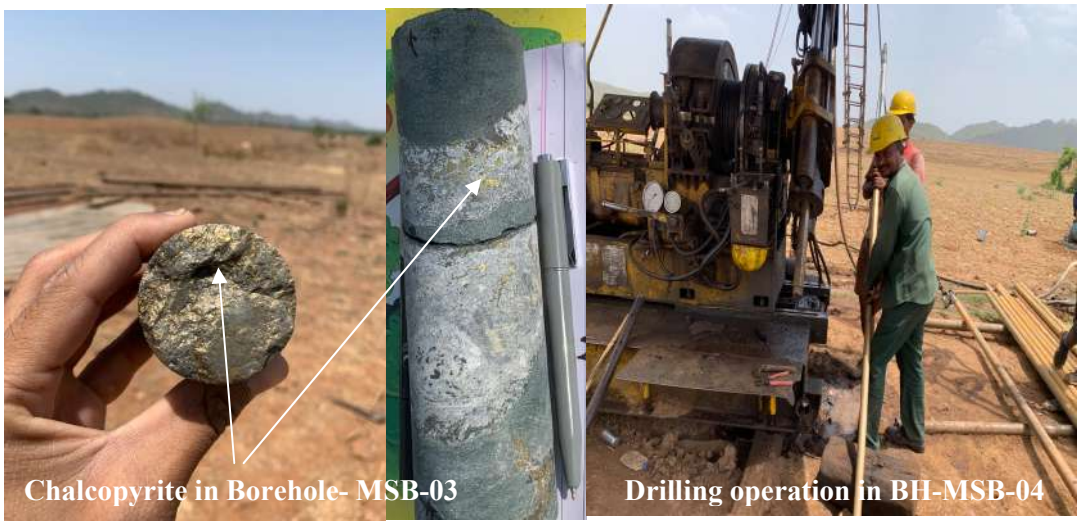
GEOLOGICAL REPORT ON RECONNAISSANCE SURVEY (G-4 STAGE) FOR COPPER, LEAD, ZINC, GRAPHITE AND ASSOCIATED MINERALS IN BAGWARI-SUKWARI BLOCK (141.75 Sq Km) DISTRICT-SIDHI, MADHYA PRADESH

(Under NMET Programme)

(TEXT AND ANNEXURE)



MINERAL EXPLORATION AND CONSULTANCY LIMITED
(Formerly known as Mineral Exploration Corporation Limited)
A Government of India Enterprises
CORPORATE OFFICE, NAGPUR

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बागवारी-सुकवारी ब्लॉक (141.75 वर्ग किमी) में तांबा, सीसा, जस्ता, ग्रेफाइट और संबंधित खनिजों के लिए आवीक्ष सर्वेक्षण (जी-4 चरण) पर भूवैज्ञानिक रिपोर्ट

जिला- सीधी, राज्य - मध्य प्रदेश

अध्याय 1

कार्यकारी सारांश

1.1.0 प्रस्तावना

1.1.1 तांबे ने अपने अद्वितीय भौतिक, यांत्रिक और विद्युत गुणों के साथ, किसी देश के औद्योगिक विकास में महत्वपूर्ण भूमिका निभाई है। भारत में, लगभग 75% मांग आयात के माध्यम से पूरी की जाती है। आर्थिक महत्व के नए तांबे के निक्षेपों के गवेषण से देश में तांबा धातु की बढ़ती मांग को कम किया जा सकता है। मलांजखंड तांबे और रामपुरा-अगुचा Pb-Zn निक्षेप की खोज के बाद से देश में किसी भी नए आधार धातु निक्षेप की खोज नहीं की गई है, जो उन्नत गवेषण की आवश्यकता पर प्रकाश डालता है।

1.1.2 पिछले दशकों के दौरान, भारत में बड़े पैमाने पर धातु का कोई निक्षेप नहीं खोजा गया है। हालाँकि, तकनीकी प्रगति और बढ़ी हुई परिचालन दक्षता के बावजूद छोटे खनिज पिंडों के एक-दूसरे के निकट काम करने की संभावना से इंकार नहीं किया जा सकता है। इसलिए, क्लस्टर में ऐसे छोटे तांबे के निक्षेपों का पता लगाना आवश्यक और अनिवार्य है।

1.1.3 इसी प्रकार सीसा-जस्ता भी एक महत्वपूर्ण कमोडिटी है। Pb -Zn उत्पादन का लगभग 50% स्टील को जंग से बचाने हेतु गैल्वनाइजिंग स्टील के लिए उपयोग किया जाता है। जस्ता यौगिकों और डस्टों का उपयोग सौंदर्य प्रसाधन, प्लास्टिक, रबर, मलहम, सनस्क्रीन क्रीम, साबुन, पेंट, स्याही, उर्वरक और बैटरी में किया जाता है। नए निक्षेपों का पता लगाने के लिए Pb -Zn हेतु गवेषण गतिविधियाँ बहुत आवश्यक हैं।

1.1.4 ग्रेफाइट भी एक महत्वपूर्ण खनिज है और इसका व्यापक रूप से रिफैक्ट्री, लुब्रीकैंट, बैटरी, परमाणु रिएक्टर, लेखन सामग्री में उपयोग किया जाता है। इसलिए, ग्रेफाइट के लिए गवेषण गतिविधियाँ भी समय की मांग हैं।

1.1.5 दि. 29 एवं 30 नवंबर-2021 को भारतीय भूवैज्ञानिक सर्वेक्षण, डीजीसीओ, ए-II, पुष्पा भवन, नई दिल्ली में वीडियो कॉन्फ्रेंसिंग के माध्यम से आयोजित तकनीकी-सह-लागत समिति (टीसीसी), नेशनल मिनरल एक्सप्लोरेशन ट्रस्ट (एनएमईटी) की 35वीं बैठक में कॉपर, सीसा, जस्ता, ग्रेफाइट और संबंधित खनिजों के लिए बागवारी-सुकवारी जी4 ब्लॉक के प्रस्ताव पर चर्चा की गई। बागवारी-सुकवारी जी-4 गवेषण प्रस्ताव का टीसीसी द्वारा इसके विभिन्न भूवैज्ञानिक घटकों और गवेषण के जी-4 चरण में उनकी उपयुक्तता के लिए तकनीकी रूप से मूल्यांकन किया गया था। समिति ने 1: 12,500 पैमाने पर भूवैज्ञानिक मानचित्रण, 200 नमूनों की सतह का नमूनाकरण, 100 घन मीटर की ट्रेंचिंग के साथ आवीक्ष सर्वेक्षण (जी -4) की मंजूरी के लिए कार्यकारी समिति (ईसी) को प्रस्ताव की सिफारिश की और पायलट बोरहोल के माध्यम से 500 मीटर वेधन की। एनएमईटी की टीसीसी समिति ने 12 महीने की समय सीमा में 1,81,20,575 रुपये यानी जीएसटी सहित लगभग 181 लाख रुपये की अनुमानित लागत के साथ आवीक्ष सर्वेक्षण (जी -4) के अनुमोदन के प्रस्ताव की सिफारिश की।

1.1.6 दि. 22 दिसंबर, 2021 को आयोजित 22वीं कार्यकारी समिति (ईसी) द्वारा बागवारी-सुकवारी जी4 ब्लॉक के लिए राशि 1,81,20, 575 यानि लगभग 181 लाख, रुपये की अनुमानित गवेषण लागत पर कार्यालय ज्ञापन फाइल सं. 6/2/2015-एनएमईटी/186, नई दिल्ली, दिनांक, 03 जनवरी, 2022 के द्वारा जी-4 चरण गवेषण प्रस्ताव को मंजूरी दे दी है।

1.2.0 ब्लॉक का स्थान और पहुंचने की सुविधा

1.2.1 तांबा, सीसा, जस्ता और ग्रेफाइट के लिए बागवारी-सुकवारी जी -4 गवेषण ब्लॉक भारतीय सर्वेक्षण टोपोशीट संख्या 63H/11 और 63H/15 के हिस्सों में आता है और यह 24°18' 00.83"N से 24° 23' 41.38"N अक्षांश और 81°41'22.18" पूर्व से 81° 59' 58.76 " पूर्व देशांतर के बीच स्थित है।

1.2.1 यह ब्लॉक सुकवारी, बागवारी, खिरखोरी, परखुरी, सेमरिया, कुसुमहार, धनखोरी, पनवार, मौहरियां, तेंदुआ, पथेरा, महाराजपुर, जमुनिया जिला सिधी का खुर्द, राज्य-मध्य प्रदेश के गांवों के आसपास 141.75 वर्ग किमी के क्षेत्र को कवर करता है। गवेषण ब्लॉक का स्थान मानचित्र प्लेट-I में दिया गया

है। जियोडेटिक और यूटीएम दोनों में ब्लॉक क्षेत्र के कोने बिंदुओं के निर्देशांक तालिका संख्या 1.1 में दिए गए हैं।

तालिका सं.-1 .1

तांबा, सीसा, जस्ता और ग्रेफाइट, जिला-सिधी , मध्य प्रदेश के लिए बागवारी-सुकवारी जी -4 ब्लॉक की ब्लॉक सीमा के कार्डिनल बिंदुओं के निर्देशांक

ब्लॉक कार्नर बिंदू	डब्ल्यूजीएस 84 (डीडी एमएम एसएस)		यूटीएम जोन-44 (एम)	
	अक्षांश	देशान्तर	ईस्टिंग (एम)	नॉर्थिंग (एम)
ए	24° 23' 41.38"	81°44'31.32"	575242.54	2698142.06
बी	24° 23' 36.05"	81°59'58.76"	601368.27	2698142.10
सी	24° 23' 15.95"	81°59'58.61"	601368.27	2697523.62
डी	24° 20' 00.44"	81°44'58.89"	576055.75	2691350.79
इ	24° 18' 00.83"	81°44'58.97"	576077.70	2687671.81
एफ	24° 18' 01.56"	81°41'22.18"	569966.70	2687662.60
जी	24° 21' 11.64"	81°41'23.64"	569978.88	2693509.06

1.2.3 गवेषण सिधी शहर के दक्षिण में स्थित है, जो सिधी जिले का जिला मुख्यालय है। यह ब्लॉक मोटर योग्य /पक्की सड़क से अच्छी तरह जुड़ा हुआ है। झाँसी-रांची राष्ट्रीय राजमार्ग एनएच-39 ब्लॉक के उत्तर में गुजरता है । इस राजमार्ग का एक हिस्सा रीवा को सीधी से जोड़ता है। सिधी से ब्योहारी और सिधी-मड़वास से जोड़ने वाला राज्य राजमार्ग एसएच-55 प्रमुख सड़क है जो ब्लॉक से होकर गुजरती है। गवेषण ब्लॉक के नजदीकी रेलवे स्टेशन ब्यौहारी (55 किमी), रीवा (70 किमी), सतना (101 किमी) हैं, ये सभी रेलवे स्टेशन पश्चिम मध्य रेलवे के जबलपुर मंडल में आते हैं । गवेषण ब्लॉक से निकटतम हवाई अड्डा बनारस है जो ब्लॉक से उत्तर पूर्व दिशा में 190 किमी दूर है।

1.3.0 गवेषण का उद्देश्य

1.3.1 वर्तमान गवेषण कार्यक्रम निम्नलिखित उद्देश्यों को पूरा करने के लिए तैयार किया गया है:

1. भूवैज्ञानिक मानचित्रण और 1:12,500 पैमाने पर भूवैज्ञानिक मानचित्र तैयार करना।
2. तांबा, सीसा, जस्ता और ग्रेफाइट और संबंधित खनिजों सहित खनिजकरण की जांच करना।

3.यूएनएफसी मानदंडों और खनिज (खनिज सामग्री के साक्ष्य) नियम 2015 और खनिज (खनिज सामग्री के साक्ष्य) संशोधन नियम 2021 के अनुसार प्रतिच्छेदन के प्रथम स्तर के लिए आवीक्षण संसाधनों (334) का अनुमान लगाना।

4.ब्लॉक की नीलामी के लिए राज्य सरकार को सुविधा प्रदान करना।

1.4.0 क्षेत्रीय भूविज्ञान

1.4.1 बागवारी क्षेत्रीय रूप से, यह क्षेत्र मध्य भारत टेक्टोनिक जोन (सीआईटीजेड) की उत्तरी सीमा के निकट और महाकोशल और विंध्य सुपरग्रुप के निकट पड़ता है। मध्य भारत टेक्टोनिक ज़ोन (CITZ) EW से ENE-WSW दिशा में लगभग 20 से 40 किमी चौड़ा और 300 से 350 किमी लंबा ट्रेंडिंग में है। क्षेत्रीय रूप से, सीआईटीजेड में तीन प्रोटेरोज़ोइक सुपरक्रस्टल बेल्ट शामिल हैं, अर्थात् उत्तर में महाकौशल बेल्ट, मध्य में बैतूल बेल्ट और दक्षिणी भाग में सौसर बेल्ट जो बड़े पैमाने पर अविभाजित नीस और पोस्ट टेक्टोनिक ग्रेनाइट्स में सेट हैं। सीआईटीजेड के उत्तरी भाग में प्रारंभिक प्रोटेरोज़ोइक महाकौशल रिफ्ट जोन की एक महत्वपूर्ण लिथो-टेक्टोनिक इकाई शामिल है, जो दो मोहो रीचिंग फॉल्ट, एसएनएनएफ और एसएनएसएफ के बीच सीमित है। एसएनएसएफ गोंडवाना बेसिन की उत्तरी सीमा को भी चिह्नित करता है, जबकि एसएनएनएफ महाकोशल बेल्ट की उत्तरी सीमा और मेसो-नियोप्रोटेरोज़ोइक विंध्य बेसिन की दक्षिणी सीमा को चिह्नित करता है।

1.4.2 आर्कियन युग के पुराने मेटामोर्फिक्स में टैल्क-क्लोराइट-शिस्ट, क्वार्ट्ज सेरीसाइट शिस्ट और ग्रेनाइट नीस आदि शामिल हैं। इन मूल शिस्टों में बुनियादी, अति बुनियादी और अम्लीय चट्टानों द्वारा अंतर्वेधन हुआ है। पुराने मेटामोर्फिक्स के ऊपर एक फाल्टेड कंटैक्ट के साथ पडा हैं, तुलनात्मक रूप से युवा मेटासेडिमेंटरी रॉक इकाइयों के सदस्य, जिनके लिए जिसे सीधी श्रृंखला नाम दिया गया है (नारायण केदार, 1956)। पुराने शिस्टों को मेटाडोलराइट्स और एम्फिबोलाइट्स में मेटामोर्फोज़ किए गए मूल और अल्ट्राबेसिक चट्टानों द्वारा भी अंतर्वेधित किया गया है और यह ग्रेनाइट द्वारा भी अंतर्वेधित किया गया है। आर्कियन पुरापाषाण-प्रोटेरोज़ोइक एजेड चट्टानों के महाकोशल समूह से आच्छादित हैं, जिनमें मेटा आर्कोस , कांग्लोमरेट, फाइलाइट्स , क्वार्टजाइट्स , मेटाबेसिक्स , टफ्स, बीएचजे और बीएचक्यू शामिल हैं। इनके ऊपर, महाकौशल समूह से संबंधित बेसिक डाइक और ग्रेनाइट के कुछ उदाहरण भी अंर्वेधन के रूप में पाए जाते हैं। महाकोशल समूह के ये पुरापाषाण-प्रोटेरोज़ोइक चट्टानें जंगेल की मेसो-प्रोटेरोज़ोइक एजेड चट्टानों से आच्छादित है जिसमें ऊपरी बलुआ पत्थर, निचला बलुआ पत्थर और समूह और विंध्यन सुपर ग्रुप की सेमरी श्रृंखला शामिल है और इसमें देवलैंड बलुआ पत्थर, अरंगी/ कनवारी शेल, कजराहाट चूना पत्थर और देवनार पोर्सलानाइट शामिल हैं।

1.5.0 ब्लॉक का भूविज्ञान और संरचना

1.5.1 यह क्षेत्र ज्यादातर पुराने मेटामोर्फिक्स टैल्क-क्लोराइट-शिस्ट, क्वार्ट्ज-सेरीसाइट-शिस्ट आदि, माफिक्स और अल्ट्रामैफिक्स और ग्रेनाइट्स द्वारा दर्शाए गए आर्कियन युग के ग्रेनाइट नीस और शिस्ट से संबंधित लिथो इकाईयां को उजागर करता है। इन पुराने शिस्टों में बुनियादी और अल्ट्राबेसिक चट्टानों का अंतर्वेधन हुआ है जो मेटाडोलेराइट्स और एम्फिबोलाइट्स में रूपांतरित हो गए हैं और इसमें ग्रेनाइट का भी अंतर्वेधन हुआ है । ग्रेनाइट बुनियादी शिस्टों में अंतर्वेधन कर रहा है और सुकवारी-बागवारी क्षेत्र में बड़े पैमाने पर खुला है। सिधी के बैंडेड-हेमेटाइट-क्वार्टजाइट का एक्सपोजर श्रृंखला, खनिजयुक्त इलाकों के आसपास सुक्वारी क्षेत्र में पुराने रूपांतरों पर आधारित पाई गई। ग्रेनाइटिक चट्टान मुख्य रूप से क्वार्ट्ज, ऑर्थोक्लेज़, एल्बाइट , मस्कोवाइट बायोटाइट और हॉर्नब्लेंड से बनी है। इस क्षेत्र में शीयरिंग जारी है, जो कि मूल चट्टानों के साथ-साथ ग्रेनाइटिक क्षेत्र के कंटैक्ट्स के पास क्वार्ट्ज वेंसो पर रिपोर्ट की गई चिकनी सतहों से स्पष्ट है। ऊपर चर्चा की गई चट्टानों के अलावा, ब्लॉक क्षेत्र में फाइलाइट्स , चेर्टी क्वार्टजाइट्स , महाकौशल समूह के बीएचजे/बीएचक्यू और सेमरी समूह के निचले बलुआ पत्थर, निचले शेल्स पाए जाते हैं।

1.5.2 बागवारी-सुकवारी जी-4 ब्लॉक का सामान्यीकृत स्ट्रैटिग्राफिक अनक्रमण तालिका -1.2 में दिया गया है।

तालिका संख्या 1..2

क्षेत्र (जीएसआई के बाद) का ब्लॉक लिथो- स्ट्रेटीग्राफिक अनुक्रम

समूह	लिथो-इकाइयाँ
सेमरी ग्रुप	देवनार पोर्सलानाइट
	कजराहाट चूना पत्थर
	अरंगी / कांवरी शैले
	देवलैंड बलुआ पत्थर
महाकौशल ग्रुप	बीएचक्यू/बीएचजे
	चेर्टी क्वार्टजाइट
	फिलाइट
फाल्टेड कंटैक्ट्स	
पुराने मेटामोर्फिक्स (	ग्रेनाइट, ग्रेनाइट-नीस और क्वार्ट्ज वेंस

समूह	लिथो-इकाइयाँ
आर्कियन्स)	माफ़िक और अल्ट्रामैफिक चट्टानें
	क्वार्ट्ज- सेरीसाइट -शिस्ट
	एम्फिबोलाइट्स, बेसिक शिस्ट -हॉर्नब्लेंड-क्लोराइट-शिस्ट-टैल्क-क्लोराइट-शिस्ट, हॉर्नब्लेंड-शिस्ट, हॉर्नब्लेंड, मैग्नेटाइट, एपिडोट , क्वार्टजाइट और एपिडोसाइट के लेंस के साथ

1 .5.3 ग्रेनाइट नीसिस और टैल्क-क्लोराइट-शिस्ट, क्वार्ट्ज-सेरीसाइट-शिस्ट सहित पुराने रूपांतर तांबे के खनिजकरण के लिए मेजबान चट्टान हैं । इन चट्टानों में क्वार्ट्ज वेंस का अंतर्वेधन होता है जिनमें ये खनिजकरण देखा जा सकता है।

1.5.4 लिथो-इकाइयों की सामान्य नतिलंब एनएनई-एसएसडब्ल्यू है और एसएसई की ओर 40-60° तक नति है। गवेषण कार्यक्रम के दौरान, ब्लॉक के पूरे 141.75 वर्ग किमी क्षेत्र को 1:12,500 पैमाने पर मैप किया गया है ।

1.6.0 ब्लॉक में खनिजीकरण

1.6.1 वर्तमान गवेषण ब्लॉक में, ध्यान देने योग्य तांबा खनिजकरण को देखा गया है। अज़ूराइट, पाइराइट, मैलाकाइट सतह, खाई और साथ ही बोरहोल में पाए गए। बोरहोल कोर में चालकोपाइराइट देखा गया। क्लोरिटिसेशन और बायोटाइज़ेशन को कोर में हाइड्रोथर्मल परिवर्तन के रूप में देखा जाता है। सीधी के दक्षिण में सुकवारी, बागवारी और अन्य गांवों के पास भंगुर शीयर जोन में तांबे के खनिजकरण की छिटपुट उपस्थिति देखी जाती हैं। बैराइट वेंस भी मुख्य रूप से E-W और NNW-SSE में प्रचलित ग्रैनिटॉइड चट्टानों में देखी जाती हैं, जैसा कि पहले के श्रमिकों द्वारा रिपोर्ट किया गया था। छोटी वेंस 5-10 मीटर तक लंबी और 0.5 मीटर तक चौड़ी होती हैं। बेस मेटल खनिजकरण सतह पर मैलाकाइट, अज़ूराइट एन्क्रस्टेशन और चालकोपाइराइट और क्वार्ट्ज वेंस और स्ट्रिंगर्स से जुड़े ब्लॉक के विभिन्न शिस्टोज़ और नीसिस रॉक असेंबलियों में पाइराइट प्रसार के रूप में प्रकट होता है। कुछ तांबे के क्षेत्र सोने के मूल्यों (1.75पीपीएम एयू तक) के साथ निकटता से जुड़े हुए हैं। अयस्क क्षेत्रों में उच्च आर्सेनिक मान भी देखे गए हैं। ब्लॉक में तांबे का खनिजकरण संरचनात्मक रूप से नियंत्रित होता है, और यह ग्रेनाइट नीस और क्वार्ट्ज कोराइट शिस्ट और अन्य शिस्ट द्वारा होस्ट की गई शीयर क्वार्ट्ज वेंस में भी मौजूद होता है।

1.6.2 सटीक रूप से यह कहा जा सकता है कि ब्लॉक में खनिजकरण का सतही प्रभाव मैलाकाइट स्टैन्स, अज़ूराइट आदि के रूप में नीस और शिस्ट में क्वार्ट्ज वेंसों के साथ देखा गया है। ड्रिल किए गए

बोरहोल में तांबे के खनिजकरण को धब्बों, वेंसों, चालकोपाइराइट के लेंस, पाइरोटाइट और परिवर्तित क्वार्ट्ज वेंसों में पाइराइट के रूप में देखा गया। हाइड्रोथर्मल परिवर्तन की विशेषता क्लोरीटाइजेशन, बायोटाइटाइजेशन और सर्सिटाइजेशन के रूप में देखी जाती है जिसे खनिज क्षेत्रों के रूप में सीमांकित किया जा सकता है। खनिजकरण की प्रकृति नीचे उल्लिखित है-

क. सतह संकेत - तांबे के खनिजकरण के लिए गॉसनाइज्ड/ऑक्सीडाइज्ड गुण, मैलाकाइट एन्क्रस्टेशन और एजुराइट के कारण एजुर नीला मेनिफेस्टेशन

ख. अयस्क बनावट - धात्विक

ग. उपस्थिति का तरीका - शियरिंग के कारण वेन अंतर्वेधन के दौरान परिवर्तन से निर्मित

घ. नतिलंब की लंबाई - दो स्थानों पर प्रत्येक 100 मीटर (बोरहोल एमएसबी-01 और एमएसबी-03)

ङ . खनिजीकरण का नियंत्रण: बैराइट और संबंधित सल्फाइड खनिजकरण महाकोशल बेल्ट के बेसमेंट में भ्रंश के एक सेट का अनुसरण करता है। एपिथर्मल बैराइट वेंसों, सल्फाइड के साथ या उसके बिना, महाद्वीपीय और महाद्वीपीय मार्जिन सेटिंग दोनों में, रिफ्ट बेसिन के मार्जिन पर और उसके निकट होना समान्य हैं। वेंसों और अयस्क पिंडो को स्थानीयकृत करने के लिए पहले से मौजूद फ्रैक्चर और भ्रंश आवश्यक हैं।

च. अयस्क पिंड ज्यामिति- लेंसोइडल

1.6.3 बोरहोल में, चालकोपाइराइट को क्लोराइट शिस्ट के भीतर क्वार्ट्ज वेंस के साथ देखा जाता है (फोटो 1.1 और फोटो 1.2)। हाइड्रोथर्मल परिवर्तन के रूप में कोर में क्लोरिटिसेशन और बायोटाइज़ेशन देखा जाता है। ट्रेंच MSB-T3 में अज़ूराइट का प्रकटीकरण देखा गया। (फोटो 1.3).

फोटो 1.1 32.00 मीटर-32.30 मीटर की गहराई पर बीएच-एमएसबी-01 के बोरहोल कोर की तस्वीर, जो चालकोपाइराइट की उपस्थिति को दर्शाती है।

फोटो 1.2 बीएच-एमएसबी-03 के बोरहोल कोर की तस्वीर जिसमें विभिन्न गहराई पर चालकोपाइराइट खनिजकरण दिखाया गया है

फोटो 1.3 खिरखोरी गांव के पास ट्रेंच MSB-T2 में अज़ूराइट प्रत्यक्षीकरण दिखाने वाली तस्वीर

1.7.0 वर्तमान जांच के दौरान किया गया गवेषण

1.7.1 ब्लॉक में गवेषणात्मक कार्य 1:12,500 पैमाने पर भूवैज्ञानिक मानचित्रण के साथ 24.01.2022 को शुरू किया गया था। इसके साथ-साथ, वेडरॉक, मिट्टी और स्ट्रिम के नमूने सहित सतह का नमूना लिया गया। सतह के नमूने के आधार पर सकारात्मक क्षेत्रों को चित्रित करने के बाद , नवंबर 2022 में ट्रेंचिंग की गई और उसके बाद अप्रैल-जून, 2023 में वेधन की गई। गवेषणात्मक वेधन 20.04.2023 को बोरहोल नंबर एमएसबी-01 में वेधन के साथ शुरू हुई और दिनांक 21.06.2023 को बोरहोल नं. MSB-06 में समापन के साथ पूरी हुई। ट्रेंचेज की मैपिंग और ट्रेंच के नमूने, नमूना तैयार करना, बोरहोल स्थानों पर सर्वेक्षण, बोरहोल कोर लॉगिंग और बोरहोल नमूनाकरण सहित संबद्ध क्षेत्र-कार्य एक साथ किए गए हैं। विश्लेषणात्मक/प्रयोगशाला अध्ययन एमईसीएल और अन्य सरकारी/एनएबीएल मान्यता प्राप्त प्रयोगशालाओं में किए गए थे।

1.7.2 141.75 वर्ग. किमी के पूरे क्षेत्र के लिए 1:12,500 पैमाने पर भूवैज्ञानिक मानचित्रण किया गया था, जिसमें लिथोलॉजी, संरचना और खनिजकरण प्रतिक जैसे कि गॉसनाइज्ड/ऑक्सीडाइज्ड ज़ोन को दर्शाया गया था। ऑक्सीकृत/गॉसनाइज्ड क्षेत्रों की पहचान और सीमांकन से बेडरॉक, मिट्टी और धारा

के नमूने के लिए भू-रासायनिक नमूना स्थानों को चिह्नित करने में मदद मिली। व्यापक लिथोलॉजिकल इकाइयों और लिथो-संपर्कों को हैंडहेल्ड जीपीएस की मदद से मैप किया गया है। ब्रंटन कम्पास द्वारा चट्टानों के रुख और संरचनात्मक विशेषताओं जैसे बेडरॉक, शल्कन, बलन और ज्वाइंट्स को दर्ज किया गया है। लिथो-इकाइयों की सामान्य नतिलंब NE-SW है जो SE दिशा की ओर 40-60° तक नति है। क्षेत्र में दर्ज की गई रीडिंग को प्लेट III के रूप में दिए गए भूवैज्ञानिक मानचित्र के रूप में प्लॉट और उत्पादित किया गया था।

1.7.3 बागवारी-सुकवारी क्षेत्र की स्थलाकृति मुख्यतः समतल है। भूवैज्ञानिक मानचित्रण के दौरान जिन प्रमुख लिथोलॉजी का सामना किया गया, वे हैं ग्रेनाइट नीस, क्वार्ट्ज क्लोराइट शिस्ट, ग्रेनाइट, फाइलाइट्स, क्वार्टजाइट्स, बीएचजे/बीएचक्यू, बलुआ पत्थर, शेल, एम्फिबोलाइट्स डाइक और क्वार्ट्ज वेंस। ग्रेनाइट नाइस और शिस्ट के भीतर कई क्वार्ट्ज वेंस मौजूद हैं जो तांबे सहित सल्फाइड खनिजकरण के लिए मेजबान के रूप में कार्य करती हैं, जबकि, कुछ स्थानों पर इसमें सोने के खनिजकरण के कुछ उदाहरण शामिल हैं। खिरखोरी के दक्षिण और उत्तर पूर्व में, बगवारी के दक्षिण में और कुशमहर गांवों के दक्षिण में तांबे और सोने के खनिजों के निशान देखे गए। ब्लॉक के दक्षिण-पश्चिमी हिस्से में तुलनात्मक रूप से अधिक ऊंचाई है, जिसमें बीएचक्यू/बीएचजे युक्त एनई-एसडब्ल्यू ट्रेंडिंग रिज हैं। ब्लॉक के दक्षिणी भाग में, कार्बोनेसियस फ़िलाइट्स मौजूद हैं जिनमें ग्रेफाइट के उदाहरण देखे गए थे।

1.7.4 भूवैज्ञानिक मानचित्रण के दौरान, एमईसीएल ने सतह का नमूना लिया है और कुल 202 सतह के नमूने एकत्र किए हैं, जिसमें Cu, Pb, Zn , Co, Mo, Al, As B, Ba Be, Bi,Ca, Cd, Cr, Fe, Ta, K, La, Li, Mg, Mn, Na, Ni , P, S, Nb , Si , Y , Sr , Ti , V, Sc , U, Cs सहित 34 तत्वों के विश्लेषण के लिए 65 बेडरॉक नमूने, 111 मिट्टी के नमूने और 26 धारा नमूने शामिल हैं। 5 बेड रॉक नमूनों में तांबे का मान> 1000 पीपीएम बताया गया है और यह 1755 पीपीएम से 19,590 पीपीएम की सीमा में है। Pb, Zn आदि सहित अन्य तत्वों ने उत्साहजनक मूल्य नहीं दिखाए हैं। इसके अलावा, ग्रेफाइट को लक्षित करने वाले कार्बोनेसस फ़िलाइट्स से तीन नमूने एकत्र किए गए थे, जिन्होंने 0.51-0.57% (अनुलग्नक-III) और 25 सतह की सीमा में स्थिर कार्बन के लिए मान दिए हैं। सोने को लक्षित करने वाले नमूने एकत्र किए गए और उनका विश्लेषण किया गया, जिसमें 1.653 पीपीएम (अनुलग्नक-आईवीए) के एयू मान वाला एक एनामोलस क्षेत्र दिया गया है।

1.7.5 सतह के नमूनों के विश्लेषण के आधार पर, सोने के खनिजकरण के लिए एक क्षेत्र सहित पांच एनामोलस क्षेत्रों की पहचान की गई। बेड रॉक नमूना MSB-BR47 और MSB-BR27 क्रमशः खिरखोरी और बागवारी गांवों के दक्षिण में मौजूद थे, जिन्होंने क्रमशः 3020 पीपीएम और 6218 पीपीएम का cu मान दिया है। बेड रॉक नमूना एमएसबी-बीआर31 और एमएसबी-बीआर12 कुसमहर गांव के दक्षिण में मौजूद हैं, जिनका cu मान क्रमशः 1755पीपीएम और 4710 पीपीएम है। कुसमहर गांव के उत्तर-पूर्व में बेड रॉक नमूना MSB-BR09 मौजूद है, जिसका cu मान 19,590 पीपीएम और Au मान 1.653 पीपीएम है। इन मूल्यों के आधार पर, ट्रेंचिंग और ड्रिलिंग सहित आगे की जांच के लिए पांच एनामोलस जोन की पहचान की गई।

1.7.6 पांच नग. सतह के नमूनों के परिणामों के आधार पर सीमांकित पांच अलग-अलग स्थानों पर ट्रेंचो की खुदाई (114 घन मीटर) की गई है। सभी ट्रेंचो की खुदाई सभी पांच क्षेत्रों (प्लेट-III) में मौजूद लिथो इकाइयों की नतिलंब के लंबवत दिशा में की गई थी। ट्रेंच MSB-T1, MSB-T2, MSB-T3, MSB-T4 और MSB-T5 की खुदाई MSB-BR12, MSB-BR47, MSB-BR27, MSB- के बेडरॉक नमूनों के विश्लेषण परिणाम द्वारा सीमांकित एनामोलस ज़ोन में की गई है। क्रमशः BR31 और MSB-BR09। खाइयों का आयाम (लंबाई x चौड़ाई x गहराई) MSB-T1, MSB-T2, MSB-T3, MSB-T4 और MSB-T5 हैं 12m x 1m x 2m, 12m x 1m x 2m, 15m x 1m x 2m, 12m x 1m x 2m और 12m x 1m x 1m क्रमशः। खाइयों की खुदाई के बाद, खनिजयुक्त क्वार्ट्ज वेंस और ऑक्सीकृत क्षेत्र उजागर हुए है। ट्रेंचों के उचित भूवैज्ञानिक मानचित्रण (प्लेट-V) के बाद ट्रेंचों से नमूने एकत्र किए गए।

1.7.7 5 ट्रेंच में से 35 नमूने एकत्र किए गए। सभी नमूनों का विश्लेषण Cu, Pb, Zn , Co, Mo, Al, As B, Ba Be, Bi,Ca, Cd, Cr, Fe, Ta, K, La, Li, Mg, Mn, Na, Ni , P, S, Nb , Si , Y , Sr , Ti , V, Sc , U, Cs सहित 34 तत्वों के लिए किया गया। सभी ट्रेंचों ने Cu के लिए कमोबेश एनामोलस मान दिखाया है, 35 ट्रेंच नमूनों में से 24 में Cu मान >1000ppm है, जो 1068 पीपीएम से 6576 पीपीएम तक भिन्न है। संबंधित सतह के नमूनों के संबंध में Cu के लिए खाइयों और ट्रेंच नमूना मूल्यों का विवरण भी तालिका 1.3 में सारणीबद्ध किया गया है। Pb, Zn आदि सहित अन्य तत्वों ने ट्रेंच नमूनों से उत्साहजनक मूल्य नहीं दिखाए हैं। ट्रेंच MSB-T5 से Au-Ag के लिए तीन नमूनों का विश्लेषण किया गया, जिसमें 0.10-0.15ppb Au और 1.39ppm-2.20 ppm Ag की रेंज में मान दिए गए हैं। ग्रेफाइट के लिए किसी भी ट्रेंच के नमूने का विश्लेषण नहीं किया गया।

1.7.8 संभावित सतह नमूनों के संबंध में Cu के लिए ट्रेंचेज और ट्रेंच नमूना मूल्यों का विवरण नीचे तालिका 1.3 में दिया गया है।

तालिका **1.3**

बागवारी-सुकवारी (जी-4 चरण) ब्लॉक, सीधी, मप्र में सकारात्मक सतह के नमूने के संबंध में Cu के लिए ट्रेंच और ट्रेंच नमूना मूल्यों का विवरण।

Sl. No.	Surface Sample No.	Surface Sample analysis, Cu (ppm)	Trench Name	Trench Location (Lat/Lon/Village)	Trench Dimension (L x W x H) in meters	Trench volume (Cu. M.)	Trench Sample Nos.	Trench Sample Analysis, Cu (In ppm)
1	MSB-BR12	4710	MSB-T1	N24.31111, E81.73493, MADWA TOLA KUSHMAHAR VILLAGE	12 x 1 x 2	24	MSB-T1/1	948
							MSB-T1/2	431
							MSB-T1/3	1068
							MSB-T1/4	1440
							MSB-T1/5	115
2	MSB-BR47	3020.	MSB-T2	N24.346662, E81.789959, KHIRKHORI VILLAGE	12 x 1 x 2	24	MSB-T2/1	325
							MSB-T2/2	686
							MSB-T2/3	3619
							MSB-T2/4	4601
							MSB-T2/5	1215
							MSB-T2/6	2414
							MSB-T2/7	2226
							MSB-T2/8	2288
							MSB-T2/9	2857
3	MSB-BR27	6218	MSB-T3	N24.348884, E81.813215, BAGWARI VILLAGE	15 x 1 x 2	30	MSB-T3/1	1516
							MSB-T3/2	1899
							MSB-T3/3	1404
							MSB-T3/4	1706
							MSB-T3/5	3877
							MSB-T3/6	5537
							MSB-T3/7	4676
							MSB-T3/8	4368
							MSB-T3/9	1108
							MSB-T3/10	3291
							MSB-T3/11	6576
4	MSB-BR31	1755	MSB-T4	N24.309163, E81.713814, SOUTH OF KUSMAHAR VILLAGE	12 x 1 x 2	24	MSB-T4/1	233
							MSB-T4/2	144
							MSB-T4/3	176
							MSB-T4/4	218
							MSB-T4/5	532
							MSB-T4/6	1429
							MSB-T4/7	560

Sl. No.	Surface Sample No.	Surface Sample analysis, Cu (ppm)	Trench Name	Trench Location (Lat/Lon/Village)	Trench Dimension (L x W x H) in meters	Trench volume (Cu. M.)	Trench Sample Nos.	Trench Sample Analysis, Cu (In ppm)
5	MSB-BR09	19590.	MSB-T5	N24.314832, E81.741792, NORTH-EAST OF KUSMAHAR VILLAGE	12 x 1 x 1	12	MSB-T5/1	5120
							MSB-T5/2	3276
							MSB-T5/3	2504
	5					**114**	**35**	

***१००० पीपीएम से अधिक कॉपर के मान हरे रंग से चिन्हित किये गए हैं**

1.7.9 एमईसीएल ने 500.00 मीटर के अनुमोदित मीटर के मुकाबले 6 बोरहोल में कुल 454.50 मीटर की गवेषणात्मक वेधन की। तालिका 1.3 से यह स्पष्ट है कि सभी पांच ट्रेंचों ने कुछ प्रकार के सकारात्मक परिणाम दिखाए हैं। इस आधार पर, 6 बोरहोल ड्रिल किए गए, MSB-T3 और MSB-T2 में से प्रत्येक में दो बोरहोल जबकि MSB-T1 और MSB-T5 में एक-एक बोरहोल ड्रिल किया गया। MSB-T4 में एक बोरहोल की योजना बनाई गई थी, लेकिन बहुत पतला होने के कारण क्षेत्र और वन बाधाओं के कारण इसे क्रियान्वित नहीं किया गया। बोरहोल MSB-01 को ट्रेंच स्थान MSB-T3 और MSB-02 पर ड्रिल किया गया था। पश्चिम में ट्रेंच वाले स्थान MSB-T3 तक 180 मीटर की दूरी पर ड्रिल किया गया। इसी प्रकार, बोरहोल MSB-03 को ट्रेंच स्थान MSB-T2 पर ड्रिल किया गया था और MSB-04 को ट्रेंच स्थान MSB-T2 के पश्चिम में 200 मीटर की दूरी पर ड्रिल किया गया था। बोरहोल MSB-05 को ट्रेंच स्थान MSB-T1 पर ड्रिल किया गया था और बोरहोल MSB-06 को ट्रेंच स्थान MSB-T5 पर ड्रिल किया गया था। बोरहोल का विवरण अनुलग्नक-आईबी में दिया गया है और ड्रिल किए गए बोरहोल का सारांश तालिका 1.4 में दिया गया है।

तालिका - 1.4

तांबा, सीसा, जस्ता और ग्रेफाइट के आवीक्षण सर्वेक्षण (जी-4 चरण) के लिए बागवारी-सुकवारी ब्लॉक में एमईसीएल द्वारा ड्रिल किए गए अनुभाग-वार बोरहोल का विवरण जिला-सीधी, मध्य प्रदेश

क्र.सं.	बोरहोल सं..	यूटीएम (जोन- 44)		आरएल(मी.)	कुल गहराई (मी.)	अजीमुथ	कोण	सेक्शन लाईन
		पूर्वांक	उतरांक					
1	MSB-01	582545.03	2693021.08	308.27	70.50	N30°W	50°	S1-S1'
2	MSB-02	582374.57	2692939.02	312.64	71.00	N30°W	50°	S2-S2'

क्र.सं.	बोरहोल सं..	यूटीएम (जोन- 44)		आरएल(मी.)	कुल गहराई (मी.)	अजीमुथ	कोण	सेक्शन लाईन
		पूर्वांक	उतरांक					
3	MSB-03	580115.69	2692733.36	324.02	82.50	N10°E	50°	S3-S3'
4	MSB-04	579903.46	2692767.29	318.39	76.00	N10°E	50°	S4-S4'
5	MSB-05	575307.17	2689193.72	383.99	77.50	N	50°	S5-S5'
6	MSB-06	574574.49	2688759.96	378.88	77.00	N15°W	50°	S6-S6'

1.7.10 सभी संरचनात्मक, लिथोलॉजिकल और खनिज संबंधी टिप्पणियों के साथ बोरहोल कोर की भूवैज्ञानिक लॉगिंग ठीक से की गई थी। बोरहोल संख्या में तांबे के खनिजकरण की पुष्टि की गई है। MSB-01 (32.00m -32.50m, 1.44% Cu) और MSB-03 (48.85m-49.85m, 0.76% Cu और 70.50m-71.00m, 1.49% Cu) और MSB में सोने और चांदी का उदाहरण देखा गया है -03 (70.50 मी-71.00 मी, 1.75 पीपीएम Au और 4.68 पीपीएम Ag)। डब्ल्यूजीएस-84 डेटाम में डीजीपीएस की मदद से सभी बोरहोल के लिए आरएल के साथ बोरहोल समन्वय निर्धारित किए गए हैं। संबंधित प्रयोगशाला अध्ययन यानी रासायनिक और भौतिक विश्लेषण, पेट्रोग्राफिक और खनिज अध्ययन एक साथ पूरा कर लिया गया है और भूवैज्ञानिक रिपोर्ट प्रस्तुत की गई है।

1.7.11 प्रस्तावित कार्य की प्रकृति एवं मात्रा बनाम वास्तविक उपलब्धि का विवरण तालिका-1.5 में दिया गया है।

तालिका- 1.5

तांबा, सीसा, जस्ता, ग्रेफाइट और संबंधित खनिजों के लिए आवीक्ष सर्वेक्षण (जी -4) के लिए बागवारी - सुकवारी ब्लॉक में एमईसीएल द्वारा प्रस्तावित कार्य की मात्रा बनाम वास्तविक उपलब्धि

जिला : सिधी , मध्य प्रदेश

क्र.सं. नहीं।	कार्य की वस्तु	इकाई	लक्ष्य	उपलब्धि
1	**भूवैज्ञानिक मानचित्रण** (1:12,500 पैमाने पर)	वर्ग किमी	141.75 वर्ग कि.मी	141.75 वर्ग कि.मी
2	**सर्वे**			
	बोर होल निर्धारण (स्काउट बोरहोल)	नग	6 नग	6 नग
	आरएल एवं निर्देशांक निर्धारण*	नग	6 नग	6 नग
3	**भू-रासायनिक नमूनाकरण** a) Pb , Zn आदि सहित 34 तत्वों के लिए मिट्टी/धारा तलछट का नमूना। b) एयू और एजी के लिए बेड रॉक/चैनल/मिट्टी/स्ट्रीम तलछट नमूने c) ग्रेफाइट के लिए बेड रॉक/चैनल नमूने	संख्या	200 नग 25 नग 30 नग	202 नग 25 नग 03 नग

क्र.सं. नहीं।	कार्य की वस्तु	इकाई	लक्ष्य	उपलब्धि
4	**गवेषमात्मक खनन**	**मी.**	**100 घन मीटर**	
	उत्खनन (ट्रेंचिंग/पिटिंग)	घन मी.	100 घन मीटर	114 घन मी
5	**वेधन (कोरिंग)**	**मी.**	**500 मीटर (6 बीएच)**	**454.50 मीटर (6 बीएच)**
6	**भूवैज्ञानिक कार्य**			
	क) भूवैज्ञानिक कोर लॉगिंग, नमूना तैयार करना आदि।	मी.	500 मीटर (6 बीएच)	454.50 मीटर (6 बीएच)
7	**प्रयोगशाला अध्ययन**			
	i) सतह के नमूने (वेडरॉक/चैनल/मिट्टी/नमूने) ए) आईसीपी-एमएस द्वारा प्राथमिक, 5% आंतरिक और 10% बाहरी जांच बी) अग्नि परख द्वारा एयू और एजी के लिए प्राथमिक और जांच नमूने ग) ग्रेफाइट के लिए प्राथमिक एवं जांच नमूने (अनुमानित विश्लेषण)	**नग**	230 नग 29 नग 35 नग	232 नग 26 नग 03 नग
	ii) गड्ढे/खाई के नमूने ए) आईसीपी-एमएस द्वारा प्राथमिक, 5% आंतरिक और 10% बाहरी जांच बी) अग्नि परख द्वारा प्राथमिक और जांच नमूने एयू और एजी ग) ग्रेफाइट के लिए प्राथमिक एवं जांच नमूने (अनुमानित विश्लेषण)	**नग**	58 नग 12 नग 23 नग	41 नग 03 नग 00 नग
	iii) ड्रिल कोर नमूने Pb , Zn, Co और Mo) के लिए प्राथमिक, 5% आंतरिक और 10% बाहरी जांच बी) अग्नि परख द्वारा प्राथमिक और जांच नमूने एयू और एजी ग) ग्रेफाइट के लिए प्राथमिक एवं जांच नमूने (अनुमानित विश्लेषण)		230 नग 23 नग 23 नग	112 नग 17 नग 00 नग
	iv) समग्र नमूने			
	a) 5 रेडिकल्स के लिए (Cu, Pb , Zn, Co और Mo)	नग	15 नग	0 नं.
	बी) अग्नि परख द्वारा एयू और एजी	नग	15 नग	0 नं.
	ग) ग्रेफाइट (निकटतम विश्लेषण)	नग	15 नग	0 नं.
8	**पेट्रोलॉजिकल नमूने (सतह और बीएच कोर नमूने)**			
	क) पतले अनुभाग की तैयारी ख) पतले खंड का अध्ययन	नग नग	20 नग 20 नग	20 नग 20 नग
9	**खनिज विज्ञान अध्ययन (सतह एवं बीएच कोर नमूने)**			
	क) पॉलिश अनुभाग की तैयारी बी) पॉलिश अनुभाग का अध्ययन	नग नग	10 नग 10 नग	10 नग 10 नग

क्र.सं. नहीं।	कार्य की वस्तु	इकाई	लक्ष्य	उपलब्धि
10	नमूनों का विशिष्ट गुरुत्व	संख्या	00 नग	02 नग
11	रिपोर्ट तैयार करना (डिजिटल प्रारूप)	संख्या	01 नग	01 नग

1.8.0 संसाधन और ग्रेड का अनुमान

1.8.1 तांबे के लिए बोरहोल नमूनों के विश्लेषण के अनुसार, बोरहोल एमएसबी-01 में कॉपर के 0.5 मी के एक जोन की पुष्टि हुई है जिसका ग्रेड 1.44% Cu है। बोरहोल एमएसबी-03 में, कॉपर के 0.5 मी के दो क्रमशः जोन की पुष्टि हुई है जिसका ग्रेड 1.17% Cu एवं 1.49% Cu है। 0.5% Cu कट-ऑफ पर तांबे के क्षेत्रों का विवरण तालिका 1.6 में सारणीबद्ध किया गया है।

तालिका : 1.6

0.5% Cu कट-ऑफ पर तांबे के लिए क्षेत्रों का सारांश

बागवारी-सुकवारी (जी-4 चरण) ब्लॉक में 0.5% Cu कट-ऑफ पर तांबे के लिए क्षेत्रों का सारांश									
क्र.सं.	बोरहोल सं..	से	तक	मोटाई (मी.)	प्रतिच्छेन का आरएल	क्षेत्र (वर्ग किमी.)	नतिलंब प्रभाव (मी.)	विशिष्ट गुरूत्व	ग्रेड Cu (%)
S1-S1'	MSB-01	32.00	32.50	0.50	283.42	23.90	100.00	3.34	1.44
								उप कुल	**1.44**
S3-S3'	MSB-03	49.35	49.85	0.50	285.95	37.16	100.00	3.34	1.17
	MSB-03	70.50	71.00	0.50	269.73	43.62	100.00	3.34	1.49
								उप कुल	**1.33**
								सकल कुल	**1.37**

1.8.2 इसके अतिरिक्त 0.2% कट-ऑफ में भी ताम्बे के जोन को चिन्हित करने का प्रयास किया गया है। जिसके तहत, बोरहोल MSB-03 में 0.76% कॉपर ग्रेड के १ मी जोन की उपस्थिति है। इसके अतिरिक्त, ताम्बे के अन्य सभी जोन जो पारा 1.81 में उल्लेखित हैं, वे अपरिवर्तित हैं। 0.2% Cu कट-ऑफ पर तांबे के क्षेत्रों का विवरण तालिका 1.7 में सारणीबद्ध किया गया है।

तालिका: 1.7
0.2% Cu कट-ऑफ पर तांबे के लिए क्षेत्रों का सारांश

बागवारी-सुकवारी (जी-4 चरण) ब्लॉक में 0.2 % Cu कट-ऑफ पर तांबे के लिए क्षेत्रों का सारांश									
क्र.सं.	बोरहोल सं..	से	तक	मोटाई (मी.)	प्रतिच्छेन का आरएल	क्षेत्र (वर्ग किमी.)	नतिलंब प्रभाव (मी.)	विशिष्ट गुरूत्व	ग्रेड Cu (%)
S1-S1'	MSB-01	32.00	32.50	0.50	283.42	23.90	100.00	3.34	1.44
								उप कुल	**1.44**
S3-S3'	MSB-03	48.85	49.85	1.00	286.08	63.03	100.00	3.34	0.76
	MSB-03	70.50	71.00	0.50	269.73	43.62	100.00	3.34	1.49
								उप कुल	**1.00**
								सकल कुल	**1.11**

1.8.3 अतः, तांबे के क्षेत्र की अधिकतम मोटाई 1.00 मीटर है। बोरहोल में तांबे के बहुत पतले क्षेत्रों की उपस्थिति के कारण, ब्लॉक में तांबे के संसाधन का अनुमान लगाना उचित नहीं था। संछिप्त में, बोरहोल संख्या MSB-01 और MSB-03 को मिलाकर तांबे के खनिजकरण की पुष्टि की संचयी नतिलंब लंबाई 200 मीटर और 0.5% Cu कट-ऑफ पर 1.5 मीटर मोटाई है, जबकि कॉपर जोन की संचयी मोटाई 0.2% Cu कट-ऑफ पर 2.00 मीटर है। बोरहोल संख्या में सोने और चांदी के नमूने भी देखे गए हैं। (एमएसबी-03. 70.50 मी-71.00 मी, 1.75 पीपीएम Au और 4.68 पीपीएम Ag)।

1.9.0 सिफ़ारिशें

1.9.1 मध्यप्रदेश के बागवारी-सुकावारी ब्लॉक में 12500 पैमाने पर भूवैज्ञानिक मानचित्रण, ट्रेंचिंग, सैंपलिंग और ड्रिलिंग से संबंधित जी-4 चरण की जांच से क्षेत्र की पुरानी मेटामॉर्फिक चट्टानों के भीतर दो आशाजनक क्षेत्रों के साथ सोने के खनिजकरण से जुड़े तांबे की पहचान की गई है। इसने लक्ष्य क्षेत्र को वर्तमान में खोजे गए 141.75 वर्ग किमी से घटाकर 5 वर्ग किमी कर दिया है। तदनुसार, जी3 चरण की जांच में बोरहोल एमएसबी 01 और एमएसबी 03 में प्रतिच्छेदित सकारात्मक क्षेत्रों को शामिल करने की सिफारिश की जाती है, जिसमें तांबे और सोने के क्षेत्रों को लक्षित किया जाता है, जिसमें विस्तृत भू-रासायनिक नमूनाकरण, जमीनी भूभौतिकीय सर्वेक्षण और आर्थिक महत्व के क्षेत्रों को चित्रित करने के लिए बंद स्थान और गहरे स्तर की ड्रिलिंग शामिल है।

GEOLOGICAL REPORT ON RECONNAISSANCE SURVEY (G-4 STAGE) FOR COPPER, LEAD, ZINC, GRAPHITE AND ASSOCIATED MINERALS IN BAGWARI-SUKWARI BLOCK (141.75 SQKM) DISTRICT-SIDHI, MADHYA PRADESH

CHAPTER-1

EXECUTIVE SUMMARY

1.1.0 INTRODUCTION

1.1.1 Copper with its unique physical, mechanical and electrical properties, plays a vital role in the industrial growth of a nation. In India, around 75% of demand of copper is met through imports. The increasing demand of copper metal in the country could be eased with the stepped up exploration activities. No new base metal deposits have been discovered in the country, since the discovery of Malanjkhand copper and Rampura-Agucha Pb-Zn deposits, highlights the need for enhanced exploration..

1.1.2 In preceding decades, no large scale metal deposit has been discovered in India. However, the possibility of working of smaller deposits occurring in proximity to each other, through technological advances and increased operational efficiency cannot be ruled out. Therefore, it is necessary and imperative to locate and explore such small copper deposits occurring in cluster.

1.1.3 Similarly, Lead-Zinc is also an important commodity. About 50% of Pb-Zn production is used for galvanising steel to protect it from rust. Zinc compounds and dusts are used in cosmetics, plastics, rubber, ointments, sun screen creams, soaps, paints, ink, fertilisers and batteries. Exploration activities for Pb-Zn are very much required for finding new deposits.

1.1.4 Graphite is also a critical mineral and is widely used in refractory, lubricants, Batteries, Nuclear Reactors, writing materials. Therefore, Exploration activities for Graphite are also the need of hour.

1.1.5 The proposal for Bagwari-Sukwari G4 block for copper, lead, zinc, graphite and associated minerals was discussed in the 35th meeting of Technical-cum-Cost Committee (TCC), National Mineral Exploration Trust (NMET) held on 29th & 30th November- 2021, through video conferencing at Geological Survey of India, DGCO, A-II Pushpa Bhawan, New Delhi. The Bagwari-Sukwari G4 exploration proposal was technically evaluated by the TCC for its various geological components and their suitability in the G-4 stage of exploration. The committee recommended the proposal to Executive Committee (EC) for approval of Reconaissance Survey (G-4) with Geological Mapping at 1: 12,500 scale, Surface Sampling of 200 samples, Trenching of 100 cu m. and 500m of drilling by means of pilot boreholes. The TCC committee of NMET recommended the proposal for approval of Reconaissance Survey (G-4) with estimated cost of Rs. 1,81,20, 575 i. e. approximately 181 Lakhs including GST in a time schedule of 12 months.

1.1.6 The 22nd Executive Committee (EC) held on 22nd Dec 2021 has approved the G-4 stage exploration proposal for Bagwari-Sukwari G4 block at an estimated exploration cost of of Rs. 1,81,20, 575 i. e. approximately 181 Lakhs, vide Office Memorandum F.No. 6/2/2015-NMET/186, New Delhi, dated, 03rd Jan 2022

1.2.0 LOCATION AND ACCESSIBILITY OF THE BLOCK

1.2.1 The Bagwari – Sukwari G-4 exploration block for copper, lead, zinc and graphite falls in parts of the Survey of India toposheet no. 63H/11 and 63H/15 and lies between 24° 18' 00.83"N to 24° 23' 41.38"N latitudes and 81°41'22.18"E to 81° 59' 58.76""E longitudes.

1.2.1 The block covers an area of 141.75 sq.km in and around villages of Sukwari, Bagwari. Khirkhori, Parkhuri, Semaria, Kusumhar, Dhankhori, Panwar, Mauharian, Tendua, Pathera, Maharajpur, Jamuniya Khurd of district Sidhi, State- Madhya Pradesh. The Co-

ordinates of the corner points of the block area both in geodetic and in UTM are given in Table No. 1.1.

Table No.-1.1

Co-ordinates of Cardinal Points of Block Boundary of Bagwari-Sukwari G-4 Block for Copper, Lead, Zinc and Graphite, Distt-Sidhi, Madhya Pradesh

Block Corner points	WGS 84 (DD MM SS)		UTM Zone-44 (m)	
	Latitude	Longitude	Easting (m)	Northing (m)
A	24° 23' 41.38"	81°44'31.32"	575242.54	2698142.06
B	24° 23' 36.05"	81°59'58.76"	601368.27	2698142.10
C	24° 23' 15.95"	81°59'58.61"	601368.27	2697523.62
D	24° 20' 00.44"	81°44'58.89"	576055.75	2691350.79
E	24° 18' 00.83"	81°44'58.97"	576077.70	2687671.81
F	24° 18' 01.56"	81°41'22.18"	569966.70	2687662.60
G	24° 21' 11.64"	81°41'23.64"	569978.88	2693509.06

1.2.3 The exploration block is located in the south of Sidhi town, which is the district headquarter of Sidhi district of Madhya Pradesh. The exploration block is well connected with motorable/ metalled road. The Jhansi-Ranchi National Highway NH-39 passes in the north of the block.Part of this Highway connects Rewa to Sidhi. State Highway SH-55 connecting Sidhi to Beohari and Sidhi-Madwas are the major road which passes through the block. Beohari (55 Km), Rewa (70 Km), Satna (101 Km), of Jabalpur Division of West Central Railway are the nearby Railway stations. The nearest airport from the exploration block is Varanasi which is 190 Km away in NE direction from the block.

1.3.0 OBJECTIVE OF EXPLORATION

1.3.1 The present exploration programme has been formulated to fulfil the following objectives:

1. Geological Mapping and preparation of Geological map at 1:12,500 Scale.
2. To check the mineralisation including Copper, Lead, Zinc and Graphite and associated minerals.
3. To estimate Reconnassance Resources (334) for 1st level of intersection as per UNFC norms and Minerals (Evidence of Mineral Contents) Rules 2015 and Minerals (Evidence of Mineral Contents) Amendment Rules 2021.
4. To facilitate the state govt. for auctioning of the block.

1.4.0 REGIONAL GEOLOGY

1.4.1 The area falls near the northern boundary of the Central India Tectonic Zone (CITZ) in the close vicinity of Mahakoshal and Vindhyan Supergroup. Central Indian Tectonic Zone (CITZ) is trending in the E-W to ENE-WSW direction with about 20 to 40 km wide and 300 to 350km long. Regionally, the CITZ includes three Proterozoic supracrustal belts namely the Mahakoshal belt in the north, Betul belt in the central and Sausar belt in southern part set in largely undifferentiated gneisses and syn- to post tectonic granites. The northern part of the CITZ consists of an important litho-tectonic unit of Early Proterozoic Mahakoshal rift zone, confined between two Moho reaching faults, the SNNF and SNSF. The SNSF also marks the northern boundary of the Gondwana basins, whereas the SNNF marks the northern boundary of the Mahakoshal Belt and the southern boundary of the Meso-Neoproterozoic Vindhyan basin.

1.4.2 Archaean aged Older Metamorphics consist of talc-chlorite-schist, quartz sericite schist and granite gneiss etc. are the oldest rocks forming the basement rocks in the area. These basic schists have been intruded by basic, ultra basic and acidic rocks. Over the older metamorphics lie with a faulted contact, members of the comparatively younger metasedimentary rock units to which the name Sidhi Series has been attributed (Narain Kedar,1956).The older schists have also been intruded by basic and ultrabasic rocks metamorphosed into metadolerites and amphibolites and it is also intruded by granite. Archeans are overlain by Palaeo-Proterozoic Mahakoshal Group aged rocks comprising of meta arkose, conglomerate, phyllites, quartzites, metabasics, tuffs, BHJ and BHQ. Above them, few instances of basic dykes and Granites belonging to Mahakoshal Group are also found as intrusive.These Palaeo-Proterozoic rocks of Mahakoshal Group are overlain by Meso-Proterozoic aged rocks of Jungel Goup comprising Upper Sandstone, Lower sandstone & conglomerate and Semri Series of Vindhyan Super Group which includes Deoland sandstone, Arangi/Kanwari shale, Kajrahat limestone and Deonar porcellanite.

1.5.0 GEOLOGY AND STRUCTURE OF THE BLOCK

1.5.1 The area mostly exposes lithounits belonging to Archaen granite gneisses and schists represented by the older Metamorphics comprising talc-chlorite-schist, quartz-sericite-schist etc, mafics and ultramafics and granites. These older schists have been intruded by basic and ultrabasic rocks metamorphosed into metadolerites and amphibolites and further intruded by granite. The granite is intrusive into the basic schists and is exposed extensively in the Sukwari - Bagwari area. Exposures of banded-haematite-quartzite of the Sidhi Series, were found to overlie the older metamorphics in the Sukwari area in the vicinity of the mineralised localities. The area has undergone faulting which is evident from the slickenside surfaces reported on the basic rocks as well as the quartz veins near the contacts of the granite. Apart from this, phyllites, cherty quartzites, BHJ/BHQ of Mahakoshal Group and Lower Sandsotne, Lower Shales of Semri Group are found in the block area.

1.5.2 The generalized stratigraphic succession of the Bagwari – Sukwari G-4 block is given in Table-1.2.

Table No. 1.2

Block Litho-stratigraphic sequence of the area (After GSI)

Group	Litho-units
Semri Group	Deonar Porcellanite
	Kajrahat Limestone
	Arangi/Kanwari Shale
	Deoland Sansdstone
Mahakoshal Group	BHQ/BHJ
	Cherty Quartzite
	Phyllite
Faulted Contact	
Older Metamoerphics (Archaeans)	Granite, Granite-Gneiss and quartz veins
	Mafic and ultramafic rocks
	Quartz-sericite-schist
	Amphibolites, Basic schists-hornblende-chlorite-schist-talc-chlorite-schist, hornblende-schist with lenses of hornblende, magnetite, epidote, quartzite and epidosite

1.5.3 Older metamorphics including granite gneisses and talc-chlorite-schist, quartz-sericite-schist are the host rock for copper mineralsation. These rocks are intruded by quartz veins in which these mineralsation can be observed.

1.5.4 General strike of the litho-units is NE-SW and dipping 40-60° towards SE. During the course of exploration programme, entire 141.75 sq km area of the block has been mapped on 1:12,500 scale.

1.6.0 MINERALISATION IN THE BLOCK

1.6.1 In the present exploration block, noticeable copper mineralization has been encountered. Azurite, pyrite, malachite were encountered in surface, trench and as well as in Boreholes. Chalcopyrite was observed in borehole cores. Chloritisation and biotitisation are seen in the cores as hydrothermal alteration. Sporadic occurrences of copper mineralisation are seen in the brittle shear zones near Sukwari, Bagwari and other villages south of Sidhi. Baryte veins are also noticed mainly in the granitoid rocks trending in E-W and NNW-SSE as reported by earlier workers. The smaller veins are upto 5-10m in length and up to 0.5 m in width. The base metal mineralisation is manifested on the surface as malachite, azurite encrustations and chalcopyrite and pyrite disseminations in various schistose and gneissic rock assemblages of the block associated with quartz veins and stringers. Some of the copper zones are closely associated with gold values (up to 1.75ppm Au). High arsenic values are also noticed in the ore zones. Copper mineralization in the block is structurally controlled, and is present in sheared quartz vein hosted by granite gneiss and quartz chorite schist and other schists as well.

1.6.2 Precisely it can be said that the surface menfestations of mineralization noticed in the block as malachite stains, azurite etc. along quartz veins in gneisses and schists. In the drilled boreholes, copper mineralization was noticed in the form of specks, veins, lense of chalcopyrite, pyrhotite and pyrite in the altered quartz veins. The hydrothermal alteration feature are noticed in the form of chloritisation, biotitization and sercitization which can be demarcated as mineralized zones. The nature of the mineralization are mentioned below-

a. Surface Indication – For Copper mineralization -Gossanised/Oxidised attributes, Malachaite encrustations and Azure blue menifestations.

b. Ore Texure- metallic

c. Mode of occuerence- Lensoidal. confined to quartz veins and stringers along brittle shear zones

d. Strike length – 100m each at two locations (Borehole MSB-01 and MSB-03).

e. Controls of Mineralization: The barite and associated sulphide mineralization follow a set of faults in the basement to Mahakoshal belt. Epithermal barite veins, with or without sulphides, are common at and near the margins of rift basins, both in continental and continental margin settings. Pre-existing fractures and faults are essential in localising the veins and orebodies.

f. Ore body geometry- Lensoidal.

1.6.3 In boreholes, chalcopyrite is observed in association with quartz vein within chlorite schists (Photo 1.1 and Photo 1.2). Chloritisation and biotitisation seen in the cores as hydrothermal alteration. Azurite menifestations were observed in trench MSB-T3. (Photo 1.3).

Photo 1.1 Photograph of borehole core of BH- MSB-01 at depth 32.00m-32.30m, showing the prsence of chalcopyrite.

Photo 1.2 Photograph of borehole core of BH- MSB-03 showing chalcopyrite mineralisation at various depth

Photo 1.3 Photograph showing azurite menifestations in trench MSB-T2 near Khirkhori village

1.7.0 EXPLORATION UNDERTAKEN DURING CURRENT INVESTIGATION

1.7.1 The exploratory work in the block was commenced on 24.01.2022 with geological mapping on 1:12,500 scale. Simultaneously, surface sampling including the bedrock, soil and stream sampling were taken up. After, delineating the anamolous zones based on the surface sampling, trenching was done in November 2022 followed by drilling in Apr-June, 2023. The exploratory drilling commenced with drilling in borehole no. MSB-01 on 20.04.2023and completed with the closure of borehole No. MSB-06 on 21.06.2023. The allied field-works including mapping of trenches and trench sampling, sample preparation, surveying at borehole locations, borehole core logging and borehole sampling has been carried out simultaneously.The analytical/laboratory studies were carried out in laboratories of MECL and and other NABL accredited laboratories, JNARDDC, Nagpur.

1.7.2 Geological mapping was carried out at 1:12,500 scale for the entire area of 141.75 sq. km depicting the lithology, structure and mineralization signatures such as gossanised/oxidised zones. Identification and demarcation of oxidized/gossanised zones helped in marking the geochemical sampling locales for Bedrock, soil and stream sampling. Broad lithological units and litho-contacts have been mapped with the help of handheld GPS. Attitude and structural features of rocks like bedding, foliation, folds and joints has been recorded by Brunton Compass. General Strike of the litho-units is NE-SW dipping 40-60° towards SE direction. The readings recorded in the field were plotted and produced in the form of geological map given as Plate III.

1.7.3 The Bagwari-Sukwari area mainly has the flat topography. Major lithologies which were encountered during geological mapping are granite gniess, quartz chlorite schist, granite, phyllites, quartzites, BHJ/BHQ, sandstone, shale, amphibolites dykes and quartz veins. Several quartz veins are present within granite gneiss and schist serves as the host for sulphide mineralization including copper, while, at few places it contain some instances of gold mineralization. Signatures of copper and gold mineralsation were observed near south and north east of Khirkhori, south of Bagwari and south of Kusmahar villages. South western part of the block has comparatively higher elevation

having NE-SW trending ridges containing BHQ/BHJ. In the southern portion of the block, carbonaceous phyllites are present in which graphite instances were observed.

1.7.4 During, geological mapping, MECL has carried out surface sampling and collected a total of 202 surface samples that includes 65 bedrock samples, 111 soil samples and 26 stream samples for the analysis of 34 elements including Cu, Pb, Zn , Co, Mo, Al, As B, Ba Be, Bi,Ca, Cd, Cr, Fe, Ta, K, La, Li, Mg, Mn, Na, Ni , P, S, Nb , Si , Y , Sr , Ti , V, Sc , U, Cs. Copper values >1000ppm has been reported in 5 no. of bed rock samples and are in the range of 1755ppm to 19,590 ppm. Other elements including Pb, Zn etc. have not shown encouraging values.Apart from that, three samples were collected from carbonaceous phyllites targeting graphite which have given values for fixed carbon in the range of 0.51-0.57% (Annexure-III) and 25 surface samples targeting for gold were collected and analysed which has given one anamolous area having Au values of 1.653ppm (Annexure-IVA).

1.7.5 On the basis of surface samples analysis, five anamolous zones were identified including one zone for gold mineralization. Bed rock sample MSB-BR47 and MSB-BR27 were present in the south of Khirkhori and Bagwari villages respectively have given cu values of 3020ppm and 6218 ppm respectively. Bed rock sample MSB-BR31 and MSB-BR12 are present in the south of Kusmahar village are having cu values of 1755ppm and 4710 ppm respectively. Bed rock sample MSB-BR09 is present in the north-east of Kusmahar village has given cu value of 19,590 ppm and Au value of 1.653 ppm. On, the basis of the these values, five anamolus zones were identified for further investigations including trenching and drilling.

1.7.6 Five nos. of trenches have been excavated (114 cu. m) at five anamolous locations demarcated on the basis of the results of surface samples. All the trenches were excavated in the perpendicular direction to the strike of the litho units present in all the five zones (Plate-III). Trench MSB-T1, MSB-T2, MSB-T3, MSB-T4 and MSB-T5 have been excavated at the anamolous zones demarcated by the analysis result of bedrock samples of MSB-BR12, MSB-BR47, MSB-BR27, MSB-BR31 and MSB-BR09 respectively. Dimension (Length x Width x Depth) of the trenches MSB-T1, MSB-T2, MSB-T3, MSB-T4 and MSB-T5 are 12m x 1m x 2m, 12m x 1m x 2m, 15m x 1m x 2m,

12m x 1m x 2m and 12m x 1m x 1m respectively. After excavation of trenches, mineralized quartz veins and oxidized zones were exposed. Samples were collected from the treches after propoer geological mapping of the trenches (Plate-V).

1.7.7 Out of 5 trenches, 35 samples were collected. All the samples were analysed for 34 elements including Cu, Pb, Zn , Co, Mo, Al, As B, Ba Be, Bi,Ca, Cd, Cr, Fe, Ta, K, La, Li, Mg, Mn, Na, Ni , P, S, Nb , Si , Y , Sr , Ti , V, Sc , U, Cs. All the trenches has shown more or less anamolous values for Cu, 24 out of 35 trench samples have Cu values >1000ppm, varying from 1068 ppm to 6576 ppm. The details of trenches and trench sample values for Cu with respect to the corresponding surface samples are also tabulated in Table 1.3. Other elements including Pb, Zn etc. have not shown encouraging values from trench samples. Three samples were analysed for Au-Ag from Trench MSB-T5 has given values in the range of 0.10-0.15ppb Au and 1.39ppm-2.20 ppm Ag. None of the trench samples were analysed for graphite.

1.7.8 The details of trenches and trench sample values for Cu with respect to the prospective surface samples are tabulated below in Table 1.3.

Table 1.3

Details of trenches and trench sample values for Cu wrt. to the positive surface sample in Bagwari-Sukwari (G-4 stage) Block, Sidhi, M.P.

Sl. No.	Surface Sample No.	Surface Sample analysis, Cu (ppm)	Trench Name	Trench Location (Lat/Lon/Village)	Trench Dimension (L x W x H) in meters	Trench volume (Cu. M.)	Trench Sample Nos.	Trench Sample Analysis, Cu (In ppm)
1	MSB-BR12	4710	MSB-T1	N24.31111, E81.73493, MADWA TOLA KUSHMAHAR VILLAGE	12 x 1 x 2	24	MSB-T1/1	948
							MSB-T1/2	431
							MSB-T1/3	1068
							MSB-T1/4	1440
							MSB-T1/5	115
2	MSB-BR47	3020.	MSB-T2	N24.346662, E81.789959, KHIRKHORI VILLAGE	12 x 1 x 2	24	MSB-T2/1	325
							MSB-T2/2	686
							MSB-T2/3	3619
							MSB-T2/4	4601
							MSB-T2/5	1215
							MSB-T2/6	2414
							MSB-T2/7	2226
							MSB-T2/8	2288
							MSB-T2/9	2857
3	MSB-BR27	6218	MSB-T3	N24.348884, E81.813215, BAGWARI VILLAGE	15 x 1 x 2	30	MSB-T3/1	1516
							MSB-T3/2	1899
							MSB-T3/3	1404
							MSB-T3/4	1706
							MSB-T3/5	3877
							MSB-T3/6	5537
							MSB-T3/7	4676
							MSB-T3/8	4368
							MSB-T3/9	1108
							MSB-T3/10	3291
							MSB-T3/11	6576
4	MSB-BR31	1755	MSB-T4	N24.309163, E81.713814, SOUTH OF KUSMAHAR VILLAGE	12 x 1 x 2	24	MSB-T4/1	233
							MSB-T4/2	144
							MSB-T4/3	176
							MSB-T4/4	218
							MSB-T4/5	532
							MSB-T4/6	1429
							MSB-T4/7	560
5	MSB-BR09	19590.	MSB-T5	N24.314832, E81.741792, NORTH-EAST OF KUSMAHAR VILLAGE	12 x 1 x 1	12	MSB-T5/1	5120
							MSB-T5/2	3276
							MSB-T5/3	2504
						114	**35**	

Note- Highlighted in green are the samples with Cu values >1000ppm.

1.7.9 MECL carried out a total of 454.50m of exploratory drilling in 6 boreholes against an approved meterage of 500.00m. It is evident from the Table 1.3 that all five trenches has shown some sort of positive outcome. On this basis, 6 Nos. of boreholes were drilled, two borehole each in MSB-T3 and MSB-T2 while one borehole each were drilled at MSB-T1and MSB-T5.One borehole was planned at MSB-T4 but due to very thin zone and forest constraints, it wasn't executed. Borehole MSB-01 was drilled at trench location MSB-T3 and MSB-02 was. drilled at 180m apart in west to the trench location MSB-T3. Similarly, borehole MSB-03 was drilled at trench location MSB-T2 and MSB-04 was drilled at 200m apart in west to the trench location MSB-T2. Borehole MSB-05 was drilled at trench location MSB-T1 and borehole MSB-06 was drilled at trench location MSB-T5. The details of boreholes are given in Annexure- IB and summary of boreholes drilled are tabulated in Table 1.4.

Table- 1.4

Details of Section-Wise Boreholes drilled by MECL in Bagwari - Sukwari block for Reconaissance Survey (G-4 stage) of Copper, Lead, Zinc and Graphite, District-Sidhi, Madhya Pradesh

Sl. No.	BH No.	UTM (Zone- 44)		RL (m)	Total Depth (m)	Azimuth	Angle	Section Line
		Easting	Northing					
1	MSB-01	582545.03	2693021.08	308.27	70.50	N30°W	50°	S1-S1'
2	MSB-02	582374.57	2692939.02	312.64	71.00	N30°W	50°	S2-S2'
3	MSB-03	580115.69	2692733.36	324.02	82.50	N10°E	50°	S3-S3'
4	MSB-04	579903.46	2692767.29	318.39	76.00	N10°E	50°	S4-S4'
5	MSB-05	575307.17	2689193.72	383.99	77.50	N	50°	S5-S5'
6	MSB-06	574574.49	2688759.96	378.88	77.00	N15°W	50°	S6-S6'

1.7.10 Geological logging of borehole cores were properly done alongwith all the structural, lithological and mineralogical observations. Copper mineralization has been confirmed in borehole no. MSB-01 (32.00m -32.50m, 1.44% Cu) and MSB-03 (48.85m-49.85m, 0.76% Cu & 70.50m-71.00m, 1.49% Cu) and a gold and silver instance has been noticed in MSB-03 (70.50m-71.00m, 1.75 ppm Au and 4.68 ppm Ag). Borehole co-ordinates along with RL have been determined for all the boreholes with the help of DGPS in WGS-84 Datum. The associated laboratory studies i.e., chemical and physical analysis, petrographic and mineragraphic studies have been completed simultaneously and geological report has been submitted.

1.7.11 The details of the nature and quantum of work proposed vs actual achievement is given in Table-1.5.

Table – 1.5
Proposed Quantum of Work vs. Actual achievement by MECL in Bagwari - Sukwari Block for Reconnaissance Survey (G-4) for Copper, Lead, Zinc, Graphite and associated minerals, District: Sidhi, Madhya Pradesh

Sl. No.	Item of Work	Unit	Target	Achievement
1	**Geological Mapping** (on 1:12,500 Scale)	Sq km	141.75 sq.km	141.75 sq.km
2	**Survey**			
	Bore Hole Fixation (Scout Boreholes)	Nos	6 Nos	6 Nos
	RL & Coordinate Determination	Nos	6 Nos	6 Nos
3	**Surface Geochemical Sampling** a) Bed rock //Soil/Stream Sediment sampling for 34 elements including Cu, Pb, Zn etc. b) Bed Rock/Channel/Soil/Stream sediment Samples for Au & Ag c) Bed Rock/Channel Samples for Graphite	Nos.	200 Nos 25 Nos. 30 Nos.	202 Nos 25 Nos. 03 Nos.
4	**Exploratory Mining**	**m**	**100 Cu m**	
	Excavation (Trenching/Pitting)	Cu. m.	100 Cu m	114 Cu m
5	**Drilling (coring)**	**m**	**500m (6 BHs)**	**454.50m (6 BHs.)**
6	**Geological work**			
	a) Geological Core Logging, Sample Preparation etc.	m	500m (6 BHs.)	454.50m (6 BHs.)
7	**Laboratory Studies**			
	i) Surface Samples (Bed rock/Channel/Soil/ Samples) a) Primary,5% Internal & 10% External check by ICP-MS b) Primary & Check Samples for Au & Ag by Fire assay c) Primary & Check Samples for Graphite (Proximate Analysis)	**Nos**	230 Nos 29 Nos 35 Nos	232 Nos 26 Nos 03 Nos
	ii) Pit/Trench Samples a) Primary,5% Internal & 10% External check by ICP-MS b) Primary & Check Samples Au & Ag by Fire assay c) Primary & Check Samples for Graphite (Proximate Analysis)	**Nos**	58 Nos 12 Nos 23 Nos	41 Nos 03 Nos 00 Nos
	iii) Drill Core Samples a) Primary,5% Internal & 10% External check For 5 Radicals (Cu, Pb, Zn, Co & Mo) b) Primary & Check Samples Au & Ag by Fire assay c) Primary & Check Samples for Graphite (Proximate Analysis)		230 Nos 23 Nos 23 Nos	112 Nos 17 Nos 00 Nos
	iv) Composite Samples			
	a) For 5 Radicals (Cu, Pb, Zn, Co & Mo)	Nos	15 Nos	0 Nos.

Sl. No.	Item of Work	Unit	Target	Achievement
	b) Au & Ag by Fire assay	Nos	15 Nos.	0 Nos.
	c) Graphite (Proximate Analysis)	Nos	15 Nos.	0 Nos.
8	**Petrological Samples (Surface & BH Core Samples)**			
	a) Preparation of Thin Section b) Study of Thin Section	Nos Nos	20 Nos 20 Nos	20 Nos 20 Nos
9	**Mineragraphic Studies (Surface & BH Core Samples)**			
	a) Preparation of Polished Section b) Study of Polished Section	Nos Nos	10 Nos 10 Nos	10 Nos 10 Nos
10	**Specific Gravity of samples**	Nos.	00 Nos	02 Nos
11	**Report Preparation (Digital format)**	Nos.	01 Nos	01 os

1.8.0 MINERALISATION ZONES AND GRADE

1.8.1 As per the analysis of borehole samples for copper, one zone of copper for 0.5m has been encountered in MSB-01 with Cu grade of 1.44%. Two zones of copper of 0.5m each has been encountered in MSB-03 with Cu grade of 1.17% and 1.49%. Details of the zones for copper at 0.5% Cu Cut-off has been tabulated in Table 1.6.

Table: 1.6

Summary of zones for copper at 0.5% Cu Cut-off

Summary of zones for copper at 0.5% Cu Cut-off in Bagwari-Sukwari (G-4 stage) block									
Section No	**Borehole No**	**From**	**To**	**Thickness (m)**	**RL of Intersection**	**Area (sq m)**	**Strike Influence (m)**	**Specific Gravity**	**Grade**
									Cu (%)
S1-S1'	MSB-01	32.00	32.50	0.50	283.42	23.90	100.00	3.34	1.44
								Sub Total	**1.44**
S3-S3'	MSB-03	49.35	49.85	0.50	285.95	37.16	100.00	3.34	1.17
	MSB-03	70.50	71.00	0.50	269.73	43.62	100.00	3.34	1.49
								Sub Total	**1.33**
								GRAND TOTAL	**1.37**

1.82 An attempt has been made to demaracate the cu at 0.2% Cu cut -off also. In such case, in MSB-03, there is one zone of copper for 1 m has been estimated with average Cu grade of 0.76% .Apart from that, other mineralisation zones of MSB-01 and MSB-03 as mentioned in para 1.81are unchanged. Details of the zones for copper at 0.2% Cu Cut-off has been tabulated in Table 1.7.

Table: 1.7
Summary of zones for copper at 0.2% Cu Cut-off

Summary of zones for copper at 0.2% Cu Cut-off in Bagwari-Sukwari (G-4 stage) block									
Section No	**Borehole No**	**From**	**To**	**Thickness (m)**	**RL of Intersection**	**Area (sq m)**	**Strike Influence (m)**	**Specific Gravity**	**Grade**
									Cu (%)
S1-S1'	MSB-01	32.00	32.50	0.50	283.42	23.90	100.00	3.34	1.44
								Sub Total	**1.44**
S3-S3'	MSB-03	48.85	49.85	1.00	286.08	63.03	100.00	3.34	0.76
	MSB-03	70.50	71.00	0.50	269.73	43.62	100.00	3.34	1.49
								Sub Total	**1.00**
								GRAND TOTAL	**1.11**

1.8.3 Hence, maximum thickness of the copper zone encountered is 1.00m. Due to the presence of very thin zones of copper in the boreholes, resource of copper was not advisable to be estimated in the block. Precisely, Copper mineralization has been confirmed in borehole no. MSB-01 and MSB-03 having cummulative strike length of 200m and 1.5m thickness at 0.5% Cu cut-off,while cummulative thickness of copper zone is 2.00m at 0.2% Cu cut-off. Gold and silver instances has also been noticed in borehole no. MSB-03. (70.50m-71.00m, 1.75 ppm Au and 4.68 ppm Ag).

1.9.0 RECOMMENDATIONS

1.9.1 G-4 Stage investigations involving geological mapping on 12500 scale, trenching, sampling and drilling done in Bagwari- Sukawari block, MP, has identified copper associated with gold mineralisation along two promising zones within older metamorphic rocks of the area. This has narrowed down the target area to 5 sq.km, from presently explored 141.75 sq.km. Accordingly, G3 stage investigations are recommended covering positive zones intersected in boreholes MSB 01 and MSB 03, targeting copper and gold zones comprising detailed geochemical sampling, ground geophysical surveys and closed spaced and deeper level drilling for delineating zones of economic importance.

CHAPTER-2

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

2.1.0 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

Dr. Babasaheb Ambedkar Bhawan, High Land Drive Road,

Seminary Hills, Nagpur-440006

Maharashtra, India

2.2.0 QUALIFIED PERSONS

Exploration agency: Mineral Exploration and Consultancy Limited

Experience: 51 Years, Since 1972

Email: cmd@mecl.gov.in; gm-exploration@mecl.gov.in

Sl No.	Name
1	Shri P. Ravindran, GM (Exploration)
2	Shri G.S. Dhami GM (Geophysics)/ Lab. in-charge
3	Shri P. P. Kulkarni, Dy. GM (Exploration)
4	Vikash Kumar, Manager (Geology)
5	Shri Dashmesh Singh, Assistant Manager (Geology)
6	Shri Rohit Sharma, Manager (Chemical lab)
7	Shri Rajnikant Singh, Assistant Manager (Drilling)
8	Shri Sayantan Pal, Asstt. Manager (Geology)

CHAPTER-3

3.0.0 TITLE AND OWNERSHIP

3.1.0 TITLE OF THE REPORT

GEOLOGICAL REPORT ON RECONNAISSANCE SURVEY (G-4 STAGE) FOR COPPER, LEAD, ZINC, GRAPHITE AND ASSOCIATED MINERALS IN BAGWARI-SUKWARI BLOCK (141.75 SQKM) DISTRICT-SIDHI, MADHYA PRADESH

TEHSIL- GOPAD-BANAS, DISTRICT-SIDHI, 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, Maharashtra, India

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 ABOUT PERIOD OF PROSPECTING

The exploratory work in the block commenced on 24.01.2022 with geological mapping on 1:12,500 scale and surface geochemical sampling. A total of five nos. of anamolous zones identified from the sample analysis of surface samples. Accordingly, five nos. of trenches were excavated (1 each at each anamolous zone) during November 2022. As the trench samples shown high values, six boreholes were drilled in the block. The exploratory drilling commenced with Borehole No. MSB-01 on 20.04.2022 and was completed with the closure of Borehole No. MSB-06 on 21.06.2023. The allied field-works including surveying, geological mapping, trenching, drilling and surface chip/ trench/ borehole sampling etc. were completed simultaneously. The analytical /

laboratory studies were also carried out simultaneously in laboratories of MECL and other Govt. /NABL accredited laboratories.

3.3.0 DETAILS OF EXPLORATION AGENCY, QUALIFICATION, AND EXPERIENCE OF ASSOCIATED TECHNICAL PERSONS ENGAGED IN EXPLORATION

3.3.1 Exploration Agency: Mineral Exploration and Consultancy Limited

(Formerly Mineral Exploration Corporation Limited)

A Govt. of India Enterprise-A Miniratna-ICPSE

3.3.2 Qualification: M.Sc. / M. Sc. Tech. (Geology)

3.3.3 Experience:

Experience: 51 Years, Since 1972

Exploration agency: Mineral Exploration and Consultancy Limited

CHAPTER-4

DETAILS OF THE AREA

4.1.0 LOCATION AND ACCESSIBILITY OF THE BLOCK

4.1.1 The Bagwari – Sukwari G-4 exploration block falls in parts of the Survey of India Toposheet No. 63H/11 and 63H/15 and it lies between 24° 18' 00.83"N to 24° 23' 41.38"N latitudes and 81°41'22.18"E to 81° 59' 58.76"E longitudes.

4.1.2 The block covers an area of 141.75 sq.km in and around villages of Sukwari, Bagwari. Khirkhori, Parkhuri, Semaria, Kusumhar, Dhankhori, Panwar, Mauharian, Tendua, Pathera, Maharajpur, Jamuniya Khurd of district Sidhi, State- Madhya Pradesh. The location Map of the exploration block is given in PLATE-I. The Co-ordinates of the cardinal points of the block area both in geodetic and in UTM are given in Table No. 4.1 and in Annexure-IA.

Table No.-4.1

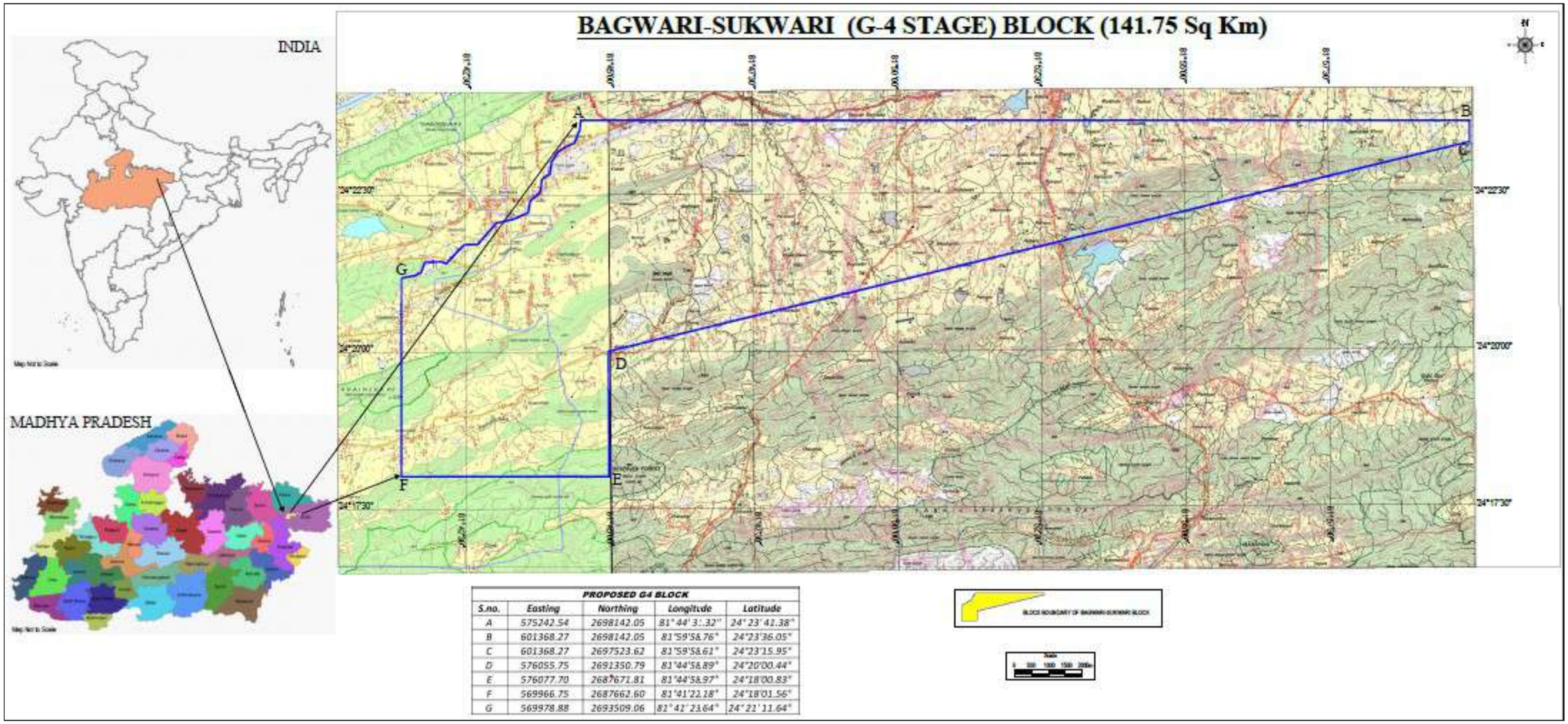
Co-ordinates of Cardinal Points of Block Boundary of Bagwari-Sukwari G-4 Block for Copper, Lead, Zinc and Graphite, Distt-Sidhi, Madhya Pradesh

Block Corner points	WGS 84 (DD MM SS)		UTM Zone-44 (m)	
	Latitude	Longitude	Easting (m)	Northing (m)
A	24° 23' 41.38"	81°44'31.32"	575242.54	2698142.06
B	24° 23' 36.05"	81°59'58.76"	601368.27	2698142.10
C	24° 23' 15.95"	81°59'58.61"	601368.27	2697523.62
D	24° 20' 00.44"	81°44'58.89"	576055.75	2691350.79
E	24° 18' 00.83"	81°44'58.97"	576077.70	2687671.81
F	24° 18' 01.56"	81°41'22.18"	569966.70	2687662.60
G	24° 21' 11.64"	81°41'23.64"	569978.88	2693509.06

4.1.3 The exploration block is located in the south of Sidhi town, which is the district headquarter of Sidhi district. The block is well connected with motorable/ metalled road. The Jhansi-Ranchi National Highway NH-39 passes in the north of the block.Part of this Highway connects Rewa to Sidhi. State Highway SH-55 connecting Sidhi to Beohari and Sidhi-Madwas are the major road which passes through the block. The nearby railway

stations from the exploration block are Beohari (55 Km), Rewa (70 Km), Satna (101 Km), all these railway stations comes in Jabalpur Division of West Central Railway.

The nearest airport from the exploration block is Banaras which is 190 Km away in NE direction from the block.



PROPOSED G4 BLOCK				
S.no.	Easting	Northing	Longitude	Latitude
A	575242.54	2698142.05	81°44'31.32"	24°23'41.38"
B	601368.27	2698142.05	81°59'58.76"	24°23'36.05"
C	601368.27	2697523.62	81°59'58.61"	24°23'15.95"
D	576055.75	2691350.79	81°44'58.89"	24°20'00.44"
E	576077.70	2687671.81	81°44'58.97"	24°18'00.83"
F	569966.75	2687662.60	81°41'21.18"	24°18'01.56"
G	569978.88	2693509.06	81°41'21.64"	24°21'11.64"

Text Figure-4.1: Location Map of Bagwari - Sukwari (G-4 stage) Block for Copper, Lead, Zinc and Graphite, District- Sidhi, Madhya Pradesh

4.2.0 DETAILS OF THE AREA WITH LAND USE

4.2.1 Major part of the block is devoid of forest and falls under private land. Some parts of the block falls under Thakurdeva and Pabaia Reserve Forest area.

4.2.2 The cadastral details of the area are not acquired.

4.3.0 MINERAL(S) UNDER INVESTIGATION

4.3.1 The block has been explored for copper, lead, zinc and graphite and associated minerals.

CHAPTER-5

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 general physiography of the area is flat low lying (peneplain) terrain except some isolated low rising hillocks and mostly northeast-southwest striking ridges in the southern part of the block. The altitude of the study area varies between 280m (west) and 490 m (east & south).

5.1.2 The drainage pattern in the area is of dendritic type. The dendritic drainage (South Central part of the Block) channels flow towards North forms to Tendum Nala. Drainage (in the North-Eastern part of the Block) channels flow towards North in the form of Deonar Nala.

5.1.3 Block area is primarily characterized by its rural and semi-urban landscape. Water resources play a crucial role in the lives of its residents for various purposes, including agriculture, drinking water supply, and industrial use. Groundwater is an essential source of water for both agricultural and domestic purposes in the area. The area has numerous wells, hand pumps, and tube wells that tap into the groundwater reserves. The area has number of small ponds and lakes, some of which are natural, while others have been created for water storage and irrigation purposes. These water bodies contribute to local water availability and are used for irrigation and livestock. Irrigation canals, often derived from the rivers/streamlets, are used to distribute water to agricultural fields across the district

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

5.2.1 The exploration block is located to the south of Sidhi town, which is the district headquarter of Sidhi district. The block is well connected with motorable/ metalled road. The Jhansi-Ranchi National Highway NH-39 passes in the north of the block.Part of this Highway connects Rewa to Sidhi. State Highway SH-55

connecting Sidhi to Beohari and Sidhi-Madwas are the major roads which passes through the block.

5.2.2 The nearby railway stations from the exploration block are Beohari (55 Km), Rewa (70 Km), Satna (101 Km), All of these railway stations comes in Jabalpur Division of West Central Railway. The nearest airport from the exploration block is Banaras which is 190 Km away in NE direction from the block.

5.2.3 There is one 132 KV power transmission line passes through the block connecting Sidhi to Madwas. There is another high tension power transmission lines passes through the present exploration block in NE-SW direction. Telephone and Internet line network is well developed in Sidhi district.

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

5.3.1 Sidhi district comprises 7 tehsils -Bahari, Churhat, Gopad Banas, Rampur Naikin, Majhauli, Kusmi and Sihawal. The Bagwari – Sukwari (G-4 stage) block lies in the Gopad-Banas Tehsil, Sidhi district Madhya Pradesh. There are 202 villages and 1 town in Gopadbanas Tehsil. As per the Census India 2011, Gopadbanas Tehsil has 57704 households, population of 289481 of which 149864 are males and 139617 are females. The population of children between age 0-6 is 49784 which is 17.2% of total population. The total area of Gopadbanas is 879.70 sq.km with population density of 329 per sq.km.

5.3.2 Out of total population, 81.23% of population lives in Urban area and 18.77% lives in Rural area. There are 12.78% Scheduled Caste (SC) and 30.75% Scheduled Tribe (ST) of total population in Gopadbanas Tehsil. The details of the Population Census 2011, of Gopad-Banas Tehsil are given in Table-5.1.

Table-5.1

Census Data of Gopad-Banas Tehsil, Sidhi district, Madhya Pradesh

Description	Urban	Rural
Number of households	10599	47105
Total Population	54331	235150
Population (%)	52.49%	48.4%

Description	Urban	Rural
Male Population	28521	121343
Female Population	25810	113807

Source: https://www.censusindia2011.com/madhya-pradesh/sidhi/gopadbanas-population.html

5.3.3 Sidhi District in the state of Madhya Pradesh has a significant tribal population. Some of the prominent tribal communities in the region include:

1. Gond: The Gond tribe is one of the largest tribal communities in Central India, including parts of Madhya Pradesh. They have their own unique culture, language, and traditions.

2. Baiga: The Baiga tribe is another prominent tribal community in the region. They are known for their traditional agricultural practices and strong ties to the forest.

3. Korku: The Korku tribe is found in parts of Madhya Pradesh, including Sidhi District. They have their own language and cultural practices.

4. Agariya: The Agariya community is primarily involved in salt production and is found in some parts of Sidhi District.

5. Bharia: The Bharia tribe is also present in some areas of Madhya Pradesh. They have their own language and customs.

5.4.0 SOCIO DEMOGRAPHIC PROFILE OF THE AREA AND NEARBY

5.4.1 According to the 2011 census, Sidhi District has a population of 1,127,033, roughly equal to the nation of Cyprus or the US state of Rhode Island. This gives it a ranking of 411th in India (out of a total of 640). The district has a population density of 232 inhabitants per square kilometre (600/sq mi). It's population growth rate over the decade 2001-2011 was 23.66%. Sidhi has a sex ratio of 952 females for every 1000 males, and a literacy rate of 66.09%. 8.26% of the population lives in urban areas. Scheduled Castes and Tribes made up 11.55% and 27.80% of the population respectively. In town, public facilities are easily available like auto rickshaw, bus, taxi. The district currently didn't have its own railway station. The nearest railway is Rewa railway station. Due to the efforts under Sarva

Shiksha Abhiyan (SSA), access to primary school is available to every child within 1 km., middle school within 3 km., high school within 5 km. and higher secondary school within 8 km, in Sidhi district. There are number of colleges situated at various places in the district. But coverage is not very much satisfactory. District suffers from lack of vocational training institutes. There is only one polytechnic institute and one functional I.T.I.

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

5.5.1 Sidhi district, located in the Indian state of Madhya Pradesh, is rich in historical sites, archaeological monuments, places of worship, and public utilities. Here are some notable ones:

1. **Rewa Fort**: Although technically in the neighboring Rewa district, this historic fort is a major attraction in the region. It was built by Maharaja Martand Singh in the 16th century and offers a glimpse into the rich history of the area.

2. **Bees Bhuja Devi Temple**: This ancient temple is dedicated to Goddess Durga and is known for its unique 20-armed idol of the goddess. It's a significant religious site in Sidhi.

3. **Gopad Banas Temple**: Another important religious site, this temple is dedicated to Lord Shiva and is located on the banks of the Gopad River.

4. **Shri Sita Ram Temple**: This temple, situated in Sidhi town, is dedicated to Lord Rama and Sita. It is a revered place of worship in the region.

5. **Jayanti Mata Temple**: Located in Majhauli, this temple is dedicated to Goddess Jayanti. It is a popular pilgrimage site, especially during festivals.

6. **Hinglajgarh Fort**: This historic fort is known for its archaeological significance. It is believed to date back to the Gupta period and has ruins that attract history enthusiasts.

7. **Uma Maheshwar Temple**: Situated in Churhat, this temple is dedicated to Lord Shiva and Goddess Parvati. It is an important religious site for the locals.

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

5.6.1 Part of Thakurdeva and Pabaia Reserve Forest falls in the Bagwari – Sukwari (G-4 stage) Exploration Block area. There are no Wild Life Sanctury and National Park situated within 10 km of radius from the block.

5.7.0 FLORA AND FAUNA WITHIN AND NEARBY

5.7.1 The region is known for its diverse flora and fauna, which are typical of the central Indian region. The flora of the area is of the tropical dry deciduous type comprising mixed forest range. Block area is dominated by the sal tree (Shorea robusta). Sal forests are rich in biodiversity and provide habitat for various wildlife species. Teak (Tectona grandis) is another important tree species found in the region. It is highly valued for its timber. Bamboo groves are common in Block area. Bamboo is used for various purposes, including construction and crafts.Mahua (Madhuca longifolia) is a significant tree in the region. Its flowers are used to make traditional alcoholic beverages, and its oil is used for cooking.There are grasslands and meadows in the area, which provide grazing grounds for herbivores like deer and antelopes.

5.7.2 Few wild animals are found in the area including dear, wild boar, wild dog, jackal, wolf, bison etc. Domestic cattle like dog, goat, cow and buffaloes are also present in the area including birds like crow, hen etc. Various snake species, including python and various species of vipers and cobras are found in and around the area. Crocodiles can be found in some of the water bodies in the region. The area also hosts a diverse range of insects and butterflies.

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

5.8.1 The Son, the Gopad and the Banas are the three perennial rivers flowing through the district. In addition to these, there are a number of small seasonal streams. Two canals, originating from Van Ganga Dam have started irrigating some parts of the district. The status of ground water is relatively comfortable as compared to other parts of the country. The depth of ground water varies from 60 to 150 feet in Sidhi area. The streams within the exploration block follow the drainage pattern of dendritic type. In the south central part of the block, channels flow towards North

forms to Tendum Nala.On the other hand, drainage in the North-Eastern part of the Block, channels flow towards North in the form of Deonar Nala. River Son drains the entire district (preventing draught situation) and valley region along with Bandsagar dam prevents the flood.

5.9.0 CLIMATIC CONDITIONS

5.9.1 The area has a moderate semi-arid / sub-tropical climate. It experiences a tropical climate, characterized by three distinct seasons: summer, monsoon, and winter.

(Source:https://www.worldweatheronline.com/sidhi-weather-averages/madhya-pradesh/in.aspx).

1. Summer (March to June):
    - Summers in the area are hot and dry.
    - The temperature during this season can often rise above 40°C (104°F). Generally in summer, temparature ranges between 32°C to 45°C.
    - Hot and dry winds, known as "loo," are common during the daytime.
2. Monsoon (July to September):
    - The monsoon season in Sidhi region is characterized by heavy rainfall.
    - The region receives a significant amount of its annual precipitation during this time.
    - Humidity levels are high, and the temperature drops to a more comfortable range.
    - The average annual rainfall in the area is 1132 mm. Most wet month of the year is July while windiest Month is June.
3. Winter (October to February):
    - Winters in Sidhi region are relatively mild and dry.
    - Temperatures during this season are cooler and more comfortable, with daytime temperatures ranging from 15°C to 25°C (59°F to 77°F).

- Nights can be cooler, with temperatures occasionally dropping to single digits.

5.10.0 OTHER PHYSIOGRAPHIC, SOCIAL AND ENVIRONMENTAL FACTOR

5.10.1 Various physiographic, social, and environmental factors play a significant role in shaping the region. Here are some of the key factors in each of these categories:

5.10.2 Physiographic Factors:

1. Topography: Sidhi is characterized by a diverse topography, including plateaus, hills, and plains. The Vindhya Range runs through the district, creating a hilly terrain in parts.

2. Rivers and Water Bodies: The area is crisscrossed by several rivers, streams, Nala including Tendum and Deonar Nala.

3. Forests and Natural Resources: Sidhi has forests that provide valuable natural resources, including timber and non-timber forest products.

5.10.3 Social Factors:

1. Demographics: The district has a diverse population comprising various ethnic groups, including indigenous communities. The demographic composition affects cultural practices, languages spoken, and social dynamics.

2. Education: Access to quality education is a critical social factor. The literacy rate and educational infrastructure in Sidhi impact the overall development of the region.

3. Healthcare: Healthcare facilities and access to healthcare services play a crucial role in the well-being of the population. Availability of hospitals and healthcare professionals is an important social consideration.

4. Cultural Diversity: Sidhi is known for its rich cultural heritage, with various festivals, traditions, and art forms that reflect the diversity of its residents.

5. Livelihood: The livelihood in the area is diverse and can vary depending on factors such as education, skills, and local economic conditions. Here are some common livelihood opportunities. Agriculture is a significant source of livelihood

in region, with a substantial portion of the population engaged in farming. Crops such as rice, wheat, pulses, and oilseeds are cultivated here. Farming practices range from traditional to modern, and some farmers also engage in horticulture and floriculture. Rearing livestock, including cattle, goats, and poultry, is another common livelihood option. Dairy farming is popular, with many households involved in milk production. Apart from that, There are few small-scale industries in Sidhi, including food processing, textiles, and handicrafts. These industries provide employment opportunities for local residents. Additionaly, Retail businesses, including grocery stores, small shops, and market stalls, offer opportunities for entrepreneurship and self-employment. Local Laborers are available which work in construction projects, road building, and other infrastructure development activitiy etc. Many people in Sidhi may engage in multiple livelihood activities to support their families. Additionally, efforts are often made by the government and non-governmental organizations to promote skill development and entrepreneurship in the region, thereby enhancing livelihood opportunities.

5.10.4 Environmental Factors:

1. Biodiversity: The district's diverse ecosystem supports a variety of flora and fauna. Conservation efforts are essential to protect the region's biodiversity.

2. Agriculture: Agriculture is a major source of livelihood in Sidhi. Environmental factors such as rainfall, soil quality, and irrigation infrastructure influence crop production.

3. Environmental Conservation: Issues like deforestation, soil erosion, and water pollution are environmental challenges that need attention to ensure sustainable development.

4. Climate: The district's climate, influenced by its geographical location, impacts agricultural practices, water resources, and the overall environment. Climate change concerns also need to be addressed.

5. Pollution: As industrialization and urbanization increase, issues related to air and water pollution may arise, affecting the health and well-being of the population.

6. Water Resources: Managing water resources is crucial for agriculture, drinking water supply, and overall sustainability. Dams, reservoirs, and rivers in the region are essential for water management.

5.10.5 These factors interact in complex ways to shape the physiographic, social, and environmental landscape of region. Sustainable development and improving the quality of life in the district require a comprehensive understanding of these factors and their interplay.

CHAPTER-6

INFRASTRUCTURE AND ENVIRONMENT

6.1.0 LOCAL INFRASTRUCTURE, HOST POPULATION, HISTORICAL SITES, FORESTS, SANCTUARIES, NATIONAL PARK AND ENVIRONMENTAL SETTING OF THE AREA.

6.1.1 Tha Bagwari–Sukwari G-4 stage block lies in the vicinity of Sukwari, Bagwari. Khirkhori, Parkhuri, Semaria, Kusumhar, Dhankhori, Panwar, Mauharian, Tendua, Pathera, Maharajpur, Jamuniya Khurd villages of Gopad-Banas Tehsil in Sidhi District of Madhya Pradesh. The exploration block is located in the south of Sidhi town, which is the district headquarter of Sidhi district. The Sidhi town is located near the northern margin of the block. The block is well connected with motorable/ metalled road. The Jhansi-Ranchi National Highway NH-39 passes in the north of the block.Part of this Highway connects Rewa to Sidhi. State Highway SH-55 connecting Sidhi to Beohari and Sidhi-Madwas are the major road which passes through the block. The nearby railway stations from the exploration block are Beohari (55 Km), Rewa (70 Km), Satna (101 Km), All these railway stations comes in Jabalpur Division of West Central Railway. The nearest airport from the exploration block is Banaras which is 190 Km away in NE direction from the block.

6.1.2 The district is an abode of numerous reputed educational institutions. It also provides platform for higher education. Several recognised educational institutions like Government College, Sidhi, Government Polytechnic College Sidhi, Govt. Girls Higher Secondary School Sidhi, Govt. Boys Higher Secondary School Sidhi, St. Xavier's Higher Secondary School Sidhi, Kendriya Vidyalaya Sidhi, Delhi Public School Sidhi, Saraswati Shishu Mandir, Vidya Bhawan Public School Sidhi etc are situated in Sidhi district.

6.1.3 The banking facilities are also available in the Sidhi including State Bank of India (SBI), Bank of Baroda (BOB), Punjab National Bank (PNB, HDFC Bank, ICICI Bank, Axis Bank, and Kotak Mahindra Bank, Cooperative banks, Regional Rural Banks (RRBs), Gramin Banks. Gramin Banks are specifically established to cater to the banking needs of rural areas. Other infrastructure facilities like, market,

workshops etc. are also available in the close vicinity of the block. Hospitals and hotels are available at Sidhi.

6.1.4 There are no nationally recognized sanctuaries or national parks are present in Sidhi district of Madhya Pradesh, India.

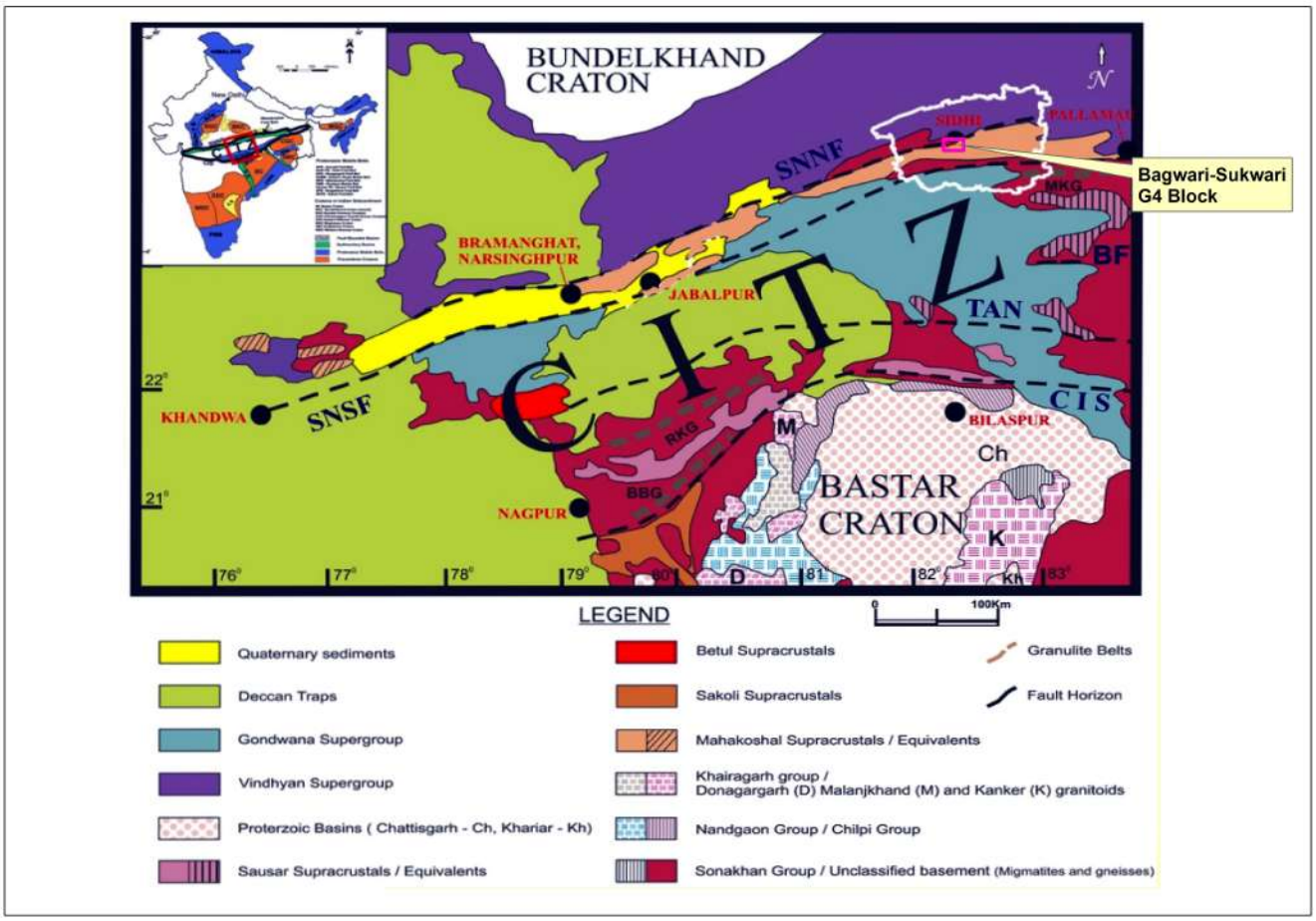
6.1.5 The host population, historical sites, forests and environmental setting of the area has been described in Chapter-5 (Physiography and Environment).

CHAPTER-7

GEOLOGY OF THE AREA

7.1.0 REGIONAL GEOLOGY

7.1.1 The area falls near the Northern boundary of the Central India Tectonic Zone (CITZ) (Text Figure 7.1) and in the close vicinity of Mahakoshal and Vindhyan Supergroup. Central Indian Tectonic Zone (CITZ) is trending in the E-W to ENE-WSW direction with about 20 to 40 km wide and 300 to 350km long. Regionally, the CITZ include



Text Figure 7.1 Geological Map of central sector of the Central Indian Tectonic Zone (CITZ) showing location of Bagwari-Sukwari (G4 stage) Block, Sidhi, Madhya Pradesh modified after Ramachandra & Roy, 2001; Roy et al., 2002).

three major Proterozoic supracrustal belts namely the Mahakoshal belt in the north, Betul belt in the central and Sausar belt in southern part set in largely undifferentiated gneisses and syn- to post tectonic granites. The northern part of the CITZ consists of an important litho-tectonic unit of Paleo Proterozoic Mahakoshal rift zone, which is confined between two Moho reaching faults, the Son Narmada

North Fault (SNNF) and Son Narmada South Fault {SNSF). The SNSF also marks the northern boundary of the Gondwana basins, whereas the SNNF marks the northern boundary of the Mahakoshal Belt and the southern boundary of the Meso-Neoproterozoic Vindhyan basin. Granites are exposed intermittently along the Narmada Rift Zone bordering the Mahakoshal Greenstone Belt. The area under investigation forms a part of the ENE-WSW trending narrow belt of meta-sediments occurring along SNNF. Archaean Older metamorphics, rocks belonging to the Mahakoshal Group, later intrusives and Vindhyans constitute the major lithotypes in the area.

7.1.2 The rocks of different Groups ranging in age from Archean to Meso Proterozoic are exposed in this region. The Paleo-Proterozoic Agori formation of Mahakoshal Group are underlain by the Archaean aged Older metamorphic and Sidhi Series and overlain by the rocks of Vindhyan Supergroup.

7.1.3 Archaean Older Metamorphics consist of talc-chlorite-schist, quartz sericite schist and granite gneiss etc. These units have been intruded by basic, ultra basic rocks including amphibolites and acidic rocks e.g. granites. Over the older metamorphics, members of the comparatively younger metasedimentary rock units to which the name Sidhi Series has been attributed (Narain Kedar,1956), lies with a faulted contact.The older schists have also been intruded by basic and ultrabasic rocks metamorphosed into metadolerites and amphibolites and it is also intruded by granite.

7.1.4 Archaens are overlain by Mahakoshal Group of Palaeo-Proterozoic rocks comprising of meta arkose, conglomerate, phyllites, quartzites, metabasics, tuffs, BHJ and BHQ. The Mahakoshals are inturn intruded by basic dykes and granites.

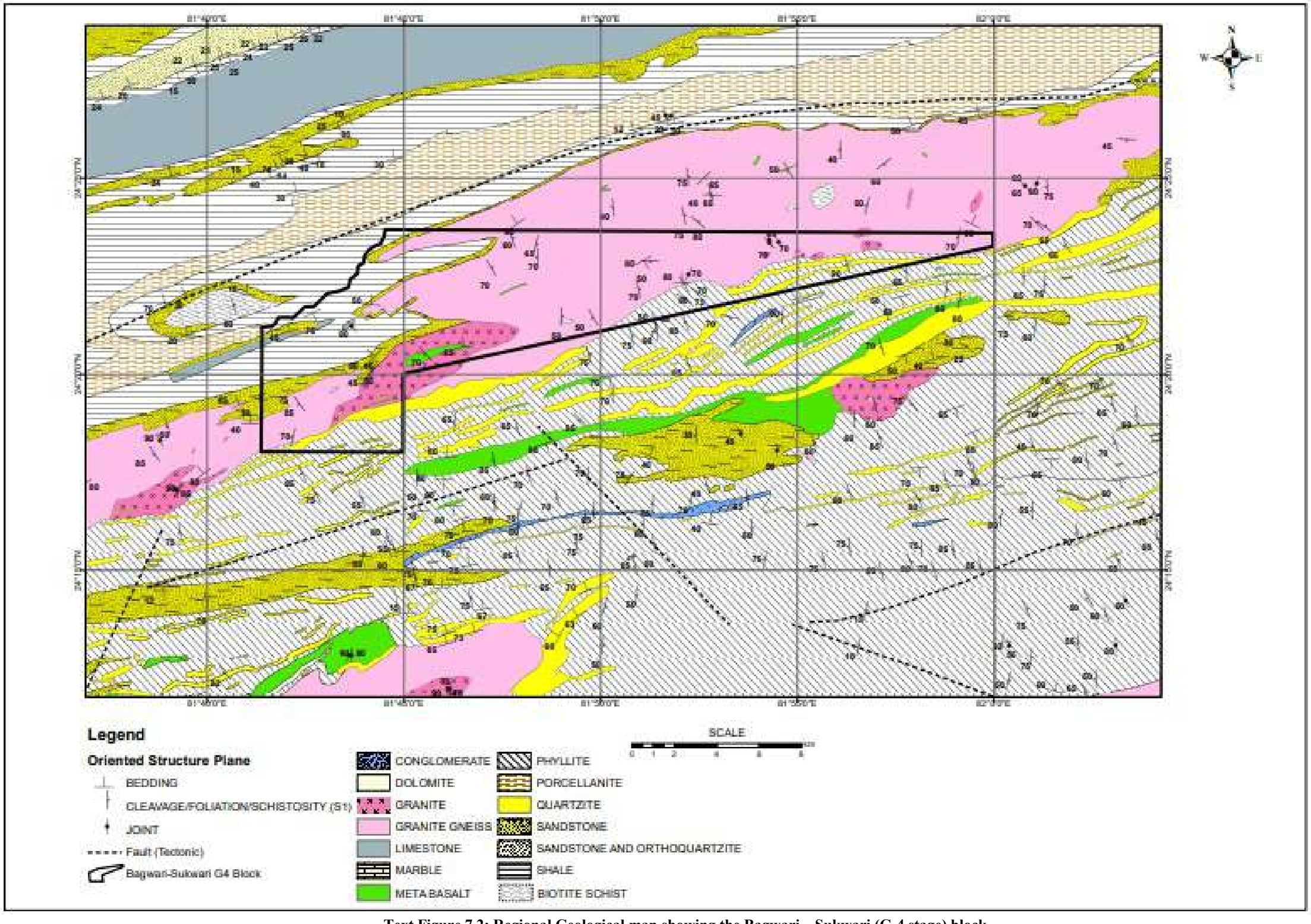
7.1.5 These Palaeo-Proterozoic rocks of Mahakoshal Group are overlain by Meso-Proterozoic aged rocks of Jungel Goup comprising upper sandstone, lower sandstone & conglomerate and Semri Series of Vindhyan Super Group including Deoland Sandstone, Arangi/Kanwari Shale, Kajrahat Limestone and Deonar Porcellanite.

7.1.6 The regional geological sequence of litho units exposed in the region is illustrated further in Table 7.1 (After GSI). Regional geological map alongwith the Bagwari-Sukwari block is given in PLATE-II and in the Text Figure 7.2.

Table No. 7.1

Regional litho-stratigraphic sequence of the area (After GSI)

Age	Super Group/Group	Litho-units
MESO PROTEROZOIC	Vindhyan Super Group/ Semri Group	Salkhan/Chorhat Limestone
		Koldaha Shale
		Deonar Porcellanite
		Kajrahat Limestone
		Arangi/Kanwari Shale
		Deoland Sansdstone
	Vindhyan Super Group/ Jungel Group	Upper Sandstone
		Lower Sandstone and Conglomerate
PALAEO-PROTEROZOIC	Mahakoshal Group	Basic dykes
		Granite
		BHQ/BHJ
		Metabasics and Tuffs
		Cherty quartzite
		Phyllite
		Meta Arkose
ARCHAEAN		Granite Gneisses, Amphibolites and Schists



Text Figure 7.2: Regional Geological map showing the Bagwari – Sukwari (G-4 stage) block

7.2.0 REGIONAL STRUCTURE

7.2.1 In the Central Indian Shield, the volcano-sedimentary units of Mahakoshal and sedimentary assemblages belonging to Semri Group (Lower Vindhyan) were deposited in Vindhyan-Mahakoshal basin. This was developed along ENE-WSW to EW trending Son-Narmada-Tapti lineament zone over a Tonalite-Trondjhemite basement representing ancient sialic crust. The end of sedimentation witnessed post tectonic intrusion of granitic plutons and alkaline suits of rocks. After a prominent hiatus, next spell of sedimentation in the form of Semris started around 1.4 Ga over Gneiss – Mahakoshal basement. Subsequent to Semri sedimentation, tectonic and magmatic activities became operative causing reactivation of basin margin faults and other tectonic elements.

7.2.2 The ENE-WSW trending Mahakoshals have mostly faulted contact with basement as well as Semri sediments except at few places, where unconformable contact between Mahakoshals and younger sediments are observed. The lithounits show a general trend of ENE-WSW with moderate to steep dips due southward.

7.3.0 REGIONAL MINERALIZATION

7.3.1 Sporadic occurrences of copper mineralisation are present in the shear zones in and around the Bagwari-Sukwari block. Copper mineralisation can be observed in the forms of malachite and azurite encrustations at several places in amphibolites, talc-chlorite-schist and hornblende-chlorite-schist in the area.Chalcopyrite is the major copper mineral found to be present with the quartz vein hosted by various schists. Copper deposits in Sidhi are found in various forms, including copper-bearing minerals, veins, and disseminations. Apart from copper, carbonaceous phyllites/graphite is also present especially in the southern part of the proposed block. Graphite ores in Sidhi are mainly of two types:

- **Flaky Graphite**: characterized by its flaky or platy nature, making it suitable for various industrial applications.
- **Amorphous Graphite**: also known as microcrystalline graphite, is found in more massive and less distinct forms.

7.4.0 BLOCK GEOLOGY

7.4.1 The area mostly exposes lithounits belonging to Archaen granite gneisses and schists represented by the Older Metamorphics comprising talc-chlorite-schist, quartz-sericite-schist etc, Mafics and Ultramafics and Granites. These older schists have been intruded by basic and ultrabasic rocks metamorphosed into metadolerites and amphibolites and intruded by granite. The granite is intrusive into the basic schists and is exposed extensively in the Bagwari- Sukwari area. Exposures of banded-haematite-quartzite of the Sidhi Series, were found to overlie the older metamorphics in the Sukwari area in the vicinity of the mineralised localities. The granitic rock is composed mainly of quartz, orthoclase, albite, muscovite biotite and hornblende. The area has undergone faulting which is evident from the slickenside surfaces reported on the basic rocks as well as the quartz veins near the contacts of the granitic area. Apart from the rocks discussed above, phyllites, cherty quartzites, BHJ/BHQ of Mahakoshal Group and Lower Sandsotne, Lower Shales of Semri Group are found in the block area.

.7.4.2 The generalized stratigraphic succession of the Bagwari – Sukwari G-4 block is given in Table-7.2.

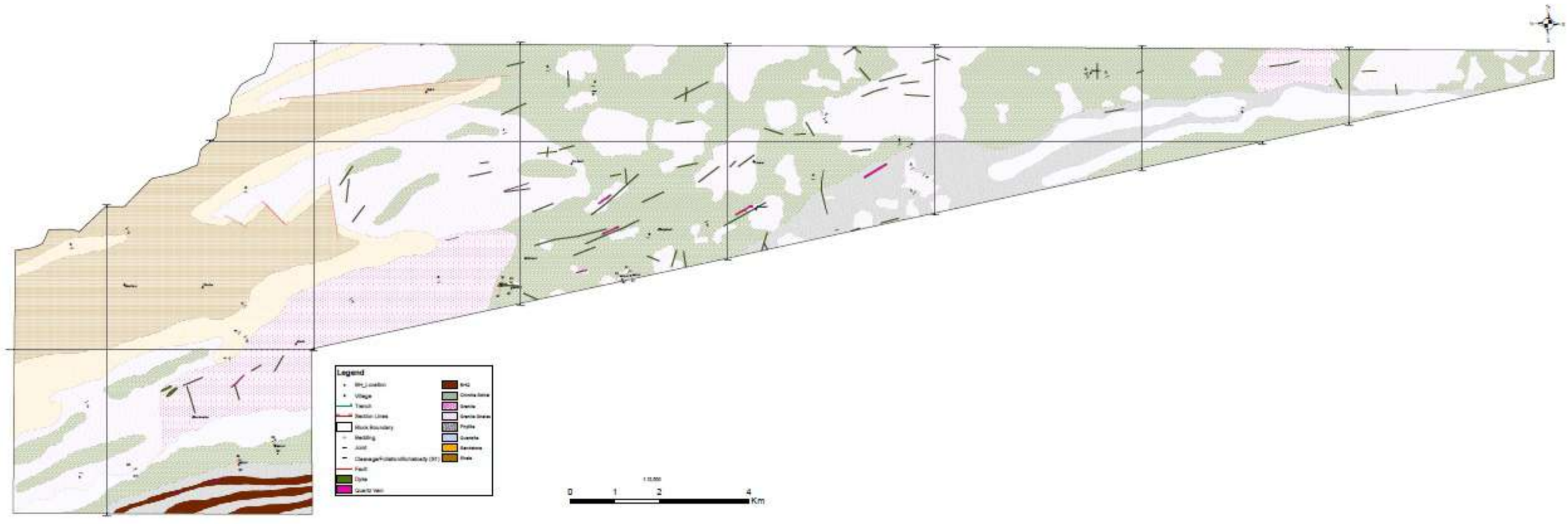
Table No. 7.2

Block Litho-stratigraphic sequence of the area (After GSI)

Group	Litho-units
Semri Group	Deonar Porcellanite
	Kajrahat Limestone
	Arangi/Kanwari Shale
	Deoland Sansdstone
Mahakoshal Group	BHQ/BHJ
	Cherty Quartzite
	Phyllite
Faulted Contacts	
Older Metamorphics (Archaeans)	Granite, Granite-Gneiss and quartz veins
	Mafic and ultramafic rocks
	Quartz-sericite-schist
	Amphibolites, Basic schists-hornblende-chlorite-schist-talc-chlorite-schist, hornblende-schist with lenses of hornblende, magnetite, epidote, quartzite and epidosite

7.4.3 Older metamorphics including granite gneisses and talc-chlorite-schist, quartz-sericite-schist are the host rock for copper mineralsation. These rocks are intruded by quartz veins in which these mineralsation can be observed.

7.4.4 General Strike of the litho-units is NE-SW and dipping 40-60° towards SE. During the course of exploration programme, entire 141.75 sq km area of the block has been mapped on 1:12,500 scale.The block geology map is presented in 1:12,500 scale as Plate-III and as Text figure. - 7.3.



Text Figure 7.3: Block Geology Map of Bagwari – Sukwari (G-4) Block for Copper, Lead, Zinc, Graphite and associated minerals, Distt.- Sidhi, Madhya Pradesh

7.5.0 DESCRIPTION OF ROCK TYPES

Various lithounits exposed in the Bagwari-Sukwari (G-4 stage) block are described as follows-

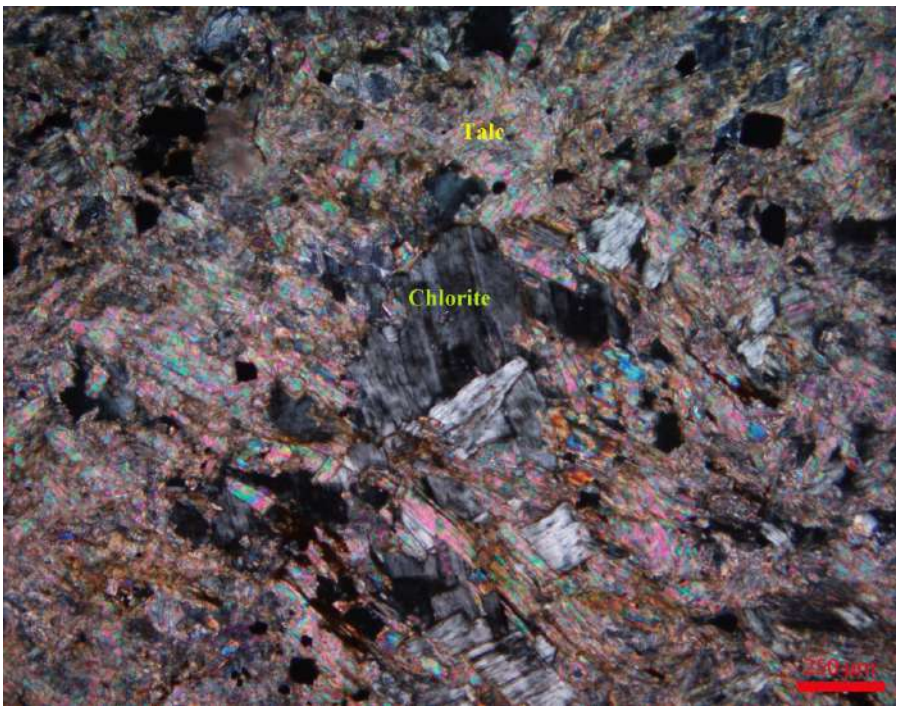
7.5.1 SCHIST:

7.5.5.1 The low lying areas are mostly underlain by different varieties of schistose rocks. These include hornblende schist, talc schist, talc-tremolite-schist, tremolite-actinolite schist, quartz chlorite schist etc. Exposures are seen around north and south of Bagwari, Sukwari, Panwar, south of Rampur Parnkhuri, Jaraundha, Bijaypur, Batauli, Shivpurwa, Janakpur and around Kushmahar. It is not possible to map these units separately, because of smaller individual size and gradational contacts. The chlorite schists are fine to medium grained, whereas the hornblende and actinolite schists are coarse grained. Commonly these are grey, pale green, olive green and dark green coloured rocks. But, depending upon the percentage of hornblende and/or actinolite-tremolite, the colour may be dark green or even brownish. The schistose character is well exhibited in all the schists. Linear arrangement of minute magnetite crystals and hornblende laths is generally seen in the chlorite and hornblende schists, respectively. The general trend of the schistosity N50°E-S50°W to N80°E-S80°W with steep to moderate dip to the SSE.

Photo-7.1 Photograph showing chlorite schist in well section in south of Kushmahar.

Photo-7.2 Photograph showing exposure of quartz chlorite schist in south of Padra village.

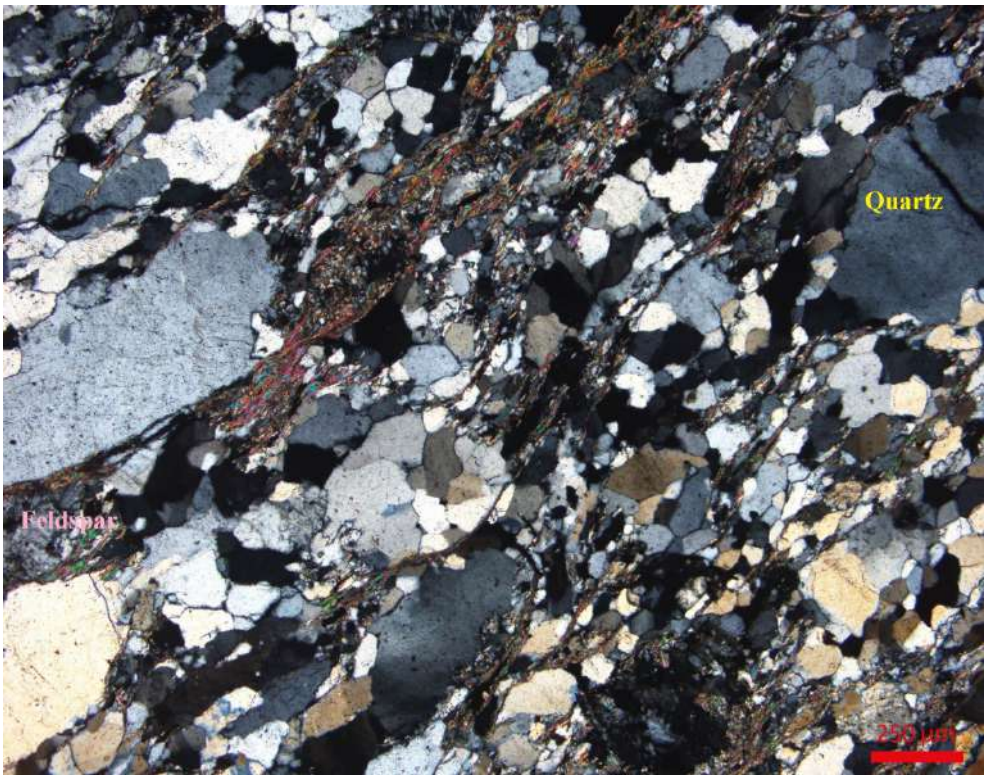
7.5.5.2 Megascopically, talc-chlorite schist is a greenish grey coloured fine grained rock showing schistosity. It feels soapy in hand. Under microscope, the talc-chlorite schist specimen is mainly composed of talc and chlorite, occurring as fine flakes and flaky aggregates showing parallel alignment (Pmg 7.2). Opaques occur as fine euhedral to subhedral grains in dissemination. Ferruginous matter is noted as reddish stains, fillings and as pseudomorphic patches.



Pmg- 7.1: Photomicrograph showing association of talc, chlorite and opaquesas seen undercrossed nicols.

Specimen No. : MSB-PG-05 **Magnification :40X**

7.5.5.3 Under the microscope, quartz-plagioclase-sericite/ muscovite schist is a fine to medium grained rock showing schistosity.Quartz and plagioclase occur as fine anhedral grains and as medium to moderately coarse subrounded lensoidal and elongated grains showing parallel alignment, where plagioclase grains are partially sericitised. Sericite/ muscovite are present as very fine to fine flakes and flaky aggregates showing parallel alignment. Reddish ferruginous patches and fillings are seen intruded along schistosity in areas. Opaques occur as fine to very fine anhedral grains, specks and as relicts within ferruginous matter.



Pmg- 7.2: Photomicrograph showing association and parallel alignment of quartz, feldspar and sericite/ muscovite as seen under crossed nicols.
Specimen No. : MSB-PG-18 **Magnification :40X**

7.5.2 GRANITE GNEISS:

Granite gneiss occurs in isolated patches. Several exposures are seen in nala, road sections and some exposures in agriculture fields near Parkhuri, Sukwari, Bagwari, Khirkhori, Panwar, South of Sidhi and Janakpur villages.The gneiss is predominantly pink in colour, but dark greenish colour and greyish colour are also seen.The rock is medium to coarse grained. The granite gneiss is traversed by dykes and quartz veins of small dimensions.

Photo-7.3 Photograph showing exposure of Granite Gneiss near south of Khirkhori village

7.5.3 PHYLLITE:

Phyllites occur extensively and cover most of the low lying areas. The phyllites sometimes carry, as intercalations, thin quartzite or ferruginous phyllite bands. At places, phyllites to form hillocks, ridges and mounds, they were found around the South of Kushmahar, Jaraundha, Bijaypur, Batauli, Shivpurwa and Janakpur. It occurs in a variety of colours, mostly greenish grey (chloritic look), purple dirty white, silver grey and black. Such black phyllites have been termed as carbonaceous phyllites. These variations are due to the difference in mineralogical-composition. The phyllites break along the foliation which is rather crudely developed but it breaks easily along the bedding planes. The rocks are usually soft but sometimes the presence of free silica or later silicification causes some hardness. General trend of the phyllites varies from N50°E-S50°W to N80°E-S80°W with steep to moderate dips to the SSE. At places reversals have also been seen.

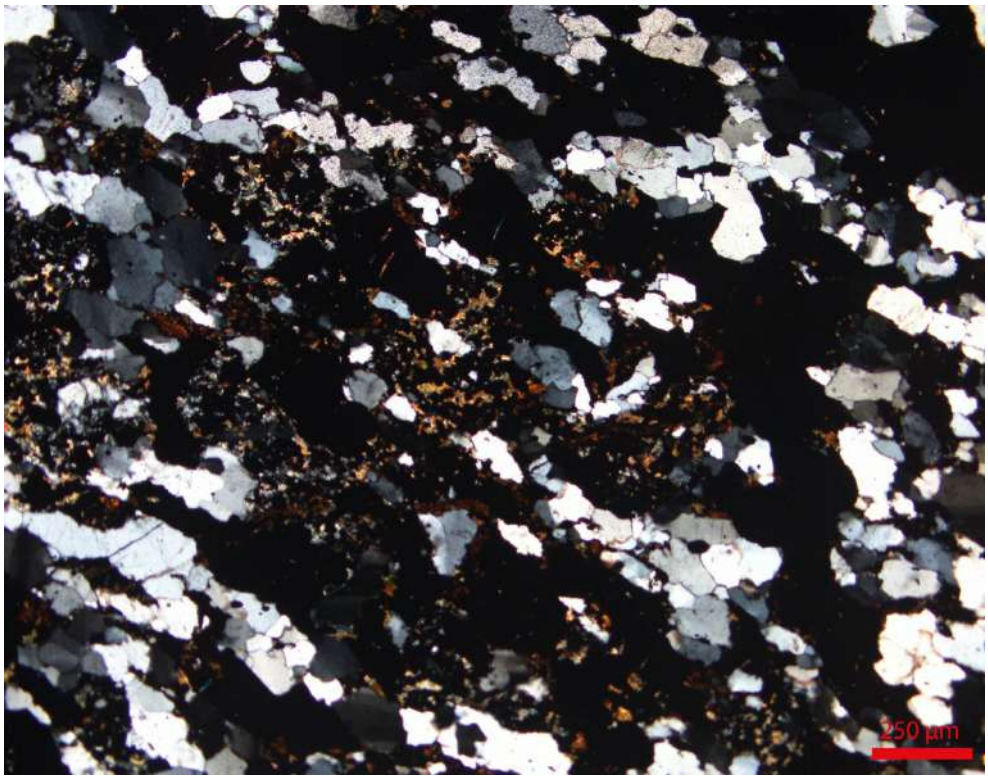
Photo-7.4 Photograph showing exposure of Carbonaceous phyllites in south of Kushmahar

7.5.4 BANDED HEMATITE QUARTZITE AND BANDED HEMATITE JASPER (BHQ/BHJ)

7.5.4.1 BHQ/BHJ is present in the form of continuous ridges in the ENE-WSW direction and the occurrence is similar to the quartzites in all respects. Exposures are noticed at south of Kusumhar village, in the south west of the exploration block. The banded rock alternately consists of arenaceous material and ferruginous material. The ferruginous material is mainly magnetite on altered to hematite. Thus the rock occurs mainly as banded hematite quartzite. The two compositionally different bands often merge in to each other laterally. The hematite is some tines secular. Occasional concentrations of hematite were used locally for smelting purposes. The hematite is cherry red. Some crenulations and shear slips are observed in the rock and the crenulations ore clear due to the thinness and alternation of the bands.

7.5.4.2 Under microscope, mineralized (hematite) quartzite is a fine to medium grained foliated rock showing granular texture and mineralization. Pmg 4.2 shows that Quartz occurs as fine to medium anhedral and elongated grains showing granular texture and crude alignment. Opaques (hematite) are present as fine to medium anhedral to subhedral grains, its aggregates and patches showing crude alignment

and also occur as fine fillings along the foliation. Biotite and sericite are present as fine to very fine flakes, often segregated in pocket. Reddish ferruginous patches and fillings are seen associated with opaques in areas.



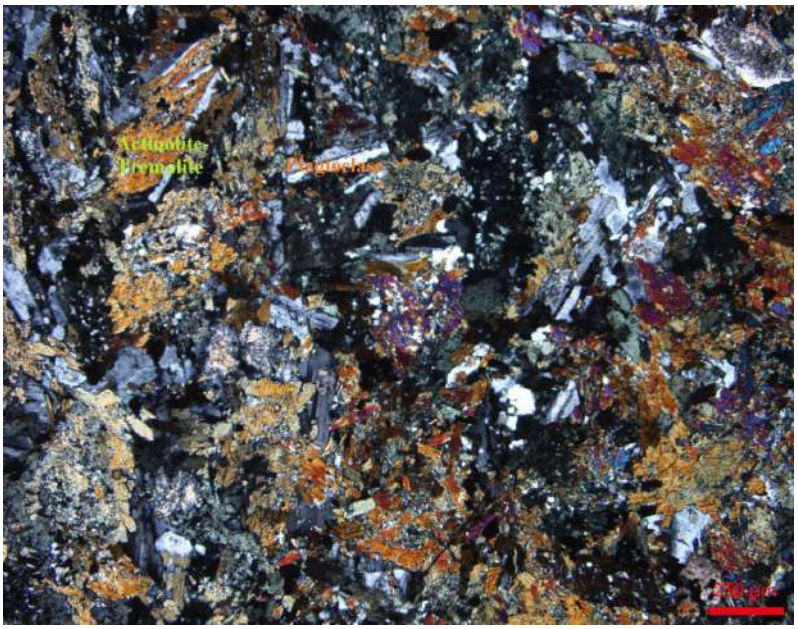
Pmg- 7.3: Photomicrograph showing association and parallel alignment of quartz, opaques (hematite) and biotite under crossed nicols.
Specimen No. : MSB-PG-12 **Magnification :40X**

7.5.5 BASIC INTRUSIVES AND QUARTZ VEINS :

7.5.5.1 A number of basic/metabasic rocks and quartz veins are seen to traverse the different rock types. At places, quartz vein within granite gneiss and schist are having copper mineralisation. Occurrences of these intrusions are numerous and widespread in the block. Exposures near Bagwari, Sukwari, Panwar, south of Rampur Parnkhuri, Jaraundha, Bijaypur, Batauli, Shivpurwa, Janakpur and around Kushmahar are seen.The basic rocks are mostly doleritic, and when affected by metamorphism, have given rise to amphibolites. These occur as thin discontinuous lenses. Most of the intrusives have a general trend parallel to that of the country rock. The rocks are light to dark green, medium to coarse grained and massive.

7.5.5.2 Under microscope, Amphibolite is a greenish grey coloured medium to fine grained rock showing granular texture. Pmg 7.4 shows actinolite-tremolite occurs as medium

to fine subhedral prismatic grains and its aggregates. Plagioclase occurs as subhedral prismatic laths and as anhedral turbid patches showing partial sericitisation in areas. Opaques are present as fine to medium anhedral to subhedral and skeletal grains in disseminations. Sericite occurs as very fine flaky aggregates seen developing after plagioclase alterations. Calcite is seen intruding as patches and fillings. Chlorite is noted as patches replacing amphiboles.



Pmg- 7.4: Photomicrograph showing association of plagioclase and actinolite-tremolite, where plagioclase grains are partially sericitised as seen under crossed nicols.**Specimen No. : MSB-PG-01** **Magnification :40X**

7.5.6 QUARTZITE:

The quartzite is generally white, dirty white to grey in colour, hard, massive and silicified at some places. Due to its massive and resistant nature it forms continuous prominent ridges running for long distances in the ENE-WSW direction. Prominent ridges occur to the south of Kushamahar, Ainthi & near Maharajpur, Lahoritola and Janakpur. It also occurs as thin intercalations within the phyllites. It's often highly fractured and jointed. Thick Breccia / conglomerate bands (NW of Katrikani) also occur in Quartzite.

Photo 7.5 Field photograph showing exposure of quartz fragments in ferruginous cement near NW of Katrikani

Photo 7.6 Field photograph showing exposure of Quartzite exposure near east of Kusmahar

7.5.7 GRANITE:

Granite occurs in isolated patches. Exposures are seen in nala and road sections as well as in some outcrops in agriculture fields nearby Kushmahar, Ainthi, Obraha, Bahamni and East of Shivpurwa. The granite is predominantly pink in color, but greyish colours are also seen. The pink variety gradually grades into grey. The rock is medium to coarse grained and is comprised of laths of idiomorphic pink K-feldspar, vitreous quartz and greyish plagioclase. Muscovite is generally less, but has varying amount of biotite.The granite is traversed by dykes and quartz veins of small dimensions. Basic dykes and quartz veins are seen in North and North-West of Kushmahar and near Ainthi. The quartz veins have ENE-WSW trend. The irregular occurrence, graphic intergrowth between quartz and feldspar and effect of metamorphism on the schist in contact with the granite, suggest intrusive nature of the granite. Definite intrusive contacts, however, have not been noticed on surface exposure, but the granite occurring in borehole MSB-01 & MSB-02 at Bagwari show definite contact.

Photo 7.7 Field photograph showing exposure of granite in north of Kushmahar

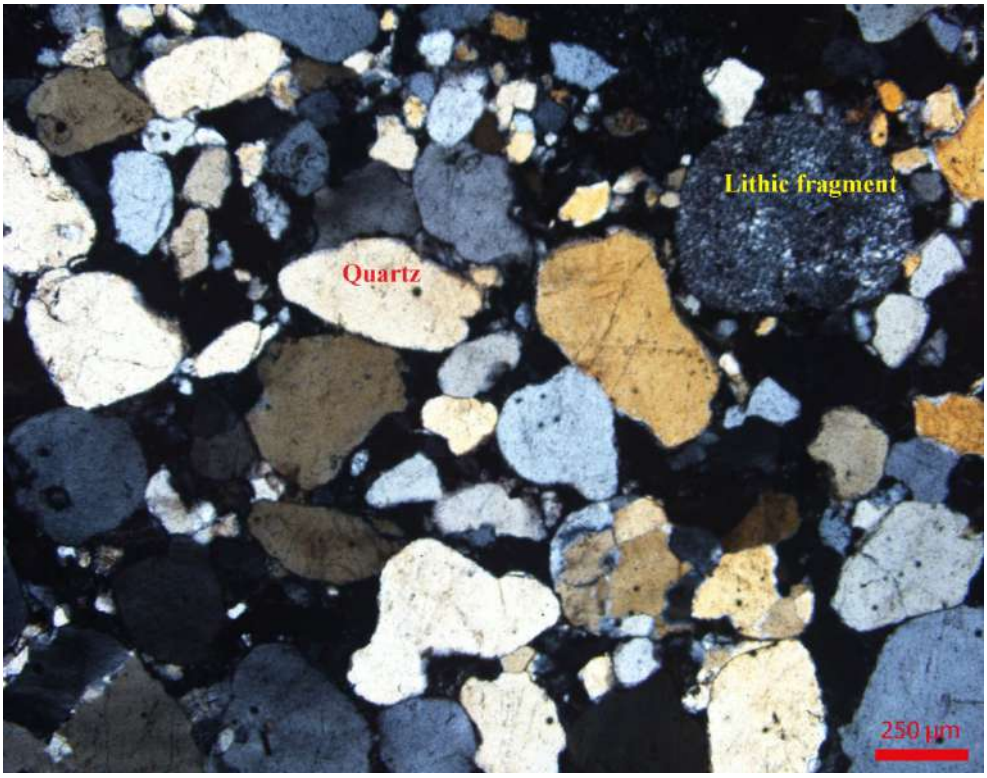
Photo 7.8 Field photograph showing exposure of granite near Ainthi village

Photo 7.9 Field photograph showing exposure of pink granite in east of Bahmani village.

7.5.8 SANDSTONE:

7.5.8.1 It occurs in direct contact with the older rocks i.e. basic schists, granite gneiss & granite. The contact is sometimes a faulted one, particular mention may be made for the occurrence in west of Parnkhuri. Sandstone is grey to greyish white in colour, hard, compact and massive consisting mainly of fine to medium grained quartz cemented by siliceous matter. It forms continuous prominent ridges running for long distances in the ENE-WSW direction. Prominent ridge occurs south of Karaudiya, Mankisar, Hasthinapur and Bahmni.

Photo 7.10 Field photograph showing exposure of Sandstone near south of Mankisar



Pmg- 7.5: Photomicrograph of sandstone showing quartz and lithic fragment clasts are floating over clayey matrix as seen under crossed nicols.

Specimen No. : MSB-PG-06 **Magnification :40X**

7.5.8.2 Under microscope, sandstone is medium to coarse grained clastic rock showing granular texture (Pmg 7.3).The specimen is mainly made up of quartz clasts floating over clayey matrix. Quartz clasts are showing overall bi-modal grain size distributions, occurring as coarse sand to gravel sized well rounded grains and as fine sand sized subangular to subrounded grains. Lithic fragments are present as medium to fine well rounded clasts consisting of very fine to fine quartz grains. Clay minerals occur as very fine dull semi-opaque particles and acting as matrix material. Opaques occur as fine disseminated grains. Ferruginous matter is present as very fine reddish fillings and acting as cement. Biotite occurs as flakes and patches, mostly leaching ferruginous stains. Feldspar is noted as fine to medium subrounded grains in accessories. Over all grains are poorly sorted and moderately packed.

7.5.9 SHALE

7.5.9.1The low lying areas in the north-west corner of the block are mostly underlain by this rock type. It varries in colour from green to dark black.It is thinly bedded, have a

general trend of ENE-WSW and low to moderate dips to the north. Exposures of shale are observed near Mankisar, Obhraha, Deocha, Kathariya.

7.6.0 PETROGRAPHIC STUDIES:

7.6.1 A total of 20 nos of surface samples of various litho-units collected during geological mapping and field traverses in Bagwari-Sukwari, were subjected to petrographic studies at Petrology Laboratory, MECL Nagpur. The results are furnished as Annexure-X.

7.6.2 Summary of the petrographic study done by Petrology Laboratory, MECL is displayed in Table 7.3.

Table No. 7.3

Summary of the petrographic study done by Petrology Laboratory, MECL

SL. NO	SAMPLE NO.	WGS 84 (DD MM SS)		ROCK TYPE CONFIRMED BY PETRO LAB
		EASTING	NORTHING	
1	MSB-PG-01	24.373515	81.833440	Amphibolite.
2	MSB-PG-02	24.329833	81.731558	Tourmaline rich mineralized (hematite) quartzite.
3	MSB-PG-03	24.330570	81.715180	Sericite quartzite.
4	MSB-PG-04	24.352190	81.774740	Altered granite.
5	MSB-PG-05	24.357266	81.785462	Opaque rich talc-chlorite schist.
6	MSB-PG-06	24.373287	81.754278	Conglomeratic sandstone.
7	MSB-PG-07	24.383311	81.958073	Quartzite.
8	MSB-PG-08	24.386090	81.802810	Amphibolite schist.
9	MSB-PG-09	24.378636	81.818563	Mineralized (hematite) quartzite.
10	MSB-PG-10	24.334951	81.720635	Quartz arenite.
11	MSB-PG-11	24.372350	81.858870	Quartz-chlorite schist.
12	MSB-PG-12	24.373698	81.819839	Mineralized (hematite) quartzite.
13	MSB-PG-13	24.364969	81.810764	Altered meta-basalt.
14	MSB-PG-14	24.350060	81.763800	Quartz arenite.
15	MSB-PG-15	24.368840	81.8699.70	Meta-quartz diorite.
16	MSB-PG-16	24.313840	81.724090	Quartzite.
17	MSB-PG-17	24.308840	81.734770	Banded mineralized (hematite) quartzite.
18	MSB-PG-18	24.310660	81.747991	Quartz-plagioclase-sericite/ muscovite schist.
19	MSB-PG-19	24.375920	81.876470	Botite-plagioclase-calcite and quartz rich rock
20	MSB-PG-20	24.369010	81.862720	Tremolite schist.

7.7.0 MINERALISATION IN THE BLOCK

7.7.1 In the present exploration block, noticeable copper mineralization has been encountered. Azurite, Pyrite, Malachite were encountered in surface, trench and as

well as in Boreholes. Chalcopyrite was observed in borehole cores. Chloritisation and biotitisation are seen in the cores as hydrothermal alteration. Sporadic occurrences of copper mineralisation are seen in the brittle shear zones near Sukwari, Bagwari and other villages south of Sidhi. Baryte veins are also noticed mainly in the granitoid rocks trending in E-W and NNW-SSE as reported by earlier workers. The smaller veins are upto 5-10m in length and up to 0.5 m in width. The base metal mineralisation is manifested on the surface as malachite, azurite encrustations and chalcopyrite and pyrite disseminations in various schistose and gneissic rock assemblages of the block associated with quartz veins and stringers. Some of the copper zones are closely associated with gold values (up to 1.75ppm Au). High arsenic values are also noticed in the ore zones. Copper mineralization in the block is structurally controlled, and is present in sheared quartz vein hosted by granite gneiss and quartz chorite schist and other schists as well.

7.7.2 Precisely it can be said that the surface menfestations of mineralization noticed in the block as malachite stains, azurite etc. along quartz veins in gneisses and schists. In the drilled boreholes, copper mineralization was noticed in the form of specks, veins, lense of chalcopyrite, pyrhotite and pyrite in the altered quartz veins. The hydrothermal alteration feature are noticed in the form of chloritisation, biotitization and sercitization which can be demarcated as mineralized zones.The nature of the mineralization are mentioned below-

a. Surface Indication – For Copper mineralization -Gossanised/oxidised attributes, malachaite encrustations and azure blue menifestations.

b. Ore Texure- metallic

c. Mode of occuerence- Lensoidal. confined to quartz veins and stringers along brittle shear zones

d. Strike length – 100m each at two locations (Borehole MSB-01 and MSB-03).

e. Controls of Mineralization: The barite and associated sulphide mineralization follow a set of faults in the basement to Mahakoshal belt. Epithermal barite veins, with or without sulphides, are common at and near the margins of rift basins, both in continental and continental margin settings. Pre-existing fractures and faults are essential in localising the veins and orebodies.

f. Ore body geometry- Lensoidal.

7.7.2 In boreholes, chalcopyrite is observed in association with quartz vein within chlorite schists (Photo 7.11 and Photo 7.12). Chloritisation and biotitisation seen in the cores as hydrothermal alteration. Azurite menifestations were observed in trenches. (Photo 7.13).

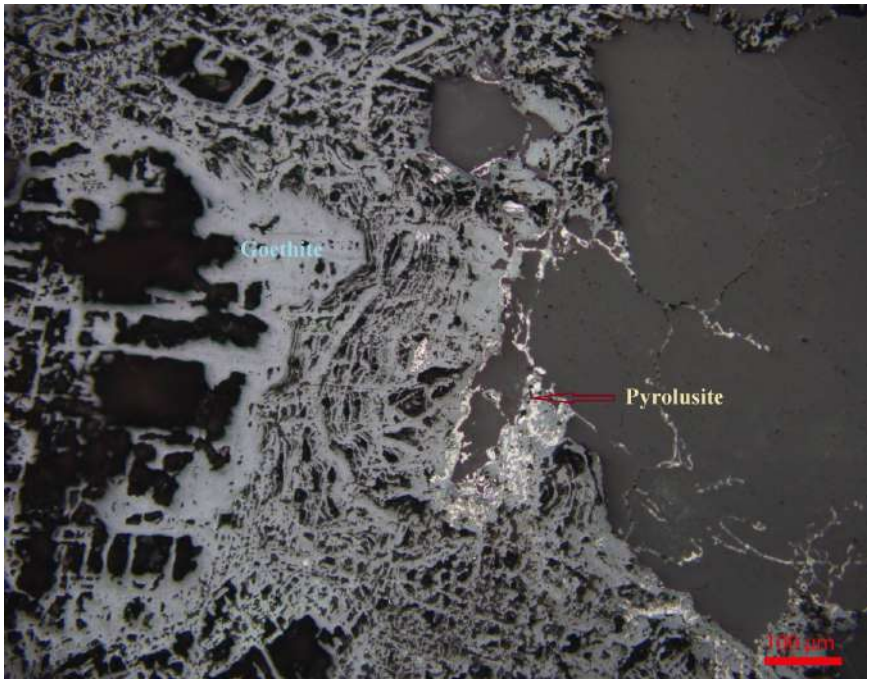
Photo 7.11 Photograph of borehole core of BH- MSB-01 at depth 32.00m-32.30m, showing the prsence of chalcopyrite.

Photo 7.12 Photograph of borehole core of BH- MSB-03 showing chalcopyrite mineralisation at various depth

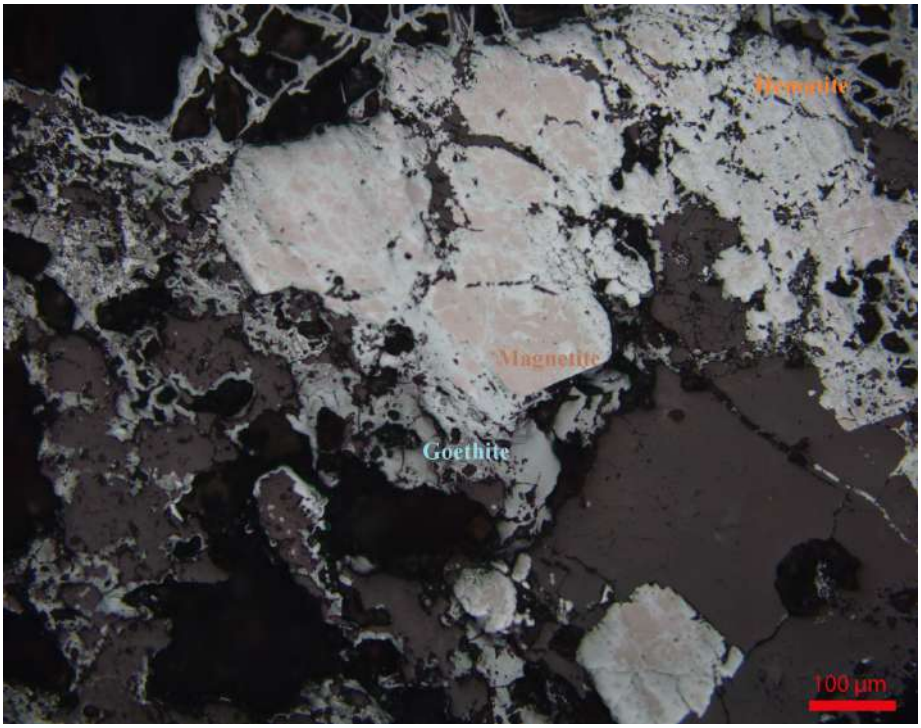
Photo 7.13 Photograph showing azurite menifestations in trench T2 near Khirkhori village

7.8.0 MINERAGRAPHIC STUDIES

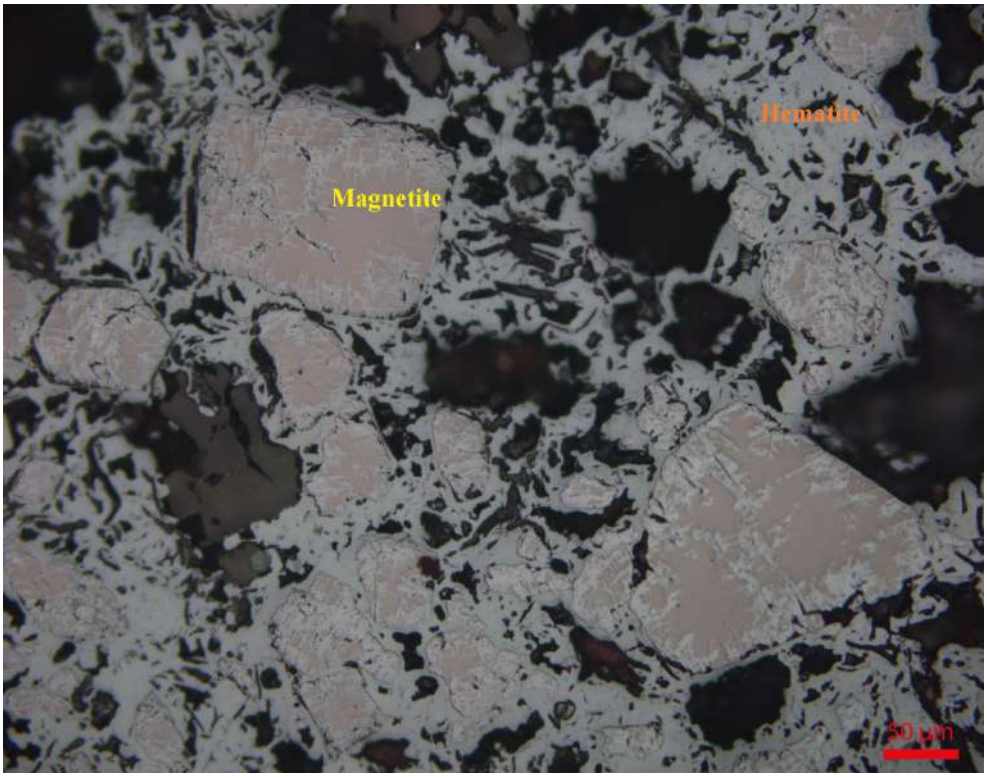
7.8.1 A total of 10 nos. of polished sections of mineralized surface samples were subjected to mineragraphic studies. The polished section studies suggest the presence of chalcopyrite, haematite, magnetite, goethite and limonite. The sample wise details of the mineragraphic studies are presented as Annexure-XI and the photomicrographs of the thin section are given as Pmg-7.6 to Pmg-7.10.



Pmg – 7.6: Photomicrograph showing occurrence pyrolusite in association with goethite as seen under reflected light.
Specimen No. : MSB-MG-03 **Magnification :100X**

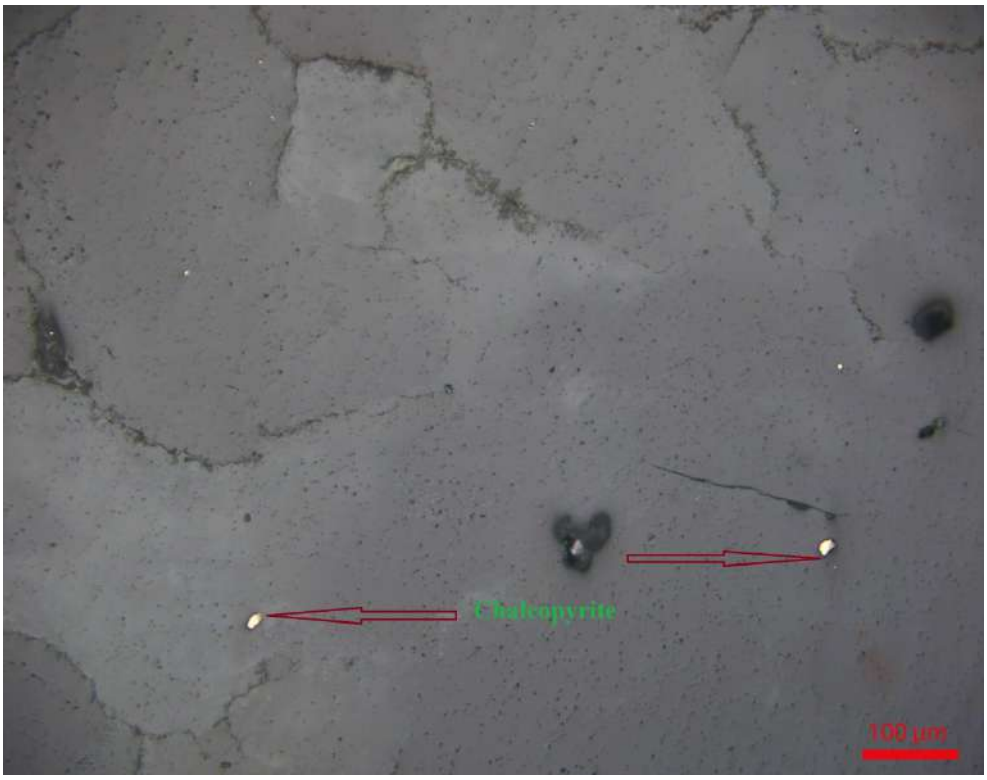


Pmg – 7.7: Photomicrograph showing martitisation of magnetite,which is being replaced by goethite fillings as seen under reflected light.
Specimen No. : MSB-MG-05 **Magnification :100X**



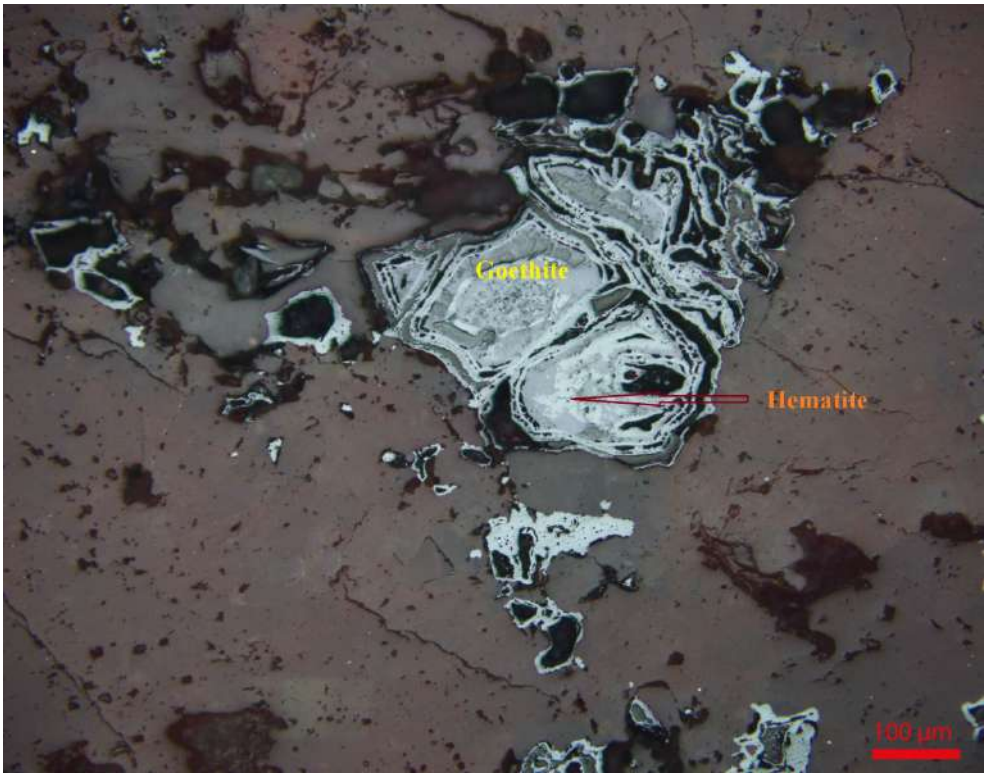
Pmg – 7.8: Photomicrograph showing martitisation of magnetite as seen under reflected light.

Specimen No. : MSB-MG-07 **Magnification :200X**



Pmg – 7.9: Photomicrograph showing very fine specks of chalcopyrite under reflected light.

Specimen No. : MSB-MG-08 **Magnification :100X**



Pmg – 7.10: Photomicrograph showing hematite and goethite intermixed patches and reddish limonitic stains seen under reflected light.
Specimen No. : MSB-MG-10 **Magnification :100X**

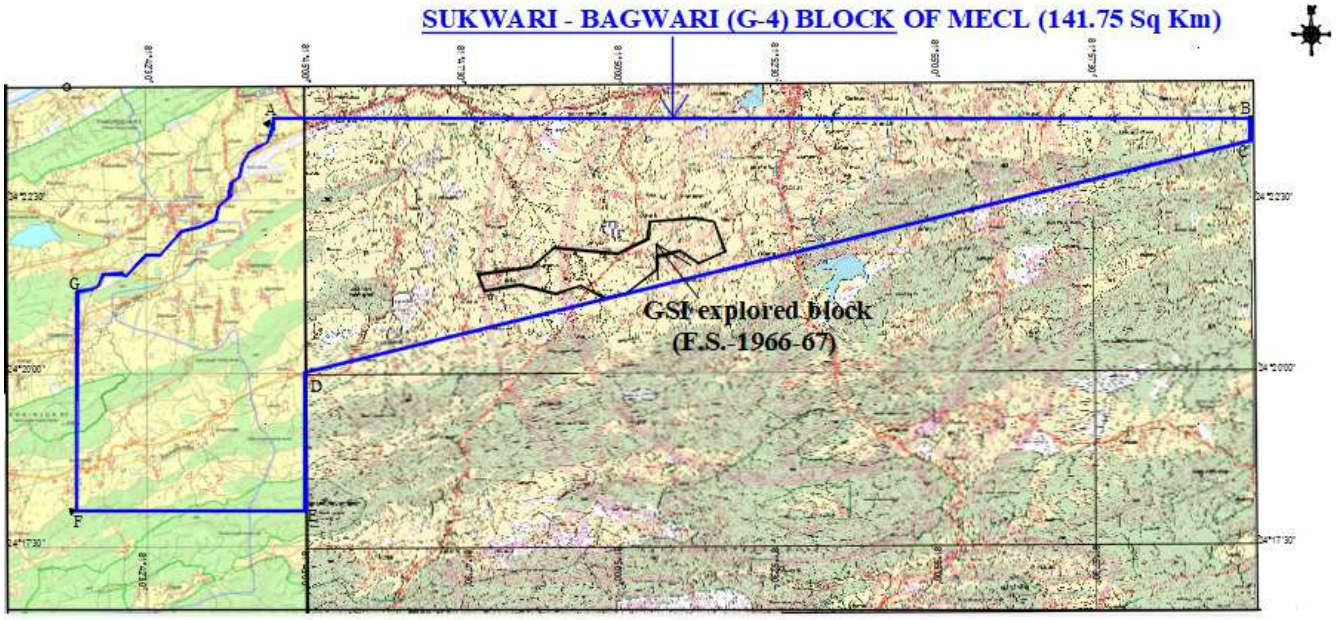
CHAPTER-8
PREVIOUS WORK

8.1.0 DETAILS OF PREVIOUS EXPLORATION CARRIED OUT BY OTHER AGENCIES/PARTIES

8.1.1 The earliest account of the area was given by Mallet (1869) who carried out traverse survey, while mapping in adjacent Vindhyans. Subsequent work in the area and neighboring tracts carried out by Oldham, (1901) Dutta and Vredenburg. Kedar Narain (1956) mapped the area around Sidhi in 1952-53 and parts of the area to the east and SE of Sidhi in 1954-55. He has referred the metasedimentary rocks in the area first as Bijawars in his earlier report and as "Sidhi Series" in his later report. He has correlated the Sidhi Series with the Iron Ore Series of the Singhbhum District in Bihar and the Lora (?) stage of Jabalpur Series. J. Narayan Murthy and T.S. Radhakrishna (1961) carried out preliminary examination in the neighboring Satnara-Byriah Section during 1959-60. T.S. Radhakrishna and M.N. Biswanath (1962) investigated in detail in Satnara- Byriah area during 1961-62 with particular reference to the copper deposits. G.V. Rao and P.K. Ramam (1965, p. 3,7-10) have carried out systematic mapping in the Archaeans and Lower Vindhyans in parts of the Gopad-Banas Tehsil, Sidhi district during the field season 1964-65 and have accepted in general the idea of the "Sidhi Series" of Kedar Narain. Occurrences of chalcopyrite in association with pyrite, azurite, and malachite have been reported by them from the vicinities of Gara (24°27': 81°55'; 63H/15). They have collected 190 geochemical samples from an area of 450m x 275m of that locality and concluded that the mineralisation is of sporadic nature. They have also reported the occurrence of malachite encrustations from the vicinities of Gurjara (24°22':81°53'; 63H/15) Byriah (24°20':81°52'; 62H/15). Malachite encrustations, associated with azurite and covellite have been reported from the cultivated fields of Sonbersa (24°24':81°48'; 63H/15) and west of Bagwari (24°20':81°47'; 63H/15).

8.1.2 During the F.S. 1965-66, GSI has carried out the study of barytes occurrence of Sukwari and Bagwari area in Sidhi district of Madhya Pradesh. Together with baryte, preliminary investigation has also been carried out for copper mineralisation in Sukwari area by pitting and trenching. Based on the malachite and azurite staining on baryte and limonitization on the surface seven sites were selected for deep pitting. Out of these seven sites, only pit no. 1 showed some specks of chalcopyrite within a shallow depth of one metre from the surface. Chalcopyrite has been found segregated in a very hard basic amphibolitic rock. The mineralisation is in the western direction and deep pitting through it has been possible only upto a depth of about 2.1m. It has been suggested that further lateral extension of mineralisation at depth can be proved by extensive excavation or by drilling only. Besides this pit, boulders of malachite and azurite have been found together with baryte in pit nos. 2 and 3. A lateritic iron ore resembling murrum, occasionally used for road building, has also been found in these pits. From other pits, satisfactory results could not be achieved for locating any copper mineralisation.

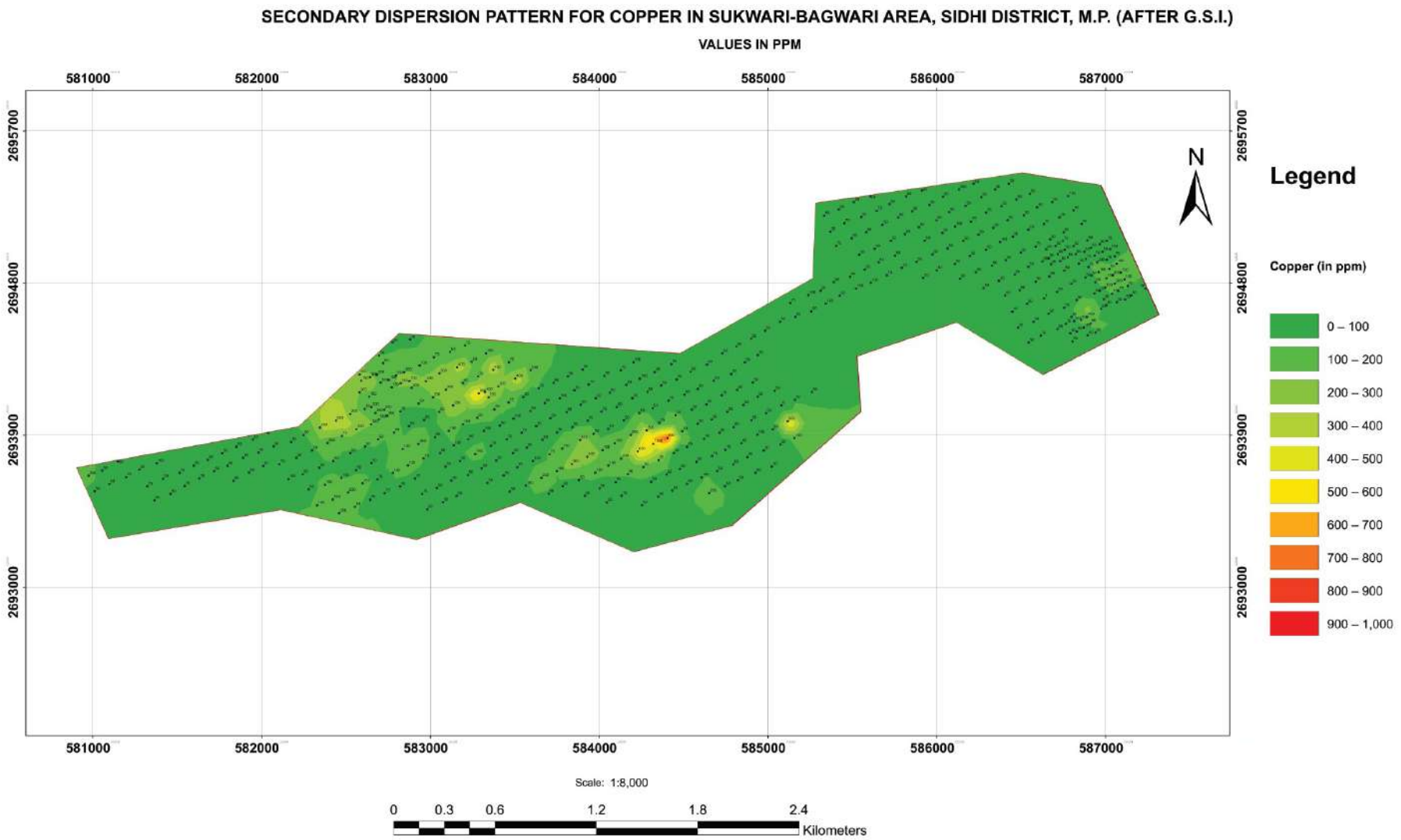
8.1.3 During the F.S. 1966-67, GSI has carried out geochemical sampling to explore for copper, lead and zinc in Sukwari and Bagwari area, in Sidhi district of Madhya Pradesh. The GSI explored block with respect to present exploration block of MECL is shown in Text Figure 8.1.



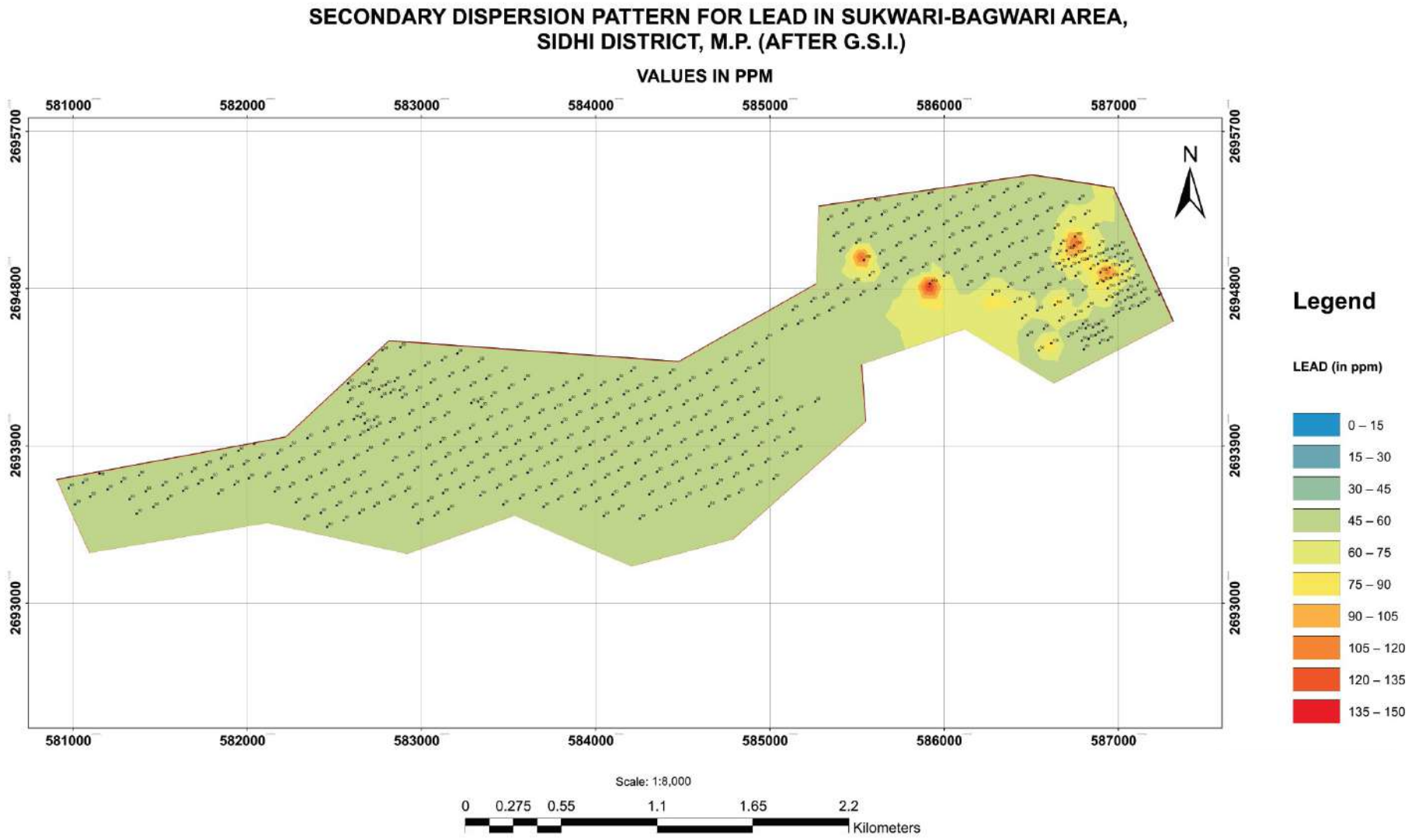
Text Figure 8.1-Map showing GSI Explored Block of GSI in FS 1966-67and the present exploration block of MECL

8.1.4 The soil cover in the area is of residual type. Geochemical soil samples were collected from the shear zone areas to find out the anomalous zones. Soil sampling was carried out on a grid pattern of 100m and 50m intervals in the shear zones and barytes areas respectively. The sample lines were aligned 67°-227° and 157°-337°. The villages traversed include Sukwari (24°21':81°51'; 63H/15), Bagwari (24°20':81°47'; 63H/15), Khirkhori (24°21':81°48'; 63H/15), Tendua (24°23':81°47'; 63H/15) and Panwar (24°23':81°47'; 63H/15). From the village of Panwar (24°23': 81°47'; 63H/15) eleven samples were collected from a linear zone marked by shearing.As the width of the shear zone is more than 100m, a spacing of 100m for the collection of samples was found to be quite ideal. A total of 499 samples were collected from the areas, and analysed to for copper, lead and zinc contents.

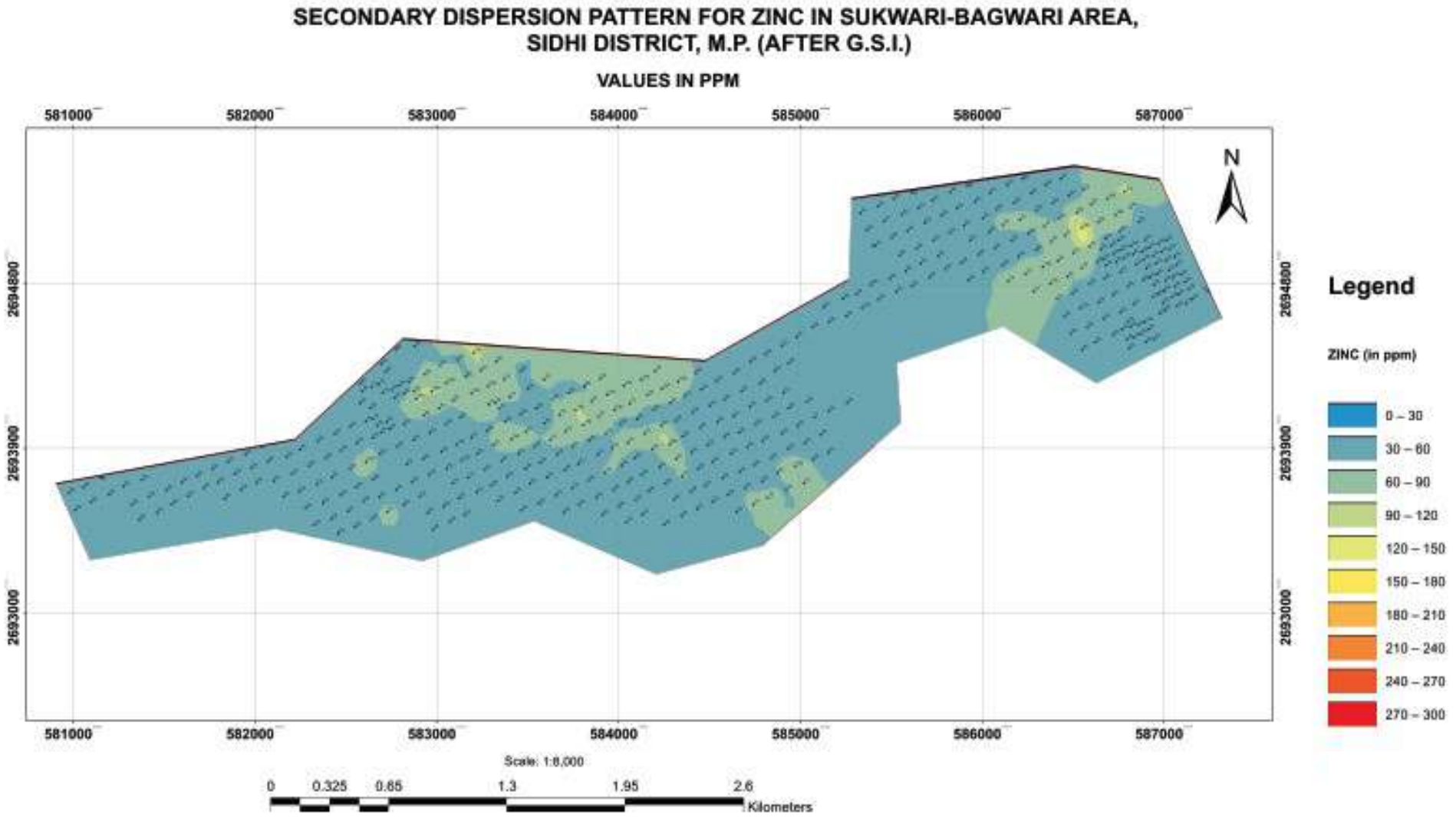
8.1.5 Geological mapping on a scale 1:10,000 was carried out in the mineralised area, based on sample points. Chemical data showing the copper, lead and, zinc contents in the samples were plotted on the grid points in order to get the 'Iso-grads'. The values thus plotted ranges from 50 to 1000 ppm. The plottings brought to light a few anomalous zones around high index values arranged parallel to the mineralised belt of the shear zone (Text Figure 8.2, 8.3, 8.4). For copper, the anomalous points coincide mainly with the barytes occurrences. Concentrations upto 700 ppm of copper were recorded in the barytes occurrences (Text Figure 8.2). The maximum copper concentrations were met with in the high grounds of the Bagwari (24°20':81°47'; 63H/15) village. The basic schistose rocks recorded copper values as much as 1000 ppm besides, 800, 600, 300 and 200 ppm concentrations were also noted in the spots. The Bagwari occurrences are similar to the Sukwari occurrences. In the western and north western parts of the Bagwari (24°20':81°47'; 63H/15) village, the copper contents touched the 800 ppm mark in the barytes zone. Besides, copper showing as much as 100 ppm are also scattered in the localities.



Text figure 8.2- Map showing available Secondary Dispersion pattern for copper in GSI explored block in FS 1966-67.



Text figure 8.3- Map showing available Secondary Dispersion pattern for Lead(Pb) in GSI explored block in FS 1966-67.



Text figure 8.4- Map showing available Secondary Dispersion pattern for Zinc(Zn) in GSI explored block in FS 1966-67.

8.1.6 Lead with values upto 150 ppm was recorded adjoining the barytes occurrences of Sukwari (24°21':81°51'; 63H/15) village. Scattered spots showing 100 ppm were found in the Bagwari (24°20':81°47'; 63H/15) village. (Text Figure 8.3)

8.1.7 Values for Zinc ranging upto 300 ppm were also recorded in the villages of Sukwari (24°21':81°51'; 63H/15) and Bagwari (24°20':81°48'; 63H/15). These were upto 150 ppm (Text Figure 8.4)

8.1.8 Aero Electro Magnetic Survey was carried out by GSI in and around the area. Ground evaluation of 95 aero-electromagnetic anomalies was carried out in toposheet Nos. 63 H/11, 12, 15 and 63 L/7 in Block-5 (BRGM/CGG), Sidhi district, Madhya Pradesh during field season 1993-94.Minor malachite encrustations are observed in ferruginous rock located about 1 km west of Khirkhori (24°21'06":81°47'39") and 900 ppm to 0.15% Cu values are reported by GSI, FS. 1993-94.

CHAPTER-9

EXPLORATION UNDERTAKEN DURING CURRENT INVESTIGATION

9.1.0 INTRODUCTION

9.1.1 The Bagwari – Sukwari (G-4 stage) block over an area of 141.75 sq. km.lies in the Gopad Banas tehsil of Sidhi district in Madhya Pradesh and it is covered in Survey of India Toposheet no. 63 H/11 and 63H/15. The current investigation was aimed to find out the potentiality for Cu,Pb, Zn, graphite and associated minerals in the block.

9.1.2 The proposal for Bagwari-Sukwari (G-4 stage) block for Copper, Lead, Zinc, Graphite and associated minerals was discussed in the 35th meeting of Technical-cum-Cost Committee (TCC), National Mineral Exploration Trust (NMET) held on 29th & 30th November- 2021, through video conferencing at Geological Survey of India, DGCO, A-II Pushpa Bhawan, New Delhi. The Bagwari-Sukwari (G-4 stage) exploration proposal was technically evaluated by the TCC for its various geological components and their suitability in the G-4 stage of exploration. The committee recommended the proposal to Executive Committee (EC) for approval of Reconaissance Survey (G-4) with geological mapping at 1: 12,500 scale, surface sampling of 200 samples, trenching of 100 cu m. and 500m of drilling by means of pilot boreholes. The TCC committee of NMET recommended the proposal for approval of Reconaissance Survey (G-4) with an estimated cost of Rs. 1,81,20, 575 i. e. approximately 181 Lakhs including GST in a time schedule of 12 months.

9.1.3 The 22nd Executive Committee (EC) held on 22nd Dec 2021 has approved the G-4 stage exploration proposal for Bagwari-Sukwari (G-4 stage) block at an estimated exploration cost of of Rs. 1,81,20, 575 i. e. approximately 181 Lakhs, vide Office Memorandum F.No. 6/2/2015-NMET/186, New Delhi, dated, 03rd Jan 2022 (Annexure- XII).

9.2.0 OBJECTIVES OF INVESTIGATION

9.2.1. The present exploration programme has been formulated to fulfil the following objectives:

1. Geological mapping and preparation of geological map at 1:12,500 Scale.
2. To check the mineralisation including copper, lead, zinc and graphite and associated minerals.

3. To estimate Reconnassance Resources (334) for 1st level of intersection as per UNFC norms and Minerals (Evidence of Mineral Contents) Rules 2015 and Minerals (Evidence of Mineral Contents) Amendment Rules 2021.
4. To facilitate the state government for auctioning of the block.

9.3.0 EXPLORATION ACTIVITIES TAKEN UP

9.3.1 The exploratory work in the block was commenced on 24.01.2022 with geological mapping on 1:12,500 scale. Simultaneously, surface sampling including the bedrock, soil and stream sampling were taken up. After, delineating the anamolous zones based on the surface sampling, trenching was done in November 2022 followed by drilling in Apr-June, 2023. The exploratory drilling commenced with drilling in borehole no. MSB-01 on 20.04.2023and completed with the closure of borehole No. MSB-06 on 21.06.2023. The allied field-works including mapping of trenches and trench sampling, sample preparation, surveying at borehole locations, borehole core logging and borehole sampling has been carried out simultaneously.The analytical/laboratory studies were carried out in laboratories of MECL and and other NABL accredited laboratories, JNARDDC, Nagpur.

9.3.2 **Geological mapping** was carried out at 1:12,500 scale for the entire area of 141.75 sq. km depicting the lithology, structure and mineralization signatures such as gossanised/oxidised zones. Identification and demarcation of oxidized/gossanised zones helped in marking the geochemical sampling locales for Bedrock, soil and stream sampling. Broad lithological units and litho-contacts have been mapped with the help of handheld GPS. Attitude and structural features of rocks like bedding, foliation, folds and joints has been recorded by Brunton Compass. General Strike of the litho-units is NE-SW dipping 40-60° towards SE direction. The readings recorded in the field were plotted and produced in the form of geological map given as Plate III.

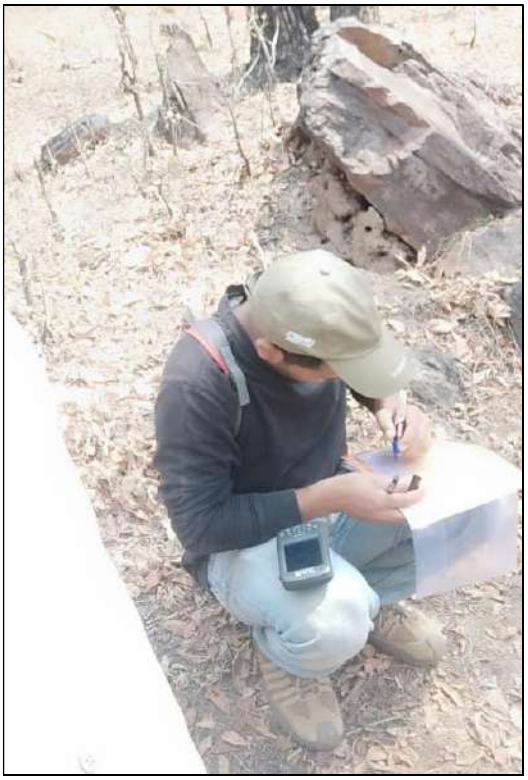


Photo 9.1 Photograph showing geologist involved in Geological mapping in the block

9.3.3 The Bagwari-Sukwari area mainly has the flat topography. Major lithologies which were encountered during geological mapping are granite gniess, quartz chlorite schist, granite, phyllites, quartzites, BHJ/BHQ, sandstone, shale, amphibolites dykes and quartz veins. Several quartz veins are present within granite gneiss and schist serves as the host for sulphide mineralization including copper, while, at few places it contain some instances of gold mineralization. Signatures of copper and gold mineralsation were observed near south and north east of Khirkhori, south of Bagwari and south of Kusmahar villages. South western part of the block has comparatively higher elevation having NE-SW trending ridges containing BHQ/BHJ. In the southern portion of the block, carbonaceous phyllites are present in which graphite instances were observed.

9.3.4 During, geological mapping, MECL has carried out surface sampling and collected a total of 202 surface samples that includes 65 bedrock samples, 111 soil samples and 26 stream samples for the analysis of 34 elements including Cu, Pb, Zn , Co, Mo, Al, As B, Ba Be, Bi,Ca, Cd, Cr, Fe, Ta, K, La, Li, Mg, Mn, Na, Ni , P, S, Nb , Si , Y , Sr , Ti , V, Sc , U, Cs. Copper values >1000ppm has been reported in 5 no. of bed rock samples and are in the range of 1755ppm to 19,590 ppm. Other elements including Pb, Zn etc. have not shown encouraging values.Apart from that,

three samples were collected from carbonaceous phyllites targeting graphite which have given values for fixed carbon in the range of 0.51-0.57% (Annexure-III) and 25 surface samples targeting for gold were collected and analysed which has given one anamolous area having Au values of 1.653ppm (Annexure-IVA).

9.3.5 On the basis of surface samples analysis, five anamolous zones were identified including one zone for gold mineralization. Bed rock sample MSB-BR47 and MSB-BR27 were present in the south of Khirkhori and Bagwari villages respectively have given cu values of 3020ppm and 6218 ppm respectively. Bed rock sample MSB-BR31 and MSB-BR12 are present in the south of Kusmahar village are having cu values of 1755ppm and 4710 ppm respectively. Bed rock sample MSB-BR09 is present in the north-east of Kusmahar village has given cu value of 19,590 ppm and Au value of 1.653 ppm. On, the basis of the these values, five anamolus zones were identified for further investigations including trenching and drilling.

9.3.6 **Trenching** Five nos. of trenches have been excavated (114 cu. m) at five anamolous locations demarcated on the basis of the results of surface samples. All the trenches were excavated in the perpendicular direction to the strike of the litho units present in all the five zones (Plate-III). Trench MSB-T1, MSB-T2, MSB-T3, MSB-T4 and MSB-T5 have been excavated at the anamolous zones demarcated by the analysis result of bedrock samples of MSB-BR12, MSB-BR47, MSB-BR27, MSB-BR31 and MSB-BR09 respectively. Dimension (Length x Width x Depth) of the trenches MSB-T1, MSB-T2, MSB-T3, MSB-T4 and MSB-T5 are 12m x 1m x 2m, 12m x 1m x 2m, 15m x 1m x 2m, 12m x 1m x 2m and 12m x 1m x 1m respectively. After excavation of trenches, mineralized quartz veins and oxidized zones were exposed. Samples were collected from the treches after propoer geological mapping of the trenches (Plate-V).

Photo 9.2 Photograph showing trench excavation of MSB-T1 in South of Kusmahar village	Photo 9.3 Photograph showing Trench excavation of MSB-T3 in South of Khirkhori village

9.3.7 Out of 5 trenches, 35 samples were collected. All the samples were analysed for 34 elements including Cu, Pb, Zn , Co, Mo, Al, As B, Ba Be, Bi,Ca, Cd, Cr, Fe, Ta, K, La, Li, Mg, Mn, Na, Ni , P, S, Nb , Si , Y , Sr , Ti , V, Sc , U, Cs. All the trenches has shown more or less anamolous values for Cu, 24 out of 35 trench samples have Cu values >1000ppm, varying from 1068 ppm to 6576 ppm (Annexure-VA). Trench mapping mapping with analysis results of the samples for Cu values are displayed in plate-V. The details of trenches and trench sample values for Cu with respect to the corresponding surface samples are also tabulated in Table 9.2. Other elements including Pb, Zn etc. have not shown encouraging values from trench samples. Three samples were analysed for Au-Ag from Trench MSB-T5 has given values in the range of 0.10-0.15ppb Au and 1.39ppm-2.20 ppm Ag (Annexure-VF). None of the trench samples were analysed for graphite.

9.3.8 The details of trenches and trench sample values for Cu with respect to the prospective surface samples are tabulated below in Table 9.1.

Table 9.1.
Details of Trenches and Trench Sample values for Cu wrt. to the Positive Surface Sample in Bagwari-Sukwari (G-4 stage) Block, Sidhi, M.P.

Sl. No.	Surface Sample No.	Surface Sample analysis, Cu (ppm)	Trench Name	Trench Location (Lat/Lon/Village)	Trench Dimension (L x W x H) in meters	Trench volume (Cu. M.)	Trench Sample Nos.	Trench Sample Analysis, Cu (In ppm)
1	MSB-BR12	4710	MSB-T1	N24.31111, E81.73493, MADWA TOLA KUSHMAHAR VILLAGE	12 x 1 x 2	24	MSB-T1/1	948
							MSB-T1/2	431
							MSB-T1/3	1068
							MSB-T1/4	1440
							MSB-T1/5	115
2	MSB-BR47	3020.	MSB-T2	N24.346662, E81.789959, KHIRKHORI VILLAGE	12 x 1 x 2	24	MSB-T2/1	325
							MSB-T2/2	686
							MSB-T2/3	3619
							MSB-T2/4	4601
							MSB-T2/5	1215
							MSB-T2/6	2414
							MSB-T2/7	2226
							MSB-T2/8	2288
							MSB-T2/9	2857
3	MSB-BR27	6218	MSB-T3	N24.348884, E81.813215, BAGWARI VILLAGE	15 x 1 x 2	30	MSB-T3/1	1516
							MSB-T3/2	1899
							MSB-T3/3	1404
							MSB-T3/4	1706
							MSB-T3/5	3877
							MSB-T3/6	5537
							MSB-T3/7	4676
							MSB-T3/8	4368
							MSB-T3/9	1108
							MSB-T3/10	3291
							MSB-T3/11	6576
4	MSB-BR31	1755	MSB-T4	N24.309163, E81.713814, SOUTH OF KUSMAHAR VILLAGE	12 x 1 x 2	24	MSB-T4/1	233
							MSB-T4/2	144
							MSB-T4/3	176
							MSB-T4/4	218
							MSB-T4/5	532
							MSB-T4/6	1429
							MSB-T4/7	560
5	MSB-BR09	19590.	MSB-T5	N24.314832, E81.741792, NORTH-EAST OF KUSMAHAR VILLAGE	12 x 1 x 1	12	MSB-T5/1	5120
							MSB-T5/2	3276
							MSB-T5/3	2504
	5					**114**	**35**	

Note- Highlighted in green are the samples with Cu values >1000ppm.

9.3.9 **Drilling** MECL carried out a total of 454.50m of exploratory drilling in 6 boreholes against an approved meterage of 500.00m. It is evident from the Table 9.2 that all five trenches have shown some sort of positive outcome. On this basis, 6 Nos. of boreholes were drilled, two borehole each in MSB-T3 and MSB-T2 while one borehole each were drilled at MSB-T1and MSB-T5.One borehole was planned at MSB-T4 but due to very thin zone and forest constraints, it wasn't executed. Borehole MSB-01 was drilled at trench location MSB-T3 and MSB-02 was. drilled at 180m apart in west to the trench location MSB-T3. Similarly, borehole MSB-03 was drilled at trench location MSB-T2 and MSB-04 was drilled at 200m apart in west to the trench location MSB-T2. Borehole MSB-05 was drilled at trench location MSB-T1 and borehole MSB-06 was drilled at trench location MSB-T5. The details of boreholes are given in Annexure- IB and summary of boreholes drilled are tabulated in Table 9.2.

Table- 9.2

Details of Section-Wise Boreholes drilled by MECL in Bagwari - Sukwari block for Reconaissance Survey (G-4 stage) of Copper, Lead, Zinc and Graphite, District-Sidhi, Madhya Pradesh

Sl. No.	BH No.	UTM (Zone- 44)		RL (m)	Total Depth (m)	Azimuth	Angle	Section Line
		Easting	Northing					
1	MSB-01	582545.03	2693021.08	308.27	70.50	N30°W	50°	S1-S1'
2	MSB-02	582374.57	2692939.02	312.64	71.00	N30°W	50°	S2-S2'
3	MSB-03	580115.69	2692733.36	324.02	82.50	N10°E	50°	S3-S3'
4	MSB-04	579903.46	2692767.29	318.39	76.00	N10°E	50°	S4-S4'
5	MSB-05	575307.17	2689193.72	383.99	77.50	N	50°	S5-S5'
6	MSB-06	574574.49	2688759.96	378.88	77.00	N15°W	50°	S6-S6'

9.3.10 Geological logging of borehole cores were properly done alongwith all the structural, lithological and mineralogical observations.(Annexure VIA and VIB). Copper mineralization has been confirmed in borehole no. MSB-01 (32.00m - 32.50m, 1.44% Cu) and MSB-03 (48.85m-49.85m, 0.76% Cu & 70.50m-71.00m, 1.49% Cu) (Annexure VIIA and VIIIB) and one gold and silver instance has been found in MSB-03 (70.50m-71.00m, 1.75 ppm Au and 4.68 ppm Ag) (Annexure-IXA). Borehole co-ordinates along with RL have been determined for all the boreholes with the help of DGPS in WGS-84 Datum. The associated laboratory studies i.e., chemical and physical analysis, petrographic and mineragraphic studies have been completed simultaneously and geological report has been submitted. Primary chemical analysis of borehole samples for Cu, Pb, Zn, Co and Mo are

tabulated in Annexure VII-A while primary chemical analysis of borehole samples for Au-Ag are tabulated in Annexure IX-A

9.3.11 The details of the nature and quantum of work proposed vs actual achievement is given in Table-9.1.

Table – 9.3

Proposed Quantum of Work vs. Actual achievement by MECL in Bagwari - Sukwari Block for Reconnaissance Survey (G-4 stage) for Copper, Lead, Zinc, Graphite and associated minerals, District:Sidhi, Madhya Pradesh

Sl. No.	Item of Work	Unit	Target	Achievement
1	**Geological Mapping** (on 1:12,500 Scale)	Sq km	141.75 sq.km	141.75 sq.km
2	**Survey**			
	Bore Hole Fixation (Scout Boreholes)	Nos	6 Nos	6 Nos
	RL & Coordinate Determination	Nos	6 Nos	6 Nos
3	**Surface Geochemical Sampling** a) Bed rock //Soil/Stream Sediment sampling for 34 elements including Cu, Pb, Zn etc. b) Bed Rock/Channel/Soil/Stream sediment Samples for Au & Ag c) Bed Rock/Channel Samples for Graphite	Nos.	200 Nos 25 Nos. 30 Nos.	202 Nos 25 Nos. 03 Nos.
4	**Exploratory Mining**	**m**	**100 Cu m**	
	Excavation (Trenching/Pitting)	Cu. m.	100 Cu m	114 Cu m
5	**Drilling (coring)**	**m**	**500m (6 BHs)**	**454.50m (6 BHs.)**
6	**Geological work**			
	a) Geological Core Logging, Sample Preparation etc.	m	500m (6 BHs.)	454.50m (6 BHs.)
7	**Laboratory Studies**			
	i) Surface Samples (Bed rock/Channel/Soil/ Samples) a) Primary,5% Internal & 10% External check by ICP-MS b) Primary & Check Samples for Au & Ag by Fire assay c) Primary & Check Samples for Graphite (Proximate Analysis)	**Nos**	230 Nos 29 Nos 35 Nos	232 Nos 26 Nos 03 Nos
	ii) Pit/Trench Samples a) Primary,5% Internal & 10% External check by ICP-MS b) Primary & Check Samples Au & Ag by Fire assay c) Primary & Check Samples for Graphite (Proximate Analysis)	**Nos**	58 Nos 12 Nos 23 Nos	41 Nos 03 Nos 00 Nos
	iii) Drill Core Samples a) Primary,5% Internal & 10% External check For 5 Radicals (Cu, Pb, Zn, Co & Mo) b) Primary & Check Samples Au & Ag by Fire assay c) Primary & Check Samples for Graphite (Proximate Analysis)		230 Nos 23 Nos 23 Nos	112 Nos 17 Nos 00 Nos
	iv) Composite Samples			

Sl. No.	Item of Work	Unit	Target	Achievement
	a) For 5 Radicals (Cu, Pb, Zn, Co & Mo)	Nos	15 Nos	0 Nos
	b) Au & Ag by Fire assay	Nos	15 Nos.	0 Nos.
	c) Graphite (Proximate Analysis)	Nos	15 Nos.	0 Nos.
	Petrological Samples (Surface & BH Core Samples)			
8	a) Preparation of Thin Section b) Study of Thin Section	Nos Nos	20 Nos 20 Nos	20 Nos 20 Nos
9	**Mineragraphic Studies (Surface & BH Core Samples)**			
	a) Preparation of Polished Section b) Study of Polished Section	Nos Nos	10 Nos 10 Nos	10 Nos 10 Nos
10	**Specific Gravity of samples**	Nos.	00 Nos	02 Nos
11	**Report Preparation (Digital format)**	Nos.	01 Nos	01 Nos

9.4.0 DETAILS OF SURFACE SAMPLING, TRENCHING, DRILLING, ETC.

9.4.1 The present scheme of Reconaissance Survey (G-4 stage) in Bagwari-Sukwari Block formulated by MECL includes geological mapping, surface sampling, trenching, trench mapping and sampling, drilling, core logging, core sampling and associated laboratory studies to establish the copper, lead, zinc and graphite mineralisation over a promising strike length, depth continuity and to establish the resource at 334 category.

9.4.2 Considering the potentiality of base metal and graphite mineralization in the area, MECL carried out Reconaissance Survey (G-4 stage) covering geological mapping at 1: 12,500 scale (Plate-III), surface sampling of 202 samples including 65 bedrock samples, 111 soil samples and 26 stream samples (Plate-IVA, Plate-IVB) and Plate-IVC), 35 trench samples from 5 nos.of trench locations (Plate-III) and by means of drilling in 6 boreholes (Plate-III) with 454.50m drilling and other associated geological and analytical work. Geological mapping of trenches with sample details and with corresponding Cu values is displayed in Plate-V. On the basis of the surface sample results, four zones were identified for the Copper mineralization around sample locations (MSB-BR12, BR47, BR27, BR31) and another zone was identified for copper and gold mineralization (MSB-BR-09). In these five location, 5 trenches were excavated. The trench details alongwith trench sample values for Cu with respect to the prospective surface samples are tabulated already in Table 9.2.

9.4.3 The Table 9.2 shows that all five trenches has shown more or less some anamolous values for copper. On that basis, MECL carried out a total of 454.50m of exploratory drilling in 6 boreholes against an approved meterage of 500.00m.During the present exploration, a total of 97 nos. of primary core samples, 5 nos. of internal check samples and 10 nos. of external check samples were analysed for 5 radicals including Cu, Pb, Zn, Co and Mo. The details of analysis of primary core samples, internal check samples and external check samples for Cu, Pb, Zn, Mo and Co are given in Annexure-VII A, Annexure-VII B, Annexure-VII C respectively. A total of 16 nos. of primary core samples, 1 nos. of internal check samples and 2 nos. of external check samples were analysed for Au and Ag by fire assay. The details of analysis of primary core samples, internal check samples for gold are given in Annexure-IXA, Annexure-IXB respectively.

CHAPTER-10

LOCATION OF DATA POINTS

10.1.0 ACCURACY AND QUALITY OF SURVEY USED TO LOCATE DRILL HOLES

10.1.1 The survey of boreholes drilled in the block has been carried out by the DGPS (Make-Trimble GNSS System, Model-R8s) (Annexure I-B). The photograph of DGPS is given in Photo-10.1.

Photo-10.1: DGPS (Make-Trimble GNSS System, Model-R8s)

10.1.2 The base station has been utilised for fixing of the boreholes position on the ground as well as for reduced levels of the boreholes. The coordinate of base station is given in Table-10.1.

Table-10.1

Co-ordinates of the Base Point for DGPS survey of Bagwari - Sukwari Block for Reconaissance Survey (G-4 Stage) for Copper, Lead, Zinc and Graphite, Sidhi District, Madhya Pradesh

Sl. No.	Point Name	WGS-84 (DMS)		UTM (m)		RL (m)
		Latitude	Longitude	Northing	Easting	
1	Base Point	24° 21' 5.7"N	81° 49' 8.5" E	2693397.818	583078.076	313.387

10.2.0 TECHNICAL SPECIFICATION OF DGPS

MAKE	**TRIMBLE DGPS**
MODEL	**R8-S**
YEAR	**2017**

a) <u>MEASUREMENT ACCURACY</u>:

- Static Mode
- Horizontal – 10 mm +0.1 ppm or better.
- Vertical – 20 mm +0.4 ppm or better.
- **b) <u>BASE LINE ACCURACY</u>**:
    a. Accuracy Horizontal shall not be more than 4 mm for 10 km baseline with occupation line of 10 minutes or less.
    b. Accuracy vertical shall not be more than 7.5 mm for 10 km baseline for with occupation of 10 minutes or less.
- c) **<u>FAST STATIC:</u>**
    a. Horizontal – 3mm +0.5 ppm
    b. Vertical – 5 mm +0.5 ppm
- **<u>GNSS RECEIVER:</u>**
- Trimble R8s Multiple frequency GNSS Receiver has internal on board memory via SD card or internal memory.
- Trimble R8s has 440 channels (GPS + GLONASS +GAGAN) and should be capable of tracking.
- GPS: LIC/A, L2C, LIC, L2E,L5
- GLONASS: LIC/A, L2C/A, LIP, L2P, & L3
- Beidou : B 1 complete with(phase 2) & B2
- SBAS: LIC/A,L5
- Galileo: E1, E5A, E5B
- Systems: EGNOS, QZSS, SBAS, WAAS, GAGAN, (MUST take correction from GAGAN) etc.
- R8s is water proof, shock proof, dust proof, humidity proof, and condensation proof.
- IP 67 with temporary submission in water up to 1 m.
- **<u>SOFTWARE & COMMUNICATION</u>**: Fully functional and Trimble business centre office post processing software.

- **<u>CONTROLLER:</u>**
- Trimble TSC 3 windows based controller for base and 02 nos. Rovers should be provided.
- Alpha numeric hard QWERTY keyboard for Base and 02 no's Rover should be provided.
- Internal Memory – 256 MB RAM & 8 GB Non Volatile memories should be provided.

- Integrated camera for Geo Tagging Must with inbuilt GPS, Compass and Accelerometer should be provided.

  CO-ORDINATE SYSTEM MANAGER: Should have datum and projection support & should support Grid coordinates.
- **COGO:** support COGO functionality & able to Key in lines, Sub-divide lines and creating parallel lines for staking out purpose.
- **TRANSFER DATA BETWEEN FIELD AND OFFICE:** Should be capable of e-mail data collected in the field, should be able import and export DXF files in the field for effective GIS support.
- **BACKGROUND MAP**: Able to accept background maps in CAD format.
- **OPERATING SYSTEMS**: Windows 6.5 should be provided.
- **EXPORT**: Able to exporting the data in RINEX format as well in CAD format.
- **REPORTING**: Software should be capable of generating reports directly from the surveyed data.
- **POST PROCESSING SOFTWARE ADVANCE CAPABILITY**: Trimble Business Centre Post Processing software capable of processing Base line with IGS station and processing drawing including engineering application such as contouring, Cross section & L section etc. All software shall be same OEM make.

CHAPTER-11

SAMPLING TECHNIQUE

11.1.0 NATURE AND QUALITY OF SAMPLING AND MEASURES TAKEN TO ENSURE SAMPLE REPRESENTATIVITY

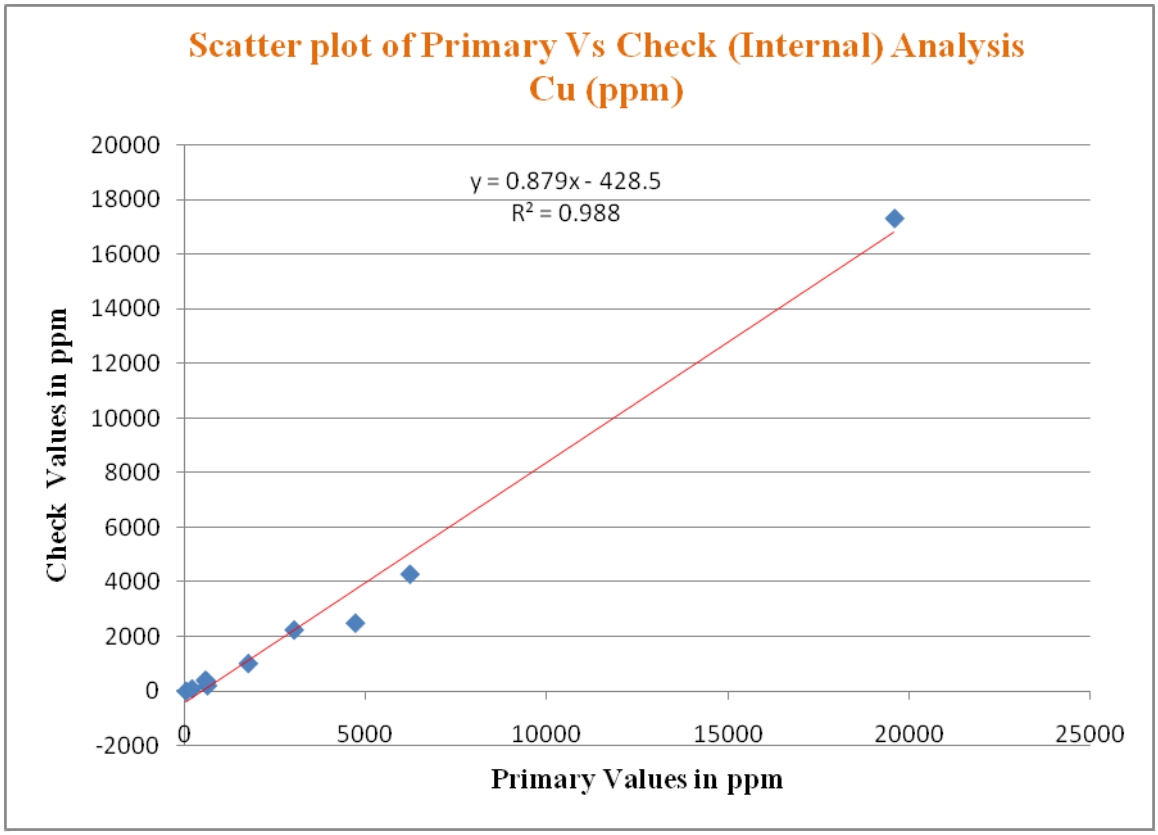
11.1.1 The present work has been formulated to take up the Reconaissance Survey (G-4 stage) for copper, lead, zinc and graphite mineralization in Bagwari - Sukwari block on the basis of the presence of Copper and associated minerals and Graphite mineralization reported in earlier work done by GSI. Sampling has been done during the exploration programme which includes surface sampling, trench sampling, primary borehole and composite samples and sampling for petrography, mineragraphy and specific gravity.

11.1.2 During the course of geological mapping, areas were identified for surface sampling.A total of 202 surface samples were collected including 65 bedrock, 111 soil samples and 26 stream samples. (Plate-IVA, Plate-IVB, Plate-IVC). Bedrock samples were taken by chipping across the strike of the body with the help of hammer and chisel. For about 1m x 1m area, one representative chip sample was collected. During the sampling, surface was properly cleaned and each sample was collected in separate plastic bag. After collecting each sample, all the instruments were properly cleaned before proceeding for next sample collection to maintain quality and to avoid contamination. Soil samples were collected below the humas material. Stream sediments were collected at suitable trap site from the streams for -5mm fraction using sieves. On the basis of the chemical analysis of surface samples, five zones were identified. Further, at identified five positive surface locations, trenching was carried out and sampling from trenches was done. From trenches, lithological and mineralogical variations were taken into consideration while collection of samples. Samples were collected from the wall of the trenches using hammer and chisel. All the samples were collected with utmost care to avoid contamination and packed in separate plastic bags.

11.1.3 During the present exploration, a total of 202 nos. of primary surface samples for 34 elements including copper, lead, zinc were collected, Accordingly, 10 nos. of internal check samples and 20 nos. of external check samples were prepared and

analysed. The primary and internal check samples have been analysed at Chemical Laboratory of MECL, Nagpur. The, external check samples have been analysed at Jawaharlal Nehru Aluminium Research Development and Design Centre, (JNARDDC) Nagpur (A NABL accridited Laboratory). The details of analysis of primary surface samples, internal check samples and external check samples are given in Annexure-IIA, Annexure-IIB, and Annexure-IIC respectively. Comparison of primary and internal check surface sample result for Cu and primary and external check surface sample result for Cu are given in Annexure-IID and Annexure-IIE respectively.

11.1.4. Scatter plot of Primary Vs Internal check samples of surface samples for Cu is provided in the Text figure-11.1. Correlation Coefficient is 0.994, which is near to 1, suggests repeatability and reliability of the analysis and homogeneity of the prepared samples.



Text Figure 11.1 Scatter Plot of Primary vs Check (Internal) sample Analysis of Surface samples

The details of all the statistical parameters pertaining to radical for Cu are provided in Table-11.1.

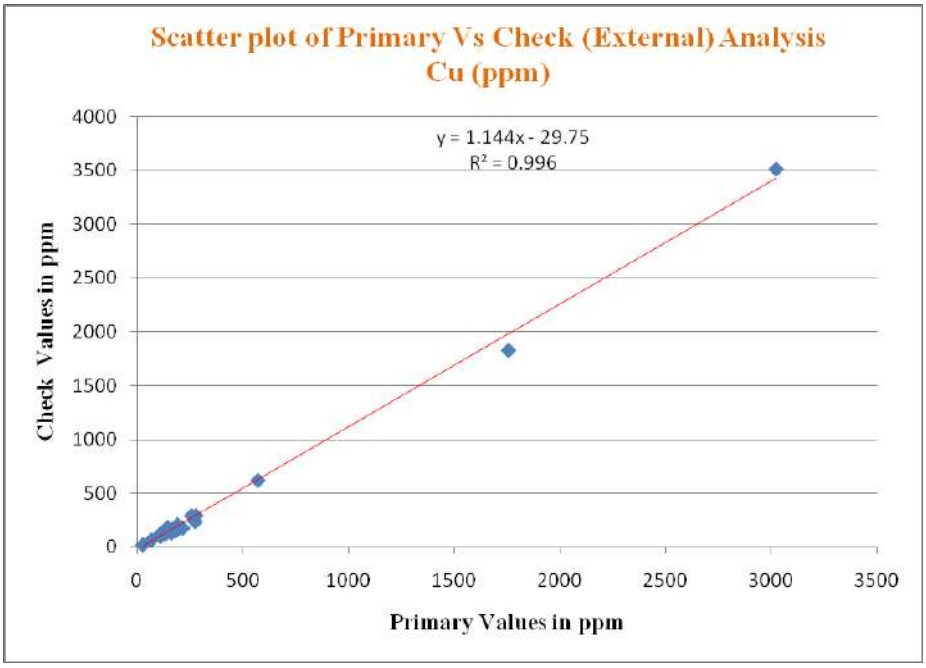
Table-11.1

Statistical comparison of Primary and Internal Check sample analysis for Cu (Surface samples)

COMPARISON OF PRIMARY Vs.INTERNAL CHECK ANALYSIS OF SURFACE SAMPLES

COMPARISON INDEX	Cu (ppm)	
	Primary	Check
No. of Sample Pairs	10	
Arithmetic Mean	3734.484	2854.974
Standard Deviation	5643.765	4989.993
Std. Error of Mean	1784.715	1577.974
Variance	31852083.288	24900026.846
Mean of Deviation	879.51	
Standard Deviation (Error)	860.523	
Correlation Coefficient	0.994	
Mean Absolute Error	879.51	
Mean Relative Random Error	23.551%	
Paired T value	3.232	
F - test value	1.279	

11.1.5. Scatter plot of Primary Vs External check samples of surface samples for Cu is provided in the Text figure-11.2. Correlation Coefficient is 0.998, which is close to 1, suggests repeatability and reliability of the analysis and homogeneity of the prepared samples



Text Figure 11.2 Scatter Plot of Primary vs Check (External) sample Analysis of Surface samples

The detail of all the statistical parameters pertaining to radicals for Cu is provided in Table-11.2.

Table-11.2
Statistical comparison of Primary and External Check sample analysis for Cu (Surface samples)

COMPARISON INDEX	Cu (ppm)	
	Primary	Check
No. of Sample Pairs	20	
Arithmetic Mean	405.027	433.795
Standard Deviation	699.219	801.553
Std. Error of Mean	156.35	179.233
Variance	488907.716	642487.163
Mean of Deviation	-28.768	
Standard Deviation (Error)	110.842	
Correlation Coefficient	0.998	
Mean Absolute Error	47.083	
Mean Relative Random Error	11.625%	
Paired T value	-1.161	
F - test value	0.761	

11.1.6 At five positive zones identied on the basis of surface samples, five trenches (MSB/T1, MSB/T2, MSB/T3, MSB/T4 and MSB/T5) were excavated to expose the host rock for the mineralization. Samples were collected from the trenches depending upon the lothological, mineralogical variations and alterations noticed.

11.1.7 A total of 35 nos. of primary trench samples for 34 elements including copper, lead, zinc. Accordingly, 2 Nos. of internal check samples and 4 Nos. of external check samples were analysed to detect any analytical or lab bias. The primary and internal check samples were analysed at Chemical Laboratory of MECL, Nagpur. The external check samples were analysed for at Jawaharlal Nehru Aluminium Research Development and Design Centre, (JNARDDC) Nagpur (A NABL accridited Laboratory). The details of the analysis of primary trench samples, internal check samples and external check samples are given in Annexure-VA, Annexure-VB, and Annexure-VC. Comparison of Primary and Internal check trench sample result for Cu and Primary and External check trenchsample result for Cu are given in Annexure-VD and Annexure-VE respectively. Camparion data of primary and check samples suggests repeatability and reliability of the analysis and homogeneity of the prepared samples.

CHAPTER-12

DRILLING TECHNIQUES AND DRILL SAMPLING EMPLOYED

12.1.0 DRILLING TYPES AND DETAILS

12.1.1 MECL has drilled 6 nos. of scout boreholes involving 454.5m of drilling and other associated geological and analytical work. The details of boreholes are given in Annexure-IB.

12.1.2 All the boreholes in the block were drilled by skid mounted wire line conventional core drill (RD-100). Drill rig is equipped with ALU-370, 4-cylinder IC Engine as prime mover. Drilling was continued in NQ string by using NQ IMP DIAMOND BIT (Hyden, Rock drill, Sandvik) till closure of the borehole. Drilling was done with three no. (MEC-355, MEC-339 & MEC-353) of conventional drill rigs (RD-100) with capacity to drill down up to a depth of 1000m (Photo 12.1 and 12.2).

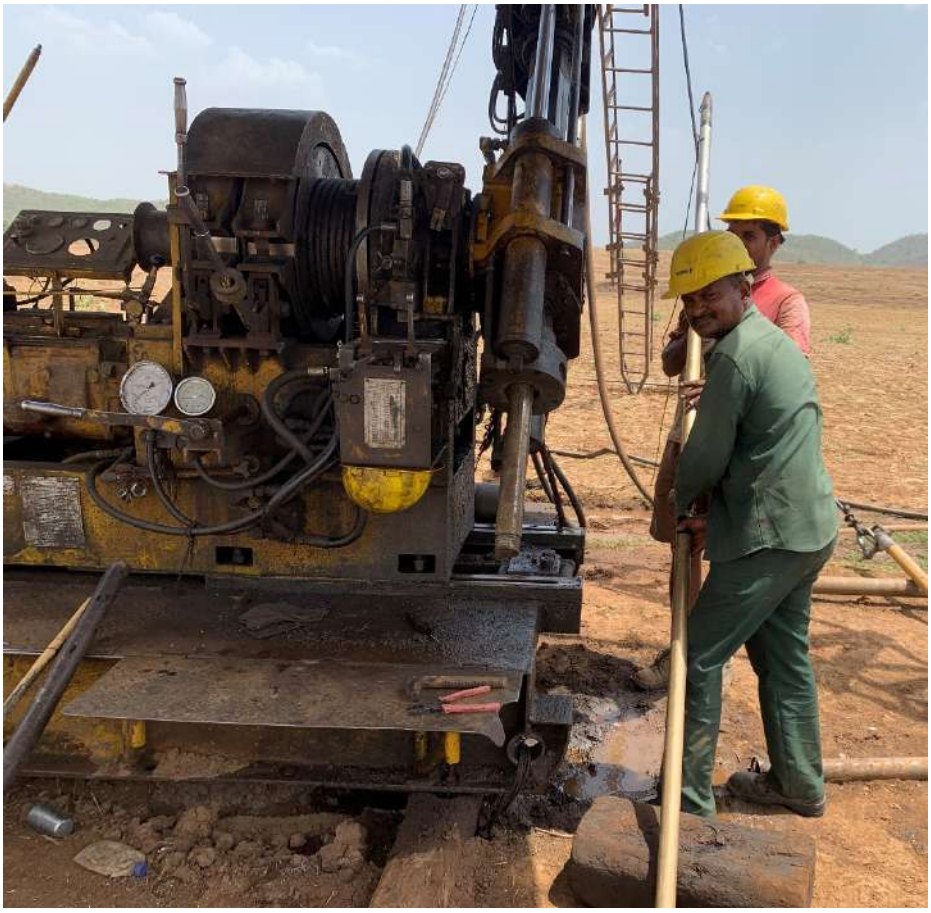


Photo-12.1 Photograph of Skid mounted drill rig at Borehole MSB-04

Photo-12.2 Photograph of RD-100 Drill Rig

12.1.3 The quality of drilling was ensured during the operation. After closure, all the boreholes have been properly plugged and sealed with cement pillars. The details of all 6 boreholes with number, DGPS coordinate details, RL, angle, azimuth, depth, section lines numbers etc are provided in Annexure-IB.

12.2.0 DEVIATION SURVEY IN DRILLING

12.2.1 All the inclined exploratory boreholes drilled in the block have been surveyed to ascertain deviation in azimuth and in the borehole path, if any, with the help of multi shot deviation camera. The specifications of the deviation survey instrument are given in Table-12.1.

Table-12.1

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 Limited (Germany)
3	Parameters	Inclination and azimuth angle
4	Inclination range	0 to 90 degrees
5	Azimuth range	0 to 360 degree from north
6	Inclination resolution	NA
7	Azimuth resolution	NA

12.2.2 Boreholes deviation survey was carried out by multi shot deviation camera instrument. 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.

12.2.3 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.

12.2.4 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-I C.

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

12.3.1 On completion of each run drill cores were laid out on corrugated GI sheets and washed at the drill site for initial field logging, which includes marking of downhole indications, meterage intervals, fitting of core and inspection for lost intervals, and recording of basic geotechnical parameters by the site geologists. Recovery is recorded by core runs, and any areas of core loss that can be more specifically identified are recorded. Cores are kept in GI boxes with 5m core placing capacity, in book pattern. Proper run wise depth marking and directional indications are shown throughout.

12.3.2 The core samples have been recorded properly and the detailed run wise litholog and summarized litholog for boreholes are given in Annexure-VIA and Annexure-VIB respectively. The logging of run wise borehole cores have helped in deciphering the physical characters like colour, shape, size and nature of the 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.

12.3.3 The mineralised zones / length recorded during the geological core logging have been sampled and analysed for 5 radicals i.e., Cu, Pb, Zn, Mo and Co. The primary samples have marked in the mineralized zones intersected in the borehole based on ore type and concentration of mineralisation/lithology and in general the sample length has been kept as 0.50 m which varied in some instances upto 1.0m because of variation in lithology and type and concentration of mineralisation.The details of analysis of primary core samples are given in Annexure-VII A.

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

12.4.1 The entire core drilling has been done by wire line method in NQ size using diamond bits and NX casing has been used up to the loose portion. The polymer was used as drilling fluid to flush out the cuttings and stabilize the borehole wall. The drilling fluid also works as a coolant to avoid burning of drill bits. Proper core recovery of more than 90% was maintained, however in case of weathered, loose and fractured zone, the core recovery was low. Whenever core recovery is less, the grade of the recovered portion has been extrapolated over the non-recovered section. However, all the precautions like modulated water pressure, proper liner and outer tubes, optimum head pressure and the hands of an expert drilling technician had been taken to maintain the quality of drilling.

12.5.0 WHETHER THE RELATIONSHIP EXISTS BETWEEN SAMPLE RECOVERY AND GRADE

12.5.1 No such definite relation exists between sample recovery and grade.

12.6.0 CORE LOGGING

12.6.1 The borehole cores were geologically logged recording textural, lithological, mineralogical and structural details. Each lithology was identified based on accepted nomenclature. Their colour, grain size, mineral variations and lithological changes etc meticulously recorded. Depth parameters of zones of weathering, oxidation and fracturing etc are recorded. Similarly, mineralisation zones, various physically identifiable ore minerals and their megascopic characteristics are

identified. The core recovery figures, changes in recovery percentage with changes in lithology, weathering characteristics of respective rocks etc are also noted. The core dip measurement (α) between the core axis and core foliation intersection is measured wherever variation in dip is noticed so that subsurface structure could be ascertained. Core chip samples also have been logged, the mineralisation zones relogged after splitting of the core for additional information, that can support resource estimation.

12.6.2 In short, all relevant data that complements the resource estimation was collected while logging. These data will also guide the future investigations that may follow-up.All the cores were kept and preserved properly in the GI core boxes of specifications given by NMET following "book pattern" (Photo 12.3). The detailed run wise litholog and summarized litholog for boreholes are given in Annexure-VIA and Annexure- VIB respectively.

Photo-12.3: Photograph showing preservation of borehole cores in GI core boxes with proper marking

12.7.0 ROCK QUALITY DESIGNATION (RQD %)

12.7.1 During the detailed geological logging of the core samples, RQD have been measured over entire column of the core, mineralized zone and footwall. RQD data is incorporated in the run-wise litholog, given as Annexure-VIA. Rock Quality Designation (RQD) is a modified measure of the degree of jointing and the fracture in a rock mass, measured as a percentage of drill cores in lengths of 10cm or more.

High quality rock has RQD more than 75%, low quality rock has RQD of less than 50%. D.U. Deere in 1963 defines the RQD as the ratio of the sum of the total length of the cores of the length 10cm and longer recovered from drilling of one run (3.0 m) drilling.

RQD (%) = (Total length of the core in pieces of 10cm or more) / Length of the run) X 100.

CHAPTER-13

SUB SAMPLING TECHNIQUES AND SAMPLE PREPARATION

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

13.1.1 The core sampling and analyses have been carried out for entire mineralized zones/length intersected in the boreholes. Samples were marked and collected for copper and gold. Chalcopyrite and pyrite were observed during logging of cores. The mineralized core has been split into two equal halves (Photo-13.1) by core splitter (Photo-13.2) in such a way that the concentrations of ore minerals are uniform in both the halves. The one half portion of the sample was crushed to (-) 200 mesh and about 500g representative sample of (-) 200 mesh was drawn by coning and quartering method of gradual size reduction with the help of crusher and pulverizer (Photo-13.3 and 13.4). Two samples weighing 100gm each were drawn, one of which were sent to MECL, Chemical Laboratory, Nagpur for primary chemical analysis for 5 radicals and the other was used for the purpose of check analysis. The remaining 300g fraction is kept for any further study in furure. For gold analysis, powdered fraction was kept as (-) 100 mesh.

Photo-13.1: Photograph showing Splitted mineralized core of borehole no. MSB03

Photo-13.2: Photograph showing Hydraulic Core Splitter

Photo-13.3 Photograph showing sample Crusher used in sample processing

Photo-13.4: Photograph showing Pulveriser used in sample processing

13.1.2 During the present exploration, a total of 97 nos. of primary core samples, 5 nos. of internal check samples and 10 nos. of external check samples were prepared for analysis of 5 radicals including Cu, Pb, Zn, Co and Mo. The primary and internal check samples have been analysed for 5 radicals i.e., Cu, Pb, Zn, Co and Mo, at chemical laboratory of MECL, Nagpur. External check samples have been analysed for same elements at Jawaharlal Nehru Aluminium Research Development and Design Centre, (JNARDDC) Nagpur (A NABL accredited Laboratory). The details of analysis of primary core samples, internal check samples and external check samples for Cu, Pb, Zn, Mo and Co are given in Annexure-VII A, Annexure-VII B, Annexure-VII C respectively.

13.1.3 During the present exploration, a total of 16 nos. of primary core samples, 1 nos. of internal check samples and 2 nos. of external check samples were prepared for analysis of Au and Ag by fire assay. The primary and internal check samples have been analysed for Au and Ag by fire assay, at chemical laboratory of MECL, Nagpur. External check samples have been analysed for same elements at

JNARDDC, Nagpur. The details of analysis of primary core samples, internal check samples for gold are given in Annexure-IXA, Annexure-IXB respectively.

13.2.0 NATURE, QUALITY AND APPROPRIATENESS OF THE SAMPLE PREPARATION TECHNIQUE

13.2.1 The details of sampling procedure for primary samples are described in Para 13.1.0. Quality of the sample preparation is maintained by proper cleaning, maintainence of the equipment and proper crushing, sieving and coning and quatering of samples. For sample preparation proper technique and expertise has been used.

13.3.0 QUALITY CONTROL PROCEDURES ADOPTED

13.3.1 The primary core samples have been collected from entire mineralized zones/length intersected in the boreholes drilled and the samples have been prepared at centralized mechanized sampling unit. The standard sampling procedure in supervision of qualified sampling technician has been adopted to control the quality of samples. Similarly, internal check and external check samples have also been prepared under the supervision of qualified sampling technician following the standard sampling procedure.

13.4.0 MEASURES TAKEN TO ENSURE THE SAMPLING IS REPRESENTATIVE OF THE IN SITU MATERIAL COLLECTED

13.4.1 All the primary samples have been marked and prepared from 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 described in Para 13.1.0. The proper marking of primary samples from drilled cores and following standard procedure for sample preparation shows the representative samples have been collected from the in situ materials.

13.5.0 WHETHER SAMPLE SIZES ARE APPROPRIATE TO THE GRAINSIZE OF THE MATERIAL BEING SAMPLED

13.5.1 For the analysis of Au & Ag, samples have been prepared at (–) 100 mesh size. For all other analysis like Cu, Pb, Zn, Co and Mo samples have been prepared at (–) 200 mesh size

CHAPTER-14

QUALITY OF ASSAY DATA AND LABORATORY TESTS

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

14.1.1 Reconnaissance Survey (G-4 stage) for Copper, Lead, Zinc, Graphite and associated minerals in Bagwari-Sukwari block encompasses several lab analysis including analysis for surface and trench Samples for 34 elements by ICP-MS method including Cu, Pb,Zn , Co, Mo, Al, As B, Ba Be, Bi,Ca, Cd, Cr, Fe, Ta, K, La, Li, Mg, Mn, Na, Ni , P, S, Nb , Si , Y , Sr , Ti , V, Sc , U, Cs. Analysis of surface, trench and borehole samples for Au-Ag by fire assay, analysis of surface samples for graphite by proximate analysis method and analysis of borehole samples for Cu, Pb, Zn, Co and Mo by AAS method. Description of each analysis method is given in subsequent para.

14.2.0 INDUCTIVELY COUPLES PLASMA- MASS SPECTROSCOPY (ICP-MS) METHOD

14.2.1 PRINCIPLE OF ICP-MS METHOD OF ANALYSIS

Inductively coupled mass spectroscopy is a technique that combines two technologies (ICP and MS) into one. The ICP operates using Argon plasma into which the atomised sample is injected. The sample ionises in the plasma and the ions are extracted through a series of cones into a mass spectrometer where the ions are separated on the basis of mass-to-charge ratio and a detector receives an ion signal proportional to concentration. The concentration of sample can be determined through calibration with single or multi-element reference standards.

14.2.2 PROCEDURE OF ICP-MS METHOD OF ANALYSIS

1. Weigh the exact amount of the representative sample (0.25g) and transfer into the sample container of microwave digester. Add 10ml of aqua regia (HNO_3+HCL in 1:3 ratio) and 2-3ml of HF (Hydrofluoric acid) and HLO4 (Perchloric Acid) to it. Place the sample container into the microwave digester and digest the sample to obtain syrup.

2. After digestion filter the contents of the syrup in a volumetric flask using Whatman filter paper No. 40. Give hot water washing to the filter residue and make up the volume in the volumetric flask.
3. Take 10-15 ml of the filtrate from the volumetric flask and transfer it in the test tube. Place the test tube in the test tube holder of the auto sampler unit of ICP-MS.
4. The instrument is calibrated by measuring intensities of all the elements of interest in a number of calibration standards that represent a range of calibration likely to be encountered in the unknown sample.
5. The sample is then aspirated into the nebuliser with the help of peristaltic pump attached to the auto sampler where the sample liquid is converted into fine aerosols.
6. The sample aerosols are injected into the plasma torch where they are ionised due to the high temperature of the plasma.
7. The ions are separated on the basis of mass-to-charge ratio using quadrupole mass filter and are detected by the detector.
8. The unknown samples are analysed by plotting against the calibration curve and the concentration is calculated.

Photo 14.1 Photographs showing ICP-MS instrument (Agilent, USA) at Chemical Lab, MECL

14.3.0 ANALYSIS OF GOLD-SILVER BY FIRE ASSAY METHOD

14.3.1 METHOD OF ANALYSIS FOR GOLD-SILVER BY FIRE ASSAY METHOD

Samples are prepared as weighed 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 at 1050°C for 45 minutes and the molten melt is poured into a cast iron mold. The Lead button is separated from the slag and oxidised in a cupellation furnace 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.

Photo 14.2 Photographs showing Fire assay analysis set up at Chemical Lab, MECL

14.4.0 ANALYSIS OF GRAPHITE SAMPLE BY PROXIMATE ANALYZER (MODEL – ADVANCE - APA)

14.4.1 **OBJECTIVE**: Determination of Moisture content (%), Volatile matter (%) and Ash content (%) in Graphite Samples.

14.4.2 METHOD OF ANALYSIS OF GRAPHITE BY PROXIMATE ANALYZER

The chemical analysis of primary samples has been carried out in Chemical Laboratory of MECL for Proximate Analysis i.e. Moisture. Ash, VM, FC. The analysis has been carried out by advance made APA2 instrument.

1. **Determination of Moisture content**
   Moisture content was determined at 110 °C, by usual procedure as per standard IS 1350(part 1): 1984 (RA 2013).

2. **Determination of Volatile matter**
   Volatile matter was determined at 900 °C, by usual procedure

3. **Determination of Ash content**
   0.80 g graphite sample was taken in a crucible and heated to reach 850 °C. It was kept at 850 °C for 30 min. The temperature was increased to 880 °C. It was kept at 880 °C for 1.5 hours and finally Ash content was calculated .

Photo 14.3 Photographs showing Proximate Analyser instrument at Chemical Lab, MECL

14.5.0 ANALYSIS OF COPPER (Cu), LEAD(Pb) ZINC (Zn), MOLYBDENUM (Mo), COBALT (Co) BY AAS METHOD

Reagents and Standards

- Aqua Regia – 30-40 ml (Prepared using AR Grade Acids)
- Hydrofluoric acid – 10 ml (AR Grade Acid)
- Stock standards for copper – 1 ml of solution of 1000ppm strength

14.5.1 METHOD OF ANALYSIS OF COPPER (Cu), LEAD (Pb) ZINC (Zn), MOLYBDENUM (Mo), COBALT (Co) BY AAS METHOD

1. Weigh 0.3 – 1.0 gm of the sample in a Teflon beaker and add 30-40 ml aqua regia and 10 ml hydrofluoric acid.
2. Cover the beaker with lid, 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.
7. Read the absorbance and concentration on atomic absorption spectrophotometer (Analytical Jena ZEEnit model).
   (Run CRM and repeat samples after every 20 samples)

14.5.2 INSTRUMENT: ATOMIC ABSORPTION SPECTROMETER (AAS)

The technique makes use of absorption spectrometry to assess the concentration of an analyte in a sample. It requires standards with known analyte content to establish the relation between the measured absorbance and the analyte concentration and relies therefore on the Beer-Lambert Law. In short, the electrons of the atoms in the atomizer can be promoted to higher orbitals (excited state) for a short period of time (nanoseconds) by absorbing a defined quantity of energy (radiation of a given wavelength). This amount of energy, i.e., wavelength, is specific to a particular electron transition in a particular element. In general, each wavelength corresponds to only one element, and the width of an absorption line is only of the order of a few picometers (pm), which gives the technique its elemental selectivity. The radiation flux without a sample and with a sample in the atomizer is measured using a detector, and the ratio between the two values (the absorbance) is converted to analyte concentration or mass using the Beer-Lambert Law.

Photo 14.4 Photographs showing Atomic Absorption Spectrometer (AAS) instrument at Chemical Lab, MECL

14.6.0 NATURE OF QUALITY CONTROL PROCEDURES ADOPTED

14.6.1 NATURE OF QUALITY CONTROL PROCEDURES ADOPTED IN ICP-MS METHOD OF ANALYSIS:

In order to ensure the accuracy of the analyzed samples, GSD-12,GSD-6,NCSDC-73014,NCSDC-73022 has been used as certified reference material. The Certified Reference Material (CRM) was processed under similar conditions as samples and run after every 20 samples.

14.6.2 STANDARD CRM AND SECONDARY REFERENCE CALIBRATION STANDARDS IN ANALYSIS OF GOLD-SILVER BY FIRE ASSAY METHOD

The following reference materials may routinely be used: GLG 910-5, GPP-03, GPP-07, OREAS 45e, OREAS 502b, OREAS 700, OREAS 503b, OREAS 202, OREAS 204, OREAS 205, OREAS 504b, OREAS 206, OREAS 60c, OREAS 207, OREAS 210, OREAS 62e, OREAS 208, G312-10 etc., .These standards have varying concentration ranges, usually representing different concentration levels, representative of our samples, and have detectable levels for all elements being

measured. Their purpose is to verify calibration, as well as midpoint calibration and linearity. Other CRMs may be chosen with a similar mineralogy/matrix/analyte concentration for the analytes of interest being tested. Reference material list with analyte concentrations is available in Certified Reference Materials

14.6.3 During the present exploration, a total of 97 nos. of primary borehole core samples, 5 nos. of internal check samples and 10 nos. of external check samples were analysed for 5 radicals including Cu, Pb, Zn, Co and Mo. Apart from that, a total of 16 nos. of primary core samples, 1 no. of internal check sample and 2 nos. of external check samples were analysed for Au and Ag by fire assay.

14.6.4. Comparison of primary Vs internal check samples of borehole samples for various radicals are provided in annexure VIIB indicate that the analysis results are very much similar which suggests the repeatability and reliability of the analysis and homogeneity of the prepared samples. It also suggests that the primary analysis is reliable and the data can be used for resource estimation.

14.7.0 CHECK ANALYSIS FROM THIRD PARTY NABL ACCREDITED LABORATORY

14.7.1 The third party samples analyses has been carried out at JNARDDC, Nagpur (A NABL accridited Laboratory). During the present exploration, a total of 10 nos. of external check samples were analysed for 5 radicals including Cu, Pb, Zn, Co and Mo. Apart from that, a total of 2 nos. of external check samples were analysed for Au and Ag by fire assay. Comparison of primary Vs etxternal check samples of borehole samples for various radicals are provided in annexure VIIC, indicate that the analysis results are very much similar which suggests the repeatability and reliability of the analysis and homogeneity of the prepared samples. It also suggests that the primary analysis is reliable

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

14.8.1 The samples have been prepared at centralized mechanized sampling unit with proper labeling and tag and sent to chemical laboratory in supervision of qualified sampling technician. At the sampling unit, standard procedure has been followed

and all the precautionary measures have been taken to avoid the contamination. The sampling unit is separate from the chemical laboratory, so there is no chance of contamination.

CHAPTER-15

MOISTURE

15.1.0 All the analysis has been carried out with natural moisture.

CHAPTER-16

BULK DENSITY

16.1.0 The G4-stage exploration carried out in Bagwari-Sukwari block, Sidhi district, MP had no provisions made for bulk density measurements. However, specific gravity measurements were attempted.

CHAPTER-17

BENEFICIATION STUDIES

17.1.0 The present exploration carried out is of Reconnaissance Survey (G-4 stage) category in Bagwari – Sukwari block for which there was no provision of benification studies.

CHAPTER-18

RESOURCE ESTIMATION TECHNIQUE

18.1.0 DISCUSSION ON DATA DENSITY AND MINERALISATION ZONES

18.1.1 The present Reconaissance Survey (G-4) for copper, lead, zinc and graphite in Bagwari - Sukwari block has been carried out to establish the presence of copper or any other mineralization and to estimate Reconnaissance Resources (334) and to perform associated laboratory studies. A total of 6 pilot boreholes (MSB-01, MSB-02, MSB-03, MSB-04, MSB-05 and MSB-06) in 6 cross sections numbered as S1-S1′ to S6-S6′ have been prepared (Plate-VI and Plate-VII), based on the interpretation of sub-surface borehole data along with surface geological data, which is perpendicular to general strike of the ore body. Ore zone in both the boreholes in which mineralization has been encountered as per the local dip.

18.1.2 There are 97 no. of primary samples analysed from the borehole cores. On the basis of all the primary samples, ore zone / lode have been delineated above cut-off vlaue (≥0.5% of Cu and ≥0.2% of Cu) (Plate-VI and Plate-VII). However, maximum thickness of the copper zone encountered is 1.00m. Due to the presence of very thin zones of copper in the boreholes, resource of copper was not advisable to be estimated in the block. Precisely, Copper mineralization has been confirmed in borehole no. MSB-01 and MSB-03 having cummulative strike length of 200m and 1.5m thickness at 0.5% Cu cut-off,while cummulative thickness of copper zone is 2.00m at 0.2% Cu cut-off. Gold and silver instances has also been noticed in borehole no. MSB-03. (70.50m-71.00m, 1.75 ppm Au and 4.68 ppm Ag). Details of the zones calculated for copper at 0.5% Cu Cut-off and 0.2% Cu Cut-off has been tabulated in Table 18.1 and Table 18.2.

Table: 18.1
Summary of zones for Copper at 0.5% Cu Cut-off

Summary of zones for copper at 0.5% Cu Cut-off in Bagwari-Sukwari (G-4 stage) block									
Section No	Borehole No	From	To	Thickness (m)	RL of Intersection	Area (sq m)	Strike Influence (m)	Specific Gravity	Grade Cu (%)
S1-S1'	MSB-01	32.00	32.50	0.50	283.42	23.90	100.00	3.34	1.44
								Sub Total	**1.44**
S3-S3'	MSB-03	49.35	49.85	0.50	285.95	37.16	100.00	3.34	1.17
	MSB-03	70.50	71.00	0.50	269.73	43.62	100.00	3.34	1.49
								Sub Total	**1.33**
								GRAND TOTAL	**1.37**

Table: 18.2
Summary of zones for Copper at 0.2% Cu Cut-off

Summary of zones for copper at 0.2% Cu Cut-off in Bagwari-Sukwari (G-4 stage) block									
Section No	Borehole No	From	To	Thickness (m)	RL of Intersection	Area (sq m)	Strike Influence (m)	Specific Gravity	Grade Cu (%)
S1-S1'	MSB-01	32.00	32.50	0.50	283.42	23.90	100.00	3.34	1.44
								Sub Total	**1.44**
S3-S3'	MSB-03	48.85	49.85	1.00	286.08	63.03	100.00	3.34	0.76
	MSB-03	70.50	71.00	0.50	269.73	43.62	100.00	3.34	1.49
								Sub Total	**1.00**
								GRAND TOTAL	**1.11**

18.2.0 SPECIFIC GRAVITY

Specific gravity determinations were made on 02 no. of borehole core samples by walker steel yard balance in MECL Laboratory, Nagpur. Specific gravity of Copper ore comes out to be 3.34, which may be considered for estimation of resource in future, if required. It is represented in table 18.3.

Table 18.3
Specific Gravity determination of Copper, from borehole core samples for Bagwari – Sukwari (G-4 stage) block for copper, lead, zinc and graphite, Sidhi, MP

Sl.No.	Sample No.	BH No.	Location: From - To (m)	Specific Gravity
1	MSB-01/SG1	MSB-01	32.0-33.10	3.61
2	MSB-03/SG2	MSB-03	49.45-49.55	3.07
Average Specific Gravity				**3.34**

18.3.0 COMPUTATION OF AVERAGE GRADE

All calculations for grade estimation are made by weighted average method. Since the sample interval was uniformly maintained at 0.50m interval for Cu mineralisation with the exception of some variations or structural implications, the weighted average method of calculation is made by the following formula:

$$\text{Weighted average grade} = \frac{V1XG1+V2XG2+V3XG3+ \text{----------}+VnXGn}{V1+V2+V3+ \text{----------}+Vn}$$

Where `V' = Volume of Copper ore in individual borehole

`G'= Grade of the respective Copper ore in the corresponding borehole

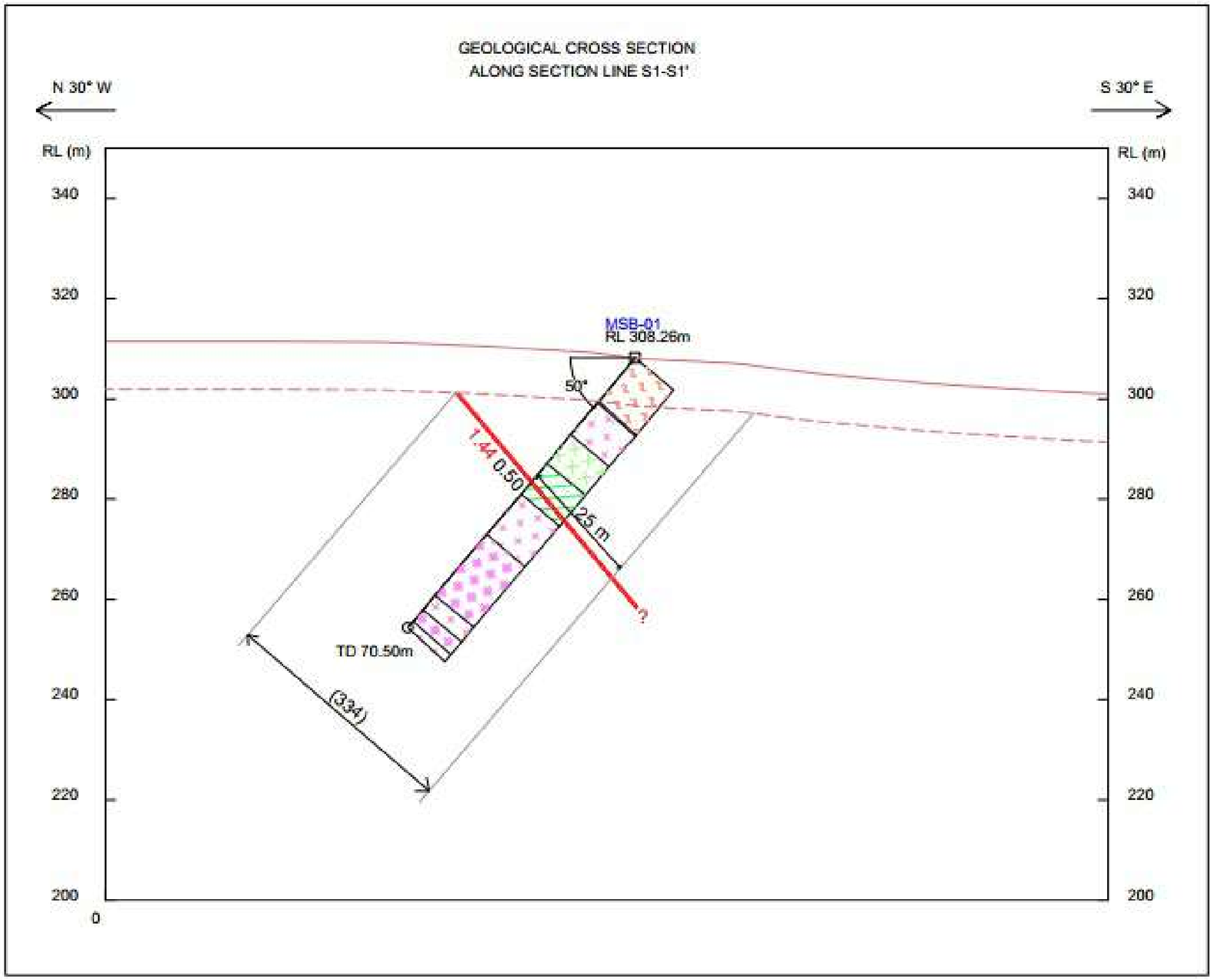
CHAPTER-19

REPORTING OF RESOURCES

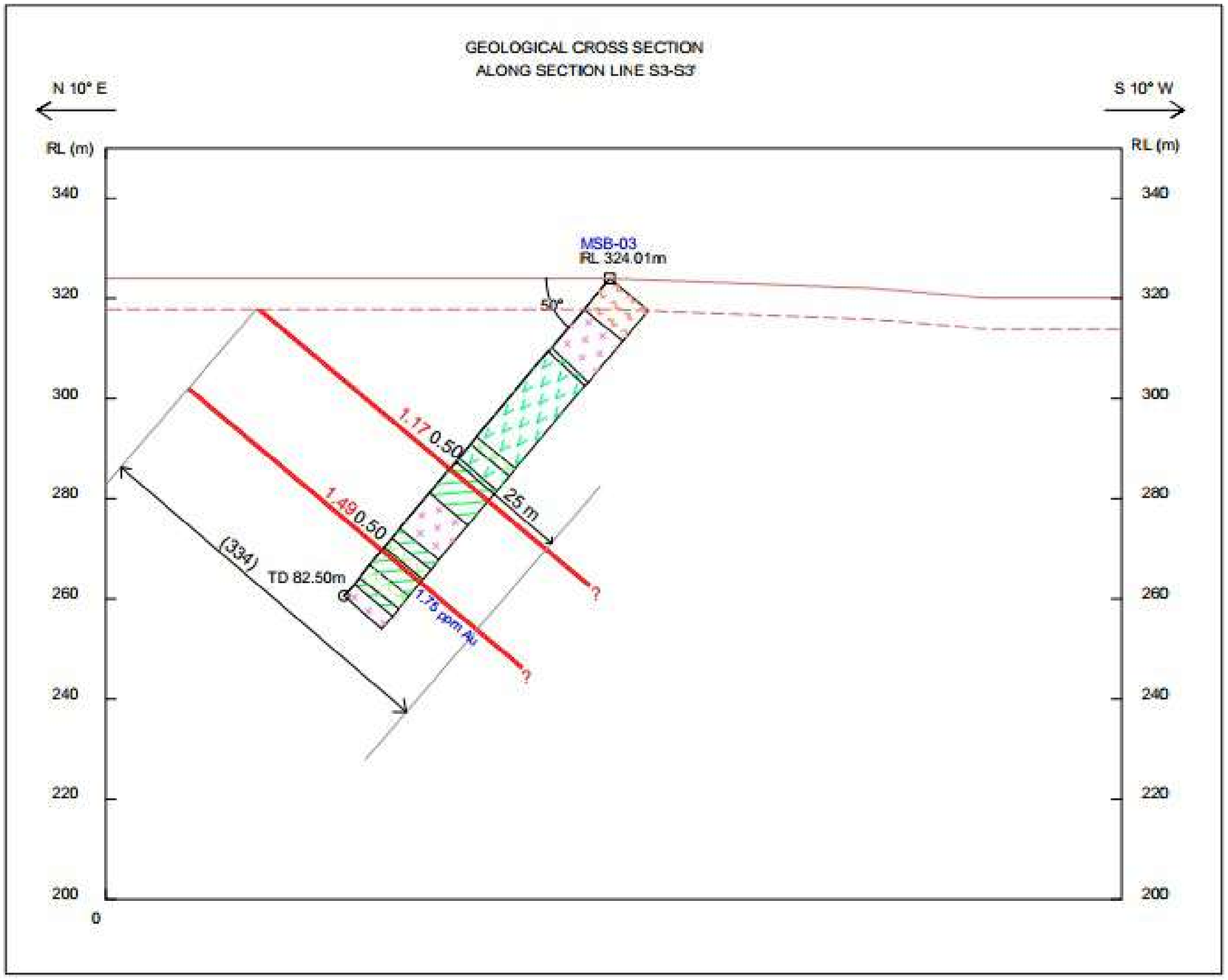
19.1.0 RESOURCE ESTIMATION

19.1.1 As per the analysis of borehole samples for copper, one zone of copper for 0.5m has been encountered in MSB-01 with Cu grade of 1.44%. Two zones of copper of 0.5m each has been encountered in MSB-03 with Cu grade of 1.17% and 1.49%. Details of the zones for copper at 0.5% Cu Cut-off has been tabulated in Table 18.1. Additionally, an attempt has been made to demaracate the cu at 0.2% Cu cut-off also. In such case, in MSB-03, there is one zone of copper for 1 m has been estimated with average Cu grade of 0.76% .Apart from that, other mineralisation zones of MSB-01 and MSB-03, as mentioned above, are unchanged. Details of the zones for copper at 0.2% Cu Cut-off has been tabulated in Table 18.2. Maximum thickness of the copper zone encountered is 1.00m. **Due to the presence of very thin zones of copper in the boreholes, resource of copper was not advisable to be estimated in the block.**

19.1.2 Precisely, Copper mineralization has been confirmed in borehole no. MSB-01 and MSB-03 having cummulative strike length of 200m and 1.5m thickness at 0.5% Cu cut-off,while cummulative thickness of copper zone is 2.00m at 0.2% Cu cut-off. Gold and silver instances has also been noticed in borehole no. MSB-03. (70.50m-71.00m, 1.75 ppm Au and 4.68 ppm Ag).



Text Figure 19.1: Representative Geological Cross Section along Section Line S1-S1′, Bagwari – Sukwari G4 Block, District- Sidhi, Madhya Pradesh



Text Figure 19.2: Representative Geological Cross Section along Section Line S3-S3′, Bagwari – Sukwari G4 Block, District- Sidhi, Madhya Pradesh

CHAPTER-20

SUMMARY AND RECOMMENDATIONS

20.1.0 SUMMARY

20.1.1. The Bagwari – Sukwari exploration block (G-4 stage) for copper, lead, zinc and graphite falls in parts of the Survey of India Toposheet No. 63H/11 and 63H/15 and it lies between 24° 18' 00.83"N to 24° 23' 41.38"N latitudes and 81°41'22.18"E to 81° 59' 58.76""E longitudes covering an area of 141.75 sq.km in and around villages of Sukwari, Bagwari. Khirkhori, Parkhuri, Semaria, Kusumhar, Dhankhori, Panwar, Mauharian, Tendua, Pathera, Maharajpur, Jamuniya Khurd of district Sidhi, State-Madhya Pradesh.

20.1.2. The area mostly exposes lithounits belonging to Archaen granite gneisses and schists represented by the Older Metamorphics comprising talc-chlorite-schist, quartz-sericite-schist etc. Paleoproterozoic Mahakoshal rocks which includes mafics and ultramafics and granites. These older schists have been intruded by basic and ultrabasic rocks metamorphosed into metadolerites and amphibolites and it is also intruded by granite. Older metamorphics including granite gneisses and talc-chlorite-schist, quartz-sericite-schist are the host rock for copper mineralsation. These rocks are intruded by quartz veins in which these mineralsation can be observed. General Strike of the litho-units is NE-SW and dipping 40-60° towards SE.

20.1.3 In Bagwari-Sukwari (G-4 stage) block, promising zones of copper mineralization has been identified in the block. Surface manifestations include malachite and azurite encrustation and ferruginisation, minor pyritic sulphides associated with quartz veins emplaced along brittle shear zones in older metamorphic schists and granites. Other sulphides include chalcopyrite and minor bornite. Gold values are also reported in such zones.

20.1.4 The exploratory work in the block was commenced on 24.01.2022 with geological mapping on 1:12,500 scale. Simultaneously, surface sampling including the bedrock, soil and stream sampling were taken up. After, delineating the positive zones based on the surface sampling, trenching was done in November 2022 followed by drilling

in April-June, 2023. The allied field-works including mapping of trenches and trench sampling, sample preparation, surveying at borehole locations, borehole core logging and borehole sampling has been carried out simultaneously.The analytical/laboratory studies were carried out in laboratories of MECL and other NABL accredited laboratories.

20.1.5 Geological Mapping was carried out at 1:12,500 scale for the entire area of 141.75 sq. km. A total of 202 surface samples that includes 65 bedrock samples, 111 Soil samples and 26 Stream samples were collected for the analysis of 34 elements including Cu, Pb,Zn , Co, Mo, Al, As B, Ba Be, Bi,Ca, Cd, Cr, Fe, Ta, K, La, Li, Mg, Mn, Na, Ni , P, S, Nb , Si , Y , Sr , Ti , V, Sc , U, Cs. Apart from that, 3 samples were analysed from carbonaceous phyllites targeting fixed carbon content and 25 surface samples targeting gold. On the basis of the surface sample results, four zones were identified for the copper mineralization (MSB-BR12, BR47, BR27, BR31) and one zone was identified for copper and gold mineralization (MSB-BR-09). In these five location, 5 trenches were excavated. Three Samples were analysed for Au-Ag. The copper values in trench samples were quite encouraging with values ranging from 1068ppm to 6576 ppm.

20.1.6 On this basis, 6 Nos. of boreholes were drilled involving 454.50m drilling, two borehole each for MSB-T3 and MSB-T2 while one borehole each were drilled at MSB-T1 and MSB-T5.One borehole was planned at MSB-T4 but due to very thin zone and forest constraints, it wasn't executed. Borehole MSB-01 was drilled at Trench location MSB-T3 and MSB-02 was. drilled at 200m apart in west to the Trench Location MSB-T3. Similarly, Borehole MSB-03 was drilled at Trench location MSB-T2 and MSB-04 was. drilled at 200m apart in west to the Trench Location MSB-T2. Borehole MSB-05 was drilled at Trench location MSB-T1 and Borehole MSB-06 was drilled at Trench location MSB-T5.

20.1.7 Boreholes have encountered the sulphide mineralization including pyrite, chalcopyrite and minor bornite etc. A total of 97 mineralsied core samples were analysed for Cu, Pb, Zn, Co and Mo. On the basis of all the primary samples, ore zone / lode have been delineated above cut-off vlaue (≥0.2% of Cu and ≥0.5% of Cu). 16 Borehole core samples were analysed for Au-Ag. Copper mineralization has been confirmed in borehole no. MSB-01 and MSB-03 with significant gold values in borehole no. MSB-03.

20.1.8 As per the analysis of borehole samples for copper, one zone of copper for 0.5m has been encountered in MSB-01 at 0.2% cu cut-off and 0.5% cu cut-off and two zones of copper for 1.0m and 0.5m has been encountered in MSB-03 at 0.2% cu cut-off. While, two zones of copper for 0.5m each has been encountered in MSB-03 at 0.5% cu cut-off. Maximum thickness of the copper zone encountered is 1.00m. Due to the presence of very thin zones of copper in the boreholes, resource of copper was not advisable to be estimated in the block.

20.1.9 Precisely, Copper mineralization has been confirmed in borehole no. MSB-01 and MSB-03 having cummulative strike length of 200m and 1.5m thickness at 0.5% Cu cut-off,while cummulative thickness of copper zone is 2.00m at 0.2% Cu cut-off. Gold and silver instances has also been noticed in borehole no. MSB-03.

20.1.10 Geological Report has been prepared by the author and peer reviewed by Dr. S. Kamalakaram, Ex. DGM (Exploration, MECL). All the cooments from the peer reviewer have been attended by the author.Comments from the peer reviewer and response from the author has been enclosed as Annexure-XIII.

20.2.0 RECOMMENDATIONS

20.2.1 G-4 Stage investigations involving geological mapping on 12500 scale, trenching, sampling and drilling done in Bagwari- Sukawari block, MP, has identified copper associated with gold mineralisation along two promising zones within older metamorphic rocks of the area. This has narrowed down the target area to 5 sq.km, from presently explored 141.75 sq.km. Accordingly, G3 stage investigations are recommended covering positive zones intersected in boreholes MSB 01 and MSB 03, targeting copper and gold zones comprising detailed geochemical sampling, ground geophysical surveys and closed spaced and deeper level drilling for delineating zones of economic importance.

CHAPTER-21

PLATES AND MAPS

21.1.0 Location Map of the block showing various topographic and physiographic features on SoI toposheet is given as Plate-I.

21.2.0 Regional Geology Map is given as Plate-II.

21.3.0 Geological Map on 1:12,500 scale showing BH, Trench Locations etc is given as Plate-III.

21.4.0 Map showing bedrock sample location with cu assay values on geological map at 1:12,500 scale is given as Plate-IVA.

21.5.0 Map showing soil sample and stream sediment sample location with cu assay values on geological map at 1:12,500 scale is given as Plate-IVB.

21.6.0 Map showing surface sample locations for Graphite, Gold And Silver with analysis on geological map at 1:12,500 scale is given as Plate-IVC.

21.7.0 Map showing Trench Mapping with analysis results for Copper on 1: 100 scale is given as Plate-V.

21.8.0 Map showing Geological Cross Section along Section Lines S1-S1'1 S2-S2', S3-S3', S4-S4', S5-S5' and S6-S6' with copper zone at 0.5% Cu cut-off in Bagwari-Sukwari G-4 Block, on 1: 1000 scale is given as Plate-VI.

21.9.0 Map showing Geological Cross Section along Section Lines S1-S1'1 S2-S2', S3-S3', S4-S4', S5-S5' and S6-S6' with copper zone at 0.2% Cu cut-off in Bagwari-Sukwari G-4 Block, on 1: 1000 scale is given as Plate-VII.

CHAPTER-22

ANNEXURE / ENCLOSURES TO THE REPORT

22.1.0 The report includes all the relevant annexure and maps, plans, sections, photographs & photomicrograph etc. List of annexures, tables, maps/plans/sections, photographs, Text figures & photomicrograph etc are provided before the start of the text part of the Geological Report.

CHAPTER-23

ANY OTHER INFORMATION

23.1.0 ANY OTHER INFORMATION

No Such information is required to be mentioned additionally.

CHAPTER-24

CERTIFICATE FROM THE QUALIFIED PERSON WITH NAME, DATE AND SIGNATURE

NAME: **P. RAVINDRAN**

DESIGNATION: **GENERAL MANAGER (EXPLORATION)**

DATE: 20-11-2023

LIST OF PERSONNEL ASSOCIATED WITH RECONAISSANCE SURVEY (G-4) FOR COPPER, LEAD, ZINC AND GRAPHITE IN BAGWARI - SUKWARI, DISTRICT: SIDHI, MADHYA PRADESH

1	Overall guidance	Shri P. Ravindran, GM (Exploration)
2	Overall Planning, Co-ordination & Supervision	Shri P. P. Kulkarni, Dy. GM (Exploration)
		Vikash Kumar, Manager (Geology)
3	Project Management	Shri Hitendra Bhanarkar, Manager (Drilling) / Project Manager Shri Rajnikant Singh, Assistant Manager (Drilling) / Project Manager
4	Physical Execution of work	
	a) Geology	Shri Ram Pramod, Assistant Manager (Geology) Shri Dashmesh Singh, Assistant Manager (Geology)
	b) Survey	Shri Dev Singh. T.A., S & D
	c) Drilling	Shri Bharat Baghel, Assistant Manager (Drilling)
		Shri Rajnikant Singh, Asst. Manager (Drilling)
5	Sample Processing	Shri Ram Pramod, Assistant Manager (Geology) Shri Dashmesh Singh, Assistant Manager (Geology) Sri Mohammad Dastageer, Manager (Geology)
6	Chemical Laboratory	Shri G.S. Dhami GM (Geophysics)/ Lab. in-charge
		Shri Rohit Sharma, Manager (Chemistry)
		Dr. Deepti Rahangdale, Manager (Chemistry)
		Shri Pijush Kanti Mohanti, Asstt. Manager (Chemistry)
7	Petrographic Studies	Shri Sayantan Pal, Asstt. Manager (Geology)
8	Documentation	Vikash Kumar, Manager (Geology)
		Shri Dashmesh Singh, Assistant Manager (Geology)
9	Non-Coal Geological Report Cell	Shri P. P. Kulkarni, Dy. GM (Exploration)
		Shri Uday Patil, Sr. Computer Operator
		Shri Shivanand, Sr. Computer Operator
10	Reprography and Printing	Shri Jagdish Thakral, Survey & Map Officer
		Shri Kaushik Bhattacharya, Assistant Survey & Map Officer
		Shri Durgesh Devarshee, Senior Technical Assistant (S & D)
		Shri Punit Khandale, Sr. Technician (S & D)
		Shri Jawahar D. Chouvhan, Technician (S & D)
11	Hindi Translation	Shri Srikant Rai, Hindi Officer

LOCALITY INDEX

Locality	Latitude	Longitude
Bagwari	24°20'59.92"N	81°49'5.93"E
Batauli	24°22'55.91"N	81°54'26.78"E
Dhankhori	24°21'20.12"N	81°47'37.47"E
Karudiya	24°19'44.23"N	81°42'30.31"E
Kusmahar	24°18'37.72"N	81°43'25.93"E
Padra	24°22'31.94"N	81°51'47.29"E
Parkhuri	24°21'57.95"N	81°48'29.01"E
Jhokharwar	24°22'31.05"N	81°45'38.79"E

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ABBREVIATIONS USED

SL. No.	Abbreviation	Full form
1	UNFC	United Nation Framework Classification
2	IBM	Indian Bureau of Mines
3	DGCO	Directorate General Camp Office
4	GSI	Geological Survey of India
5	MECL	Mineral Exploration and Consultancy Limited
6	CPSE	Central Public Sector Enterprises
7	NMET	National Mineral Exploration Trust
8	TCC	Technical cum Cost Committee
9	EC	Executive Committee
10	DMG, MP	Directorate of Geology & Mining, Madhya Pradesh
11	NABL	National Accreditation Board for Testing and Calibration Laboratories
12	JNARDDC	Jawaharlal Nehru Aluminium Research Development and Design Centre
13	F.S.P.	Field Season Programme
14	MEMC	Minerals (Evidence of Mineral Contents)
15	MMDR	Mines & Minerals (Development and Regulation)
16	NH	National Highway
17	WGS-84	World Geodetic System-84
18	UTM	Universal Transverse Mercator
19	RL	Reduced Level
20	cu m	Cubic Meter
21	ICP-MS	Inductively Coupled Plasma Mass Spectrometry
22	DGPS	Differential Global Positioning System
23	DMS	Degree Minute Second
24	M / m	Meter
25	mt	Million Tonne
26	Sq. km	Square Kilometer
27	M. Sc.	Master of Science
28	M. Sc. Tech	Master of Science Technology
29	mRL	Reduced Level in metre
30	R.F.	Reserve Forest
31	P.F.	Protected Forest
32	QA/QC	Quality Assessment/ Quality Checks
33	WD-XRF	Wavelength Dispersive X-ray Fluorescence
34	CRM	Certified Reference Material
35	SARM	South African Reference Material
36	SoI	Survey of India