
**Report on Reconnaissance Survey
(G4 Stage)
for Base metal, Gold and associated
minerals in and around
Nagavanda area, Davangere,
Haveri & Shivamogga Districts, Karnataka.
(Block ID : KIOCL_34_KA_NGGB)**



KIOCL Ltd

Notified Exploration Agency

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(G4 Stage) for Basemetal, Gold and associated
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(Block ID : KIOCL_34_KA_NGBB)

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1. Summary

In accordance with the recommendations of 50th meeting of Technical cum Cost Committee (TCC) of National Mineral Exploration Trust (NMET) and 28th meeting of Executive Committee (EC), vide sanction order no. F.No 23/329/2023-NMET/413 Dtd 27th March 2023, G4 level of mineral exploration works of Nagavanda basmetal block is awarded to KIOCL. The objective of the investigation is to target and delineate, the potential zones of gold, basemetal and graphite mineralisation in carbonaceous phyllite and banded ferruginous chert.

An area of around 63.3 sqkm was carved out. The block is bounded on the north western corner by Medur to the south eastern corner Somannanamallapura to the south west Maravalli south central part Kaginehalli and on the north Hosakatti. Large Scale geological mapping is to delineate the potential zones for gold, copper and associated mineralisation and fixed carbon content based on analytical results of different media of samples. The area mapped forms southern part of Shivamogga schist belt and examined in and around Nagavanda and south of Medur area. The study area forms part of Western Dharwar Craton (WDC) having complex geological set up of Joldhal, Medur and Ranibennur formation's. During prefield studies, samples collected over the old pits and dumps showing malachite stains and stringers of quartz containing chalcopyrite and bornite minerals.

The current area reveals litho packages of three major formations of Shivamogga Schist Belt i.e. Joldhal, Medur and Ranibennur formations with its detail stratigraphic assemblage. The three formations are differentiated on the basis of physical characteristics, geographical region and stratigraphic position. Joldhal formation consist of phyllites (ferruginous and carbonaceous), chlorite schist, quartzite, cherts, banded ferruginous cherts, and meta volcanics represented by metabasalt. Medur formation represent the meta-andesite and the Ranibennur formation occurring at the southern part of the mapped area characterised by greywacke-argillites, banded ferruginous chert and metabasalt. The contacts between different lithologies and formations are gradational and continuous. All the lithounits are trending along WNW-ESE to NW to SE with dip towards north east. The area has suffered lower greenschist to lower amphibolite grade of metamorphism. Litho assemblage has suffered three phases of deformation and produced various types of isoclinal, concentric folds, schistosity, crenulation cleavages etc.

During mapping the carbonaceous phyllite was traced and delineated for more than 2.5 km in strike length with width varying from 145m to more than 350m extending along N 55° - 70° W to S 55° - 70° E. Sampling was carried out at close spaced intervals as far as possible across the width and strike in the outcrops and in trenches.

To understand the mineral potential of the area, samples were collected across all the lithounits at closed spaced intervals and importance was given to carbonaceous phyllite (*previous studies by DMG. Kar 1961 and 1994*) and banded ferruginous formations (*GSI has located many potential zones for gold in other areas over the schist belt*). 124 nos of Bed rock samples (BRS), 30 nos of Stream sediment samples, 100 cum of trenching works and 326 m of core drilling works with 2 scout boreholes were drilled. The collected samples are analysed for 7 radicals (Cu, As, Pb, Ag, Sn, Au and Bi) and the analytical results are not encouraging for basemetal, gold and fixed carbon content. The yielded results for gold and basemetal elements are in ppb/ below detection limit/ ppm levels and the fixed carbon content is below 2%.

The Bed Rock Samples (BRS) collected over banded ferruginous chert has indicated Manganese and Iron mineralisation, moderately significant over a small areal extent with Mn value varying from 15% to 32% and Fe 37% to 61% over a strike length of 300m with average width of 35m. The area is falling inside the reserve forest land. Hence, no subsurface activities for establishing Fe and Mn were carried out. The possibility of continuation of the Fe and Mn mineralization in this zone can not be ruled out.

Based on the analytical results it is concluded that Carbonaceous phyllite band is not potential for gold, Basemetal and Graphite mineralisation and further work is not recommended.

2. Introduction

For India, Gold and Copper are considered strategic and critical minerals because of their essential roles in the nation's economic development and defence capabilities. In the current scenario these minerals plays a vital role in various industries, including infrastructure, construction, electronics, and renewable energy. Globally copper becomes much more critical than any other mineral because of its huge role played in making of lithium batteries for electric vehicles. Net zero emissions by 2050 by various countries including India, critical minerals such as copper, lithium, nickel, cobalt and rare earth elements are essential components of many of today's rapidly growing energy technologies. Pursuing domestic

exploration and production of copper is crucial for the country and to reduce dependence on imports to meet the ever-growing demand. The below table shows the copper production in the country for the years 2017 to 2021-22 (*Ministry of Mines - Source: ICSG press release dated 7.10.21, 20.10.2021 & 20.12.21 – Copper: International Copper Study Group (ICSG) World Copper Fact book 2021*).

Table 1: Details of Copper production in the country

Sl	Company	Refined Copper Production Capacity (Tonne)	Type of Copper Producer	Location	Actual Production (Tonne)				
					2017-18	2018-19	2019-20	2020-21	2021-22
1	HCL	68,500	CPSE (integrated producer)	Ghatsila, Jharkhand & Jhagadia, Gujarat	25,949	16,215	5,340	Nil	620.7
2	Birla	5,00,000	Private (Port based custom smelter)	Dahej, Gujarat	4,13,806	3,47,000	3,25,568	2,62,203	3,58,890
3	Sterlite	4,60,000	Private (Port based custom smelter)	Tuticorin, Tamilnadu & Silvasa, Daman and Diu	4,03,206	90,000	77,490	1,01,435	1,25,104
Total		10,28,500			8,42,961	4,53,215	4,08,398	3,63,638	4,84,614.7

Similarly gold production in the country is also reduced drastically and India is dependent on imports to an extent of 802.8 tonnes in 2024. The total gold demand value went up by 31% at ₹5,15,390 crore in 2024, compared to ₹3,92,000 crores in 2023 (*Source: The Hindu 5th February 2025*). Details of gold production in India is provided in the below table.

Table 2: Details of Gold production in India as per Indian Minerals Yearbook 2020

Production of Gold Ore 2018-19 and 2019-20 (By States)						
(In tonnes)						
	2018-19		2019-20 (P)			
State	Ore Produced	Avg. Grade (g/t)	Ore Produced	Avg. Grade (g/t)		
India	565653	3.41	591251	3.78		
Jharkhand	2134	1.48	-	-		
Karnataka	563519	3.42	591251	3.78		
Gold Ore Treated 2018-19 and 2019-20 (By States)						
(In tonnes)						
	2018-19		2019-20 (P)			
State	Ore Treated	Avg. Grade (g/t)	Ore Treated	Avg. Grade (g/t)		
India	589499	2.84	638702	2.99		
Jharkhand	2134	1.48	-	-		
Karnataka	587365	2.85	638702	2.99		
Production of Gold, 2017-18 to 2019-20 (By States)						
(Quantity in kg. Value in ₹' 000)						
	2017-18		2018-19		2019-20 (P)	
State	Quantity	Value	Quantity	Value	Quantity	Value
India	1650	4770022	1664	5241705	1724	6431034
Primary Gold	1650	4770022	1664	5241705	1724	6431034
Jharkhand	11	31952	3	7897	-	-
Karnataka	1639	4738070	1661	5233808	1724	6431034

Source: Indian Minerals Yearbook 2020 (Part- II: Metals and Alloys)

2.1 Details of project

An area of 63.3 sq. km was carved out in the Shivamogga schist belt around Nagavanda in Davanagere, Haveri and Shivamogga districts, Karnataka for exploration based on the previous studies and reported occurrence of copper mineralisation in the carbonaceous phyllite.

2.2 Investigating agency

M/s KIOCL Limited

(A Govt. of India Enterprise under Ministry of Steel, GoI),

Block II, Koramangala, Sarjapura Road,

Bengaluru 560 034, Karnataka-India, Website: www.kioclltd.in

Notified Exploration Agency under Second provision of Sub Section (1) of Section-4 of the Mines and Minerals (Development and Regulation) Act 1957 vide Ministry of Mines (MoM), Govt of India notification no. 16/08/2015-MVI dated 16.02.2015,

Represented by:

The Director (Production and Projects)

KIOCL Limited, Bengaluru 560 034, Karnataka-India

e-Mail: dpp@kioclltd.in; bmed@kioclltd.in;

2.3 Objectives of investigation

The investigation for targeting Copper and Gold mineralisation in and around Nagavanda area was taken up with an objective to arrive at a broad appraisal in carbonaceous phyllite and banded ferruginous chert. The previous studies have indicated the presence of carbonaceous phyllite hosting Cu and Au mineralisation over an area of 200m around Nagavanda. The area of investigation, exposes both the meta-sedimentary (chemogenic) and meta-volcanic rocks of Shivamogga schist belt. Work component consists of

- Large-scale geological mapping, sampling and systematic search on surface examination for any indications / manifestation of mineralisation.
- To study the nature of mineralisation, controls etc. by way of trenching to expose the country rock.

2.4 Basis for taking up investigation

As discussed earlier, copper and gold are critical minerals for India in the wake of current economic and use in the electric vehicle batteries.

The basis for taking up the reconnaissance survey is the work of DMG, Karnataka which were carried out in 1994. It was reported that the carbonaceous phyllite and banded ferruginous chert of the green stone belt are potential for these minerals. Details of the works carried out in the area are provided in Chapter no 4.4 of this document.

2.5 Details and nature and quantum of work proposed vs achievement

Details of the works executed against the NMET approved is provided below;

Table 3: Details and nature and quantum of work proposed vs achievement

Sl	Work Components		Units	Quantities						
				WO	Executed	Mode of execution				
	(a)		(b)	(c)	(d)	(e)				
1	Interpretation of Aero geophysical and NGPM data		No's	1	1	Inhouse (NGPM data available in NGDR portal is utilized for interpretation)				
2	Large Geological Mapping in 1:12,500 scale		sqkm	63.3	63.3	Inhouse				
3	Bed Rock samples		nos	100	76	Inhouse				
4	Stream Sediment Samples		nos	35	30	Inhouse				
5	Pit / Trench sampling		cum	100	100	Inhouse				
6	Drilling		m	500	326	Out sourcing				
7	Detailed core / sample logging including supply of core / sample boxes		m	140	326	Inhouse				
8	DGPS Survey of borehole points		nos	5	2	Inhouse				
9	Sample analysis (7 radicals)	Primary Analysis for 7 radicals	BRS	nos	100	335	27	27	Prefeasibility study samples for 1 radical (Outsourced to IBM)	
							46	168		Out sourced to MECL
							3			Inhouse
10			Trench samples	nos	100		23			Inhouse
11			Drill Core	nos	100		66			Inhouse
12			Stream Sediment Samples	nos	35			30		Inhouse
13		Internal Check sample analysis for 7 radicals (5%)	BRS	nos	5	17	4	10	Inhouse	
14			Trench samples	nos	5					2
15			Drill Core	nos	7					4
16		BRS	nos	10	34	7	17			

		External Check sample analysis for 7 radicals (10%)	Trench samples	nos	10		3		Out sourcing- Shiva analytical lab
			Drill Core	nos	14		7		
17			BRS	nos			16		Outsourcing- HGML
18			Trench samples	nos			0		-
19			Drill Core	nos			10		Outsourcing- Shiva analytical lab
20			BRS	nos			0		
21			Trench samples	nos			0		-
22			Drill Core	nos			0		
23			BRS	nos			0		
24			Trench samples	nos			0		
25			Drill Core	nos			10		
26	Proximate analysis of Graphite			nos	20		24		Inhouse (20 nos) & Outsourcing (4 nos- MECL)
27		Preparation of Standard Thin sections	nos	10			10		
28		Complete petrological report of rock samples	nos	10			10		Outsourcing – IIT, Bombay
29		Preparation of Polished thin sections	nos	10			10		
30		Mineragraphic studies	nos	10			10		
31	Geological report preparation			nos	1		1		Inhouse

Vide sanction order Dtd. 27th Mar 2023, the project is approved with project duration of 12 months. Chronology of events of the works executed are provided below.

Table 4: Chronology of events

Sl.	Details of Work	Timeline	
		Approved	Executed
1	Camp setting	Apr 2023	Apr 2023
2	Large Scale Geological Mapping works with collection of BRS and Stream sediments (3 months)	May - July 2023 (3 months)	<ul style="list-style-type: none"> ➤ Vide letter Dtd 12.04.2023, KIOCL has placed request to DCF, Haveri, Karnataka for providing permissions for undertaking mapping works in Kaginahalli and Madenahalli Reserve forest.. ➤ LSM works along with collection of BRS and SSS in revenue land was executed from May to July 2023 (3 months). ➤ Vide letter Dtd June 2023, DCF, Haveri has provided permissions to KIOCL for undertaking mapping works in Kaginahalli and Madenahalli Reserve forest area.

			<ul style="list-style-type: none"> ➤ LSM works with collection of BRS in reserve forest area was carried out from July to September 2023 (3 months). ➤ Sample analysis works of BRS and SSS were carried out from May to September 2023 (Parallel activity). ➤ 59th meeting of TCC- NMET held on 29th November 2023 reviewed the project status.
3	Detailed mapping (1:4,000 scale)	-	<ul style="list-style-type: none"> ➤ Detailed mapping works of carbonaceous phyllite zone situated in forest area along with Trenching works in revenue land are executed from Nov to Dec 2023. ➤ 60th meeting of TCC- NMET meeting held on 28th Dec 2023, reviewed LSM and DM works executed by KIOCL and suggested to carryout drilling with 2 boreholes.
4	Forest Clearance for carrying out subsurface activities (Trenching and Drilling) in forest land	-	<ul style="list-style-type: none"> ➤ Vide letter Dtd. 12th Jan 2024 KIOCL has placed request to PCCF Bangalore for carrying out 04 nos of boreholes and 04 nos of trenching works in reserve forests of Hirekeruru (Tq), Haveri(Dist), Karnataka. ➤ 63rd meeting of TCC- NMET held on 27th March, 2024 extended the project duration up to 30th June 2024. ➤ 66th meeting of TCC- NMET held on 26th June 2024 extended project duration up to 31st Dec 2024. ➤ Vide letter Dtd. 22.01.2025, DRFO, Hirekerur provided permissions to KIOCL for initiating drilling and trenching works. ➤ 73rd meeting of TCC- NMET held on 31st January 2025 extended project duration up to 31st May 2025.
5	Trenching and Core drilling works in Reserve forest area	-	<ul style="list-style-type: none"> ➤ Trenching and core drilling works were carried out from January to March 2025. ➤ DGPS survey works of borehole points was executed during April 2025. ➤ PTS studies was carried out at IIT, Bombay from April to May 2025. ➤ 75th meeting of TCC- NMET held on 28th Mar 2025 reviewed the project.
6	Sample analysis works of trenches and borehole samples	-	<ul style="list-style-type: none"> ➤ Camp winding up during April 2025. ➤ Sample analysis works of trenches and borehole samples were carried out from March to April 2025. ➤ 77th meeting of TCC- NMET held on 26th May 2025 reviewed the project and extended project timeline up to 26th July 2025 for submission of Geological Report.
7	Synthesis and collation of all the data, drafting of Report and finalisation of the Report along with Peer review	-	<ul style="list-style-type: none"> ➤ May – July 2025

2.6 Personal involved

Details of the KIOCL's officials involved in the project are provided below;

Table 5: Details of Personnel involved in execution of works.

Sl.	NAME (S/Sri)	EXPERIENCE
1	Shiva Kumar M, Assistant General Manager (ME)	>23 years in mining and mineral management.
2	D Mohan raj, Rtd ADG GSI Consultant (ME)	>33 years in Geological mapping and mineral exploration in GSI
3	Palani Murugan A, Sr. Manager (ME)	>20 years in mining and mineral management.
4	Ramakrishna Konari, Sr.Manager(ME), <i>Project In-Charge</i>	>20 years in mining and mineral management.
5	Dnyaneshwar Gaonkar Dy.Manager(Geo)	>12 years of experience in Mineral Exploration.
6	Dr Hema Geologist	>05 years of experience in Mineral Exploration and GIS platform
7	Vipin Kumar Asst Geologist	>05 years of experience in Mineral Exploration.
8	Sharath K Asst Geologist	>05 years of experience in Mineral Exploration.
9	Narayana T Deputy Manager (Survey)	>05 Years of Experience in Mine Surveying.
10	Kotresh Asst Surveyor	>01 years of experience in Surveying.

2.7 Mode of operation of different work components and associated agency

Details of works along with mode of operations are provided in table no 3.

3. Property description

3.1 Location

The proposed area is falling in parts of Sol toposheet nos. 48N/07 and 48N/11. The block is located 63 Km towards South from Haveri District, 20 Km from Hirekerur and 313 Km from State capital Bangalore. Shikarpur, Ranibennur, Davanagere, Shivamogga are the nearby cities to the block.

The study area is accessible via National Highway 4 (NH4) up to Harihar followed by State Highway 57 (SH 57), or alternatively through NH 69. Metal and mud roads provide access to

the interior areas. The nearest airport is in Hubli which is approximately 150 km away from the block.

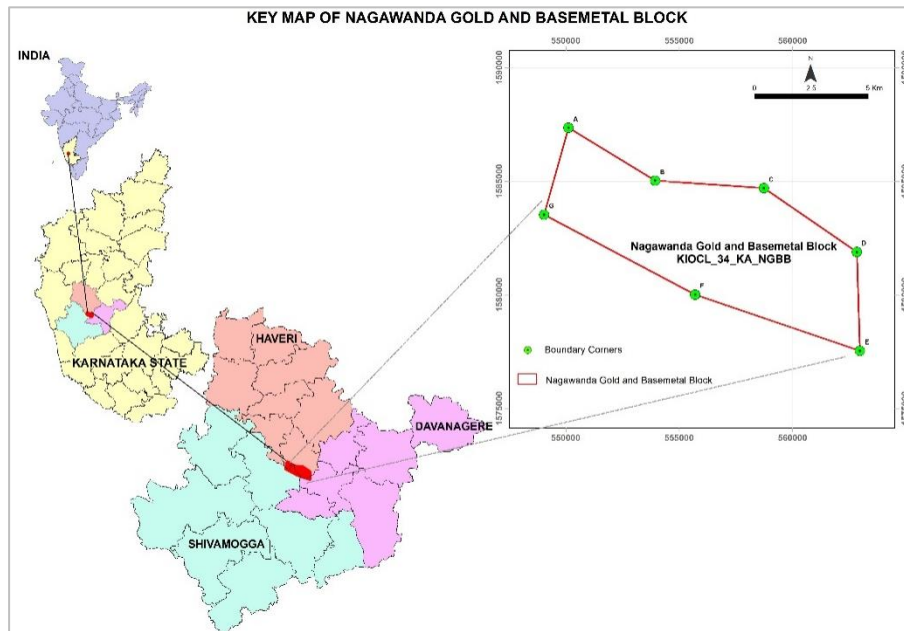


Figure 1: Key Map

The schematic diagram of the block demarcated on the District / State / India map is presented in above figure and enclosed as Plate 01 (Key Map).

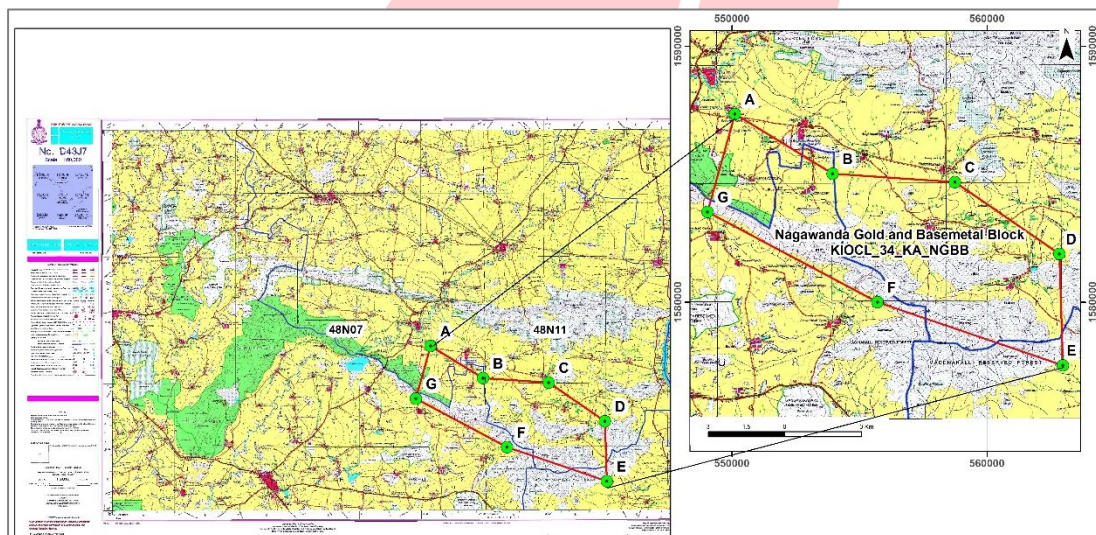


Figure 2: The Block demarcated and shown on Sol TS No. 48N07 & 48N11

Block lies between the southeastern part of the Survey of India (SoI) toposheet No. 48N07 and South western part of 48N11. The Block boundary marked on SoI toposheet of 1:50,000 scale is provided in the above figure and enclosed as Plate 02 (Topo Map).

3.2 Geo-coordinate with the corner points of the investigated area

Geo – coordinates with the corner points of the block measured using handheld GPS unit is provided below;

Table 6: Geo-Coordinates of Boundary Points of the Block (Handheld GPS unit)

Point ID	Northing	Easting	Longitude	Latitude
A	1587357	550123	75° 27' 53.500" E	14° 21' 28.370" N
B	1585028	553946	75° 30' 1.000" E	14° 20' 12.300" N
C	1584698	558737	75° 32' 40.900" E	14° 20' 1.200" N
D	1581894	562827	75° 34' 57.200" E	14° 18' 29.620" N
E	1577541	562959	75° 35' 1.260" E	14° 16' 7.910" N
F	1580014	555702	75° 30' 59.250" E	14° 17' 28.960" N
G	1583534	549051	75° 27' 17.480" E	14° 19' 24.010" N

3.3 Land use pattern

The block area forms the part of a hill range trending NW to SE, predominantly covered by Madehalli and Kaginahalli Reserved Forest on its southern side and also smaller forest cover to the south of Nagavanda NE of Guddadamadapur. Approximately 39% of the block, spanning 24.65 Sq. Km, is with the forest land. Diagram indicating forest area and revenue/ patta land is provided below;

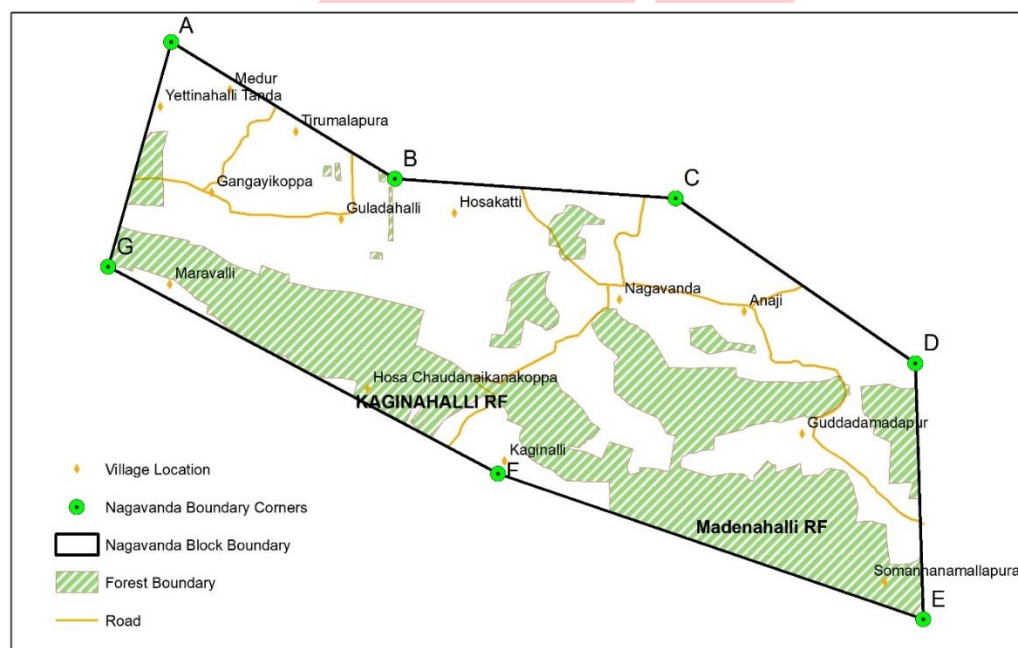


Figure 3: Land use pattern of the Block Google Imagery

3.4 Hydrology of the area

A number of small streams draining the area forms the tributaries to the Kumudvati River located 1.2 km northeast, flowing along northeast direction. The area also features several scattered ponds wet during rainy season and dry during summer.

3.5 Drainage pattern

The block has a non-perennial nature, with seasonal water channels draining into the Kumudvati river during the monsoon season. The terrain's natural slope facilitates rainwater drainage, forming a dendritic drainage network with a maximum stream order of 4, notably in the northeastern corner. Figure indicating the drainage pattern of the block is provided below;

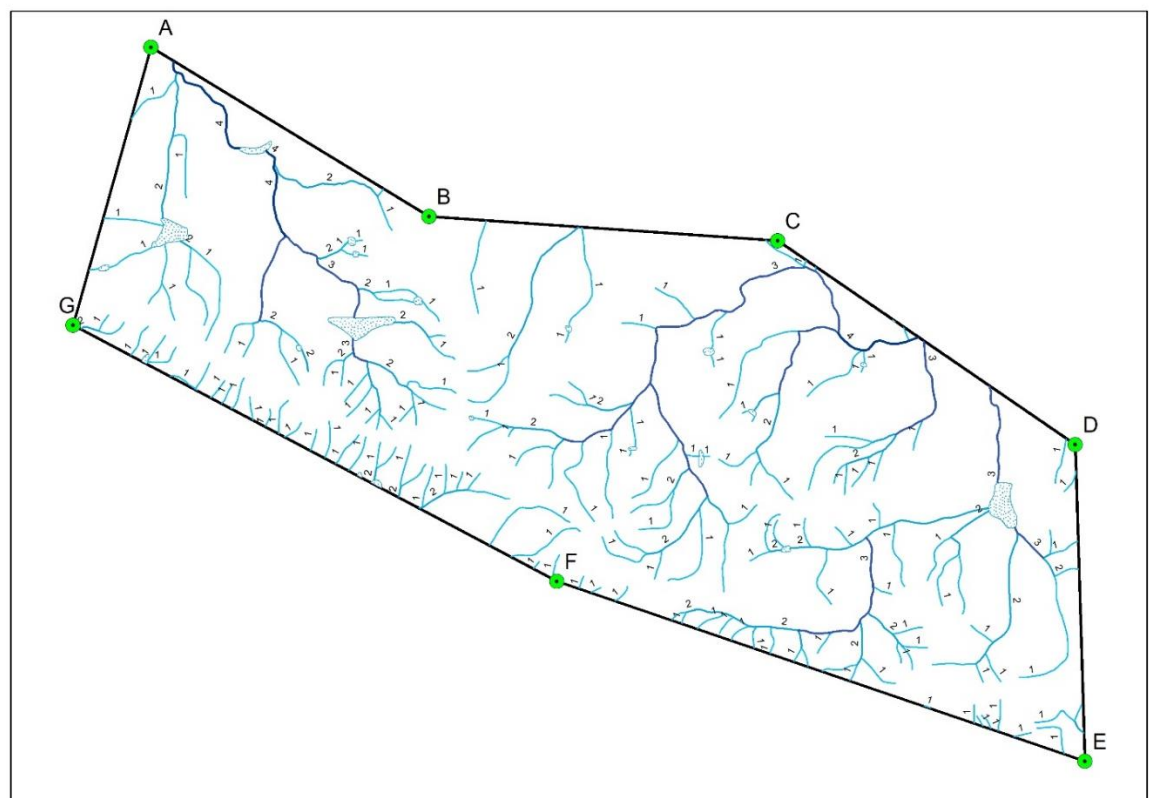


Figure 4: Drainage pattern in NGBB block

3.6 Accessibility

The study area can be approached from Shikaripura town which is 32 km away. The nearest railway station is Kumsi Railway Station connecting Shivamogga and Bangalore. The closest airport to the area is Hubli Airport, which is about 161 km from Shikaripura. The nearest

international airport is Mangaluru International Airport, which is about 210 km from the block.

Nagavanda is the village situated at the centre of the block. The district head quarter Haveri is located 63 km to the south, 20km from Hirekerur and 313 km from state capital Bangalore.

The study area is accessible via National Highway 4 (NH4) up to Harihar, followed by State Highway 57 (SH 57), or alternatively through NH 69. Metal and mud roads provide access to the interior areas. Harihar railway station is 48Km away and the nearest airport is in Hubli, approximately 150Km away.

The villages Anaji, Gangayikoppa, Guddadamadapur, Guladahalli, Hosa Chaudanaikanakoppa, Hosakatti, Kaginghalli, Maravalli, Medur, Nagavanda, Somannanamallapura, Tirumalapura, Yettinahalli Tanda are within and near the study area.

3.7 Climate

Davangere, Haveri & Shivamogga districts located almost in the centre of Karnataka state has a tropical wet and dry climate, characterized by distinct dry and wet seasons. The northwest monsoon breaks in the 2nd week of June and continued up to the end of September, most of the rainfall occurs during this period. The summer sets in from March to May and the warmest months being April and May where the temperature goes up to 40°C. The Winter period from November to February and driest months are January and February. The average annual rainfall is 819.36 mm. The average temperature in April for a typical day range from a high of 100°F (38°C) to a low of 72°F (22°C). High precipitation occurs in July where a typical day has a 76% chance of precipitation and gets 0.03 in (0.7 mm) of precipitation, while the driest month is February where a typical day has a 1% chance of precipitation and gets 0.03 in (0.8 mm) of precipitation.

The summary of the meteorological data at IMD, Ballari is given below:

Table 7: Summary of Meteorological Data Observed at IMD (1991–2020)

Sl. No.	Parameters	Davangere Value	Haveri Value	Shivamogga Value
1	Average Daily Max. Temperature	31.4 °C	31.0 °C	32.0
2	Average Daily Min. Temperature	18.5°C	19.4°C	19.6
3	Average Relative Humidity %	56 %	64.3 %	57
4	Average Annual Rainfall (mm)	753	822.1	882.3

3.8 Rainfall data

Annual rainfall in the block varies from 1.2 mm to 819 mm. Rainfall is mostly (62.30%) confined to the period from June to September during south west monsoon and during north east monsoon (October to November) 22.07 % of the annual rainfall is received and another 16.0 % of rainfall occurs as sporadic in balance months of the year.

3.9 Flora and Fauna

The study area forms a part of the forests division is characterized by a variety of flora and fauna. Madenahalli and Kaginahalli are reserve forest area, likely refers to areas within the Shivamogga Forest Division, which is part of the Shivamogga Circle within the Karnataka Forest Department. The Shivamogga Forest Division covers parts of Shivamogga and Tirthahalli taluks, encompassing various forest types, including evergreen, semi-evergreen, and dry deciduous forests.

The block is situated 30 km away from protected areas like the Ranibennur Blackbuck Sanctuary and Bankapura Peacock sanctuary of Haveri District. Ranbenuur Blackbuck Sanctuary was primarily created to protect the majestic Blackbuck antelope, spread over an area of around 119 sq. km, it has a core area of 14.87 km and a buffer zone of 104.13 km. The vegetation here comprises mainly of scrub forests and eucalyptus plantations. Apart from the Blackbuck, the Sanctuary also has Wolf, Wild Pig, Hyena, Fox, Jackal, Langur, Porcupine, Common Mongoose, Hare and Pangolin. The Sanctuary has witnessed a steady rise in the Blackbuck population since its inception. It is also home to the critically endangered bird 'the Great Indian Bustard'. Other available fauna of this Sanctuary includes Peafowl, Sirkeer Cuckoo, Large Grey Babbler, Baybacked Shrike, Black Drongo, Grey Partridge, Sand Grouse and many others. Bankapura Peacock Sanctuary is the second prominent sanctuary for the preservation and breeding of peacocks in Karnataka. The other one being at Adichinchunagiri. It is situated within the Bankapura Fort and the moat around the fort has become an ideal habitat for peafowls and peacocks. It is estimated that around 1000 peacocks are there in the sanctuary. It also has other birds like Woodpecker, Owls, Magpie, Robin, Green Bee Eater, Paradise Flycatcher, Spotted Dove, Parakeet, Kingfisher, Grey Hornbill, etc.

3.10 Geomorphology

The southern part of the block is characterised by the structural hills covered by Madenahalli and Kaginahalli Reserved Forest which runs in an east west direction. The hill ranges around

this forest area have a maximum elevation of 860m, followed by troughs on either side. The central part of the block is made up of smaller hill mounds with elevation of 805m to 684m. North western part of the block is characterized by shallow weathered pediplane.

The area of the block is having an undulating topography with linear to curvilinear ridges of banded ferruginous chert in the southern and central part of the area. The remaining area forms plain country with undulating topography. The highest elevation observed over the linear ridges is 860m above MSL and varies up to MSL 684m. The lowest elevation point is 596m above MSL.

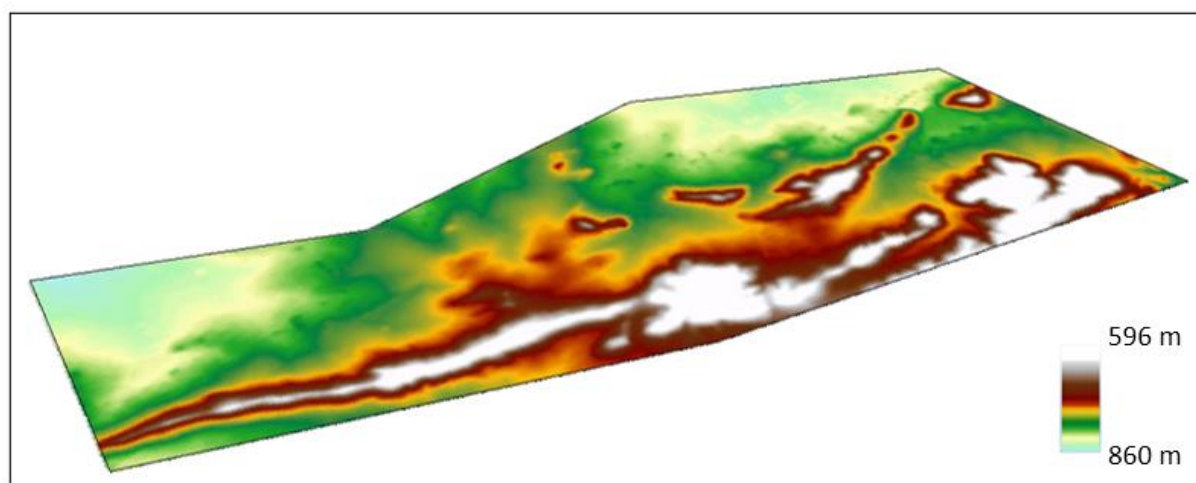


Figure 5: 3D Perspective View Digital Elevation Model (DEM) of the block

3.11 Local infrastructure

Numerous educational and medical facilities can be found in the Haveri district. There are many schools, and in some places, the student enrollment rate is 137%, which suggests that education is highly valued. The district offers a wide range of healthcare services to the public through its 67 Primary Health Centers, 5 Community Health Centers, 132 Allopathic Hospitals, 16 Ayurvedic Hospitals, and 54 Private Hospitals. There are four polytechnic colleges, two engineering colleges, one medical college, and 69 ordinary colleges in terms of higher education. Notable educational institutions that provide a wide range of academic programs and opportunities for students include PVS Institute of Paramedical Sciences, Ranebennur, JESS Sri Kumareswar Education College, Hangal, B.R. Tambakad Arts, Commerce and Science College, Hirekerur, S.T.J Institute of Technology, Ranebennur, and Government Engineering College, Haveri.

Table 8: Demographic Profile of villages in the block

Sl	Village	Population
1	Anaji	2543
2	Gangayikoppa	807
3	Guddadamadapur	2023
4	Guladahalli	1,586
5	Hosa Chaudanaikanakoppa	887
6	Hosakatti	2172
7	Kaginalli	2,277
8	Maravalli	2,219
9	Medur	3900
10	Nagavanda	2975
11	Somannanamallapura	798
12	Tirumalapura	-
13	Yettinahalli Tanda	963

3.14 Archaeological/Historical sites

There are no archaeological/ historical sites within the block or in immediate surroundings.

3.15 National parks/ environments

The block is situated around 30 km away from protected areas like the Ranibennur Blackbuck Sanctuary and Bankapura Peacock Sanctuary of Haveri District.

4. Previous work

Dharwar craton has been extensively studied geologically, and explored for economically viable deposits of iron and manganese ore as early as 1840's as commissioned by various authorities.

4.1 Geological mapping and Mineral exploration work carried out by Geological Survey of India (GSI)

Bruce Foote (1900) brief reference to the schistose rocks of Harihar, Malebennur, Honnali, Shikaripur and Tarikere areas. He described the granitoids of Honnali, Shivamogga and Tarikere valley as inliers of Archaean basement within Dharwar System.

Slater (1904) reported the occurrence of quartz porphyry or pseudo greywacke in the northeastern part of Sorab taluk a few kms northeast of Shiralkoppa. He emphasised that they

presented the appearance of an accumulation of sub- angular fragments of several types of intermediate felspathic lava.

Jayaram (1915) examined a large portion of Shivamogga schist belt. He considered all the rocks to be massive and schistose igneous rocks of volcanic and plutonic origin, ranging from basic to acid composition. He did not rule out the sedimentary intercalations but their quantity was negligible.

Rama Rao (1935) while examining some of the parts of Shivamogga schist belt, he discovered at numerous places unmistakable signs of current bedding and ripple marks in Dharwar quartzites.

Reconnaissance survey around Masur by *Chennabasappa (1951)* shows the existence of pockets and lenses of yellow ochre, resulted from the prolonged weathering of hematite-phyllites and hematite-rich ferruginous quartzites. Between the 7/4 and 7/5 milestones on the Shikarpur-Masur Road, a few pockets and lenses of yellow ochre varying in size from a few feet to a maximum of 25 feet across are noticed. The pockets and lenses of ochre are very small in size and are only seen on either side of the narrow valley, between the hillocks Δ 2717 and Δ 2502.

Sastry (1954) mapped the adjoining area falling in toposheet 48-N/8. He observed that chlorite schists present adjacent to gneiss were felspathised, hence he considered the gneisses are younger to schists.

Narayana Murthy (1961) reported the occurrences of massive, grey, fine grained calc-chlorite schists in the south western part of the area around Shikaripur. The exposure of grey fine grained phyllites in the canal excavations near Amptekoppa and Appanahalli have also been reported by him. He observed chlorite schists and phyllites with banded haematite quartzite in the area.

Pushkar Singh (1973) has carried out preliminary geochemical survey and geological mapping in the area due to inaccessibility in the Kudurikonda and palavanahalli area, where a series of old workings for gold has been noted. The area has investigated for gold mineralisation, the Haveri gold occurrences examined by M/s John Taylor and Sons earlier. The same area was investigated by geological mapping, surface sampling and examination of old workings. The

gold mineralisation in this area is found along the contact zone between banded magnetite-quartzite and chlorite – schist.

Rajan (1979) mapped the area and found that the rock formations comprise meta-volcanics, cherty banded haematite quartzites overlain by a thick sequence of greywacke interbedded with banded haematite quartzites phyllites and shales. The rocks have been subjected to a low-grade metamorphism of green schist facies. The cherty banded haematite quartzites, south of Indavalli, have been folded in to a microscopic antiform, the eastern limb of which parasitic has folded on macroscopic and mesoscopic scales.

The area studied by the *Thakkar (1979)*, constitutes a part of the Dharwar-Shivamogga schist belt of the Dharwar Supergroup and comprises a sequence of volcano-sedimentary rocks. The volcanics are represented by meta-andesite, meta-basalt, meta dacite, the sedimentaries are represented by quartz-chlorite schist, ortho-quartzites, argillite, phyllites, ferruginous shale, banded ferruginous chert/quartzite and greywackes. The rocks of the area have suffered two periods of deformations. First deformation is antiformal anticline plunging to the south near Kopenhalli with low plunge. This fold movement has co-folded the volcanic that are syntectonic with younger greywacke suite of rocks over them.

Pazhamalainathan, Nagaraja Rao, and VenkataSubba (1984) while carrying out systematic geological mapping in parts of Sagar and Shikaripur taluks of Shivamogga district, mapped a thick sequence of meta-greywacke-argillite suite of rocks represented by quartz-mica-chlorite schist and calc-chlorite schists. Within the meta-greywacke argillite are found small bands of banded haematite quartzite and acid volcanics. The schistose rocks have undergone *greenschist facies* metamorphism. They correlated schistose rocks with Ranebennur Formation of Chitradurga Group in Shivamogga schist belt.

Mariappa and Mukut Singha Konwar (2017) carried out Reconnaissance survey covered an area of 200 sq.km on 1:12, 500 scale target for Fe content in major banded iron formation (BIF). Delineated 12 major band and numbered 1 to 12, and collected 222 samples of which 71 samples indicated 10 to 20%, 56 samples show 20 to 30% 18 samples given 30 to 45% and 18 samples indicate above 45% Fe₂O₃. He concluded that the Iron ore is haematite and consists of minor amount of magnetite, goethite and limonite. The depth persistence of the laminated ore and supergene-hypogene zone has to be proved by shallow drilling at 250 m interval. The area consists of low to medium grade iron ore.

Arpita Karmakar and Nirmal Kumar (2023) has carried out STM redefined three major Formations of Shivamogga schist belt in the area based on its major litho assemblages and geochemistry. The Jhandimatti Formation is recognized as intermediate to basic pyroclastics and BIF dominated litho-association i.e. variants of basaltic pyroclastics intercalated with minor BIF and tuffaceous horizons. Ranibennur Formation, previously characterised as argillite dominated, is found to be andesitic pyroclastic and BIF dominated litho-association. Whereas bimodal volcanics represented by meta-rhyolite and metabasalt is recognized as Medur Formation. The rocks of Shivamogga schist belt have suffered three phases of deformations. D1 and D2 deformations are coaxial and forms Type-3 interference pattern in field.

4.2 National Geochemical mapping works done by GSI.

Reshma and Trigun trivikram, (2017) Geochemical mapping under NGCM in toposheet nos. 48N/07 was carried out shows the trace element and minor element contour pattern in the area is mainly controlled by the WNW-ESE and NE-SW trending lithology and structure of the area. Trace elements and minor elements like Co, Cr, Cu, Ni, V, Sc, Nb and Y contour pattern reflects the folded terrain present in the central part of the area. Folded litho assemblage like andesite, ferruginous phyllite and BMQ shows comparatively high value contours for all the above.

Neethu, Shiwendra Pratap Singh, and Selva Rathika (2016-17) carried out Geochemical mapping in Toposheet No 48N/11 and parts of A1 quadrant of 57K/08 in, Haveri, Davangere, Shivamogga and Kolar districts, Karnataka, Higher contours of Fe_2O_3 9.26% and MnO 0.17% in the area between Jokanahalli and Hooliyal villages over BIF and Fe phyllite lithounits. Higher contours of Cu 57.50ppm is noted South of Jokanahalli over ultramafite and gabbro dyke. The higher contours of Co 33.20ppm and Ni 92ppm observed in south of Jokanahalli over ultramafite and gabbro dyke.

4.3 National Geophysical mapping works done by GSI.

Bhattacharya, Niharika Das & Sarita Tiwari (2018-19) carried out Regional Gravity and Magnetic total field in Toposheet Nos. 48 N/7, N/8, N/9, N/13 and N/14 under the project National Geophysical Mapping (NGPM). A total number of 1470 gravity and magnetic (total field) observations were taken maintaining an average station density of one station for every 2.5 sq.km area. A total of 141 rock samples have been collected and their density and magnetic

susceptibility are measured. In Toposheet nos. 48N/7 & 8 the bouguer gravity map shows overall variation of 26.4 mGal.

Akanksha Tirkey, Inderjeet Singh and Sorabh Sharma (2018-19) carried out NGPM, Regional Gravity and Magnetic Toposheet Nos; 57C/02 & C/03, 48N/11, 48N/15, 48N/16 in parts of Bellary, Chitradurga, Chikkamangalur, Dharwar, Hassan and Shivamogga districts in Karnataka covering an area of 3,600 sq.km. A total of 1436 Gravity, Magnetic and DGPS observations have been taken along available roads, cart-tracks and foot-tracks with an average station density of one station in 2.5 sq. km. High gradient zones demarcated the contact zone for the Dharwar Group of the rocks with Peninsular gneissic complex basement.

4.4 Geological mapping and Mineral exploration work carried out by Department of Mines and Geology (DMG), Government. of Karnataka.

Narasimha Murthy (1961-62) reported the occurrence of graphite schist near Nagavanda, four large pits and 1 deep trench opened up for making an assessment of graphite reserves in the area. 1,12,000 tons of graphitic shale containing 3.56% carbon was estimated. (*Administration report of DMG, for the Year 1961*).

Narayana Murthy and Umapathi Rao (1962) have reported the occurrence of grey, fine to medium grained chlorite schists with occasional intercalations of grey and purple phyllites around Manamane and Kolagunasi.

Regional geological mapping around Nagavanda and Medur covering an area of 80 sq km Carried out by *Sonne Gowda (1983-84)*.

Vasudev, Venugopal, Shankar and Sonne Gowda (1994) carried out exploration for graphite-sulphide mineralisation in the carbonaceous phyllite, shows graphite bearing zones with malachite stains and also Gossan zones intercalated with carbonaceous phyllite gave Cu values range between 0.64% to 12.80% and concluded that the Nagavanda area is ideal for investigation of hidden sulphide deposits. The report has indicated that a 200m strike length and 50m thickness of carbonaceous phyllite has gossans and malachite stains.

The Honnali dome region the basement gneiss and its flanking cover of supra crustal rocks include Nagavanda area were mapped by *Chadwick et.al (1990)*.

5. Geology of the Area

5.1 Regional geological set up of the area with stratigraphy, structure and metamorphism

The area was studied by many eminent geoscientists of GSI, Dept of Mines and Geology, GoK, other geoscientific communities over many decades for geological complexities, structure, metamorphism, depositional environment and minerals of economic importance remain contentious. The Dharwar Craton is broadly classified into the Western Dharwar Craton (WDC) and Eastern Dharwar Craton (EDC) are divided by a major north south tectonic or suture. The Dharwar craton is characterized by an N-S tectonic grain formed as the consequence of Late Archaean deformation including E-W shortening, and crustal scale transcurrent shearing (*Drury and Holt, 1980; Chadwick et al., 1989; Moya et al., 2003*) this has given space for the emplacement of the Closepet granite (*Jayananda and Mahabaleshwar, 1991; Jayananda et al., 2000*). The Shivamogga Schist Belt (SSB) forms one of the major schist belts of Western Dharwar Craton (WDC) covering major part of the cratonic area. Shivamogga belt, the largest of the three belts in the Shivamogga basin, is separated from the other two belts, Bababudhan and Kudremukh in the south, by basement (TTG) tonalite-trondhjemite gneiss (*Harinadha Babu et al. 1981*).

The Shivamogga schist belt is a broad open trough covering an area of over 6,000 Sq. Km in southern Karnataka with a maximum length of 100km from Tarikere valley to the former state frontier. It has a maximum width of about 100km from Sorab to Davangere in the north and Tirthahalli to Ajjampur in the south. Further North of the former state boundary, the Shivamogga belt extends through north Kanara to Goa, where it is lost under the younger platform (*Harinadha Babu et al. 1981*). The local stratigraphic units of this super belt, though correlatable with the type area of Chitradurga belt, classified the Shivamogga schist belt into 4 different formations based on the lithological associations as

Table 9: Summary Stratigraphic Successions of Shivamogga Schist belts (SSB)

<i>Stratigraphic succession (Harinadha Babu et.al 1981)</i>	
<i>Shivamogga Belt</i>	<i>Chitradurga Belt</i>
Laterite	
Basic and Ultrabasic intrusives	
Granite, pegmatite and quartz vein.	
Ranibennur Formation.	Hiriyur Formation
Medur Formation	Ingaldhal Formation
Joldhal Formation	Vanivilas Formation
Jhandimatti Formation	

Jhandimatti Formation is the most widespread unit, overlies immediately the basement complex, named after the Jhandimatti a steep conical hill Δ 3021, type area exposes the complete succession. This formation consists mainly of a basal polymict conglomerate, arenites, chlorite-quartz schist interbedded with quartzite and rarely volcanics and pyroclastic rocks. This formation immediately overlies the basement gneissic complex.

Joldhal Formation is well developed and exposed in the Joldhal area where it conformably overlies the lower Jhandimatti formation. This formation is made up of chemogenic sedimentary units consisting of limestone-dolomite, manganiferous and ferruginous cherts, phyllites, carbonaceous phyllites and cherts and chlorite schist. All these lithounits are closely interleaved with thin units of volcanics and chlorite schist. The Joldhal and Jhandimatti Formations together equated with the Vanivilas Formation of Chitradurga belt (*Harinadha Babu et al. 1981*)

Medur Formation is a thick pile of predominantly basic, intermediate and acid volcanic rocks, with subordinate chemical and detrital sediments (*Gururaja Rao et.al 1976*) The volcanic rocks of Medur Formation are essentially quartz porphyry and rhyolite, andesitic lava and tuff, porphyritic and pillowed andesites and basalts. The acid volcanic rocks of Medur Formation are dated at 2565 ± 28 Ma by Rb/Sr method (*Taylor et al., 1984*).

Ranibennur Formation is the youngest sequence of Shivamogga belt deposited in a relatively deeper and active part and mainly consisting of a greywacke argillite-chert volcanic rocks assemblage with intermittent volcanics (*Radhakrishna, 1964, 1967*) initially called it as Sirsi-Ranibennur series and later as Ranibennur Group (*Radhakrishna and Vasudev 1977*) SVP Iyengar (1976) name it as G.R. Halli-Ranibennur group. This formation is well developed around Malebennur, Harihar, Shikaripur, Shiralkoppa and further north Kanara and Goa, forming a major portion (*Harinadha Babu et.al 1981*).

Regional Structure:

The Shivamogga schist belt is characterised by broad open folds on regional scale. The major folds are governed by the shape of the granitic and gneissic domes jutting out through the belt. The beds dip away from these masses. The primary structures in quartzites like current bedding and ripple marks generally show younging in the dip direction suggesting the anticlinal nature of folds. The major folds of the area have NNW trending axial plane. The regional schistosity is parallel to this trend (*Harinadha Babu et.al 1981*).

As discussed earlier that, the structure of the Dharwar cratons is also a debate for a long time. Interpretation of the Late Archaean structure of the Dharwar Supergroup and its sialic basement is controversial (Mukhopadhyay 1986). Naqvi (1973) and Naha and Chatterjee (1982) took the view that banded iron formations host early, large-scale isoclinal folds that are refolded by younger structures. Drury and Holt (1980) and Drury et al (1984) took a wider view, they believed that the Dharwar Supergroup is characterized by early E-W recumbent folds and thrusts propagated from the south which were refolded by movements in wide N-S or NW-SE shear zones. The claims of large-scale recumbent folds" are not supported by stratigraphic data (Chadwick et.al 1997). In contrast, Chadwick et al (1981a, 1985b, 1988, 1989, 1992) interpreted the Dharwar schist belts in terms of one principal phase of deformation with superimposed younger folds related to transcurrent sinistral displacements. Mukhopadhyay and Ghosh (1983); Mukhopadhyay and Baral (1985) and Naha et al (1995) believed that the principal structures are the result of two distinct periods of deformation which gave rise to broadly parallel upright folds or refolded recumbent folds.

Regional Metamorphism

The rocks of Shivamogga schist belt have undergone little amount of metamorphism producing low grade schist except to the south where relatively high-grade rocks are located along the core of the major WNW - ESE trending antiform. The grade of metamorphism ranges from meta-greywacke or lower green schist facies to green schist-amphibolite transition regional metamorphism, gradually increasing from north to south. The lower green schist facies of rocks belong to chlorite zone is widespread and irregularly distributed amidst the relatively fresh under formed rock in the area. Increase in the grade of metamorphism is accompanied by change in the mineralogical assemblages, textural development and crystallisation of some index minerals like chlorite, biotite and garnet. The development of axial plane cleavage initiates the first imprint of metamorphism, whereby greywacke first passes into a semi schist and then into schistose simultaneously shale changes to phyllite and ultimately schist. At the early stage the schistosity, plane defined mostly by reoriented detrital micas, which are rotated from their original disposition along the bedding plane to present position together with little amount of recrystallised sericite and chlorite (A. Roy 1975).

6. Activity during the period (Geoscience investigation)

6.1 Geological mapping

The mapped area consists of volcano-sedimentary sequence representing the Shivamogga schist belt of Western Dharwar Craton (WDC).

The area carved out for investigating gold and basemetal mineralisation in the carbonaceous phyllite and banded ferruginous chert. This is based on the reported occurrence of Cu values ranging from 0.64% to 12.80% from the samples drawn from gossan and carbonaceous phyllite horizon. The carbonaceous phyllite has a width of around 250m and is likely to extend for more than 2km strike length Vasudev et.al (1994). It was further recorded that the gold may have also present in these lithologies, however the same could not be analysed due to non-availability of analytical facilities as reported by *Vasudev et.al 1994*. The occurrence of graphite schist near Nagavanda, four large pits and 1 deep trench opened up for making an assessment of graphite reserves in the area. It contains 1,12,000 tons of graphitic shale containing 3.56% carbon (*Narasimha Murthy (1961-62 of DMG, Karnataka)*).

The objective of the investigation is to arrive at a broad appraisal of the Cu, including the carbon content and Au mineralisation in the individual horizons of carbonaceous phyllite and banded ferruginous chert respectively. As suggested, the other lithounits of the area were also sampled to understand the mineral potentiality, if any. The work component consist of large-scale geological mapping and systematic search on surface examination for any indications / manifestation of mineralisation. A number of grooves, chips and Bed Rock Samples (BRS) were collected from the individual litho units to understand the possible host rock for mineralisation.

The area was mapped by taking close spaced traverses across the area by a team of geoscientists from KIOCL with Brunton compass and GPS. The purpose of large-scale geological mapping is to bring out the finer details of the geological disposition of the litho-assemblages, structural parameters and to find any surface manifestation or indication for mineralisation in the area for further detailed studies. Overall assessment was to find out the presence of gold, basemetal and graphite mineralisation, if any, in the area, the same will be delineated based on the analytical results and petrographic studies of bed rock and trench samples.

Large Scale Geological Mapping on 1: 12,500 scale

The block is bounded on the north western corner Medur to the south eastern corner Somannanamallapura to the south west Maravalli south central part Kaginahalli and on the north Hosakatti covering an area of 63.3 Sq.km. The area includes the rocks of carbonaceous phyllite, ferruginous phyllites, quartzite, banded ferruginous chert, greywacke-argillite, metabasalt, meta-andesite and meta-ultramafics. The emphasis of large-scale geological mapping to target and delineate the potential zones for Cu and Au in the carbonaceous phyllite and Au and associated mineralisation in the banded ferruginous chert horizons.

The area exposes rocks of Joldhal, Medur and Ranibennur formations of Shivamogga belt, consists of well-developed chemogenic, sedimentary and metavolcanic sequences. The major rock types met with include Quartz chlorite schist with interbedded quartzite, metabasalt belong to the lower most formation – Jhandimatti. The Joldhal formation consists mainly of ferruginous phyllites covering a large part, while the carbonaceous phyllite is interbedded with ferruginous phyllite, banded ferruginous chert, cherts, metabasalt and meta ultramafics. The Medur formation consists mainly of andesites exposed to the northwest of the area. The greywacke-argillites are part of Ranibennur formation occupying the core portion of the antiformal part, mapped to the southern part of the investigated area. (Ref Plate -3).

Outcrop Geological Mapping on 1: 12,500 scale

The quartz chlorite schist interbedded with thin quartzite band marked to the south eastern corner of the block around the Somannanamallapura and to the north of it metabasalt is exposed belonging to Jhandimatti formation.

The outcrop map was prepared based on the observations and tracing outcrops of various lithounits present in the investigation area.

Among the lithounits, the conspicuous and continuously discontinuous bands observed are the banded ferruginous chert (BIF) of Joldhal formation. BIF bands run across the block, stand out as linear to curvilinear ridges due to resistance to weathering and folding. The ferruginous phyllites, carbonaceous phyllites and interbedded chert bands within the phyllites, metabasalt, talc tremolite schist were also been traced as small out crops and shown on the map belong to the Joldhal formation. In addition, north of the carbonaceous phyllite, there are small detached out crops of banded ferruginous chert depicting the isolated bodies

with fold closures. The other prominent outcrops are the metabasalt, seen as detached bodies under soil cover traced across the area.

In the western boundary of the block, one small out crop of meta-andesite of medur formation is traced and mapped.

Within the folded anticlinal core, the greywacke-argillites are occurring as smaller outcrops and are sparsely distributed were also traced belonging to the Ranibennur formation.

All the lithounits are trend along WNW - ESE to NW – SE with a dip range from 30° to 60 ° degrees along north east and south west. (Ref Plate -4).

Interpreted Geological Mapping on 1: 12,500 scale

Large scale geological mapping of an area of 63.3 sq.km covered on 1: 12,500 scale by outcrop mapping and interpretation based on the lithological, their geological continuity and structural parameters. The prepared geological map showing lithological continuity, though majority of them are under soil cover. The mapping has brought out the lithologies of all the formations viz., Jhandimatti, Joldhal, Medur and Ranibennur of Shivamogga Schist belt.

Phyllites are the most predominant rock type of the area covering major part of the area mapped (42.01 sq.km ferruginous phyllite and 0.59 sq. km carbonaceous phyllite). The phyllites occur in the plains around Gangayikoppa-Guladahalli-Hosakatti-Nagavanda-Anaji-Guddadamadpur and on hill slopes next to banded ferruginous chert. The phyllite at places carbonaceous, contact between the carbonaceous and ferruginous nature are gradational and continuous in nature. Due to differential weathering the exposures vary from fresh to highly weathered and ultimately to black cotton soil. The other lithounits like banded ferruginous chert (1.62 sq.km), consists of alternate layers of hematite (iron) and chert (silica) layers in a rhythmic pattern. The quartz chlorite schist with interbanded quartzite (0.04 sq.km). The country rock is interbedded with a few basic and intermediate volcanic rocks represented by metabasalt (6.44 sq.km) and meta-andesite (3.58 sq.km), meta ultramafics represented by the Talc tremolite schist (0.66 sq.km). The meta sedimentary units are highly inter banded and one rock grades into the other forms greywacke-argillite sequence. Thus, they represent a continuous sedimentary sequence without any visible break. The meta basalt, meta-andesite shows a conformable relation with the meta sedimentaries of the area, indicating contemporaneous sedimentation with volcanism.

While carrying out large scale geological mapping, came across the reported occurrence of carbonaceous phyllite / shale horizon, old pits and dumps. The biased samples drawn during pre-field studies from old pit and dumps of carbonaceous phyllite with malachite stain and associated quartz stringers contain chalcopyrite and bornite minerals which as indicated Cu value of 5.88 %(34BRS-37).

A very mild nature of hydrothermal activity is indicated by presence of goethite as coating, fracture-filling, brecciation in both phyllites and banded ferruginous chert and pyrite along the foliation planes in the carbonaceous phyllite. It is evident from the mineralization point of view; the hydrothermal solutions of the area are without significant metal content and non-fertile in nature.

Jhandimatti formation

Jhandimatti formation being the oldest formation of the Shivamogga schist belt. Rocks of the Jhandimatti formations are represented in the area by the quartz chlorite schist interbedded with thin bands of quartzite and thin band of metabasalt. The above rock types are exposed to the south eastern corner of the area around Somannanamallapura. The rocks are striking NE-SW and dipping 30 to 55 degree towards north west.

Joldhal formation

Joldhal formation consists of well-developed chemogenic sedimentary sequences consisting of banded iron formations represented by banded ferruginous chert at places manganiferous of Joldhal formation is observed in the block. There are 6 such bands traced in the area, whose details are discussed in the foregoing para. Phyllites occupy a major part of the area, mostly ferruginous in nature. The carbonaceous phyllite is 2.5 km in strike length with width varying from 145m to 350m. The other rock types of the area are metabasalt, meta-ultramafics represented by talc tremolite schist, and small chert bands.

As discussed previously, major part of investigation area is occupied by the phyllites which is the most predominant rock type of the block. The phyllites occur in the plains and on hill slopes next to banded ferruginous chert. The phyllite at places carbonaceous, contact between the carbonaceous and ferruginous nature are gradational. Due to differential weathering the exposures vary from fresh to highly weathered and ultimately to black cotton soil. Metabasalt, meta-ultramafics and chert bands are occurring interbedded with each other.

The other prominent lithounit observed in the area is banded ferruginous chert which occupies extent of around 1.62 sq.km in the block. The BFC band-1 is found exposed from the south eastern part of the block. Band lies to the west of Somannanamallapura and east to Kagainahalli. BFC band-2 and 3 are exposed to the north of Kagainahalli. BFC band-4 exposed north of Guddadamadapur. BFC Band-5 and 6 are exposed to the south east and west of Nagavanda respectively (Ref Plate 5). Banded hematite chert consists of alternate layers of hematite (iron) and chert (silica) layers in a rhythmic pattern.

As far as mineralisation is concerned, there are no visible indications or manifestation for mineralisation observed in the area. The banded ferruginous chert horizon shows at places brecciation, fracture filling and cubic voids. Hence, it may be construed that very mild nature of hydrothermal activity is indicated by presence of goethite as coating, fracture-filling, brecciated banded ferruginous quartzite and pyrite along the foliation planes in the carbonaceous phyllite. BFC at places manganiferous are also traced and mapped.

Medur formation

A small outcrop of meta-andesite is exposed near western boundary of the block south of Yettinahalli Tanda and another exposure out of boundary north of Tirumalapura. Another small outcrop occurs in south of Hosakatti.

Ranibennur formation

The lithounit forms part of this formation is the greywacke-argillite which occupies a major part of the area 7.87 sq. km and outside the block. The entire southern boundary of the block is occupied by the greywacke-argillites around from west to east are Maravalli – Hosa Chaudanaikanakoppa – Kagainahalli and west of Somannanamallapura.

Stratigraphic succession in the area mapped and extents of various lithounits exposed in the block are provided in the below tables;

Table 10:Stratigraphic succession in the area mapped

Schist Belt	Formation	Lithology	
		Soil	Recent
		Laterite	
		Gabbroic dykes, Quartz Vein	
Shivamogga schist Belt	Ranibennur	Metabasalt	Meta volcanics
		Greywacke - Argillites	Metasedimentary
	Medur	Meta Andesite	Meta volcanics
	Joldhal	Talc Tremolite schist	Meta ultramafics
		Metabasalt	Meta volcanics
		Carbonaceous Phyllite	Chemogenic meta sedimentary rocks
		Ferruginous Phyllites	
		Banded ferruginous chert (at places Manganiferous)	
	Jhandimatti	Metabasalt	Meta volcanics
		Quartz chlorite schist with quartzite	Meta sedimentary

Table 11:Table showing the area covered by lithounits

Sl	Litho Units	Area Sq. Km
1	Andesite	3.58
2	Greywacke -Argillite	7.87
3	BFC	1.61
4	BFC/MN ore	0.01
5	Carbonaceous Phyllite	0.59
6	Chlorite Schist	0.55
7	Ferruginous Phyllite	42.01
8	Laterite	0.001
9	Talc - Trimollite Schist	0.66
12	Metabasalt	6.44
13	Quartzite	0.004
Total		63.32

Detailed Geological mapping on 1: 4,000 scale

Detailed mapping works of carbonaceous phyllite band was not the part of NMET approved component. Inspite of the above, Detailed Geological mapping works in 1:4,000 scale of carbonaceous phyllite band covering an extent of 0.59 sq.km was carried out in order to build adequate technical details of the host rock (carbonaceous phyllite) which was anticipated for copper mineralization. This was done in order to explore this lithounit for higher level of investigation. Detailed Geological map of the Carbonaceous phyllite band in 1: 4,000 scale is enclosed as Plate no 7.

During mapping the carbonaceous phyllite horizon was traced by way of trenching to expose the covered part of the horizon south east of Nagavanda and was demarcated. The carbonaceous phyllite was traced and delineated for around 2.5 km in strike length extending along N 60° W and S 60° E dipping towards north east with a width varying from 145m to 350m. Sampling was carried out at close spaced regular interval and collected across the width and strike in the outcrops and trenches.

Description of rock types

Chemogenic metasedimentary rocks

Banded Ferruginous Chert (BFC)

Banded iron formation represented by banded ferruginous chert (BFC) covering an area of 1.61 sq.km associated with the phyllites and metabasalt is mapped in the area. There are 6 bands of BFC, numbered 1 to 6 (six) from south to north have been traced as narrow, linear to curvilinear, continuously discontinuous bands and they form prominent strike ridges stand out due to resistance otherwise in a plain country. The curvilinear nature is due to folding, and is prominent. The strike of the bands trending along WNW-ESE and NE-SW varies locally because of deformation and folding with a steep dip varying from 30 to 60° towards north easterly and at places south westerly. The bands extend in strike length from 2.2 km to 9.5 km without any break forming conspicuous linear ridges. Approx dimensions of the BFC bands are provided below;

Table 12: Table showing the dimension of BFC bands

BFC band no	Strike length in km	Avg width in m
1	9.5	41.19
2	9.0	41.63
3	3.7	31.52
4	3.3	31.75
5	2.1	51.18
6	2.6	110.93

The rock consists of alternate rhythmic layers of siliceous and ferruginous material. The thickness of different layers varies from a few mm to several cm, Fe-rich mesobands varies from 0.5 mm to 5 cm and the quartz rich chert band from few cm to as thick as 12 to 15cm. Bedding is very conspicuous and is well displayed by both compositional as well as colour bands. The compositional band is shown by alternate silica and iron oxide rich bands, whereas colour banding is shown by cream to greyish as silica rich bands and brownish or

reddish bands of hematite or iron rich layers. The BFC bands are associated with phyllite and metabasalt. The bands are massive and at places, brecciated and fractured, the fractures are filled with iron oxide material. The bands are occasionally traversed by very thin quartz veins.

The bands have suffered intense deformation and as a result non-plunging to moderately plunging open to very tight minor folds have developed. Mineralogically the bands consist of fine-grained quartz (cherty at place), magnetite and haematite. Carbonates such as ankerite/siderite and calcite are associated with BIF. All the BIF bands have been systematically sampled and analysed for gold.

BFC band 2 in and around sampled area (34BRS 72) exposed in Cave/ Temple is sheared, highly fractured intruded by quartz veins contains plenty of altered and oxidized pyrites and limonitic alteration. The sampled location (34BRS 72) has yielded Au value of 0.8 g/tonne and it is located inside reserved forest area without proper accessibility. The BFC band 2, other than the above zone is observed to be void of presence of sheared and fractured zones favourable for gold mineralization.



Figure 7: Out Crop of Banded ferruginous Chert (34BRS-72, Au value 0.8 g/t)

The banded ferruginous chert exhibits at places as manganeseiferous in nature and extends over a strike length of 300m, with an observed width varying between 25 to 40m and striking along N 60° W to S 60° E with south westerly dip of 30° to 60° showing visible Mn and Fe mineralization. 4nos of Bed Rock Samples (BRS) (34BRS 79, 80, 81 & 82) collected from this zone as indicated Mn% ranging from 10.02 to 20.33 with average Mn% of 13.68 %.

In addition to the above an isolated patch of BFC measuring approx. 70m X 30m is situated to the east. 1 random sample (34BRS-85) collected from this zone has indicated Mn% of 9.24. This indicated enrichment of Fe and Mn mineralization in these zones. Further detailed study in these 2 BFC zones were not taken up, as these zones are situated inside the forest land.



Figure 8: Manganese Ore (34BRS-79, Mn% : 12.51)



Figure 9: Manganese Ore (34BRS-82, Mn% : 20.33)

Ferruginous phyllite

A major part of the area (42.01 sq.km) is covered by the ferruginous phyllite. Ferruginous phyllite is frequently well-bedded and it shows rhythmic interbanding of ferruginous material. In the area phyllite occur as intercalations and interbanding as carbonaceous and ferruginous phyllites and minor chert bands. Phyllites are exposed in the plains around Gangayikoppa-Guladahalli-Hosakatti-Nagavanda-Anaji-Guddadamapur and on hill slopes next to banded ferruginous chert.

Megascopically phyllite is light grey, brown and greyish-green to black with well-developed non-diastrophic and diastrophic planar structures. The petrographic study reveals that the rock is predominantly made up of very fine-grained muscovite and quartz. The rock is made up of quartz, chlorite, muscovite and opaque minerals as pyrite. It consists of very fine grained, subrounded detrital grains of quartz, together with needle-shaped chlorite set in a fine-grained matter. The schistosity or the foliation is marked by preferred orientation of platy minerals like quartz and muscovite. Later shearing event caused the deformation in quartz veins developing new fabric. Hydrothermal activity is marked by isolated crystallisation of quartz. Framboidal pyrite is also observed in the rock. Photo micrograph - NGBB-PTS-08 is presented in the Annexure.32.

Carbonaceous Phyllite

The carbonaceous phyllites covering an area of 0.59 sq.km exposed south east of Nagavanda, is fine grained in nature, colour varying from grey to greyish to black, soft and dense, moderate to highly fractured is found interbedded with ferruginous phyllite and banded ferruginous chert. It extends around 2.5 km in strike length along WNW – ESE to NW – SE with a dip varying from 40 to 50 degree to the north east and having a thickness varying from 145m to 350m. The phyllites in the area shows frequent intercalations and interbanding of carbonaceous phyllites. Megascopically, rock shows grey to black, black organic material? which soils the finger with black powder, soft and dense, quartz, chlorite, mica and feldspars, highly foliated, and intruded by quartz vein, at places mild disseminations of pyrite parallel to foliation plane and along fractures are observed. Originally the protolith is shale, subjected to low grade metamorphism becomes phyllite. The presence of pyrite shows very mild nature of hydrothermal activity, the hydrothermal solutions of the area are without significant metal content, and non-fertile.

The petrology of the carbonaceous phyllite with stringers of quartz has been studied NGBB-PTS-07 mineralogy of the vein is predominantly very fine quartz with minor amount of muscovite. The vein quartz shows straight to sutured grain boundary, based on the texture it is inferred that the formation of very fine-grained quartz and fine-grained muscovite was taken place after vein intrusion during the later shearing event, which produced recrystallisation and very fine-grained quartz along with muscovite and caused suturing grain boundaries.

At the time of mapping, a vertical borewell sunk by the farmer for irrigation purpose was observed over the carbonaceous phyllite. Some chips of this borehole was noticed with pyrite and very minor chalcopyrite. These samples were collected for chemical analysis. Though the samples/chips were showing mainly pyrite and very sparsely scattered chalcopyrite minerals, the analytical result has indicated Cu values <100ppm (34 BRS 123).

The carbonaceous phyllite is completely under the cover of soil, hence by way of auger drilling samples were collected. 10 nos of auger drill holes were carried out up to a depth of 1m. (BRS 101,102,103,104,105,106,107,113,115 & 116). However, these samples has shown maximum Cu value of 0.05%.



Figure 10: Outcrop of Carbonaceous phyllite



Figure 11: Auger drillhole

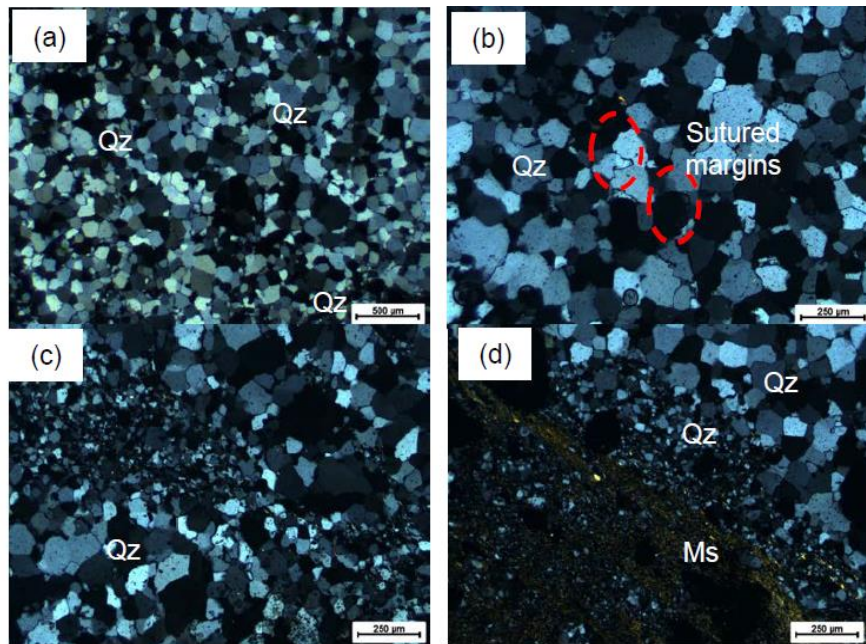


Figure 12: Photomicrographs of NGBB-PTS-07



*Figure 13: Water well borehole (RC) cuttings containing sulphides (pyrite and chalcopyrite)
Sample No : 34 BRS 123*

As per the recommendations of previous literatures, and as chips at borehole drilled for irrigation purpose shown mineral content, presence of old pits, dumps over the carbonaceous phyllite was indicating malachite stain, stringers of quartz containing chalcopyrite and bornite, it was planned for few scout boreholes to further understand the mineral potential of this horizon.

Metasedimentary rocks

Quartz chlorite schist

The quartz chlorite schist occupies an area of 0.55 sq. km. The rock is exposed to the south eastern corner of the block around Somannanamallapura is characterized by light to dark green, dark to black coloured hard and compact, at times massive, presence of quartz, mica and chlorite minerals, with chlorite being the dominant mineral and imparting a green colour to the rock. Petrographically, the rock is predominantly comprised of fine-grained quartz and muscovite with minor amount of chlorite and plagioclase showing cloudy appearance due to sericitization. The foliation is defined dominantly by the quartz and muscovite. It is formed through metamorphism of basaltic rocks or through the alteration of other minerals, resulting in a schistosity, the platy minerals like chlorite are aligned parallel to each other. Biotite, tourmaline and calcite are the accessory minerals (Harinadha Babu, 1979). The quartz chlorite schist striking along NE-SW with a dip varying from 40 to 45 degrees to the north west. Though it is found to occur as a small part in the corner of the block extends on either side outside the block.

PTS report along with photo micrograph NGBB-PTS-10 is presented in the Annexure no 32

Quartzite

A small out crop of quartzite sandwiched and exposed within the quartz chlorite schist to the south eastern corner of the block around Somannanamallapura. The quartzite is noticed interbedded within the quartz chlorite schist. It is light grey, at times purple in colour, fine to medium grained occurring as thin band varying in strike length from 30m to 45m with width varying from 20m. This rock strikes along NE-SW-ESE with dips varying from 40 ° to 55° towards NW direction.

Meta greywacke-Argillites

The Greywacke- argillite suite is mapped around Maravalli – Hosa Chaudanaikanakoppa – Kaginahalli – NW of Somannanamallapura. It is a dark grey to black, fine grained, hard and compact thinly laminated meta sedimentary rock megascopically containing chlorite, mica, quartz and hornblende. The argillite consists of very fine grained, rounded to subrounded detrital grains of quartz and little plagioclase, together with needle-shaped chlorite and sericite set in a matrix, is greenish grey to grey in colour, hard and compact. Megascopically, quartz, chlorite, carbonate minerals and pyrite are identified. Pyrite cubes are generally oxidised to limonite. Thin section studies have indicated that the rock is predominantly fine grained consist of chlorite, muscovite, quartz and orthoclase, along with minor minerals like epidote is also observed. The rock is foliated and foliation is defined by the fine-grained muscovite, chlorite and quartz. Orthoclase shows cloudy appearance indicating replacement by sericite. Quartz shows undulose extinction and polycrystalline nature indicating further strained after deformation. The general trend of the lithounits is N15°E to N25°E dipping 45° to 85° easterly; at places dips are vertical and occupies an area of 7.87 sq. km. Photo micrograph - NGBB-PTS- 04, 06 and 09 is presented in the Annexure no .32.

Meta - volcanic rocks

Metabasalt

There are three linear bodies of metabasalt traced in the area around Somannanamallapura – Hosa Chaudanaikanakoppa covering an area of 6.44 sq. km. The one in the northern most is part of the Joldhal formation (Metabasalt band 3), crop out as conformable horizons with the meta-sedimentary phyllite sequence. This is a major linear ribbon-like body of metabasalt is found extending along east west, occur in south central part of the mapped area south of Guddadamadapur (present in Eastern part of the block) to south of Gangayikoppa (present in Western part of the block). The foliation planes are extending along WNW and ESE direction with dipping towards north east. This body is extending and covering entire width of the block.

The other band (metabasalt-2) occur to the south of the previous one extending along the same strike that of northern band having a strike length of 5km intermittently with a width of 12 to 18m forms part of the Ranibennur formation extending from Hosa Chaudanaikanakoppa to west of Maravalli.

The third one (metabasalt-1) is very smaller band occur in south eastern corner of the block, near Somannanamallapura. This is a small band interbedded with quartz chlorite schist in the east and to the west ferruginous phyllite. It is light to dark green coloured, massive at places schistose, hard and compact fine-grained rock. These lithounits are co-folded with the underlying quartz chlorite schist and banded ferruginous phyllite. The outpouring of basaltic lava marks, a period of basic volcanic activity contemporaneous with deposition of sedimentaries.

The metabasalt of the area is light grey to dark grey coloured, fine grained, hard and compact, massive to slightly schistose, rock consisting of minerals like Hornblende, quartz, mica etc. Small amount of quartz is occasionally present which indicated its release after the saussuritization of plagioclase. Carbonate is associated partially replacing the phenocrysts as well as groundmass (Guru Raja Rao et al. 1976).

Thin section studies indicated that the rock is predominantly consists of coarse-grained hornblende and plagioclase, with minor amount of muscovite epidote, quartz and calcite. The rock is extensively altered and original texture of the rock is totally obliterated. Hornblende is replaced by epidote, saussuritization has converted the plagioclase into epidote and quartz. Photo micrographs - NGBB-PTS-02, 03, and 05 is presented in the Annexure no 32.



Figure 14: Outcrop of Metabasalt

Meta - Andesite

It is exposed on the western most corner of the block around Yettinahalli Tanda – Tirumalapura – Medur in the investigated area and occupy an area of 3.58 sq. km. The rock is intercalated with ferruginous phyllite indicating volcanism contemporaneous with sedimentation. The rock is light coloured, moderately heavy, homophonous to crudely

schistose, consisting of aphanitic groundmass and numerous carbonates together with pyrite specks. Pillow lavas are andesitic to dacitic in composition and devoid of any ferromagnesian phenocrysts. The andesite represents the 1st volcanic activity in the area. (N. Subramani et al. 1996-1998).

Ultramafic (Talc tremolite schist)

These rocks in the area are represented by talc-tremolite-schist. The rock is dark grey with several light grey spots, hard and less dense, in hand specimen the rock shows amphiboles, talc, calcite and ilmenite, strongly foliated. They occur as very narrow sill like bands conformable with the country rocks. To the south west of approximately at a distance of 2.5 kms from the village Nagavanda, outcrops of tremolite talc-schist is occurring. In addition there are several isolated patches and pockets are also noted. The larger one is trending roughly E-W, NE – SW and is quite conformable with the adjoining country rocks. Petrographically, the rock is strongly foliated, defined predominantly fine-grained talc and tremolite, calcite is occurring as porphyroblasts within the foliation. Recrystallisation of talc causes coarsening of the grains. The rock is affected by metamorphism and multiple episodes of deformation that are clear from the features such as S2 schistosity cutting across S1 schistosity, where S1 is preserved in the intrafolial regions. Based on the mineral assemblage the rock belongs to green schist facies regional metamorphic conditions with 300 – 400°C temperature. These rocks are possibly Alpine type of intrusives because of their association with basic volcanic rocks, narrow sill like intrusion and association with regionally metamorphosed rocks of intermediate pressure green schist facies. (Guru Raja Rao et al. 1976). Photo micrograph - NGBB-PTS-01 is presented in the Annexure no 32.

Structure

The area exhibits both diastrophic and non-diastrophic structures in the area.

Primary structure

Primary structures displayed by mainly the sedimentary rocks (meta).

Bedding

The bedding, stratification or layers are exhibited by the sedimentary rocks viz., Banded ferruginous chert, quartzite, greywacke-argillites and phyllite, are the non-diastrophic structures. The bedding or stratification is conspicuous in majority of sedimentary (meta)

rocks of the area. These structures are defined by colour, compositional banding and difference in grain size between successive layers. Thickness of the bedding plane varies from fraction of a centimetre to a meter in different rock units. Thinner ones frequently show rhythmic banding with alternate coarse and fine layers. The general trend of bedding is WNW – ESE to NW - SE with moderate to steep dips towards north and south.

Diastrophic planar structures

These structures are represented by planar and linear fabrics in most of the rocks.

Foliation (Planar)

The foliations are pervasive planar diastrophic structure developed typically in quartz chlorite schist, mica schist and phyllite and in argillite-greywacke. It is defined by parallel arrangement of flaky minerals like chlorite, mica, hornblende. This structure is synchronous with the first phase of folding being subparallel to the axial trace. The cleavage is parallel to slightly oblique to the bedding plane. The foliation is trending along N10°-20°W- S10-20°E and making an angle with the trend of bedding.

Crenulation cleavage

The effect of later deformation on previously formed cleavage planes is observed in the form of crenulations cleavage. The crenulation cleavage is noticed primarily in metabasalt, chlorite schist, and phyllite.

Folds

The mesoscopic folds on bedding planes are very well-developed in banded ferruginous chert, greywacke and in phyllite or shale. The area exposes as many as more than 6 bands of banded ferruginous chert in the area, many of them exhibit the folds of various types. Folding is a process of ductile deformation that preserves continuity of layers at the scale of observation. In the present area, the BHC has expose for 8.5 to 9.5 km strike length showing various deformational effects.

Mesoscopic folds on bedding planes are very well-developed in banded ferruginous chert and at times in greywacke or shale / phyllite. The earlier F1 is more conspicuous and is open to tightly isoclinal in nature, concentric to near concentric in geometry. Hinge is subangular to rounded and at places thickened. Limbs are at places thinned and sheared because of intense lateral compression.

The F1 folds are developed in BIFs where the form surface is bedding (S0). Presence of isoclinal folds, and hook shaped regional folds are the best examples for D1 deformation. They show thickening near the hinges and thinning on the limbs in both siliceous and iron oxides layers.

The second set of fold F2, congruous to across fold of the area, are commonly exhibited as broad warpings, plunging down dip the bedding plane.

Joints

Joints are the most common planar structures seen in almost all the rock types, usually they are seen parallel to and at right angle to S0. Quartz vein is also seen emplaced along some of these joint planes.

Metamorphism

The rocks of Shivamogga shist belt has undergone greenschist facies metamorphism, as per the mineral assemblage noticed in various lithounits of the area. The grade of metamorphism ranges from metagreywacke or lower green schist facies to green schist-amphibolite transition facies of regional metamorphism. The lower green schist facies rocks belong to chlorite zone are widespread to the southern part, and gradually passing to biotite zone towards north. The increase in grade of metamorphism is accompanied by change in the mineralogical assemblages, textural development (more schistose) and recrystallization of some index minerals, viz. chlorite and biotite.

Mineralogy of the ore zones and ore textures

Detailed description of mineralogy of ore zone and ore textures with photographs/ photomicrographs are given as Annexure – 32.

Pitting and trenching

After mapping and initial analysis of samples, the likely potential rock in the area is carbonaceous phyllite. Carbonaceous phyllite of the area is fully under soil cover except old pit and other areas show marginal out crop. Hence, it necessitates to excavate trenches across the band to expose it under soil cover.

The purpose and objective of the trenching bears the following

- i) to expose the concealed host rock for exposing the band under cover,
- ii) collection of lithological, structural and mineralisation details of the band, if any,

- iii) collection of samples to know the quality of the mineralized zone after chemical analysis,
- iv) delineate / prove the strike extension of the already delineated zones / bands and connect with one already delineated in the previous profile on the surface.
- v) forming the profiles for planning of boreholes.
- vi) to know the exact width of the carbonaceous phyllite band and also to check the contact rock, and for delineation of the continuity of the band.

A total of 100 cu. m. of trenching was done across the carbonaceous phyllite band generating 67 nos. of samples from 4 trenches. The sample length was kept uniformly at 1m. Out of 67 nos of trench samples collected, 23 samples are analysed for 7 radicals. These samples were indicating brecciation and presence of quartz stringers etc. Details of the trenches along with number of samples analysed for 7 radicals are provided below;

Table 13:Details of the trenches

Trench No	Location	Length (m)	Width (m)	Depth (m)	Volume in Cum	No of samples collected	No of samples analysed for 7 radicals
1	E 557697, N 1581623 and E 557692, N1581613	12	1	1.5	18	12	7
2	E 557885, N 1581604 and E 557884, N1581595	20	1	1.5	30	20	5
3	E 558102, N 1581577 and E 558101, 1581568	20	1	1.5	30	20	6
4	(E 558585, N 1581428 and E 558582, 1581419)	15	1	1.5	22.5	15	5
Total					100.5	67	23

Trenches marked on geology map (1:4,000 scale) is enclosed as plate 07. Primary sample analysis report of trenches is enclosed as Annexure 14.

Profiles of trench sections along with description, chemical analytical results are discussed below.

Trench No. NGBB TR 01:

Trench no 01, was excavated with 12m length with width of 1m and to a depth of 1.5m. Top soil up to the depth of 60cm is exposed, thereafter carbonaceous phyllite is exposed up to 1.5m. 7 nos of trench samples collected from this trench indicated Cu value ranging from 68 to 102ppm. Profile mapping of trenches with photographs and analytical results is provided below;



Figure 15:Field Photographs of Trench 1

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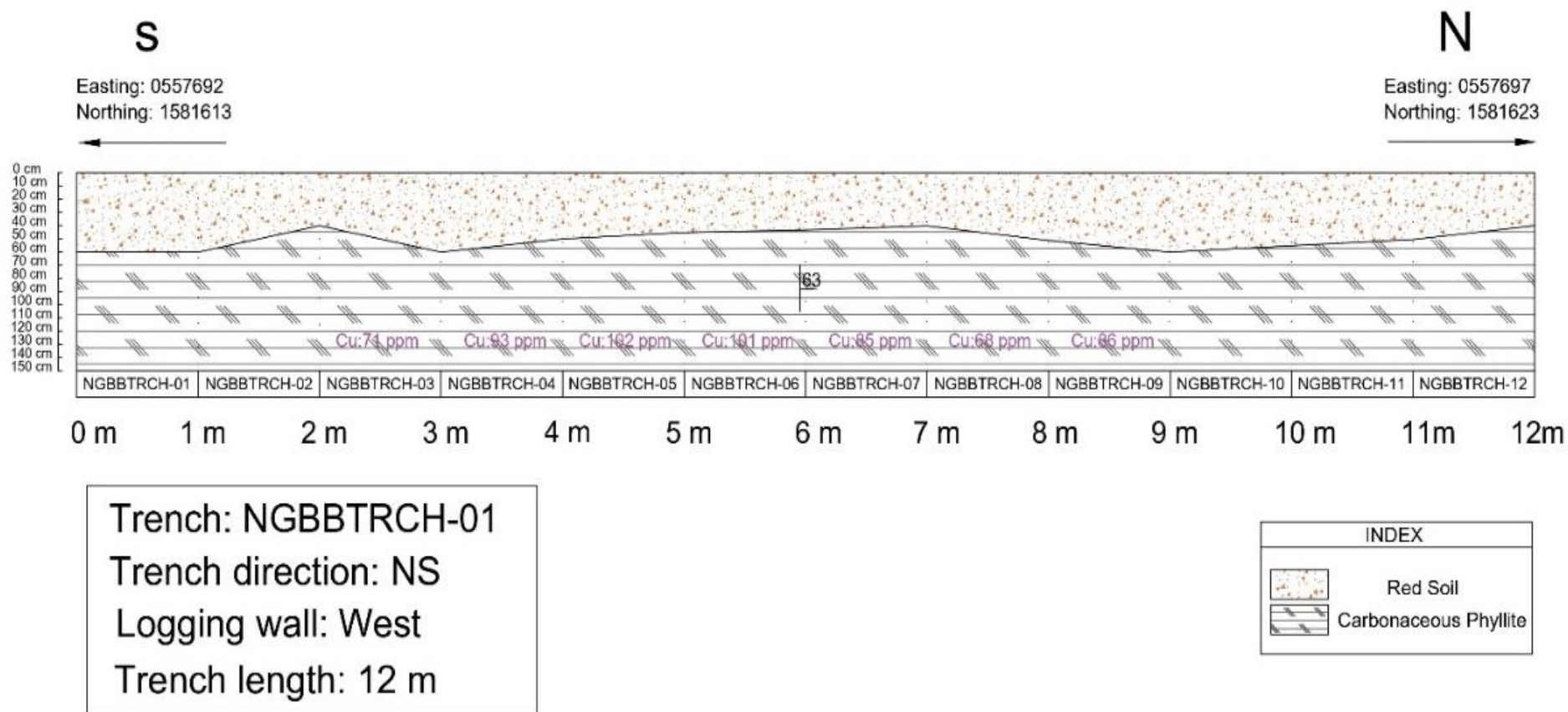


Figure 16: Trench 1 profile map

Table 14:Trench-1 Sample analysis

NGBB TR01												
Total trench length- 12.00 m.												
Trench trend- N-S, Sampling from North-South.												
Trench co-ordinates (E 557697, N 1581623 and E 557692, 1581613)												
Sr.No.	Sample ID	From	To	Width (m)	Lithology description	Cu	Mo	Pb	Ag	Sn	w	zn
						PPM						
1	NGBBTR_CH 01	0.00	1.00	1.00	Greyish black foliated, carbonaceous phyllite (5cm quatz vein observed at 0.80 -0.85m)	-	-	-	-	-	-	-
2	NGBBTR_CH 02	1.00	2.00	1.00	Reddish grey highly foliated, ferrugenuos phyllite with very low carbon content.	-	-	-	-	-	-	-
3	NGBBTR_CH 03	2.00	3.00	1.00	Greyish, fine grained, foliated, phyllite exhibits lustrous and wrinkled surface with carbon content.	71	0	7	0	1	0	97
4	NGBBTR_CH 04	3.00	4.00	1.00	Greyish black ,fine grained, foliated, phyllite exhibits lustrous and wrinkled surface with carbon content.	93	0	5	0	1	0	80
5	NGBBTR_CH 05	4.00	5.00	1.00	Greyish black ,fine grained, foliated, phyllite exhibits lustrous and wrinkled surface with carbon content.	102	0	7	0	1	1	85
6	NGBBTR_CH 06	5.00	6.00	1.00	Greyish black ,fine grained, foliated, phyllite exhibits lustrous and wrinkled surface with carbon content.	101	0	5	0	1	0	72
7	NGBBTR_CH 07	6.00	7.00	1.00	Greyish black ,fine grained, foliated, phyllite exhibits lustrous and wrinkled surface with carbon content.	85	0	7	0	1	0	87
8	NGBBTR_CH 08	7.00	8.00	1.00	Greyish black ,fine grained, foliated, phyllite exhibits lustrous and wrinkled surface with carbon content.	68	0	6	0	1	1	55
9	NGBBTR_CH 09	8.00	9.00	1.00	Greyish black ,fine grained, foliated, phyllite exhibits lustrous and wrinkled surface with carbon content.	86	0		0	1	1	63
10	NGBBTR_CH 10	9.00	10.00	1.00	Greyish black ,fine grained, foliated, phyllite exhibits lustrous and wrinkled surface with carbon content.							
11	NGBBTR_CH 11	10.00	11.00	1.00	Greyish black ,fine grained, foliated, phyllite exhibits lustrous and wrinkled surface with carbon content.	-	-	-	-	-	-	-
12	NGBBTR_CH 12	11.00	12.00	1.00	Greyish black ,fine grained, foliated, phyllite exhibits lustrous and wrinkled surface with carbon content.	-	-	-	-	-	-	-

Trench No. NGBB TR 02:

Trench no 2, was excavated in the forest land with 20m length, depth of 1.5m and width of 1m. Thickness of top soil in this trench is ranging from 10 to 60cm, thereafter, Carbonaceous phyllite exposed up to the depth of 1.5m. 5 nos of trench samples collected from this trench as indicated Cu value ranging from 68 to 85 ppm. Profile mapping of trench with photographs and analytical results are provided below;



Figure 17: Field Photographs of Trench 2

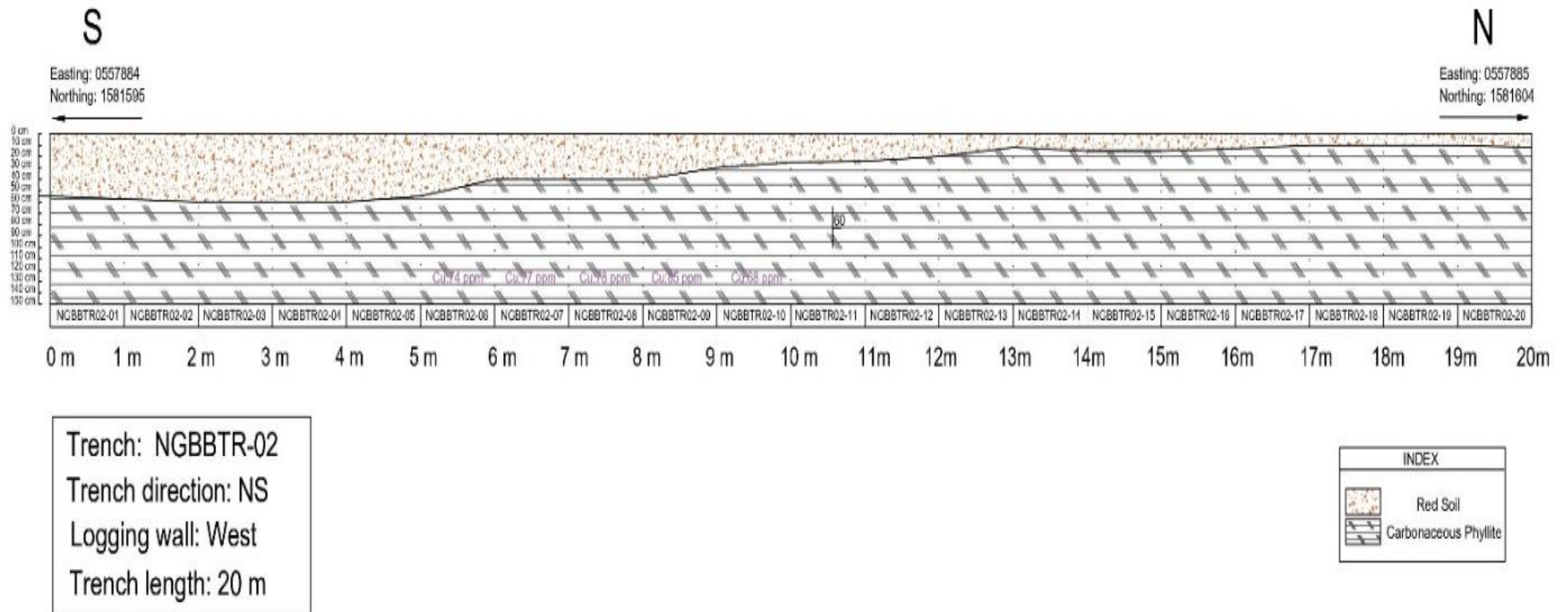


Figure 18: Trench 2 profile map

Table 15:Trench-2 Sample analysis

<p style="text-align: center;">NGBB TR02 Total trench length- 20.00 m. Trench trend- N-S, Sampling from North -South. Trench co-ordinates-(E 557885, N 1581604 and E 557884, 1581595)</p>												
Sr.No	Sample ID	From	To	Width (m)	Lithology description	Cu	Mo	Pb	Ag	Sn	w	zn
						PPM						
1	NGBBTR_TR02/01	0.00	1.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
2	NGBBTR_TR02/02	1.00	2.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
3	NGBBTR_TR02/03	2.00	3.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
4	NGBBTR_TR02/04	3.00	4.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
5	NGBBTR_TR02/05	4.00	5.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
6	NGBBTR_TR02/06	5.00	6.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
7	NGBBTR_TR02/07	6.00	7.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite containing thin quartz veins with limonitic alteration	74	0	5	0	1	0	123
8	NGBBTR_TR02/08	7.00	8.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite containing thin quartz veins with limonitic alteration	77	0	5	0	1	1	146
9	NGBBTR_TR02/09	8.00	9.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite containing thin quartz veins with limonitic alteration	78	0	5	0	1	1	140
10	NGBBTR_TR02/10	9.00	10.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite containing thin quartz veins with limonitic alteration	85	0	4	0	1	1	156
11	NGBBTR_TR02/11	10.00	11.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite containing thin quartz veins with limonitic alteration	68	1	4	31	1	1	167
12	NGBBTR_TR02/12	11.00	12.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
13	NGBBTR_TR02/13	12.00	13.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
14	NGBBTR_TR02/14	13.00	14.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
15	NGBBTR_TR02/15	14.00	15.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
16	NGBBTR_TR02/16	15.00	16.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
17	NGBBTR_TR02/17	16.00	17.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
18	NGBBTR_TR02/18	17.00	18.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
19	NGBBTR_TR02/19	18.00	19.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-
20	NGBBTR_TR02/20	19.00	20.00	1.00	Greyish black, fine grained, foliated, carbonaceous phyllite	-	-	-	-	-	-	-

Trench No. NGBB TR 03:

Trench no 3 was excavated in the forest land with length of 20m, depth of 1.5m and width of 1m. Top soil ranging from 20 to 30cm is exposed in this trench thereafter carbonaceous phyllite is exposed up to 1.5m depth. 6 nos of trench samples analysed from this trench indicated Cu value ranging from 70 to 119 ppm. Profile mapping of trench with photographs and analytical results are provided below;



Figure 19: Field Photographs of Trench3

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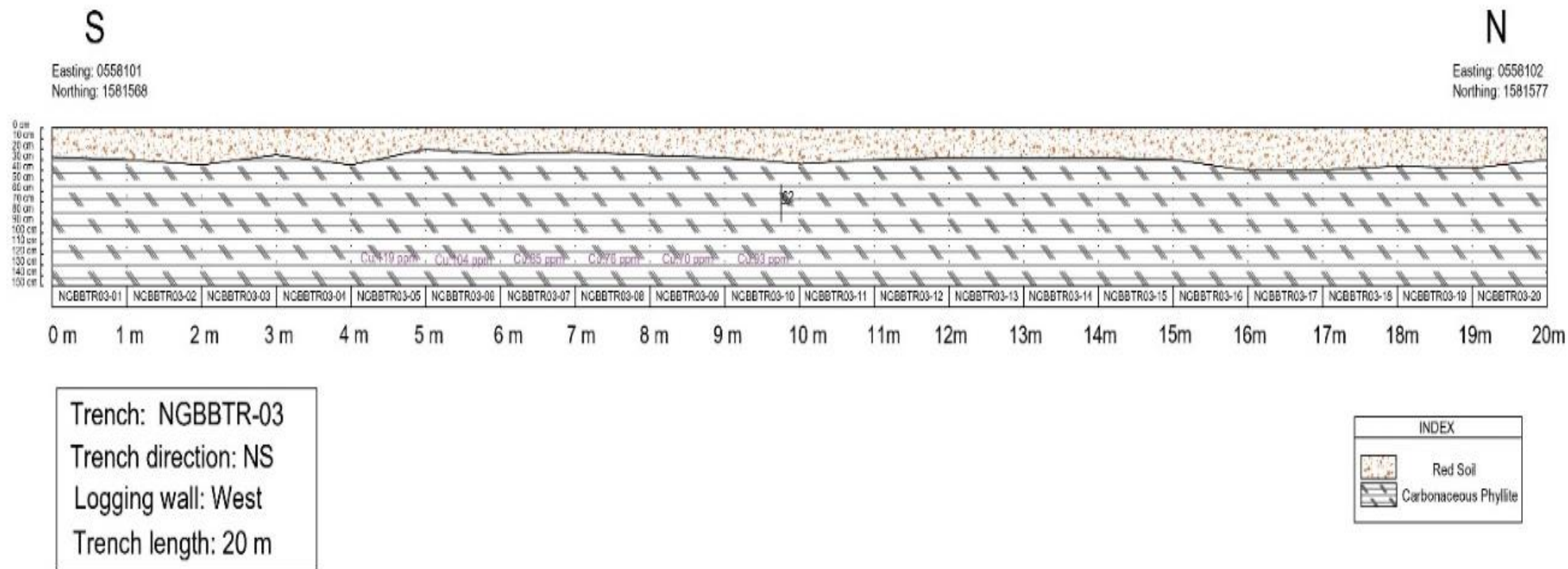


Figure 20:Trench 3 profile map

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Table 16:Trench-3 Sample analysis

NGBB TR03												
Total trench length- 20.00 m.												
Trench trend- N-S, Sampling from North -South.												
Trench co-ordinates (E 558102, N 1581577and E 558101, 1581568)												
Sr.No.	Sample ID	From	To	Width (m)	Lithology Description	Cu	Mo	Pb	Ag	Sn	w	zn
						PPM						
1	NGBBTR_TR03/01	0	1	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
2	NGBBTR_TR03/02	1	2	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
3	NGBBTR_TR03/03	2	3	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
4	NGBBTR_TR03/04	3	4	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
5	NGBBTR_TR03/05	4	5	1	Greyish black foliated, carbonaceous phyllite	119	0	5	0	1	1	148
6	NGBBTR_TR03/06	5	6	1	Greyish black foliated, carbonaceous phyllite containing thin quartz veins with limonitic alteration	104	0	6	0	1	1	130
7	NGBBTR_TR03/07	6	7	1	Greyish black foliated, carbonaceous phyllite containing thin quartz veins with limonitic alteration	85	0	6	0	1	1	140
8	NGBBTR_TR03/08	7	8	1	Greyish black foliated, carbonaceous phyllite containing thin quartz veins with limonitic alteration	76	0	4	0	0	0	120
9	NGBBTR_TR03/09	8	9	1	Greyish black foliated, carbonaceous phyllite containing thin quartz veins with limonitic alteration	70	0	5	0	0	1	131
10	NGBBTR_TR03/10	9	10	1	Greyish black foliated, carbonaceous phyllite containing thin quartz veins with limonitic alteration	96	0	5	0	1	1	139
11	NGBBTR_TR03/11	10	11	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
12	NGBBTR_TR03/12	11	12	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
13	NGBBTR_TR03/13	12	13	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
14	NGBBTR_TR03/14	13	14	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
15	NGBBTR_TR03/15	14	15	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
16	NGBBTR_TR03/16	15	16	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
17	NGBBTR_TR03/17	16	17	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
18	NGBBTR_TR03/18	17	18	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
19	NGBBTR_TR03/19	18	19	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
20	NGBBTR_TR03/20	19	20	1	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-

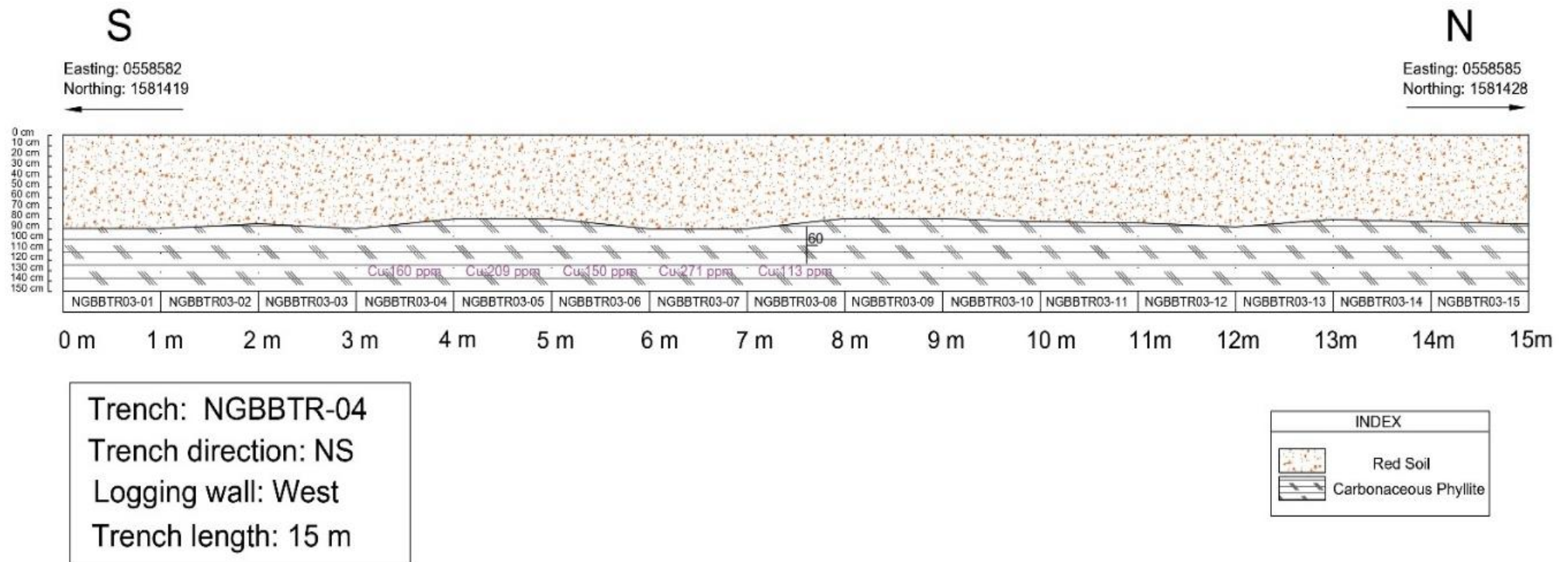
Trench No. NGBB TR 04:

Trench no 4 was excavated in the forest land with length of 15m, depth of 1.5m and width of 1m. Topsoil is exposed upto 90cm depth thereafter Carbonaceous phyllite exposed up to 1.5m depth. 5 nos of trench samples shows Cu value ranging from 113 to 271ppm. Profile mapping of trench with photographs and analytical results are provided below;



Figure 21:Field Photographs of Trench4

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Figure 22: Trench 4 profile map

Table 17:Trench-4 Sample analysis

NGBB TR04												
Total trench length- 15.00 m.												
Trench trend- N-S, Sampling from North -South.												
Trench co-ordinates (E 558585, N 1581428 and E 558582, 1581419)												
Sr.No.	Sample ID	From	To	Width (m)	Lithology Description	Cu	Mo	Pb	Ag	Sn	w	zn
						PPM						
1	NGBBTR_TR04/01	0.00	1.00	1.00	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
2	NGBBTR_TR04/02	1.00	2.00	1.00	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
3	NGBBTR_TR04/03	2.00	3.00	1.00	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
4	NGBBTR_TR04/04	3.00	4.00	1.00	Greyish black foliated, carbonaceous phyllite containing quartz veins with limonitic alteration	160	1	8	0	1	0	44
5	NGBBTR_TR04/05	4.00	5.00	1.00	Greyish black foliated, carbonaceous phyllite containing quartz veins with limonitic alteration	209	1	11	0	1	0	27
6	NGBBTR_TR04/06	5.00	6.00	1.00	Greyish black foliated, carbonaceous phyllite containing quartz veins with limonitic alteration	150	1	7	0	1	0	22
7	NGBBTR_TR04/07	6.00	7.00	1.00	Greyish black foliated, carbonaceous phyllite containing quartz veins with limonitic alteration	271	0	5	0	1	0	19
8	NGBBTR_TR04/08	7.00	8.00	1.00	Greyish black foliated, carbonaceous phyllite containing quartz veins with limonitic alteration	113	1	8	0	1	0	18
9	NGBBTR_TR04/09	8.00	9.00	1.00	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
10	NGBBTR_TR04/10	9.00	10.00	1.00	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
11	NGBBTR_TR04/11	10.00	11.00	1.00	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
12	NGBBTR_TR04/12	11.00	12.00	1.00	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
13	NGBBTR_TR04/13	12.00	13.00	1.00	Greyish black foliated, carbonaceous phyllite	-	-	-	-	-	-	-
14	NGBBTR_TR04/14	13.00	14.00	1.00	Greyish black foliated, carbonaceous phyllite							
15	NGBBTR_TR04/15	14.00	15.00	1.00	Greyish black foliated, carbonaceous phyllite							

Sampling

The investigation is envisaged for targeting Copper and Gold mineralisation and fixed carbon content in the carbonaceous phyllite and banded ferruginous chert.

Totally 124 nos of Bed Rock Samples (BRS) were collected from various lithology. Out of 124 nos, 11 nos of Bed Rock Samples were collected outside the block boundary during prefeasibility studies (Prior to approval of TCC- NMET). Balance 113 Bed Rock Samples were collected from inside the block boundary and these includes 55 samples collected from banded ferruginous chert, 5 from BFC /Manganiferous ore, 35 nos from carbonaceous phyllite, 4 over ferruginous phyllite, 2 over metabasalt, 4 over the talc tremolite schist, 6 over the meta-andesite and 1 each from quartzite and laterite. Details of the Bed Rock Samples collected are provided in Annexure 01 and lithowise segregation of Bed Rock Samples along with chemical values are provided at Annexure 07.

30 nos of Stream Sediment Samples (SSS) were collected from 2nd and 3rd order streams in order to trace the resource bearing host rocks. Stream beds in the area are rocky and fine sediments are very scanty and mostly present in low lying areas or where the streams have been converted to agricultural fields or in root zones of the bushes on the stream bed. Latitude, longitude and elevations were recorded using Global Positioning System (GPS).

SSS were collected from drainage leading from banded ferruginous chert, carbonaceous phyllites and other lithounits to target the gold mineralisation and their path finding elements.

Stream Sediment samples were collected after removing the organic layer. 3-4 kg of sample was collected from each cell and brought to the camp in thick polythene bags for further processing. The samples were sieved with plastic sieves at sample sites. Totally, 30 numbers of stream sediment samples were collected. In the field camp wet stream sediments were sun dried on transparent plastic sheets. The samples are delumped, sieved through 80mesh through nylon cloth mesh. The -80 fractions are collected, wet panned, heavies were collected and sent for chemical analysis. At every level of sample preparation, due care was taken to avoid contamination.

Details of the stream sediments collected along with respective chemical values are provided at Annexure 12.



Figure 23: Field photograph Stream sediment sample collection

Emphasis was laid to trace the carbonaceous phyllite, which was originally seen as 200m and this has been traced for a considerable strike length based on the 4 nos of trenches laid across the strike. The carbonaceous phyllite was traced to a strike length of 2.5 km with a width varying between 145m to 300m.

10 nos of auger drill holes were carried out up to a depth of 1m and samples were collected for analysis. 66 nos of borehole core samples were collected from the carbonaceous phyllite horizon of 2 boreholes drilled. Details of boreholes along with respective run in meters and chemical values are provided in Annexure 21.

Discussion of chemical analytical results

Totally 113 nos of Bed Rock Samples were collected from various lithounits of the block. Majority of the Bed Rock Samples collected has indicated Cu values in ppm levels only.

Certain carbonaceous phyllite samples were analysed for fixed carbon content. The analytical results indicates FC content less than 2%.

30 nos of Stream sediment samples were collected from 2nd and 3rd order streams wherever possible draining from the banded ferruginous chert and carbonaceous phyllites and other lithounits. Stream sediments samples were collected in order to target the gold mineralisation and their path finder elements in order to trace the resource bearing host rocks. Samples are

analysed for 7 radicals (Cu, As, Pb, Ag, Sn, Au and Bi) and the analytical results have indicated that in all the samples gold is analysed *below detection limit*, whereas the path finder's viz., Cu values ranging from 26.14 to 176 ppm, As ranging from 2 to 31ppm, Ag value of 1 ppm and nil value of Bi. Sample analysis report of stream sediment samples is provided as Annexure 13.

25 nos of samples from Bed Rock Samples, trench and borehole core collected from BIF, quartz vein and carbonaceous phyllite are analysed for Au using fireassay method. These samples have shown value of gold in most of the samples as below detection limit and only 2 samples (34BRS 69 and 34 BRS79) have indicated Au value of 0.4 g/t and 0.8 g/t respectively. Details of the samples (Bed Rock Samples, Trench and borehole) along with Au value is provided as Annexure 09. Respective sample analysis reports are enclosed at Annexure 10 & 27.

In the other area, BIF band with 300m length and 25m to 35m width has shown Bed Rock Samples value the Fe% varying from 37% to 61% and Mn% from 15% to 32%. The iron minerals are mostly hematite and Mn minerals are Pyrolusite, Psilomelane and Wad.

Though 4 number of trenches were excavated, up to 1.5m depths and 1m width, the sample length was kept uniformly has 1m, a total of 67 samples were collected. For analytical purpose only 23 nos of samples were chosen for chemical analysis based on the presence of brecciation, quartz stringers etc. Upon the analysis of 23 trench samples have given the Cu values ranging from 68ppm to 209ppm.

From borehole, core samples are collected from different depth encountered with carbonaceous phyllite; importance was given to the samples showing the disseminations of pyrite along the foliation. None of the samples of boreholes has shown any significant Cu value.

The copper values in the carbonaceous phyllite from Bed Rock Samples, Trench and Core samples have indicated maximum of 0.04% and are not forming any consistent zone.

Ore Zones / Extent of Mineralization:

Based on the detailed geological mapping works and analysis of bedrock, trench and borehole core samples, it is observed that, the area is barren as far as the Cu, Au and Graphite mineralisation. Hence, under above discussions and analysis, it is concluded that, there is no

potential zones or ore zones for Copper, Gold and Graphite in the area which warrants for further investigation.

The banded ferruginous chert exhibits a continuous strike length of approximately 300 meters, with an observed width varying between 25 to 35m and striking along N 60° W to S 60° E with south westerly dip of 30° to 60° showing visible Mn and Fe mineralization. Analytical results of samples indicate the presence of both iron and manganese. The iron (total Fe) content ranges from 37% to 61% and manganese (Mn) values range from 15% to 32%. This indicated enrichment of Fe and Mn mineralization. Further detailed study could not be taken up as the area is in the reserve forest land.

6.2 Geophysical exploration

The investigation carried out is G4 stage exploration and the geophysical exploration is not the part of this investigation. However, available National Geophysical Mapping (NGPM) data from National Geoscience Data Repository (NGDR) portal is utilized for integration of NGPM data with geology.

6.3 Geochemical exploration

Type of sample media

6.3.1 Bed rock sampling

Geochemical sampling is a technique and an integral part of mineral exploration works. In G4 stage generally bed rock sampling is given importance while carrying out mapping. The Bed Rock Samples were collected based on the lithology and physical appearance of the rocks. In the present block, totally 124 nos of bed rock samples were collected during large geological mapping to delineate various lithounits. Details of the samples collected are provided in Annexure 01.

Out of 124 nos of Bed Rock samples collected, 76 nos of Bed Rock Samples are analysed. The samples are analysed at IBM, Bengaluru, MECL, Nagpur and KIOCL lab, Mangalore. Abstract details of the bed rock samples analysed along with laboratory details are provided in Annexure 02 and respective sample analysis reports are enclosed in Annexure 03,04,05 & 06.

Abstract details of Bed Rock Samples collected from various lithounits with Cu value are provided below;

- Bed Rock Samples collected from banded ferruginous chert (BFC) have indicated Cu values in traces for most of the samples only in few samples the values are ranging from ppm level to maximum of 0.02%.
 - Bed Rock Samples collected from carbonaceous phyllite have indicated Cu value ranging from 24.87ppm to 0.11%(34BRS-35) excluding the bias samples (34BRS-37 and 34 BRS-52) collected during prefield studies.
 - From Meta Andesite – 6 samples, out of which 2 sample indicated below detection limit while 4 samples shown values of Cu from 27.35 ppm to 0.01% (34BRS-58).
 - Samples collected from ferruginous phyllite/ chert as indicated Cu value as traces and 1 sample as 0.01%.
 - From Meta-ultramafic rock, 4 samples were collected and the analytical result for Cu is ranging maximum up to 41.22 ppm.
 - Meta-basalt – 2 samples have indicated the Cu value as 11.79ppm to 33.5ppm.
 - Quartzite, 1 Sample is drawn and it is indicating Cu value below detectable limit.
 - 60 nos of Bed Rock Samples collected from BIF were analysed for Fe and Mn and these have indicated Mn value ranging from 9.24% to 20.33% (34BRS-82) with total Fe% ranging from and total Fe 36% to 61.62%.
 - Laterite zone, 1 sample is collected and Cu indicated here as 0.04%.
- Lithounit wise sample analysed are provided at Annexure 07.
- Total 25 nos samples (14 nos of BRS + 2 Trench + 9 Borehole samples) were analysed for Au by Fire assay method. Many of the samples have shown Au value < 0.01 g/t or ND. Only 2 samples, Sample ID 34BRS 72 and 34 BRS 69 collected from BIF and metabasalt have shown some stray Au value of 0.8 g/t and 0.4 g/t respectively.
- Details of samples analysed for Au along with the details of the lab is provided at Annexure 09 and respective analysis reports are enclosed in Annexure 10 and 27.

During the course of mapping, the banded ferruginous chert exhibits a continuous strike length of approximately 300m, with an observed width varying between 25 to 35m and striking along N 60° W to S 60° E with south westerly dip of 30° to 60° showing visible Mn and Fe mineralisation. Analytical results of samples indicate the presence of both iron and manganese. The iron (total Fe) content ranges from 37% to 61%, suggesting low to moderate iron and manganese (Mn) values range from 9.24% to 20.33%. This indicated enrichment of Fe and Mn mineralization. Further detailed study in this bands could not be taken up due to occurrence of these bands inside the reserve forest area.

6.3.2 Stream sediment sampling and Trench sampling

Stream sediment sampling is a valuable tool in the early-stages of mineral exploration, in assisting to narrow down areas for more detailed investigations based on the values of various elements. 30 nos of stream sediment samples were collected from the 2nd and 3rd order confluences streams that flow through various litho units. Samples were analysed for 7 radicals (Cu, As, Pb, Ag, Sn, Au & Bi) and have not indicated any favourable values for Gold and Copper.

Details of the stream sediment sample analysis along with coordinates are provided at Annexure 12 and respective sample analysis report is enclosed as Annexure 13.

Details of the trenching works carried out is already explained in the earlier chapter.

6.3.3 Borehole core sampling

Borehole core sampling was carried out only in the carbonaceous phyllite showing signs of shearing and mild / low concentration of sulphide. The mineralisation is very scanty in nature, mainly pyrite and negligible amount of chalcopyrite. Totally 66 nos of borehole core samples were drawn with sample length ranging from 0.5m or 1m from 2 boreholes. Details of the samples along with respective sampling width/ run meter is provided in Annexure 21. Primary sample analysis report of borehole cores is provided as Annexure 22.

In borehole 01, totally 32 nos of core samples were analysed. The samples are drawn from 2 sulphide zones, Zone 1 from 63m to 99m and Zone 2 from 113m to 117.5m. Core samples has indicated Cu value ranging from 52ppm to 256ppm with average of 102 ppm and for Zn value from 25ppm to 428ppm with average of 305ppm.

In borehole PBH-2, 34 nos of core samples are drawn from 7 sulphide zones. Borehole samples represent Cu value varying from 63ppm to 475ppm with average value of 148ppm, and for Zn value ranging from 39ppm to 363ppm with average value of 123ppm. The results are of academic in nature and not encouraging in the mineral exploration parlance.

The analytical results of both the borehole core samples for all the elements showing ppm in single digit except for Cu and Zn.

Total 24 nos of samples from carbonaceous phyllite zones were analysed for FC. The samples were appearing like graphitic in nature. Hence, 24 samples (20 borehole samples + 4 Bed Rock Samples) were analysed for fixed carbon content. The analytical results indicates less

than 2% of FC value (FC varies from 0.16% to 1.60%, Ash content 92.85% to 95.30% and volatile matter 4.42% to 6.64%). Fixed carbon value is maximum of 1.60% which has no economic viability currently.

A very mild nature of hydrothermal activity is indicated by presence of goethite as coating, fracture-filling, brecciation in both phyllites and banded ferruginous chert and pyrite along the foliation planes in the carbonaceous phyllite. Though the hydrothermal systems are known for their role in ore formation, transportation of metals, and deposition at suitable locales as sizable mineral deposit. It invariably depending on the nature, origin, intensity and duration of hydrothermal process, composition of the fluids, and geologic environment plays a major role in the nature and size of the mineral deposit. It is evident from the mineralisation point of view in the Nagavanda block, the hydrothermal solutions of the area are without significant metal content and non-fertile in nature.

6.3.4 Sample preparation and analysis

Procedure adopted for sample preparation and analysis is provided below;

Procedure of sample preparation

- Sample ranging from 20mm to 40mm were reduced to 05mm with jaw crusher.
- Samples are further ground in roller crusher and vibratory cup mill (pulverizer) to reduce the samples to less than 150 microns (-100# mesh) size for analytical procedures.
- A representative sample, each of about 100g was made from this by coning and quartering method.
- Each sample was prepared in 06 packets of 100 gram each.

Table 18: Details of Sample

Sl. No.	Details	No of Packets
1	Primary Sample analysis	01
2	Internal Check Sample analysis	01
3	External Check Sample analysis (External NABL Lab)	01
4	Composite Sample analysis (Internal)	01
5	Preservation Sample	02
6	Total	06

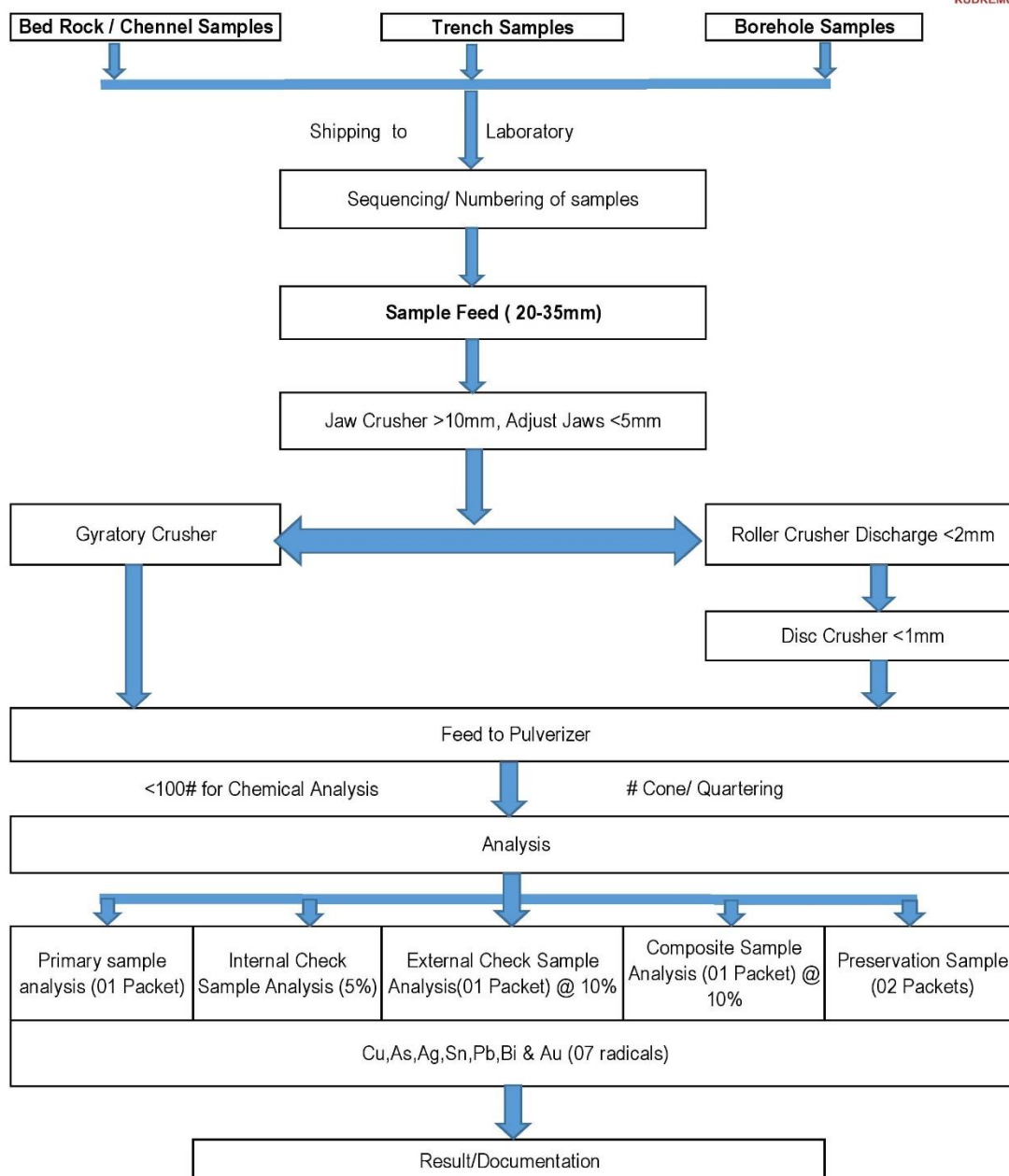


Figure 24: Work Flow Chart in Sampling

6.3.5 Details of IS Standard adopted for chemical analysis

Samples are analysed for 7 radicals at KIOCL laboratory using ICPOES method and Au by Fire assay method at laboratories of HGML- Hutti, IBM- Bengaluru and M/s Shiva Analyticals- Bengaluru

6.3.6 Internal check sample analysis of Bed rock samples

- 10 nos. of internal check sample analysis were carried out for 7 radicals.
- Internal check sample analysis report is provided at Annexure 23.
- Comparison of Primary sample vs. Internal Check sample analysis is provided at Annexure 24.
- Statistical analysis to establish the agreement between primary and check sample analyses of Cu value in ppm is provided below.
 - Cu weight percentages of all samples are falling within the best fit curve with a slope of 0.640.
 - Statistical analysis of Cu shows mean difference of 27.97ppm and concentration of primary samples shows a positive correlation with internal check samples, with a correlation coefficient of 0.903.

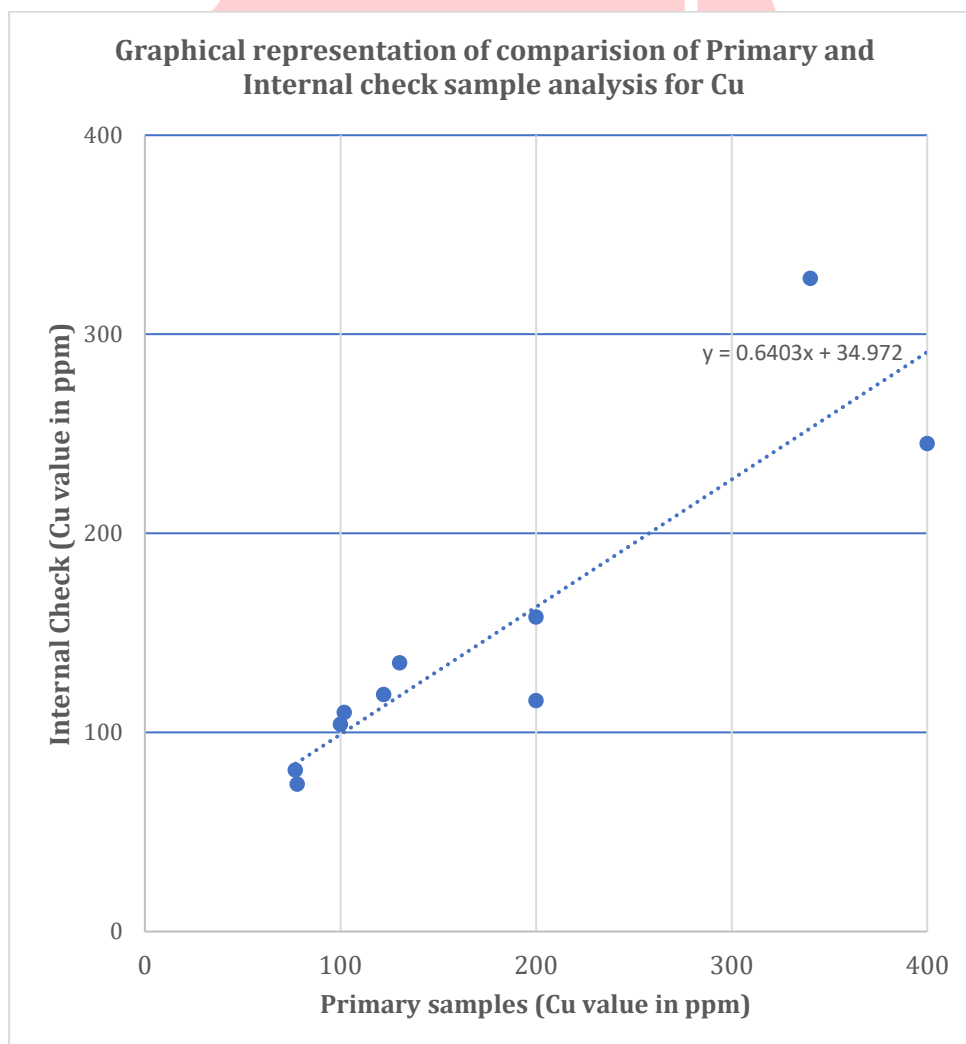


Figure 25: Graphical representation of comparison of primary and internal check sample analysis for Cu value (ppm)

Table 19: Statistical Parameters of Primary and internal Check Sample analysis results of Cu value (ppm)

Cu value in ppm	Primary	Internal Check	Diff	% Diff
Mean	174.97	147.00	27.97	15.99
Median	126.25	117.50		
Standard Deviation	112.52	79.78		
Minimum	77.00	74.00		
Maximum	400.00	328.00		
Count	10.00	10.00		

6.3.7 External check sample analysis of Bed rock samples

- 17 nos. of external check sample analysis @ 10% were carried out for 7 radicals.
- External check sample analysis works is carried out in M/s Shiva Analyticals India Private Limited, Bengaluru. NABL certificate is enclosed at Annexure 34.
- External check sample analysis report are provided at Annexure 08 (BRS), 15 (Trench) and 25 (Borehole).
- Comparison of Primary sample vs. External Check sample analysis is provided at Annexure 26.
- Statistical analysis to establish the agreement between primary and external check sample analyses of Cu value are provided below.
 - Cu value of all samples are falling within the best fit curve, which are having a slope of 0.886.
 - Statistical analysis of Cu shows mean difference of -21.24 and concentration of primary samples shows a positive correlation with external check samples, with a correlation coefficient of 0.67.

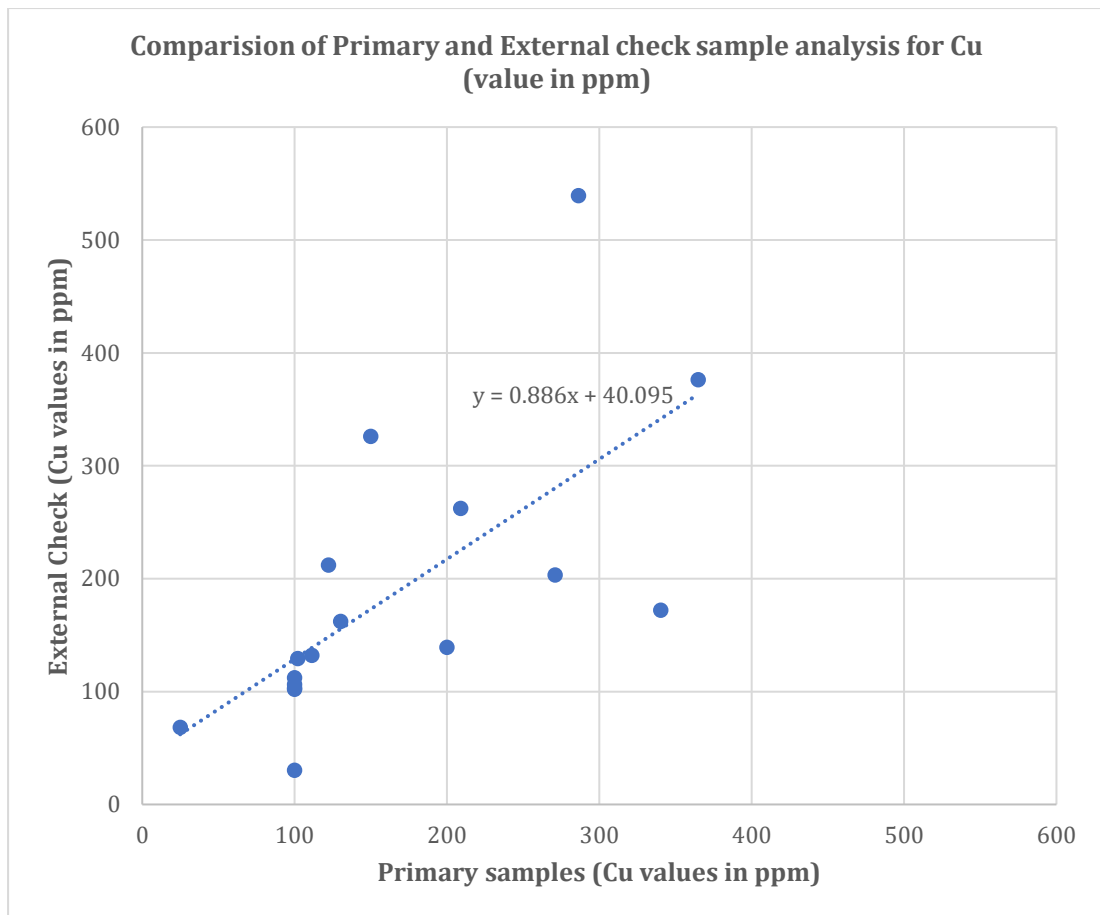


Figure 26: Graphical representation of comparison of primary and external check sample analysis of BRS, Trench & Borehole samples for Cu (in ppm)

Table 20: Statistical Parameters of Primary and External Check Sample analysis results of Cu (value in ppm)

	Primary	External Check	Diff
Mean	165.41	186.65	-21.24
Median	122.23	139.00	
Standard Deviation	97.03	127.54	
Minimum	24.87	30.00	
Maximum	364.85	539.00	
Count	17.00	17.00	

7. Integration of Geology, geophysics (with available aero geophysical data) and geochemical exploration data and the interpretation: (Not required for bedded and stratiform type deposit. Ex. Limestone, bauxite, iron ore etc.)

7.1 NGPM Magnetic Data

GSI's NGPM (National Geophysical Mapping) data for the toposheet no. 48N/07 and 48N/11 is interpreted for the proposed block. Oasis Montaj Geosoft software was used to process and visualize the data. The ground magnetic data shows a range of magnetic values from 39801 nT to 42496 nT. The area of investigation falling in the low magnetic zones and correlatable with the surface data, geologically the area consists of greywacke-argillites, phyllite, metabasalt and banded ferruginous chert. Even the BFC also showing very thin zones of ferruginous content which may not have been picked up.

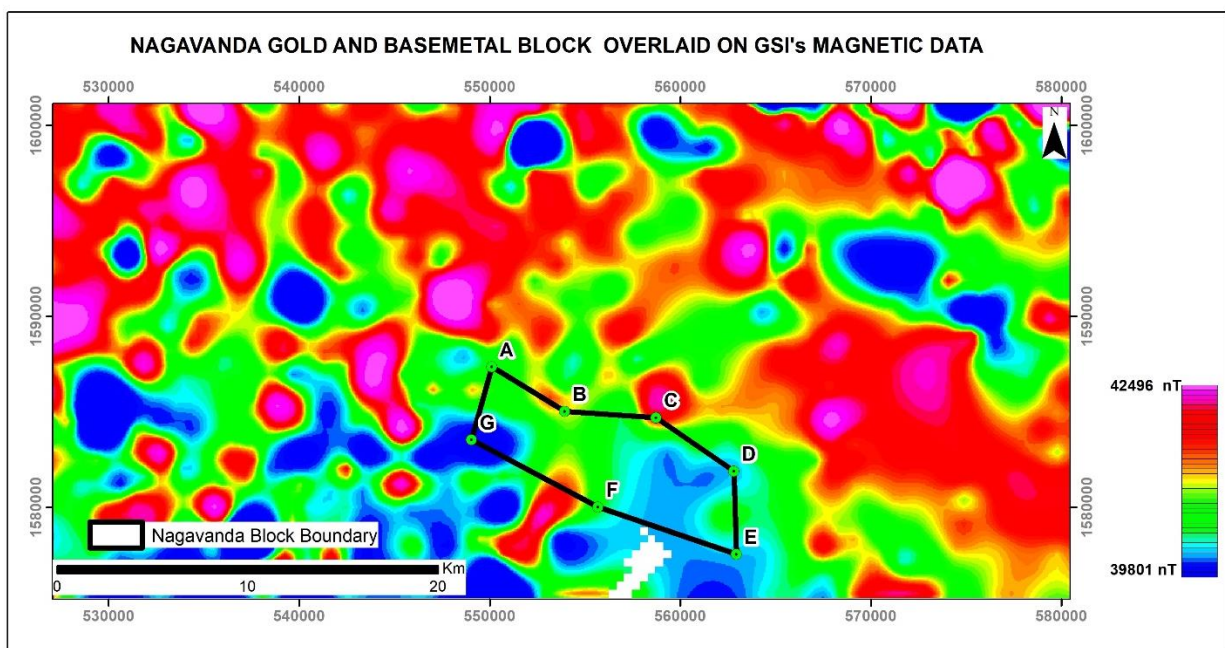


Figure 27: GSI's NGPM (National Geophysical Mapping) Magnetic data

7.2 NGPM Observed and Bouguer Gravity Data

GSI's NGPM (National Geophysical Mapping) data for the toposheet no. 48N/07 and 48N/11 is interpreted for this proposed block. Oasis Montaj Geosoft software was used to process and visualize the data. 400 mGal of fluctuation is seen in the observed gravity readings. The values of the bouguer gravity anomaly vary from -69 to -95 mGal. The observed and bouguer gravity

data is divisible into higher and lower respectively in the NW and SE part of the map. The higher gravity data in the north western part is not correlatable with the magnetic data, whereas the south eastern part can well be correlated with the low magnetic data. They may be indicating the sub surface feature, which has not bearing on the investigation.

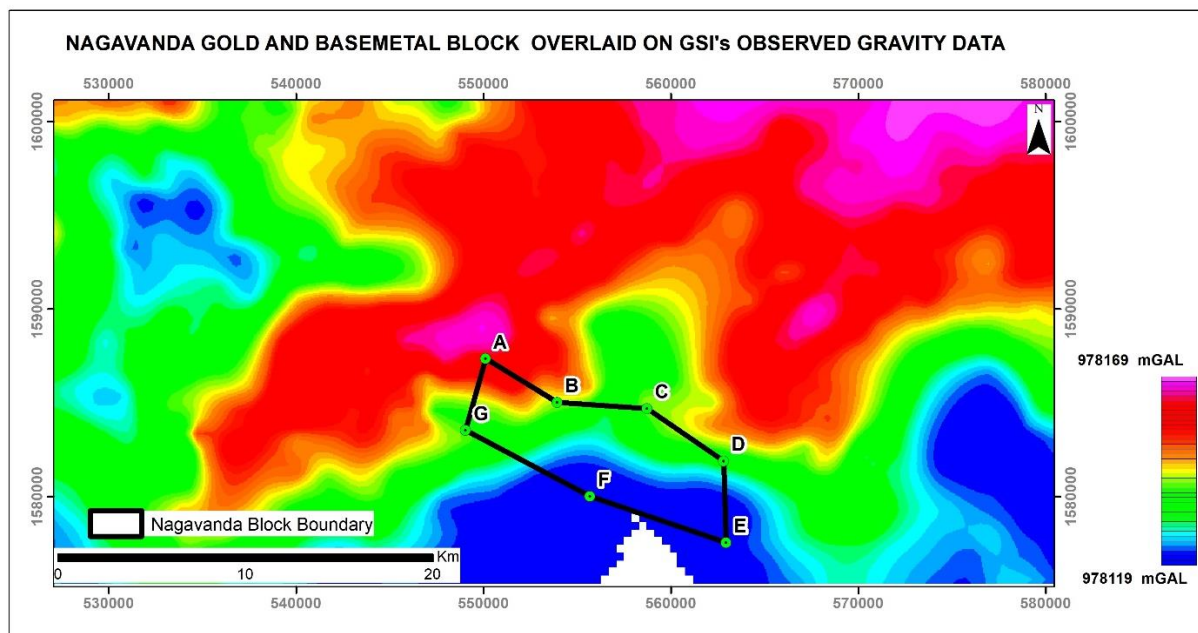


Figure 28 : GSI's NGPM (National Geophysical Mapping) Observed Gravity Data

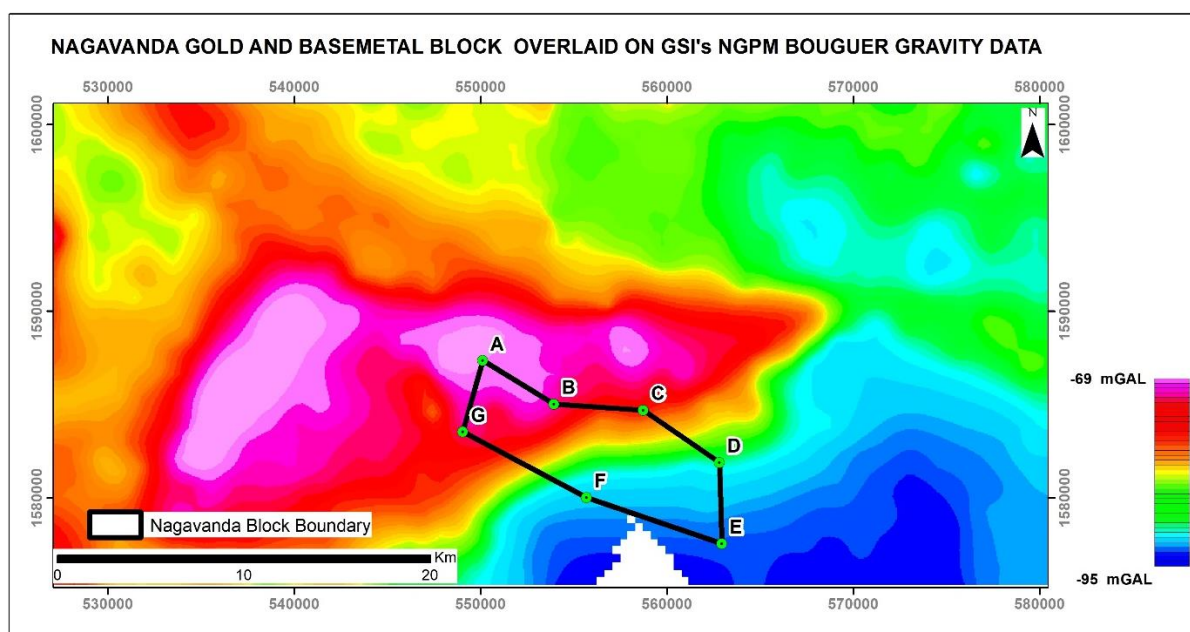


Figure 29: GSI's NGPM (National Geophysical Mapping) Bouguer Gravity Data

8. Mineral prospect

8.1 Surface indication

Surface indication for copper mineralisation in carbonaceous phyllite is in the form of malachite stains, stringers of quartz showing copper minerals such as chalcopyrite, bornite in the dumps around the old pits. The exposed part of the carbonaceous phyllite is very little, hence could not find any surface indications on them.

Banded ferruginous chert bands in the area shows surface indication for mineralisation in the form of limonitization, brecciation and sulphide box works. The previous exploration programmes have revealed, that brecciation, sulphide box works and quartz carbonate veins are important for gold mineralisation as seen in Chitradurga and in Shivamogga belt and delineated several bands potential for gold mineralisation by GSI.

In the present area among the number of samples collected for analysis of gold, only few samples have shown the values of Au in the range of 0.01 g/t to 0.8 g/t and majority of them revealed as non-detectable limit.

Surface indication for Iron and Manganese mineralisation is noticed in the form of fine layers and botryoidal nature. As discussed above in geochemical exploration, there is ample scope for iron and manganese mineralisation indicating the Fe and Mn values ranging from 37% to 61%, and 15% to 32% respectively.

8.2 Mode of occurrence

As such the mineralisation for copper and gold is very sparse to nil. As per the previous reporting, the carbonaceous phyllite is the rock hosting copper, gold and graphite mineralisation in the area. Except the old dumps and pits mineralisation is not seen in the area. The boreholes drilled in the area shows very few mineralised zones along the borehole showing disseminations mainly pyrite and negligible amount of chalcopyrite. The mineralisation found to occur along the foliation planes indicative of hydrothermal nature and non-fertile as no significant mineralisation is noticed.

The banded ferruginous chert band of 300m X 35m shows iron and manganese mineralisation with Fe value ranging from 37% to 61% and Mn value ranging from 15% to 32%.

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

The investigation has exhibited that after careful examination of lithogeochemical sampling of various lithounits of the area, only the carbonaceous phyllite and banded ferruginous chert are potential for mineralisation. They have been delineated and mapped as separate units.

The carbonaceous phyllite is extending for a strike length of 2500m (2.5km) with a thickness of 145m to 350m. Major portion of this lithounit is weathered covered under thick soil and some portion is under cultivation. 4 nos. of trenches were excavated to expose the rock

Banded ferruginous chert, a strike length of 300m along N 60° W to S 60° E, with width varying from 25m to 35m and dipping 30° to 60° towards south westerly is observed. The analytical results have indicated total Fe content from 37% to 61%, and manganese (Mn) values from 15% to 32%, reflecting substantial manganese enrichment within the band.

8.4 Alteration zones and its relevance with mineralization

The area investigated has devoid of any specific alteration zones, except the fracture filling in banded ferruginous chert by goethite and some minor zones of brecciation. The petrological study of BIF samples showing some evidences depicting significant alteration of magnetite to hematite (*Mariappa and Konwar (2017)*).

8.5 Genesis of mineralisation

The area is devoid of mineralisation; genesis could not be discussed.

9. Exploration by scout Drilling

The hunch for copper mineralisation in the carbonaceous phyllite is continued, as the old pits and dumps over the carbonaceous phyllite showing the malachite stains and stringers of quartz containing chalcopyrite and other sulphide minerals was observed in the present block. Out crops are very scanty and fully covered by soil and the trenches as exposed the rock. Presence of pyrite and associated minor chalcopyrite elements in the borewell drilled for agricultural purpose to be tested beyond doubt the presence or absence of mineralisation in the carbonaceous phyllite.

The previous work reported geological setting and association of carbonaceous phyllite and sulphidic cherts speak of potentiality in the area, where the Cu, Au, Mo, Co, Pb and Zn, were not analysed for want of facilities (Vasudev et.al 1994).

The outcomes of surface geological mapping and trenching works were presented to the 60th meeting of TCC, NMET with the request for drilling few scout boreholes in order to find out the presence of copper mineralisation in carbonaceous phyllite band. TCC, NMET after deliberations approved 4 nos of boreholes with a total meterage of 500m, with a condition to initially drill two boreholes, (one near the old pit in the forest area and another in the cultivated land near the irrigation borewell). if positive, then the balance two boreholes may be taken up.

In accordance with the recommendations of TCC- NMET, 2 nos of boreholes were drilled with cumulative meterage of 326m. Details of the boreholes drilled are provided below;

Table 21: Details of boreholes drilled (DGPS data)

Sl	Borehole no	Angle of drilling in degree	Azimuth of drilling	Co ordinates (DGPS data)				Drilled Meterage
				Easting	Northing	Latitude	Longitude	
1	BH-01	60	N10 E	558,333.95	1,581,641.35	14°18'21.74650"N	75°32'27.21004"E	135m
2	BH-02	60	N10 E	558,590.75	1,581,439.04	14°18'15.14191"N	75°32'35.76607"E	191m
3	Total							326m

As per the records of Forest department, 4 boreholes and 4 trenches which were planned for execution are falling in forest land which are encroached by localities for carrying out agricultural activities. Due to presence of boreholes and trenches in forest encroached agricultural land, KIOCL vide letter dtd. 16.01.2024 requested PCCF(FC) and NO(FCA) for providing permissions to KIOCL for carrying out subsurface activities (trenching and drilling) in reserve forest of Hirekerur (Tq), Karnataka.

In reply to above, DCF, Haveri, Karnataka vide letter dtd 16.01.2025 has provided permissions to KIOCL for carrying out subsurface activities (Trenching and drilling) in forest area with the below indicated conditions;

- No tree or forest growth shall be felled or damaged during the course of work.
- The user agency shall use the existing forest roads and no new or fresh road will be constructed by the user agency.

Forest permission letter received from DCF, Haveri, Karnataka is enclosed at Annexure 33.

9.1 Methodology and type of drilling

One diamond core drilling (Kratos 800 hydraulic power rig) was deployed for drilling. The boreholes were drilled to recover NQ size core. Core size was maintained for the entire length of the borehole. Tripple tube core barrel having core lifter case NMLC / NXM was used with short runs in order to ensure maximum core recovery.



Figure 30 : Kratos 800 hydraulic power rig deployed at site



*Figure 31 : Pyrite clusters observed in drill cuttings.
(BH 01)*



*Figure 32 : Pyrite clusters observed in
drill cuttings. (BH 01)*



Figure 33: Drill core of BH -01 indicating Carbonaceous Phyllite with veining and pyrite



Figure 34 : Pyrite clusters observed in drill cuttings. (BH 01)



Figure 35 : Drill core cutting of BH 02 indicating Carbonaceous phyllite containing sulphides (Pyrite)

9.2 Borehole planning (spacing of boreholes, level of intersection), co-ordinates, RL of collar, borehole logging, core recovery percentage

The borehole planning including the spacing of boreholes and level of intersection are planned as per lithology and surface manifestations for mineralisation. There is no known control of mineralisation on the surface, the only indication is the old working pit and dumps showing malachite stains and stringers of chalcopyrite and bornite minerals. The other evidence of mineralisation has come to notice that pyrite and some chalcopyrite in the chips of borewell drilled for irrigation purpose which was traced at the time of mapping. In addition, there are some of the evidences of previous work (1994). 6 samples collected from gossan from different trenches gave copper values from 0.06% to 0.51% and malachite chert bearing carbonaceous shale given values of Cu 0.26% to 12.80%.

Based on the above evidences, section lines are drawn fixing the first section line on the irrigation borewell (section line A-A'). BH-01 was planned on this section line. From this site, the old pit is located at around 440m east. The section line (B-B') is drawn 320m east of section line A-A' and BH-02 is executed on this line. BH-02 was planned to intersect the old pit area. The other 2 section lines (C-C' and D-D') along with boreholes (PBH -3 and PBH -4) were planned towards west of section line A-A' at a grid interval of 400 m each. Among the above 4 planned boreholes, only 2 boreholes (BH-01 and BH-02) were executed.

The first borehole BH-01 is drilled with inclination of 60 degree and located at 122m north of the borewell drilled for irrigation purpose. The borehole was fixed over the carbonaceous phyllite, with a plan to drill the entire thickness of carbonaceous phyllite in order to understand the nature and style of mineralisation. The borehole was drilled to a depth of 135m intersected the intercalations of alternate sequence of ferruginous and carbonaceous phyllite.

The second borehole BH-02, was planned and fixed 315m east of borehole No. BH-01 and 100m north west of the dump (old pit which shown the Cu value of 0.11%). The borehole is drilled with 60 degree upto a depth of 195m. The borehole has intersected intercalated zone of ferruginous and carbonaceous phyllite and closed at 191m in metabasalt.

9.3 Borehole core Logging, core recovery percentage

Core logging was carried out as per the standard logging format provided under Exploratory Drilling guidelines for NMET funded projects, May 2018, Ministry of Mines, Govt of India. The

cores of 2 boreholes (BH-01 to BH-02) have been logged in a very systematic manner with utmost care and accuracy taking into consideration of the lithology, colour, texture, structure, mineralization, core size, core recovery and RQD etc. Simplified and summarised lithologies of the boreholes are provided below.

Table 22: Summarised litholog of Borehole 01 (BH 01)

FROM	TO	LITHOLOGY	LITHOLOGY DISCRIPTION
0	1.15	Red Soil	Red colour soil observed, fine grain size, Agriculture land
1.15	2	Carbonaceous & Ferruginous phyllite	Intercalation of carbonaceous phyllite with Ferruginous phyllite. Fine grained in nature, greyish to reddish in colour and moderately to highly weathered.
2	4.16	Ferruginous phyllite	Ferruginous phyllite, fine grained in nature, reddish in colour moderately to highly weathered.
4.16	42	Carbonaceous & Ferruginous phyllite	Intercalation of carbonaceous phyllite with Ferruginous phyllite. Fine grained in nature, greyish to reddish in colour and moderately to highly weathered.
42	62	Carbonaceous phyllite	Carbonaceous phyllite, fine grained in nature, greyish in colour moderately to highly fractured, no mineralization noticed.
63	85	Carbonaceous phyllite	Carbonaceous phyllite, fine grain in nature, greyish to dark greyish in colour moderately fractured, sulphide zones noticed from 63.00 to up to 85.00m. Disseminations of pyrite, pyrrhotite along the foliation and in fracture mineralization recorded. At places very thin quartz vein noticed which is parallel to foliation and also cut across type.
85	113	Carbonaceous phyllite	Carbonaceous phyllite, fine grain in nature, greyish in colour moderately to highly fractured Disseminations of pyrite, pyrrhotite along the foliation and in fracture mineralization recorded. At places very thin quartz vein noticed which is parallel to foliation and also cut across type. Mineralization noticed in negligible amount.
113	117.5	Carbonaceous phyllite	Carbonaceous phyllite, fine grain in nature, greyish in colour moderately to highly fractured Disseminations of pyrite, pyrrhotite along the foliation and in fracture mineralization recorded. At places very thin quartz vein noticed which is parallel to foliation and also cut across type.
117.5	120	Carbonaceous phyllite	Carbonaceous phyllite, which is fine grain in nature, moderately to highly fractured, greyish in colour, mineralization noticed in negligible amount in form of dissemination.
120	135	Basalt	Fine grained, dark grey in colour, massive, meta basalt with small, almond shaped cavities filled with secondary minerals like quartz & calcite.

Table 23: Summarised litholog of Borehole 02 (BH 02)

FROM	TO	LITHOLOGY	LITHOLOGY DISCRIPTION
0	3	Red soil	Red colour soil observed, fine grain, Agriculture land
3	7	Ferruginous & Carbonaceous phyllite	Intercalation of carbonaceous phyllite with ferruginous phyllite. Fine grained in nature, greyish to reddish in colour and moderately to highly weathered.
7	8	Ferruginous phyllite	Ferruginous phyllite, fine grained in nature, reddish in colour moderately to highly weathered.
8	20	Carbonaceous phyllite	Carbonaceous phyllite, fine grained in nature, greyish in colour moderately to highly fractured, no mineralization noticed.
20	21	Carbonaceous & Ferruginous phyllite	Intercalation of carbonaceous phyllite with ferruginous phyllite. Fine grained in nature, greyish to reddish in colour and moderately to highly weathered.
21	22	Carbonaceous phyllite	Carbonaceous phyllite, fine grained in nature, greyish in colour moderately to highly fractured, no mineralization noticed.
22	27	Ferruginous phyllite	Ferruginous phyllite, fine grained in nature, reddish in colour moderately to highly weathered.
27	91	Carbonaceous phyllite	Carbonaceous phyllite, fine grained in nature, greyish in colour moderately to highly fractured, no mineralization noticed.
91	122	Carbonaceous phyllite	Carbonaceous phyllite, fine grain in nature, greyish in colour moderately to highly fractured Disseminations of pyrite, pyrrhotite along the foliation and in fracture mineralization recorded. At places very thin quartz vein noticed which is parallel to foliation and also cut across type. Negligible mineralization noticed.
122	124	Carbonaceous phyllite	Carbonaceous phyllite, fine grained in nature, greyish in colour moderately to highly fractured, no mineralization noticed.
124	125	Carbonaceous phyllite	Carbonaceous phyllite, fine grained in nature, greyish in colour moderately to highly fractured. mineralization is in the form of dissemination but noticed in negligible amount.
125	126	Carbonaceous phyllite	Carbonaceous phyllite, fine grain in nature, greyish in colour, slightly fractured, , no mineralization noticed.
126	148	Carbonaceous phyllite with quartz	Carbonaceous phyllite, fine to medium grain, very small quartz grain noticed in phyllite, greyish to dark greyish in colour, low sulphides
148	190.5	Carbonaceous phyllite with thin quartz veins	Carbonaceous phyllite, dark greyish in colour containing plenty of fresh sulphides (upto 2%), sulphides are in clusters mostly pyrites.
190.5	191	Metabasalt	Fine grained, dark grey in colour, massive, meta basalt showing shearing and fractured.

Details of average core recovery and RQD achieved from borehole 01 and 02 are provided below;

Table 24: Details of borehole core recovery and RQD

Borehole	Drilled depth	Recovery %	RQD %
1	135	92.01	15.53
2	191	94.43	5.41
Total/ Weighted average	326	93.43	9.60

Borehole PBH-01 recorded an average core recovery of 92.01% with an average Rock Quality Designation (RQD) of 15.53%, while Borehole PBH-02 showed a slightly higher average recovery of 94.43% but with a lower RQD of 5.41%. Both the borehole indicates weighted average core recovery of 93.43% and weighted average RQD% of 9.6. The core recovery in both boreholes are observed to be optimum in spite of drilling zones containing carbonaceous phyllite, a rock type that is inherently soft, highly fractured, and prone to disintegration during drilling. This has significantly affected both recovery and RQD values.

Litholog data sheets of borehole 1 and 2 are provided at Annexure 19 & 20.

9.4 Methodology of ore zone sampling and sample preparation

After careful study of the borehole cores, the mineralised zones are demarcated based on the identification of the ore bearing minerals such as the pyrite, iron sulphides and very few grains of copper minerals like the chalcopyrite. These zones are demarcated run wise in order to consider the core recovery. The core samples were drawn by keeping the sample length uniformly as 0.5m or 1m.

After systematic core logging of 326m of drilled cores, 66 nos mineralized zones of cores were selected for chemical analysis. These cores are selected based on the indication of minor amount of pyrite, iron sulphides and few grains of chalcopyrite. The details of the zones formed and number of samples analysed are provided below;

Table 25: Details of borehole core sample zones analysed.

Borehole No	Total meterage drilled	Details of the zones	Nos of samples analysed		Avg Cu value in ppm with min and max
01	135m	Zone-01 (Run meter from 63.0 to 99.0m)	28	32	107 (min 80 to max 256)
		Zone-02 (Run meter from 113.0 to 117.5m)	04		70 (min 52 to max 88)
02	191m	Zone-01 (Run meter from 91.0 to 96.0m)	05	34	278 (min 153 to max 475)
		Zone-02 (Run meter from 148.0 to 170.0m)	22		123 (min 63 to max 340)
		Zone-03 (Run meter from 173.0 to 175.0m)	02		114 (min 90 to max 137)
		Zone-04 (Run meter from 176.0 to 177.0m)	01		152
		Zone-05 (Run meter from 180.0 to 181.0m)	01		100
		Zone-06 (Run meter from 182.0 to 183.0m)	01		225
		Zone-07 (Run meter from 188.0 to 190.0m)	02		112 (min 106 to max 118)
Total	326m		66	66	

The core samples have been split longitudinally into two halves one is the mirror image of the other. One half has been preserved in the core box and other half was powdered to (-) 200 mesh size using mechanised ball mill crusher. The powdered sample was mixed properly and it has been divided into two equal halves by coning and quartering method. One half of each sample has been submitted to the Chemical Laboratory, KIOCL, Mangalore for chemical analysis. Remaining half of the powdered samples is preserved as duplicate sample for check analysis and repository.

9.5 DGPS survey works of borehole points.

KIOCL has carried out borehole point survey of 2 boreholes BH 01 & BH 02 using DGPS instrument. Details are provided below;

Table 26: DGPS survey details of borehole points drilled by KIOCL

Sl. No	Borehole No	Easting	Northing	Z (Elevation in m)	Hours of observations
1	BH-01	558333.950	1581641.357	638.555	02:03:11
2	BH-02	558590.752	1581439.045	647.581	02:03:08

DGPS survey report is provided at Annexure 31.

10. Resource estimation

The ore zones, cut-off grade, correlation of lodes, specific gravity, bulk density and assumptions cannot be worked out, as the area is not potential and no bearing on mineralisation.

11. Conclusion and recommendation

Conclusion

The area mapped and examined the lithounits around Nagavanda and south of Medur area forms part of Shivamogga schist belt, Karnataka. The study area forms part of western Dharwar Craton (WDC) having complex geological set up consisting of all the formations of Shivamogga schist belt viz., Jhandimatti, Joldhal, Medur and Ranibennur Formations.

The current area reveals litho packages of all the formations of Shivamogga schist belt i.e. Jhandimatti, Joldhal, Medur and Ranibennur formation with stratigraphic assemblage. The various formations are differentiated on the basis of physical characteristics of lithounits, geographical region and stratigraphic position. The Jhandimatti formation is represented by the quartz chlorite schist interbedded with quartzite and metabasalt. The oldest formation of Shivamogga schist belt, the Joldhal Formation consist of chemogenic meta sedimentaries include Banded ferruginous chert at places manganiferous, phyllites (ferruginous and carbonaceous), cherts and meta-volcanics (metabasalt). The Medur formation represented by meta-andesite and the youngest Ranibennur formation occurring at the southern part of mapped area characterised by greywacke-argillites and metabasalt. The contact between the different lithologies and formations are gradational and continuous in nature. All the litho units are trending along WNW - ESE and varying to NW – SE with dip towards north easterly and at places south westerly. The nature of metamorphism is determined based on mineral assemblages. It is observed that the area has suffered lower greenschist facies of metamorphism to lower transitional amphibolite metamorphism. The study indicates that the whole litho assemblage has suffered at least three major phases of deformation and produced various types of isoclinal and non-cylindrical folds, schistosity, crenulation cleavages etc.

In order to understand the mineralisation and to delineate the potential zones, sampling by various media are applied. 76 numbers of bedrock samples (27 nos of PFI samples + 49 nos

of Mapping samples), 30 nos of stream sediment samples, 23 nos of trench samples and 60 nos of scout borehole core samples were collected and subjected to chemical analysis (ICPMS and Fire Assay methods). These samples has not yielded significant results. Maximum Cu value observed is 0.05 % (34BRS 107) and many of the samples have shown Au value < 0.01 g/t or ND. Only 2 samples, Sample ID 34BRS 72 and 34 BRS 69 collected from BIF and metabasalt have shown some stray Au value of 0.8 g/t and 0.4 g/t respectively.

Surface indications (malachite staining, stringers of chalcopyrite) are observed mainly in old pits and dumps, not on in-situ outcrops. Drilling results from BH-01 and BH-02 show low Cu values (maximum 475 ppm), well below the economic threshold for copper mineralization.

Mineralization is mostly pyrite-dominated and occurs as disseminations along foliation planes, suggesting a hydrothermal but non-fertile origin. Sparse and low-grade copper mineralization is observed in the block.

No substantial zones of gold-bearing quartz veins were found. The gold potential appears similar to that seen in Chitradurga/Shivamogga belts but not well-developed here.

16 samples analysed from carbonaceous phyllite indicates fixed carbon content less than 2% (FC varies from 0.16% to 1.60%, Ash content 92.85% to 95.30% and volatile matter 4.42% to 6.64%).

This indicate that the hydrothermal solutions of the area are barren of metal content. Based on the analytical results it is concluded that the area is not potential either for gold or basemetal or graphite mineralisation.

Manganiferous banded ferruginous chert (BFC band 2) measuring 300m strike length with an observed width varying between 25 to 40m and striking along N 60° W to S 60° E with south westerly dip of 30° to 60° showing visible Mn and Fe mineralization. 4nos of BRS (34BRS 79, 80, 81 & 82) collected from this zone as indicated Mn% ranging from 10.02 to 20.33 with average Mn% of 13.68 %. Further works viz trenching and drilling could not be taken up due to presence of this band deep inside forest area with thick vegetation in and around and without out motorable road.

Recommendation

Stream sediment, bedrock , trench, and borehole core sample analysis results have not yielded any significant values. The values for basemetal, Au, Ag and graphite are in traces, ppm levels and in very low percentage respectively.

Based on the above, it is concluded that the area is barren for gold, basemetal and graphite mineralisation.

Bed Rock Samples collected from the BIF (BFC band 2) has indicated Mn and Fe moderately significant over a smaller area. The band having a strike length of 300m and width of 35m indicated the Mn value ranging from 10.02 % to 20.33 % with average Mn% of 13.68. The area is falling within the forest land hence, further work by trenching and drilling could not be carried out. The possibility of continuation of the mineralised zone further cannot be ruled out.

It is recommended that, no further work is required for gold, basemetal and associated minerals and graphite mineralisation in the area.

12. Expenditure:

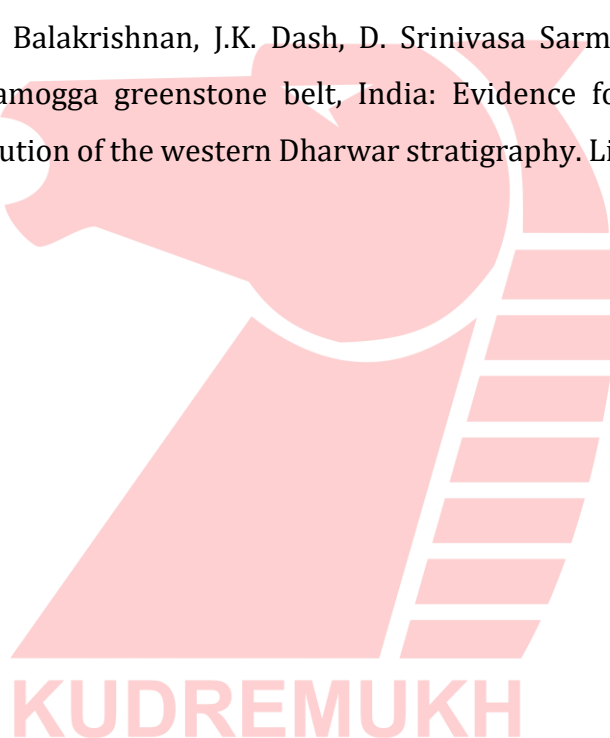
The project is executed under NMET funding with total amount of Rs. 89,51,047/- (Including GST).

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14. Locality index

Table 27: Locality index

Si	Locality	Latitude	Longitude
1	Anaji	75° 33' 19.794" E	14° 18' 58.425" N
2	Angargatti	75° 31' 12.773" E	14° 21' 2.430" N
3	Balamuri	75° 37' 34.667" E	14° 15' 33.339" N
4	Bannihatti	75° 24' 53.716" E	14° 22' 21.586" N
5	Chaudanaikanakoppa	75° 28' 28.720" E	14° 18' 10.398" N
6	Chikka Gonigere	75° 38' 25.438" E	14° 18' 24.531" N
7	Chikka Kabbar	75° 35' 55.430" E	14° 20' 53.089" N
8	Dindadahalli	75° 25' 47.440" E	14° 19' 2.550" N
9	Gangayikoppa	75° 28' 16.356" E	14° 20' 4.922" N
10	Gogga	75° 28' 19.355" E	14° 16' 39.299" N
11	Guddadamadapur	75° 33' 52.551" E	14° 17' 50.635" N
12	Guladahalli	75° 29' 30.343" E	14° 19' 50.063" N
13	Hale Virapura	75° 25' 29.527" E	14° 22' 49.043" N
14	Hallur	75° 37' 17.010" E	14° 20' 6.806" N
15	Hire Kabba	75° 34' 27.589" E	14° 21' 4.203" N
16	Hole Alehalli	75° 37' 53.513" E	14° 18' 21.152" N
17	Holliyal	75° 32' 3.031" E	14° 21' 18.455" N
18	Hosa Chaudanaikanakoppa	75° 29' 7.390" E	14° 17' 50.943" N
19	Hosakatti	75° 30' 40.877" E	14° 20' 33.046" N
20	Hosur	75° 38' 35.845" E	14° 19' 10.370" N
21	Kaginalli	75° 30' 0.125" E	14° 17' 5.831" N
22	Kamalapur	75° 35' 56.709" E	14° 19' 16.019" N
23	Kittadahalli	75° 25' 20.106" E	14° 19' 48.981" N
24	Kodamaggi	75° 27' 1.777" E	14° 21' 37.183" N
25	Lambadi Tanda	75° 37' 38.300" E	14° 16' 37.466" N
26	Maidur	75° 34' 46.817" E	14° 19' 39.110" N
27	Maravalli	75° 27' 29.831" E	14° 18' 53.628" N
28	Masur	75° 27' 22.822" E	14° 22' 15.528" N

29	Medur	75° 29' 23.645" E	14° 21' 15.053" N
30	Nagavanda	75° 32' 8.624" E	14° 19' 5.133" N
31	Sommannana Mallapur	75° 35' 40.667" E	14° 15' 28.441" N
32	Tadakanahalli	75° 32' 24.441" E	14° 20' 17.996" N
33	Tirumalapura	75° 29' 4.479" E	14° 20' 38.515" N
34	Vithalanagar	75° 26' 33.021" E	14° 16' 25.316" N
35	Yettinahalli Tanda	75° 27' 31.418" E	14° 21' 6.186" N

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COVER PHOTO:

Photograph of diamond core drilling
(Kratos 800 hydraulic power rig)

