plate-III.** Total 04 boreholes drilled by MECL during present exploration i.e. MSC-01 to MSC-04 have been fixed by DGPS survey instrument. Borehole locational co-ordinates & Reduced level (RL) of the borehole are given in **Annexure-VI** and also shown in **Plate-IV-A.**

11.2.0 QUALITY AND ADEQUACY OF TOPOGRAPHIC CONTROL

11.2.1 The survey work has been carried out with the help of DGPS (Make-Trimble GNSS/DGPS System, Model-R8s) for higher level measurement accuracy. In order to have control on survey work, one base station S-1 has been fixed. After competition of field survey work, raw data was downloaded from Base & Rover of DGPS Instrument and data has been processed through Trimble Business Centre software (TBC) for generating point list summary and Base line processing report. Survey work carried out by the experienced qualified surveyor as per the prevailing standard procedures.

CHAPTER-XII

12.0.0 SAMPLING TECHNIQUES AND SAMPLE PREPARATION

12.1.0 SAMPLING

12.1.1 Sampling inludes Surface bedrock sampling, soil sampling, Trench sampling and drill core sampling. All samples subjected to analysis for Cu, Pb, Zn, Ni, Co, Te, Mo & Se by AAS method. Selected samples analysed for Au by fire assay method and 34 element analysis by ICP-MS method.

12.2.0 NATURE, QUALITY AND APPROPRIATENESS OF SAMPLE PREPARATION TECHNIQUE

12.2.1 Sampling methodology adopted for bedrock, soil, trench and borehole core sample is different from each other. The detailed description of sampling techniques discussed in subsequent paragraphs.

12.2.2 **Sampling techniques:**

A. Bedrock Samples: A total of 22 nos. of bed rock samples (BRS) were collected systematically from varied litho units (quarz vein, metadolerite/amphibolites, granodiorite gneiss and mylonite rock) exposed in the study area. The Bedrock chip samples were collected by chipping exposed rock units in 1 m radius by sledge hammer (5kg) and chisel. During the sampling, surface was properly cleaned and each sample was collected in separate plastic bags. After collecting each sample, all the instruments were properly cleaned before proceeding for next sample collection to maintain quality and to avoid contamination. The sample locations are plotted on geological map (**Plate No-IV-A**). First, each Bedrock sample of around 2 kgs collected from the field was sent to MECL Sampling unit, Nagpur. All the crushed samples were mixed thoroughly and reduced the sample size to 500 gm by coning and quartering. This representative samples were powdered and completely passed through (-) 200 mesh size sieves from which 100 gm sample packed in polythene sample pouch at Sampling unit, and sent to MECL Chemical Laboratory, Nagpur for chemical analysis for Cu, Pb, Zn, Ni, Co, Te, Mo & Se by AAS method.

B. Soil Samples: Soil sampling work done by excavation of pit and samples generally collected from the rnriched zone of soil profile. Pits were dug manually with help of local labour having dimension of 1 m length 0.3-0.5m width and around 0.5-1.0m dept. Around 3-5 kg material was collected from B+C horizon from the pit. Thus, a total of 47 nos of soil samples were collected from northwestern, central, eastern and southern end sectors in Sitapur Block. All pit sample locations were recorded with handheld GPS device and their locations shown in Geochemical Anomaly map (soil) for copper as **Plate No. IV-B**. All the samples were passed through available (-)72 mesh sieve seperately to get uniform natural fraction of the sample and sent to MECL sampling unit, Nagpur for processing and analysis. The samples were pounded and passed through (-) 200 mesh sized sieve from which 500 gm sample was collected by coning and quartering. From the 500 gm sample, 100 gm sample packed in polythene sample pouch and submitted for chemical analysis for Cu, Pb, Zn, Ni, Co, Te, Mo & Se by AAS method. The remaining 400 gm sample has been preserved in another polythene pouch for future reference.

C. Trench Samples: Trench samples were collected from the walls of trench sections by cutting channels/groves. The channelling was done cutting across the strike direction of the zone by using proper hammer and chisel. The sampling zones were marked properly by measuring tape and white marking powder. Channel samples were mostly collected with an interval of 1m based on the type of mineralization/lithology and interval varies at some instances based on lithology. Chipped samples were collected along the channel cut and packed in polythene sample bags with proper labelling. While sampling, due care was taken to avoid contamination of samples. The trench locations are plotted on geological map (**Plate No-IV-C**). A total of 47 Nos. channel samples were collected from nine trenches (Trench-1 to 9) and processed -200 mesh size at MEC: sampling unit, Nagpur and sent to MECL Chemical Laboratory, Nagpur for chemical analysis for Cu, Pb, Zn, Ni, Co, Te, Mo & Se by AAS method.

D. Drill Core Samples: The sampling and analysis have been carried out for entire mineralized zones/length intersected in the boreholes drilled on visual basis. The primary samples have been marked in the mineralized zones intersected in the borehole based on type and concentration of mineralization /lithology and in general the sample length has been kept as 0.50 m which varied in some instances because of variation in lithology and type and concentration of mineralisation. The mineralized core has been split longitudinally into two equal halves in such a way that the concentrations of ore minerals are uniform in both the equal halves. One half of the core sample has been crushed to (–) 200 mesh size and another half kept in the core box for future reference. By progressive coning and quartering and repeatedly mixing the sample has been reduced to 600 grams. The representative sample completely passed through (-) 200 mesh size sieves from which 100 gm sample packed in polythene sample pouch at MECL Sampling unit, Nagpur and sent to MECL Chemical Laboratory, Nagpur for chemical analysis for Cu, Pb, Zn, Ni, Co, Te, Mo & Se by AAS method.

12.3.0 QUALITY CONTROL PROCEDURES ADOPTED DURING SAMPLING

12.3.1 The samples have been prepared under the supervision of geologist and qualified sampling technician. During the sampling, surface was properly cleaned and each sample was collected in separate plastic bags. After collecting each sample, all the instruments were properly cleaned before proceeding for next sample collection to maintain quality and to avoid contamination. After collecting the chip samples all samples properly packed in polythene samples bags with proper labelling.

12.3.2 Further measures have been taken during sieving and pounding/grinding of samples. The sieve and containers have been cleaned after processing of each sample to avoid contamination and measures have also been taken to avoid loss of powder in air. The prepared/processed samples sent to MECL chemical laboratory, Nagpur. All measures taken for packing and transportation of samples. It has been thoroughly checked that none of the sample bags were damaged during transportation.

12.4.0 MEASURES TAKEN TO ENSURE THAT THE SAMPLING IS REPRESENTATIVE OF THE IN-SITU MATERIAL COLLECTED.

12.4.1 It is very important to submit the representative sample of collected material for geochemical analyses. Bed rock, soil, trench samples and drill core samples quantity has been reduced by coning and quartering method after thoroughly mixing to maintain the homogeneity of the samples. All measures taken that samples remain representative in nature of in situ material collected.

12.5.0 APPROPRIATENESS OF GRAIN SIZE

12.5.1 In accordance with the standard sampling procedures, it has also been observed that smaller the particle size, higher the homogeneity of the sample as well as higher the dissolvability during the chemical analysis. As per the standard practice adopted for basemetal mineralisation in Malanjkhand Copper belt, Bedrock, soil, trench and drill core samples are generally pounded to (-) 200 mesh size for analysis of Copper and associated minerals.

CHAPTER-XIII

13.0.0 DRILLING TECHNIQUE AND DRILL SAMPLING EMPLOYED

13.1.0 DRILLING TYPES AND DETAILS

13.1.1 During the present investigation, MECL drilled total 17 no of boreholes involving total 2200m diamond core drilling along with associated borehole deviation survey and borehole core logging, sampling and laboratory studies in the block area. The details of boreholes drilled by MECL are given in **Annexure-IV-A** and summary of borehole is given in **Table-10.3**. of **Chapter-X.**

13.1.2 Drilling operation was carried out by deploying one conventional wire line drill rig RD-100 (MEC-363) in Sitapur Block. Rotary wash type of wireline drilling method was undertaken. Diamond impregnated NQ bit (outer diameter 75.7 mm and inner diameter 47.6 mm) had been used during drilling operation. At the starting few meters, all the boreholes have been used with HX and NX casing to cover soil cover and loose friable weathered formation. All the precautions had been taken to maintain quality of drilling and achieve maximum core recovery. The core recovery varies from minimum 92.04% and maximum 97.77% with an average core recovery is about 94.56%. The average core recovery in the mineralized zones is about 96% which is satisfactory. The quality of drilling was ensured during the operation. After closure, all the boreholes have been properly plugged and sealed.

13.1.3 All the inclined boreholes drilled by MECL in Sitapur block have been surveyed to ascertain deviation in azimuth and in the borehole path, if any, with the help of multi shot deviation camera (**Photo-13.1**). The specifications of the deviation survey instrument are given in **Table-13.1.**

Table-13.1
The specifications of the Deviation Survey Instrument

1	Name of instrument	Borehole deviation survey instrument
2	Name of manufacturer (model and make)	Eastman Company Private Ltd (Germany)
3	Parameters	Inclination and azimuth angle
4	Inclination range	0 to 90 degrees
5	Azimuth range	0 to 360 degrees from north
6	Inclination resolution	NA
7	Azimuth resolution	NA

13.1.4 The boreholes have been washed properly after closing and before pull down the deviation camera and after that drill strings have been pulled out from the borehole.

13.1.5 Deviation survey instrument is based on the concept of continuous recording of azimuth and inclination when it is lowered into the borehole. After assembling the deviation survey instrument, it is lowered into the borehole so that its top coincides with the ground level. The instrument is lowered to desired depth i.e., 6.00m interval and keep it stationary for half a minute in order to record stabilized readings required. Several readings have been obtained in this way at regular depth interval i.e., 6.00m till the closure depth of the bore hole. Once the survey instrument reaches the closure depth, it is pulled out of borehole and transfer the recording in a system.

13.1.6 The initial readings are generally erratic due to magnetism on account of casing lowered in the borehole and hence not considered for deviation data plotting. The borehole deviation data is plotted on the geological cross section with the help of GDM software. The borehole wise deviation data obtained/determined is presented as **Annexure-IV-B.**

Photo-13.1: Borehole deviation survey instrument

13.2.0 WHETHER CORE AND CHIP SAMPLE RECOVERIES HAVE BEEN PROPERLY RECORDED AND RESULTS ASSAYED

13.2.1 The core samples have been recorded properly and the details run wise litholog and summarized litholog for boreholes drilled by MECL are given in **Annexure- VII- A** and **Annexure- VII- B** respectively. The logging of run wise core as well as the cuttings from boreholes have helped in discerning the physical characters like colour, shape, size and nature of mineralisation as well as texture, structural features of different litho units.

13.2.2 The mineralised zones/length recorded during the geological core logging has been subjected for sampling and analyses for copper (Cu) and associated elements. The primary sample had been marked in the mineralized zones intersected in the borehole based on ore type and concentration of mineralisation/lithology. In general, the sample length has been kept mostly at 0.50 m interval which varied in some instances because of variation in lithology and type and concentration of mineralisation. The details of analysis of primary borehole core samples for Cu, Pb, Zn, Ni, Co, Te, Mo & Se are given in **Annexure-VIII-A.**

13.3.0 MEASURES TAKEN TO MAXIMIZE SAMPLE RECOVERY AND ENSURE REPRESENTATIVE NATURE OF THE SAMPLES.

13.3.1 The short runs were drilled as per necessity so that optimum core recovery is maintained. The core recovery in the mineralized zones is about 96% which is satisfactory. Whenever core recovery is less, the grade of the recovered portion has been extrapolated over the non-recovered section. The quality of drilling was ensured during the operation.

13.4.0 WHETHER THE RELATIONSHIP EXISTS BETWEEN SAMPLE RECOVERY AND GRADE

13.4.1 The core recovery in the mineralized zones is about 96% approximately which is satisfactory. The entire mineralized zones / length recorded during the geological logging on visual basis have been analysed for copper (Cu) and associated elements and the copper ore zones identified at 0.10% cut-off grade. As the recovery in mineralized zones is consistently high, it is unlikely to have any significant impact on the grade estimation.

13.5.0 CORE LOGGING

13.5.1 The drilled core recovered from the boreholes has been logged systematically to demarcate various litho-units. The core recovery from the drilled boreholes varies from minimum 92.04% and maximum 97.77% with an average core recovery percentage of all the boreholes is about 94.56%. The logging of run wise core as well as the cuttings from boreholes have helped in discerning the physical characters like colour, shape, size and nature of copper mineralisation as well as texture, structural features such as joints, fractures, foliations etc. and their attitude with respect to core axis and identification of different litho units. Besides, the qualitative analytical data have helped in delineating the ore and non-ore litho units.

13.5.2 The borehole logging was carried out run-wise for boreholes drilled by MECL. Since the variation of litho units in schistose rock in down-hole direction and run lengths were short, thus consolidated / summarized litholog for all the boreholes were prepared with all details to show the litho units as graphic representation. The grouping of litho units intersected in the boreholes was done as Top Soil, Weathered/Fractured rock, Metadolerite, Granodiorite gneiss, Hornblende Quartz /Chlorite schist. Detailed borehole core logging is given as **Annexure-VII-A** and summerised borehole logs given as **Annexure-VII-B** respectively. Geological cross sections along 4 borehole profile lines 200-200', 600-600', 1100-1100' and 1300-1300' drawn and sections for drilled boreholes prepared and given as **Plate No. V.**

13.6.0 BOREHOLE GEOPHYSICAL LOGGING

13.6.1 Introduction:

Borehole geophysical logging has been carried out as a part of basemetal exploration program during present exploration in Sitapur Block. The borehole geophysical logging technique is primarily based on measurements of a series of petro-physical parameters made within a borehole and displayed for study on a continuous depth synchronized chart. The measurements made for variation in physical properties of the formation.

13.6.2 OBJECTIVES:

The main objective of borehole geophysical logging in base metal exploration was to delineate the minaralised zones along with their depths and thicknesses encountered in the boreholes. The parameters recorded are variations in magnetic susceptibility, resistivity, chargeability, conductivity, self potential, density, borehole diameter (caliper) and spectral gamma.

13.6.3 QUANTUM OF WORK:

The multi parametric borehole geophysical logging was undertaken during present investigation by MECL in Sitapur Block. Total 573 m. of Borehole Geophysical logging was carried out in 4 boreholes for magnetic susceptibility, resistivity, chargeability, conductivity, self potential, density, borehole diameter (caliper) and spectral gamma. Statement showing the details of borehole geophysical logging carried out by MECL is given below given in **Table 13.2.**

Table No. 13.2
Details of Geophysical Logging Parameters of boreholes drilled by MECL in Sitapur Block, Balaghat District, Madhya Pradesh

S.no	Date of logging	Bore hole No	Drill Depth	Log Depth	RS	SP	IP	SG	BD	CL	MS
1	13.02.2025	MSC-01	110.00	109.00	Y	Y	Y	Y	Y	Y	Y
2	25.03.2025	MSC-02	160.00	159.00	Y	Y	Y	Y	Y	Y	Y
3	26.04.2025	MSC-03	140.00	139.00	N	N	Y	Y	Y	Y	Y
4	30.05.2025	MSC-04	166.00	166.00	Y	Y	Y	Y	Y	Y	Y
				573.00							

NOTE: **RS-** Short Normal Resistivity, **SP-** Self Potential Suceptability **IP-** Induced Polarisation/ Chargeability, **SG-** Spectral Gamma, **BD**- Bulk Density, **CL**- Caliper, **MS** – Magnetic susceptibility

13.6.4 LOG DATA ACQUISITION

13.6.4.1 The borehole geophysical logging by MECL has been carried out using RG (Robertson Geologger) Logger in 04 boreholes in the block. The recording system of Robertson Geologger (R.G.) unit is digital and a printer is attached with a high speed integral thermal plotter. RG-Win logger software is installed in the system for data acquisition, calibration of the tools and replay of logs.

13.6.4.2 The probes used are i) ELTG (Electrical, Temperature, Gamma Probe, (ii) INPS (Induced Polarisation) Probe (iii) SGAM (Spectral Gamma) Probe and Dual Inducation Sonde, Dual density and Magnetic susceptibility probe.

13.6.4.3 For recording geophysical logs, each probe is lowered carefully into the borehole and the data recorded while hoisting the probe. Uniform speed of 6 m per minute or less maintained for recording depending on the requirement of specific probe/sonde and vertical scale of 1:200 was maintained for replay/ print of geophysical logs.

13.6.5 DATA PROCESSING AND INTERPRETATION

13.6.5.1 Well CAD software is used for processing the log data. A composite record of logs was prepared during processing stage. Different litho-units have different characteristic log responses and by combining the same it could be possible to categorize the litho-units as encountered in the boreholes.

13.6.5.2 The identification of lithology from the geophysical logs is based on the response of physical properties i.e., natural radioactivity (spectral gamma), electrical resistivity, magnetic sucesptibility, conductivity, density, self potential and chargeability (IP) of various formations.

13.6.6 DISCUSSION OF RESULTS

13.6.6.1 The multi parameter log responses of each borehole have been studied and interpreted separately for identification of litho units and sulphide mineralized zones along with their depths and thickness. The borehole geophysical logs show that the disseminated, low-grade sulphides produce only weak to moderate IP responses with minor SP variations indicating sparse chalcopyrite/pyrite/pyrrhotite. These zones are marked by slightly lower resistivity due to sulphide-related conductivity and alteration, while magnetic susceptibility remains low to variable, reflecting shear or altered zones with little magnetite content. Bulk density values are uniform without any sharp increases, ruling out massive sulphide bodies, and spectral gamma readings show no radioelement enrichment. Overall, the geophysical responses confirm poor, dessiminated nature of sulphide mineralisation of limited continuity at shallow levels.

13.6.6.2 The borehole geophysical logs for four boreholes are presented in **PlateVI.**

13.6.7 CONCLUSION

Borehole geophysical logging delineated sparse sulphide zones, along with their depths and thicknesses, thereby adding detail to the dataset and enhancing the information obtained from drilling. Overall, geophysical log responses indicated poor concentration of copper bearing sulphides in the drilled boreholes.

CHAPTER-XIV

14.0.0 SUB-SAMPLING TECHNIQUES AND SAMPLE PREPARATION

14.1.0 WHETHER CUT OR DRAWN AND WHETHER QUARTER, HALF OR ALL CORE TAKEN

14.1.1 The details of sampling procedure described in previous Chapters No. X & XII. During the sample preparation the borehole core sample has been split longitudinally into two equal halves with the help of hydraulic core splitter. One half has been preserved and the other has been crushed for the preparation of primary samples at -200 mesh size. Sample has been homogenized by proper mixing and coning quartering as per the standard sampling procedure.

14.2.0 NATURE, QUALITY AND APPROPRIATENESS OF THE SAMPLE PREPARATION TECHNIQUE

14.2.1 The details of sampling procedure and techniques for bedrock, soil, trench and borehole core primary samples described in previous chapters No. X & XII.

14.3.0 QUALITY CONTROL PROCEDURES ADOPTED

14.3.1 Standard sampling procedure under the supervision of qualified sampling technician has been adopted and the samples have been prepared at MECL sampling unit, Nagpur. Prepared samples were anlaysed at MECL chemical laboratory, Nagpur as per the standard sample analysis procedures and protocols. Samples were analysed for Cu, Pb, Zn, Ni, Co, Te, Mo & Se by AAS method, Gold analysis by fire assay method and 34 element analysis by ICP-MS method. All qualtity control procedures adopted while sample preparation and analysis as per the standard operationg procedures. To check the sampling and analytical bias if any, a total 17 nos. of Bedrock, Trench samples and 20 nos. of Borehole core samples (10% of primary samples) have been analysed in external JNARDDC Laboratory, Nagpur for analysis of Cu, Pb, Zn, Ni, Co, Te, Mo & Se and found no major differences between two laboratories.

14.4.0 MEASURES TAKEN TO ENSURE THAT THE SAMPLING IS REPRESENTATIVE OF THE IN-SITU MATERIAL COLLECTED

14.4.1 All the primary samples have been marked and prepared from copper mineralised cores. During the preparation of primary samples, the mineralised cores have been studied meticulously and samples have been marked properly. These mineralised cores are subjected for preparation of primary samples as per the sampling procedure for primary samples are described in Chapter X & XII. The proper marking of primary samples from drilled cores and following standard procedure for primary sample preparation shows the representative samples have been collected from the in-situ materials.

14.5.0 WHETHER SAMPLE SIZES ARE APPROPRIATE TO THE GRAIN

14.5.1 The primary samples have been prepared (–) 200 mesh size and all the other samples have been prepared from primary samples. As per the previous studies in and surroung the area, the (–) 200 mesh size is appropriate for the liberation of mineral grains and analysis for copper (Cu) and associated elements in the block area.

CHAPTER-XV

15.0.0 QUALITY OF ASSAY DATA AND LABORATORY TESTS

15.1.0 THE NATURE, QUALITY AND APPROPRIATENESS OF THE ASSAYING AND LABORATORY PROCEDURES

The chemical analysis of primary samples for copper (Cu) and associated elements (Pb, Zn, Ni, Co, Te, Mo and Se) has been carried out in Chemical Laboratory of MECL. The analysis has been carried out by Atomic Absorption Spectroscopy (AAS) method by Analytical Jena ZEEnit model instrument. The Standard Operating Procedure (SOP) for the Determination of Copper (Cu) and associated elements using AAS is given below.

15.1.1 Analysis of Copper by AAS method.

Reagents and Standards

- Aqua Regia – 50-60 ml (Prepared using AR Grade Acids)
- Stock standards for copper – 1 ml of solution = 1 mg of copper (1000 ppm).

Procedure

1. Weigh 0.3 – 1.0 gm of the sample in a 250 ml beaker and add 50-60 ml aqua regia.
2. Cover the beaker with watch glass, and digest on hot plate for 5-6 hrs till syrup like solution is formed.
3. After digestion, add 10-20 ml water and heat for 5-10 minutes and filter by Whatman grade – 40 filter paper, in 250 ml volumetric flask.
4. Wash the residue with hot distilled water for four to five times.
5. Add the washings to the filtrate and makeup the volume up to 250ml.
6. Aspirate the sample solution in AAS using Air-Acetylene flame mode with following settings-
   (AAS to be calibrated before testing samples with at least 10 calibration points)
   - Wavelength - 324.7 nm,
   - Slit width - 0.5 nm,
   - Lamp current - 4.0 mA

- Instrument mode - Absorbance

7. Read the absorbance and concentration on atomic absorption spectrophotometer (Analytical Jena ZEEnit model).
(Run CRM and repeat samples after every 20 samples)

Calculation

$$\text{copper in \%} = \frac{\text{Cu ppm reading x volume (ml) x 100 x Dilution factor}}{\text{1000000 x weight of sample (gm)}}$$

15.1.2 Analysis of Gold (Au) by fire assay method.

Samples are prepared as weighted 50 fusion pots in a batch. Prior to using fusion pots for weighing a visual inspection inside the fusion pot is performed. The sample is weighed 50g in a fusion crucible containing flux of Lead monoxide, sodium carbonate, borax, silica, silver nitrate fused in a preheated fusion furnace 1050^{0}C for 45 minutes and the molten melt is poured into a cast iron mold. The lead botton is separated from the slag and oxidized in a cupellation furnase keeping in a cupel for one hour. The obtained Prill is cooled and digested in aqua regia and aspirated in Atomic Absorption Spectrometer for ppm levels.

15.1.3 Methodology of Chemical Analyses by ICP-MS

Chemical Laboratory, MECL, Nagpur is having Agilent make ICPMS 7800 model for elemental analyses. ICP-MS (inductively coupled plasma-mass-spectrometry) is a technique to determine low-concentrations (ppb = parts per billion = µg/l) and ultra-low-concentrations of elements (ppt = parts per trillion = ng/l). ICP-MS can also measure elements at concentrations up to 100s or even 1000s of parts per million (ppm). Accuracy and precision (standard deviation) for 34 of these elements is either excellent (<5%) or good (5–10%).

15.1.4 SOP for 34 Element Analysis by ICP-MS Procedure:

1. **Acid Digestion Method**

a) **Weigh and Add Acids:** Place ~0.1–0.5 g of powdered sample in a PTFE vessel. Add ~3 mL concentrated HF + 1-2 mL concentrated $HClO_4$. Cover loosely with a PTFE lid or watch glass.

b) **Heat to Dryness:** Gently heat at 150–200 °C under the hood. The acid will react, dissolving most matrix; white fumes indicate silica removal. Continue heating until nearly dry (residual melt).

c) **Evaporate to Near Dryness:** Carefully evaporate to a small volume, then add ~1–2 mL concentrated HNO_3 and heat again to remove HF residues. If fuming ceases, add fresh $HClO_4$ (0.5–1 mL) and repeat to ensure all organics are oxidized.

d) **Re-dissolve:** Cool the vessel and add ~2 mL concentrated HCl or aqua regia (HCl : HNO_3 3:1) to re-dissolve any residue. Then dilute with 5–10 mL 2% HNO_3, transfer to a 50–100 mL volumetric flask, and dilute to volume with ultrapure/Millipore water.

2. ICP-MS Calibration and Tuning

Inductively Coupled Plasma Mass Spectrometer (ICP-MS) instruments must be warmed up and tuned before each run. Start the plasma and allow ~30 min stabilization. Use a commercial tune solution to adjust torch position, nebulizer gas flow, sample depth, lens voltages, and RF power. Optimize for high count rates and low oxide formation.

a. Calibration: Prepare multi-element calibration standards covering the expected concentration range (e.g. 0.1–100 µg/L). Include a calibration blank and at least 4 non-zero. It is common to match the acid matrix of standards to samples (e.g. 2% HNO_3 + a few % HCL).

b. Sample Introduction and Data Acquisition

Introduce samples via an auto sampler and nebulizer (typically concentric or cyclonic) into the plasma.

c. Target Elements (34-Element Suite)

The 34-element geochemical ICP-MS suite typically includes major, minor and traces metals plus all rare earths. Report elemental concentrations in appropriate units (e.g. ppm or mg/kg) on a dried sample basis.

3. Quality Control (CRMs, Blanks, Duplicates)

a) **CRM:** Digest and analyze at least one certified reference material (geochemical standard of similar matrix) as an unknown. Recoveries should be within ~10% of certified values.

b) **Blanks:** Process method blanks (all reagents, no sample) through digestion and analysis to detect contamination. Instrument blanks (2% HNO_3) should also be run.

c) **Duplicates/Replicates:** Include sample duplicates or matrix spike duplicates to assess precision. Relative percent difference (RPD) between duplicates should typically be <10–20%.

d) **Calibration Checks:** Run a second source standard or CCV to check calibration drift. Internal standard signals should remain within ~80–120% of initial intensities.

15.2.0 NATURE OF QUALITY CONTROL PROCEDURES ADOPTED

15.2.1 The standard procedure of quality control has been adopted during the chemical analysis in Chemical laboratory, MECL, Nagpur which includes

(i) Analysis of Certified reference materials/measurement standards
(ii) Analysis of blind samples
(iii) Use of QC samples and control charts
(iv) Analysis of blank samples
(v) Analysis of spiked samples
(vi) Analysis in duplicate samples

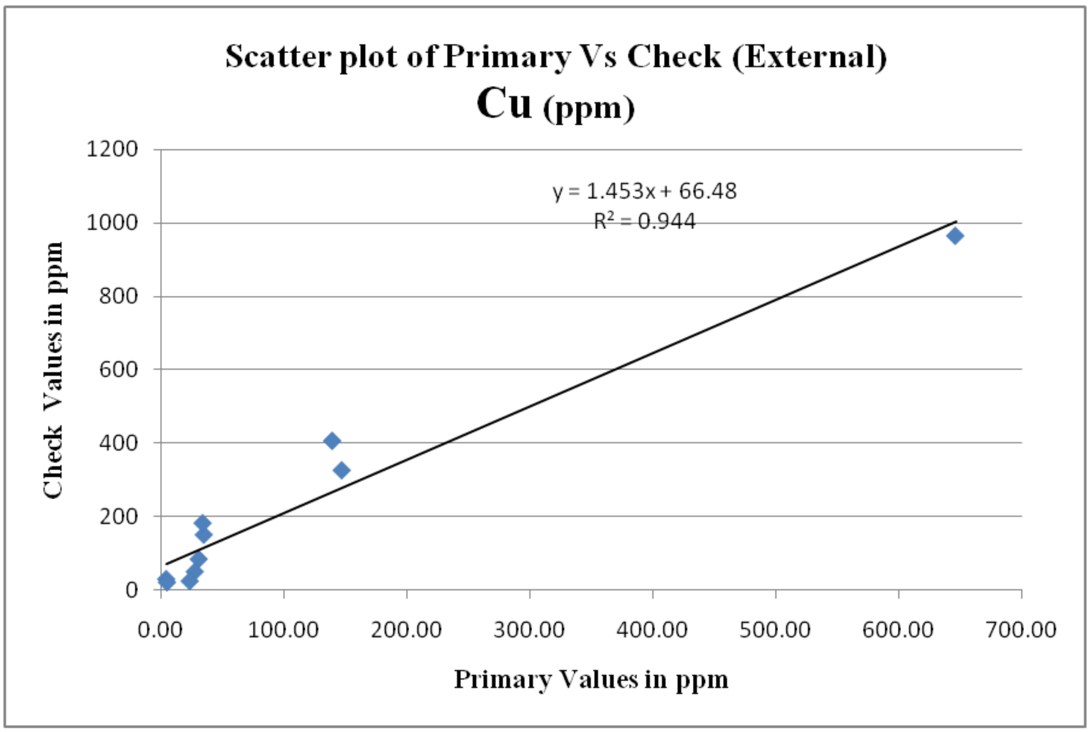
15.3.0 CHECK ANALYSIS FROM THIRD PARTY NABL ACCREDITED LABORATORY

15.3.1 In accordance to the standard practice of quality assurance and quality control, total 17 nos. external check samples from bedrock, soil and trench samples and 20 nos. borehole core samples (10% of primary sample) have been analysed as external check samples for Cu, Pb, Zn, Ni, Co, Te, Mo & Se in external laboratory i.e. M/s JNARDDC Laboratory, Nagpur. In order to assess the reliability of homogeneity of primary samples and repeatability of their chemical analysis with primary samples results of MECL laboratory. External check sample results of M/s JNARDDC Laboratory have been compared with primary sample results for Cu, Pb, Zn, Ni, Co, Te, Mo & Se and found no major or significant difference between the results. The details of Primary and External Check samples for bedrock, soil and trench are given in **Annexure-IV** and borehole core samples are given in the **Annexure-IX-A.**

15.3.2 The comparative studies of primary Vs External check analysis of bedrock samples for Copper (Cu) is given in **Table-15.1**, and scatter plots is represented as **Text Figure- 13**.

Table-15.1: Comparison of Primary Bedrock Sample vs External Check Samples for Copper

SL. NO.	Comparision Index	Primary Analysis for Cu (ppm)	External Check Analysis for Cu (ppm)
1	No. of Samples	10	
2	Arithmetic Mean	109.102	225.082
3	Standard Deviation	185.398	277.299
4	Standard Error of Mean	58.628	87.69
5	Variance	34372.534	76894.584
6	Mean of Deviation	-115.98	
7	Correlation coefficient	0.971	
8	Paired T value	-3.445	
9	F test value	0.447	



Text Figure-13: Scatter Plot of Primary Vs Check (External) Analysis of Cu

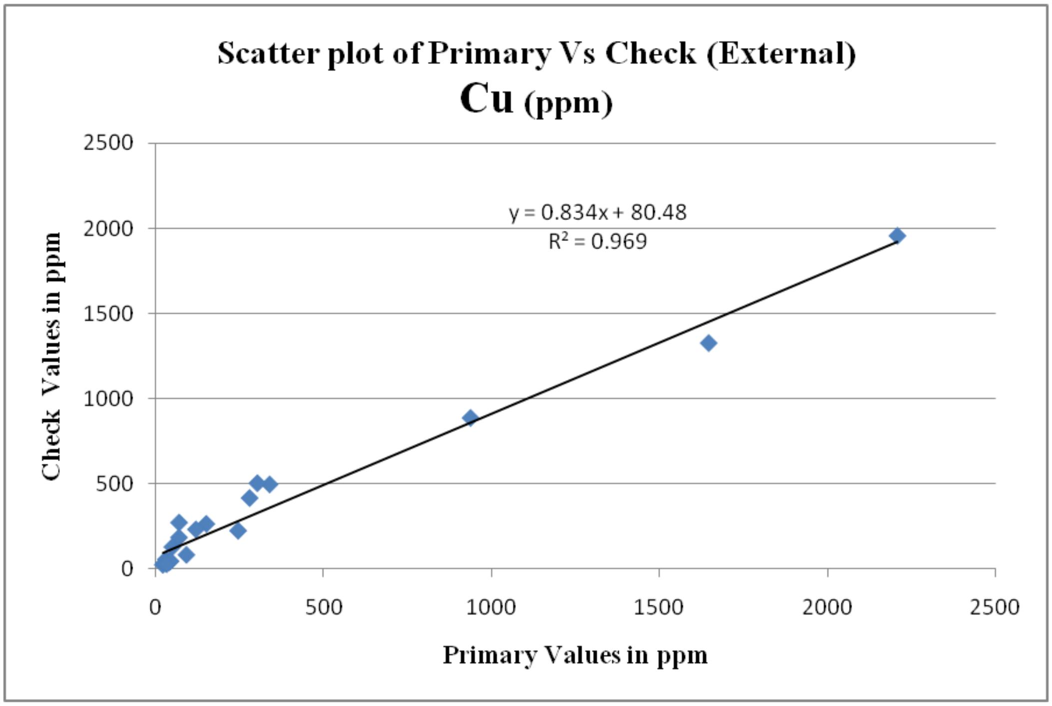
15.3.3 The data set for primary Vs External check analysis comprises 10 pairs of bedrock samples. **Table-15.1** shows that the difference in arithmetic mean, standard deviation, of primary and exterrnal check samples are not high. The value of R^2 given in scatter plot (Text Figure – 13) is 0.944, which is close to 1.00 and indicates a good correlation in primary and external check analysis.

15.3.4 The statistical and comparative studies for primary Vs external check samples shows the repeatability of the analysis for Cu i.e. insignificant differences between primary and exterrnal check analysis, which support the reliability of sampling procedure.

15.3.5 The comparative studies of primary Vs External check analysis of borehole core samples for Copper (Cu) is given in **Table-15.2** and scatter plots is represented as **Text Figure- 14.**

Table-15.2: Comparison of Primary Borehole Sample vs External Check Samples for Copper

SL. NO.	Comparision Index	Primary Analysis for Cu (ppm)	External Check Analysis for Cu (ppm)
1	No. of Samples	20	
2	Arithmetic Mean	337.087	361.839
3	Standard Deviation	574.548	487.058
4	Standard Error of Mean	128.473	108.91
5	Variance	330104.964	237225.859
6	Mean of Deviation	-24.752	
7	Correlation coefficient	0.984	
8	Paired T value	-0.868	
9	F test value	1.392	



Text Figure-14: Scatter Plot of Primary Vs Check (External) Analysis of Cu

15.3.6 The data set for primary Vs External check analysis comprises 20 pairs of borehole core samples. **Table-15.2** shows that the difference in arithmetic mean, standard deviation, of primary and exterrnal check samples are not high. The value of R^2 given in scatter plot (Text Figure – 14) is 0.969, which is close to 1.00 and indicates a good correlation in primary and external check analysis.

15.3.7 The statistical and comparative studies for primary Vs external check samples shows the repeatability of the analysis for Cu i.e. insignificant differences between primary and exterrnal check analysis, which support the reliability of sampling procedure.

15.4.0 SECURITY AND CHAIN OF CONTROL OF SAMPLES SHOULD BE CLEARLY MENTIONED

15.4.1 The samples collected from the field were packed in polythene bags with proper labeling and tagging, and sent to the MECL Laboratory, Nagpur, for sample preparation and analysis. At the sampling unit, standard procedures were followed, and all precautionary measures were taken to avoid contamination. All samples were prepared under the supervision of a qualified sampling technician in coordination with the geologist. The prepared samples were then sent to the MECL Chemical Laboratory, Nagpur, for analysis, with the sampling bags properly sealed and verified at the Chemical Laboratory. The remaining half-split core samples have been preserved with sample tags for any future reference, under the custody of the company.

CHAPTER-XVI

16.0.0 MOISTURE

16.1.0 METHOD OF DETERMINIATIONOF MOISTURE CONTENT

16.1.0 Mositure content not determined.

CHAPTER-XVII

17.0.0 BULK DENSITY

17.1.0 METHOD OF DETERMINIATION AND RESULT

17.1.0 Bulk density/Specific gravity studies have not been carried out during present exploration as there is no scope of approved quantum of work.

CHAPTER-XVIII

18.0.0 BENEFICIATION STUDIES AS MAY BE REQUIRED

18.1.0 DETAILS OF BENEFICIATION STUDIES

18.1.0 Beneficiation studies have not been carried out during the present exploration as there is no scope of the approved quantum of work.

CHAPTER-XIX

19.0.0 RESOURCE ESTIMATION TECHNIQUES

19.1.0 The present exploratory test drilling has not intersected any significant copper mineralized zones as per the minimum cut-off grade and thickness criteria (i.e., >0.2% Cu cut-off and 2.0 m minimum stoping width as true width) required for resource estimation. Hence, resource estimation has not been undertaken for the Sitapur Block.

CHAPTER-XX

20.0.0 REPORTING OF RESOURCES

20.1.1 Resources not estimated in Sitapur Block.

CHAPTER-XXI

21.0.0 SUMMARY AND RECOMMENDATIONS

21.1.0 DISCUSSION ON THE OUTCOME OF THE EXPLORATION WORK DETAILING THE NATURE OF THE DEPOSIT

21.1.1 Sitapur Block, covering 3.5 sq.km., forms part of the Malanjkhand Granitoids within the Malanjkhand Copper Belt. It lies about 5 km northwest of the presently operating Malanjkhand Copper Mines of Hindustan Copper Limited (HCL) in Balaghat District, Madhya Pradesh, and falls within Toposheet No. 64 B/12.

21.1.2 During 2001–03, MECL carried out integrated geological, geophysical, geochemical, and drilling investigations in the adjoining Shitalpani Block (2 sq.km.). The geophysical surveys revealed an 800 m long ENE–WSW trending shear zone marked by negative self-potential, high chargeability, and low resistivity, which indicated possible sulphide mineralisation. Geochemical results supported these anomalies. Exploratory drilling of 9 boreholes (1544.85 m) confirmed copper mineralisation over a 600 m strike length at 0.2% Cu grade. On this basis, 0.36 million tonnes of reconnaissance resources averaging 0.37% Cu (at 0.2% cut-off) were estimated under UNFC 334 category. MECL recommended further exploration eastwards, near Sitapur, as the low magnetic intensity shear zone extended beyond Shitalpani and offered mineralisation potential in Sitapur Block.

21.1.3 Recently, the Shitalpani Block for copper was successfully auctioned by the State Government of Madhya Pradesh under a composite licence in the 11th tranche held on 13th September 2023.

21.1.4 The shear zone identified in Shitalpani is seen to continue into the adjoining Sitapur Block, indicating structural continuity and suggesting similar copper mineralisation potential. Based on this continuity, a G3 stage exploration programme was initiated under NMET funding to test the strike and depth extension of the mineralised zone associated with shear zone and assess the mineralisation potential in Sitapur block.

21.1.5 The Preliminary Exploration (G3 stage) project for copper and associated minerals in Sitapur Block was recommended by the 57th Technical Cum Cost Committee (TCC) of NMET during its meeting on 26th–27th September 2023. It was subsequently approved by the 32nd Executive Committee (EC) of NMET on 6th December 2023, with approval formally communicated to MECL through MoM letter F.NO.23/397/2023-NMET/367 dated 12th December 2023.

21.1.6 The Phase-I work under the G3 exploration programme at Sitapur Block included detailed geological mapping and topographical survey of the 3.5 sq.km. area at 1:2000 scale. Surface sampling included collection of 22 bedrock samples and 47 soil samples. A trenching programme involving 150 cu.m. was completed with 101 trench samples collected. Geophysical surveys (IP, Resistivity, SP and Magnetic methods) were carried out over 30 Lkm of survey lines. This was followed by exploratory drilling of 576.10 m in 4 boreholes, along with borehole deviation surveys, borehole geophysical logging, and associated laboratory studies including chemical analysis, petrography (10 samples), and mineragraphy (10 samples) studies.

21.1.7 Sitapur Block is mainly underlain by Malanjkhand granitoids consisting of granitic to granodioritic gneissic rocks. These rocks are intruded by quartz veins and metadolerite dykes along shears, joints, and fractures. The area is largely soil-covered, though scattered exposures occur in some parts. Granodiorite gneiss, metadolerite/amphibolite dykes, and quartz veins are exposed in the northwestern, central, and eastern sectors, while laterite occurs in the south and mylonite outcrops in the extreme north.

21.1.8 Most of Sitapur Block is concealed beneath soil and under intensive cultivation, primarily paddy fields, with only sparse outcrops. No mineralised quartz veins were observed at surface. Surface indications of mineralisation present if any not observed due to soil cover and cultivated lands. However, alteration features such as ferruginisation, goethitisation, and limonite staining, with rare occurrences of sulphides, were noted in quartz veins, amphibolites, and granodiorite gneiss. In the drilled boreholes, mineralised Vein quartz associated with shear zone has not intersected in all drilled 4 boreholes. To some extent, lean copper mineralization has been noticed in metadolerties and moderaly sheared granodiorite gneiss in one Borehole (MSC-01). Overall, base metal mineralisation appears weak in the block.

21.1.9 From 22 bedrock samples collected, 4 samples indicated copper values greater than 100 ppm, ranging between 118 ppm (granodiorite gneiss) and 494 ppm (quartz vein). Analyses for other elements including Pb, Zn, Ni, Co, Te, Mo, and Se yielded poor results. Three samples analysed for gold by fire assay gave low values (<10 ppb Au).

21.1.10 Soil sampling (47 samples) was conducted across different sectors of the block. Copper values ranged from 15 ppm to 140 ppm, with only 2 samples exceeding 100 ppm (111 and 140 ppm), both from the northwestern sector. An isolated anomaly of 98 ppm was found in the central sector. The anomalies were weak, isolated, and scattered, lacking any continuity or geochemical trend. Results for Pb, Zn, Ni, Co, Te, Mo, and Se were poor and not encouraging.

21.1.11 Nine trenches were excavated in the northwestern and central parts to trace concealed quartz veins. Only two trenches (T3 and T5) showed copper values. Trench T3 yielded 646 ppm Cu over 1 m in granodiorite gneiss. Trench T5 yielded 385 ppm over 2 m and 158 ppm over 4 m in granodiorite gneiss and amphibolite contact zones. No mineralised quartz veins were intersected, and copper values were low. Analyses for other elements were also poor and not encouraging.

21.1.12 An integrated ground geophysical survey of 30 Lkm using IP, SP, and Magnetic methods was conducted to delineate base metal zones associated with shear zones. The survey mapped structural features such as faults and shear zones, along with lithological contacts. Resistivity and IP indicated anomalies, and magnetic data highlighted NE–SW trending low magnetic zones, interpreted as alteration/shear zone or disseminated sulphide zones. Four boreholes were proposed to test these anomalies.

21.1.13 The ground geophysical survey confirmed the extension of the N50^{0}E-S50^{0}W trending low magnetic intensity shear zone into Sitapur. Accordingly, four boreholes were drilled to test the depth extension of these anomalies up to depth range of 50m to 90m vertical depth from surface.

21.1.14 From 200 borehole core samples across 4 boreholes, 26 samples indicated >200 ppm Cu (ranging from 213 ppm to 0.22% Cu). Only two samples from Borehole MSC-01 shown 0.1% Cu, with values of 0.165% Cu over 0.5 m and 0.22% Cu over 0.5 m. Analyses for Pb, Zn, Ni, Co, Te, Mo, and Se were poor and not encouraging.

21.1.15 Total 40 nos. borehole core samples analysed for gold shown values between <10 ppb and 92.8 ppb Au. These results were poor and not encouraging.

21.1.16 Total 50 nos. borehole core samples analysed for 34 Element analysis by ICP-MS Method. Total 49 samples shown ΣREE+Sc+Y values between 114 ppm and 395 ppm. The results for REE and other elements were also not encouraging.

21.1.17 Exploratory test drilling of 4 boreholes up to depth range of 50–90 m confirmed only lean mineralisation in one Borehole MSC-01, where two zones shown > 0.1% Cu cut-off with 0.165% Cu over 0.50m and 0.157% Cu over 1.0m. No mineralised zones were intersected in the other three boreholes, suggesting that copper mineralisation is patchy and discontinuous with no lateral persistence.

21.1.18 The poor/weak copper intersections may be due to the overall low concentration of copper-bearing sulphides and the non-intersection of any significant mineralised quartz veins associated with shear zone within the explored depth range.

21.1.19 Borehole geophysical logging delineated sulphide zones, recording their depths and thicknesses, thereby enhancing the borehole dataset. Overall, geophysical log responses indicated poor concentration of copper bearing sulphides in the drilled boreholes

21.1.20 Exploratory drilling results did not reveal any significant copper mineralisation meeting the minimum considerable criteria cut-off grade (0.2% Cu) and minimum stoping width (2.0 m true width) for resource estimation. Hence, resource estimation for copper has not been done for the Sitapur Block.

21.2.0 RECOMMENDATION

21.2.1 The present G3 exploration has traced the eastward extension of the NE–SW low magnetic intensity shear zone into Sitapur Block. Test drilling of 4 boreholes up to 50-90 m depth did not intersect any significant copper mineralisation. Only Borehole MSC-01 yielded two lean zones above 0.1% Cu, indicating patchy and discontinuous mineralisation with poor persistence. Since ore shoot geometry and controls could not be ascertained from limited geophysical survey and shallow drilling, the possibility of deeper mineralisation cannot be ruled out. Hence, it is recommended to undertake deep earth imaging methods such as magnetotelluric/TDEM and high-resolution deep IP surveys to identify favourable structures for potential deep-seated mineralisation, if present.

CHAPTER-XXII

PLATES AND MAPS

22.1.0 List of Plates

22.1.0 The report includes all the relevant plates maps, plans, sections etc. List of plates are provided in the Geological Report.

CHAPTER-XXIII

23.0.0 ANNEXURE / ENCLOSURES TO THE REPORT

23.1.0 The report includes all the relevant annexure and maps, plans, sections, photographs etc. List of annexures, tables, maps, plans, sections, photographs, Text figures & etc are provided in the Geological Report.

CHAPTER-XXIV

24.0.0 ANY OTHER INFORMATION

24.1.0 GEO-TECHNICAL STUDIES

24.1.1 No specific geotechnical studies have been undertaken as there is no scope of work in present exploration at G3 stage. However, as part of geological logging, the following geo-tech parameters have been collected.

1. Core recovery
2. RQD%

24.2.0 REFERENCES

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12. Sahoo et. al (2024) Report On Reconnaissance Survey For Cu And Associated Mineralization In Baigatola - Chakarwahi Area, Balaghat District, Madhya Pradesh (Stage: G-4), Geological survey of india.

13. NGDR web portal.

CHAPTER-XXV

25.0.0 CERTIFICATION

25.1.0 CERTIFICATION

This is to certify that Geological Report has been prepared in respect of Preliminary Exploration (G-3 Stage) for Copper and Associated Minerals in Sitapur Block, Malanjkhand Copper Belt, District: Balaghat, State: Madhya Pradesh by Mineral Exploration and Consultancy Limited (MECL) on behalf of National Mineral Exploration Trust (NMET). The report has been prepared in accordance with the Minerals (Evidence of Mineral Contents) Rule 2015 specified under Mineral Auction Rule, 2015 and amended up to 2021.

NAME: **SRIKANTH SHARMA**
DESIGNATION: **HoD (Exploration)**

DATE:

LOCALITY INDEX

S.No.	Location	Latitude	Longitudes
1.	Anditola	22^0 04' 22.39''N	80^0 41' 14.69''E
2.	Baihar	22^0 06' 05.63''N	$80^0$32' 58.61''E
3.	Chartola	22^0 03' 28.43''N	$80^0$42' 57.12''E
4.	Kholwa	22^0 02' 31.69''N	$80^0$37' 38.44''E
5.	Mohgaon	22^0 03' 10.66''N	$80^0$40' 53.45''E
6.	Newargoan	22^0 03' 19.68''N	$80^0$40' 55''E
7.	Malanjkhand (MCP) Colony	22^0 02' 60''N	$80^0$42' 49.24''E
8.	Malanjkhand Copper Mines	22^0 01' 14.01'N	$80^0$42' 51.59''E
9.	Sitapur	22^0 04' 13.38'N	$80^0$40' 35.99''E
10.	Shitalpani	22^0 04' 17.64'N	$80^0$40'08.91''E

ABBREVIATIONS USED

SL. No.	Abbreviation	Full form
1	M / m	Meter
2	Cu. m	Cubic Meter
4	RL	Reduced Level
5	mRL	Reduced Level in meter
6	IBM	Indian Bureau of Mines
7	GSI	Geological Survey of India
8	NMET	National Mineral Exploration Trust
9	TCC	Technical cum Cost Committee
10	EC	Executive Committee
11	MMDR	Mines & Minerals (Development and Regulation)
12	MEMC	Minerals (Evidence of Mineral Contents)
13	MECL	Mineral Exploration and Consultancy Limited
14	NABL	National Accreditation Board for Testing and Calibration Laboratories
15	QA/QC	Quality Assessment/ Quality Checks
16	WGS-84	World Geodetic System-84
17	DMS	Degree Minute Second
18	UTM	Universal Transverse Mercator
19	Km	Kilo metre
20	DGPS	Differential Global Positioning System
21	AAS	Atomic Absorption Spectroscopy
22	NGDR	National Geoscience Data Repository
23	ICP-MS	Inductively Coupled Plasma Mass Spectrometry
24	BDL	Below detection limit
25	JNARDDC	Jawaharlal Nehru Aluminium Research Development and Design Centre