GEOLOGICAL REPORT ON

PRELIMINARY EXPLORATION (G-3) FOR GOLD IN DIMIRIMUNDA BLOCK OVER AN AREA OF 5 sq. km. KEONJHAR DISTRICT, ODISHA

TOPOSHEET NO 73 G/7, G/8 &12

Prepared by Odisha Mining Corporation LTD.

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CHAPTER 1

SUMMARY

The Dimirimunda Block forms a part of toposheet 73 G/7, G/8 & G12 and lies between the North Latitudes 85.446° 21.189° and 85.444° 21.219° and East Longitudes 85.443° 21.205° and 85.461° 21.203°. It is situated 70 km from the district headquarters, Keonjhar and 290 km away from the State Capital Bhubaneswar. The block covering an area of 5 sq km with nearby villages viz. Chua Hurhi, Namakani, Jharberha, Tangiri, Kurhabila, Telkoi etc. are well known for gold occurrences.

Ancient mining in the past was carried out through the placer. The source of the secondary gold mineralization is associated with weathering and erosion of mineralized zones. The panning activity is mainly confined to Sonajori river. Many other localities of panning for gold are active along Ib, Maini, Utial, Talda, Bharari, Makarkunda rivers and their tributaries during the monsoon. **(S.K. Ghosh & A.K. Mishra et.al, GSI, 1981-82).**

The investigation for gold in the study area was carried out in field season of 1995-96 by DoMG. The purpose of geological mapping was to identify the gold occurrences in the region. The DoMG, Odisha report titled "Investigation for Gold in Telkoi and Banspal blocks of Keonjhar" lays down the exploration carried out in the area. Around 1.1 Sq. km area was mapped on the scale of 1:2000. A total of five major quartz veins were delineated, and 30 trenches were dug to find out their continuity. The veins strike a trend of N25° W – S25°E while having a maximum persistence of about 300 m. The maximum thickness on the outcrop is observed to be around 19 m. From the 250 nos. chip and channel samples collected in the period, 53 samples were analyzed yield a value of 18.9 gm/tonne. The authors have also noticed gold extraction from the alluvium brought down by local streams near Kardangi village. The zone being panned in the Kardangi along with the regional geology indicates that the provenance of the gold mineralization must be within the auriferous quartz veins in the Dimirimunda block. (However, the zone could not be identified in the presence phase of the work.) The author of these works has mentioned anomalies of gold in their observations; however, no further work has been done to systematically analyze the viability or the genesis of the anomaly.

From GSI, geological mapping was carried out in field season (1993-94) by **M. A Karim** and **N. K Sahu** on 1:25,000 scales in the Chuahulli block falling in the middle of the block which is occupied by schistose meta basalt, and amygdule basalt. The predominant rock types exposed in the study area are chlorite schist, actinolite-tremolite schist and quartz vein. A total of 13 trenches were sunk at 50 mts interval across the quartz vein. A total of 68 groove samples were collected from the trenches and analyzed. Three trenches were sunk across Malayagiri shear zone around Kudubil at 1-2 km interval and 18 samples were collected and analyzed. Besides, bed rock sampling has been done in this block from various rock types which comprise quartz vein, meta basalt, and laterite. Chemical analyses data reveal that the values of gold is highly erratic and shows it ranges from 50 ppb to 260 ppb. There is no positive correlation between trace elements and gold content.

The exploration proposal was presented in the 55th TCC meeting that was held on 27th, 28th and 31st July 2023. A total area of 44.942 sq. km was proposed, out of which 5.00 sq. km was granted by the TCC committee for G3 level of exploration. Primarily, the area has been covered by Geological Mapping on a scale of 1:12,500 to understand the litho-structural controls of mineralization. Later, detailed geological mapping was conducted on 1: 2000 scale to understand the continuity of mineralization in the study area. Major rock types encountered in the area are chlorite Schist, mica schist/quartz mica schist, microgranite and laterite at places. The area under study represents a part of the Bonai-Keonjhar greenstone belt occurring in the southeastern fringe of the Archean Singhbhum craton. (**Mohanty, 2012**). Gold occurrences are encountered in quartz veins within chlorite schist whereas, silver occurrence is reported within quartz vein embedded in laterite. Due to sporadic intrusion of the quartz veins, the structural attributes are difficult to ascertain in the field.

A total of Eighty-Seven (87) Bed Rock Samples (BRS) were collected by exposing the fresh portion of the outcrops observed in the field area. Out of 87 samples, fifty-four (54) samples were analyzed for determination of Au & Ag in the chemical laboratories of Shiva Analytical (India) Pvt. Ltd., Hoskote, Bangalore. The analytical results of the samples revealed that the maximum Au values in two samples are **30 ppb** & **80 ppb** in quartz vein within chlorite schist. Apart from the above-mentioned two samples, the rest of the other samples didn’t have any promising gold value. The results show that the gold values fall below 0.1 ppm in all the samples. In addition to this, only one sample shows the Ag value is **4.39 ppm**, and the rest of all other samples show the analytical data below detection limit. From the analytical results appended in the report **(Annexure-II**), it is confirmed that gold values are not promising in the study area.

In Dimirimunda, a drone magnetic survey was carried out over an area of 5 sq km. The survey lines were spaced 100 m apart and oriented at a 45° azimuth. The acquired raw data was initially processed by Despiking, Diurnal correction, Tie line levelling, and micro levelling to remove the noises. Total Magnetic Intensity (TMI) was generated on due corrections and used for the entire block.

TMI data was further processed to prepare different maps for interpretation. The prepared maps are i. TMI map, ii. IGRF corrected TMI map, iii. Reduced to pole (RTP) map, iv. Analytical signal (AS) map, v. Residual anomaly map, vi. First vertical derivative map, vii. 2nd vertical derivative map, viii. Tilt derivative map. ix. 1st derivative map in x-direction (DX1), x. Generalized Derivative map.

Based on different methods of Geophysical investigation, the study area didn't reveal any significant structure that could be considered a favorable host for gold mineralization.

अध्याय 1

सारांश

दिमिरीमुंडा ब्लॉक टोपोशीट 73 जी/7, जी/8 और जी12 का हिस्सा है और उत्तरी अक्षांश 85.446° 21.189° और 85.444° 21.219° तथा पूर्वी देशांतर 85.443° 21.205° और 85.461° 21.203° के बीच स्थित है। यह जिला मुख्यालय क्योंझर से 70 किमी और राज्य की राजधानी भुवनेश्वर से 290 किमी दूर स्थित है। यह ब्लॉक 5 वर्ग किमी के क्षेत्र में फैला हुआ है और इसके आस-पास के गांव जैसे चुआ हुरही, नामकानी, झारबरहा, तंगिरी, कुरहाबिला, तेलकोई आदि सोने की खोज के लिए जाने जाते हैं।

अतीत में प्राचीन खनन प्लेसर के माध्यम से किया जाता था। द्वितीयक स्वर्ण खनिजीकरण का स्रोत खनिज क्षेत्रों के अपक्षय और क्षरण से जुड़ा हुआ है। पैनिंग गतिविधि मुख्य रूप से सोनाजोरी नदी तक ही सीमित है। मानसून के दौरान इब, मैनी, उटियाल, तलदा, भरारी, मकरकुंडा नदियों और उनकी सहायक नदियों के किनारे सोने की खोज के कई अन्य स्थान सक्रिय हैं। (एस.के. घोष और ए.के. मिश्रा एट अल, जीएसआई, 1981-82).

अध्ययन क्षेत्र में सोने की जांच DoMG द्वारा 1995-96 के क्षेत्र मौसम में की गई थी। भूवैज्ञानिक मानचित्रण का उद्देश्य क्षेत्र में सोने की घटनाओं की पहचान करना था। DoMG, ओडिशा की रिपोर्ट जिसका शीर्षक "क्योंझर के तेलकोई और बंसपाल ब्लॉकों में सोने की जांच" है, क्षेत्र में किए गए अन्वेषण का विवरण देती है। लगभग 1.1 वर्ग किमी क्षेत्र को 1:2000 के पैमाने पर मैप किया गया था। कुल पांच प्रमुख क्वार्ट्ज नसों को चित्रित किया गया था, और उनकी निरंतरता का पता लगाने के लिए 30 खाइयां खोदी गई थीं। नसों का रुझान N25° W – S25°E है, जबकि उनकी अधिकतम दृढ़ता लगभग 300 मीटर है। आउटक्रॉप पर अधिकतम मोटाई लगभग 19 मीटर देखी गई है। लेखकों ने करदांगी गांव के पास स्थानीय जलधाराओं द्वारा लाई गई जलोढ़ मिट्टी से भी सोना निकाले जाने का पता लगाया है। क्षेत्रीय भूविज्ञान के साथ-साथ करदांगी में जिस क्षेत्र की खोज की जा रही है, उससे संकेत मिलता है कि सोने के खनिजकरण का उद्गम दिमिरिमुंडा ब्लॉक में सोने की क्वार्ट्ज नसों के भीतर होना चाहिए। (हालांकि, कार्य के उपस्थिति चरण में क्षेत्र की पहचान नहीं की जा सकी।) इन कार्यों के लेखक ने अपने अवलोकनों में सोने की विसंगतियों का उल्लेख किया है; हालांकि, विसंगति की व्यवहार्यता या उत्पत्ति का व्यवस्थित रूप से विश्लेषण करने के लिए कोई और काम नहीं किया गया है।

जीएसआई के अनुसार, भूवैज्ञानिक मानचित्रण क्षेत्र सत्र (1993-94) में एम ए करीम और एन के साहू द्वारा 1:25,000 पैमाने पर चुआहुल्ली ब्लॉक में किया गया था, जो ब्लॉक के मध्य में आता है जिसमें शिस्टोज मेटा बेसाल्ट और एमिग्ड्यूल बेसाल्ट है। अध्ययन क्षेत्र में उजागर प्रमुख चट्टान प्रकार क्लोराइट शिस्ट, एक्टिनोलाइट-ट्रेमोलाइट शिस्ट और क्वार्ट्ज वेन

हैं। क्वार्ट्ज वेन में 50 मीटर के अंतराल पर कुल 13 खाइयां खोदी गईं। खाइयों से कुल 68 खांचे के नमूने एकत्र किए गए और उनका विश्लेषण किया गया। कुदुबिल के आसपास मलयागिरी कतरनी क्षेत्र में 1-2 किमी के अंतराल पर तीन खाइयां खोदी गईं और 18 नमूने एकत्र किए गए और उनका विश्लेषण किया गया। रासायनिक विश्लेषण डेटा से पता चलता है कि सोने का मान अत्यधिक अनिश्चित है और यह 50 पीपीबी से 260 पीपीबी तक है। ट्रेस तत्वों और सोने की मात्रा के बीच कोई सकारात्मक संबंध नहीं है।

अन्वेषण प्रस्ताव 55वीं टीसीसी बैठक में प्रस्तुत किया गया जो 27, 28 और 31 जुलाई 2023 को हुई थी। कुल 44.942 वर्ग किमी प्रस्तावित था, जिसमें से 5.00 वर्ग किमी को टीसीसी समिति ने जी3 स्तर के अन्वेषण के लिए मंजूरी दी थी। मुख्य रूप से, खनिजकरण के लिथो-स्ट्रक्चरल नियंत्रण को समझने के लिए 1:12,500 के पैमाने पर भूवैज्ञानिक मानचित्रण द्वारा क्षेत्र को कवर किया गया है। बाद में, अध्ययन क्षेत्र में खनिजकरण की निरंतरता को समझने के लिए 1:2000 के पैमाने पर विस्तृत भूवैज्ञानिक मानचित्रण किया गया। क्षेत्र में पाए जाने वाले प्रमुख चट्टान प्रकार क्लोराइट शिस्ट, अभ्रक शिस्ट/क्वार्ट्ज अभ्रक शिस्ट, माइक्रोग्रेनाइट और स्थानों पर लेटराइट हैं। अध्ययन के तहत क्षेत्र बोनाई-क्योंझर ग्रीनस्टोन बेल्ट के एक हिस्से का प्रतिनिधित्व करता है (मोहन्ती, 2012)। क्लोराइट शिस्ट के अंदर क्वार्ट्ज शिराओं में सोने की मौजूदगी पाई जाती है, जबकि लेटराइट में एम्बेडेड क्वार्ट्ज शिराओं में चांदी की मौजूदगी की रिपोर्ट की गई है। क्वार्ट्ज शिराओं के छिटपुट घुसपैठ के कारण, संरचनात्मक विशेषताओं को क्षेत्र में पता लगाना मुश्किल है।

क्षेत्र में देखे गए आउटक्रॉप के ताजा हिस्से को उजागर करके कुल अस्सी-सात (87) बेड रॉक नमूने (बीआरएस) एकत्र किए गए थे। 87 नमूनों में से, शिवा एनालिटिकल (इंडिया) प्राइवेट लिमिटेड, होसकोटे, बैंगलोर की रासायनिक प्रयोगशालाओं में Au और Ag के निर्धारण के लिए चौवन (54) नमूनों का विश्लेषण किया गया। नमूनों के विश्लेषणात्मक परिणामों से पता चला कि दो नमूनों में अधिकतम Au मान क्लोराइट शिस्ट के भीतर क्वार्ट्ज नस में 30 पीपीबी और 80 पीपीबी हैं। उपर्युक्त दो नमूनों के अलावा, बाकी सभी नमूनों में कोई आशाजनक स्वर्ण मूल्य नहीं था। परिणाम दर्शाते हैं कि सभी नमूनों में सोने का मूल्य 0.1 पीपीएम से कम है। इसके अलावा, केवल एक नमूने में Ag का मूल्य 4.39 पीपीएम है, और बाकी सभी नमूनों में विश्लेषणात्मक डेटा पता लगाने की सीमा से नीचे है। रिपोर्ट (अनुलग्नक-II) में संलग्न विश्लेषणात्मक परिणामों से, यह पुष्टि होती है कि अध्ययन क्षेत्र में सोने के मूल्य आशाजनक नहीं हैं।

डिमिरिमुंडा में, 5 वर्ग किलोमीटर के क्षेत्र में ड्रोन चुंबकीय सर्वेक्षण किया गया। सर्वेक्षण रेखाएँ 100 मीटर की दूरी पर थीं और 45 डिग्री एज़िमुथ पर उन्मुख थीं। प्राप्त कच्चे डेटा को शुरू में डेस्पिकिंग, दैनिक सुधार, टाई लाइन लेवलिंग और माइक्रो लेवलिंग द्वारा शोर को दूर करने के लिए संसाधित किया गया था। कुल चुंबकीय तीव्रता (TMI) को उचित सुधारों पर उत्पन्न किया गया और पूरे ब्लॉक के लिए उपयोग किया गया।

व्याख्या के लिए अलग-अलग मानचित्र तैयार करने के लिए टीएमआई डेटा को आगे प्रोसेस किया गया। तैयार किए गए मानचित्र हैं i. टीएमआई मानचित्र, ii. आईजीआरएफ संशोधित टीएमआई मानचित्र, iii. रिड्यूस्ड टू पोल (आरटीपी) मानचित्र, iv. एनालिटिकल सिग्नल (एएस) मानचित्र, v. अवशिष्ट विसंगति मानचित्र, vi. पहला ऊर्ध्वाधर व्युत्पन्न मानचित्र, vii. दूसरा ऊर्ध्वाधर व्युत्पन्न मानचित्र, viii. झुकाव व्युत्पन्न मानचित्र। ix. x-दिशा में पहला व्युत्पन्न मानचित्र (DX1), x. सामान्यीकृत व्युत्पन्न मानचित्र।

भूभौतिकीय जांच के विभिन्न तरीकों के आधार पर, अध्ययन क्षेत्र में ऐसी कोई महत्वपूर्ण संरचना सामने नहीं आई जिसे सोने के खनिजीकरण के लिए अनुकूल माना जा सके।

CHAPTER 2

INTRODUCTION

Gold in its purest form is a bright, slightly reddish yellow, dense, soft malleable and ductile metal. It is one of the least reactive chemical elements and is solid under standard conditions. Gold often occurs in free elemental (native) form, like nuggets or grains, in rocks, as well as secondary placer. Gold dissolves in an alkaline solution of cyanide, which is used in mining and electroplating. It also dissolves in mercury, forming amalgam alloys, but this is not a chemical reaction. Gold is resistant to corrosion to most acids and has unique properties distinct from other metals. Gold is relatively scarce metal in the world and a scarce commodity in India. The domestic demand is mainly met through imports.

The proposed block of Dimirimunda falls in the South-western corner of Telkoi Tehsil of Keonjhar district Odisha flanked by Iron bearing formations in the North and South. The area has been covered by workers of GSI and DoMG in the 1970's and have documented gold occurrences in Telkoi and Banspal blocks.

2.1 Details of Project

It is NMET Project which has been approved by the Executive committee in its 31st meeting held on 05th October 2023 for G-3 level exploration.

The proposed gold block is located in Dimirimunda village of Telkoi Tehsil, District Keonjhar of Odisha and falls in the Survey of India Toposheet Nos 73 G/7, G/8 & G/12.

2.2 Investigating Agency

The Odisha Mining Corporation (OMC) carried out exploration in the Dimirimunda block.

2.3 Objectives for Investigation

The primary objective of the investigation is to evaluate the gold mineralization potential in the Dimirimunda area through systematic exploration under the guidelines of the UNFC classification for G3 stages. Specifically, the study aims to establish geological understanding, identify mineralization potential, collect baseline data, establish exploration targets and enhance economic understanding.

2.4 Details of Basis of taking of Investigation:

The Dimirimunda area in Odisha is situated in a geologically favorable region, with potential gold mineralization associated with greenstone belts and auriferous quartz veins. Previous studies and regional surveys indicate the presence of favorable litho-structural settings and altered zones conducive to gold mineralization, yet the area remains underexplored. Systematic exploration is essential to assess its potential, contributing to India's goal of enhancing domestic gold resources and reducing import dependency.

The favorable litho-structural settings in the area are chlorite schist and quartz mica schist as dominant litho-units with extensive foliation, providing suitable permeability pathways. While the visible hydrothermal alteration (e.g. silicification and chloritization) is not prominently developed and enrichment of Fe, Mn, and Al in lateritic samples suggests possible **supergene enrichment**.

2.5 Nature and quantum of work and achievement:

The nature and quantum of work and achievement for the year 2023-2025 at G3 stage have been listed in Table 1.

Table 1: Nature and Quantum of work and achievements

Activity	Unit	Target Quantity	Status
Detailed Geological Work			
Geological mapping (1: 2000)	Sq km	5	Completed
Survey Work			
DGPS survey	Per point of observation	10	2 Points
Topographical survey	Per point of observation	30	2 Points
Trenching & Pitting			
Excavation of Trenches	Cu.M	40	Not done
Physical and Petrological Studies			
Preparation of standard thin sections	Nos	10	Not done
Complete petrographic/Ore microscopy/Mineragraphic study	Nos	5	Not done
Preparation of unmounted polished section of the rock	Nos	10	Not done
Digital photographs	Nos	10	Not done
Laboratory studies			
Primary samples for gold through fire assay (40 BRS + 20 Trench samples + 40 Core samples)	Nos	70	Total 54 BRS samples including 3 check samples
Check samples for Gold by Fire Assay	Nos	7	3 samples
Gold analysis by AAS method	Nos	30	Not done
Check samples for Gold by AAS method	Nos	3	Not done
Ground Geophysical Survey			
Induced Potential (IP) survey	Nos	20 LKM	Not taken
Drilling			
Exploratory drilling	m	1000 m	Not taken

Quantum of work: (Target vs Achievement)

IP Survey:

No favorable major structure which may serve as a set up (i.e. Fault/Shear) for gold mineralization, could be identified from the Drone Magnetic survey. From the analytical results, the gold values were not encouraging in the study area (Annexure II). Hence, IP survey was not carried out in the block.

Sampling:

The analytical results from bedrock samples did not yield encouraging values, indicating weak or insignificant mineralization.

From the field observations and drone magnetic interpretation, no major structural lineaments have been observed, and the study area is covered by soil and the thickness was more than 3-meters so, trenching was also not carried out in the area. In such contexts, surface grab sampling is a standard and cost-effective method to screen large areas and prioritize specific zones for further detailed work. Hence, the grab sampling method is carried out in the study area. Apart from this, the analytical results from bedrock samples did not yield encouraging values, indicating weak or insignificant mineralization. So, no other sampling methods were deployed.

Trenching and Pitting:

The areas which had moderately promising values of Au from the sampling data had access limitations due to forest cover, land use restrictions and additional local constraints that made trenching impractical.

Since the preliminary ground truthing did not yield any significant signatures or evidence of Au" contents and ancient exploration activities/ localized mining didn't say much about the secondary sources, panning was not carried out.

Laboratory Studies:

The area being poorly mineralized, studies related to Petrology/Petrography etc. and its interpretations are not carried out. The descriptions of rock types, alteration, and mineralization are based on systematic field-based visual inspection aided by hand lens and structural observations.

2.6 Personnel directly involved in exploration and report work

Different Aspect of work	Name and Designation
General Supervision and Guidance	Shri Mr. Asim Chatterjee, EX-Program Manager (STC)
Field Operation	Mr. Navneet Sharma, Senior Professional Geologist (STC) Mr. Mohd Nadeem, Junior Professional Geologist (STC) Mr. Anjuman Bahera, Professional Assistant (Geology) Mr. Satya Prakash Rout, Executive (Geology) Mr. Biswajeet Dash, Professional Assistant (Geology) Mr. Shibani Shankar Sahoo, Executive (Geology) Mr. Arjun Chandra Pani, Executive (Geology)
Drone Magnetic Survey	Steiger Geoscience and Engineering Pvt Ltd
Survey (Data Processing &Interpretation)	Mr. Stephan W. Reford, International Expert Geophysicist (PGW) Mr. Amitava Maji, Senior Professional Geophysicist (STC)
Chemical Analysis	Shiva Analytical (India) Pvt Ltd
Report writing	Mr. Mohd Nadeem, Junior Professional Geologist (STC)
Guidance and Review	Mr. Pravasa Ranjan Chinara, Interim Program Manager (STC)

2.7 Mode of operation of different work components and associated agency

Sr No	Work Component	Associated Agency
1.	Geological Mapping	OMC
2.	Sampling	OMC
3.	Drone magnetic Survey	Steiger Geoscience and Engineering Pvt Ltd
4.	Samples analysis	Shiva Analytical (India) Pvt. Ltd
5.	Submission of GR	OMC

CHAPTER 3

PROPERTY DESCRIPTION

Details of the area

Village Name	Dimirimunda
District	Keonjhar
State	Odisha
Toposheet number	73 G/7, G/8 & G/12
Geo Coordinate with corner points of the investigated area	A 85.446° 21.189° B 85.461° 21.203° C 85.444° 21.219° D 85.443° 21.205° E 85.437° 21.197°
Land use/cover	Sal tree by Forest Department and study area mainly covered by Forest
Forest with type of Forest	Part of the Lease area (3.35 sq km) falls into the Jharaberha and Raniberha reserved Forest.
Free hold/Lease Hold	Free Hold
Location	The study area is located 70 km. south of the district headquarters Keonjhar. It is surrounded by Pallahara Tehsil towards west, Kankadahad Tehsil towards south, Harichandanpur Tehsil towards east, Banspal Tehsil towards north.
Accessibility	The block is accessible via road from Telkoi, which is connected to major towns and cities in the region. The nearest town to Dimirimunda is Keonjhar located approximately 70 km. away, serving as the primary center for economic activities. The nearest airport is present at Bhubaneshwar city at around 270 km.
Climate	Keonjhar has a Tropical wet and dry or savanna climate (Classification: Aw). The district's yearly temperature is 28.07º C (82.53º F) and it is 2.1% higher than India's averages. Keonjhar typically receives about 189.9 millimetres (7.48 inches) of precipitation and has 166.54 rainy days (45.63% of the time) annually. Annual high temperature: 31.86ºC (89.35ºF) Annual low temperature: 20.82ºC (69.48ºF) Average annual precipitation: 189.9mm (7.48in) Warmest month: May (39.38ºC / 102.88ºF) Coldest Month: January (13.62ºC / 56.52ºF) Wettest Month: July (481.9mm / 18.97in) Driest Month: January (11.69mm / 0.46in) Humidity: 63.0%
Flora/Fauna	A total of 28 species of plants were recorded. Among flora diversity, Fabaceae shows domination with 6 Genus which includes total of 6 species and followed by Lamiaceae with 4 genera consisting of 4 species. Among fauna diversity, 36 species of birds and 58 species of insects including 18 species of butterfly were documented. Order Passeriformes is most dominant among the diversity of birds, which

	consists of 18 genera of a total of 20 orders. In the case of insects, there are 8 species of aquatic insects, and 11 orders of terrestrial insects were recorded. Insects of Diptera, Orthoptera and Collembola were found more by light traps, sweeping net and pitfall trap technique respectively. Nymphalidae of order Lepidoptera was the richest family among the diversity of butterfly.
Local Infrastructure	The Talcher railway station is present near the study area. The electricity supply is adequate.
Population	The population of Dimirimunda village in Keonjhar district, Odisha, is 553. The village has 129 families residing in it.
Archaeological	Buddhist and Jain sites at Anandapur, Sitabinji Fresco Painting and Rock Inscription,
Historical Sites	Murga Mahadev Temple, Gundichaghai waterfall, Gonasikha Temple, Brahmeshwar Mahadev temple, Baladevajew temple, Deogaon Kushaleswar, etc.
National Parks	Hadgarh wildlife sanctuary covering an area of 191 sq. km.

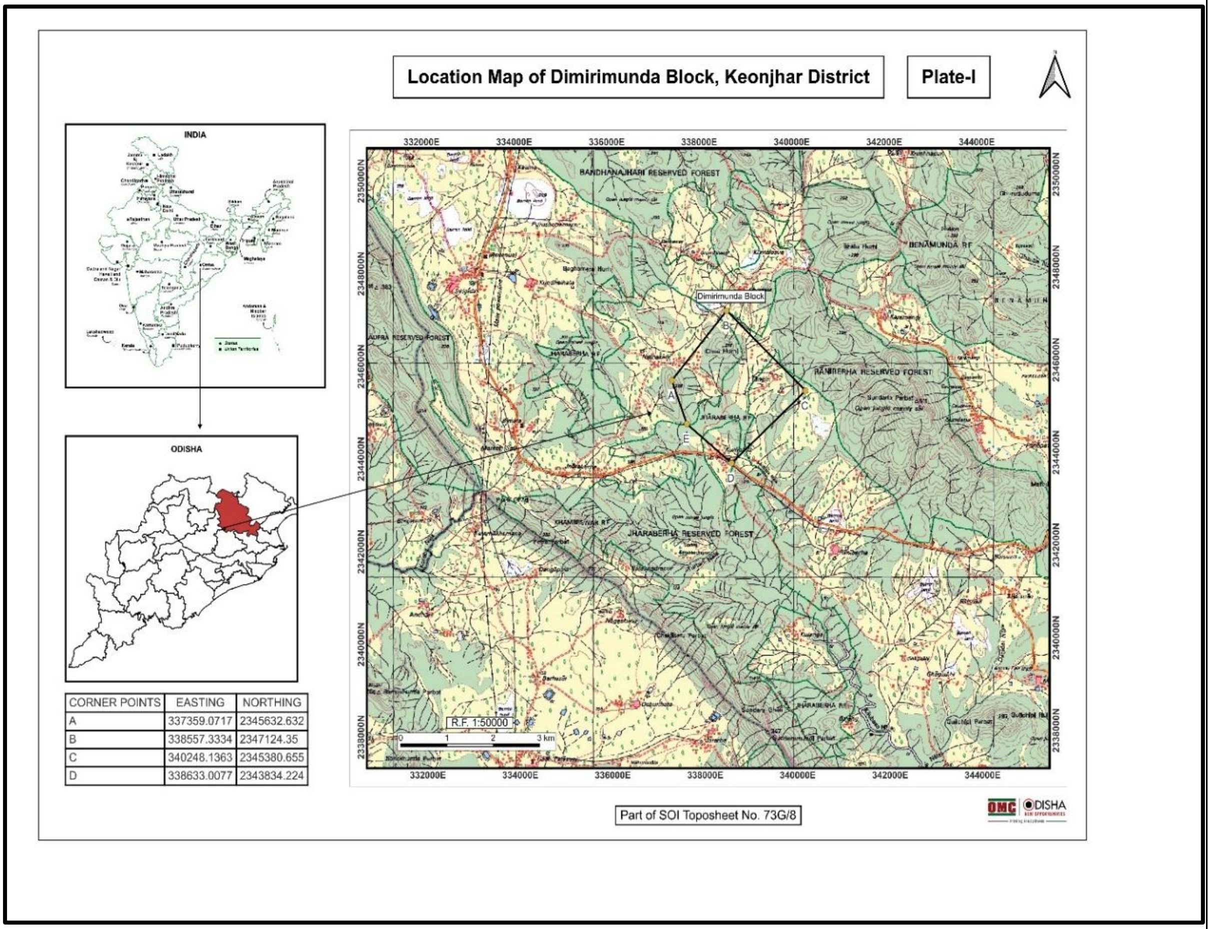


Figure 1: Location map of Dimirimunda (G3) Block

Streams seen in Plate 1 clearly show careful evaluation of stream sediment sample analysis would have given idea which watersheds are better for gold mineralization, and which are the preferred host rocks.

The stream networks visible in Plate 1 indeed offer an opportunity for stream sediment geochemical surveys but due to unavailability of a suitable trap sites, stream sediment sampling could not be carried out.

CHAPTER 4

PREVIOUS WORK

Detailed investigation in Dimirimunda area was undertaken by DoMG during the field season 1875-76. An area of 1.1 sq km was geologically mapped on a scale of 1:2,000. Five major vein quartz bodies were delineated in the area and trenches were put across them at regular strike interval for collection of samples for fire assay and to establish their continuity. 30 trenches amounting to 370 cubic meters of excavation were put. Channel and chip samples were collected at 15 ms. and 5 ms. strike interval respectively. The area represents metasediments belonging to the IOSG of rocks metamorphosed volcanites and granite. The litho-units were quartz schist, quartz sericite schist, ferruginous phyllite and amphibolite. The mineralization was controlled by subparallel shear zones within the metasediments and along the contact of amphibolites into which the quartz veins have invaded. The general trends of foliation of the metasediments varies from N10°W-S10°E to NW-SE with moderate south westerly dip. 250 nos of chip and channel samples from the area were fire assayed for gold and 53 samples indicated presence of gold from traces to 18.9 gms/tonnes.

During FS 1980-81, **M. Mahesh Babu**, and **S.K. Ghosh (GSI)**, investigated the Salaikena, Kalima area (Toposheet No.73 G/7 & G/8) and based on the promising result of Au values from bedrock samples, two boreholes were drilled with total drilling of 360.60 m to intersect. the anomalous zones at 30 m & 60 m depths. The core samples from this area have analyzed gold values of 0.5 ppm to 1.2 ppm. The Kalima area is falling to the immediate north of the present investigation block. During FS 1993-94, **M A Karim & N K Sahu** carried out large scale mapping of the area on l: 25,000 scales (Fig-02) with stream sediment sampling in the 1st and 2nd order streams. Four potential blocks, namely, Sunadeipahar, Dandahulli, Chuahulli and Purujora blocks were delineated based on color counts from the panned heavy concentrates, corroborated by chemical analysis of the heavy concentrates. The analytical results of panned concentrates reveal that the yellow metal occurs in sub-microscopic form. It occurs mostly as flakes, grains, dust or flour and rarely as nuggets. In Dandahulli block, gold is associated with quartz vein and laterite, whereas in Sunadeipahar Block, it is associated with quartz pebble conglomerate (QPC) and in Chuahulli block, it is associated with sheared meta basalts. Trace element data reveals that the meta-sedimentary rocks of Dandahulli and Sunadeipahar block are enriched in elements such as Ag, As, Zn, Cr, Co. The lithological assemblage, structure and analytical data favor gold mineralization in the area. During F.S. 1995-96, **Karim & Sahu** (1999) carried out preliminary exploration for gold by detailed mapping on a 1:5,000 scale over 1.0 sq.km area in Dandahulli block, identified during FS 1994-95. Pitting / trenching along with collection of bedrock samples were also carried out in all the other potential blocks. Three (03) trenches were dug across Malayagiri shear zone around Kudubil at 1 to 2 km interval and 18 samples were collected and sent for gold assay. The assay values range from <50 ppb to 260 ppb.

S. N. Mohanty & P. C. Dash (2016) carried out regional geochemical surveys in Binjabahal-Bhimkund-Kantalai areas (T. S No. 73G/7) and Sanda-Bimbala-Golagadia areas (T.S. No. 73G/8) in Keonjhar, Angul and Dhenkanal districts, during FS 2006-08. An area of 1440 sq. km was covered by geochemical sampling on a 1:50,000 scale. The authors have detected geochemical anomalies of P2O5 (11%), Ba (1198ppm), Th (65 ppm), Ni (265 ppm), Co (96 ppm), Zr (2412 ppm), Nb (123 ppm), Cu (131 ppm), Cr (2016ppm), F (1200 ppm), La (365.93 ppm), Ce (674.4 ppm), Hf (146.6 ppm), Nd (447.59 ppm), Mo (45.33 ppm), Li (39 ppm), As (22.35 ppm), Cd (143 ppm), Hg (56 ppm), Ag (140 ppm) in the area as interpreted from their contour maps prepared on surfer software. They have recommended a follow-up programme for further investigation in detail for these anomalies.

The GCM work has indicated gold values with a minimum of 1.5 ppb and a maximum of 192 ppb. High values are recorded in west central and north central fringe in 73G/7 (sample no. 67, 151 & 164 have values 192 ppb, 170 ppb, 180 ppb, respectively). The associated arsenic value shows a minimum of 0.5 ppm and maximum of 22.35 ppm. It is highest in the central part of 73G/7 and low in the rest. The Silver (Ag) values show a minimum of 10 ppm and a maximum of 140 ppm. It is highest in the south over quartzite, high in central part and low in the rest. The mercury values range from a minimum of 2.5 ppm and a maximum of 56 ppm. It is highest in the northeast and eastern part in 73G/7 and low in the rest.

Aero Geophysical & Ground geophysical Survey:

Directorate of Mining and Geology, Govt of Orissa initiated High-Resolution Aeromagnetic Survey (HRAS) with the help of World Geoscience Corporation of Australia in recent past (1993) to locate mineral deposits like noble metals, base metals, diamond and gemstones, besides, locating suitable groundwater resources for irrigation in Phulbani, Kalahandi, Bolangir and Keonjhar. The interpretation of the aeromagnetic data has been completed, and 186 geological and geophysical maps have been prepared for follow-up action. These interpreted aero geophysical maps can be utilized to precisely demarcate the potential mineralized zones in Keonjhar district. AMSE wing of the GSI has also carried out aero geophysical survey of parts of Dhenkanal, Keonjhar and Jajpur districts in Orissa. Derivative aero geophysical maps such as magnetic, gravity and radiometric can be used accurately to target the gold mineralization zones.

During FS 2004-07, **Bhattacharya.et.al.,** carried out geophysical mapping by gravity and magnetic methods in SOI toposheet nos. 73/ C/16, 73D/13, 73 G/11, 73 G/12, 73 G/15, 73 G/16, 73 H/1, and 73 H/5 covering approximately 7126 km2 of area. The area constitutes part of the boundary of low-grade rocks of Singhbhum craton and the Northern fringe of the high-grade terrain of Eastern Ghats Mobile Belt and comprises varied geological formations including the lower crustal granulite facies rocks of Eastern Ghats Mobile Belt, sedimentary rocks of Talcher Gondwana basin. This geophysical mapping program was aimed at identifying regional geologic structures and to characterize the subsurface features like faults / contacts or presence / absence of rocks having different magnetic susceptibilities within the geological package. The workers have explained gravity and magnetic anomalies by both qualitative and quantitative studies. Several ductile shear zones fragmenting the crustal block between high grade metamorphic assemblage and low grade supracrustal of Singhbhum have been traced by the gravity magnetic survey on a regional scale. The basin margin faults and other major lineaments in the region have also been traced. Gravity magnetic anomalies associated with various geological exposures within the study area have been correlated and inferences drawn regarding their subsurface disposition based on quantitative analysis.

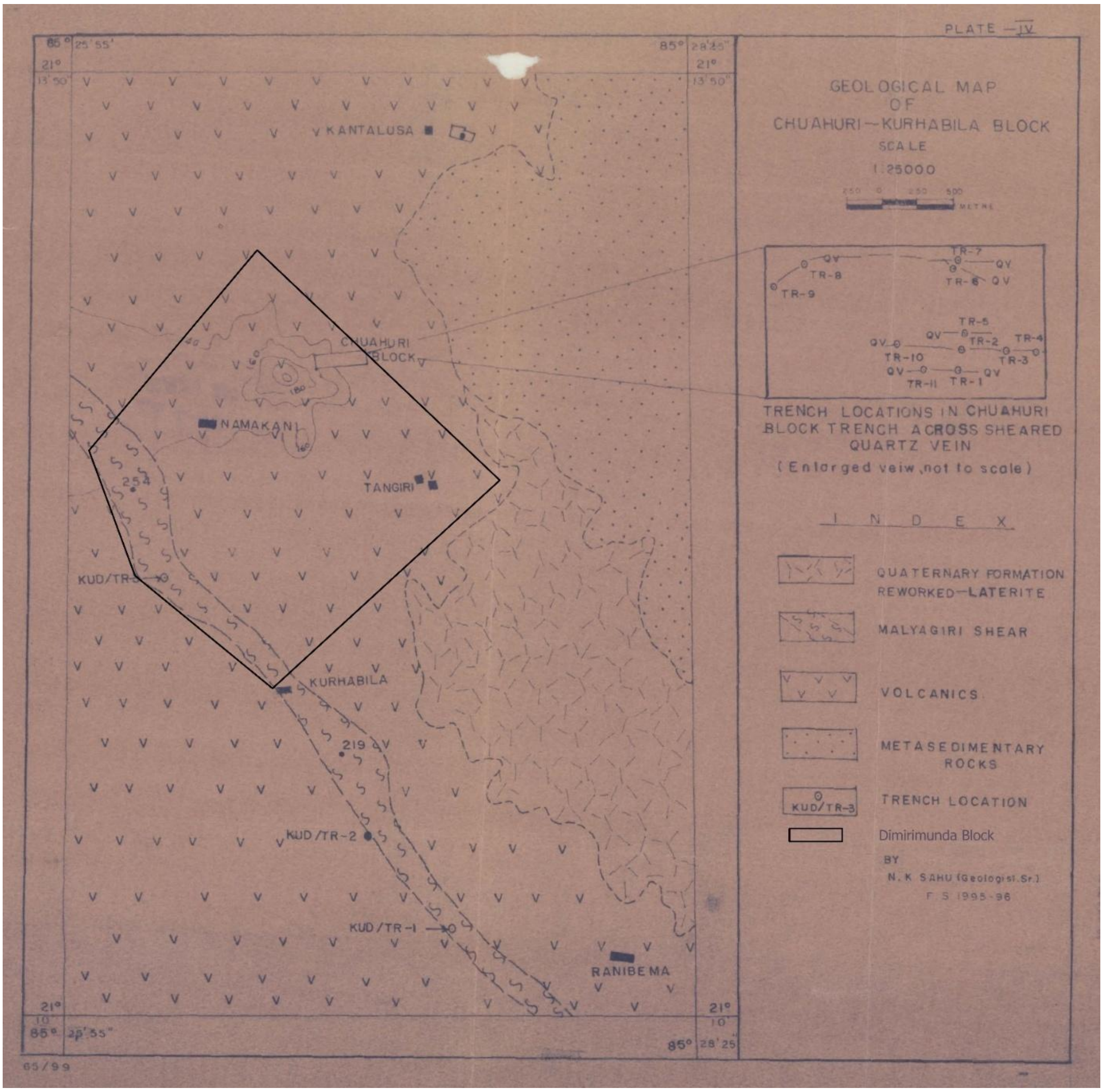


Figure 2: **Dimirimunda block overlay on the Geological map at 1:25,000 scales of GSI during F.S.1995-96.**

N.K. Sahu (1995-96) indicates that volcanic formations were prominently visible in the eastern portion of the study area, whereas the Malyagiri shear zone traversed the northwestern portions of the block. However, no such prominent shear zone could be identified during the present study.

Petrological studies of the rock types carried out by earlier workers:

During the Field season of 1993-94 by GSI, **M. A Karim** and **N. K Sahu** carried out the petrological studies in the Chuahulli block which falls squarely in the middle of the block. The predominant rock types exposed in the study area are chlorite schist, mica schist/quartz mica shist and sheared quartz veins.

The detailed petrological description of the rock types are as follows:

Metabasics: In the study area the basaltic rock undergone some metamorphism and crude foliation is developed in the rock. The grains are fine in nature. Individual grains cannot be identified in naked eye. Fine laths of plagioclase crystal show crude foliation. The major minerals are plagioclase, pyroxene, opaque and interstitial spaces are occupied by siliceous secondary minerals like quartz, k-feldspar. These metabasalt rocks contain sulphide mineraisation which shows isotropic in nature and shows black in nature as shown in sample PS-01. Under microscope, it is observed that these basalts are mostly altered into chlorite schist, tremolite-chlorite schist or actinolite-chlorite-zoisite schist with disseminated grains of pyrite and chalcopyrite. Tremolite/actinolite grains are oriented along with foliation. Isolated, stretched/flattened pockets of actinolite-sulfide-quartz are oriented parallel to foliation.

Mica Schist/quartz mica Schist: Mica-schist is well exposed along Ghurudia Nala from Kardangi to the west of Koilisuta. It is a fine to medium-grained rock with well-developed foliation planes. At places, it becomes gritty and conglomerate. A thin band of mica-schist containing elongated pebbles (mainly composed of quartzite and vein quartz) has been traced in Ghurudia nala west of Koilisuta and occasionally all along the Ghurudia Nala and its tributaries. In the thin section, the minerals identified in these rocks are quartz, muscovite, sericite and a little microcline. The overall texture identified is schistose with occasional granoblastic and porphyroblast (Ref. Reg No. OR-48 and 0R-49).

CHAPTER 5

GEOLOGY OF THE AREA

5.1 Brief Regional Geological Setup

The study area in eastern India is located within the Bonai-Kendujhar belt of Singhbhum Craton. The Singhbhum Craton in eastern India consists of diverse geological terrains with distinct evolutionary histories. This is one of the oldest Palaeo-Mesoarchaean cratonic nuclei situated in the eastern part of the Indian subcontinent. **(Sharma, 2009; Mukhopadhyay et al., 2008).** The northern edge of Singhbhum Craton is marked by Singhbhum Shear Zone which separates it from the North Singhbhum Mobile Belt (NSMB). The Sukinda thrust marks the southern boundary of this Craton separating it from the Proterozoic Eastern Ghat Mobile Belt (EGMB). The eastern part of the Singhbhum Craton is covered with the alluvium of the Bengal basin (**Dunn and Dey, 1942; Saha, 1994; Mukhopadhyay, 2001; Misra, 2006; Misra and Johnson, 2005; Valdiya, 2010; Mohanty, 2012; Mukhopadhyay et al., 2012 and references therein**).The Singhbhum Craton consists of distinct crustal blocks that preserve the signatures of several episodes of volcanism, sedimentation and metallogenic events spanning from Paleoarchean to Mesoproterozoic (**Saha, 1994; Bose, 2000; Mukhopadhyay, 2001; Mazumder, 2005; Misra, 2006; Eriksson et al., 2006; Sharma, 2009; Mukhopadhyay et al., 2014)**. The oldest components of this craton are represented by granitoids and their enclaves which are surrounded by volcano-sedimentary associations and supracrustal sequences (**Naqvi and Rogers, 1987; Saha, 1994; Weaver, 1990; Bose, 2009**). The Precambrian granite-greenstone terrains of Singhbhum Craton are divided into (1) the Older Metamorphic Group (OMG), (2) Older Metamorphic Tonalite Gneiss (OMTG), (3) older granite-greenstone belts containing banded iron formation (BIF) of the Iron Ore Group, (4) granite plutons, (5) two units of younger greenstone belts of Dhanjori -Simlipal Group, (6) younger granites and (7) mafic dyke swarms/Newer Dolerites (**Mohanty, 2012**). The OMG represents the oldest supracrustal assemblage of the Singhbhum Craton and comprises pelitic schists, quartz-magnetite, quartzites, banded calc gneiss, and para and ortho amphibolites reflecting the first cycle of mafic volcanism, plutonism and sediment deposition. The volcano-sedimentary sequences of Iron Ore Group indicate a second cycle of volcanism and sedimentation in the Craton (**Saha et al., 1988; Saha, 1994; Misra, 2006 Mukhopadhyay et al., 2012; Mondal, 2009**). The volcano sedimentary sequences of Simlipal basin are coeval with the third cycle of magmatism and sedimentation of Singhbhum Craton. The Proterozoic north Singhbhum mobile belt got accreted along the northern margin of the Singhbhum platform **(Bose, 2009**). The Dalma and Dhanjori basins of the

Proterozoic north Singhbhum mobile belt are distinctly marked by bimodal komatiite-tholeiite magmatism and sedimentary rocks. The ~2.25 Ga eruption of Jagannathpur and Malangtoli lavas post-dates the IOG mafic volcanism and in the southern part, the Malangtoli lavas overlie an unconformity consisting of quartz-sandstone pebble beds designated as Mankharchua Group (Sarkar et al., 1986) followed by the emplacement of Soda Granite (~2.22 Ga) and Kuilapal Granite (~1.64 Ga; **Saha, 1994; Saha et al., 1988; Bose, 2000; Misra, 2006**). Mohakul & Bhutia, 2015, concluded that Jagannathpur volcanic and Malangtoli/Nayakote volcanic suite constitute the lower part of the volcano sedimentary package. The OMG constitutes the oldest supracrustal assemblage in the Singhbhum Craton and is exposed around Champua and Noamundi areas. The lithological association of OMG comprises amphibolite facies pelitic schists, quartz–magnetite–cumingtonite schists, quartzites, banded calc-gneiss, para and ortho amphibolites reflecting the first cycle of mafic volcanism, plutonism and sediment deposition in the Singhbhum Craton. The OMG rocks occur as enclaves within the OMTG (older metamorphic tonalite gneiss) which is primarily composed of tonalite trondhjemite–granodiorite (TTG) rocks which show zircon U–Pb age of ~3.44–3.42 Ga (**Misra, 2006; Mukhopadhyay, 2001; Misra and Johnson, 2005**). The OMTG is intruded by granitoid plutons which show two pulses of emplacement and are referred to as Singhbhum Granites I and II (SBG I: ~3.44–~3.38 Ga; SBG II: ~3.33–3.3 Ga**; Saha, 1994**; **Mukhopadhyay, 2001; Misra, 2006; Misra et al., 1999**). These granitoid intrusions were succeeded by the deposition, structural deformation and metamorphism of the volcano-sedimentary sequences of Iron Ore Group (IOG) during ~3.30–3.16 Ga. The volcano-sedimentary sequences of IOG were deposited along the peripheral zones of the granitoid platform at Gurumahisani-Badampahar basin in the east, Jamda-Koira basin in the west and Tomka-Daitari basin in the south (**Saha, 1994; Mahadevan, 2002; Mukhopadhyay et al., 2012**). Some workers have grouped the packages of these belts into a single Iron Ore Group **(IOG, Sarkar and Saha, 1962, 1994**) while others consider an older Badampahar Group representing the litho-assemblages of BG belt and TD belts and a younger Koira Group for BK belt **(Murthy and Acharya, 1975; Jena and Behera, 2000).**

The feebly metamorphosed IOG rocks in the BK belt are bordered by Bonai granite to the west and by Singhbhum granite to the east. The litho-units of the IOG rocks clearly overlie the granitoids with an unconformity at the base marked by a basal quartzite-conglomerate horizon. The volcano-sedimentary sequence commences with a platform package consisting of quartzite which is followed upward by largely amygdular meta-basalt. Presence of pillow structure indicating sub-aqueous volcanism has been recorded at Nomira in the eastern part of the belt.

This is followed by deposition of sediments of the Lower phyllitic sequence, which constitutes both epiclastic and volcanogenic material comprising manganiferous sediments of chemogenic precipitates represented by chert and stromatolitic dolomite. This was succeeded by deposition of a fairly thick horizon of chemogenic precipitates in a relatively deeper, quiet shelf environment represented by BIF. The Upper phyllitic sequence consisting exclusively of epiclastic sediment constitutes the youngest package of the IOG. The volcano-sedimentary package of the IOG is unconformably overlain by arenaceous sediments of Kolhan Group. Geographically the volcanic suite can be classified into Bonai range volcanic in the western parts, Lotapani volcanic occurring in the central parts of the Koira valley, Jagannathpur volcanic in the eastern part and Nuakot/ Malangtoli volcanic suite occurring as an aerially extensive body south of the synclinorium **(Mohakul & Bhutia, 2015**). Saha, 1994, considered the Jagannthpur volcanic as younger to the IOG. Based on the study of aerial photographs and satellite imageries he interpreted series of faults at the contact between IOG and Jagannathpur lava. Field evidence of one such fault, Murgaberha fault, at Thakurani- Noamundi sector indicates it to well within the IOG causing repetition of sequence with Jagannatpur volcanic forming the lowest stratigraphic unit **(Mohakul & Bhutia 2015**). One of the major causes of confusion in the status of other volcanic suite is the very low grade of metamorphism and restricted development of foliation. While in the Bonai range volcanics, foliation development, related to deformational events of the IOG, has been recorded by many early workers; such data has not been recorded in the Lotapani volcanics and Jagannathpur lava. South of the synclinorium, mafic lava interbanded with clastic sequence covers a large area having a width of about 50km. It is bordered by Singhbhum granite in the east, Bonai granite in the west and Pallahara gneiss in the south. Iyengar and Murthy, 1982 designated it as Nuakot volcanic and considered it to be equivalent of Similipal Group

(Dhanjori Group) Saha, 1994, named it as Malangtoli lava and considered it to be Proterozoic in age while Sengupta et al., 1997, assigned an Archaean age. Mohakul & Bhutia, 2015, revealed that the Lotapani volcanic occur as a linear NE-SW trending body along a F2 anticlinal axial trace. Presence of deformational imprints of IOG has been recorded in restricted domain. East of Kalta this amygdule bearing basic bodies were interpreted to be sills (**Mohanty et al., 2003**). Occurrence of Lotapani volcanic along the antiformal axial trace, stratigraphically below the BIF, conclusively proves it to be part of the basal volcanic sequence of IOG (Mohakul & Bhutia, 2015). The Nuakot volcanic which skirt around the closure parts of Bonai-Keonjhar synclinorium should have been logically considered to constitute the basal parts of Iron Ore Group, particularly with the absence of any outlier of Nuakot volcanic on the sedimentary sequence of Iron Ore

Group **(Mohakul & Bhutia, 2015**). Ghosh et al, 2010, has tried to prove the antiquity of Nuakot volcanic with the help of anisotropy of magnetic susceptibility (AMS) data. Their study reveals that Nuakot volcanic has been affected by the deformational events of IOG and, hence, should be correlated with the basal volcanic sequence. Earlier workers suggested two phases of deformational structures in the low-grade metamorphosed volcano-sedimentary sequence. Chatterjee and Mukherjee, 1981 has suggested three generations of deformation and the disposition of iron ore bodies resulted by superposition of F3 over F1/F2 folds. The 'horseshoe synclinorium' is considered to be an early deformational structure which is superimposed by cross folds along an E-W axis during subsequent deformation. Mohakul and Bhutia, 2015, suggested three phases of deformation and folding. The earlier phase of fold deformational event (F1) is manifested by isoclinal to tight overturned intrafolial folds developed on the bedding plane of BIF and shales. The second phase of folding (F2) is manifested by shallow plunging folds overturned towards east in the western part of the belt and asymmetric in the eastern parts. This is accompanied by a very well developed, penetrative, axial planar cleavage striking in NNE-SSW direction with moderate to steep westerly dip. The overall disposition of litho-units in the Bonai-Keonjhar Belt is controlled by this event. The F2 and F1 are nearly coaxial and the superposition of F2 upon F1 has given rise to hook shaped interference patterns at places on outcrop scale. The last phase of folding F3 is manifested by open upright folding with NW-SE to NNW-SSE fold axes trend. It is accompanied by a crenulation cleavage in general having a NW-SE trend with steep dips on either side. It is well developed in incompetent rocks like shales whereas in BIF space cleavages are recorded. The superposition of F3 on F2 has led to dome and basin interference pattern both on outcrop and map scale. The domes and basins of the belt are formed due to this interference pattern.

Regional Geology of the Block:

The study area constitutes a part of bonai-keonjhar greenstone belt comprising litho-units are basic volcanics (Meta-Gabbro and Dolerite, which intersect the meta-volcanics) and associated laterite during the Archean (~3.3 to 3.1 Ga). (**R.N Banerjee (1961) & M. Mahesh Babu & K.V. Ramachandran (1979-80).**

The term "greenstone belt" was originally used in the Canadian Shield to describe low- to medium-grade metamorphosed volcanic and sedimentary sequences characterized by their green color, imparted by minerals like chlorite, actinolite, and epidote. Though there is no single credited originator, it became widespread in usage in early 20th-century geological literature, particularly through the works of geologists such as **Alfred E. Barlow (1906) and Norman L. Bowen (1922).**

1:50000 Regional Geological map was referred from Bhukosh portal of Geological Survey of India (plate-II). The Basic meta volcanics and laterite are present in the block.

The detailed description of the regional rock types on the block are follows as

Basic meta volcanics:

Metavolcanics occur extensively in the eastern contact with the metasedimentaries in the northwestern part of the mapped area. The unit is exposed near Chuahurhi, Namkani. East of Kurhavila. In Chuahurhi, in places, the rocks are highly weathered and fresh hillocks form. In Namkani area, it is fresh and form small hillocks. The rock is in general fine grained, light to dark greenish grey with development of foliation. The individual minerals cannot be identified in the naked eye due to the fine-grained nature. 02 set of joints are also present in the rock. Volcanic structures like amygdules are occasionally preserved with infillings of quartz and possible carbonates.

Laterite:

Laterite has been developed on a small mound within the metavolcanics in the northern part. This unit forms one of the important lithounit of the mapped area as it contains specks of sulphides, mainly pyrite. Furthermore, the Cuhahuli Block identified by the previous worker is occupied by this lithounit. The eastern contact of metavolcanics with the sheared quartzite is sharp. The metavolcanics are bound by metasedimentaries of different stratigraphic positions. Both the contact of the metavolcanics is altered as evidenced by the presence of sericite, ferruginization and fuchsite.

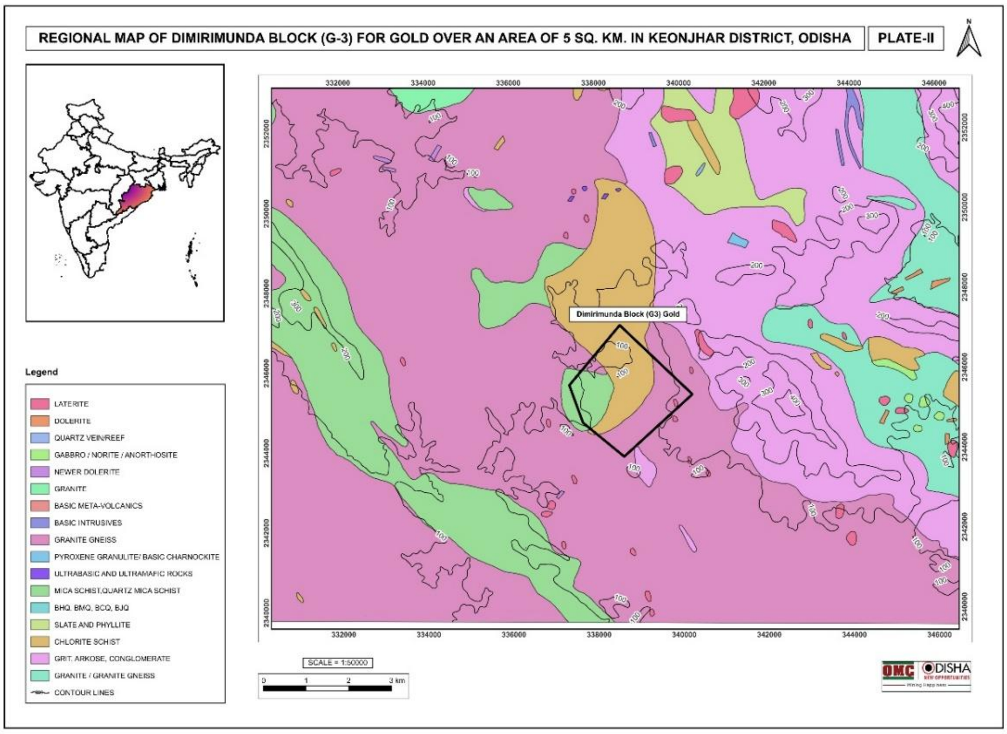


Figure 3: Regional Geological map of Dimirimunda Block

Figure **3-** shows the Dimirimunda block overlay on the regional geological map (1:50,000) of the area. The basic meta volcanics and laterite are present on the block.

5.2 Regional Stratigraphy

The general geological framework of Singhbhum Craton was established through the works of **Dunn (1937**) and **Dunn and Dey (1942**). Later on, work by **Sarkar** and **Saha (1962, 1977,1983), Saha (1988, 1992, 1994) and Mahadevan (2002**) tried to establish the stratigraphy of the area based on geological, structural and geochronological studies. The stratigraphic succession in the Precambrian of Singbhum Craton of the Indian shield given by Saha et al. is widely accepted. The succession is as follows:

Table-2 Generalized Chronostratigraphic Succession of the Singhbhum- Orissa Craton (after Saha et al., 1988).

Newer Dolerite dykes and sills Mayurbhanj Granite Gabbro - anorthosite - ultra basics	c.1600-950 Ma c.2100 Ma
Kolhan Group	c.2100-200 Ma
---------------------------------Unconformity-------------------------------------	
Dhanjori Group Dhanjori-Simlipal lava Quartzite conglomerate	c.2300 Ma
Singhbhum Group Pelitic and arenaceous Metasediments, mafic sills	c.2300-2400 Ma
---------------------------------Unconformity-------------------------------------	
Singhbhum Granite (SBG-B) (Phase III)	c.3100 Ma
Iron Ore Group Mafic lava, tuff, acid volcanics, tuffaceous shale, Banded Hematite Jasper and Banded Hematite Quartzite with iron ores, ferruginous chert, local dolomite and quarzitic sandstone	
Singhbhum Granite (SBG-A) (Phase I and II)	c.3300 Ma
---------------------------------Unconformity-------------------------------------	
Folding and metamorphism of OMG and OMTG Older Metamorphic Tonalite Gneiss (OMTG) Older Metamorphic Group (OMG) - Pelitic schist, Quartzite, Para amphibolite, ortho-amphibolite	c.3400-3500 Ma c.3700-3800 Ma c.4000 Ma

The regional geological set-up of the area was worked out by several workers. The rock types of the study area and its vicinity form a part of Iron Ore Supergroup (IOSG) comprising of metasediments and meta lavas.

Rath and Mohanty (1986) have proposed a generalized stratigraphy of the study area, which forms a part of the Singhbhum Craton. The stratigraphy is described below in Table-

Table-3 Generalized Stratigraphy of the study area given by Rath and Mohanty (1986)		
IRON ORE SUPERGROUP		Soil
		Laterites
	Intrusive	Quartz/Pegmatite veins
		Dolerite Dykes
		Granite and Granophyre
		Gabbro
	Upper sequence	Conglomerate, grit, arkosic sandstone, ortho-quartzites
	Intrusive	Ultramafic (dunite-peridotite and pyroxenite)
	Middle sequence	Banded hematite jasper, quartz grunerite rock and meta lava. Gritty quartzite, banded magnetite quartzite
	Lower sequence	Garnetiferous staurolite-kyanite-quartz rock, amphibolites, quartz mica schist, buff quartzite
----------Contact with Eastern Ghats Supergroup of rocks------------		
(Contact not defined)		

The whole succession as above corresponds to the Badampahar Group and forms the basal unit of IOSG. The lower sequence of the IOSG mainly comprises buff quartzite, quartz mica schist, amphibolites, Garnetiferous staurolite-kyanite-quartz rock. The buff-colored quartzite is exposed on small munds and nala sections east of Kalima, NE of Kundhaihata and north of Samakud. This buff quartzite may be the metamorphosed product of banded magnetite quartzite as evidenced from the presence of magnetites in these rocks. Quartz-mica schist occurs east of the NW-SE trending ridge in the toposheet 73 G/8. It also occurs along the valleys and nala sections. It is associated with amphibolites and banded magnetite quartzites along the ridges. The major occurrences are west of Bimbala west of Sirigida, near Petra Chati, south of Kulanga, east of Gobari, south of Panasia and on Petra Parbat. Amphibolites constitute a major litho-unit of the area and occur in association with quartzite and quartz-sericite schist. Near Magarmuhana and Darapuripahar, amphibolite and quartzites are associated with garnetiferousstarurolite-quartz rock and garnetiferous-starurolite-kyanite-quartz rock. Amphibolites show distinct schistosity planes in some of the areas where it could be named as hornblende schist. Along Mahabirod Jhilli section it is massive with bouldery outcrops, Generally, the litho-unit occupies the valleys, lowlands, small mounds and hill slopes. The garnetiferous staurolite-kyanite-quartz rock occurs between quartzite and amphibolites, east of Magarmuhana, west of Kalima and Jarada, in

Kaimatiparbat and in Parapuripahar. Garnet is the chief constituent of the rock. The size of garnet dodecahedra ranges from a few mm to as big as 6 cm 3 cm and the 1ong axis of kyanite are about 5 cm and that of staurolite 3 cm. Banded magnetite quartzite occurs as linear bands sandwiched between amphibolites and quartz-mica schist along the western hill slopes of the eastern ridge lying northwest of Bimbala and south of Petra Parbat. The bands occur as discontinuous patches all along the western margin of the quartz-mica schist. The quartzites form the major NW-SE trending ridge of the area and are exposed on Petraparbat, Chekakataparbat. Mahuriahuli, kaimatiparbat and parapuripahar.

The middle sequence of the IOSG mainly comprises banded-hematite-jasper, quartz grunerite rock and meta lava, gritty quartzite, and banded magnetite quartzite. Metalava is exposed as isolated patches on the unmetalled road from Kantulsua to Sirigida. Quartz- grunerite schistis exposed in the northern flank of the anticline and north of Balijuri with a very limited areal extension and is exposed on the foothills. Quartz- grunerite rock occurs on a small mound 5 km northwest of Pangatira along Pangatira-Debahali road. This is the only occurrence of this litho-unit within a predominantly granitic terrain. BHJ occurs as a small patch near Pandhaijori village and on the Kaliahata-Bimbala road.

The ultramafic in the area are of intrusive nature and are of two generations. Those of the earlier generation are highly sheared and comprise mostly dunitic peridotite with very few chromite specks. The younger phase is represented mostly by pyroxenite that is emplaced along the weak planes, developed during the 2nd deformation in the I O G sediments. Dunitic peridotite and associated serpentinised pyroxenenite are exposed near Namakani, Redha, Juangasahi and Benamunda.Dunitic-peridotite exposed near Redha has a bouldery outcrop. Serpentinised pyroxenite near Benamunda occurs in isolated patches.

The middle sequence of the IOSG mainly comprises conglomerate, grit, arkosic sandstone, ortho-quartzites. The arkosic sandstone is exposed on the western slope of Gudurdumahill. An intraformational conglomerate horizon is exposed near Karmangi and Kantalsuan. Overlying the arkose is a gritty quartzite and pebbly horizon and are well exposed near Krushnapur and north of Balijuri village.

Medium to coarse grained greenish white-coloured gabbroic rocks occur as isolated plugs near Sunduria and Paria Posi village and confined to core of the anticline. It has intruded the I O G sediments and ultramafic. Granite gneiss occurs south of Bhulkaparbat, in small mounds in Kaimatiparbat and along Brahmananadhara section. The outcrop pattern is bouldery, massive with caught up patches of amphibolite within it, alternate mafic and felsic bands of 2 to 3 mm width constitute the gneissosity structure. A small exposure of granophyre is noticed on the eastern and western boundaries of toposheet 73G/8 and G/12 respectively. Granophyre is also exposed on Guachippiparbat north-east of Samakud. Dykes of fine-grained massive dolerite intrude into all the older litho-units found in the area. These are intruded in 3 major directions N S, E-W and NE-SW.

A fairly thick capping of reddish brown cavernous to massive laterite is found in a large part of the area mapped, in most cases the laterite cover is very thick, the maximum thickness recorded near Jharbera being about 10 m. The laterite of this area is mostly of "low level‖ type developed over all rock types, at places, pebbles of quartzite and ultramafic are found embedded in the laterite. However, the thickness of this laterite varies from 1 m to 5m and at places 10 m. There are many types of soil noticed in this area. These are yellowish, reddish, grey to greyish dark in color and plastic to semiplastic in nature. Yellowish soil contains lot of Kankar nodules.

The stratigraphy of the study area put forth by **Karim & Sahoo (1995)**

Table-4 Stratigraphy given by Karim & Sahoo (1995)

Quaternary Formations	Alluvium
	Gravel bed
	Laterite
Intrusive	Quartz vein, dolerite & pyroxenite dyke
Dhanjori Group	Quartz schist, quartzite, quartz sericite schist
	Quartz pebble conglomerate
-----------------------Unconformable Contact-------------------------------	
Intrusive (ultramafic, mafic and felsic)	Granophyre
	Gabbro
	Pyroxenite
	Peridotite & serpentinite
Badampahar Group	Schistose meta basalt with quartzite/cherty quartzite, quartz schist, BIF/buff coloured phyllite
-----------------------Unconformable Contact-------------------------------	
Granite gneiss	

According to **Karim and Sahu (1995**), the block area represents a part of Bonai-keonjhar greenstone belt (BKGB), which forms a prominent part of the Singhbhum Craton in eastern India. The BKGB comprises a typical Archean greenstone sequence consisting of metavolcanic, metasedimentary, and intrusive rocks. These litho-units including chlorite schist, mica schist/quartz mica schist, weathered ultramafic and microgranite intrusion are tectonically interleaved and deformed, indicating multiple episodes of deformation and metamorphism. The area represents a structurally complex zone at the northern margin of Singhbhum Craton. The rock types and their metamorphic nature suggest a correlation with the Badampahar Group, which forms a part of the Iron Ore Group (IOG) within the Bonai-Keonjhar belt. Therefore, based on lithology, structure, and regional correlation, the Dimirimunda block can reasonably be considered as part of the Badampahar Group within the Iron Ore Group.

5.3 Regional Structure:

In the Singhbhum craton of eastern india, the supracrustal rocks of the Iron Ore Supergroup show evidence of at least three phases of deformation (F1-F3). The first folds are preserved only as rootless intrafolial folds. The first- and second-generation folds, in most of the areas, are coaxial. The F2 folds are reported to vary in geometry from upright to inclined; reclined F2 folds are also reported. The F3 cross folds are generally represented by open warps. In the Gorumahisani – Badampahar belt, the first two generations of folds are highly appressed. The Tomka – Daitari as well as Malaygiri sequences also show superposed folding (**Banerjee, 1972; Mitra and Basu Mallick, 1990**). The regional structure of the Bonai – Kendujhar basin is a low-plunging synclinorium overturned towards southeast. **Chatterjee and Mukherjee (1981**) recognized three phases of folding in the sequence (F1-F3). F1 folds are isoclinal with low plunge trending in NNE and westerly dipping axial planes. F2 folds, nearly coaxial with F1, are upright to inclined open folds. F3 open folds, with easterly or westerly plunging axis are superposed on F1/F2. The interference of F2 and F3 produced dome and basin structures.

The N-S trending axial plane of major folds in Badampahar- Gorumahisani Belt changes from NE-SW near Nuasahi to ENE-WSW near Tomka–Daitari to NW-SE near Pala Lahara and finally to NNE-SSW in Jamda-Koira valley. The curvature suggests that the folds in the supracrustal were molded around the rigid basement block (**Sarkar and Gupta, 2012**).

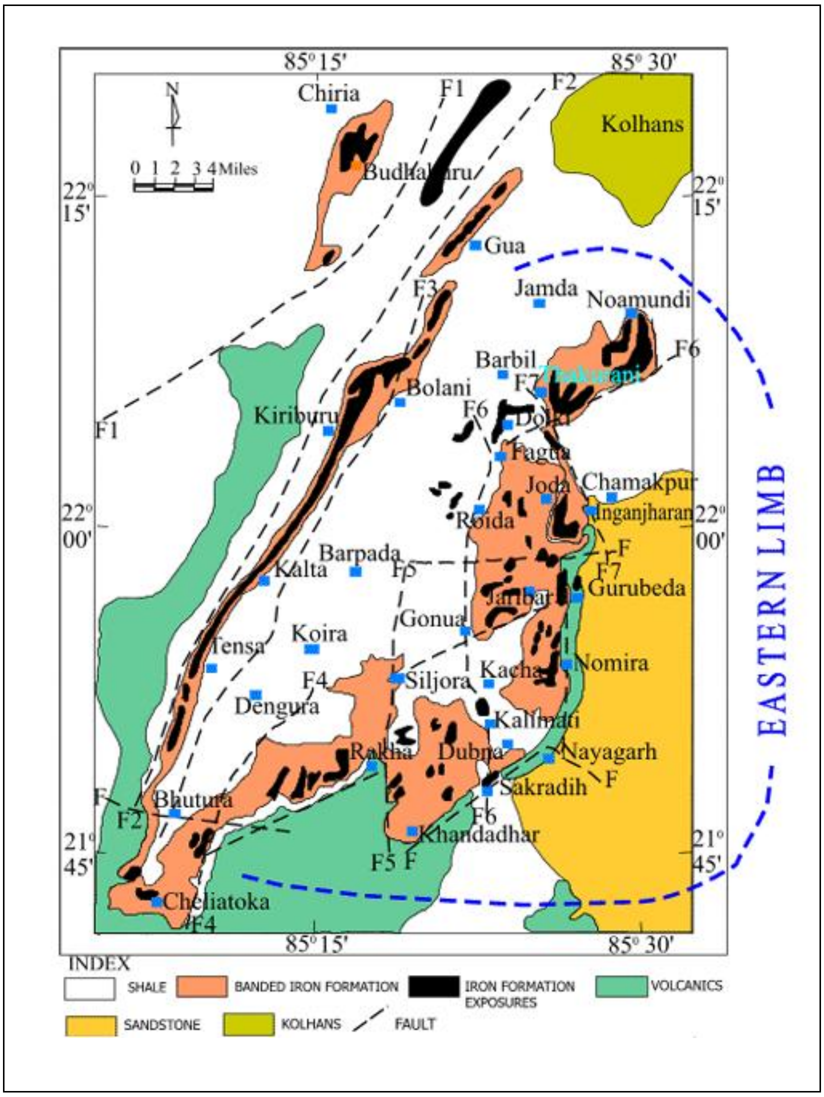


Figure 3 A: Geological map of Bonai- keonjhar belt (**Source: www.isca.in**)

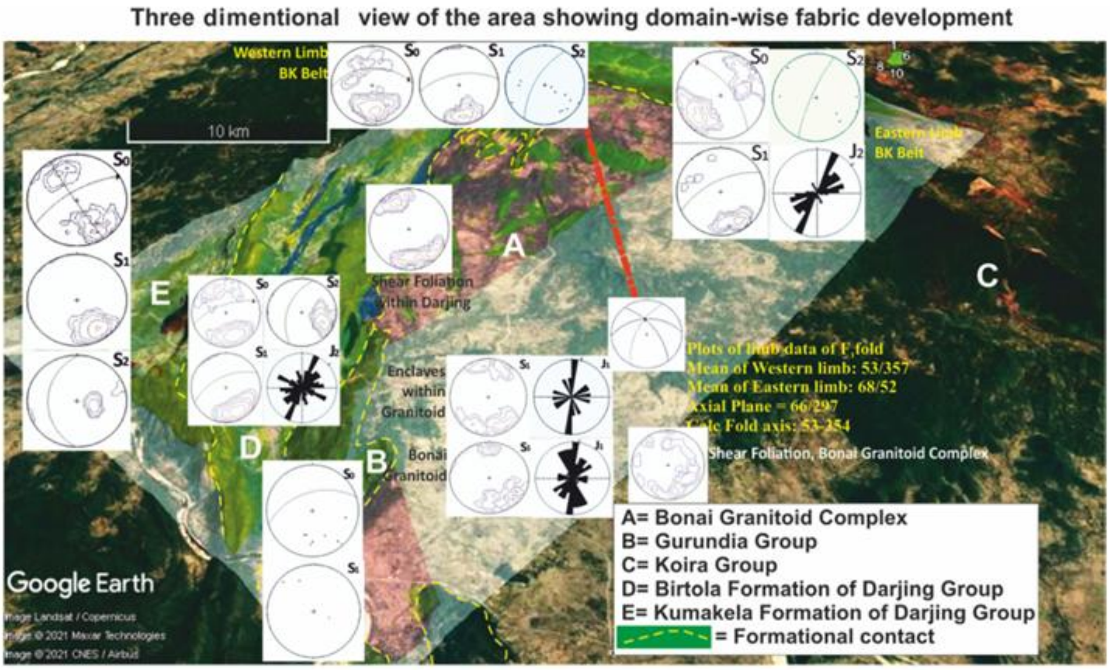


Figure 3B: Sector-wise structural data analysis (on Google Earth image background) (**Mahalik 1987; Chakra borty et al. 2018)**

Regional tectono stratigraphy along with deformational history of the study area:

Singhbhum Craton (SC), one of the oldest continental crusts, has a nucleus of Singhbhum Granite Complex with volcano-sedimentary belts in peripheral parts. Deciphering the inter-relationship between volcano-sedimentary packages and surrounding granitoids offers considerable challenges. The present study area lies in the northwestern parts of SC. Litho-units of volcano-sedimentary packages drapes around the Paleoarchean Bonai Granite Complex (BGC). An attempt has been made to understand the basin development over BGC based on the mutual relationship between litho-packages of Iron Ore Group (IOG) and their structural disposition. It is proposed that two distinct basins, Koira and Gurundia, develop over BGC during Mesoarchean. While the Eastern Koira basin witnessed continuous development accompanied by subsidence wherein lithopackages of Bonai–Kendujhar Iron-ore Belt were deposited, Western Gurundia Basin is marked by a hiatus after the deposition of Gurundia quartzite and mafic volcanics in a shoreline to shallow marine environment. Darjing Group of rocks deposited as platformal package over Gurundia, Koira groups and BGC. **(Mahalik 1987; Mohakul and Bhutia 2015;**

Chakraborty et al. 2018).

Litho-packages of Koira, Gurundia and Darjing groups exhibit structural unity as they co-deformed during Iron ore orogeny. Iron ore orogeny is marked by two phases of deformation. The first deformation phase has led to a series of NE–SW to ENE–WSW trending low plunging overturned folds with southeasterly vergence. During the first deformation event (D1), the bedding (S0) had been intensely folded (F1) due to this deformation (D1), and a strong schistosity/foliation/phyllitic cleavage/gneissosity had been developed (S1) with respect to the corresponding lithologies where the axial plane of the fold strikes NE–SW to ENE–WSW with moderate to shallow northwesterly dips. During the second deformational event (D2) is the compressional event from northwest to southeast direction with syntectonic emplacement of Tam parkola Granitic Pluton. Lithounits of kamakela and Birtola formations of Darjing group mostly suffered from this event and contained the signatures (S2) imprinted within them. The F1 fold hinge line of argillaceous facies dominated Kumakela Formation shows culmination and depression and finally became nonplane–noncylindrical in nature along with development of crenulation (S2) over schistosity. The second deformation, near coaxial with the first one, has led to relatively open, low northerly plunging folds inclined to the northwest. While the basement, i.e., BGC, occupies the core of the major second-generation fold, large-scale subcrustal reworking during second deformation has led to the emplacement of Tamparkola Granite which exhibits intrusive relationship with both Gurundia quartzite and Darjing Group of rocks. Mafic ultramafic sills intrusive into the Darjing sediments are interpreted to be post-peak metamorphism, late D1 intrusive. With the help of all this evidence, the whole package of Koira, Gurundia and Darjing groups can be put under Iron Ore Super Group (IOSG), where IOGs (Koira and Gurundia groups) represent the lower part and Darjing Group as the upper part. **(Mahalik 1987; Chakra borty et al. 2018)**

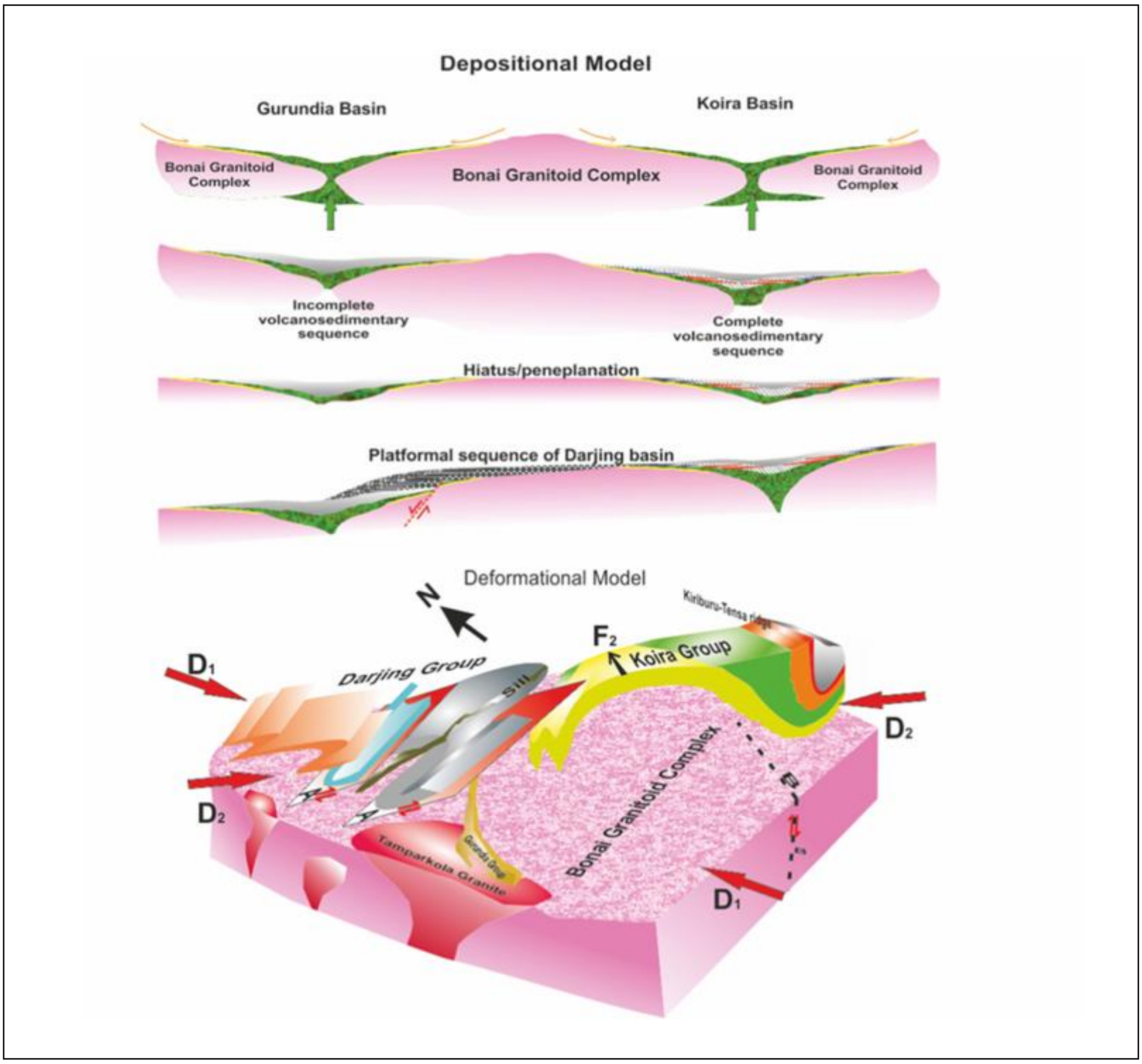


Figure 3C: Shows depositional and deformation model of the area **(Mahalik 1987; Mohakul and Bhutia 2015; Chakraborty et al. 2018).**

5.4 Metamorphism:

The rocks of the area with their mineral constituents are discussed above to ascertain the grade of metamorphism. The quartzite and quartz dominated rock are composed of quartz, sericite, muscovite, chlorite and feldspar. The mineral constituents of the metavolcanics are actinolite, tremolite, augite, epidote, zoisite, quartz, and chlorite. All these mineral associations indicate that rocks of the area have undergone a low P-T condition of metamorphism of greenschist facies (**Turner, 1968**).

5.5 Surface Indication of Mineralization, if any, So nature of host rock for mineralization

The study area is situated in the Bonai-Keonjhar Greenstone Belt (BKGB) which exhibits notable surface indications of mineralization. During the period from 1979 to 1983 GSI carried out preliminary exploration for gold in Telkoi valley after the DoMG, Orissa withdrew from the area in 1975. During this period searches for gold were carried out around Salaikena, Dimirimunda Kalima and Kanjipani area where they had located the presence of old working sites. Geological mapping has identified several auriferous quartz veins traversing the area, particularly within metavolcanic rocks. These quartz veins are emplaced along prominent schistosity planes and are associated with sulfide minerals such as pyrite and chalcopyrite. Surface manifestations of mineralization are evident through the occurrence of these quartz veins, which often display signs of brecciation and silicification. The surrounding wall rocks exhibit alterations, including chloritization and sericitization, indicative of hydrothermal activity. Furthermore, secondary gold mineralization has been observed in the form of alluvial placers within local stream sediments, suggesting the weathering and erosion of primary mineralized zones.

The study area presents significant surface indications of gold mineralization, primarily hosted within chlorite schist. The geological setting, characterized by auriferous quartz veins within schistose structures, underscores the area's potential for gold exploration.

CHAPTER 6

GEOSCIENCE INVESTIGATION

6.1 Detailed Geological Mapping

The geological mapping of the Dimirimunda block was conducted at a scale of 1:2000, covering an area of 5 sq. km. The mapped area falls in the SOI, T.S. Nos 73 G/7, G/8 & G/12, covering parts of the Keonjhar district of Odisha. The area under study represents a part of granite greenstone terrain occurring in the southeastern fringe of the Archaean Singhbhum craton (**Mohanty, 2012**). The primary goal of the mapping was to identify and demarcate the potential host rock and structural control for gold mineralization by geological mapping on 1:2,000 scale and identify mineralized zones to support further exploration.

Initially, the study area was covered by traverse mapping at a scale of 1: 12500, to understand the geological setting of the area. Later, the geological mapping of the Dimirimunda block was conducted on the scale of 1:2000, covering an area of 5 sq. km

Field mapping involved systematic traverses across the area, ensuring detailed coverage of all geological features, Observations focused on identifying rock types, their spatial distribution and structural elements such as folds, joints, local shear zone and fractured plane. However, folds and faults are noticed on the mesoscopic scale so, it could not be reflected on the geological map. Key outcrops were identified, photographed and sampled for geochemical analysis.

The major rock types encountered in the area are meta basic rocks (mainly chlorite schist), mica schist/quartz mica schist, microgranite and laterite at places.

Based on the field study, chlorite schist trends in NW-SE direction having an approximate strike length of 2.16 km, and a width of 824 m present in the eastern part of the study area. Apart from this, the exposure of microgranite trends NW-SE direction having an approximate strike length of 1.14 km and a width of 282 m present in the southwestern part of the study area. The exposure of mica schist/quartz mica schist having an approximately strike length of 2.02 km and a width of 282 m covering the southwestern part of the study area. whereas the outcrop of laterite trends in NW-SE direction has approximate strike length of 700 m, and a width of 1.9 km covering in the southern & northeastern part of the study area. The exposure of weathered ultramafic rock having an approximately strike length of 1.81 km and a width of 380 m covering the Northeastern part of the study area. The description of rock types is described below as

6.1.1 Description of Rock Types:

In Dimirimunda block, the details of litho-unit encountered during the detailed geological mapping are as given below.

a) Chlorite Schist:

Chlorite schist typically occurs as fine- to medium-grained, greenish-grey foliated rocks with a silky to micaceous sheen. The dominant mineral is chlorite, with subordinate quartz, plagioclase feldspar accessory actinolite, epidote, and sericite. Magnetite and minor sulphide phases (e.g., pyrite) are occasionally present. The protolith is believed to be basaltic to andesitic metabasic, often interlayered with volcaniclastic material. It occurs interbedded with quartz schist/ quartz mica schist, and microgranite. Based on the field observation chlorite schist exposures are predominantly located to the north of the Chua Hurhi area, extending south eastward from Chua Hurhi to the Jharberha Reserved Forest. Additionally, smaller exposures are found in the Kurhabila area. The chlorite schist observed in conformable, and gradation contact with adjacent mica schist and laterite units. The chlorite schist is characterized by well-developed schistosity (Fig- 4) and is a dominant mineral composition of chlorite laths embedded in randomly oriented porphyroblasts of quartz and zeolite also reported at few places (Fig-5). These schists generally follow the regional foliation (S1/S2), which is parallel to lithological layering. The general strike of Chlorite Schist is observed to be NW-SE with steep dip towards SW. Most of the outcrops are barren, but few displayed quartz veins and veinlets trending NW-SE consistent with regional D_2 folding trends in the Bonai-Keonjhar belt. The presence and structural disposition of chlorite schists indicate a deep-seated tectono-metamorphic imprint on the supracrustal package. It’s form under green schist facies metamorphism, typically from the alteration of mafic igneous rocks or pelitic sediments. Sulphide phases are disseminated pyrite, arsenopyrite and alteration product malachite are observed under the hand lens. The relative concentration of these phases varies from place to place. Very small (2-5mm), disseminated pockets of white and smoky quartz wit are observed at north of the chuahuri hills. The outcrop contains amygdules, which are noticed at NE of Chua Hurhi hills (Fig- 8) and contain mostly quartz and vary in shape from circular to elliptical and at places irregular. Geoid structure is also noticed within chlorite schist in SW of Jharbehra Reserve Forest (Fig-7) it may have evolved due to relict amygdules that were partially dissolved, recrystallized, or distorted during metamorphism. The general strike of chlorite schist is observed to be NW-SE with steep dip towards SW. Most of the outcrops are barren, but few displayed quartz veins and veinlets trending NE-SW. A few quartz veins predominantly trend east-west, observed within chlorite schist to the southwest of the Tangiri area. (Fig-6), but devoid of any mineralization. Regionally, the chlorite schist horizons represent altered meta basic slices emplaced and deformed during crustal accretion and greenstone belt evolution in the Singhbhum Craton.

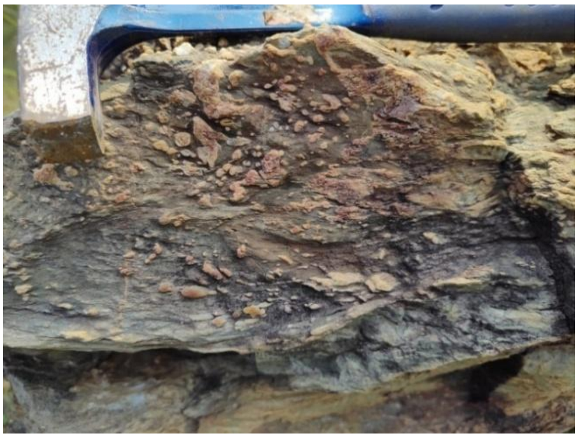
	
Fig 4: An outcrop showing well defined schistosity (S1) in the southern section of Chuahuri hill.	**Fig 5: A photograph taken parallel to the strike direction, showing thin lamination of chlorite laths embedded in randomly oriented porphyroblasts of quartz and zeolite.**
	
Figure 6: Presence of quartz vein on chlorite schist trending E-W indicating mineralization, found towards SW of Tangiri area.	**Figure 7: Geoid structure on the chlorite schist outcrop found towards SW of Jharberha Reserved Forest.**

	
Figure 8: Outcrop of chlorite schist containing amygdales trending NW- SE/due SW at NE of Chua Hurhi hill.	**Figure 9: An outcrop of steeply dipping chlorite schist with well-defined schistosity trending NW-SE at south-Eastern part of Chua Hurhi hill.**

b) Weathered ultramafic rock:

In the dimirimunda block, schistose rock primarily chlorite schist, and mica schist/ quartz-mica schist form the dominant lithological assemblage of the greenstone sequence. Within or at the margins of these units occur weathered ultramafic rocks, which are typically altered peridotites, pyroxenites, or serpentinites now exposed as laterited, clayey masses. Surface expression is marked by reddish-brown to yellowish soils, rich in Fe-Mg oxides. The weathered ultramafic rock has been observed in the northeastern side of the study area. Due to tropical and monsoon weathering, ultramafic rocks have undergone chemical alteration leading to lateralization. Lateritic profile has developed over the weathered ultramafic rock in the northeastern side of the study area. The relict textures of olivine or pyroxene can be seen in float material. The schistose rocks, being deformed and metamorphosed earlier or concurrently, provided planes of weakness that may have controlled the emplacement or later reworking of ultramafic bodies. Overall, these ultramafic bodies are caught up in polyphase deformation, particularly during D_2 and D_3 events. However, no proper exposure of ultramafic rock noticed in the study area. Some samples were collected and analyzed. However, samples show poor value for gold.

The ultramafic rock occurs as a discontinuous, highly altered and deformed bodies within or adjacent to schistose rock (chlorite schist) and laterite. These ultramafic rocks are not considered part of the primary, conformable volcano-sedimentary sequence. These ultramafic bodies are interpreted as tectonically emplaced slivers through fractured zone possibly as obducted mantle fragments or deep crustal mafic-ultramafic cumulates, which were incorporated during regional Archean tectonothermal events. Their tectonic contact with chlorite schist marked by foliation wrapping around the ultramafic and gradational transitions supports their allochthonous nature. The weathered nature of the ultramafic rocks makes direct correlation challenging, but their structural association with meta basic may reflect a polyphase deformational history involving early greenstone volcanism, emplacement of ultramafic bodies.

c) Mica schist/Quartz mica schist:

Mica schist is second dominant lithology of the mapped area located along NW-SE oriented Malyagiri shear zone which extends westward direction beyond the block. Mica schist/quartz mica schist occur as fine to medium grained, foliated rocks exhibit well developed schistosity and micaceous parting. The exposure primarily found to the southwest of the Kurhabila located in the southern part of the mapped area. The outcrop is white to greyish white in the colour and characterized by foliation marked by the parallel alignment of flaky muscovite and platy quartz that give the rock a shiny or reflective surface. The rock is highly weathered and kaolinitised with the development of muscovite and quartz (Fig-10). Mica schist/quartz mica schist shows strong foliation (S1/S2), crenulation cleavage in more deformed zones, and occasional mineral lineation defined by elongate micas or quartz rods with regional D_2 folding trends in the Bonai-Keonjhar belt. The dominant foliation in mica schist trends WNW-ESE to NW-SE is dipping moderately to steeply NW. Some exposures are notably harder and more quartz-rich compared to typical mica schist. The presence of quartz veins within mica-schist enhances its rigidity thereby increasing its hardness relative to a standard mica-schist. A small narrow band of quartz-mica-schist has been mapped along Ghurudia Nala from Kardangi to the west of Koilisuta contains pyrite specks. Small patches of the outcrop are also noticed in drainage section. Though supposed to be direct contact with chlorite schist, the contact is buried under soil but occasionally seen thrusted over chlorite schist. These schists occur interlayered with phyllites and chlorite schist. However, the rock type of phyllite is noticed on minor scale. Contacts are mostly gradational and conformable but may be tectonically reworked, especially near shear zones.

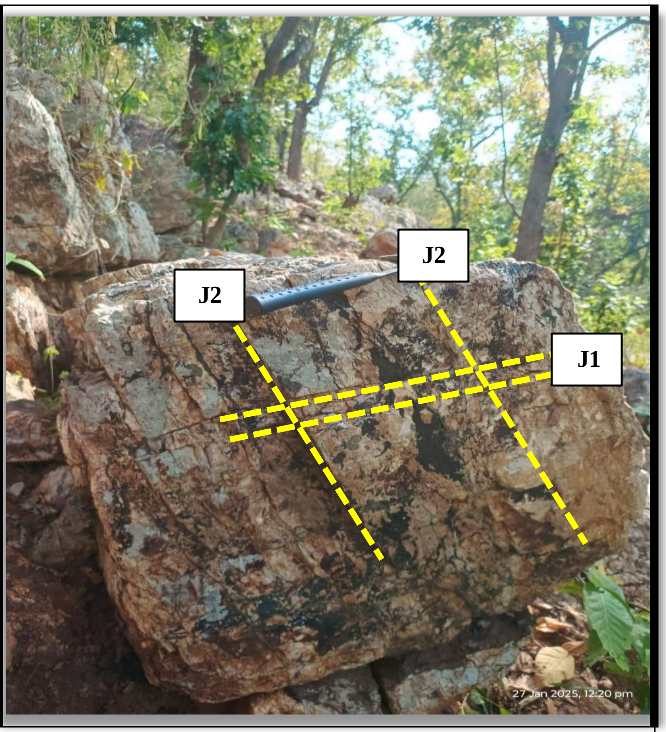
Figure 10: An exposure of a quartz mica-schist with well-developed schistosity trending towards NW-SE/ 67 due SW, towards SW of Kurhabila area.

The contact between chlorite schist and mica schist is interpreted as a thrust contact, supported by local shearing, abrupt lithological transition, and contrasting metamorphic grades. However, due to poor exposure and structural overprinting, the thrust plane is not consistently mappable across the area.

d) Microgranite:

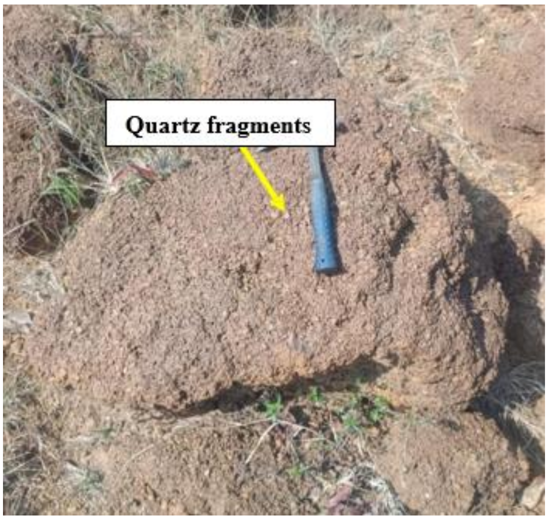
Microgranite is a fine to medium-grained, equigranular to sub-porphyritic felsic intrusive rock. It is generally composed mainly of quartz, alkali feldspar (orthoclase/microcline), plagioclase, and minor biotite or muscovite, often exhibiting graphic intergrowths. The occurrences of microgranites are considered late to post-tectonic felsic intrusions emplaced within the greenstone sequence and surrounding metamorphic terrain. Based on the field observation, the rock shows granophyric to micrographic texture by the hand lens, suggesting shallow-level crystallization under relatively low pressure. Microgranite shows light grey to pinkish, with a blocky to massive appearance in fresh exposures and a crumbly surface due to weathering. Microgranite is intrusive, non-foliated and non-gneissic in nature, typically emplaced as dykes into the surrounding schistose rock as mica schist/quartz mica schist and chlorite schist. It is younger than the surrounding schistose rocks. The contact is sharp and chilled, suggesting rapid cooling against the host rocks. It lacks schistosity or gneissic banding, which is a key indicator that it post-dates the major deformation events that produced foliation in the surrounding schists and gneisses. The microgranite dykes cross-cut regional foliation and fold structures, indicating a post-deformational (post-D_2 or D_3) emplacement. These dykes follow fractured zones or fault planes, suggesting emplacement along pre-existing tectonic weaknesses. Outcrops of microgranite are occupying in the western part of the study area and are prominently exposed in the Southeastern section of the Namakani area, aligning closely with the NW-SE trending Malyagiri Shear Zone (Fig-11). Most of the outcrops trend NW-SE, with a dip of approximately 42° towards the southwest. In some areas, the outcrops also exhibit mylonitic textures, characterized by alternating layers of orthoclase feldspar and quartz (Fig-12). The individual quartz grains are elongated and aligned along the shear direction, indicating significant deformation. These features collectively suggest the occurrence of intense tectonic activity associated with the shear zone. Prominent malyagiri shear zone falls outside of the block and passes adjacent to the western side of the block.

The rock has been classified as microgranite based on its fine-grained felsic composition, intrusive field relationship, and relict igneous textures. While plagioclases are not macroscopically visible due to intense alteration and local shearing, mineral alteration patterns support its original presence. The body is not entirely a shear zone, as portions retain massive character, indicating partial overprinting by deformation post-intrusion. The microgranite intrudes the schistose host, suggesting that it is younger and intrusive, and later subjected to regional shearing.

	
Figure 11: A large outcrop of pink colored (due to orthoclase feldspar content) microgranite trending NW-SE/68 due SW found towards SE of Namakani area.	**Figure 12: Mylonitised microgranite outcrop having two sets of joints trending J1- NW-SE and J2- NE- SW, found towards SE of Namakani area.**

e) Laterite:

In the northeastern part of the mapped area laterites are developed over weathered ultramafic whereas in the southern part of the area, small, isolated laterite mounds have been developed over the chlorite schist. A thick capping of massive reddish brown, cavernous to friable in nature laterites is observed to the east of the Tangiri towards east of study area. Lateralization has taken place extensively in the mapped area and is developed over all the rock types. Notable outcrops are also visible along the Kaubasa Nala, which flows to the East of Chua Hurhi Hill near Tangiri (Fig-13). These are brown and chocolate colored and show porous and pisolitic structures. The ferruginous laterites are also noticed a few places that made up generally of goethite and limonite with minor amounts of silica and alumina. Encrustations of quartz clasts are also observed in the outcrops. The thickness of the laterite in the study area varies from 3 m to 10 m. The exact maximum thickness of laterite could not be ascertained. The laterites in the study area are of low-level types. At places, pebbles of quartz are found within the laterite. The outcrops are sporadic in nature, and the structure attributes are difficult to ascertain in the field.



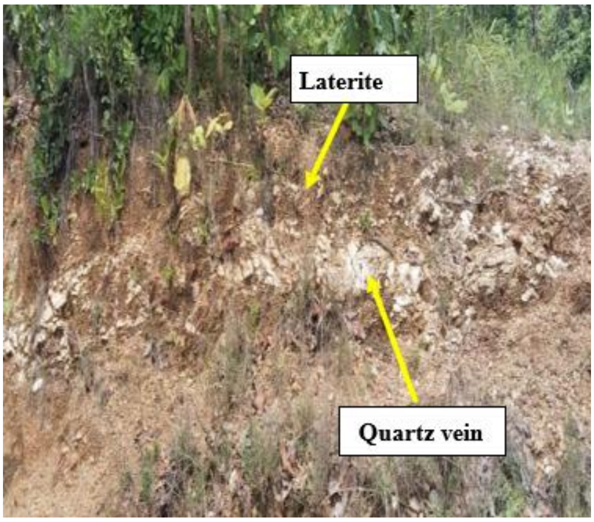


Figure 13: An outcrop of matured laterite, rich in iron oxide content, with small fragments of quartz Encrustations, towards SE of Tangiri area.	**Figure 14: A profile section of laterite containing quartz vein (milky) trending nearly E-W direction, towards NE of Tangiri area.**

f) Quartz veins:

In the mapped area, quartz veins have been observed in almost all the rock. Small thin mappable quartz stringers, veinlets and veins are mainly observed in the northeastern part of the study area (Fig-15), whereas unmappable small quartz veins are seen in the southern part. In the northern part thicker quartz veins are seen around Namakani, Purunapani, Karamangi, Chua hurhi and nearby areas and are intruded along NW-SE and E-W directions. The core portion of the study area is occupied by milky white to smoky quartz veins, hard massive and fractured at places and devoid of any mineralization, ferruginization and oxidation. The quartz veins show alteration zoning of potassic alteration manifested by high K values within the samples, mainly from orthoclase feldspar. The quartz veins have intruded within chloritic schist that shows unconformable relation with chlorite schist body. Minor gold values in 2 samples have been analysed from 2 samples of minute En-echelon quartz veins within Chlorite Schist. However, these quartz veins are not consistent. Due to sporadic intrusion of the quartz veins, the structural attributes are difficult to ascertain in the field. The general dimension of the quartz veins ranges from 0.3 cm to up to 2 meters are observed in the study area.

Fig 15: Exposure of milky quartz vein near Namakani

Fig 16: Exposure of milky quartz vein near east of chuahuri village

Based on detailed geological mapping on l:2000 scale in Dimirimunda block, the rock types exposed in the study area are chlorite schist, weathered ultramafic, mica schist/quartz mica shist, microgranite, and laterite. The quartz veins are of Proterozoic Origin (Source: bhukosh.gsi.gov.in). Based on the field evidence the tentative stratigraphic succession is given in the following table.

The stratigraphic succession has been constructed based on cross cutting relation and younging direction as per field geology.

Table 5: Tentative Lithostratigraphic Succession of the study area

Lithology	Group	Age
Lateritic soil/Latosol		Recent
Fe & Al rich Laterite		Cenozoic
Quartz vein		Proterozoic
Microgranite	Iron Ore Group	Mesoarchean to Neoarchean
Mica Schist/quartz mica schist		
Weathered Ultramafic		
Metabasalt, Amygdular basalt (Chlorite Schist)		Palaeoarchaean-Mesoarchaean
Basement	No exposures found	

The Dimirimunda block, falling within the Bonai-Keonjhar Greenstone Belt, exhibits a volcano-sedimentary sequence deformed through multiple tectonic events. The rock succession, arranged from oldest to youngest, is as follows:

Chlorite Schist represents metamorphosed meta basic; it shows NW-SE to ENW-WSE schistosity (S_1), often associated with BIF.

Weathered Ultramafic Rocks occur as deformed, tectonically emplaced slivers within schistose rocks, suggesting older deep-crustal or mantle-derived origin.

Mica Schist / Quartz Mica Schist overlies chlorite schist and shows transposition foliation (S_2), indicating pelitic protoliths and higher-grade metamorphism.

Microgranite is an intrusive, post-tectonic felsic body that locally shows shearing but generally cuts across foliation planes.

Laterite and Quartz Veins represent late-stage supergene alteration and hydrothermal activity; quartz veins are often structurally controlled.

The tectonic trends follow a general NW-SE alignment, with evidence of polyphase deformation (D_1–D_3). Rock contacts are often sheared, and structural elements control both lithological disposition and mineralization.

Relationship of schistose rocks with microgranite and weathered ultramafic:

In the study area, the schistose rocks (chlorite schist and mica schist) form part of a metamorphosed volcano-sedimentary sequence and structurally host both the microgranite intrusions and the weathered ultramafic bodies.

Microgranite is observed to intrude into the schistose rocks (mica-schist/quartz mica schist), particularly along shear zones and foliation planes, and is locally sheared. This indicates a post-metamorphic, syn- to late-tectonic intrusive event. The lack of plagioclase and presence of quartz and K-feldspar with shearing textures support its intrusive and slightly deformed nature.

Weathered Ultramafic Rocks appear as deformed bodies tectonically emplaced within or along the contact zones of chlorite schist. Their sheared nature and dismembered contacts with chlorite schist suggest they are tectonic slivers rather than conformable stratigraphic units.

Thus, the relationship among these units reflects multi-phase tectonism, where schists act as host and structural markers, ultramafic represent tectonically emplaced remnants, and microgranite represents post-deformational intrusive phases. **(Sarkar, S. N. and Saha, A. K. 1962, Saha, A. K. (1994).**

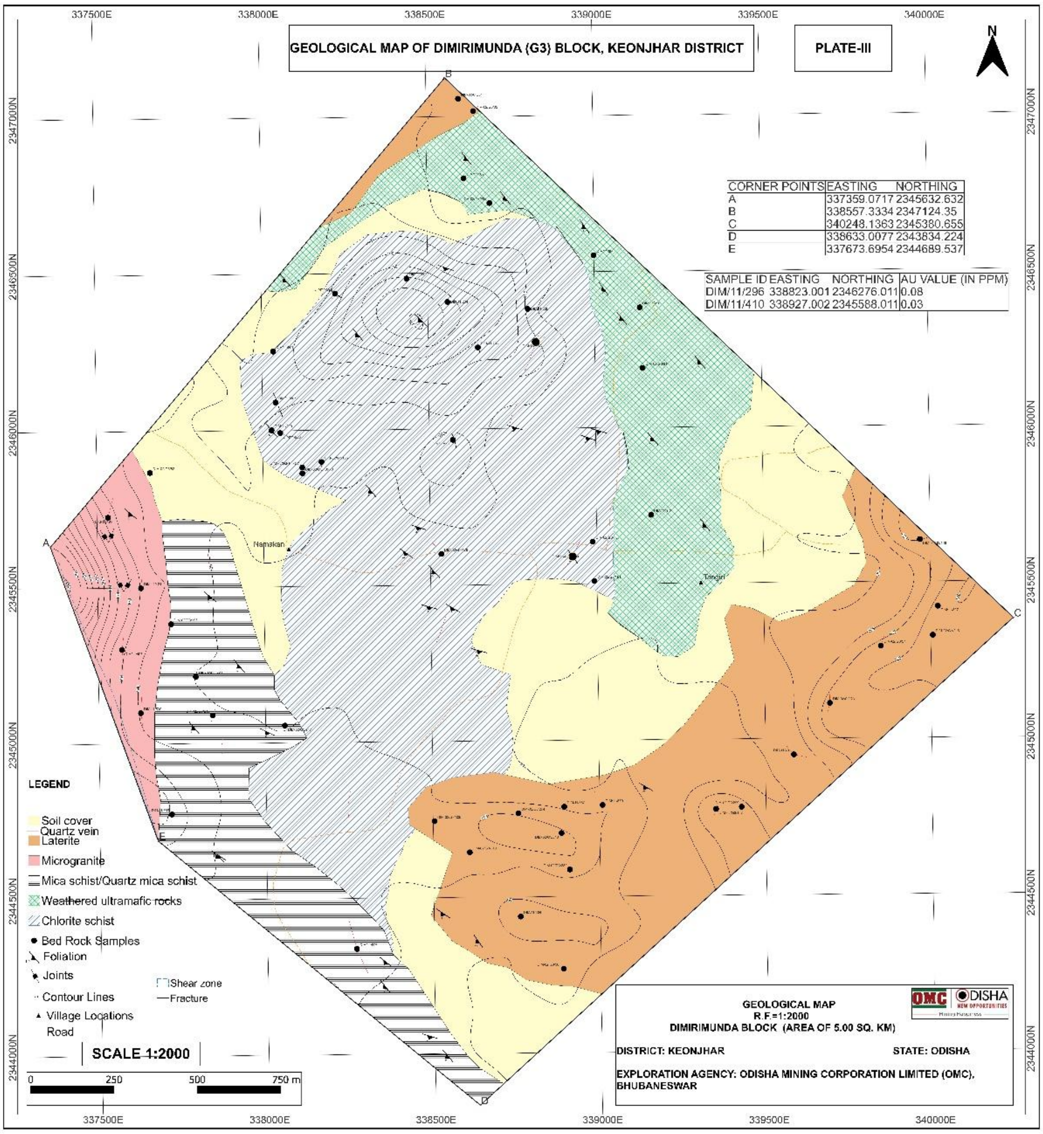


Figure 17: Detailed Geological map of the Block

Map preparation and survey method

OMC has carried out detailed Geological mapping on a scale of 1:2000 scale, by taking traverse over an area of 5 sq. km. of the block. A systematic traverse was implemented with a 20-meter grid spaced pattern. Geological observation including lithological variations, structural attribute and mineralization were recorded. Coordinates were recorded at every point using GPS to ensure spatial accuracy. Structural data was captured using a Brunton compass. Contacts between different rock units were mapped on the ground and correlated with stratigraphic sequences. The geological mapping revealed litho-units of chlorite schist, weathered ultramafic, mica schist/quartz mica schist, microgranite, laterite and quartz vein with well-defined contact. These litho-units were mapped and correlated with respect to their stratigraphic disposition. Structural features including foliations, joint planes and local shear zone were identified, influencing the control of mineralization. Bed Rock Samples (BRS) of different litho- units occurring in the area have been collected for chemical analysis. The geological map was prepared by plotting the different litho units i.e. chlorite schist, weathered ultramafic rock, mica schist/quartz mica schist, microgranite, Laterite, Quartz vein and Soil cover etc. and structural features i.e. strike and dip of Foliation, Joints, fractured zone, local shear zone and Bed Rock Samples (BRS) location. An interpreted Geological map of the block has been prepared on a 1:2000 scale through GIS platform and presented as Plate-III.

As the study area has undergone Greenschist facies of metamorphism so, the structural measurements were recorded mainly of S1 foliation in the study area and the same is reflected in the text and Geological map (plate-3).

6.1.2 Structure Foliation/Schistosity (S_1)

In the area under study, the most prominent structural feature of foliation (S1) has been developed in meta basic (chlorite schist) and mica schist/quartz mica schist. Foliation planes are recognized in the Chlorite Schist that is well-defined, characterized by the preferred alignment of flaky and platy minerals along with siliceous and sulphide minerals (pyrite) exhibiting a preferred orientation within chlorite schist and mica schist/quartz mica schist. The foliation (S1) is prominently observed in the chlorite schist towards NE of Chua Hurhi hill, mica schist towards SW of Kurhabila area, and quartz mica schist towards SE of Kurhabila area (Fig-18). The general trend of foliation varies from NNE-SSW with shallow to steep (12-55^o) south westerly dip. In the eastern part of the study area towards Chua Hurhi hills, the trend of S1 is N65°-75°W dipping 55° to 65° towards SW. In the southwestern part of the study area towards Kurhabilla village, the trend of S1 is almost E-W dipping 65° to 70° towards south.

Figure 18: An outcrop of chlorite schist showing well developed Schistosity/ found in North of Chua Hurhi Hill area

Lineation

Mineral Lineation is formed by the linear arrangement of tabular minerals like tremolite, epidote, chlorite and biotite in chlorite schist (Fig-19). Alignment of stretched or elongated quartz clasts, amygdales of quartz, chalcedony and chert defines mineral lineation trending NNW- SSE in Southwest of Chua Hurhi hill. Down dip mineral lineation is also observed in mica schist/quartz mica schist towards kurhabila in the southwestern side of the block. The plunge varies from 50° to 70° towards N10°W to S10°E. No prominent lineation is observed in the study area.

Figure 19: An outcrop of chlorite schist containing stretched Quartz clasts towards west of Tangiri area, trending NW-SE.

Joints

All the litho- units of the area have numerous non-pervasive planar structures like joints. Two sets of joints are prominently observed in the microgranite towards SE of Namakani area. Joint 1 trending NW-SE and Joint 2 trending NE-SW (Fig-20).

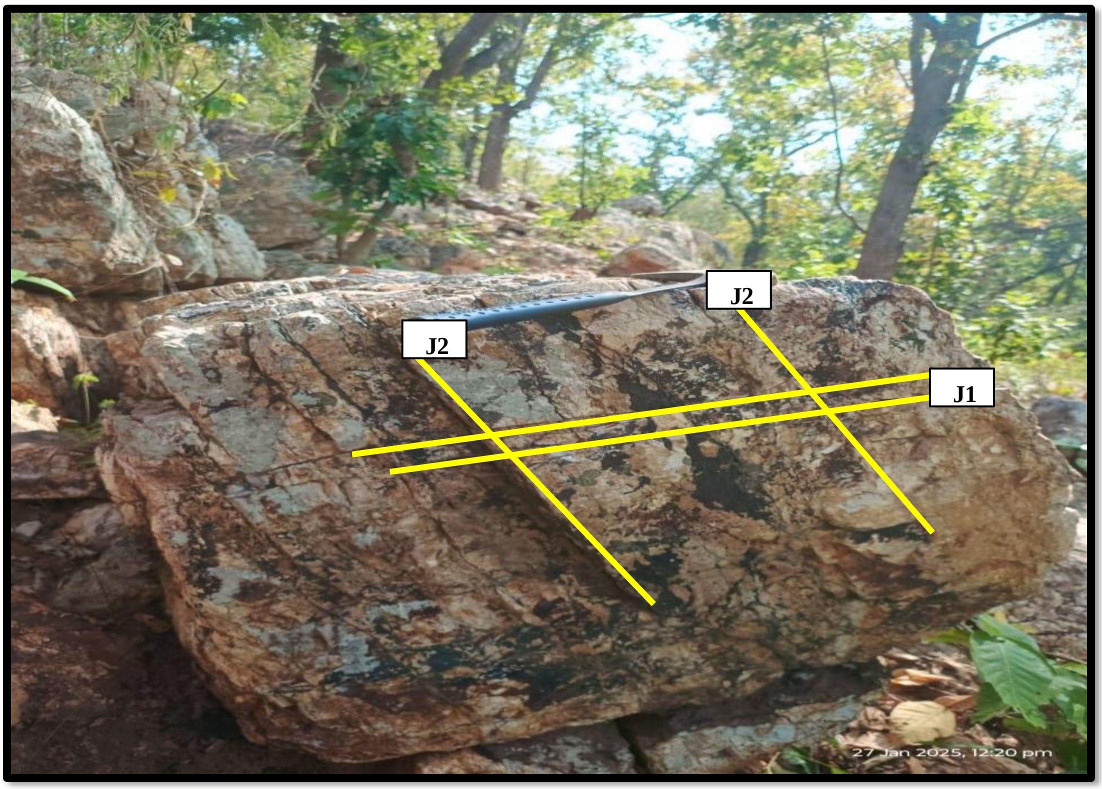


Figure 20: An outcrop of Microgranite showing two sets of joints. Joint 1(J1) trend NW-SE, while Joint 2(J2) trends NE-SW, found towards west of Jharberha RF.

Folds:

There is no mesoscopic fold noticed in the study area. In the northern and southwestern regions of the mapped area, near Namankani Hill and southwest of the Kurhabila area, drag folds have been observed among chlorite schist and mica schist (Fig-21). The axial plane of such folds trend N50°W – S50°E to N80° W-S80°E with dip 45° to 50° in southerly direction. The axial plunge varies from 40° to 50° between S40° W and S70°W.

Fig 21: Outcrop showing drag folds within chlorite schist found near Namakani hills.

Folds were observed and described during fieldwork, particularly affecting schistose units and banded lithologies such as quartz-mica schist and chlorite schist. However, most of these folds were identified at the outcrop or mesoscopic scale, and due to their limited lateral continuity and exposure, they were not marked explicitly on the compiled geological map.

Shear Zones:

Evidence of the shearing is manifested in the study area in the form of quartz boudins, number of inter-foliated/micro folding and brecciation of rocks in Mica-Schist, S-C fabric and stretching of quartz pebbles in quartz mica schist, towards SW of Kurhabila area have been observed. Quartz grains and porphyroclasts of feldspar show dextral shear movements as observed in quartz mica schist and chlorite schist. Besides, shearing evidence is also recorded in the form of minor silica veins with pinch and swell structures within chlorite schist in the northeastern side of the mapped area. This above evidence is suggestive of the presence of shearing phenomena. However, all the shearing evidence is observed on minor scales which are not mappable. Crinkling or crenulation is observed in drag folds within mica schist to the southwest of the Kurhabila area, resulting from deformation during metamorphism (Fig-22). Stretching of quartz/chert pebbles/clasts also noticed. Although, a NW-SE trending prominent Malyagiri Shear zone (200 km long and 1 km wide) passing towards the western boundary of the study area but falls outside of the block. No prominent shear zone could be identified in the study area.

Figure 22: Drag folds within Mica-Schist trending NW-SE/72 due SW found towards SW of Kurhabila area.

6.1.3 Metamorphism:

Based on field study, the chlorite schist is dominantly present in the eastern part of the study area suggesting that the area has undergone low-medium grades of metamorphism. The mineral assemblages contain minerals like chlorite, zeolite, talc and biotite identified by hand lens in the study area. All these mineral associations indicate that rocks of the area have undergone a low P-T condition of metamorphism of greenschist facies (**Turner, 1968**).

6.1.4 Mineralogy of ore zones and ore textures:

Based on the analytical results for Au. No ore zone is found in the study area.

6.1.5 Pitting & Trenching

BRS samples yielding negative results, pitting & trenching were not carried out in the area.

6.1.6 Sampling

The study area shows signs of sulphide (pyrite) in the form of specks and altered malachite stain in quartz veins within chlorite schist, exposed in the Chuahuri area & Namakani hills towards eastern side and Kurhabila area towards southwestern side of the block, as they can be possible loci for gold mineralization. Sulphides are present as specks form in chlorite schist. So, for the sampling, more emaphasis was given to quartz veins in the above-mentioned areas. Indirect evidence of surface manifestation of mineralization is exhibited in the form of intense silicification and profuse ferruginization. Previous workers had carried out panning of stream sediment samples and established the presence of placer gold in submicroscopic form in the Chua hurhi block, falling within the present area. To identify the source of gold in the present area and its host rock potentiality, Bed rock sampling (BRS) was carried out in the important geological domain predicted to have contained gold mineralization.

Sampling details:

Bed rock samples: In bed rock sampling, emphasis was given for selection of sample points at lithological contact zones, brecciation, chloritisation, ferruginization, silicification and altered zones, as they are the favorable loci for concentration of remobilized gold. Bed rock Grab samples were collected from different rock types such as chlorite schist, weathered ultramafic mica schist/quartz mica schist, microgranite & laterite. A total of 87 BRS Grab samples were collected during the course of detailed mapping in the study area. More emphasis was given to quartz veins embedded within chlorite schist, mica schist showing alteration like silicification, oxidation and the localities showing sulphides in the form of pyrite specks and malachite stain, So, 54 grab samples were sent for the analysis to determine Au & Ag values of the bed rock (location of the grab samples have been shown in (Fig-26).

A total 54 numbers of bedrock samples were analyzed from different localities plotted in the detailed geological map (Fig-26) and tabulated in Annexure-I. Five hundred grams of each sample were processed using iron mortar and pestle to -200 mesh sizes. Two sets of samples (original and duplicate) were prepared by means of coning and quartering. One set of 250 gm was sent at Chemical Laboratory of Shiva Analytical (India) Pvt. Ltd., Hoskote, Bangalore for the chemical analysis. In addition to Au & Ag, other 32 elements were also analysed as Al, As, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, In, Cs, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Sn, Sr, Te, Ti, Tl, V, W, Zn & Zr. These samples were analyzed used by ICP-OES, ICPMS & Fire Assay method.

Check Samples analysis:

As part of quality assurance and validation of analytical results, three check samples were re-analyzed at JRARDCC laboratory Nagpur Maharashtra. These samples were collected from key lithological units and the results of the three check samples showed good correlation with the original analytical data for gold which are described below table

Gold Pulp Samples Analysis Details			
Sr No	Original Sample id (Shiva)	Original Au Value (ppb)	Check samples Au value (ppb) (JNARDCC)
1	DIM/11/296	80	40
2	DIM/11/410	30	110
3	DIM/11/497	5	40

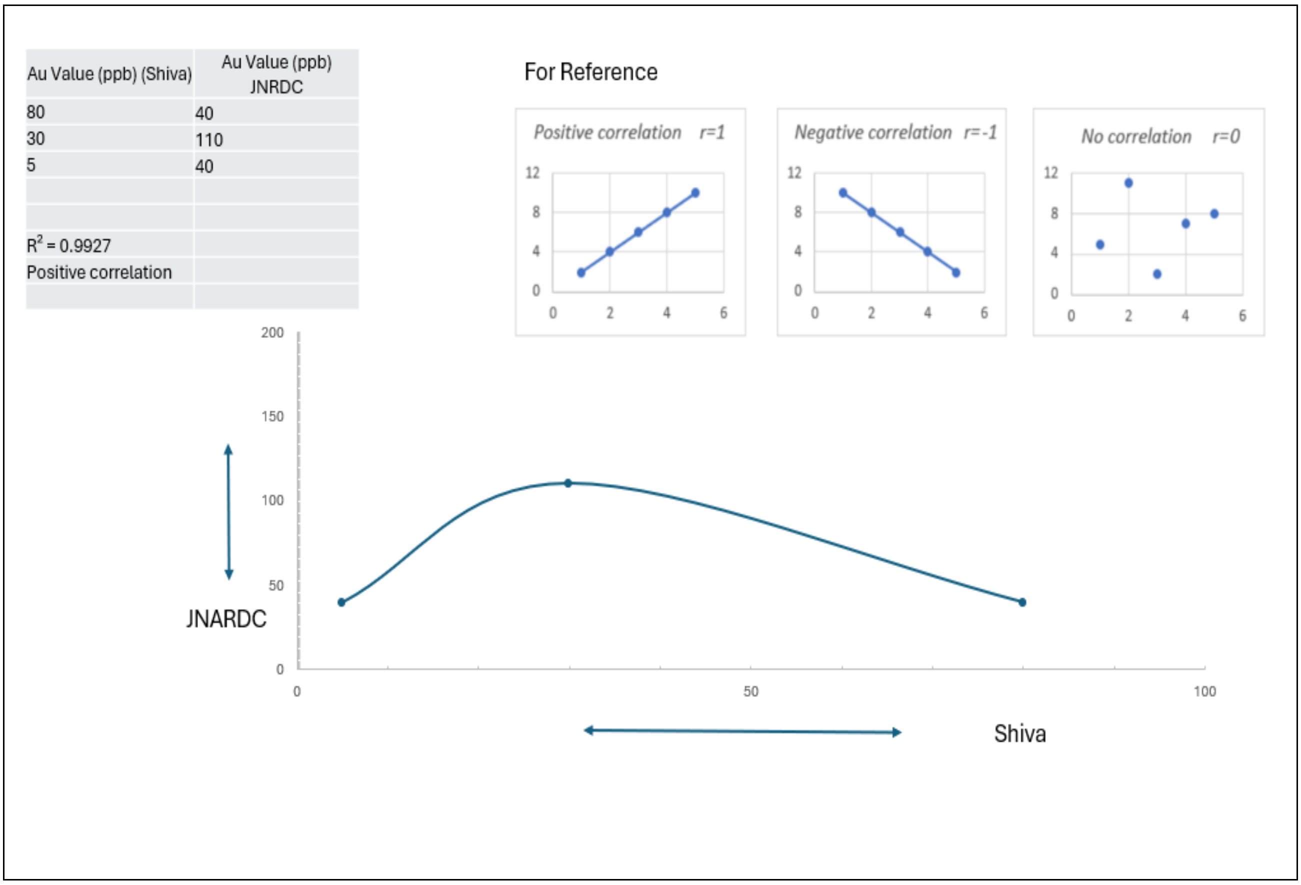


Figure: Map shows the scatter diagram of check samples

The above scatter diagram revealed the results of the three check samples appeared to have positive correletaion as R=0.9927 (approx. 1). For the positive correlation, R value should be equal to 1 and in the present study, all check sample results for gold fall within this range, confirming the data reliability.

6.1.7 Geophysical Exploration

The study area is covered by the available high resolution (250m) Airborne magnetic and radiometric data (**DoMG, Odisha 1993**). The ground gravity and magnetic data (NGPM) collected by GSI are also available for this area. The Aeromagnetic map shows NW-SE trended linear features at the western side of the block, alternate low & high mag values indicate possibility of shear zone. (Fig-23). Geological map of GSI by **N.K. Sahu** (1995-96) (Fig) shows the Malyagiri Shear zone falling over this feature with the same trends. This magnetic lineament extends up to 14 km along the NW-SE direction in this block. The aeromagnetic maps don't show any significant anomalies inside the G-3 area, but the topography of this area suggests the possibility of subparallel shear zones/faults towards NE direction. The drone magnetic survey with 100/50 m line spacing and 65m altitude was expected to helpful to delineate the mineralized quartz veins and associate sub parallel shear zones/faults towards NE directions if any. So, a drone magnetic survey was carried out in the block.

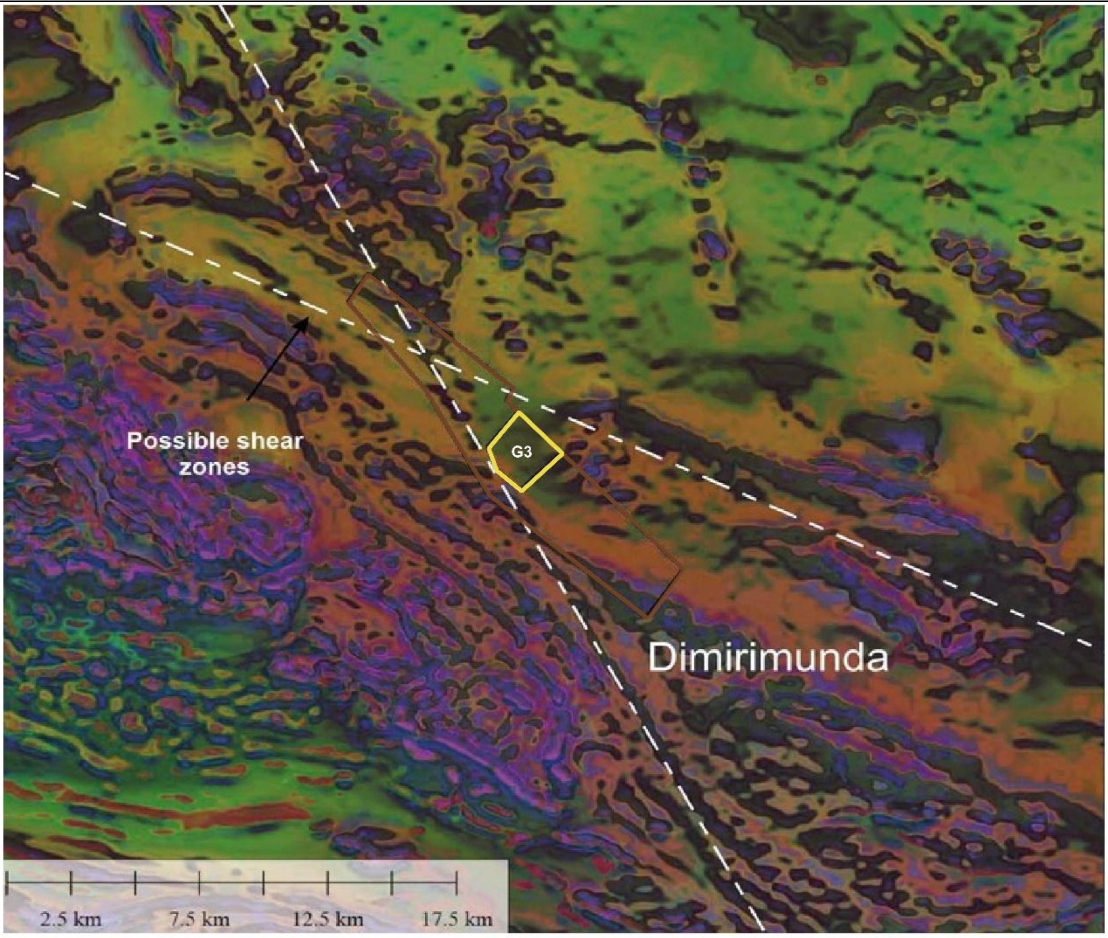


Figure 23: Stacked Airborne geophysical data showing lineaments as contrast in high and low magnetic values (White line- Possible shear zone)

Steiger Geoscience and Engineering Private Limited and Enerson Geophysical Explorations Company conducted drone magnetic survey on behalf of Odisha Mining Corporation Limited over the Dimirimunda area. A 47-line-kilometer drone magnetic survey was conducted over 5 sq km. survey lines were spaced 100/50m apart, and oriented at a 45° azimuth. The field surveys were performed. The average altitude for magnetometers in this survey was 65 m.

The objective of the drone magnetic geophysical survey was to obtain high- resolution magnetic data set over the survey area to improve the understanding of the geology and find locations with possible mineralization in the area.

Processing

The total magnetic intensity (TMI) data was processed to prepare different mathematically derived grids/images for interpretation.

The prepared grids are

i. TMI map,

ii. IGRF corrected TMI map,

iii. Reduced to pole (RTP) map,

iv. Analytical signal (AS) map,

v. Residual anomaly map,

vi. First vertical derivative map,

vii. 2nd vertical derivative map,

viii. Tilt derivative map,

ix. 1^{st} derivative map in x-direction (DX1),

x. Generalized Derivative map.

Every evening after a field survey, data was downloaded from magnetometers, then checked for spikes and corrected. Then diurnal corrections were made. The final ASCII raw data files were then loaded into separate Oasis Montaj databases and processed according to the descriptions below:

• Quality control

• Visual inspection of data and manual spike removal

• Import basemag data to database

• Inspection of basemag data and removal of spikes

• Correction of data for diurnal variation

• Importing final data (TMI - Total Magnetic Intensity data) to Geosoft

• Application of Lowpass filter with 50 fiducials (approx. 50m) to remove the instrumental & overlapping noises and levelling of data using Tie lines & Micro levelling techniques.

• IGRF calculation and subtracting from data to have residual magnetic anomaly.

• Minimum curvature Gridding with 25m cell size for 100m spacing block.

• Application of different filters on IGRFs grid

Drone Magnetic Survey Methodology

Magnetometer (Geometrics-Magarrow) with DJI M350 Drone was used to obtain airborne magnetic data. The survey lines were spaced 100 m apart, and oriented at a 90° azimuth in WGS-84 UTM zone 45N.

Figure 24: Figure shows Drone Magnetic Survey Methodology

The Magarrow magnetic sensor was housed in a single 1 meters long bird, which was supposed to fly at a constant altitude above the topographic surface. Terrain was generally rugged with many tall trees measuring 35 – 45m. Rugged terrain and abrupt changes in topography affected the Drone's ability to 'drape' the terrain; therefore, there are positive and negative variations (±5 m.) in Drone altitude with respect to the standard, which is defined as 50-60 m. The average altitude for the magnetometer in this survey was 65 m. The accuracy achieved with no differential corrections is reported to be less than ±5 m in the horizontal directions. The ground speed of the drone varied from 0 to 7 m/s depending on topography, wind direction and its magnitude. On average the ground speed during the whole survey was calculated to be 27 km/h.
The base magnetometer Gem Systems GSM-19TW 9018211 v7.0 was used to monitor diurnal variations in the magnetic field which is located near field. The magnetic base station data were recorded once every 5 seconds. The coordinate of base as follows:

• Drone Mag survey base Co-ordinates: X: 332950, Y: 2368927

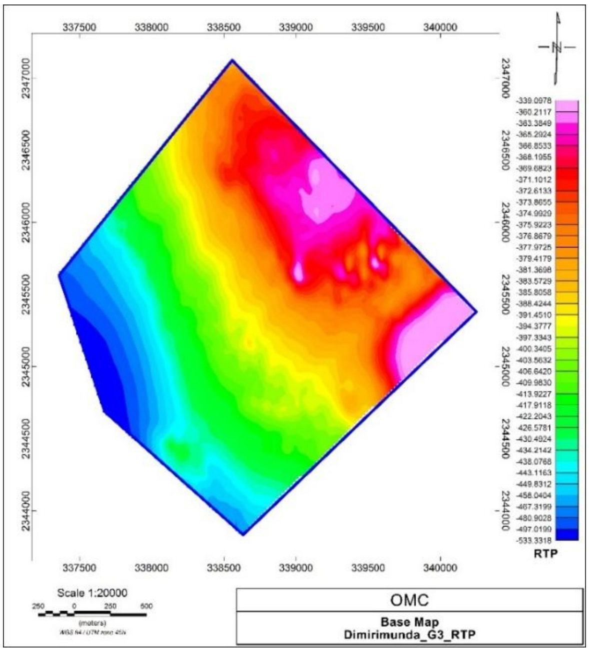
The magnetic, altitude and navigation data were recorded into Magnetometers micro-SD card during flight and ground mag surveys. The raw data files were backed up onto USB flash drive in the field.

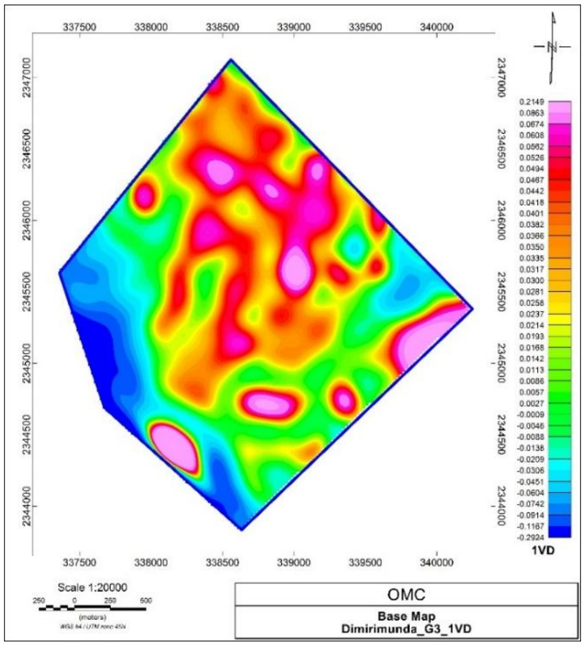
Instrument Specifications

Instrument	Producer/Model	Accuracy/Sensitivity	Sampling Freq. interval
Drone Magnetometer	Geometrics Magarrow MFAM - Laser pumped cesium vapor (Cs133 non-radioactive) total field scalar magnetometer	2.5 nT / 0.002 nT	1000 Hz
Base Magnetometer	GSM-19TW	0.15 nT	5 s

Observation

Study of different Geophysical maps mentioned below did not reveal any significant structure to be considered as a favorable host for gold mineralization in the study area. So, no further Geophysical survey is recommended in the Dimirimunda Block.


RTP
Scale 1:20000
(meters)
OMC
Base Map
Dimirimunda_G3_RTP


1VD
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Base Map
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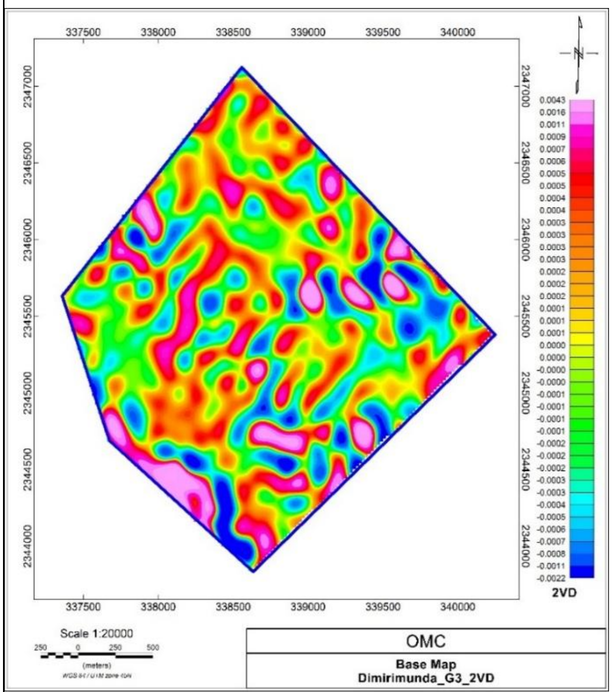
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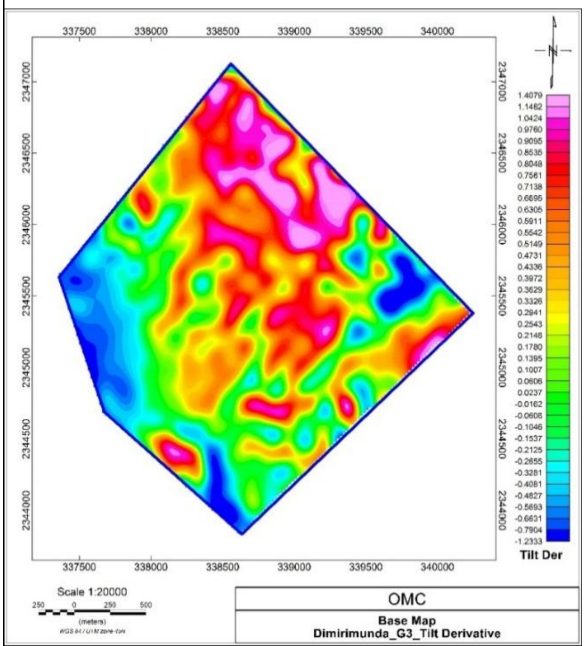
Tilt Der
Scale 1:20000
(meters)
OMC
Base Map
Dimirimunda_G3_Tilt Derivative

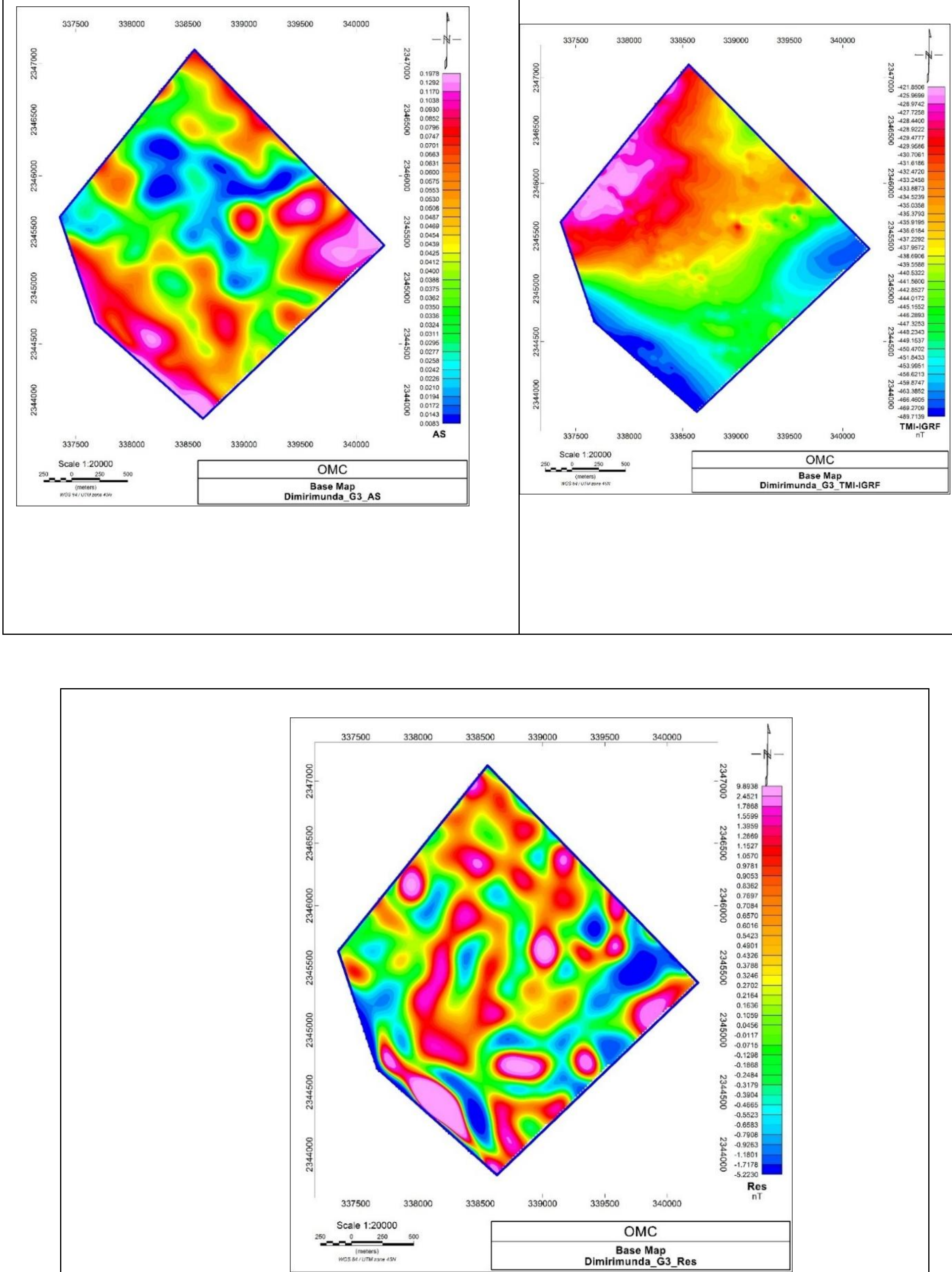

Figure 25: **RTP, 1VD, 2nd VD, Tilt, Residual and Generalized Derivative maps in the study area**

Based on the field observations as described (under the heading structure 6.1.2), the mesoscopic to small scale shearing features such as foliation, stretching lineation slickensides, and local mylonitic texture were observed in the field and these features are documented in the lithological description and interpreted as evidence of ductile deformation. Although, drone based geophysical interpretation that shows no prominent structures as regional-scale shear zone, fold or fault structure were identified in the study area.

6.1.8 Geochemical Exploration

During the course of geological mapping, only bed rock samples were collected from the exposures of chlorite schist, weathered ultramafic, mica schist/quartz mica schist, microgranite, laterite and the localities which are showing sulphides in the form of pyrite specks and altered malachite stain, as they can be possible loci for gold mineralization.

Bed rock sampling

Gold mineralization was expected in different geological set up in the area and was expected in chlorite schist, mica schist/quartz mica schist, microgranite & laterite. Hence bed rock sampling was carried out in these rock types.

Mapping at 1:2000 scale helps to demarcate the lithological disposition of chlorite schist, mica schist/quartz mica schist, microgranite and laterite present in the study area. During the course of geological mapping, only bed rock samples were collected from the above-mentioned exposures associated with quartz vein and sulphide (pyrite specks and altered malachite stains) along with fracture planes. A total of 87 Bed Rock Samples (BRS) were collected by grab method. Out of 87 samples, 54 samples were analysed for determination of Au and Ag values in the chemical laboratories of Shiva Analytical (India) Pvt. Ltd., Hoskote, Bangalore. Following the collection, a screening process was conducted to determine the most suitable samples for chemical analysis.

The screening process was carried out based on the following criteria:

1- Field Observations & Lithological Suitability:

- Samples exhibiting distinct mineralization, alteration, or lithological variations indicative of potential economic mineralization were prioritized.
- Samples with visible sulfide mineralization, quartz veins, or iron-staining were given preference.

2- Representative Sampling & Spatial Distribution:

- To maintain a spatial balance, redundant samples from closely spaced locations with similar lithological characteristics were excluded.
- Preference was given to samples covering a diverse range of lithological units.

3- Sample Quality & Integrity:

- Foreign samples were excluded to ensure that only in-situ bedrock samples were analyzed.

Samples affected by surface contamination (e.g., soil, lateritic cover, or external debris) were removed from consideration

As a result, 54 samples were selected and sent for determination of Au and Ag values and plotted in the LSM map and tabulated in (**Annexure I**).

Out of 54 samples, only 2 samples yielded maximum gold value of **30 ppb** & **80 ppb** in quartz vein within the Chlorite Schist in Chua hurhi area. The results show that gold values fall below 0.1 ppm in all the samples, From the analytical results (Annexure II), it is confirmed that the gold values are not promising in the study area. The Analytical results of 54 samples are listed in (Annexure II).

Table 6 :Table showing 54 Bed rock samples that were sent for chemical analysis

Lithology	Quartz veins within Chlorite Schist	Quartz veins within laterite	Weathered ultramafic rocks	Total nos. of samples
Nos. of samples	18	16	20	**54**
Nos. of samples (>0.01ppm) Au	2	1	0	
Au content (ppb)	**30 & 80**	0	0	
Ag content (ppm)		**4.39**		

Element	Au (ppm)	Ag (ppm)	Al (ppm)	As (ppm)	Ba (ppm)	Ca (ppm)	Cd (ppm)	Co (ppm)	**Cr (ppm)**	**Cu (ppm)**	Fe (ppm)	Ga (ppm)	In (ppm)	Cs (ppm)	K (ppm)	Mg (ppm)
Positive samples	2	1	56	10	**53**	53	12	28	**54**	**47**	56	**28**	0	0	47	52
Minimum	0.029	4.39	143.28	6.77	**6.98**	113.14	8.68	5.31	**10.54**	**5.63**	3357.71	**10.52**	0.00	0.00	105.42	141.43
Maximum	0.078	4.39	113167.13	30.71	**4036.73**	104044.62	21.49	257.14	**6128.08**	**307.78**	482782.55	**77.09**	0.00	0.00	44026.60	126213.08
Element	Mn (ppm)	Mo (ppm)	Na (ppm)	**Ni (ppm)**	P (ppm)	S (ppm)	Sb (ppm)	Sn (ppm)	Sr (ppm)	**Te (ppm)**	**Ti (ppm)**	Tl (ppm)	**V (ppm)**	W (ppm)	**Zn (ppm)**	Zr (ppm)
Positive samples	48	1	54	**50**	30	1	55	55	22	**16**	**33**	1	**40**	11	**34**	30
Minimum	30.44	20.48	116.77	**5.21**	56.88	141.79	5.45	0.00	8.07	**10.33**	**134.23**	11.16	**6.62**	11.63	**6.42**	10.18
Maximum	66000.42	20.48	33360.30	**846.46**	1903.87	141.79	54.38	0.00	754.97	**66.79**	**6112.38**	11.16	**886.85**	94.94	**243.44**	162.63

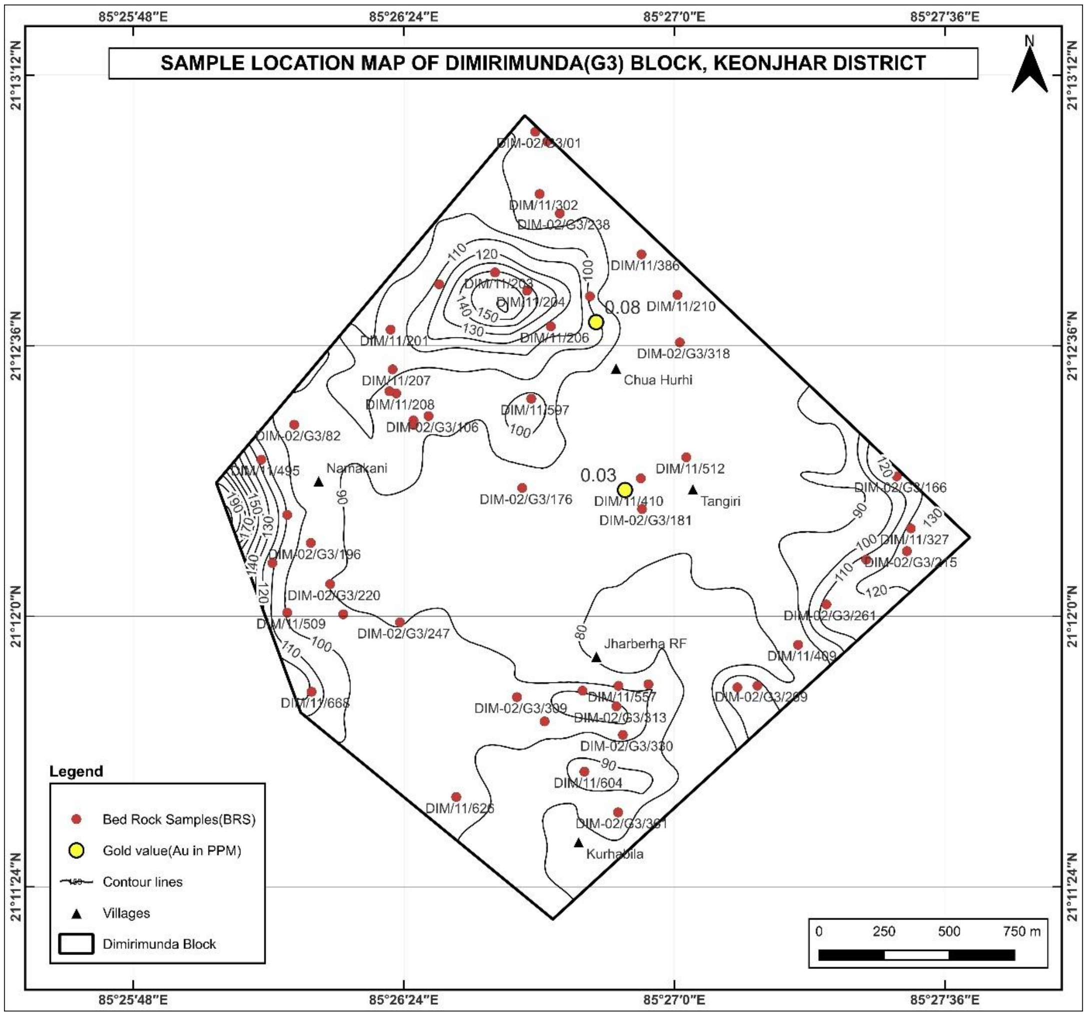

Figure 26: Map showing location of samples in Dimirimunda Block

With reference to the above figure 26, the bed rock samples were collected from a diverse range of lithologies such as chlorite schist, weathered ultramafic, mica schist/quartz mica schist, microgranite and laterite. However, the sampling preference was given to chlorite schist and laterite due to presence of quartz vein, alteration like ferruginisation, visible sulphide mineralization (pyrite specks and malachite stain) associated with quartz vein and fractured plan.

The interpretation that fracture systems may control gold mineralization in the Dimirimunda block is primarily based on field observations of quartz veins along the fracture planes and association of sulphide mineralization (pyrite) along the foliation plane. The structures were recorded in the field as minor lineaments and joint patterns, which have been incorporated in the final revised map and bed rock samples have been collected from the same and discussed more explicitly in the sampling rationale.

Analytical Method:

These samples were analyzed for Au values used by ICP-OES, ICPMS & Fire Assay method at Shiva Analytical (India) Pvt. Ltd, Hoskote, Bangalore. A total of 54 nos. of BRS samples were analyzed for Au, Ag, Au, Ag, Al, As, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, In, Cs, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Sn, Sr, Te, Ti, Tl, V, W, Zn & Zr. The lab analytical results of the samples including all elements have been appended to the report as **Annexure-II.**

Estimation of Au in bed rock samples involves aqua regia digestion method. At the initial stage of analysis, 10gms of samples were taken after systematic homogenization by conning and quartering with the addition of 25-30ml aqua regia. The mixture compound was kept on hot plate for 5-6 hours after that excess of N2 expelled by adding 12-15ml HCl. After that 2N, add 100ml of HCl and heated to boil. The solution is filtered, to filtrate 10 ml HgCl2 (saturated solution) is added and reduced by 40% SnCl2. The solution kept for overnight and decanted, next day. The Hg-Au amalgam dissolved into aqua regia, and final solution subjected to measurement by ICP-MS, ICP-OES & Fire assay for metal concentration.

Table 7: Show Analytical results of Bed Rock Samples of Dimirimunda block

Sr No.	Sample Id	Au (PPM)	Ag (PPM)	Co (PPM)	Cr (PPM)	Cu (PPM)	Mn (PPM)	Ni (PPM)	Zn (PPM)
1	DIM/11/201	<0.01	<1	34	243	111	949	93	63
2	DIM/11/202	<0.01	<1	67	598	59	1290	240	78
3	DIM/11/203	<0.01	<1	54	392	56	1533	100	52
4	DIM/11/204	<0.01	<1	88	2088	<5	705	778	58
5	DIM/11/205	<0.01	<1	<5	470	9	72	20	<5
6	DIM/11/206	<0.01	<1	37	100	42	781	67	61
7	DIM/11/207	<0.01	<1	<5	281	13	106	8	7
8	DIM/11/208	<0.01	<1	<5	136	9	54	8	6
9	DIM/11/209	<0.01	<1	<5	87	8	30	7	<5
10	DIM/11/210	<0.01	<1	<5	144	8	79	11	<5
11	DIM/11/296	**0.080**	<1	<5	95	7	104	13	<5
12	DIM/11/302	<0.01	<1	<5	159	7	89	10	<5
13	DIM/11/327	<0.01	<1	54	1263	81	951	383	65
14	DIM/11/386	<0.01	<1	<5	213	8	49	15	<5
15	DIM/11/409	<0.01	<1	33	72	8	900	60	50
16	DIM/11/410	**0.030**	<1	22	36	19	583	41	54
17	DIM/11/424	<0.01	<1	9	13	40	203	20	11
18	DIM/11/495	<0.01	<1	<5	11	29	121	20	<5
19	DIM/11/497	<0.01	<1	<5	25	9	49	7	243
20	DIM/11/509	<0.01	<1	25	166	27	584	111	32

Sr No.	Sample Id	Au (PPM)	Ag (PPM)	Co (PPM)	Cr (PPM)	Cu (PPM)	Mn (PPM)	Ni (PPM)	Zn (PPM)
21	DIM/11/512	<0.01	<1	<5	14	7	49	<5	<5
22	DIM/11/557	<0.01	<1	<5	56	6	89	10	<5
23	DIM/11/559	<0.01	<1	<5	34	<5	58	6	<5
24	DIM/11/597	<0.01	<1	<5	26	6	84	<5	<5
25	DIM/11/604	<0.01	<1	100	971	205	4107	141	87
26	DIM/11/626	<0.01	<1	89	677	118	1185	846	78
27	DIM/11/668	<0.01	<1	<5	45	8	43	25	<5
28	DIM-02/G3/01	<0.01	<1	<5	121	27	<100	30	<5
29	DIM-02/G3/02	<0.01	<1	<5	324	10	217	21	9
30	DIM-02/G3/57	<0.01	<1	18	191	77	554	66	34
31	DIM-02/G3/82	<0.01	<1	<5	295	<5	<100	7	<5
32	DIM-02/G3/105 (A)	<0.01	<1	23	84	69	773	45	41
33	DIM-02/G3/105 (B)	<0.01	<1	<5	295	<5	201	5	9
34	DIM-02/G3/106	<0.01	<1	26	118	29	701	59	45
35	DIM-02/G3/157	<0.01	<1	17	35	14	667	32	21
36	DIM-02/G3/158	<0.01	<1	32	6128	23	122	38	58
37	DIM-02/G3/166	<0.01	<1	23	1950	228	449	71	39
38	DIM-02/G3/176	<0.01	<1	<5	120	<5	<100	7	<5
39	DIM-02/G3/181	<0.01	<1	15	111	34	648	25	40
40	DIM-02/G3/196	<0.01	<1	<5	161	<5	<100	<5	7
41	DIM-02/G3/215	<0.01	<1	56	972	116	2741	84	53
42	DIM-02/G3/220	<0.01	<1	<5	126	<5	<100	<5	<5
43	DIM-02/G3/238	<0.01	<1	34	222	170	355	260	134
44	DIM-02/G3/245	<0.01	<1	<5	109	17	<100	8	<5
45	DIM-02/G3/247	<0.01	<1	<5	53	<5	<100	<5	<5
46	DIM-02/G3/261	<0.01	<1	26	1084	255	1251	81	61
47	DIM-02/G3/299	<0.01	<1	<5	55	<5	<100	<5	<5
48	DIM-02/G3/309	<0.01	<1	25	1299	99	640	153	80
49	DIM-02/G3/310	<0.01	<1	5	357	19	127	67	11
50	DIM-02/G3/313	<0.01	<1	12	1377	55	559	79	39
51	DIM-02/G3/330	<0.01	**4.39**	18	443	64	66000	41	21
52	DIM-02/G3/361	<0.01	<1	<5	125	6	171	7	<5
53	DIM-02/G3/318	<0.01	<1	257	1114	308	14791	152	122
54	DIM-02/G3/294	<0.01	<1	89	987	112	4285	102	62

The above table shows the results of only 8 elements and the results of all elements is appended to the report as Annexure II.

CHAPTER 7

Integration of Geology, geophysics (with available Drone magnetic data) and geochemical exploration data and interpretation

Integrating geology, geophysics and geochemical exploration data in the Dimirimunda area involves systematic analysis and interpretation to identify mineralized zones if any. Below is an outline of the integration process: -

Geological Interpretation: -

The study area lies within the Singhbhum Craton's Paleo-Mesoarchean granite-greenstone terrain. **(Sharma, 2009; Mukhopadhyay et al., 2008).** The area investigated comprises rocks belonging to chlorite schist, weathered ultramafic, mica schist/quartz mica schist, microgranite and laterite. Thin quartz veins of white and grey colour are found mostly within the chlorite schist, mica schist/quartz mica schist, microgranite and laterite at places. The detailed description of all the litho units is already covered in sub-section 6.1.2. Sampling was carried of quartz veins as per density disposition in the mapped litho-units.

The present work has not identified any visible gold mineralization in the study area. but there are previous reports of the occurrence of gold mineralization in the study area based on the panned concentrates of the stream sediment samples. Besides, panning activities by local people in the vicinity of the present area, i.e., Kalima are also reported. The present study area does not show any sign of sulphide mineralisation, except in the chlorite schist exposed in the northeastern direction of the study area. Surface manifestation of gold mineralization in the study area is in the form of minor sulphides (pyrite specks) in dissemination form, altered malachite stains and occasional reddish yellow oxidation patches noticed in chlorite schist. Some minor quartz veins embedded within chlorite schist show sulphidation in the form of pyrite specks have been observed towards Chua- Huri hills. This sulphide bearing chlorite schist is expected to be auriferous. Hence to identify the potentiality of the chlorite schist as a host rock, bed rock samples have been collected and analyzed. The analytical results for Au & Ag have been received for all the samples but no such high values of Au have been recorded within the chlorite schist except 02 bed rock samples showing 80 & 30 ppb of Au value. Rest all other samples are fall below the detection limit. Hence, chlorite schist is not promising for Au as per the analytical results (Annexure II).

During the course of investigation, the quartz veins are both white and smoky have been observed in the area. Except towards Chua hurhi hills as discussed above, other quartz veins are devoid of any kind of surface manifestation like ferruginization/ presence of sulphides. Prominent quartz veins wherever found in the area have been sampled. The analytical results for Au and Ag have been received for all the samples but no such high values of Au & Ag have been recorded in all quartz vein exposed in the study area. Hence, quartz veins in the study area are devoid of gold mineralization.

Based on the mapping data available, gold mineralization in Dimirimunda area is not spatially associated with any major transcrustal shear zone. A NW-SE trending Malyagiri shear zone is passing outside of the study area towards the western direction of the block. No prominent shear zone could be located in the study area. On the basis of structural data collected from the study area, the controlling factor for sitting of the gold mineralization in the Dimirimunda area is interpreted to be a fracture system within chlorite schist. Within the veinlet zone sulphide mineralization is preferred apparently concentrated along the foliation planes. Sulphide mineralisation occurs in the form of dissemination, specks and fracture fillings. Pyrite is the major sulphide and arsenopyrite being the other subordinate sulphide minerals and along with altered malachite stain with occasional reddish yellow oxidation patches noticed within chlorite schist at a few places.

Geochemical Interpretation: -

On careful study of the analytical data, quartz veins are dominantly present in chlorite schist and at some places associated with mica-schist and laterite. However, the analytical results of gold samples were erratic, no such ore zones for Au can be established as only two samples show values for gold of **30 ppb and 80 ppb** have been observed in quartz vein within chlorite schist. Rest all other samples fall below the detection limit, referred to in annexure II. Besides, only one sample that shows value for silver of **4.39 ppm** has been observed in laterite, rest all other samples fall below the detection limit. Moreover, five laterite samples show high Fe, Mn, and Al content (in table below), both within laterite and associated quartz veinlets, indicating supergene enrichment. This enrichment is likely due to residual concentration from leaching of mobile elements and reprecipitation of Fe-Mn oxides along fractures and veins during lateritization of underlying mafic-ultramafic rocks.

Sr No	Sample id	Fe (ppm)	MN (ppm)	Al (ppm)
1.	DIM/11/604	289140	4107	80502
2.	DIM/02/G3/215	191547	2741	37482
3.	DIM/02/G3/330	482783	66000	40437
4.	DIM/02/G3/318	327451	14791	91843
5.	DIM/02/G3/294	31910	4285	113167

To assess any potential gold bearing subsurface structures, a drone magnetic survey was planned in the study area.

The relationship between sulphides and structural elements:

In the study area, sulphide mineralization, primarily pyrite and arsenopyrite being the other subordinate sulphide minerals and along with altered malachite stain is generally observed to be disseminated and fracture filled type within chlorite schist (Fig-29) and weathered ultramafic rock. In the surface, pyrite specks are observed within the vein quartz (Fig-30). Field observations suggest a preferential alignment of sulphides along foliation planes and fractured system indicating that structural elements such as foliation and fractured system likely played a role in controlling fluid pathways and the localization of sulphide deposition.

Geophysical Interpretation: -

Geophysical survey observations as per Total Magnetic Intensity (TMI) map (fig-27) show high magnetic intensity (~ 45323 nT) in the northern part of the study area whereas in the southern part it shows lower magnetic intensity (~45246 nT). However, no significant geological structural features have been identified from drone magnetic data which may serve as a favorable host for gold mineralization.

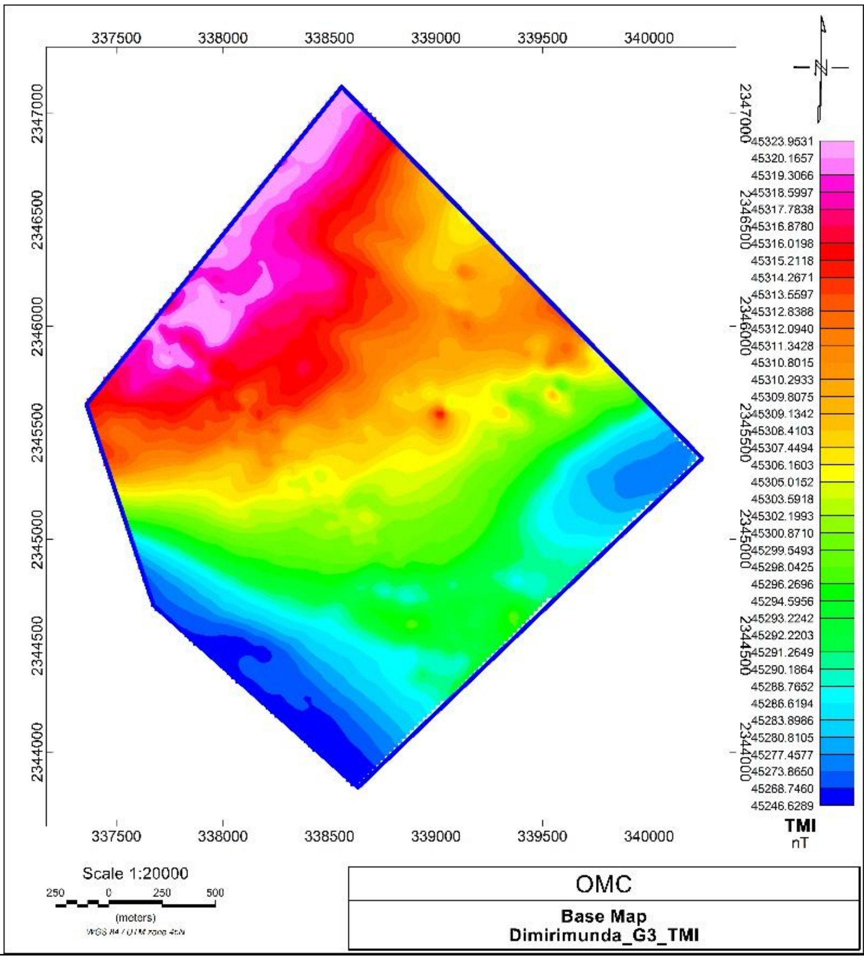

Figure 27: Map showing Total Magnetic Intensity (TMI) over the block

Data integration

The data integration studies comprising field observations, Geochemical (NGCM), analytical data and the available Geophysical data were carried out for identification of target areas.

The study area is undulating and comprises rocks belonging to chlorite schist, mica schist/quartz mica schist, microgranite and laterite (Fig-28). Thin quartz veins of white and grey colour are found mostly within the chlorite schist, mica schist/quartz mica schist, microgranite and laterite at places. High magnetic signatures were observed in the eastern part of the study area, while the central portion shows moderate, and the western portion shows low magnetic zone.

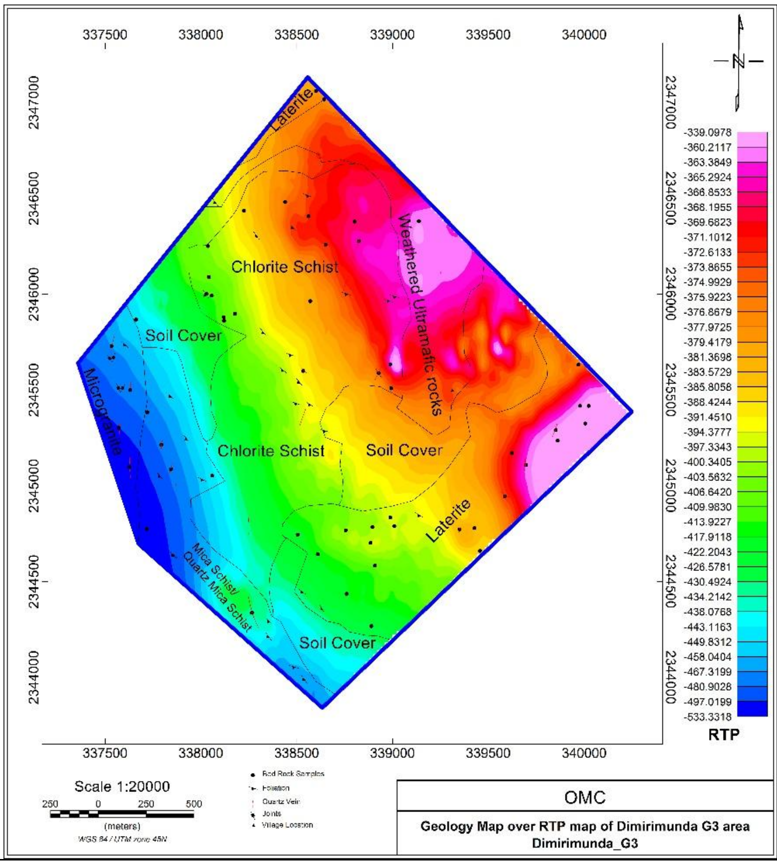

Fig-28 Map showing Geological map over RTP map

The integrated study of Geology and Geophysical maps reveals that the high magnetic signature in the eastern part of the study area is due to weathered ultramafic rocks, while the western part of the study area reveals that low magnetic signatures are due to mica schist/quartz mica schist and microgranite and the southern part reveals the moderate magnetic signature is characterized by lateritic soil cover.

Out of numerous samples, only 2 samples show Au values of 30 and 80 ppb within chlorite schist. The results of samples show that gold values fall below 0.1 ppm in all samples.

Hence, with integration of geological field survey observations, Geophysical interpretation and chemical analysis data, no potential gold bearing zones have been detected in the Dimirimunda area.

CHAPTER 8

MINERAL PROSPECT

8.1 Surface Indication of Mineralization

The present work has not identified any visible gold mineralization, but there are previous reports on the occurrence of gold mineralization in the study area based on the panned concentrates of the stream sediment samples. Panning activities by local people in the vicinity of the present area, i.e., Kalima are also reported. The anomalous values obtained based on the stream sediments sampling coupled with local panning activities suggest the presence of placer gold in the study area. **(Dr. Biswajeet Lenka & Dr Rajendra Kumar Ghadei et.al, GSI, 2017-18).**

The present study area does not show any sign of sulphide mineralisation, except in the meta basic (chlorite schist) exposed in the Chua hurhi hill and its western contact. Based on the field observation, surface manifestation of possible gold mineralization in the study area is in the form of sulphide mineralisation occurs in the form of dissemination, specks and fractured fillings. Pyrite is the major sulphide and arsenopyrite being the other subordinate sulphide minerals and altered malachite stain with occasional reddish yellow oxidation patches noticed within chlorite schist at a few places. This sulphide bearing chlorite schist is expected to be auriferous.

Besides, direct surface manifestation, indirect evidence of potential mineralization are exhibited in the form of intense silicification, profuse ferruginization could be due to supergene enrichment and development of minor box work occupying the prominent NW-SE trending ridge occurring in the eastern part of the study area.

The contact between the metasedimentary and metabasic is sharp and marked by alteration. The alteration in the western contact is marked by the development of fuchsite (Cr Muscovite) whereas the eastern contact is marked by the development of sericite. The intensity of the sericite alteration is pervasive whereas the Cr-Muscovite alteration is localized. Intense silicification is observed within the chlorite schist and occupy the prominent NW-SE trending ridge occurring in the eastern of the study area. Besides silicification, occasional ferruginization is also noticed at sporadic places.

The ferruginisation observed in laterite samples characterized by elevated Fe, Mn, and Al values is interpreted as supergene in nature, developed through intense chemical weathering and residual enrichment. Ferruginisation in laterite profiles is attributed to **supergene enrichment**, consistent with tropical weathering regimes.

8.2 Mode of occurrence:

Quartz vein associated gold deposit found to be associated with a brittle-ductile shear zone and folds in deformed and metamorphosed volcanic, sedimentary and granitoid rocks. In these deposits, gold occurs in veins or as disseminations in immediately adjacent altered wall rocks and is generally the only or the most significant economic commodity (**Poulson & Robert, 1989**). The veins occur in structural environments characterized by low to medium grade metamorphic rocks. This type of gold deposit occurs in rocks belonging to greenschist to locally lower amphibolite facies. Volcano plutonic terranes are the most important hosts to vein gold mineralization in Canada (**Poulson & Robert, 1989**). Gold is found to be intimately associated with sulphide minerals, among which most dominant is pyrite, arsenopyrite with minor amount of chalcopyrite, pyrrhotite, sphalerite and galena. Gold typically occurs as coatings on or as inclusions, as fracture fillings within sulphide grains as well as isolated grains and fracture fillings in quartz (**Poulson & Robert, 1989**).

Based on field observation, gold mineralization in the Dimirimunda area is not spatially associated with any major transcrustal shear zone. With inherent limitations of lack of conclusive field data in a lateritised terrain, the controlling factor for sitting of gold mineralization in Dimirimunda area is interpreted to be fracture system. Sulphide mineralisation occurs in the form of dissemination of specks and fractured fillings. Pyrite is the major sulphide and arsenopyrite being the other subordinate sulphide minerals and along with altered malachite stain with occasional reddish yellow oxidation patches noticed within chlorite schist at a few places. In the surface, pyrite specks are observed within the vein quartz. Field observations suggest a preferential alignment of sulphides along foliation planes and fractured system. It is suggesting that structural elements such as foliation and fractured system likely played a role in controlling fluid pathways and the localization of sulphide deposition.

In the study area, gold is occurring as a placer as evidenced from panning activities in the vicinity of study area coupled with anomalous values of panned concentrates of stream sediment samples. Based on the present data, the source rock for gold may be associated with sulphides, which are often zoned as an invisible gold and are occurring in meta basic (chlorite schist).

	
Fig 29: Sulphide mineralization (pyrite) in chlorite schist	Fig 30: vein quartz exposure showing evidence of sulphide mineralization at Chua hurhi hill

8.3 Nature of mineralization:

During FS 1993-94, (**Karim and Sahu**) discussed the nature of gold of the present and surrounding area from the panned concentrate of stream sediments samples. Panning of stream sediment samples yielded visible gold specks which vary in size from extremely fine grain to small nuggets. The precious yellow metal occurs more commonly as flakes, grains, dust or flour and rarely as nuggets. The sub-microscopic nature of this valuable metal is only confirmed by chemical analyses. Dust and flour forms are more predominant than the other forms of gold. Gold occurs as a free milling type and is easily recovered by panning. Usually, 3 to 25 specks are recovered from panning out of about 15 kgs of stream sediments or colluvial debris. Sunadeipahar block yields dust to medium sized flakes of gold on panning test while the Purujora and Chua hurhi block yield very fine dust varieties. Panning test in the Dandahuli block reveals the medium to coarse flaky nature of the yellow metal. Nuggets are scarce and are negligible when compared to other varieties of gold. Though in Chua hurhi block the visible gold flakes on panning are only few but analytical results show high gold assay value of the panned concentrates. This in turn suggests that the precious yellow metal also occurs in sub-microscopic forms (in micron sizes). During the present investigation, no panning activities were carried out.

8.4 Details of mineralized zones:

Gold mineralization was expected in different geological set ups in the area. Those are of different categories which are described below**:**

a) Sulphide bearing Metabasic:

Based on field observation, sulphide in the form of dissemination occurs in chlorite schist associated with pyrite specks and arsenopyrite being the other subordinate sulphide minerals and along with altered malachite stain with occasional reddish yellow oxidation patches in the eastern side of the study area. Pyrite grain also occurred in thin quartz veins cutting through the chlorite schist at Chua hurhi hills and it also align along the schistosity planes in chlorite schist. This sulphide bearing metabasic (chlorite schist) is expected to be auriferous. Hence, identifying the potentiality of Metabasic rock so bed rock samples have been collected from it and analyzed. The analytical results for Au & Ag have been received for all the samples but no such high values of Au have been recorded within the chlorite schist except 02 bed rock sample showing 30 & 80 ppb of Au value. The results show that the gold values fall below 0.1 ppm in all the samples. Here the metabasic are not promising for Au as per the analytical results (annexure II).

b) Contact zone between Metabasic and metasedimentaries

The contact between mica schist/quartz mica schist and chlorite schist are sharp and marked by alteration with the development of alteration minerals like biotite and fuchsite in the western and sericite in the eastern contact. Gold mineralization may be associated with alteration in the form of sericitization and biotisation. The alteration zone has been sampled. The analytical results indicate that there is no correlation between the Ag values and Au values and all the BRS samples fall below the detection limit. From the Au mineralization point of view, the alteration zone does not have significant as per the analytical results.

The presence of sericite and biotite is interpreted as a result of hydrothermal alteration, these minerals mark fluid pathways within fractured zone and are commonly associated with gold-bearing quartz veins. Their alignment with foliation planes and their spatial relationship with sulphides suggest syn-tectonic hydrothermal alteration associated with gold mineralization.

c) Quartz veins:

The quartz veins are mostly white quartz with few smoky quartz. These quartz veins are devoid of any kind of surface manifestation like ferruginization/ presence of sulphides**.** However, few minor quartz veins embedded within chlorite schist show sulphidation in the form of pyrite specks have been observed towards Chua-huri hills. Prominent quartz veins wherever found in the area have been sampled. The analytical results for Au and Ag have been received for all the samples but no such high values of Au & Ag have been recorded in all quartz vein exposed in the study area. Hence, quartz veins in the study area are devoid of gold mineralization.

As discussed above, no mineralized zone is formed in the study area pertaining to gold and associated minerals. Only two BRS samples gave comparatively better analytical data, however those values were not encouraging. Rest all other samples were below the detection limit of 10 ppb. The description of these positive samples is as below-

Table 8: Description of the few bed rock samples of the Dimirimunda block			
Sr. No.	**Sample Id**	**Au (ppb)**	**Description**
1.	DIM/11/296	80	Sample was collected from Chua Hurhi hills running along NW-SE in the central part of the study area. The Sample shows quartz vein embedded with chlorite schist. The quartz vein contains pyrite specks in disseminated form.
2.	DIM/11/410	30	Sample was collected from quartz vein embedded within the chlorite schist in the eastern part of the study area. The sample shows pyrite specks along with altered malachite stains. The sulphide mineralisation was noticed as fracture filled type.

Hence, the values above the detection limit are from the eastern part of the study area. No zone was identified.

8.5 Strike length and width of anomalies identified on the basis of geology, geochemical, geophysical exploration

No anomalies identify based on geology, geochemical and geophysical interpretation.

8.6 Alterations zones:

The main types of alteration around quartz-carbonate veins include sulphidation, alkali-metasomatism, chloritization and silicification (**Boyle, 1979**). Sulphidation of wall rocks is common around veins and in most cases is restricted to immediate proximity. Pyrite is the most common sulphide followed by pyrrhotite, mostly present in amphibolite grade rocks. Arsenopyrite is common around veins hosted by clastic sedimentary rocks. Gold is commonly enriched in intensely altered rocks adjacent to quartz-carbonate veins. In many cases these altered zones reach economic grades (**Robert and Brown, 1986**). Potassium metasomatism is the most common and typically consists of sericitization of chlorite and plagioclase. (at constant Fe & Mg) of amphibole and pyroxene commonly accompanies. In some deposits, intense chloritization may accompanied by addition of

Fe and Mg to the rock (**Poulson & Robert, 1989**).

Based on field observations, in Dimirimunda area, chlorite schist consists of lots of chlorite, epidote plagioclase, with opaque in the form of sulphides. This chlorite schist contains quartz veins. The sulphides are dominantly pyrite in the form of specks and very minor amount of arsenopyrite and altered malachite stain. The quartz veins are embedded within chlorite schist. Rocks may indicate that they have undergone alteration of silicification, sulphidation and chloritization.

8.7 Genesis of mineralization:

The genesis of gold mineralisation in the Archean Greenstone belt is very controversial. There are many models suggested by different authors, but metamorphic model of (**Groves et. al, 1987)** gained considerable importance in genesis of vein quartz hosted gold deposit. This model depicts low salinity, moderate density near neutral H2O-CO2 fluids interpreted to carry Au as reduced S complexes. The main structural control is provided by shear zones where there is extensive fluid wall rock interaction. Gold is possibly deposited at greenschist facies condition as a result of general decrease in gold solubility with falling temperature. It has also been emphasized that source rock with 2 ppb Au is sufficient to produce large gold enriched deposits (**Groves et. al., 1987**).

The present study area does not show any sign of sulphide mineralisation, except in the chlorite schist exposed in the Chua hurhi hills and its eastern contact. Pyrite specks occur in the form of dissemination of specks and fractured fillings in chlorite schist towards Chua hurhi hills in the eastern part of the study area. The placer gold was found in many areas but unable to locate primary sources and these were disseminated types of mineralisation other oxides areas with lesser evidence of sulphides, carbonates, weak structural loci (wide fracture types) are widely distributed and not well recognized in the field. Subsequently, the area has undergone a process of supergene enrichment where gold associated with sulphides were liberated and freely concentrated in the zone of residual concentration. Placers are found in larger areas, but primary deposits are missed.

The presence of gold in Chua hurhi block, as established by previous workers from the panned concentrates of the stream sediments sampling clearly suggests that the gold might have associated with pyrites. Gold might have released from pyrite bound gold from the volcanic rocks during Precambrian (**Groves et al., 2016**).

CHAPTER 9

EXPLORATION BY SYSTEMATIC DRILLING

Drilling was not carried out in the study area.

CHAPTER 10

RESOURCE ESTIMATION

Systematic mapping followed by bed rock grab sampling yielded no mineralized zone, hence drilling to prove sub-surface continuity of the gold mineralization was not carried out. So, resource estimation cannot be attempted for study area.

CHAPTER 11

CONCLUSION & RECOMMENDATION

Based on geological, geophysical and geochemical data, the following conclusions have been derived: -

1. Detailed geological mapping has been carried out in the area on a scale of 1:2000. The area forms a part of the Greenstone belt of the Archaean age represented by the profuse presence of chlorite schist. Major rock types encountered in the area are chlorite schist, mica schist/quartz mica schist, microgranite, and laterite. The gold occurrences are encountered in quartz veins within chlorite schist. Due to sporadic intrusion of the quartz veins, the structural attributes are difficult to ascertain in the field. From the field observation, it is indicated that the quartz vein in the chlorite schist is consistent in its extent and associated with sulphide and this litho-unit is given more emphasis with respect to mapping and sampling.
2. From the analytical results, gold occurrences are encountered in quartz veins within chlorite schist whereas, silver occurrences are encountered in laterite. The values above the detection limit are from the eastern part of the study area. No zone was identified.
3. Shearing in the area is manifested in the form of inter-foliated silicification, mineral lineation, stretching of quartz/chert pebbles/clasts in chlorite schist as well as in mica schist/quartz mica schist. However, all the shearing evidence is observed on minor scales which are not mappable, besides, no prominent shear zone could be located in the study area.
4. Based on structural data collected from the study area, the controlling factor for sitting of the gold mineralization in the Dimirimunda area is interpreted to be a fracture system within meta basic. Within the veinlet zone sulphide mineralization is preferred apparently concentrated along the foliation planes. Sulphide occurs in the form of dissemination, specks and fractured fillings. Pyrite is the major sulphide and arsenopyrite being the other subordinate sulphide minerals and along with altered malachite stain with occasional reddish yellow oxidation patches noticed within chlorite schist at a few places.
5. Based on field study, chlorite schist is dominantly present in the eastern part of the study area suggesting that the area has undergone low-medium grade of metamorphism. The mineral constituents of the meta basic are actinolite, tremolite, augite, epidote, zoisite, quartz, and chlorite. All these mineral associations indicate that rocks of the area have undergone a low P-

T condition of metamorphism of greenschist facies (**Turner, 1968**).

6. A total of Fifty-four (54) Bed Rock Samples (BRS) were collected from the quartz veins mainly within chlorite schist and laterite at places. Out of 87 samples, 54 samples were analyzed for Au & Ag. The analytical results of the samples revealed that the maximum Au values are **30 ppb & 80 ppb** within chlorite schist. The results show that the gold values fall below 0.1 ppm in all the samples. In addition to this, only one sample shows Ag value of 4.39 ppm within quartz vein embedded laterite, with rest all other samples showing analytical data below the detection limit. From the analytical results appended in the report (Annexure II), it is confirmed that gold values are not promising in the study area.

7. Based on the field observations & Drone Magnetic survey result, no significant structure which may serve as a favorable control for mineralization was found.

8. On the basis of data integration of geological field survey observations, Geophysical interpretation and chemical analysis data, no potential gold bearing zones have been detected in the Dimirimunda area.

Recommendations:

1. During the present work, no mineralized zones were identified based on Geological Mapping and Geochemical Sampling data. As per the assay data, the Au values in the area are not promising.

2. Based on geophysical interpretation, no significant structure has been identified in the area. So, ground geophysical surveys may not be recommended in the area.

3. No further for gold exploration in the area is recommended.

CHAPTER 12

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CHAPTER 13

LOCALITY INDEX

Sl. No.	LOCALITY	Latitude	Longitude
1	Chua Hurhi	21.209177°	85.447846°
2	Namakani	21.205009°	85.436851°
3	Tangiri	21.204708°	85.450683°
4	Jharberha RF	21.198524°	85.447119°
5	Kurhabila	21.191666°	85.446461°
6	Kardangi	21.2958°	85.31111°
7	Koilisuta	21.27777°	85.3638°
8	Bhodaibelna	21.3138°	85.4138°
9	Sirgida	21.3069°	85.39166°
10	Kalima	21.2444°	85.3986°
11	Dimirimunda	21.2500°	85.3791°
12	Kandaposi	21.2638°	85.3777°

ANNEXTURE – I: Detailed Metadata and Characteristics of Samples chosen for Laboratory Analysis

SAMPLE NO.	LONGITUDE	LATITUDE	AU VALUE (ppm)	SAMPLE DESCRIPTION
DIM/11/201	85.43951174	21.21059339	<0.01	Small fragments of quartz embedded within chlorite schist; amygdales are present
DIM/11/202	85.4413051	21.21227201	<0.01	chlorite schist with fragments of quartz
DIM/11/203	85.44337164	21.2127066	<0.01	Quartz and chlorite schist contact showing angularity of quartz grains
DIM/11/204	85.44455395	21.21203099	<0.01	Chlorite schist with amygdales
DIM/11/205	85.44687765	21.21182656	<0.01	Fragments of quartz and chlorite schist
DIM/11/206	85.44543474	21.21071126	<0.01	Chlorite schist and quartz contact
DIM/11/207	85.43958501	21.2091217	<0.01	Small fragments of quartz embedded within chlorite schist
DIM/11/208	85.43971952	21.20823771	<0.01	Sulphidised quartz
DIM/11/209	85.43946824	21.20831669	<0.01	Milky quartz and chlorite schist
DIM/11/210	85.45011384	21.21187436	<0.01	Quartz having high iron oxide content showing smoky appearance
DIM/11/296	85.44710921	21.21087129	**0.08**	Quartz vein embedded with chlorite schist. The quartz vein contains pyrite specks in disseminated form.
DIM/11/302	85.45832411	21.20324173	<0.01	Laterite
DIM/11/327	85.45873827	21.20324551	<0.01	laterite
DIM/11/386	85.45489903	21.20099734	<0.01	Laterite
DIM/11/409	85.45457363	21.19894388	<0.01	Laterite
DIM/11/410	85.44817589	21.20466642	**0.03**	The sample shows pyrite specks along with altered malachite stains. The sulphide mineralisation was noticed as fracture filled type.
DIM/11/424	85.43569218	21.20374722	<0.01	Rock has pinkish appearance with quartz
DIM/11/495	85.43473631	21.20578884	<0.01	Microgranite
DIM/11/497	85.43514267	21.20196264	<0.01	Microgranite
DIM/11/509	85.4356917	21.20013404	<0.01	Quartz showing layering (laminae of quartz grains)
DIM/11/512	85.4488247	21.19787949	<0.01	Channel sample of quartz
DIM/11/557	85.44793363	21.19742869	<0.01	Laterite
DIM/11/559	85.44904074	21.19748402	<0.01	Laterite
DIM/11/597	85.44471136	21.20803988	<0.01	Milky quartz with limonitic in nature, iron content is also seen

DIM/11/604	85.4466761	21.19425559	<0.01	Laterite
DIM/11/626	85.44193744	21.19331769	<0.01	Talc mica schist
DIM/11/668	85.43658941	21.19720665	<0.01	Microgranite shows pinkish appearance
DIM-02/G3/01	85.44485848	21.21790531	<0.01	Quartz containing vugs with limonitic soil found along the nala section
DIM-02/G3/02	85.44529572	21.21754802	<0.01	Quartz containing vugs with limonitic soil having cherty nature found along nala section
DIM-02/G3/57	85.45709346	21.20209233	<0.01	Laterite
DIM-02/G3/82	85.43595	21.20708	<0.01	Milky Quartz shows alteration
DIM-02/G3/105 (A)	85.44035613	21.20724104	<0.01	Quartz sample collected from chlorite schist. Quartz is embedded within chlorite schist as geoid structure
DIM-02/G3/105 (B)	85.44036	21.20707	<0.01	Quartz sample collected from chlorite schist. Quartz is embedded within chlorite schist as geoid structure
DIM-02/G3/106	85.44091316	21.20739974	<0.01	Quartz fragments embedded within chlorite schist
DIM-02/G3/157	85.45232647	21.19736963	<0.01	Laterite sample from top of the mound
DIM-02/G3/158	85.44875898	21.20509633	<0.01	Sample having fine to medium grain texture, some light green color minerals are there (it may be chrome rich)
DIM-02/G3/166	85.45821737	21.20517391	<0.01	Laterite
DIM-02/G3/176	85.444379	21.20474	<0.01	Quartz sample collected through Channel Sampling
DIM-02/G3/181	85.448806	21.20396	<0.01	Sample having fine to medium grain texture, some light green color minerals are there (fuchsite) (it may be chrome rich)
DIM-02/G3/196	85.43656042	21.20270754	<0.01	Quartz containing iron with some sulphidation
DIM-02/G3/215	85.45859289	21.20240421	<0.01	Laterite containing pulverized quartz
DIM-02/G3/220	85.43727958	21.20118763	<0.01	Quartz within micro-granite
DIM-02/G3/238	85.45720486	21.20156953	<0.01	Channel sample of laterite
DIM-02/G3/245	85.43776329	21.20007202	<0.01	Quartz
DIM-02/G3/247	85.4398566	21.19977521	<0.01	Milky quartz
DIM-02/G3/261	85.45561769	21.20043494	<0.01	Laterite
DIM-02/G3/299	85.45306752	21.19743071	<0.01	Quartz embedded within laterite block
DIM-02/G3/309	85.444182	21.19701	<0.01	Laterite
DIM-02/G3/310	85.44520228	21.19611196	<0.01	Laterite and Quartz
DIM-02/G3/313	85.44785489	21.19666929	<0.01	Dark brown colour laterite with lots of pore within it. some of them are limonitic.
DIM-02/G3/330	85.44809707	21.19561466	<0.01	Laterite dark brown in colour

DIM-02/G3/361	85.44792	21.19275	<0.01	Smoky quartz
DIM-02/G3/318	85.4533581	21.19634942	<0.01	Laterite
DIM-02/G3/294	85.44660634	21.19724496	<0.01	Laterite

ANNEXTURE – II: Analytical results of Bed rock samples of Dimirimunda Block

Sl. No.	Customer Code	Customer Description	Lab ID	Au	Ag	Al	As	Ba	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	In	Cs
			METHOD	SOP/OM/058	SOP/OM/059	SOP/OM/051	SOP/OM/059	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051
			UNITS	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)
			DL	0.01	1	100	5	5	10	100	10	5	10	5	100	10	10	10
1	OREAS 231	CRM	Cert.	NA	NA	71400	NA	112	NA	74700	NA	45	NA	161	80500	16	NA	NA
2	OREAS 137	CRM	Cert.	NA	26	48200	236	NA	NA	14700	100	27	20	246	96900	NA	NA	NA
3	DIM/11/201	Rock Sample	G7475-1	<0.01	<1	82390	<5	150	<10	53613	<10	34	243	111	67281	19	<10	<10
4	DIM/11/202	Rock Sample	G7475-2	<0.01	<1	66693	16	285	<10	41855	<10	67	598	59	77450	21	<10	<10
5	DIM/11/203	Rock Sample	G7475-3	<0.01	<1	59692	<5	270	<10	1408	13	54	392	56	126751	28	<10	<10
6	DIM/11/204	Rock Sample	G7475-4	<0.01	<1	20636	<5	9	<10	21920	<10	88	2088	<5	64076	13	<10	<10
7	DIM/11/205	Rock Sample	G7475-5	<0.01	<1	1993	<5	15	<10	595	<10	<5	470	9	5718	<10	<10	<10
8	DIM/11/206	Rock Sample	G7475-6	<0.01	<1	82354	<5	34	<10	60136	<10	37	100	42	63532	24	<10	<10
9	DIM/11/207	Rock Sample	G7475-7	<0.01	<1	10380	<5	40	<10	722	<10	<5	281	13	6929	<10	<10	<10
10	DIM/11/208	Rock Sample	G7475-8	<0.01	<1	341	<5	8	<10	329	<10	<5	136	9	6435	<10	<10	<10
11	DIM/11/209	Rock Sample	G7475-9	<0.01	<1	143	<5	<5	<10	415	<10	<5	87	8	6529	<10	<10	<10
12	DIM/11/210	Rock Sample	G7475-10	<0.01	<1	2063	<5	9	<10	303	<10	<5	144	8	6733	<10	<10	<10
13	DIM/11/210	Rock Sample	G7475-10	<0.01	<1	2059	<5	10	<10	297	<10	<5	140	7	6769	<10	<10	<10
14	DIM/11/296	Rock Sample	G7475-11	0.08	<1	2275	<5	12	<10	502	<10	<5	95	7	4933	<10	<10	<10
15	DIM/11/302	Rock Sample	G7475-12	<0.01	<1	272	<5	13	<10	428	<10	<5	159	7	7841	<10	<10	<10
16	DIM/11/327	Rock Sample	G7475-13	<0.01	<1	60122	<5	156	<10	55816	<10	54	1263	81	62663	17	<10	<10
17	DIM/11/386	Rock Sample	G7475-14	<0.01	<1	1469	<5	8	<10	648	<10	<5	213	8	6467	<10	<10	<10
18	DIM/11/409	Rock Sample	G7475-15	<0.01	<1	97159	<5	97	<10	94416	<10	33	72	8	63624	37	<10	<10
19	DIM/11/410	Rock Sample	G7475-16	0.03	<1	103603	<5	39	<10	91706	<10	22	36	19	64910	45	<10	<10
20	DIM/11/424	Rock Sample	G7475-17	<0.01	<1	13593	<5	9	<10	1622	<10	9	13	40	20473	<10	<10	<10
21	DIM/11/495	Rock Sample	G7475-18	<0.01	<1	1800	<5	9	<10	382	<10	<5	11	29	6087	<10	<10	<10
22	DIM/11/497	Rock Sample	G7475-19	<0.01	<1	895	<5	8	<10	414	<10	<5	25	9	4330	<10	<10	<10
23	DIM/11/509	Rock Sample	G7475-20	<0.01	<1	48692	<5	16	<10	71796	<10	25	166	27	36382	12	<10	<10
24	DIM/11/509	Rock Sample	G7475-20	<0.01	<1	49101	<5	14	<10	72393	<10	26	162	28	36691	14	<10	<10
25	DIM/11/512	Rock Sample	G7475-21	<0.01	<1	1072	<5	8	<10	643	<10	<5	14	7	5347	<10	<10	<10
26	DIM/11/557	Rock Sample	G7475-22	<0.01	<1	7947	<5	9	<10	480	<10	<5	56	6	17342	<10	<10	<10
27	DIM/11/559	Rock Sample	G7475-23	<0.01	<1	2699	<5	7	<10	256	<10	<5	34	<5	7132	<10	<10	<10
28	DIM/11/597	Rock Sample	G7475-24	<0.01	<1	209	<5	8	<10	266	<10	<5	26	6	8332	<10	<10	<10
29	DIM/11/604	Rock Sample	G7475-25	<0.01	<1	80502	21	985	<10	920	21	100	971	205	289140	53	<10	<10
30	DIM/11/626	Rock Sample	G7475-26	<0.01	<1	31573	<5	70	<10	43107	10	89	677	118	92362	16	<10	<10
31	DIM/11/668	Rock Sample	G7475-27	<0.01	<1	2128	<5	9	<10	659	<10	<5	45	8	4544	<10	<10	<10
32	OREAS 231	CRM	Meas.	-	-	71150	-	116	-	74673	-	44	-	163	80573	18	-	-
33	OREAS 137	CRM	Meas.	-	27	48302	238	-	-	15143	103	29	19	244	96918	-	-	-

Sl. No.	Customer Code	Customer Description	Lab ID	K	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sn	Sr	Te	Ti	Tl	V	W	Zn	Zr
			METHOD	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/059	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051
			UNITS	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)
			DL	100	100	10	10	100	5	50	5	100	10	10	5	10	100	10	10	10	5	20
1	OREAS 231	CRM	Cert.	2880	39000	1390	NA	17500	88	390	13	NA	NA	NA	179	NA	6170	NA	285	NA	113	50
2	OREAS 137	CRM	Cert.	44000	8190	3250	NA	1500	38	890	6730	94200	21	NA	262	NA	1580	NA	78	NA	49200	106
3	DIM/11/201	Rock Sample	G7475-1	7733	30532	949	<10	31645	93	381	28	<100	<10	<10	172	16	3214	<10	153	<10	63	39
4	DIM/11/202	Rock Sample	G7475-2	9252	60492	1290	<10	4989	240	321	7	<100	<10	<10	116	16	3199	<10	179	15	78	51
5	DIM/11/203	Rock Sample	G7475-3	6506	3643	1533	<10	590	100	464	32	<100	<10	<10	<5	23	2672	<10	231	18	52	73
6	DIM/11/204	Rock Sample	G7475-4	113	126213	705	<10	500	778	<50	7	<100	<10	<10	<5	16	643	<10	63	12	58	57
7	DIM/11/205	Rock Sample	G7475-5	804	1325	72	<10	349	20	<50	9	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	<20
8	DIM/11/206	Rock Sample	G7475-6	806	26893	781	<10	33360	67	358	14	<100	<10	<10	290	14	3369	<10	196	<10	61	76
9	DIM/11/207	Rock Sample	G7475-7	2220	389	106	<10	850	8	57	15	<100	<10	<10	<5	<10	166	<10	15	<10	7	35
10	DIM/11/208	Rock Sample	G7475-8	107	155	54	<10	254	8	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	6	<20
11	DIM/11/209	Rock Sample	G7475-9	<100	143	30	<10	<100	7	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	<20
12	DIM/11/210	Rock Sample	G7475-10	310	1118	79	<10	<100	11	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	<20
13	DIM/11/210	Rock Sample	G7475-10	316	1104	77	<10	<100	10	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	<20
14	DIM/11/296	Rock Sample	G7475-11	164	1902	104	<10	221	13	<50	6	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	<20
15	DIM/11/302	Rock Sample	G7475-12	<100	185	89	<10	<100	10	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	<20
16	DIM/11/327	Rock Sample	G7475-13	3985	85037	951	<10	10747	383	330	<5	<100	<10	<10	73	14	2238	<10	144	<10	65	29
17	DIM/11/386	Rock Sample	G7475-14	113	951	49	<10	117	15	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	<20
18	DIM/11/409	Rock Sample	G7475-15	1290	22683	900	<10	22166	60	569	<5	<100	<10	<10	422	16	3046	<10	219	<10	50	57
19	DIM/11/410	Rock Sample	G7475-16	1807	13227	583	<10	21063	41	261	8	<100	<10	<10	700	10	2181	<10	249	<10	54	44
20	DIM/11/424	Rock Sample	G7475-17	238	11447	203	<10	<100	20	512	<5	<100	<10	<10	<5	<10	<100	<10	24	<10	11	<20
21	DIM/11/495	Rock Sample	G7475-18	<100	1895	121	<10	<100	20	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	<20
22	DIM/11/497	Rock Sample	G7475-19	154	427	49	<10	260	7	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	243	<20
23	DIM/11/509	Rock Sample	G7475-20	327	30788	584	<10	1189	111	197	<5	<100	<10	<10	96	<10	1655	<10	103	<10	32	<20
24	DIM/11/509	Rock Sample	G7475-20	310	30940	588	<10	1197	112	204	<5	<100	<10	<10	102	<10	1674	<10	99	<10	33	<20
25	DIM/11/512	Rock Sample	G7475-21	<100	310	49	<10	<100	<5	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	<20
26	DIM/11/557	Rock Sample	G7475-22	105	305	89	<10	<100	10	133	<5	<100	<10	<10	<5	<10	435	<10	24	<10	<5	<20
27	DIM/11/559	Rock Sample	G7475-23	<100	169	58	20	<100	6	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	<20
28	DIM/11/597	Rock Sample	G7475-24	<100	152	84	<10	<100	<5	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	<20
29	DIM/11/604	Rock Sample	G7475-25	1795	965	4107	<10	907	141	833	47	142	<10	<10	<5	55	3287	<10	712	51	87	79
30	DIM/11/626	Rock Sample	G7475-26	167	112258	1185	<10	426	846	378	<5	<100	<10	<10	<5	26	3821	11	112	12	78	53
31	DIM/11/668	Rock Sample	G7475-27	263	1545	43	<10	231	25	<50	<5	<100	<10	<10	<5	<10	<100	<10	<10	<10	<5	12
32	OREAS 231	CRM	Meas.	2873	39098	1406	-	17102	92	395	14	-	-	-	175	-	6112	-	290	-	117	52
33	OREAS 137	CRM	Meas.	44027	8165	3250	-	1571	35	894	6745	94331	23	-	268	-	1581	-	80	-	49569	105

Sl. No.	Customer Code	Customer Description	Lab ID	Au	Ag	Al	As	Ba	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	In	Cs	K	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sn	Sr	Te	Ti	Tl	V	W	Zn	Zr
			METHOD	SOP/OM/058	SOP/OM/059	SOP/OM/051	SOP/OM/059	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/059	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051	SOP/OM/051
			UNITS	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)	ppm(mg/kg)
			LOQ	0.01	1	100	5	5	10	100	5	5	10	5	100	10	10	10	100	100	100	10	100	5	100	5	100	5	50	5	50	100	50	10	50	5	5
1	OREAS 231	CRM	Cert.	NA	NA	71400	NA	112	NA	74700	NA	45	NA	161	80500	16	NA	NA	2880	39000	1390	NA	17500	88	390	13	NA	NA	NA	179	NA	6170	NA	285	NA	113	50
2	OREAS 137	CRM	Cert.	NA	26	48200	236	NA	NA	14700	100	27	20	246	96900	NA	NA	NA	44000	8190	3250	NA	1500	38	890	6730	94200	21	NA	262	NA	1580	NA	78	NA	49200	106
3	DIM-02/G3/01	ROCK Chip	G9366-1	<0.01	<1	4974	<5	15	<10	348	<5	<5	121	27	14819	<10	<10	<10	371	351	<100	<10	<100	30	<100	7	<100	<5	<50	<5	<50	175	<50	16	<50	<5	<5
4	DIM-02/G3/02	ROCK Chip	G9366-2	<0.01	<1	3563	<5	46	<10	206	<5	<5	324	10	12376	<10	<10	<10	134	141	217	<10	<100	21	<100	14	<100	<5	<50	<5	<50	<100	<50	15	<50	9	<5
5	DIM-02/G3/57	ROCK Chip	G9366-3	<0.01	<1	29545	<5	225	<10	32710	<5	18	191	77	24975	12	<10	<10	8986	15670	554	<10	1447	66	391	25	<100	7	<50	85	<50	980	<50	70	<50	34	10
6	DIM-02/G3/82	ROCK Chip	G9366-4	<0.01	<1	1085	<5	7	<10	157	<5	<5	295	<5	8209	<10	<10	<10	173	675	<100	<10	<100	7	<100	<5	<100	<5	<50	<5	<50	<100	<50	10	<50	<5	<5
7	DIM-02/G3/105	ROCK Chip	G9366-5	<0.01	<1	78149	<5	324	<10	65371	<5	23	84	69	47174	25	<10	<10	9354	15140	773	<10	15243	45	285	7	<100	<5	<50	146	<50	2472	<50	142	<50	41	22
8	DIM-02/G3/105 (B	ROCK Chip	G9366-6	<0.01	<1	46342	<5	361	<10	39364	<5	<5	295	<5	14024	38	<10	<10	7763	199	201	<10	2637	5	319	9	<100	11	<50	103	<50	<100	<50	38	<50	9	<5
9	DIM-02/G3/106	ROCK Chip	G9366-7	<0.01	<1	61667	<5	138	<10	50335	<5	26	118	29	42926	17	<10	<10	4819	20276	701	<10	17431	59	280	<5	<100	<5	<50	140	<50	2185	<50	123	<50	45	17
10	DIM-02/G3/157	ROCK Chip	G9366-8	<0.01	<1	101962	<5	123	<10	104045	<5	17	35	14	64651	51	<10	<10	2992	11913	667	<10	22331	32	104	<5	<100	<5	<50	755	<50	1733	<50	292	<50	21	20
11	DIM-02/G3/158	ROCK Chip	G9366-9	<0.01	<1	13313	<5	68	<10	197	<5	32	6128	23	9710	11	<10	<10	5955	2509	122	<10	152	38	<100	<5	<100	54	<50	<5	<50	201	<50	49	<50	58	33
12	DIM-02/G3/166	ROCK Chip	G9366-10	<0.01	<1	67626	20	232	<10	1557	10	23	1950	228	238044	37	<10	<10	3373	1011	449	<10	<100	71	1904	42	<100	21	<50	18	<50	3390	<50	452	<50	39	74
13	DIM-02/G3/166	ROCK Chip	G9366-10	<0.01	<1	66802	21	226	<10	1582	10	21	2082	220	235574	35	<10	<10	3252	1085	445	<10	<100	70	1892	42	<100	21	<50	17	<50	3317	<50	443	<50	44	70
14	DIM-02/G3/176	ROCK Chip	G9366-11	<0.01	<1	1225	<5	<5	<10	361	<5	<5	120	<5	4478	<10	<10	<10	112	<100	<100	<10	574	7	<100	<5	<100	<5	<50	<5	<50	<100	<50	<5	<50	<5	<5
15	DIM-02/G3/181	ROCK Chip	G9366-12	<0.01	<1	69497	<5	195	<10	65546	<5	15	111	34	34550	27	<10	<10	6108	8404	648	<10	9141	25	192	9	<100	<5	<50	142	<50	1318	<50	116	<50	40	16
16	DIM-02/G3/196	ROCK Chip	G9366-13	<0.01	<1	2228	<5	<5	<10	113	<5	<5	161	<5	5380	<10	<10	<10	<100	<100	<100	<10	<100	<5	<100	<5	<100	6	<50	<5	<50	<100	<50	7	<50	7	<5
17	DIM-02/G3/215	ROCK Chip	G9366-14	<0.01	<1	37482	31	602	<10	447	9	56	972	116	191547	32	<10	<10	2837	801	2741	<10	241	84	1723	43	<100	18	<50	11	<50	2074	<50	380	<50	53	41
18	DIM-02/G3/220	ROCK Chip	G9366-15	<0.01	<1	2204	<5	7	<10	<100	<5	<5	126	<5	5014	<10	<10	<10	<100	<100	<100	<10	<100	<5	<100	<5	<100	<5	<50	<5	<50	<100	<50	7	<50	<5	<5
19	DIM-02/G3/238	ROCK Chip	G9366-16	<0.01	<1	60563	7	57	12	246	17	34	222	170	423554	45	<10	<10	542	305	355	<10	<100	260	1676	28	<100	27	<50	<5	67	3457	<50	454	81	134	46
20	DIM-02/G3/245	ROCK Chip	G9366-17	<0.01	<1	4061	<5	21	<10	5315	<5	<5	109	17	6704	<10	<10	<10	692	668	<100	<10	<100	8	1155	<5	<100	<5	<50	16	<50	134	<50	16	<50	<5	<5
21	DIM-02/G3/247	ROCK Chip	G9366-18	<0.01	<1	1546	<5	13	<10	<100	<5	<5	53	<5	3358	<10	<10	<10	804	153	<100	<10	<100	<5	<100	<5	<100	5	<50	<5	<50	<100	<50	<5	<50	<5	<5
22	DIM-02/G3/261	ROCK Chip	G9366-19	<0.01	<1	93120	24	335	<10	1037	14	26	1084	255	323030	61	<10	<10	2135	786	1251	<10	166	81	1883	52	<100	27	<50	16	60	4774	<50	763	<50	61	59
23	DIM-02/G3/299	ROCK Chip	G9366-20	<0.01	<1	745	<5	9	<10	<100	<5	<5	55	<5	5177	<10	<10	<10	<100	<100	<100	<10	<100	<5	<100	<5	<100	<5	<50	<5	<50	<100	<50	<5	<50	<5	<5
24	DIM-02/G3/299	ROCK Chip	G9366-20	<0.01	<1	738	<5	10	<10	<100	<5	<5	53	<5	5203	<10	<10	<10	<100	<100	<100	<10	<100	<5	<100	<5	<100	<5	<50	<5	<50	<100	<50	<5	<50	<5	<5
25	DIM-02/G3/309	ROCK Chip	G9366-21	<0.01	<1	75093	10	208	<10	305	17	25	1299	99	413599	70	<10	<10	1069	394	640	<10	<100	153	935	38	<100	47	<50	8	55	2595	<50	887	81	80	101
26	DIM-02/G3/310	ROCK Chip	G9366-22	<0.01	<1	39086	<5	55	<10	178	<5	5	357	19	110563	21	<10	<10	911	197	127	<10	<100	67	366	6	<100	14	<50	<5	<50	1581	<50	216	<50	11	51
27	DIM-02/G3/313	ROCK Chip	G9366-23	<0.01	<1	105400	15	117	<10	290	14	12	1377	55	333832	77	<10	<10	745	294	559	<10	<100	79	1013	24	<100	24	<50	8	56	3778	<50	698	59	39	163
28	DIM-02/G3/330	ROCK Chip	G9366-24	<0.01	4	40437	<5	540	<10	2349	20	18	443	64	482783	35	<10	<10	1162	1977	66000	<10	211	41	440	36	<100	29	<50	32	65	1413	<50	277	95	21	78
29	DIM-02/G3/361	ROCK Chip	G9366-25	<0.01	<1	1388	<5	20	<10	168	<5	<5	125	6	9330	<10	<10	<10	199	286	171	<10	<100	7	<100	<5	<100	6	<50	<5	<50	<100	<50	12	<50	<5	<5
30	DIM-02/G3/318	ROCK Chip	G9366-26	<0.01	<1	91843	14	4037	<10	567	13	257	1114	308	327451	56	<10	<10	1249	519	14791	<10	2163	152	1378	144	<100	20	<50	14	<50	4090	<50	777	75	122	56
31	DIM-02/G3/294	ROCK Chip	G9366-27	<0.01	<1	113167	18	847	<10	331	13	89	987	112	319101	55	<10	<10	586	312	4285	<10	377	102	504	225	<100	41	<50	13	51	3628	<50	846	58	62	71
32	OREAS 231	CRM	Meas.	-	-	71072	-	114	-	74763	-	47	-	160	80306	18	-	-	2899	39500	1355	-	17309	87	397	15	-	-	-	182	-	6139	-	291	-	116	51
33	OREAS 137	CRM	Meas.	-	28	48380	234	-	-	14467	103	30	19	245	97442	-	-	-	44974	8273	3319	-	1520	40	896	6774	94568	24	-	267	-	1556	-	75	-	49786	108